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Deterritorialising Climate:

Ocean-Based Approaches to Adaptation Governance

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DPhil Report

Thesis Abstract

This project asks how the Pacific climate system of El Niño Southern Oscillation (ENSO) is conceived and represented through boundary-making practices. I investigate boundary-making practices in three knowledge communities: a) ocean science (i.e. Pacific marine biogeographies), b) environmental governance (i.e. Pacific adaptation frameworks), and c) local and traditional environmental knowledge (i.e. coastal subsistence communities in Timor-Leste). Ultimately, the project asks whether these disciplinary delineations of ENSO-related climate events promote effective adaptation governance.

There are four main findings: the ontological foundations of environmental law and governance frameworks work against fundamental aims in climate adaptation governance; there is an imperative to decolonise environmental law and governance frameworks in postcolonial contexts; local and traditional practices offer alternative ways of delineating adaptive geographies; and, lastly, principles from marine scientific boundary-making practices could inform governance frameworks in conceptualising assemblages of environmental change that move over space and time.

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DPhil Report

Introduction

Oceans cover more than seventy per cent of the surface of the Earth, but despite this near ubiquity, throughout most of human history, they have been little understood. The material characteristics of oceans are experienced as inhospitable to human life (even as life relies on them). Since the development of ocean science, in the late nineteenth century, marine scientists have been responsible for liaising between the oceanic and the terrestrial using technologies that extend the human body into these 'nonhuman' spaces.

As scientific study of the oceans developed over the twentieth century, ocean law and governance frameworks developed in response. Yet the unique characteristics of the global oceans, such as their fluidity and depth, resist the land-based concepts and methods on which dominant environmental law and governance frameworks rely. This dilemma has led to considerable disagreement about how the world's oceans should be represented and managed: should we continue to govern the oceans as territorial extensions of the nation state, reflective of the 'flat' geopolitics of neoliberal power relations (Steinberg, 2001)? Or should we (as marine scientists argue) manage oceans around marine communities that move over space and time (Longhurst, 1998; Reygondeau et al., 2013; Helmreich, 2009; UNESCO, 2009)?

The conceptual separation of categories – such as land and sea, society and nature, human and nonhuman – in European-model law and governance frameworks makes the latter proposition a difficult task. These binaries all rely on the positioning of nature as 'Other' (and vice versa) – a set of ideas established during the European Enlightenment and entrenched across the spectrum of race, class, and gender during the colonial era

(Ellis, 2018; Kromidas, 2014; Blanchette, 2015; Neimanis, 2017; Probyn, 2016). The strong legacy of Enlightenment thinking in dominant contemporary institutions aids the reproduction of these same dualistic ontologies of nature. What is particularly concerning about the institutional reproduction of these ideas is how they might obstruct good environmental law and governance. This is especially evident in boundary-making practices. Boundaries form the basis of every governance framework, yet in the case of conservation governance, almost never represent the delimitations of the communities that are the subjects of governance.

Sometimes world events force the concepts of nature and society into closer proximity, rendering their connections more visible. Climate change is such a phenomenon – one that challenges the conceptual boundaries of nature, human, and territory. When anomalous climate events occur, they pierce the conceptual separation of natural and historic time and natural and human space. The materialities of the events enter our cities, our homes, and our corporeal existence – breaking the illusion that nature is somehow external to the spaces occupied by human bodies. The controversies that arise from these events call governance practices into question.

Climate change governance is facing a particular set of problems within the broad task of reforming modernist institutions. This is because climate is ocean-centric, and if marine communities are to inform environmental governance in more meaningful ways, then climate change governance needs to account for those environments in nature that are conceptually most remote from the centre of human politics – the global oceans. Recent scholarship has witnessed an 'oceanic turn'; this aims to reconfigure current oceanic thinking, which is seen as continentalist and categorically misrepresentative of ocean environments. Scholars criticise the oceans as subject to 'disciplinary imaginations' (Cardwell and Thornton, 2015) and forms of capitalist territorialism

(Steinburg, 2001). These perspectives hinder effective responses to environmental degradation, even as they aid awareness of human agency's role in this degradation (Hastrup, 2014; Hastrup and Rubow, 2014). Scholarship on the materialities of oceans instead draws attention to the connectivity between oceans and other elemental environments (Peters, Steinberg and Stratford, 2018; Anderson and Peters, 2014).

There have been some exciting inroads made to develop work on (what could be termed) materialist ocean ontologies as an empirical project. Recent scholarship analyses contemporary scientific and political productions of ocean space (Bruun and Steinberg, 2018; Lehman, 2016; Anderson and Peters, 2014) and the agency of oceans in reforming ocean governance frameworks and practices (Boucquey et al., 2019; Campbell et al., 2016; Bear, 2014; Fairbanks et al., 2018). Yet there is still very little empirical work in human geography on the central role that ocean materialities play in climate events.

From this broad foundation, my research focuses on the conceptualisation and representation of ocean boundaries, insofar as they can be seen as performances or events with the capacity to connect climate systems across the ontologically divided environments of land, ocean, and atmosphere. Using ethnographic and discourse analytic methods, I make three discreet interventions in this broad project, an investigation of ocean boundary-making, in: 1) marine science (specifically, the marine biogeographies of Alan Longhurst, 1998, 2013); 2) environmental governance (specifically, the *United Nations Convention on the Law of the Sea*, 1982; the National Oceanic and Atmospheric Administration's *Best Practice for Boundary Making*, 2009; and The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security's *Regional Plan of Action*, 2013); and 3) local and traditional knowledge (specifically participatory research carried out with co-researchers from two coastal communities in northeast Timor-Leste). These take the form of three papers, making up the body of the thesis.

Historically, oceans have been partitioned around land and as though they were land. The *United Nations Convention on the Law of the Sea* (hereafter LoS), for example, partitions territorial waters 12 nautical miles from coastal baselines – literally projecting an extension of land onto the sea. In Paper 2, I discuss the ontological bases of LoS as a set of logics that reflect static land-bound concepts of the oceans. I evidence that the boundary-making principles in LoS reproduce these logics in compliant frameworks. I critique these reproductions as a systemic problem that undermines ocean governance and exemplifies a broader problem: how to represent characteristics like mobility in the 'more-than-elemental' assemblages of climate events (Peters, Steinberg and Stratford, 2018 p. 7.).

Marine communities, like atmospheric communities, cannot be delineated by static land-based boundaries. They are fluid systems that defy conventional modes of territorialisation. Indeed, it is their physical and political resistance to solid and static states that gives impetus to the will to restrain them. In his foreword to *Territory Beyond Terra* (Peters, Steinberg and Stratford, 2018) Stuart Elden discusses the biblical account of creation, in particular the separation of the earth into dry land and sea. In this account, '[t]he dry area…*yabasha* [also 'continent' in modern Hebrew] is uncovered, rather than simply created, by the gathering of waters' (p. xi, 2018). The concept of dry land as uncovered, the creation of continents as something achieved by the drawing back of waters, harbours an innate threat – that dry land will once again be engulfed by the sea. Thus, this early separation of land and sea – critical to the development of Western concepts – is based on a logic of conflict that has become the geopolitical foundation of contemporary ocean governance. Indeed, the use of land-based methods in ocean governance can be rationalised around the geological fact that the continental shelf (the

extent of territorial ocean governance in LoS) was once dry land and stands testament to the reclamation of that land by the sea.

Below, I offer an explanation of why I orientate the project around the climate system of El Niño Southern Oscillation. I discuss why I chose to analyse specific scientific and governance frameworks and practices, as well as my choice of field sites. I also provide an overview of the three papers and how they relate to one another. A conceptual framework positions the research in relation to an interdisciplinary body of literature. A method section explains how the research questions were developed and gives an overview of the project's data collection process. A final section discusses some questions raised by a comparative analysis of the main research results.

Aims and Objectives

There are two broad arguments that frame the project and inform the research questions: first, that climate – and therefore climatic events – are primarily driven by ocean systems (Rahmstorf, 2003; England, 2008; Allison et al., 2011); and, second, that climate governance should be developed around geographic theories that take ocean systems into account. I draw four principles from climate science that define the macro-physical characteristics of the climate system around which the materialities of climate events organise:

1. Climate is a global system
2. Climate is highly interconnected
3. Climate is multi-scalar
4. Climate is predominantly driven by ocean-based thermohaline dynamics.

Based on this conception of the climate system, I orientate my scholarly inquiries around the Pacific climate system of El Niño Southern Oscillation (hereafter ENSO). The research investigates ENSO as an assemblage of different material communities that have territorial agency in climate events. It asks whether social scientific research into the spatial, temporal, and agential characteristics of this assemblage could produce different ways of engaging with and representing climate events in governance frameworks and practices. In doing so, the research develops an ontology of climate that is organised around material drivers that resist the anthropocentric and terra-centric norms of climate law and governance.[1]

Because of the seriousness of the impacts of ENSO events, the system is well documented in the natural sciences and is a concept that is included in governance frameworks and practices (UNFCCC, 2014; Pacific Climate Change Science Program, 2014; Quinn et al., 1978). There is also a wider body of literature across a number of social science disciplines. Anthropologists Kirsten Hastrup and Marie Louise Robertson's positioning of the Arctic and the Pacific as 'mirror images' draws connections between Arctic ice melt and Pacific sea level rise. Hastrup and Robertson see the two sites as being connected '*through* global climate change – rhetorically, climatically, and scientifically' (my italics, 2014, p. 84). This connection relies on the connectivity between two major drivers of ocean circulation in the North Atlantic and South Pacific. This conceptualisation of the connected materialities of climate relies on its global connectivity to draw comparisons between climate change impacts in both regions. Guided by this idea the multi-scalar approach of my research connects regional and local case studies through the materialities of climate events (e.g. temperature or

[1] The concept of climate ontologies is based on spatial characteristics of climate events. I discuss this further under the conceptual framework section as a method contributing to representations of climate in governance.

rainfall) in an approach I call 'thinking through climate'.

The Marine Biogeographies of Alan Longhurst

Alan Longhurst's marine biogeographical classification (Longhurst, 1998, 2013), which I examine in detail in Paper 1, was the first attempt in the history of ocean boundary-making to represent boundaries that move over space and time. Longhurst sees the boundaries between physical oceanographic regimes as coincident with the primary discontinuities in pelagic biogeography. In other words, he sees the physical materialities of ocean circulation (e.g. communities of salinity and temperature) as the main drivers in partitioning marine biological communities. This is a methodological approach guided by what Longhurst calls 'natural logic' (see Paper 1). I am interested in this geographical approach for two reasons. First, natural logic facilitates the participation of abiotic (i.e. physical) agents in boundary-making practices – a category of nonhuman that is under represented in the socio-scientific literature on nonhuman agency. Second, the abiotic communities that partition Longhurst's biogeographies also delineate climate events, raising the possibility that the principles of natural logic might be useful in a) developing a geographic theory of climate events, and b) developing an ontology of climate.[2] Both these aspects of the project are largely exploratory and unresolved.

LoS and Compliant Frameworks

Paper 2 investigates ocean ontologies in LoS. I take a Foucauldian approach, asking how power is exercised through boundary-making practices and whether these practices are obstructive to good governance. I also reflect on the institutionalisation of

[2] For example, an El Niño event is defined by an anomalous area of warmer sea surface temperature. That area will, during the event, delineate new boundaries of phytoplankton growth, and biotic communities along the food chain will follow. Over the course of the event, temperature will act as an abiotic community that delineates other biotic communities.

historical (colonial) paradigms in LoS and ask how these are reproduced in two frameworks: the National Oceanic and Atmospheric Administration's (NOAA) *Best Practice for Boundary Making* (2006) and the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security's (CTI-CFF) *Regional Plan of Action on Climate Change Adaptation* (2013) – the main adaptation governance framework of the Coral Triangle Region. Approaches to delineating oceanic and adaptative marine environments in these frameworks then form a basis for comparison with local and traditional environmental governance.

Field Sites

Fieldwork was carried out in the Coral Triangle (May–July 2013) for several reasons. First, there is strong evidence that the region is experiencing more frequent and intense ENSO events connected to ocean warming (Pacific Climate Change Science Programme, 2014; Quinn et al., 1978). Further, it is an area of high marine biodiversity (Veron et al., 2009); because of this, marine scientific studies of the Coral Triangle are well developed. Moreover, scientific eco-regions inform the regional boundary of the Coral Triangle, which differs from the archipelagic baselines set out in LoS that determine the limits of the territorial seas and exclusive economic zones (EEZ). This is a rare instance where the distribution of marine communities has directly informed sovereign boundaries. Further, the main climate adaptation framework of the Coral Triangle region (Coral Triangle Initiative 2013) is consultative at the local level and is informed by ecosystem-based approaches (because of the high number of subsistence fishing communities). More pragmatically, I have good contacts with marine scientists, researchers, government officials, and translators in the region, which facilitated offsite reconnaissance, completion of fieldwork, and community engagement.

Paper Abstracts

The research is presented as three distinct but interconnected papers – each relating to the others, to the research questions, and to the main theoretical and methodological framings. The distinctions between these papers are aimed at meeting the requirements of the three-paper route.

1. Oceanic Assemblages: Conceptualising El Niño Southern Oscillation in Longhurst's Marine Biogeographies

Paper 1 investigates a problem in adaptation governance frameworks: a failure to account for the oceanic components of climate systems. This omission can be explained by a conceptual disconnect between land and sea that has not allowed for meaningful spatial concepts of ocean-based climate systems in environmental governance. In this paper, I investigate how the concept of 'natural logic' used by Alan Longhurst might be used as a basis for developing a geographic ontology of climate that could inform spatial concepts in governance frameworks. This inquiry is approached through an examination of Alan Longhurst's Pacific biomes and provinces (1998). I ask how, if at all, Longhurst's partitions could better inform spatial concepts of climate events in adaptation governance frameworks.

2. Analysis of Ocean Boundary-Making in Three Frameworks: A Study of Law of the Sea Discourse

Legal frameworks have historically used a colonial territorialist approach to governing ocean space. Ocean boundary-making was a method used to claim territory (or passage between territories) by colonial powers. The *United Nations Convention on Law of the Sea* (1982) represented a theoretical departure from territorialism, instead basing ocean boundary-making on a 'functionalist logic' approach that recognises sovereign

rights, is based on a framework of consent, and uses administrative reasoning as a basis for decision-making (Johnston, 1998).

Using critical discourse analysis, this paper asks: what ontologies of the oceans are evident in LoS, and how are these reproduced in other law and governance frameworks? The aim of the inquiry is to investigate whether these ontologies are obstructive to building effective regional and national ocean governance practices. The results show that tenets of territorialism persist in both LoS and the frameworks analysed: the reliance of functionalist logic on 'rational' boundary making, 'administrative reason', and land-based methods are a reappropriation of colonial logics that territorialise (and terrestrialise) the global oceans. Further, that these discourses are not aligned with, and therefore may obstruct, empirical goals in governance frameworks. Lastly, the paper considers how a decolonisation of conceptual approaches to ocean boundary-making might allow the development of better marine governance frameworks in postcolonial regions.

3. Oceanic Embodiments: Living ENSO Events in Coastal Timor-Leste

Paper 3 presents data from participatory research carried out with co-researchers from two coastal communities in northeast Timor-Leste. The inquiry is in two parts: I use participatory methods to investigate ENSO-related drought and flood events in two coastal field sites; secondly, I ask how abiotic communities (e.g. temperature and rainfall) both territorialise adaptive landscapes and are partitioned by adaptive practices. I argue that the characteristics of ENSO events reproduce conditions of colonial conflict and challenge traditional human-environment relations. I also present the idea that the embodiment of climate events in subsistence-based communities constitute a way of partitioning the terrestrial boundaries of the event. The research situates ENSO-related environmental change in a complex postcolonial landscape of independence and state-

building but also violence and displacement. Research evidences a coastal retreat of subsistence practices, with adult participants contextualising environmental change with reference to their traditional highlands. Youth participants instead envision a set of coastal adaptive practices that increase resilience to climate events. The result is a set of embodied concepts of extreme weather that cross time, space, memory, and loss.

Relationships Between the Three Papers

The results of Paper 1, which investigates ways of partitioning El Niño Southern Oscillation in marine science, provide a basis for comparison with Paper 2, which investigates ways of conceiving and representing environmental change in Coral Triangle adaptation frameworks. Paper 1 investigates how ocean partitions are constructed in marine biogeographies and to what extent these partitions might intersect with ENSO events. Paper 2 examines how environmental governance frameworks partition ocean space and, from this position, compares ocean boundary-making practices in marine science and marine governance. The results of Paper 1 also inform Paper 3, in which I employ an ontology of climate informed by Longhurst's natural logic approach. The results of Paper 3 do in turn inform Papers 1 and 2, through comparison of the papers' analyses of multi-scalar boundary-making practices.

Conceptual Framework

The central inquiries driving this thesis ask how a) nature more broadly and b) oceans more particularly are conceptualised in the various disciplines contributing to a) environmental governance more broadly and b) climate governance more particularly. I make several inroads into this investigation. Marine biogeographies are examined in Paper 1 as 'best practice' representations of marine communities. I extrapolate principles from these representations and, based on these, present a geographic approach to

conceptualising climate events. In Paper 2, I examine socio-historical conceptualisations of the ocean and their institutionalisation in LoS. I question the claim that 'third phase' ocean governance practices are reforming 'first phase' ocean governance frameworks such as LoS (Boucquey et al., 2019), instead arguing that fundamental ontologies are systemically reproduced through compliance and conformity to LoS. Paper 3 considers an alternative geography of climate – one in which the materialities making up the land-ocean-atmosphere assemblages that form during climate events have territorial agency and, further, that they deterritorialise anthropo/terra-centric geographies of climate by resituating human settlements as peripheral to the open-ocean and deep-sea drivers of climate events. The research positions the subsistence practices of co-researchers as delineating the boundaries of these events (around discontinuities in groundwater and rainfall).

Ocean Governance

Ocean Ontologies

Framing these investigations is a body of literature that criticises European institutional representations of the oceans. The literature draws from process philosophy to: a) redefine land-ocean-atmosphere relations as multidimensional, connected, dynamic, and agential (Steinberg and Peters, 2015; Peters, Steinberg and Stratford, 2018; Anderson and Peters, 2014; Hastrup and Rubow, 2014) and as resistant to conventional territorial regimes (Bruun and Steinberg, 2018; Anderson, 2017); and b) develop ontologies that are based on these relations and that can inform new geographic theories of social organisation. Of this aim, Philip Steinberg and Kimberly Peters write that:

> [t]he sea presents us with a space that is emergent through a particular cocomposition of matter and forces. In turn, this hydroelemental assemblage allows us to rethink motion and matter and how it shapes the world as we know it. (2015, p. 250)

This forms the basis of Steinberg and Peters' concept of wet ontologies. The concept is both a theory of being (i.e. what are, or what do we know about, the characteristics of the world's oceans?) and, drawing from biophilosophy, a geographic theory that extrapolates these characteristics as analogous to socio-spatial organisation. The characteristics driving the concept include depth, verticality, volume, mobility, and agency. Volume is seen as a remedy to ontologies of verticality that are criticised as 'all too often abstract and dematerialised' (Steinberg and Peters, 2015, p. 247). In this context, volumes aren't simply the addition of verticality to otherwise 'flat' ontologies. Instead, volumes actively work against territorial reductions of space.

Wet ontologies is not necessarily proposed as a way of thinking about (or governing) physically wet spaces. Instead, it promotes the idea that ocean characteristics are illustrative of general characteristics of socio-spatial relations. Yet the theory is of empirical importance to the development of ocean governance for several reasons. The first is related to the argument set out in Paper 3: that governance is a set of rules, inclusive of rules designed to territorialise space, and that general rules of territorial governance are reproduced in, and impede, environmental governance frameworks. If this 'territorial settlement', as modernist territorial governance is referred to by Bruun and Stenberg (2018, p. 148), is unsettled by ocean characteristics, it could, in theory, also be disrupted by rules of environmental governance that take account of the 'wetness' of socio-political organisation – either at sea or in a number of other elemental environments. Secondly, rules of governance that took account of the 'wetness' of socio-political organisation could, in theory, be more easily mapped onto these elemental environments.

The concept of a wet ontology is characterised by depth, verticality, volume, mobility, and agency. In the interest of drawing from this concept in my inquiry, there are two central characteristics of ocean circulation – salinity and temperature – that need to be included. While oceans could be categorised by their spatial characteristics (e.g. volume, depth), I argue that salinity and temperature are instead the central characteristics around which land-ocean-atmosphere relations in the Anthropocene are organised. Here I agree with Dalby (2013) that in the context of climate change, oceanic and atmospheric volumes are a necessary inclusion in geographic theories; however, I go further to argue that *oceanic and atmospheric volumes form assemblages around salinity and temperature*.

Problems and Opportunities for Governance

What would it mean to develop an ontology of climate around communities of salinity and temperature, and would this facilitate the development of better rules of environmental governance? As Peters and Steinberg argue, 'today's political technologies of territory, which emerged in the context of continental (and specifically European) land masses, are inadequate for the spaces that increasingly are subjected to modern forms of governance' (2018, p. 4.). In Paper 2, I take this argument further to suggest that political technologies of territory are not simply inadequate but are fundamentally opposed to the aims of good governance.

The main problem for ocean governance, I suggest in Paper 1, is the mobility of land-ocean-atmosphere events. Longhurst's natural logic approach is more representative of these events than other approaches in marine biogeography. Yet the mobility of Longhurst's biogeographies is problematic. It encourages thought both deeper into and beyond the oceans. A partitioning of space that is voluminous and moves over time remains connected to what is 'external': deep ocean processes of global circulation,

coastal regions, atmospheres of storm systems, and rainfall patterns. It is also important to consider that the mobility of matter is coupled with instability or force. Quoting writer Jonathan Raban, Steinberg and Peters write that 'the interaction of the ocean's "unstable cascades" should be understood not simply as the movement of water but as the mutation of atmosphere – space and time – as assembled from multiple elements' (2015, p. 250). It is precisely the instability of oceanic forces that creates movement and connectivity: the horizontal stratification of more or less dense ocean waters that drives thermohaline circulation, for example, and the friction of sea-surface air and water elementals, which forms the connective material between ocean and atmosphere. As an ontological approach, Longhurst's natural logic cannot be reconciled with conventional political technologies of territory, unless those technologies are revised to include nonhuman agents. As long as there is an inside and an outside of territory, mobile environments critical to the climate system will work against being inside territory and therefore governance frameworks.

Alternatively, there are certain cases in which alternative ontologies present opportunities for governance. Silver and Campbell argue that this is particularly so for Small Island Developing States (SIDS), which they describe as 'frontiers' that are 'currently posited as ripe for developing, testing, and implementing new or expanded governance arrangements for ocean conservation and development' (2018, p. 243). I suggest that this is in part connected to the unique geopolitics of islands. For example: small low-lying islands are particularly vulnerable to climate change (particularly sea level rise), and island geographies resist anthropocentric and land-based approaches.

These characteristics inform the empirical work carried out in the Coral Triangle region. Participatory research sought to reconceive adaptive geographies from a 'Longhurstian' perspective and develop a method that could be extrapolated for use

elsewhere. The research outcomes push back against international aid and NGO agendas for climate adaptation governance in the Coral Triangle, which claim to be 'inclusive' of local knowledge on the basis of participatory research but fail to recognise the ways in which international environmental law and governance frameworks reproduce Western concepts of human-environmental relations. As I discuss in Paper 3, this is problematic for both ethical and practical reasons.

The Political Force of Climate Assemblages

Building on work exploring nonhuman agency (Whatmore, 2002; Latour, 2004; Stengers, 2010; Bennett, 2012) and the political effects of things (Bennett, 2010), my research contributes to scholarship on the agential materialities of land-ocean-atmosphere relations in the Anthropocene. More specifically, I ask how the materialities of climate events: a) deterritorialise conventionally anthropo/terra-centric concepts of space; b) challenge conventional forms of territorial practice; and c) in so doing become political forces in their own right. I argue that scholarly engagement with the materialities of the climate system allow climate events to be conceptualised as 'more-than-elemental' events (Peters and Steinberg, 2018, p.7) that not only have political effects (Whitt, 2018) but *force* political change. As Saskia Sassen argues of urban/rural carbon sinks, geographies of climate disassemble particular components of the territorial state (2013).

This concept is contextualised by the literature of new materialism, which breaks down the boundaries between matter and the political (Braun and Whatmore, 2010). Matter in the Anthropocene is a political force with the capacity to de/reterritorialise law and governance regimes. The question I am interested in is: how does climate matter *force* political change? Here I engage with Mike Hulme's question of whether climate change can be governed (2010), with the suggestion that the material forces of climate

events have (as Steinberg has said of the oceans) a politics of their own that is already agential in emergent governance regimes.

Territory and Boundaries

Territory is conventionally understood as static, bounded, space controlled by an institution and/or collective. There are a number of positions in the academic literature that instead describe processes of territorialisation and the production of territory as dynamic and resistant to territorial conventions (Brighenti, 2010a, 2010b; Elden 2010, 2013a; Deleuze and Guattari, 1987). I use the term territorialisation to refer to a process that is logically prior to, but participant in, the production of territory. I use the term territory to refer to a dynamic assemblage of human and nonhuman actors engaged in an ongoing process of de/reterritorialisation. I agree with Stuart Elden that in conventional settings, territory exists in some form prior to the production of borders and that borders are therefore a product of territorialisation and a marker of territory (2013a).

I draw distinctions between conventional and alternative territorialising practices and concepts of territory. I see conventional forms of territory as based on Western concepts of property law. The concept, or lack of concept, of land ownership directly affects how territory is formed. As Andrea Brighenti demonstrates, in Western societies, territory has historically been formed around the concept of property, and social relations self-organise around that territory. The production of territory in indigenous societies instead follows social relations (Brighenti, 2010a, 2010b). Because these alternative productions of territory follow social relations, they are, on the whole, defined by a greater level of mobility because: a) social relations in subsistence-based communities follow resources that move over space and time; and b) social relations in many traditional societies are more inclusive of nonhuman communities (e.g. totemistic and animistic societies) that also move over space and time.

I also distinguish between formal and informal practices and concepts of territorialisation and territory – formal being those connected to institutional practices and dominant forms of governance, and informal being those connected to cultural and everyday practices and nonhuman agencies. I develop the concept of informal territorialisation/territory to discuss the material agency of climate events in their territorialisation of 'human' space. I also rely on this concept to consider whether alternative forms of territorialisation necessarily produce territory where concepts of land ownership are absent. For example, I argue that women's water practices (see Paper 3) territorialise through their delineation (i.e. boundary-making) of flood and drought events; but do these practices necessarily produce territory?

The inclusion of nonhumans as political agents problematises not only conventional property-based concepts of territory but also dominant positions in the academic literature. I am critical of work on territory that is not inclusive of nonhuman materialities and that maintains an anthropo/terra-centric concept of social relations (e.g. Brighenti, 2010a, 2010b). I agree with John Anderson, who instead argues that 'territory is produced as the effect of socio-material relations between the human and non-human world' (2017, p. 52). I argue that it is imperative for environmental governance to develop territorial concepts and practices that reflect more-than-human materialities and social relations. One of the ways in which environmental change challenges governance is through the need to conceptualise environments beyond what Bruun and Steinberg term the 'territorial settlement':

> derived from a specific temperate-zone, continentalist ontological ideal where large bodies of apparently unchanging and timelessly rooted land are separated by hostile and featureless expanses of endlessly fluid water. (2018, pp. 162–163)

What Bruun and Steinberg describe is a mid-latitude, continentalist settlement, when the geopolitics of ecological and human vulnerability is instead centred around high- and low-latitude coastal regions.

Relationships Between Boundaries

This project investigates boundary-making as both a conceptual and administrative practice that takes different disciplinary forms. An example of how the project engages in interdisciplinary analysis of boundary-making across terrestrial and marine environments can be found in Paper 2 where I investigate how the conceptualisation of space in LOS is reproduced in representations of space in NOAA's *Best Practice for Boundary Making*. I argue that boundary-making in governance cannot account for scientific concepts of space (i.e. Longhurstian concepts) because the mobility of marine communities is in conflict with land-based administrative boundaries.

I have categorised my understandings of territorial practice as conventional and alternative, formal and informal; I adhere to the same categorisations in my use of the term 'boundary'. I draw a distinction between what I call formal boundaries that are directly produced by legal, scientific, and political institution and informal boundaries that are instead defined by everyday practice. I define a formal boundary as typified by boundary-making objects and artefacts such as maps, laws, physical markers, and wall-like objects (Brighenti, 2009). My research focuses on three main disciplinary methods of boundary-making, and the results show they are distinct: 1. marine boundary-making in governance is reproductive of ontologies of the oceans institutionalised in LOS (conventional/formal); 2. Longhurst's method conceptualises boundaries around material discontinuities in the ocean that move over space and time (alternative/formal); and 3. subsistence practices are in themselves boundary-making practices that trace material

discontinuities, as in Longhurst, but on land (alternative/informal). In my analysis, I extrapolate boundary-making principles from Longhurst's marine biogeographical work (i.e. those expressed in the concept of natural logic) to think about how boundary-making can be understood as the delineation of a material discontinuity in an adaptive landscape. I develop 'natural logic' as a technical term to describe a set of boundary-making practices that delineate the materialities of climate events.

Colonialism and Decolonialism

My research positions the indigenous labour of adaptation as a territorialising act, defined through subsistence practices that delineate the discontinuity of resources such as water. The argument that adaptive practices are also boundary-making practices is allied to work on colonial and slave labour and the production of territory (Goodall, 1996). This labour is contextualised by the geopolitics of ecological and socio-political resilience to climate change by which postcolonial regions are disproportionality affected.[3] In addition, the geopolitics of climate governance situates these regions as climate frontiers in an extractive relationship in which adaptation labour informs adaptive strategies in regions with higher resilience. The parallels between climate frontiers and colonial frontiers seem unavoidable given their geographic proximity to one another.

The dominant frameworks through which climate change is understood and governed are broadly neocolonial. One way in which this is evident is in the institutional territorialisation that occurs when non-Western environments are studied and governed through the lens of Western concepts of nature (see Adams and Mulligan, 2002). In Papers 2 and 3, I show that dominant environmental governance frameworks exercise

[3] Ecological and socio-political resilience to the effects of climate change is lowest in high- and low-latitude regions, where most postcolonial regions are situated.

colonial agency in their reproduction of Westphalian territorial practices and human-environment relations. Neocolonial institutions gain agency through the territorialisation of ideas. As Paul Carter argues of the project of decolonising governance more generally:

> Westphalian notions of sovereignty continue to determine political and legal arrangements…reform in this case is not simply operational but conceptual: political relationships need to be drawn differently; cultural illiteracy…needs to be recognized as a major obstacle to decolonizing governance. (2018, p. 20)

My research contributes to literature on decolonising nature and environmental governance in three ways. Firstly, I present participatory research on how traditional subsistence knowledge and practice produces alternative geographies of adaptation. Traditional cultural knowledge and practice is embedded in (already a part of the liveliness of) the local land and seascape. Adaptative practices produce an alternative form of territorialisation that I develop as a method for conceptualising geographies of adaptation in governance frameworks. From this I suggest a set of methodological principles for decolonising climate adaptation governance in postcolonial regions. Secondly, I conceptualise geographies of climate change and adaptation 'from the sea'. I work towards an ontology of climate that decentres the anthropo/terra-centric focus demonstrated by dominant environmental governance frameworks. Lastly, I critique climate events as volumatic assemblages that contribute to, resist, and form alternative territorialising practices.

I acknowledge that the geographies of adaption co-produced in this research rely on concepts from conventional natural-scientific practice. The argument for conceptualising coastal adaptation 'from the sea' relies on scientific knowledge of global climate as a highly connected and ocean-centric system. Contemporary scientific practice continues to enforce hegemonic norms in theory and method that work against the inclusion of alternative (indigenous) knowledge. I would not argue against claims that

contemporary environmental science is broadly neocolonial. I do, however, question whether environmental science is neocolonial in the particular. While I agree that conventional territorial practices are facilitated by scientific concepts, one of my strongest criticisms of environmental governance is the failure to better represent scientific concepts in boundary-making practices. Further, I argue that the scientific understandings underpinning the ontologies of climate I have outlined above (i.e. the 'principles' of climate) are allied to indigenous experience of climate events in two ways: both scientific and indigenous knowledge conceive of system boundaries that move over space and time and hence both are resistant to dominant environmental governance frameworks that conceives of boundaries as static; and both systems of knowledge (animistic and Western-scientific) have concepts of material communities arranged in mutable, assemblage-like systems that inform human-environment relations.

My research contributes to scholarship in the area of ocean geography that works to connect oceans to human settlements and, by doing so, challenges the conceptual separation of these environments. Developments in marine conservation also work to deconstruct the territorial settlement (Bruun and Stenberg, 2018) by decentring the land bias of environmental governance and by better representing SIDS. Large marine protected areas (LMPAs) are a good example. Gruby et al. note that the scaling up of MPAs to LMPAs means that island states with LMPAs in their EEZ are more visible on global maps, and thus better recognised for their globally valued resources:

> This visibility coupled with [the] rise in marine conservation on global agendas may enable less powerful groups – small islands and overseas territories in particular – to push back against colonial legacies and globalization processes that undermine their independence and authority…Local indigenous communities are also asserting claims to preserve their traditional and future rights in the context of what Leenhardt *et al*. (2013) describe as advancing state sovereignty claims via LMPAs. (2016, pp. 157–158)

I would suggest that, methodologically, the scaling up of MPAs to LMPAs is likely to reproduce many of the paradigmatic problems, such as land-based methods, that I have criticised in MMA/MPA best practice (see Paper 2). If this is the case, Gruby and Gray et al (2016) suggest that archipelagic states would still benefit from these methods, especially if they contribute to the development of 'independent regionalism' for Pacific islanders (Gruby and Campbell, 2013, p. 2046).

Method

Research Questions

This project is conceptualised around aspects of the ENSO climate system as the central driver of climate events impacting Pacific marine and coastal communities. There is one central research question:

How are ENSO events conceived and represented, and what do these representations reveal and entail about a) boundary-making in environmental governance and b) adaptive governance in particular?

The question concerns a general process of knowledge production and is broken into three further questions, each corresponding to a research paper:

How is El Niño Southern Oscillation conceived and represented in:

1. The Pacific marine biogeographies of Alan Longhurst (1998, 2013)?
2. The Coral Triangle adaptation governance frameworks (CTI, 2013)?
3. Traditional coastal communities in the Coral Triangle (Timor-Leste)?

Paper 1. Oceanic Assemblages: Conceptualising El Niño Southern Oscillation in Longhurst's Marine Biogeographies

Guided by the first research question, this paper used discourse analysis to investigate how El Niño Southern Oscillation is conceived and represented in the Pacific

marine biogeographies of Alan Longhurst (1998, 2013). As a first stage, I analysed a body of literature developed in consultation with leading scientists in the fields of marine biology and physical oceanography.[4] This included literature on the main marine biogeographical classifications (1988–2014) and contextual work on the development of the field. The aim of this analysis was to identify key methodological frameworks. I deployed basic principles of critical discourse analysis: analysing context and debates; identifying and coding linguistic mechanisms and discourse strands; and examining structure (Fairclough, 1995; Chilton, 2004; Gee, 2012).

The second stage involved a discourse analysis of two marine biogeographical classifications (Longhurst, 1997; Reygondeau and Longhurst, 2013). First, I identified three categories of linguistic mechanism in the literature, which I called: 1) agents, 2) devices, and 3) concerns. Secondly, I followed these mechanisms in the classifications under analysis to see how authors use these to define ocean partitions. Agents are identified as a central mechanism whose 'discontinuity' in space is used to define an ocean boundary (discontinuities being a general principle in marine biogeographies); for example, an ocean partition can be defined through a discontinuity of an agent such as salinity or chlorophyll. Devices were identified as key technologies used in the scientific method of each classification. Concerns were interpreted more broadly and take account of language, theoretical framings, scope, and funding. These three mechanisms – agents, devices, and concerns – were then considered in terms of how they represent marine communities over space and time. This is a key concept in Longhurst's work, which aims to create partitions that move over space and time.

[4] Prof. Alex Rogers, Department of Zoology, University of Oxford; Prof. Gideon Henderson, Department of Earth Sciences, University of Oxford; Paul Macnab, Bedford Institute of Oceanography, Department of Fisheries and Oceans, Canada.

Paper 2. Analysis of Ocean Boundary-Making in Three Frameworks: A Study of Law of the Sea Discourse

Guided by the second research question, this paper used discourse analysis to investigate how marine environments impacted by ENSO events are conceived and represented in Coral Triangle ocean governance frameworks. The inquiry has two parts. First, I investigated boundary-making in the *United Nations Convention on Law of the Sea* (1982) – in particular *Part II, Section 2: Limits of the Territorial Seas*, *Part VII High Seas, Sections 1 and 2*, *Part XI, Section 2: Principles Governing the Area*, and *Part XIII: Marine Scientific Research*. This framed an analysis of the National Oceanic Atmospheric Administration's *Marine Managed Areas: Best Practice for Boundary Making* (2006). I identified discourse strands related to how ocean partitions are 'conceived', 'described', and 'represented' for use in governance instruments.

This investigation of conventional modes of boundary-making frames an analysis of The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security's (henceforth CTI-CFF) *Regional Action Plan* (2013). The Coral Triangle region is defined by marine scientists as a global epicentre of biodiversity that crosses the economic zones of six developing countries (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste). These contexts were important for two reasons: first, the region is well represented in marine science literature; and, second, since there are a high number of coastal subsistence communities that rely on fishing, the region's marine environments are well represented in environmental governance frameworks. This allows for analysis of how scientific delineations of the region intersect with, for example, the people-centred approach used in the CTI-CFF framework and how (if at all) these take account of ENSO events.

Paper 3: Oceanic Embodiments: Living ENSO Events in Coastal Timor-Leste

Guided by the third research question, this paper investigates how ENSO events are conceived and represented by coastal communities in northeast Timor-Leste. Based on deliberative methods of inquiry, such as geographer Janet Nackoney's 'participatory process' (Nackoney and Williams, 2013), the research design follows the process of knowledge production – insofar as knowledge is produced in response to environmental change. Collectively, the methods used included 43 interviews, 2 mapping workshops (including 5 separate focus groups), 4 seasonal calendars, 2 historic timelines, 1 youth mapping workshop, observations of the 4 main occupational practices, and field walks.

Of particular relevance to the research design was the impact of occupation, violence, and displacement on the integrity of both oral knowledge and written texts (most of which were destroyed during conflict periods). With so many structural forces at play, ethnographic methods emphasised the 'situated character' of everyday practice (Katz, 2002), in an effort to avoid deterministic analysis reliant on, for example, a postcolonial framework. Kristin Asdal's (2012) argument for the reintegration of context in ethnographic methods was also important. This is a crucial consideration when working with indigenous, oral-based communities where, I suggest: the distinction between contemporary moment and historical context is less defined; where collective memory can be embedded in the landscape; and where concepts of distance, or internal and external materialities, can instead be embodied (as in animistic belief systems).

The interviews had three areas of focus: socio-environmental histories, environmental change, and custodianship/resource management. The first was investigated through oral histories and traditional stories; the second through impacts on livelihoods and homes; and the third through the identification of vital resources, everyday practices, and relationships to place. The use of mapping and interview methods

was informed by arguments against humanistic methods that position the subject as passive (Whatmore, 2002). To address this criticism, participants actively engaged with interview data in later research phases, to guide the participatory mapping of community practices and resources. This was, in turn, informed by Dydia DeLyser and Daniel Sui's defence of mapping as a practice that is not merely representational but also prompts discussion – the idea that 'today's maps are not simply used as illustrations, [but are instead] increasingly used as the medium to tell stories' (2014, p. 295). This combined approach of interviewing and mapping was important to an investigation of environmental histories as it allowed the cross-referencing of spatial and historical data.

Historical timelines were completed at each site to discuss significant environmental events, hazards, impacts, and coping mechanisms, from the establishment of the villages in 1980 to the present day (2013). This method was drawn from three NGO-led climate adaptation projects in Timor-Leste to gain a better understanding of the scope and success of different methods in the local setting. These were the Local Early Action Planning (LEAP) Guide (Coral Triangle Initiative, 2013) and two adaptation projects led by WorldFish (2012, 2013). The Coral Triangle Initiative's LEAP guide is designed for use across the Coral Triangle region, and the component exercises are necessarily broad. The WorldFish report (2012) shares some methodological approaches with the LEAP guide (e.g. historical timelines and seasonal calendars).

Lastly, youth workshops investigated how participants imagined future land- and seascapes. This was conducted over two sessions: the first involved 25 participants aged 14–17 years. The maps produced in the adult workshops were discussed, with attention paid to the impacts of both climate change and practices such as deforestation. Participants worked in groups to produce maps of future land/seascapes. A focus group of 6 participants was interviewed as a final stage to investigate environmental relations

as well as understandings of extreme weather events.

Overview of Data Collection

Data collection consisted of archival research, literature reviews, interviews, focus groups, workshops, and participant observation. Archival research of ocean cartography produced by the Bedford Institute of Oceanography (Nova Scotia) was carried out in 2013. The Bedford Institute's ocean partitions formed the standard for scientific and governance practices for much of the twentieth century. Alan Longhurst was also based at the Institute during the development of his original marine biogeographies (1998), and so the Institute's work offers an important foundation for this project's analysis of scientific representations of the global oceans as they developed over the twentieth century.

A phase of elite interviews and participant observation of governance practices was carried out in Timor-Leste (2013). There were a total of 8 interviews with regional, national, and local environmental governance officials, and participant observation notes were taken at the 2013 CTI-CFF Regional Exchange. This involved participant observation of member countries, particularly Timor-Leste's contributions to the Exchange. I participated alongside Timorese government officials to develop and present on national contributions to the key aims of the framework. A main focus was assessment of local consultation and the implementation of a newly developed local vulnerability assessment tool. I combined this with participant observation of the Regional Secretariat and other officials involved in the coordination and running of the Exchange.

Research with local communities in northeast Timor-Leste began with an interview phase of 27 individual and family group interviews, with a total of 43 participants. Two participatory mapping workshops were carried out (one at each field site). Within these workshops, focus groups were created to map economic and cultural

resources specific to occupational and cultural groups. Six such groups (fishing, wood harvesting, agriculture, weaving, women's custodial practices, and men's custodial practices) were formed at each field site (12 in total). Historical timelines from the establishment of the villages in 1980 to the present day (2013) were completed at each site. These workshops discussed significant environmental events, hazards, impacts, and coping mechanisms. Similarly, seasonal calendars were produced at each site (adjusted to account for periods of conflict in which planting and harvesting practices were interrupted), tracing weather events and subsistence practices by comparing a 'normal' year against observed changes. The information was recorded across a 12-month calendar and focused on the following features: seasonal and inter-seasonal rainfall over the wet and dry seasons; storm activity; storm surges and king tide events; planting and harvesting times for all crops; and fishing practices. Areas affected by events were added to the base map, along with associated degrees of concern.

Youth workshops held with 25 participant researchers aged 14–17 years investigated how participants imagined future land- and seascapes (visioning exercises). Participants worked in groups to produce maps of future land/seascapes based on their own environmental concerns. Youth participants were also involved in the resource mapping workshops, whereby participants cross-checked hand-drawn data produced in the adult workshops and were able to add data and make amendments. This method accounted for the different areas of land used by youth participants for play, which were often outside areas of occupational land use. A focus group of 6 youth participants was interviewed as a final stage to investigate environmental relations as well as understandings of extreme weather events.

Conclusion

The central research question guiding this project is: How are ENSO events conceived and represented, and what do these representations reveal and entail about a) boundary-making in environmental governance and b) adaptive governance in particular? The results of Paper 1 show that ENSO is represented in marine biogeographical classifications through Longhurst's physiognomic approach, which relies on the same physical materialities that characterise ENSO events (and climate events more generally) and, further, that principles drawn from Longhurst's approach might inform concepts of ENSO in governance frameworks. Paper 2 shows that while ocean governance frameworks aim to represent marine scientific understandings in boundary-making practices, these are undermined by fundamental ontologies that work against these aims. The results suggest that the latter may be incompatible with the former. The results of Paper 3 show that ENSO events are an experience embodied by participant researchers and that adaptive subsistence practices act to delineate the terrestrial boundaries of ENSO events by tracing the discontinuities of resources such as water.

The results speak, in turn, to the theoretical framings of the research. Longhurst's conceptualisation of marine communities around assemblages of salinity and temperature also elucidates a way of conceiving of living things around assemblages of nonliving things. As an ocean ontology, principles drawn from Longhurst's work situate climate events as the materialities around which space in the Anthropocene is organised. It resituates human settlements in a new spatial order – one centred around the open ocean and deep sea. In turn, the decentring of human settlements positions subsistence adaptive practices as delineating the (peripheral) discontinuities of climate events.

These conceptualisations of space that are informed by Longhurst's approach work towards an ontology of climate or a geographic theory of socio-spatial relations in the

Anthropocene whereby space is organised around assemblages of salinity and temperature. This idea expands on Steinberg and Peters' concept of 'wet ontologies' (2015) – particularly the agency of ocean materialities in the context of climate change. I argue that if rules of governance took climate ontologies into account, reform of environmental governance frameworks may result in a better spatial fit with the environments under governance. This is evidenced in the results of Paper 3, where local adaptation governance is informed by women's water practices. What these traditional ontologies evidence is a conceptualisation of space around the materialities of ENSO. Local adaptation governance is directly informed by these boundary-making practices.

The results of Papers 1 and 3 further develop the concept of nonhuman agency. The delineation of Longhurst's biogeographies is entirely reliant on the participation of abiotic communities. The animistic cosmologies of research participants reconfigure climate events around the politics of ancestral landscapes of agential things. In both cases, the material communities of climate have political force. They territorialise both physical and political spaces, and they have a politics of their own that is active in emergent governance regimes.

Based on the results of Paper 3, I position the labour of adaptation as a production of territory in the global 'fight' against climate change. This is contextualised by the geopolitics of high/low-latitude vulnerability that further marginalises postcolonial developing nations. I compare the labour exerted on the 'frontier' of climate adaptation to the production of territory by colonised peoples, and I draw comparisons based on the overlapping of postcolonial and adaptive geographies. The results of Paper 2 show that conventional governance frameworks problematise adaptation in the Coral Triangle because they are based on European continentalist ontologies.

This evidence, coupled with the fieldwork results from Paper 3, supports the case for decolonising environmental governance frameworks developed for specific or general use in postcolonial regions. I argue that dominant governance frameworks exercise colonial agency in two ways: 1. policy implementation is a form of conceptual territorialisation of traditional human-environment relations because they reproduce Western ontologies of nature; and 2. dominant environmental governance practices are legitimised through their bases in the Western scientific tradition, which works to undermine indigenous knowledge. Evidence suggests that decolonisation requires the development of alternative regional and domestic frameworks around indigenous knowledge. This project of reform addresses the material systems of environmental governance in order to avoid imposing Western human-environment relations on non-Western societies. The results from this empirical research suggest that the decolonisation of environmental governance is not just an ethical imperative but is essential for sustainable long-term governance.

The research results strongly suggest that environmental policy development and implementation would be more effective if developed around local human-environment relations. The results also suggest that the ontological foundations of environmental law and governance contribute to creating nontrivial disciplinary limits. The research points to anthropocentrism as a particular problem in dominant environmental law and governance frameworks. Scholars of environmental law have criticised anthropocentrism as obstructive to developing robust law (Redgwell, 1999; Birnie, Boyle and Redgwell, 2009; Stone, 1996). I expand on this to suggest that both anthropocentrism and terra-centrism are obstructive to developing sustainable environmental governance frameworks.

In summary, there are two themes that emerge from the research that I would like to highlight. First, the concept of 'natural logic' set out by Alan Longhurst as an approach to ocean boundary-making is in principle allied to the traditional environmental governance approaches identified through participatory research in Timor-Leste. The commonality is the reliance of boundary-making on physical materialities. I argue that this approach could be developed to better conceive and represent adaptive geographies in governance frameworks. Second, there is a need to decolonise the ontological bases of environmental law and governance frameworks. I suggest that both a 'natural logic' approach and the methodological principles that develop from traditional environmental knowledge of the adaptive environment have the potential to challenge the anthropo/terra-centric foundations of environmental law and governance frameworks in postcolonial regions.

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Paper 1.

Oceanic Assemblages:

Conceptualising Marine Boundaries for Adaptation Governance

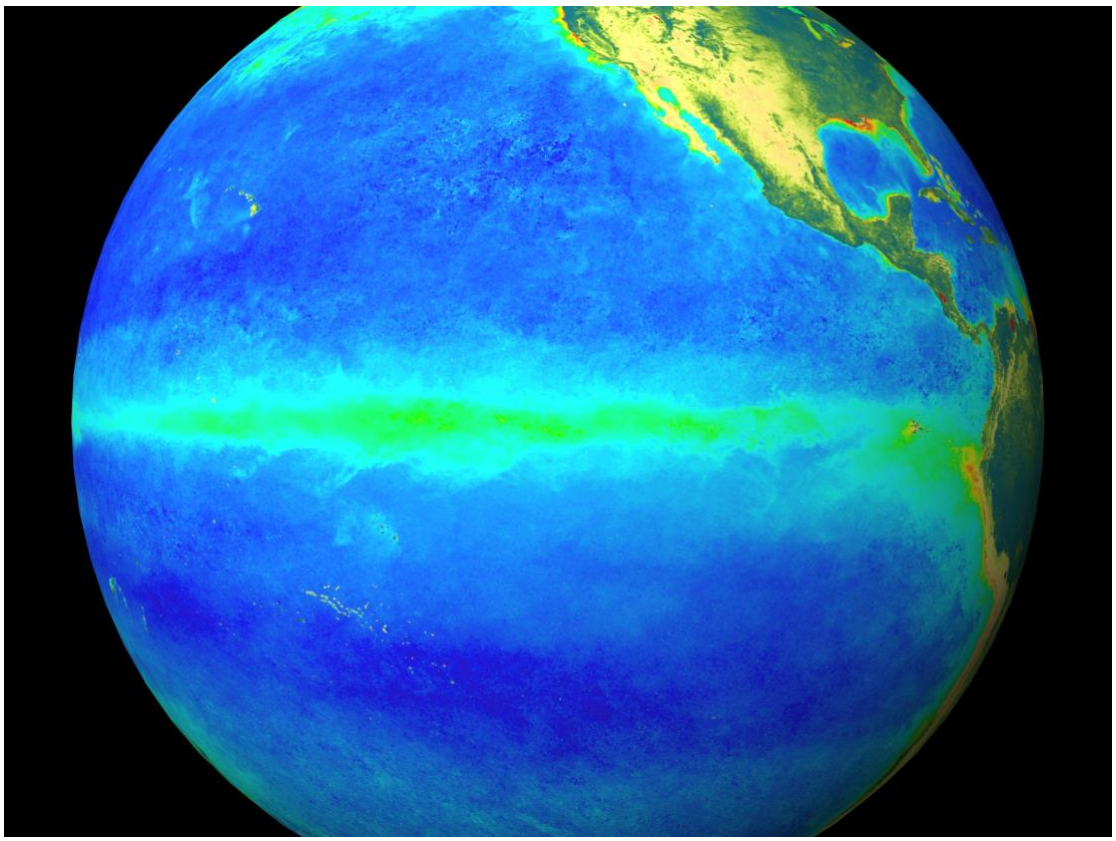


Figure 1. El Niño Related Pacific Phytoplankton Bloom, July 1998 (NASA)

'Setting spatial bounds to ecosystems is an essential step toward their quantitative study, and this is best done according to a natural logic…' (Longhurst, A. 2006)

Abstract

Approaches to marine boundary-making in science and governance differ greatly. It is fair to say that there are many difficulties in representing marine communities, most of which move over space and time. Marine scientific boundary-making is the more successful in doing so, yet scientifically delineated marine regions are poorly represented in marine governance frameworks. Instead best practice for marine boundary-making in governance frameworks conceptualises marine boundaries around socio-economic concerns, even when these frameworks' main aims are conservation. While this paper advocates for better representation of marine science in marine governance frameworks, its main aim is to extrapolate key approaches to—or principles for—marine boundary-making in the scientific literature that might potentially inform better boundary-making practices in environmental governance. In particular, this paper investigates approaches to boundary-making in Pacific marine biogeographies. I am especially interested in a) how certain approaches to delineating marine communities in marine biogeography intersect with climate events (e.g. El Niño Southern Oscillation events, and b) whether this could inform a more dynamic conceptualization of adaptive geographies that cross both oceanic and terrestrial environments.

1. Introduction

There are serious hindrances to better representing oceans in environmental governance frameworks. Recent scholarship in geography and anthropology argues that this is a conceptually based problem. Geographer Philip Steinburg argues the problem lies with the concept of the ocean as other—an externalising of the global oceans that is evident in the construction of ocean governance instruments (2010). Anthropologists Emma Cardwell and Thomas Thornton suggest that marine environments are subject to a number of 'disciplinary imaginations of the sea', that territorialise marine space as a

static and homogenous resource. Other studies show that normative ways of conceptualising ocean environments fail to account for both their interconnectivities and their complexities (Longhurst, 2003; Bischof, 2014; Stojanovic, 2012.) This body of work challenges the idea that the oceans are external to land and human society, instead focusing on how these environments are connected—through atmospheric coupling, coasts, and practices such as fishing and seafaring.

If recent challenges to ocean governance (such as the impacts of ocean warming on marine life) have revealed anything it is that oceans cannot be governed as extensions of land. They have qualities and characteristics of their own—most obviously, fluidity—that challenge all conventional modes of territorialisation. This dilemma has highlighted the importance of revising ocean governance frameworks to better enable them to address contemporary challenges. Problems like ocean pollution and climate change shift the focus of ocean governance beyond the boundaries of the exclusive economic zone, into the open ocean and deep sea where very few governance frameworks exist. These new challenges call ways of conceptualising and delineating oceans in governance frameworks into question.

In this paper I suggest that revising how oceans are represented in environmental governance is especially important in the governance of climate change, because climate is an ocean-based system. In climate adaptation governance frameworks, climate events are conceived around the small areas of the climate system that impact land and people. This approach is anthropo/terracentric and disconnects climate events from their oceanic drivers. While adaptation is largely focused on the urgent task of mitigating, and recovering from, the devastating impacts of climate events such as drought and flood, I argue that it is important for long-term adaptation governance that there are methods for conceptualising the boundaries of climate systems and events beyond the current people-

centred approach.

This paper has three aims:

1. To investigate marine boundary-making approaches in marine biogeographies.

2. To ask how these boundaries might intersect with delineations of climate systems and events

3. To consider what general principles of boundary-making might be extrapolated from these studies to inform the conceptualisation of adaptive geographies.

Marine biogeographies are well positioned for this inquiry: physiognomic approaches delineate ocean communities around discontinuities in temperature and salinity—two of the main characteristics driving climate events; they conceptualise ocean assemblages as moving over space and time; and while they remain poorly represented, they are still the best represented marine scientific framework in ocean governance instruments.

I take as a case study for this inquiry the Pacific climate system of El Niño Southern Oscillation (henceforth ENSO). ENSO is 1 of 6 regional climate systems that drive global climate, and it is the major system to which adaptation governance in the Pacific region responds. The most common impacts of an ENSO event are flood and drought (depending on location and season) and these affect not only marine and coastal environments, but also inland areas (UNFCCC, 2014; Pacific Climate Change Science Programme, 2014; Quinn et al, 1978), contributing to adaptive geographies that cross land-sea environments. While ENSO is present as a concept in governance frameworks and practices, there is no evidence that Pacific adaptation frameworks engage with the *system* of ENSO in any meaningful way, instead focusing on the terrestrial impacts of individual events (Coral Triangle Initiative, 2013; Pacific Climate Change Science Programme, 2009). ENSO events are also taken into account in the marine biogeographical classifications I focus on is this paper. This is because the main defining

features of an ENSO event are increases in sea surface temperature, which in turn supports phytoplankton blooms (and hence the parameters of some marine ecosystems). This is partially illustrated by the phytoplankton bloom in Figure 1., which occurred during an ENSO event in 1998.

The paper includes a methods section (2.) that discusses discourse analytic methods used in the analysis of marine biogeographical classifications. The results section (3.1) discusses analysis of boundary-making approaches used in the main marine biogeographies. (3.2) analyses two key marine biogeographic classifications to ask how these intersect with the parameters of environmental change. (3.3) draws key principles and approaches to boundary-making from the study and asks how these could informs spatial concepts of ENSO events in adaptation governance frameworks.

2. Method

My central research question asks:

1. How could methodological approaches used in marine science help build concepts of ENSO in adaptation governance frameworks?

This question is broken down into three further questions:

1 (a). What approaches to boundary-making are used in the field of marine biogeography?

1 (b). Do these boundaries intersect with climate systems and events?

1 (c). What general principles can be drawn from these fields that might inform the conceptualisation of adaptive geographies that cross land-sea environments?

As a basis for this inquiry I conducted a review of scientific literature in consultation with experts in the field (Table 1). The aim of the review was to analyse the methodological approaches of the main marine biogeographical classifications (1988-2014). This was

carried out to identify classifications for further analysis on the basis of the following conditions: a) the use of physical (nonliving/abiotic) characteristics in the delineation of marine areas (i.e. a physiognomic methodological approach); and b) the representation of open-ocean and deep-sea environments. The reasoning behind this approach was to identify classifications that may intersect with ENSO events that are also delineated by physical characteristics like temperature.

Table 1. Literature Reviewed

Early Ideas for Dynamic Biogeographic Provinces

Platt T. and S. Sathyendranath (1988) 'Oceanic primary production: Estimation by remote sensing at local and regional scales.' Science, Vol. 241, pp. 1613-1620.

Platt T.. C. Cavcrhill and S. Sathycndranath (1991) 'Basin-scale estimates of oceanic primary production by remote sensing: The North Atlantic.' Journal of Geophysical Research Vol.96. pp. 147-159.

Sathyendranath, S., A. R. Longhurst, C.M. Caverhill and T. Platt. (1995). 'Regionally and seasonally differentiated primary production in the North Atlantic.' Deep Sea Vol. 42 pp. 1773 – 1802.

Platt, T and Sathyendranath, S. (1999) 'Spatial structure of pelagic ecosystem processes in the global ocean.' Ecosystems, Vol. 2, pp. 384–394

Bedford Institute of Oceanography Literature

Bedford Institute of Oceanography, 2002. Annual Review (1962-2002)
http://www2.mar.dfo-mpo.gc.ca/science/review/2002/english/BIO_2002_in_Review.asp?n=8

Nettleship, D. and Gordon D, et al (Eds.), 2014. 'Plankton Ecology at the Bedford Institute of Oceanography, 1962-2012.' *Fifty Years of Marine Research at Canada's Bedford Institute of Oceanography: a commemorative volume in celebration of the 50th Anniversary of the Bedford Institute of Oceanography, Dartmouth, Canada*.

Marine Biogeographic Classifications

Briggs, J. 2007. 'Marine longitudinal biodiversity: causes and conservation' Diversity and Distributions, Vol. 13 pp. 544-555

Clark, M. et al 2011. 'A global seamount classification to aid the scientific design of marine protected area networks' Ocean & Coastal Management Vol. 54 pp. 19-36.

UNESCO, 2009. *Global Open Ocean and Deep Seabed (GOODS) Biogeographic Classification*, UNESCO-IOC (IOC Technical Series, 84.)

Spalding, M. et al 2007. 'Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas' Bioscience Vol. 57 pp. 573-583

O'Hara, T. et al, 2011 'A Southern Hemisphere Bathyal Fauna Is Distributed in Latitudinal Bands' Current Biology Vol. 21, pp. 226–230

Veron, J. et al. 2009 'Delineating the Coral Triangle' Journal of Coral Reef Studies Vol. 11, pp. 91-100

Spalding, M.D., et al, 2007. 'Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas.' Bioscience. Vol. 57 pp. 573-583

O'Boyle, R. 2009., Review of Selected Biogeographic Classification Systems with Relevance to the Canadian Marine Environment. http://www.dfo-mpo.gc.ca/Library/340688.pdf, Canadian Science Advisory Secretariat.

Longhurst, A. 2003. 'The Symbolism of large Marine Ecosystems' *Fisheries Research* Vol. 61 pp. 1-6

Reygondeau, G., Longhurst, A., Martinez, E., Beaugrand, G., Antoine, D. And Maury, O., 2013. Dynamic biogeochemical provinces in the global ocean. *Global Biogeochemical Cycles,* **27**, pp. 1046-1058.

Halliday, R. G. and A. T. Pinhorn 1990. 'The delimitation of fishing areas in the Northwest Atlantic'. Northwest Atlantic Fish, Vol. 10. pp.–51. http://journal.nafo.int/J10/halliday.pdf

Longhurst, A. 1998 *Ecological Geography of the Sea*, Academic, London.

Platt, T. *et al* 2005 'Physical Forcing and Phytoplankton Distributions' *Scientia Marina* Vol. 69 p. 55-73

Sherman, K. and Alexander, L. 1986. *Variability and Management of Large Marine Ecosystems, Westview* Press, Boulder, Colorado.

Watson R, et al, 2003. 'Mapping fisheries onto marine ecosystems for regional, oceanic and global integrations'. pp. 365–396 in Hempel G, Sherman K, (eds.) Large Marine Ecosystems of the World: Trends in Exploitation, Protection, and Research. Elsevier, Amsterdam.

The literature reviewed (Table 1) includes: a small body of key literature (Platt, T. *et al* 1988, 91, 95, 99) that informed the development of the main marine biogeographical classifications; two reviews carried out by the Bedford Institute of Oceanography (BIO) of the institutions own research and publications; and literature on the main biogeographical classifications. The research carried out by the BIO, which includes Alan Longhurst's work, formed many global standards in the field of oceanography over the C20th, and so offers an important institutional framework. The

review of plankton ecology at the BIO over the period 1962-2012 (Nettleship and Gordon et al, 2014) further contextualises Longhurst's work, which uses phytoplankton as a key agent in marine partitioning. Of those biogeographies using a physiognomic method (either exclusively or in combination with other methods) I then use interpretative methods to analyse context (authors, institutional affiliations, place and year of publication, funding) and methodological concerns.

The review identifies two biogeographical classifications for further analysis (Longhurst, 1998; Reygondeau and Longhurst et al, 2013). I deploy basic principles of critical discourse analysis: analysing context and debates; identifying and coding linguistic mechanisms and discourse strands; and examining structure (Fairclough, 1995, 2011; Chilton, 2004; Gee, 2015; Gee and Hanford, 2012). I develop an analytic framework that identifies key 'agents', 'devices', and 'concerns' in the scientific literature, with the aim of investigating what role these play in ocean boundary-making. Agents are identified as a central mechanism whose 'discontinuity' in space is used to define an ocean boundary (discontinuities being a general principle in marine biogeographies). Devices are identified as key technologies used in the scientific method of each classification. Concerns are interpreted more broadly, and take account of language, theoretical framings, scope, and funding. These three mechanisms are then considered in how they represent ocean partitions over space and time, and in response to environmental change. To clarify, an example of how I use these mechanisms is as follows: Alan Longhurst's classification (1998) uses a physiognomic method. That is, it uses physical characteristics—like salinity and temperature—to define ocean partitions. I define an **agent** of this classification as a physical community (e.g. temperature) whose discontinuity in space is used by Longhurst to establish a biogeographical partition. I define a main **device** used in Longhurst's method as the satellite technologies on which

the method relies. Lastly, I define a **concern** as a concept used by Longhurst as a methodological approach.

3.1 Results

Marine biogeographies can be classified by their methodological approach: taxonomic (conventional biogeography based on species distribution); physiognomic (based on physical characteristics such as bottom topography, depth, temperature and salinity); ecological (a combination of biological and physical factors); and socio-economic (e.g. fisheries and mineral resources) (See Table 2.). Each methodological approach relies on a set of agents (e.g. biotic, abiotic), *the discontinuities of which* partition the biogeography. Some systems of classification rely on one methodological approach (e.g. Marine Zoography (Briggs, 1974) is purely taxonomic), while others such as the Global Open Ocean and Deep-Sea Report (UNESCO, 2009) use a combination of methods.

Those classifications that did not use a physiognomic method (1, 2, 3, and 7) were not considered for further analysis, on the basis that they did not sufficiently engage with the physical agents that intersect with climate systems. Instead further analysis focused on marine biogeographies that use a physiognomic method (4, 5, and 6) either exclusively or in combination. The term physiognomic is:

> largely derived from terrestrial biogeographic work where habitats could be broadly defined by the structural or physiognomic characteristics of the vegetation. Ensuing classifications across a broad range of scales were then shown to be closely allied to driving abiotic influences and indeed that such influences (notably temperature and rainfall) could be used to map out predicted patterns of vegetation [in the case of marine biogeographies, this vegetation is phytoplankton]. (UNESCO, 2009, pp. 13-14).

Table 2. Review of the Main Marine Biogeographical Classifications

	Biogeographical Classification	Methodological Approach	Area of Focus	Methodological Concerns	Lead Scientist
1.	Marine Zoography	taxonomic	coastal/shelf provinces	biodiversity/ charismatic communities	Briggs, J. (1974)
2.	Large Marine Ecosystems	ecological socio-economic	coastal/shelf provinces	scale	Sherman, K and Alexander, L. (1989)
3.	Marine Ecosystems of the World	ecological	coastal/shelf provinces	Ecological boundaries	Spalding, M. (2007)
4.	Longhurst's Biomes and Provinces	physiognomic	global/ pelagic	natural logic	Longhurst, A., (1998)
5.	Global Open Ocean and Deep-Sea Report	taxonomic, ecological, and physiognomic	open ocean and deep sea	representation of open and deep oceans (address gaps in knowledge)	UNESCO (2009)
6.	Dynamic Biogeographical Provinces in the Global Ocean	physiognomic	global/pelagic	Influence of environmental change on spatial distributions	Reygondeau, G. and Longhurst, A. (2013)
7.	Hydrothermal vents	taxonomic	benthic environment	Deep ocean biodiversity	Rogers, A. (2012)

The basic premise of this approach is to follow (spatially) discontinuities in the abiotic drivers that control the means of primary production (i.e. discontinuities in warmer sea surface temperatures where phytoplankton blooms occur). While marine habitats do not have the same structural characteristics supporting discontinuities in vegetation as terrestrial habitats, the rationale behind using this method in the marine environment is that physiognomic characteristics (e.g. ocean temperature) are better known to marine scientists than the location of living marine communities (ibid).

Classifications 4, 5, and 6 all represent open-ocean biomes and provinces, important for analysis of how classifications intersect with ENSO. Classification 5 was excluded from further analysis, however, because of its mixed methodological approach,

which presented too complex a set of (both biotic and abiotic) parameters for this analysis. I focus the analysis on classification 4 (Longhurst, 1998), and classification 6 (Reygondeau and Longhurst, 2013) on the basis that both use a physiognomic approach and represent open-oceans in their classifications. Additional to this, classification 6 is a revision of classification 4, evidencing the development of the classification in response to new knowledge, and providing a good basis for comparison.

3.2 Classification 4: Alan Longhurst's Biomes and Provinces (1998)

Marine ecologist Alan Longhurst's classification of biomes and provinces (1998, 2010) follows the work of Terry Platt (Platt *et al*, 1991), who proposes partitioning marine areas on the basis of biogeochemical provinces in the North Atlantic. Longhurst takes the concept and performs an analysis on a global scale. This forms the first global census of marine life, a comprehensive inventory of known marine life, providing:

> A baseline picture of ocean life, past, present, and future…used to forecast, measure, and understand changes in the global marine environment, as well as to inform the management and conservation of marine resources. (http://comlmaps.org/how-to/layers-and-resources/boundaries/longhurst-biogeographical-provinces, accessed 24/11/15)

Longhurst's specific aim is to represent the spatial boundaries of marine ecosystems, expressed in the title of his classification *Ecological Geographies of the Sea*. The study works towards representing global oceans as heterogeneous, guided by the spatial and temporal complexities of marine ecology. The global standards in marine scientific boundary-making prior to Longhurst's classification were developed by the Bedford Institute of Oceanography, Canada (BIO), and resembled static grid like divisions of ocean space. Longhurst's classification is revolutionary because, unlike the standard at that time, 'the boundaries of [Longhurst's] provinces are not fixed in time and space but are dynamic and move under seasonal and inter-annual changes in physical forcing' (ibid).

There are three main criticisms of Longhurst's partitions. The first questions the methods ability to accurately represent biogeochemical provinces (BGCP) reasoning that as a result Longhurst fails to represent the temporal dynamics of the ocean over longer that annual time periods (Pauly et al, 2001). This is an important criticism to consider in this investigation, which asks how physical characteristics used to delineate marine areas in Longhurst's method intersect with ENSO events, which are mostly inter-annual. A second criticism argues that:

> [Longhurst's classification] does not strictly follow the surface circulation patterns in a number of areas. Some of its broader-scale biomes cut right across major ocean gyres, splitting in half some of the most reliable units of taxonomic integrity, while the finer-scale units would appear unlikely to capture true differences in taxa, but could perhaps be open to interpretation as finer scale ecoregions. (UNESCO, 2009, p. 11)

If an ocean gyre is established as setting the spatial bounds of some ecosystems, and Longhurst's partitions do not always reflect ocean gyres, then this appears to be at odds with Longhurst's own argument in favour of representing 'ecological discontinuities'. Particularly if, as the Global Open Ocean and Deep-Sea Report (UNESCO, 2009) suggests, this occurs through a lack of methodological consistency. A third criticism is a geographic gap, recognised by Longhurst, which fails to include the shelf and coastal fringes of the world's oceans. These criticisms are largely addressed in the revision of the classification in Reygondeau and Longhurst, A. et al (2013).

The key innovations of Longhurst's original classification relevant to this inquiry are threefold: An approach to boundary making that partitions marine communities over space and time, the use of physical characteristics of the ocean environment, particularly in so far as they represent environmental change; and the innovative use of satellite technology to assist in identifying areas of phytoplankton bloom in the open-ocean. On

the difficulty of partitioning ocean space and 'the impermanence of conditions of the sea' Longhurst comments that:

> the core problem arising from this impermanence is the extent to which the boundaries set between natural regions of the ocean shift in response to changing conditions; for an ecologist, it is rather the changing conditions within each region that are more important. (1998, p. 115)

This focus on changing conditions in Longhurst's methodological approach points to the capacity of the classification to respond to—and perhaps even delineate areas of—environmental change. According to Longhurst, a marine biogeography should have three components: 1. It should describe how and why individual species are distributed in all oceans and seas; 2. How those species form characteristic ecosystems, under regional conditions; and, 3. …'the areas within which each characteristic ecosystem may be expected to occur'…(Longhurst, 1998. p. 1). In setting these aims, Longhurst identifies a research gap in the field (at the time of publication), stating that:

> marine biogeographers have almost exclusively occupied themselves with the first of these tasks, the distribution of individual species and genera, and even in this they have made only limited progress in describing the complexity that evidently exists. (ibid)

It is this third component, concerned with representing the spatial boundaries of marine ecosystems, where Longhurst's global survey makes a contribution (Longhurst, 1998).

Longhurst's survey partitions the global oceans into 4 biomes and 52 provinces, in each ocean basin (See Figure 2.). Table 3. Shows the agents around which these partitions are made. In summary, the 4 biomes (polar, trades, westerlies, and coastal) in each ocean basin are partitioned through the identification of discontinuities in various physical agents. Table 3. shows that the polar biome, for example, is defined by discontinuities in salinity that are caused by the spring melt of sea ice. The melt defines

a region of both depth and surface area through a 'brackish layer that forms each spring in the marginal ice zone' (Longhurst, 2010, p. 90). The westerlies biome 'is forced largely by local winds and local [solar] irradiance' (ibid); The trades biome by 'geostrophic adjustment [adjustment of unbalanced atmospheric flow around the earth's orbital force] on an ocean-basin scale to local or distant wind forcing' (ibid); and, the coastal biome defined where 'many diverse coastal processes modify the mixed-layer [a dynamic surface layer of the ocean] depth and nutrient inputs' (ibid). The four biomes are thus conceived around 'observed or inferred regional discontinuities in physical processes' (ibid). These biomes are subdivided into 52 provinces conceived, in Longhurst's original partitions, around chlorophyll distribution alone.

Lastly, Longhurst's method utilises satellite imagery (TOPEX-POSEIDON and MODIS) to detect the scale and scope of plankton blooms. This method allows the detection of 'spatial nonuniformity' over large areas of the ocean for the first time, with particular attention given to 'the real complexity of fronts and frontal systems that cannot be observed at sea level' (Longhurst, 1998, p. 35).

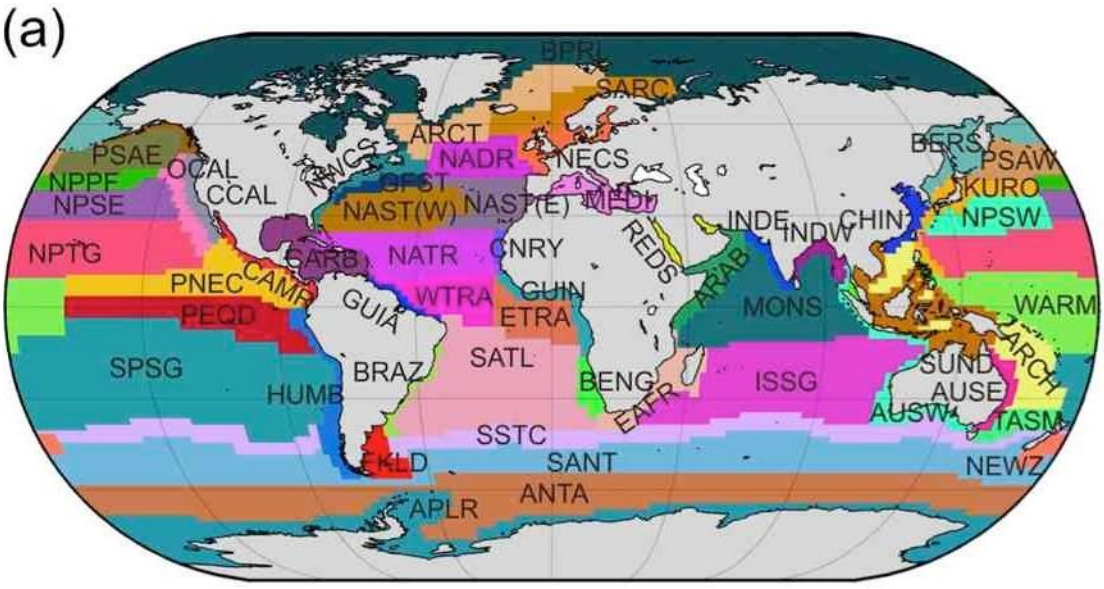


Figure 2. 'Biogeography of the global ocean (i.e., biogeochemical provinces) proposed by (a) Longhurst [1998] …' (adapted from Reygondeau, G. and Longhurst, A., et al 2013, p. 6)

Table 3. Agents through which Alan Longhurst's biomes and provinces (1998) are conceived

Biome	Mode of Discontinuity	Agents
Polar	surface brackish layer	temperature salinity
Westerlies	local winds and irradiance	atmospheric pressure irradiance
Trades	geostrophic adjustment wind forcing	atmospheric pressure
Coastal	mixed layer depth and nutrient inputs	organic deposits
Provinces	chlorophyll	chlorophyll

The method relies on the detection of chlorophyll (as a proxy for phytoplankton) from the satellite imagery:

> The global measurement of phytoplankton chlorophyll biomass in the ocean depends on analysis of the small fraction of incident radiation that is not scattered or absorbed on the surface or deeper…seawater absorbs red-green and reflects blue light, while chlorophyll absorbs the deeply penetrating blue light and preferentially reflects red-green waves (Longhurst, 1998. p. 7).

The use of satellites to partition areas of the open ocean was a novel method at the time. It enabled Longhurst to gather data from areas of open-ocean that were otherwise impossible to access with such uniformity. The significance of detecting plankton blooms over large areas is that they act as an indicator of discontinuities in physical communities, such as temperature, that Longhurst argues act as natural boundaries to marine ecologies.[1]

3.3 Classification 6.: Reygondeau and Longhurst et al, 2013.

The main contribution made in the revised version of Longhurst's original classification is a refinement of marine parameters in response to regional environmental change (Reygondeau and Longhurst et al, 2013). The most significant examples of how

[1] Other parameters used in a later revision of the 1998 study were extracted from various datasets. Monthly sea surface temperature was taken from the 'Advanced Very High-Resolution Radiometer dataset for the period 1997-2007 (NASA)'. Bathometry was taken from the 'General Bathometric Chart of Oceans (Smith and Sandwell, 1997)'. And, seas surface salinity was taken from 'monthly and annual climatologies taken from the World Ocean Atlas 2005' (Reygondeau and Longhurst, 2013, p. 1047)

the boundaries of provinces have shifted under the revised classification is in the mid-Pacific, around ENSO events, evidencing the relationship between the dynamics of ENSO and marine biogeographies, when using this approach. This is illustrated in Example (e) of Figure 5. which shows the increase in a province's 'probability of occurrence' over two ENSO events: an El Niño event occurring 1997-1998, and a La Niña event occurring 1998-2001. (See Figure 4. Below for an illustration of these two phases of ENSO, which are anomalous phases of an area of mid-Pacific ocean circulation know as Walker circulation.)

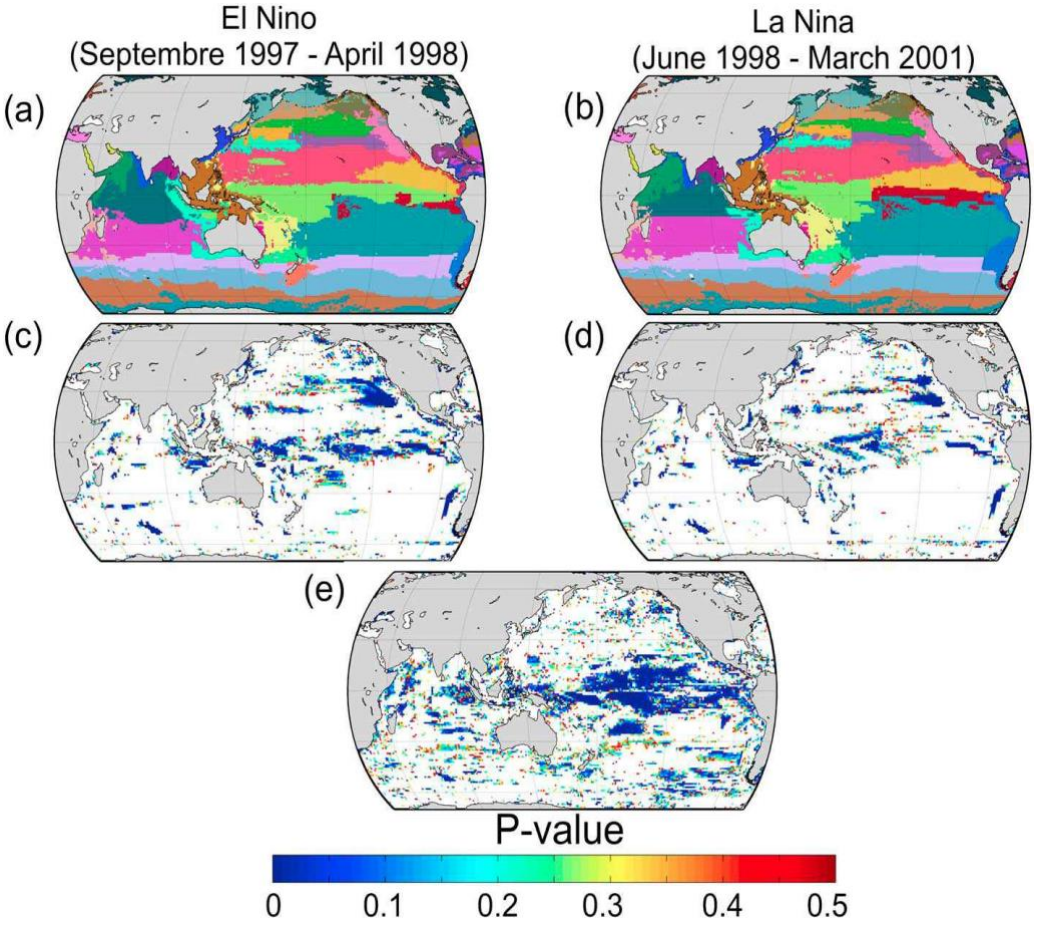


Figure 3. '(a) Biogeography of the global ocean for the 1997/1998 El Niño event (September 1997 to April 1998). (b) Biogeography of the global ocean for 1998/2001 La Niña event (July 1998 to March 2001). (c) Map of the significant change (p value ≤ 0.05) in the probability of occurrence between El Niño months and normal conditions. (d) Map of the significant change (p value ≤ 0.05) in the probability of occurrence between La Niña months and normal conditions. (e) Map of the significant change (p-value ≤ 0.05) in the probability of occurrence between El Niño months and La Niña months. The extratropical Northern Oscillation Index was used to detect the El Niño, La Niña, and normal conditions' (Reygondeau and Longhurst, 2013, p. 9.)

Table 4. Provinces affected by El Niño in the Pacific Basin (adapted from Reygondeau and Longhurst, 2013, Table 2. p. 3)

Province Name	Code	Biome	Ocean Basin
Western Pacific warm pool	WARM	trade wind	Pacific
North Pacific equatorial counter current	PNEC	trade wind	Pacific
Pacific equatorial divergence	PEQD	trade wind	Pacific
Archipelagic deep basins	ARCH	trade wind	Pacific
South Pacific gyre	SPSG	trade wind	Pacific
North Pacific Tropical gyre	NPTG	trade wind	pacific
Coastal Californian current	CCAL	coastal	Pacific
Humboldt current	HUMB	coastal	Pacific

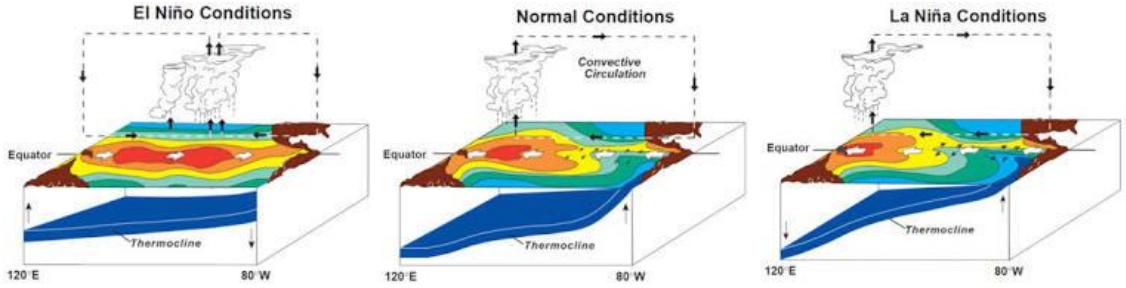


Figure 4. Normal and anomalous phases of Walker circulation in the Pacific (NOAA/PMEL/TAO Project Office)

Reygondeau and Longhurst et al, (2013) discuss the revised method, stating that:

> The effect of climatic events on our partition of the global ocean was investigated by comparing the probability of occurrence of each BGCP [bio geochemical province] during El Niño and La Niña events and normal conditions. El Niño 1997/1998 and La Niña 1998/2001 were mapped to visualize the changes in the spatial distribution of the BGCPs occurring during these specific events [Figures 4a and 4b]. Then, the probability of occurrence [of the provinces] between the different events has been investigated over 1997– 2007 [Figures 4c and 4d] (p.10).

The 'probability of occurrence' refers to the probability that the province (which moves over space and time) will occupy the proposed spatial parameters. The authors go on to state that:

> During El Niño events [Figures 3a and 3c], the Pacific Ocean was the basin most affected with an eastward extended warm pool (WARM), while areas of the eastern equatorial Pacific provinces (PNEC and PEQD) and the Pacific archipelagic deep basin provinces (ARCH) were much reduced... In addition, the adjacent gyre provinces (SPSG and NPTG) expanded their boundaries to the equator, thus decreasing the surface of the PNEC and PEQD provinces as well as those of the upwelling provinces (e.g., CCAL or HUMB). (ibid – please refer to Table 4. for province codes)

The significance of changes to the 'probability of the occurrence' is that they evidence interdependencies between marine biological communities and the drivers of environmental change. The approach conceptualises and represents marine provinces that respond spatially and temporally to seasonal and inter-annual changes in the climate system, such as ENSO.

It is because of these interdependencies between marine provinces and ENSO that I suggest Reygondeau and Longhurst (2013) could inform spatial concepts of environmental change in adaptation governance. While I argue that Longhurst's revised biomes and provinces should directly inform boundary making in ocean governance (in so far as environmental change needs to be taken into account in ocean conservation), this aim is underway in projects such as UNESCO 2009. The aim of this paper is to instead ask how general principles and approaches used in this marine biogeographical classification could inform best practice for boundary-making in adaptation governance, where I suggest the boundaries of adaptive geographies need to be revised around climate events. This approach advocates thinking about adaptive geographies 'from the sea'. I suggest the decentring of humans in the adaptive landscape allows climate events to guide the boundaries of adaptation, and thus develop a geography that takes into account the events that are, after all, the subjects of adaptation. The next section explores two key approaches used by Longhurst that I suggest might facilitate this aim.

3.4 Theoretical Approaches to Marine Boundary-Making

The way environments are conceived—historically, culturally, economically and politically—define how they are governed. As scholars such as Alfred North Whitehead (1920), and Bruno Latour (2004) have argued, contemporary environmental thinking is underpinned by epistemologies of nature embedded in the dominant (Western) frameworks and institutions. Boundary-making in environmental governance is one

tangible expression of these epistemologies of nature, and the foundations on which environmental law and governance rely. Is boundary-making, though, a fallacious project, and might this be especially so in the case of ocean boundary-making? There are two positions evident in Longhurst's work that offer a response to this question. First, Longhurst suggests that while ocean boundaries will never truly represent a marine community:

> some degree of formalism and partition may, in fact, assist us in comprehending changes in such a vast complex, interacting whole. It may, at least, help us to keep our thoughts in order (2010, p. 128)

Longhurst offers a novel way of thinking about ocean boundary-making in this statement - that boundaries are a construct with the purpose of facilitating our own human comprehension of the marine environment. New boundary making practices do therefore, also push the conceptual boundaries of what we understand. This idea also gives rise to question what understandings, if not marine scientific understandings (see Longhurst, 2003; Bischof, 2014), are guiding best practice for marine boundary-making in environmental governance? If boundary-making is a way of ordering thoughts (as Longhurst suggests), and ocean boundary-making in governance is conceived around people (See Steinburg, 2001, 2010), this is a clear indication that ocean science is not understood by ocean governance, indicating a serious interdisciplinary gap in knowledge. More seriously, though, ocean environments are being governed around boundary-making practices that are not taking the characteristics of oceans into account.

While Longhurst's approach to partitioning ocean environments is, as he suggests, a way of ordering thoughts, it also represents a radical reorganisation of oceanic thinking. This leads to the second approach used in Longhurst's work; a concept he refers to as 'natural logic'. Longhurst argues that:

> Setting spatial bounds to ecosystems is an essential step toward their quantitative study, and this is best done according to a natural logic, rather than arbitrarily (1998, p. xi)

In this statement Longhurst claims that 1) the production of partitions is essential to the study of marine ecosystems, 2) the best way of doing this is to be 'in accord with' natural logic, and 3) ocean partitions that do not follow natural logic are arbitrary, or without evidence. Claim 1) suggests that the main aim in Longhurst's work is to facilitate the study of marine ecosystems. Claim 3) reiterates that there is a knowledge gap in the field of marine biogeography, due to insufficient attention to the spatial distribution of marine ecosystems, and that this has resulted in partitions that are not based on scientific evidence of discontinuities in marine taxa. Claim 2) suggests that natural logic is a) not arbitrary (therefore based in scientific evidence) and b) essential to quantitative study.

The term 'natural logic' is used by Longhurst as a methodological framework for partitioning ocean space. It has several possible definitions based on the contexts of its use in Longhurst's work: i) the logic of a thing that is natural (not artificial); or, ii) the natural (not artificial) logic of a thing. The first defines the term as an interaction between human logic and a thing in nature (i.e. natural logic is *produced* in response to things in nature). The second defines the term as a logic existing *a priori* in a thing (i.e. natural logic is *discovered* by observing things in nature).

I suggest that Longhurst's use of the term natural logic is consistent with both these definitions. Longhurst understands natural logic as something that is generated by the scientist, as a product of scientific observation. At the same time, Longhurst's classification does aim to represent the spatial bounds of marine ecosystems over space and time using a logic *found* in nature (Longhurst, 1998, p. xi). A marine boundary, therefore, is both constructed to order thoughts produced in response to nature, but also constructed based on a logic found in nature, and then used to order thoughts. (Longhurst,

2010, p. 128). In this later interpretation, Longhurst positions agents, that define the discontinuities of marine provinces, as central participants in boundary making. The scientist follows the movements of these agents over space and time and describes this 'logic' through the partitioning of marine provinces.

Agents, Devices, and Concerns

I have identified two approaches used by Longhurst in his classification: 1. the boundary as a device used to 'order thoughts'; and, 2. natural logic as a guiding concept in this process. For the purposes of this analysis, I position these two approaches as 'concerns'. In the methods section, I introduced a framework of enquiry used in the discourse analysis based on the identification of 'agents', 'devices' and 'concerns' in the scientific literature, which I will summarise again here. I define 'agents' as those communities or characteristics whose discontinuities are used to define marine boundaries in Longhurst's approach. I define 'devices' as instruments, technologies, or concepts used to facilitate this process (Longhurst's concept of a boundary is positioned as a device in itself—one used to 'order thoughts'). Lastly, 'concerns' are those aims guiding the process of boundary-making. An example would be Longhurst's statement that boundaries should be constructed 'according to a natural logic' (op cit).

While there are many agents identifiable in Longhurst's body of work, I focus on those physical agents that are evidenced as intersecting both marine biological provinces, and climate events. Longhurst uses physical agents as a foundation for partitioning ecological communities. These agents are conceived as both qualities (such as salinity and temperature) and forces (such as movement) and are active at a number of different scales. For example, Longhurst argues that:

> …[the] boundaries of biogeographical or ecological regions will be least ambiguous where discontinuities in the physical environment are strongest and these, in the open ocean, will be located along major [ocean] fronts and frontal systems. (1998, p. 35)



Figure 5. The Pacific White Line – a convergent front viewed from space (NASA, 1992)

Ocean fronts are defined as:

> relatively narrow zones that separate broader zones with different stratification types and/or different water masses; the fronts are almost always accompanied by *enhanced horizontal gradients of temperature, salinity, density, nutrients and other properties* [my italics]…Fronts and the associated currents are critically important in heat and salt transport, ocean-atmosphere interaction and ecosystem functioning. (Belkin, and Cornillon, 2003)

Figure 5. shows an image taken from the space shuttle *Atlantis* of a convergent front (where two bodies of water move towards one another) in the Pacific. The line is formed by a convergence of fish, algae and foam in quantities so great as to be seen with the naked eye from space. There are a number of agents and devices that converge in an ocean front and are identifiable in these statements. Belkin and Cornillon list enhanced gradients of temperature, salinity, density, nutrients, and currents as agents that define an

ocean front, while Longhurst uses the concept of 'discontinuity' as a device that partitions areas of the ocean around these agents.

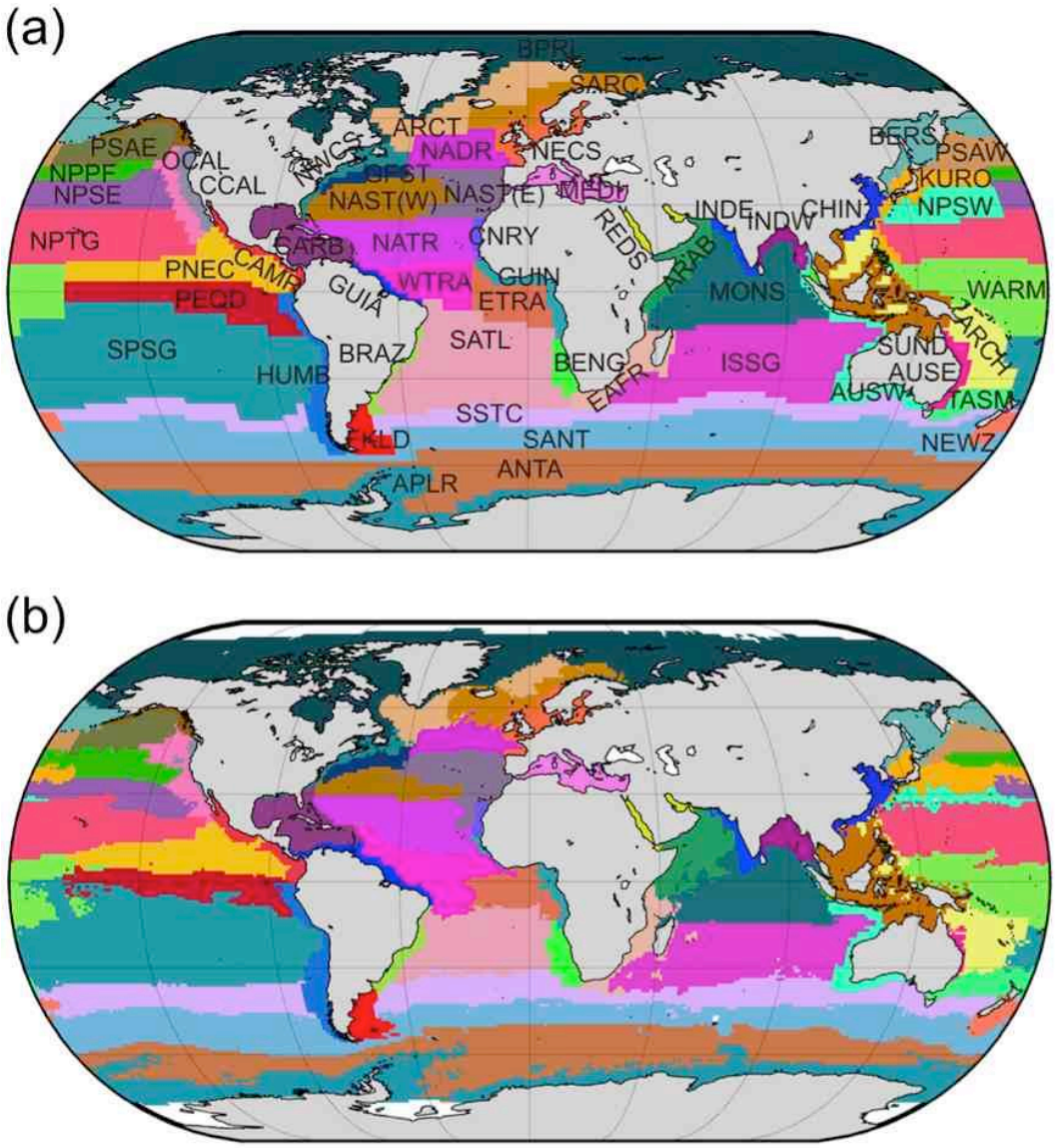


Figure 6. 'Biogeography of the global ocean (i.e., biogeochemical provinces) proposed by (a) Longhurst [1998] and (b) calculated in this study for the average period from January 1998 to December 2007.' (Reygondeau and Longhurst, 2013, p. 6)

For a comparison of how the inclusion of different types of agents elucidate interdependencies between marine provinces and environmental change, I return here to Longhurst's earlier classification (Longhurst, 1998); which partitioned provinces around chlorophyll distribution alone. Figure 6. compares the earlier classification in (a) with the revised classification in (b) (Reygondeau and Longhurst, 2013). Example (a) shows the

global distribution of provinces based on chlorophyll distribution alone and example (b) shows the addition of sea surface temperatures (SST), sea surface salinity (SSS), and bathometry parameters. The Figure shows that the revised provinces evidence considerably more detail of climate systems. While chlorophyll distribution represents the parameters of physical communities to some extent (and the similarities between the two classifications in Figure 6. evidence this), the additional physical parameters (SSS, SST, bathometry) detail not only the discontinuities of biological communities, but inter-annual changes driven by regional climate systems.

In summary, Longhurst's revised classification uses a physiognomic approach that takes into account how biological communities are reliant on physical communities. There are a number of key approaches evidenced in this analysis that I suggest could inform a revised approach to delineating adaptive geographies. I present these approaches through a framework of analysis based around key agents, devices and concerns. First, Longhurst's central concern, evidenced as both a theoretical and empirical approach, is the concept of natural logic. In principle, natural logic allows ocean boundaries to be informed by continuities and discontinuities of marine 'agents' based on their 'probability of occurrence'. Secondly, I suggest that those agents that best evidence the interdependencies between biological and physical communities in the open ocean—temperature and salinity—are agents that could also be used to delineate adaptive geographies in the Pacific: Adaptive geographies are also defined through independencies between biological and physical communities; and following Longhurst's concept of natural logic, adaptive geographies in the Pacific region, prone to the impacts of ENSO driven drought and flood events, could be delineated based on 'fronts' that converge around discontinuities in temperature and salinity. An example of this would be the oceanic and atmospheric discontinuities of temperatures related to a

drought event (see El Nino conditions in Figure 6. for an illustration of increased oceanic temperatures during a drought event in the Western Pacific territories) Thirdly, there are a number of devices used in this approach. Those I suggest might be of most relevance for revising adaptation geographies include the concept of a boundary as a device that is used self reflexively for the purpose of collecting and producing knowledge. I also point to the use of satellite imagery as a device used in Longhurst's approach for delineating large marine areas and suggest that this might be useful for conceptualising adaptive geographies across land-sea environments.

4. Conclusion

What reasons are there to draw principles from marine scientific boundary-making, for the purpose of informing the conceptualisation of adaptive geographies? I present three reasons. First, boundary-making in environmental governance fails to represent marine science in any meaningful way. Consequently, boundary-making in environmental governance is people-centred and land-based. I find this evidence deeply worrying when we are reliant on these frameworks to address challenges such as climate change, the impacts of which are only partially represented using these methods. Secondly and in response to this first point, the natural logic approach used by Longhurst might provide a remedy to the anthropocentrism of boundary-making in environmental governance. I present two reasons this might be the case: the concept of natural logic positions the production of knowledge in direct relation with the environments being governed, with a particular focus on nonhuman agents; and it also allows those agents to participate in the knowledge making process. While this later point might be a working concept in the social sciences (Isabel Stengers (1997) promotes the inclusion of nonhumans in the knowledge production process) environmental governance frameworks, instruments and practices lack such a concept. This is evidenced by the lack

of representation of marine science in marine governance, in ocean boundary making practices that delineate marine areas based on their proximity to land (e.g. the boundary making practices of the United Nations Convention on Law of the Sea), and in the construction of adaptive geographies, the boundaries of which show no engagement with the climate system to which adaptation responds. Lastly, the scientific approaches to boundary-making outlined in this paper evidence their capacity to represent the interdependencies between biological and physical communities—under changed environmental conditions. For these reasons, I suggest drawing general principles from marine scientific approaches to boundary-making could improve the way we think about, and hence govern, adaptive geographies.

Employing an analytic framework that identifies key agents, devices, and concerns, I suggest three specific approaches extrapolated from marine biogeographical practice, for use as a conceptual (and potentially methodological) tool in adaptation governance frameworks. First, to approach the delineation of adaptive geographies through the concept of natural logic, which allows the convergence of biological and physical communities to inform the boundaries of a climate event. Second, to position those boundaries as a device for knowledge collection and production, rather than a device for conventional forms of territorialisation. Thirdly, I especially draw attention to a principle of the physiognomic approach used in Longhurst's work that, I suggest, could delineate adaptive geographies—across both oceanic and terrestrial environments—around discontinuities in temperature and salinity. As this paper evidences, many climate events are driven by communities of temperature and salinity, and these extend across oceanic and terrestrial environments via atmospheric and oceanic coupling, and coastal process such as tidal inundation. This approach is evidenced in the marine biogeographical context as delineating both biological and physical communities — as

they respond to environmental change. In the Pacific context, there is particularly strong evidence that these agents have the capacity to connect ENSO events across oceanic and terrestrial environments, given the focus on ENSO in both Longhurst's original and revised classification.

There is, however, a serious hindrance to achieving these aims. The conceptual disconnect between nature and society (Whitehead, 1920; Latour, 2004), land and sea (Steinburg, 2010; Cardwell and Thornton, 2015), underpins the lack of representation of 'natural' and oceanic actors in environmental governance frameworks. While climate events are ocean-based (Rahmstorf, 2003; Stommel, 1958; Allison et al, 2009; Broecker, 2005) adaptive geographies instead conceive of events around terrestrial impacts—disconnected from their oceanic drivers. This suggests that adaptation governance frameworks use a socio-economic logic to delineate climate events around discontinuities in people and resources (Wise and Fazey et al, 2013; Coral Triangle Initiative, 2013; Pacific Climate Change Science Programme, 2009), the danger of which is that the climate event (and the system that produces it) is conceptually fragmented, a phenomenon I suggest locks adaptive efforts in a short-term cycle of emergency responses.

Based on the principle of natural logic used by Longhurst, there is a logic inherent in material communities like temperature and salinity that can inform boundary-making. What this could mean for adaptation governance is an approach that not only 'orders thoughts', but *reorders* human-nature relations in adaptive geographies. In this context, natural logic is an ethic of representation: what communities are included in the 'ordering' of space, and how are they connected? I suggest these methodological approaches form useful principles that could better account for the oceanic components of climate events in adaptation geographies.

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Paper 2.

Analysis of Ocean Boundary-Making in Three Frameworks:

A Study of Law of the Sea Discourse

Abstract

Legal frameworks have historically used a colonial territorialist approach to governing ocean space. The United Nations Convention on the Law of the Sea *(UNCLOS, 1982) represents a theoretical departure from colonial territorialism. Instead, UNCLOS employs a functionalist logic approach that is based on principles of sovereignty and consent and uses administrative reasoning as a basis for decision-making. This paper investigates the ontological principles employed in the development of UNCLOS and asks how these are reproduced in later frameworks. I consider whether ontologies can be extrapolated and studied as theories in ocean law and governance frameworks and examine how they might be obstructive to the development of effective regional ocean governance frameworks. Lastly, I ask whether ontological principles can be reformed and through what types of intervention this might be achieved. The results show that tenets of colonial territorialism persist in UNCLOS and are reappropriated towards marine communities as terrestrialising practices and, further, that there are fundamental ways in which ontological principles are obstructive to conservation goals in ocean governance frameworks. The structural reproduction of ontological principles between frameworks resists intervention. Evidence suggests that interventionist legal mechanisms that displace anthropocentrisms may offer discreet opportunities for reform.*

1. Introduction

In his book *Land and Sea*, political theorist Carl Schmitt argues that:

> Every basic order is a spatial order. To talk of the constitution of a country or a continent is to talk of its fundamental order, of its nomos…It presupposes clear dimensions, a precise division of the planet. The beginning of every great era coincides with an extensive territorial appropriation. Every important change in the image of the Earth is inseparable from a political transformation, and so, from a new repartition of the planet, a new territorial appropriation. (2015, pp. 37–38)[1]

The C20th development of ocean science, and consequentially greater knowledge and awareness of oceanic environments, prompted such an era—a change in the image of the earth that in turn catalysed extensive territorial appropriation of the oceans' resources, accompanied by a regime of ocean boundary-making practices. If ocean boundaries are analysed as a representation of this *nomos*, and law and governance the vehicles through which the sea is divided and distributed (see Footnote 1), then they reveal that institutional frameworks typically conceptualise the oceans in three ways: as a resource basin to be exploited; as a system to be studied; and as a wilderness to be protected. These perspectives institutionalise oceanic environments as external to human societies, a backdrop to human pursuits. The result has been the development of frameworks and practices in environmental law and governance that are anthropocentric and that, for the most part, exclude the open ocean and deep sea from environmental governance. Further, when marine environments *are* included in governance frameworks, their inclusion is problematic. They are 'terrestrialised': viewed through and delineated by methods developed for land-based ecosystems (Cardwell and Thornton, 2015; Mansfield, 2007;

[1] Schmitt uses the word *nomos* to mean 'seizure', from the Greek *nemein* (to take) – in this context the seizure of land and sea. But he also uses it to mean the division and distribution of what was seized and, thirdly, the exploitation of what was seized (e.g. land) in order to produce and consume (e.g. as in agricultural produce) (2015, footnote 1. p. 37).

Steinberg 2001). Further still, the characteristics of the global oceans resist these conventional methods of territorialisation, which fail to account for dynamic biotic and abiotic marine communities that shift over space and time.

These facts have prompted an oceanic turn in geography (e.g. Anderson and Peters, 2014; Peters and Steinberg, 2015; Winder and Le Heron, 2017; Boucquey and St. Martin et al, 2019) and anthropology (e.g. Hastrup and Rubow, 2014; Helmreich, 2009; Thornton, 2015; Thornton et al., 2010). These scholars aim to reconfigure the conceptual separation of land and sea through engagement with and development of alternative ocean ontologies. There have been some important inroads made in developing work on (what could be termed) materialist ocean ontologies as an empirical project. Recent scholarship analyses contemporary scientific and political productions of ocean space (Bruun and Steinberg 2018; Lehman, 2016; Anderson and Peters, 2014) and the agency of oceans in reforming ocean governance frameworks and practices (Campbell and Gray et al., 2016; Bear, 2014; Fairbanks et al., 2018). Yet there is still very little empirical work on how conventional ocean ontologies continue to obstruct good governance. Here, I depart from the claim that 'third phase' ocean governance practices are reforming 'first phase' ocean governance frameworks such as LoS (Boucquey et al., 2019), instead arguing that conventional ontologies of the oceans institutionalised in early frameworks are systemically reproduced through compliance practices. I propose there are two important research areas that require further work: a) how should conventional ocean ontologies in governance frameworks be revised? And b) how should alternative ocean ontologies that connect land-ocean-atmosphere environments be accounted for in governance practices, instruments and frameworks?

There are many reasons why such a project is important, given the role the global oceans play in sustaining life and the current crises of ocean pollution and warming. The

reason I will highlight, though, is that climate systems (and therefore climate events) are ocean-based (Rahmstorf, 2003; Stommel, 1958; England, 2009). I will argue that as a consequence of the conceptualisation of the oceans as external to or an extension of land (especially among governance personnel, as opposed to earth systems scientists) and of the fact that climate is ocean-centric, there is currently no viable method for representing climate systems in governance frameworks. I argue that, in the Anthropocene, achieving such a method may in fact require a new spatial order in which human settlements are resituated as peripheral to the open ocean and deep sea. While it is as yet unclear what might be gained from such a representation, I am gravely concerned that institutionalised dualisms prevent this from being explored, particularly in adaptation governance. Climate events are instead conceptualised around land, and the task of governing adaptation to events like tidal inundation and extreme weather is disconnected from the oceanic drivers of such events.

From within this broader project, my paper focuses on the investigation of how ocean ontologies are produced and institutionalised, particularly in the practice of ocean boundary-making. Using critical discourse analysis, I examine the delineations of ocean space used in three governance frameworks: *United Nations Convention on the Law of the Sea* (henceforth LoS) (1982); *Marine Managed Areas: Best Practice for Boundary Making* (National Oceanic and Atmospheric Association, henceforth BPBM, 2006); and, the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security's (henceforth CTI-CFF) *Regional Plan of Action* (2016). The aim is to investigate how – through which specific discourses and practices – LoS informs the construction of ocean space with instruments and frameworks compliant to it. NOAA's best practice manual was chosen because of its status as a global standard; it is used as a basis for many other national ocean boundary-making practices. The CTI-CFF's *Regional Plan of Action* (henceforth

RPoA) was chosen as the regional framework because of the Coral Triangle's status as a 'centre of origin' of global marine biodiversity. The region's ocean boundary-making is also atypical. First, as an archipelagic region, its territorial sea and exclusive economic zone (henceforth EEZ) is determined with reference to a marine baseline drawn between major land points (rather than determined wholly by a coastal baseline, as will be explained below), as shown in Figure 2. Yet, more unusually, Figure 1 shows that the regional boundary (the red dashed line) was delimited around scientifically delineated marine ecoregions. These boundary-making practices, which are very much informed by the characteristics of the ocean environment, are a particularly relevant case study for this inquiry because of their greater potential for representation of ocean communities.

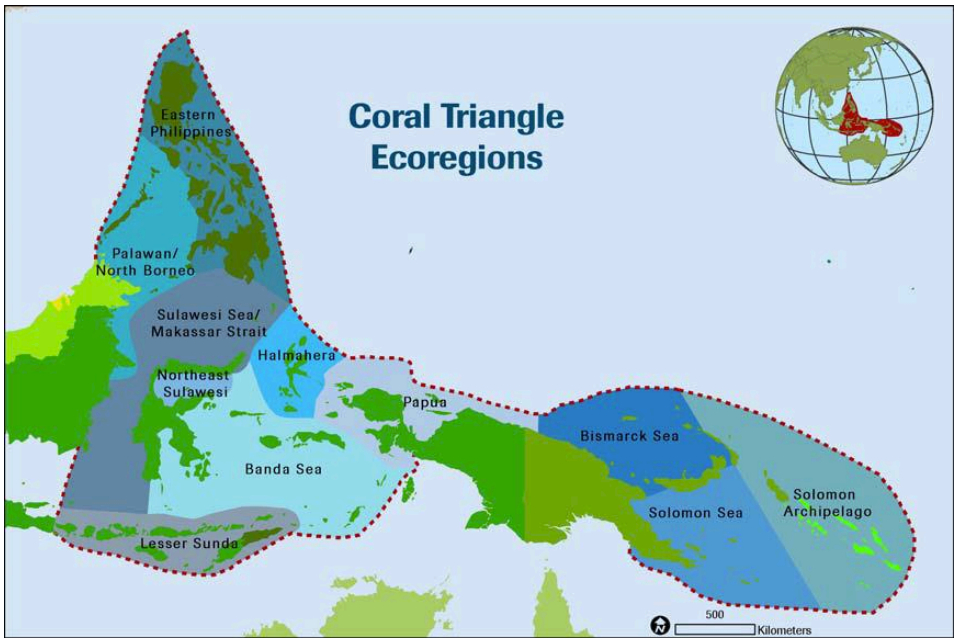


Figure 1. Ecoregions are defined as 'large areas containing geographically distinct assemblages of species, natural communities, and environmental conditions' (Green and Mous, 2008, p. vii)

The results of the analysis show the following:

1. While the functional logic approach used in LoS seeks to distinguish itself from the colonial territorialism characteristic of prior ocean governance approaches, it instead redirects this territorialism towards marine communities. This is

evidenced in part through boundary-making practices that reflect political and economic rather than scientific concerns (despite the framework being established primarily for the sustainable governance of ocean resources).

2. When marine communities *are* taken into account, the discontinuities of biotic and (particularly) abiotic communities remain poorly represented.

3. Ocean ontologies evident in LoS are replicated in compliant frameworks; further, the conceptual approaches reproduced in RPoA are obstructive to the framework's empirical goals.

Section 2 discusses the methodological approach used by this study. Section 3 shows the results of the analysis of LoS (3.2), BPBM (3.3) and RPoA (3.4). Section 4 discusses these results and reflects on the project's aim of revising the ontological underpinnings of governance frameworks.

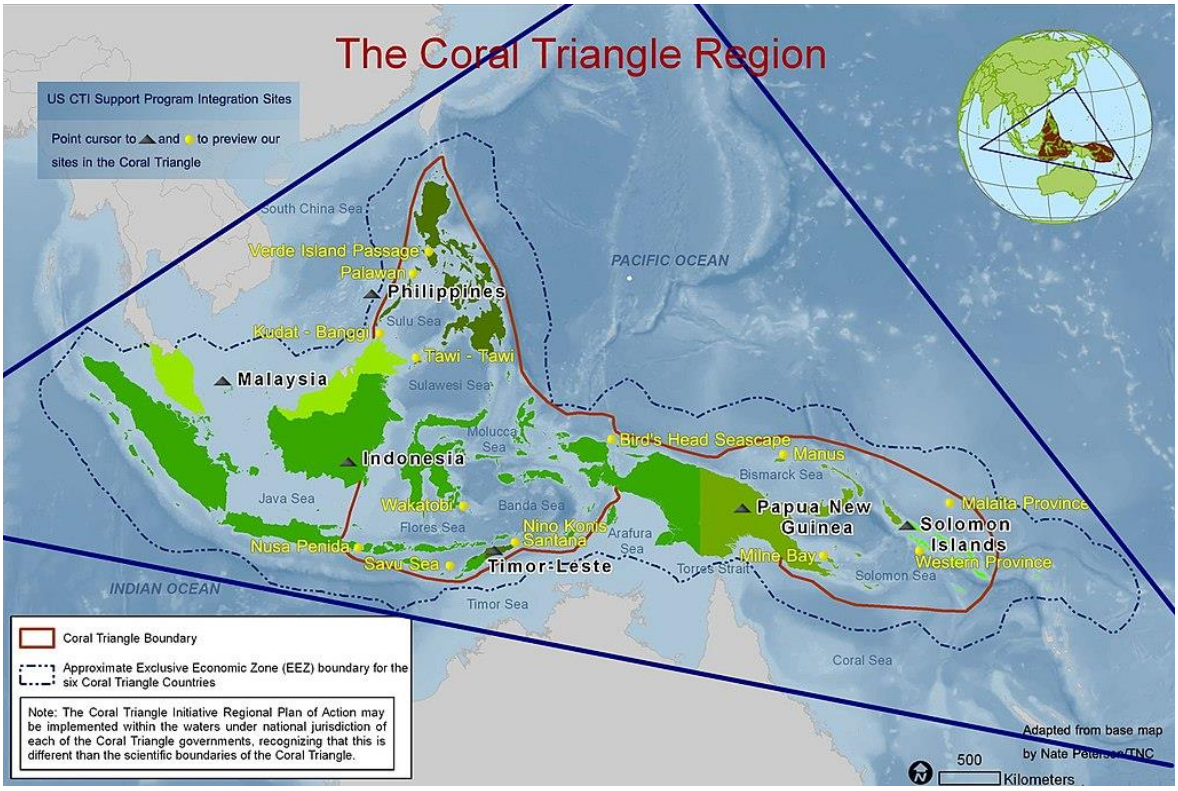


Figure 2. Map of the Coral Triangle region (CTI-CFF, 2014)

2. Method

This inquiry asks: what ocean ontologies are evident in the *United Nations Convention on the Law of the Sea*, and how are these reproduced in frameworks and practices compliant to it? The aim of the analysis is to ask whether these ontologies obstruct the stated aims of environmental governance frameworks, instruments and practices. The inquiry was conducted using critical discourse analysis. I analysed three key texts (listed in full in Table 1): *United Nations Convention on the Law of the Sea*, 1982 (henceforth LoS); the National Oceanic and Atmospheric Administration's *Marine Managed Areas: Best Practice for Boundary Making*, 2006 (henceforth NOAA); and the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security's *Regional Plan of Action*, 2016 (henceforth RPoA). The analysis focused on LoS in particular because of its greater capacity as a legally binding international framework to produce and institutionalise representations of ocean space. The BPBM is a detailed set of ocean boundary-making practices for areas within a coastal state's territorial sea. As such, it is a framework that conforms to norms institutionalised in LoS, but as an instrument used for conservation purposes, is also positioned to conceptualise boundary-making around alternative (scientific) delineations. RPoA represents the main environmental governance framework for the Coral Triangle region – a region that is delineated around marine ecoregions, presenting an exceptional opportunity for the development of alternative approaches to ocean governance.

Table 1. Research materials used for critical discourse analysis

Document	Bibliographic Details
Framework	*United Nations Convention on the Law of the Sea* (1982) United Nations
Instrument	*Marine Managed Areas: Best Practice for Boundary Making* (2006) National Oceanic and Atmospheric Administration
Framework	*Regional Plan of Action* (2016) Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF)

My use of critical discourse analysis (henceforth CDA) was informed by the work of Paul Ricoeur (1971) and Maarten Hajer (Hajer, 1997; Hajer and Versteeg, 2006). I took a Foucauldian approach, one that asked: how is power exercised through language deployed in governance? More particularly: how does power establish and institutionalise ocean ontologies through language, and do these framings obstruct the representation of marine communities in governance frameworks? CDA was used to identify obstacles to the inclusion of such communities within the network of discourses and practices in which they are located. I relied on linguist Norman Fairclough's 'analytical framework for CDA' (2011), which offers a five-step method for conducting CDA. From within this framework, I focused on structural, interactional and interdiscursive analysis. Firstly, structural analysis consisted of an analysis of the order in which particular discourses are presented (and developed) within a text. This was especially important for the documents analysed here; for example, LoS is presented in the formal and technical structure of a legal convention, in which structure plays a major role in the power relations of a particular discourse (e.g. whether a particular discourse is included as a preambulatory or operative clause). Secondly, interactional analysis involved analysing the text as a hybrid of different genres, discourses and styles. I investigated LoS as a hybrid of concepts from previous ocean governance regimes (e.g. evidence of colonial territorialist discourse). This approach also asked what representations are dominant and what voices

or spaces are left out. This is a critical question to ask of ocean boundary-making discourse, where there exists a clear correlation between the absence of actors in discourse and the absence of spaces in boundary-making. Lastly, interdiscursive analysis studies 'the ongoing working of relationships between [shifting articulations of discourse] in texts and interactions' (Fairclough, 2011, p. 5). In the present study, this technique was deployed to evidence how discourse is rearticulated in frameworks and practices compliant to LoS. This is critical, first, for revealing the fixedness of certain discourses (e.g. 'land-based' ocean governance), as they are reproduced in different governance contexts, and, second, for understanding how these progressively come into conflict with the empirical aims of compliant frameworks (e.g. the 'Annotations' of RPoA's 'Goals').

My use of CDA was further informed by the small body of work that builds on environmental discourse analysis (Hajer and Versteeg, 2006) and critical environmental law (Philippopoulos-Mihalopoulos, 2011a, 2011b), to conduct CDA of environmental law texts and practices (Gellers, 2015; Lange, 2011). This work analysed the particular characteristics of legal discourse – 'it's role in preserving social order, upholding the authority of the state, and the elitism of legal language' (Gellers, 2015, p. 484) – as they intersect with discourses of nature in the context of environmental law. Using a Foucauldian framework, political scientist Joshua Gellers suggests four principles of a 'comprehensive method' for CDA of environmental law: 1. analysis should capture both 'text and practice', expanding materials for analysis beyond 'texts or elites' to include, for example, nonlinguistic practices and built spaces; 2. these materials should be 'intertextually and intratextually…combed through for manifest and constitutive references to other works' (2015, p. 488); 3. analysis should focus on the extent to which the materials reveal power differentials, perpetuate dominance and impact the pursuit of

justice; and 4. analysis should include discourse 'across temporal and spatial planes' (ibid.).

While Gellers' approach shows some overlap with Fairclough's framework (e.g. Fairclough's interactional and interdiscursive analysis and Gellers' inter/intratextual analysis), Gellers' application of CDA approaches to environmental law texts and practices is a helpful point of departure. Yet, as this paper reveals, there are important limitations to carrying out CDA of environmental law (and, perhaps, of certain types of legal documents more generally). I also suggest that a 'comprehensive' use of CDA approaches, as Gellers suggests, might be unnecessary (and perhaps impossible) for certain enquiries. While CDA was a good method for analysing the structure, themes and relationships of discourse within and between texts, it proved problematic in attempts to conduct a more in-depth analysis of legal principles, such as those framing the CTI-CFF's RPoA, and the preambulatory clauses of LoS. In particular, I found the use of CDA to be problematic when interrogating the arguments implicit in key statements. While some approaches to CDA are designed to identify what is 'left out' of discourse (e.g. Fairclough's 'interactional analysis'), I found it necessary to revert to more traditional forms of analysis, such as critical reasoning (i.e. deconstructing statements to identify stated and suppressed premises, inferences and conclusions), to interrogate the underlying logic of legal principles and some preambulatory clauses (see Table 3). This is a critical point, as these principles and clauses are perhaps the most important components of the texts for this particular analysis. This conventional style of analysis did, in practice, feel like a departure from CDA. Maarten Hajer states that discourse analysis 'allows for a better understanding of controversies, not in terms of the rational argumentation, but in terms of the argumentative rationalities that people bring to a discussion' (2005, p. 301). In the case of the legal texts studied here, though, it was

precisely in the deeper analysis of rational argumentation that argumentative rationalities (i.e. discourse) were found. Reflecting on this combination of CDA and critical reasoning, it became clearer that the latter was imperative to the analysis, particularly in identifying the ontological bases of discourse and the reproduction of these ontologies between the three frameworks.

3.1 Results

Analysis shows three fundamental trends in the conceptual and methodological approaches of the frameworks studied: land-based methods; people-centred approaches; and the omission of non-coastal waters. The analysis suggests that these approaches are institutionalised in the LoS framework and are reproduced in frameworks compliant to it. Yet evidence also suggests this reproduction is only partly connected to legal compliance, and that certain ontologies of the ocean made normative in the discourse of LoS also play a central role. This section sets outs my analysis of each framework. Section 3.2 examines the types of baseline used for ocean boundary-making in LoS, as the primary concept around which ocean space is conceived and represented in environmental law and governance frameworks. The section also identifies themes, such as conceptualising ocean space around *terra firma* (if not land), and a discourse of 'precision' that I suggest has the contrary effect of obscuring detail. Section 3.3 examines two discursive features of NOAA: the relationship between the discourse of 'marine managed areas' and 'marine protected areas'; and the role of the discourse of 'accuracy'. Evidence shows that in context, marine managed and marine protected areas are positioned interchangeably, despite their distinct purposes. Further, it shows that when considered against the representation of oceanic form (rather than the representation of administrative purpose), the concept of 'accuracy' is fallacious. Section 3.4 on the CTI-CFF framework evidences discursive conflict between the 'people-centred' ethos of the

CTI-CFF's RPoA principles, and the 'science-led' approach of the framework's goals and targets. This, I suggest, exemplifies the ways in which certain 'ocean logics' made normative in LoS are reproduced in regional frameworks.

3.2 LoS baselines and boundaries

A baseline is a concept in LoS that uses a feature, or set of features, in a terrestrial or marine topography as a reference point for ocean boundary-making. The coastline and continental shelf are the two main concepts used to establish baselines. The coastal baseline, demarcated by the low-water line, is used as a main reference point for the delineation of the territorial sea, the contiguous zone and the EEZ. The area of the continental shelf, including the slope and rise of the shelf, is used as a baseline that demarcates the coastal boundary of the open ocean.

There are several characteristics of the discourse relating to coastal baselines that are of interest. First, while a coastal baseline (and a baseline in general) is a foundational concept on which the framework of LoS relies, and while there are several clauses dedicated to the subject of baselines (e.g. Articles, 5, 7 and 14), the discursive emphasis is in fact placed on the boundary, with the concept of baselines obscured in the text of the clauses themselves.[2] The lack of emphasis given to baselines in the framework might be explained by the fact that, as Article 5 specifies, the framework places the onus on coastal states to delineate the low-water line on which the coastal baseline is based. One of the

[2] For example, reference to a coastal baseline is first made in Part 2, Section II, Article 3, which defines the breadth of the territorial sea as 'a limit not exceeding 12 nautical miles measured from baselines'. Coastal baselines are then defined in Article 5 as 'the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State'. The coastal baseline is then further defined with reference to a number of natural and engineered coastal features, such as reefs (Article 6), ports (Article 11), and low-tide elevations (Article 13). Further, the contiguous and exclusive economic zones are defined respectively as not extending a) 'beyond 24 nautical miles from the baselines from which the breadth of the territorial sea is measured' (Article 33, Clause 2) and b) 'beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured' (Article 57).

effects of this treatment of baselines in the framework, in particular the discursive structure through which they are introduced, is to normalise the concept of basing ocean boundaries around land.

Table 2. Relationship of physical baselines to respective zones and regimes in LoS

Zone or Regime	Baseline	Area
Territorial Sea	Coastal or archipelagic baseline	12 miles
Contiguous Zone	Coastal or archipelagic baseline	24 miles
Exclusive Economic Zone	Coastal or archipelagic baseline	200 miles
Artificial Islands	Water line of artificial islands	Safety zone of 500m
Ice-Covered Areas	Water line of ice-covered areas	Safety zone of 500m
The Continental Shelf	Coastal baseline to rise of continental shelf	Area up to and including the slope and rise of the shelf
The Area	Rise of the continental shelf	Abyssal plains, open oceans and high seas

This logic is explicated later in the document in relation to artificial islands and ice-covered areas. A coastal state has the right to construct artificial islands, installations and structures within the EEZ (Part 5, Article 60) and is given additional rights to establish a 'safety zone' around the artificial feature not normally exceeding 500 metres (Article 60; Article 260). In the case of ice-covered areas within the EEZ, states are afforded special law-making powers (Section 8, Article 234). In practice, each island or ice-covered area serves as a de facto coast from which a baseline is conceived. The political agency of *terra firma* is further exemplified in emergent legal arguments for the retention of safety zones as markers of sovereignty, in cases where ice-covered areas are disappearing (Tsaltas et al., 2010).

This is also evident in archipelagic baselines. As Article 47 states:

> An archipelagic State may draw straight archipelagic baselines joining the outermost points of the outermost islands and drying reefs…The drawing of such baselines shall not depart to any appreciable extent from the general configuration of the archipelago.

Thus, yet further evidence that, despite the form baselines take, they are in principle – and as a matter of administrative practicality – rationalised geologically. An exception to this is the use of straight baselines as a method for disciplining 'unstable' areas of the coastline. Special provisions are made for cases in which:

> …the coastline is deeply indented and cut into…if there is a fringe of islands along the coast… [or if] the presence of a delta and other natural conditions the coastline is highly unstable… (Article 7.)

In sum, the conclusion to draw from this is that straight baselines are used when the coast no longer presents a 'reasonable' foundation for a baseline. This suggests, then, that a faithful projection of a coastal baseline onto oceanic space may indeed be unreasonable. The use of straight baselines to standardise (and sanitise) coastscapes points to inherent problems in the Convention, with the majority of ocean boundaries being essentially land-based. This highlights the *absence* of oceanic form in ocean boundary-making. The purpose of the straight line is not only to maintain reason in method, it is also to obscure – to lead the eye away from – the terrestrialisation of the sea.

Similar themes are evident in the conceptualisation of the continental shelf. As Figure 3 illustrates, the continental shelf generally extends 200 miles from the coastal baseline. Where the continental shelf does not physically extend 200 miles, it is conceptually extended to meet the EEZ (Article 76 (1)). The continental shelf occupies a position that is both baseline and boundary. It marks the extent of land rationalised around the shelf's geological history as dry land. It also delineates where the open ocean and deep sea begin:

> [The continental shelf] consists of the seabed and subsoil of the shelf, the slope and the rise [of the shelf, from the seabed]. It does not include the deep ocean floor with its oceanic ridges or the subsoil thereof. (ibid.)

It is along this demarcation that the natural prolongation of land territory ends and any practice of ocean partitioning is abandoned to the category of the high seas.

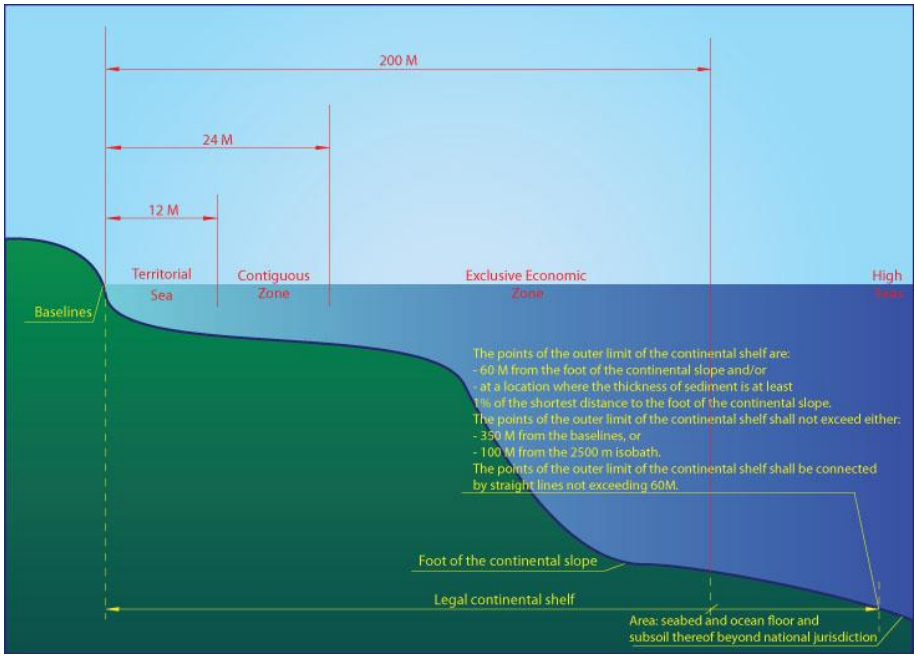


Figure 3. Marine zones under LoS

What the approaches to boundary-making outlined above have in common is that they produce boundaries that: a) are conceived and represented around *terra firma*; b) give coastal states additional rights that are based on the conceptualisation of ocean space as (or in proximity to) *terra firma*; and c) place the burden of baseline delineation, and boundary dispute, on the coastal state. These three commonalities are based on a logic of extending Westphalian states, as exclusive and 'contained territories', to the sea. The fluid environment is not only secondary to the process of ocean boundary-making but does not contribute to the process at all.

One of the problems created by land-based ocean boundary-making is that subsequent boundaries do not represent the marine communities that LoS is in part designed to conserve. LoS attempts to address these transboundary problems in a number of its Articles, particularly Articles 63 and 64. For example, Article 63 (1) states that:

> Where the same stock or stocks of associated species occur within the exclusive economic zones of two or more coastal States, these States shall seek, either directly or through appropriate subregional or regional organizations, to agree upon the measures necessary to coordinate and ensure the conservation and development of such stocks without prejudice to the other provisions of this Part.

And Article 64 (1) that:

> The coastal State and other States whose nationals fish in the region for the highly migratory species listed in Annex I shall cooperate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone. In regions for which no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region shall cooperate to establish such an organization and participate in its work.

Resolution 70/75 (2015) builds on Article 63 and 64 with a more detailed set of operative clauses for the sustainable management of highly migratory and straddling fish stocks to protect against overfishing. Yet these clauses are still bound by a set of land-based ocean boundaries that are not informed by marine science. What Articles 63 and 64 and Resolution 70/75 ask for is a scientifically informed management plan for the conservation of marine species around these existing boundaries. Yet, as with Article 5 (coastal baselines), Articles 63 and 64 place the burden of negotiating these transboundary issues entirely on states, the difficulties of which are evident in those frameworks compliant with this practice. In summary, what the LoS discourse suggests is a framework of boundary-making approaches cut off from the empirical problems that such approaches might create in regional and national marine governance frameworks. I

explore this below in two compliant frameworks, with particular attention paid to how compliance with LoS facilitates the reproduction of particular ocean ontologies.

3.3 NOAA

Marine Managed Areas: Best Practice for Boundary Making (NOAA, 2006) forms the international standard in ocean boundary-making. It was analysed as part of this research to understand how compliance to LoS shapes boundary-making in marine managed areas (MMA). The guidance for producing boundaries is structured around a tripartite process: 1: 'conceptualize the marine managed area'; 2. 'describe the marine boundary'; and 3. 'generate the digital boundary' (p. 9). This section sets out an analysis of the first stage of the process, to ask how boundary-making is conceptually framed and to what degree it replicates LoS discourse. There are two main areas of focus: first, the interdiscursive relationship between marine managed areas (MMA) and marine protected areas (MPA) and, second, the concept of accuracy in the conceptualisation of boundaries.

While the conceptual framings of LoS are informed by principles of ocean stewardship and conservation (Articles 116–120), in practice, ocean boundaries in LoS reflect the delimitations of resource exploitation. This is reproduced in BPBM even in the delineation of marine protected areas, where conservation is ostensibly the predominant concern.

In fact, while the discursive structure of BPBM suggests that the framework has the capacity to conceptualise new boundaries, in practice, this largely involves the conceptualisation of MMAs around existing boundaries, specifically: a) relevant legal frameworks (LoS) and b) an inventory of existing boundaries and jurisdictions.[3] The manual's discourse on 'marine managed areas' versus 'marine protected areas' elucidates

[3] The only conceptualisation of new boundary material is achieved under the consultative stage with agencies and stakeholders, which must comply with a) and b).

some of the concerns with this conceptualisation process. Namely, under current best practice, marine protected areas fall under the umbrella term of marine managed areas and use the same boundary-making practices.

The manual states that:

> … marine protected areas, which include no-take and other types of conservation areas, fall within the larger category of marine managed areas. Marine managed areas encompass both protected areas and those not necessarily established primarily for conservation purposes. Since the term marine protected area applies to many of the examples in this manual, protected often appears in the discussion, and readers can usually substitute managed for the purposes of this best practices manual. There are many parallels and overlaps of boundary terms, whether working with terrestrial lands, inland waters, tidelands, submerged lands, or marine zones. (p. 3)

Further:

> Executive Order 13158, signed on May 26, 2000, defines a marine protected area as 'any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.' (ibid.)

Because this definition excluded certain areas, and because of public concern that 'protected zones' might also mean 'no-take zones', the National Marine Protected Areas Center introduced the term marine managed area (MMA) in 2002. This term includes marine protected areas (MPAs), but now placed alongside a wider range of marine areas. The manual states, 'To promote the development of sound legal boundary descriptions, this best practices manual includes management areas not necessarily established for conservation purposes' (p. 5).

These examples show that these two concepts – marine managed and marine protected areas – are positioned interchangeably, in order to 'promote the development of sound legal boundary descriptions'. This means that: a) best practice boundary-making for MPAs takes the same form as for MMAs – even though the aims of each instrument may be opposed; b) MMA stakeholders are likely to be more powerful (e.g. commercial

stakeholders); and c) boundary-making is, therefore, likely to serve the interests of MMAs.

This simplification of boundary-making practices is orientated around the reduction of 'boundary misunderstandings and litigation' (p. I), with a strong emphasis on boundary 'accuracy'. The Manual opens with the statement: '[A] law or regulation for a marine area cannot have its fully intended effect if the boundary description is vague, inaccurate, or incorrectly represented on a map' (ibid.). This is reinforced throughout the conceptualisation stage, such as the modelling of the boundary ('Stage D' of conceptualisation), which states that:

> [A] boundary must meet the requirements, or purpose, of the MMA, be unambiguous administratively and legally, and serve both the user and mapping communities…Here, the boundary developer should *understand the legal, management, and technical consequences of using particular boundary components* – including straight lines, buffers, shared components, shoreline, and geographic features and place names – and use the knowledge gained in previous sections to develop appropriate boundaries. (my italics, p. 22)

The key points of this practice are then summarised: to 'create boundaries that are clearly defined and thus easy to interpret' (ibid.) and to develop, in relation to 'common boundary' practices, 'legally defensible boundaries by using unambiguous terms and precise locational references' (p. 23). If we are to substitute the term MMA with MPA (as BPBM states is possible), several contradictions become apparent in these guidelines. First, the purpose of the conceptualisation process prioritises the 'accurate' or unambiguous delineation of a marine boundary over the management or protection of a marine area. Moreover, defining an 'area' is made distinct from defining a marine community. The two priorities may be, in this case, mutually exclusive (it may not be possible to effectively protect a marine community by defining an area, as set out in the best practice guidelines). Second, the emphasis on the legal 'consequences' of methods points to competing aims: the boundary must meet the 'purpose' of an MMA, yet be

'unambiguous' for compatibility with legal frameworks. As in LoS, straight lines are used in the manual as a device to this effect. The inference is that the use of straight lines in boundary-making is best practice to avoid misunderstanding and litigation. For example, the manual states that:

> straight boundary lines specifically defined as either geodesic or rhumb lines with visible on-water reference points are generally easier to enforce and understand than other types of boundaries. (p. 26)

Further, under 'jurisdictional issues', it states that:

> [the straight line] is the easiest to create and enforce if properly defined. (Table 5, p. 26)

Under 'digital mapping issues', that:

> [the straight line] is the most easily mapped if properly defined. (ibid.)

And, under 'other considerations', that:

> using straight-line segments to create a simple polygon is easiest to depict and enforce…[even though it is acknowledged that] a polygon may generalize the area you plan to manage. (ibid.)

The empirical effects of the Manual's compliance to LoS are twofold: it necessitates methods of boundary-making wholly concerned with avoiding litigation through mapping 'accuracy'; and it replicates both the methods and logic of LoS practice. The discourse of straight lines is rearticulated and consolidated, as it is the easiest delineation to create and the easiest delineation to enforce. The note that the method 'may generalize the area' is an understated endnote, similar in discursive style to the way coastal baselines are presented in LoS. While discourse presents straight lines as the conceptualising tools of an 'accurate' and 'unambiguous' boundary, interdiscursively they represent a writing out of detail.

The exception to this, and where it differs to LoS, is in the manual's greater engagement with the 'ambiguities' of the coastal baseline. While LoS uses the low-water line to delineate a coastal boundary, the manual uses the shoreline as a boundary itself. This presents distinct problems:

> [the] shoreline is a common reference feature but one of the most complex to portray accurately…natural processes such as tides, weather, and climate can significantly change the location of the shoreline over time. If the MMA boundary's intent is to reflect these natural changes, then using shoreline features in the boundary description may be appropriate. (pp. 24–25)

Further:

> The boundary developer must also understand that referencing the shoreline in the boundary description creates the additional burden of having to update the ambulatory shoreline continuously. (ibid.)

Importantly, this makes provision for boundary-making that moves over space and time. What is particularly interesting in this example is the adaptive approach boundary-making takes in response to 'natural changes', which implies that boundary-making in the framework has the capacity to respond to environmental change.

In summary, analysis suggests that in relation to their boundary-making practices, there is a high level of interdiscursivity between BPBM and LoS. This is in part due to compliance, which dictates the conceptualisation process, and in part through a discourse of 'accuracy', which anticipates potential litigation. However, to make a marine boundary 'unambiguous' or to make a boundary 'clearly defined and thus easy to interpret' is to exclude competing actors. In this particular case, those competing actors are ostensibly ocean communities and their capacity for movement – communities that are entirely absent from the conceptualisation process. While the consultative stage of boundary conceptualisation with stakeholders has the capacity to include marine scientists and while the discursive interests of the Manual show that it, like LoS, is designed to 'protect

and manage resources within the marine environment' (BPBM p. 5), the prioritisation of commercial interests within a framework nonetheless precludes any meaningful inclusion of marine scientific ecoregions. In short, the logic used in BPBM bases ocean boundaries around areas of resource exploitation, even though the conservation aims of the framework might be better served by basing ocean boundaries around the discontinuity of the resource itself (as in physiognomic marine biogeographies). The next section evidences problems that can arise in the absence of such a boundary-making practice at both regional and national levels.

3.4 CTI-CFF

This section discusses the analysis of the *CTI-CFF Regional Plan of Action* (2016). Specifically, it discusses the principles guiding the framework and the relevant goals and targets set in relation to ocean boundary-making. The Coral Triangle region is an exceptional case study in the practice of ocean boundary-making. The region is delineated around scientifically defined marine ecoregions. While this boundary forms a baseline that informs the exclusive economic zone and retains some of the guidelines for archipelagic baselines (such as following the general form of the archipelago), it does not retain them all. What this represents is a regional ocean boundary that is conceived around the region's marine communities, informed by marine science. This presents an exciting example of an ocean governance framework better representing both marine science and subsistence fisheries. The regional governance body working towards this goal is the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF), an initiative established in May 2009 as a nonbinding agreement between Malaysia, Indonesia, Philippines, Timor-Leste, Solomon Islands and Papua New Guinea.

Analysis of CTI-CFF's *Regional Plan of Action* (RPoA), however, identifies a number of competing aims in the document's principles and goals and targets, which I

argue are a result of both compliance to LoS and the reproduction of ocean ontologies instituted and normalised through LoS. These include, first, the development of environmental governance regimes (e.g. seascapes) that are both 'ecosystem-based' and 'people-centred'; and, second, practices of ocean boundary-making that, whilst purportedly based on 'solid science', are precluded from prejudicing existing political boundaries between nations. Research suggests that, while the Coral Triangle region was conceptualised around scientifically informed ocean boundaries, and while the representation of such boundaries has been a primary concern of the CTI-CFF's RPoA, these boundaries are, in law, subordinate to the boundaries of competing governance frameworks such as LoS.

Principles

Of the nine 'Guiding Principles' of the framework, four were analysed as relevant to the conception and delineation of marine environments. These are:

> Principle #1: CTI should support people-centred biodiversity conservation, sustainable development, poverty reduction and equitable benefit sharing. (p. 7)
>
> Principle #2: CTI should be based on solid science. Solid science and data on fisheries, biodiversity, natural resources, and poverty reduction benefits should form a basis for establishing goals and implementation activities. In the absence of conclusive scientific information, the precautionary principle/approach will apply. (ibid.)
>
> Principle #6: CTI should recognize the transboundary nature of some important marine natural resources. Goals/activities should take into account the transboundary nature of some marine resources and threats (land- and sea-based) to these resources (e.g., shared fish stocks, migratory sea turtles and marine mammals, IUU fishing, live reef fish trade). Transboundary activities under CTI should not prejudice recognized boundaries or ongoing negotiations on legal boundaries between nations. (p. 8)
>
> Principle #7: CTI should emphasize *priority geographies*. Goals/activities should help focus resources and investments on priority geographies (e.g., large-scale 'seascapes' requiring prioritized attention, identified through ecoregional assessment processes). (my italics, p. 9)

These principles were analysed using critical reasoning to identify stated and suppressed premises, inferences and conclusions and to interrogate the underlying logic of legal principles and some preambulatory clauses. The analysis is shown in Table 3. The results of the analysis (see Table 4) can be summarised as:

1. The framework is 'people-centred'.
2. The framework is based on 'solid science', in the absence of which 'the precautionary principle/approach will apply'.
3. The framework 'recognizes the transboundary nature' of marine resources, but this should not prejudice 'legal boundaries between nations'.
4. The framework aims to focus resources and investments on 'priority geographies'.

Table 3. Analysis of Principles 1, 2, 6 and 7

Principle	Analysis
Principle 1	
(a) 'CTI should support people-centered biodiversity conservation'	(a) i CTI does not support biodiversity conservation for its own sake' **((a), therefore (a) i)**
(b) 'CTI should support…sustainable development'	(b) i Sustainable development means that natural resources are to be sustained, but only insofar as they can continue to be exploited for maximal intergenerational benefit (b) ii Maximal intergenerational benefit is incompatible with supporting biodiversity conservation for its own sake *Therefore* (from (b) i and (b) ii): (b) iii Sustainable development is incompatible with supporting biodiversity conservation for its own sake *From* (b): CTI should support sustainable development *Therefore* (from (b) iii and (b)): (b) iv CTI should not support biodiversity conservation for its own sake **(If (b), (b) i and (b) ii, then (b) iii)**
(c) 'CTI should support…poverty reduction'	(c) i Subsistence communities rely on sustainable access to natural resources to reduce poverty *From* Principle 1 (a): CTI should support 'people-centered' biodiversity conservation (c) ii Reducing poverty justifies sustainable resource exploitation [(b) iii CTI should not support biodiversity conservation for its own sake] **((c) and (c) i and (a), therefore (c) ii [and (b) iii])**
(d) 'CTI should support…equitable benefit sharing'	*From* (c) ii: The aim of reducing poverty justifies sustainable exploitation

	Therefore (d) i Sustainable exploitation should be shared equitably among member States **((c) ii and (d), therefore (d) i)**
Principle 2	
(a) 'CTI should be based on solid science' (b) 'Solid science and data on fisheries, biodiversity, natural resources, and poverty reduction benefits should form a basis for establishing goals and implementation activities' (c) 'In the absence of conclusive scientific information, the precautionary principle/approach will apply'	*From* Principle 1 (c) ii: Reducing poverty justifies sustainable resource exploitation *And* Principle 2 (a) i: Scientific data informs sustainable levels of resource exploitation *Therefore* Principle 2 (a) CTI should be based on solid science *And* Principle 2 (b) Solid science and data on fisheries, biodiversity, natural resources, and poverty reduction benefits should form a basis for establishing goals and implementation activities *And if not* (a) and (b) then (c) **(from P1 (c) ii and P2 (a) i, therefore P2 (a) and (b), if not (c))**
Principle 6	
(a) 'CTI should recognize the transboundary nature of marine natural resources' (b) 'Goals/activities should take into account the transboundary nature of some marine resources and threats (land- and sea-based) to these resources (e.g., shared fish stocks, migratory sea turtles and marine mammals, IUU fishing, live reef fish trade)' (c) 'Trans-boundary activities under CTI should not prejudice recognized boundaries or ongoing negotiations on legal boundaries between nations.'[4]	(c) Trans-boundary activities under CTI should not prejudice recognized boundaries or ongoing negotiations on legal boundaries between nations *Therefore* (a) i CTI should recognize the transboundary nature of some, but not all, important marine natural resources *And* (b) i Goals/activities should take into account the transboundary nature of some, but not all, marine resources and threats (land- and sea-based) to these resources **((c), therefore (a) i and (b) i)**
Principle 7	
(a) 'CTI should emphasize priority geographies' (b) 'Goals/activities should help focus resources and investments on priority geographies'	*If* (a) CTI should emphasize priority geographies, *then* (b) goals and activities should help focus resources and investments on these geographies **(If (a), then (b))**

[4] 'Prejudice v. a. to impair the validity of (a right, claim, statement, etc.)' (OED, accessed 7.11.17).

Goal	Target	Annotation to Target/Regional Action
1: '"Priority seascapes" designated and effectively managed: Large-scale geographies prioritized for investments and action, where best practices are demonstrated and expanded.' (p. 13)[10]	1: 'A set of priority seascapes across the Coral Triangle are designated, to serve as the geographic focus of major investments and action during 2010–2020. Comprehensive Seascape Investment Plans for each priority seascape are completed, along with an overall scheme for the sequencing of investments across the 10-year timeframe of the CTI Plan of Action.'(ibid.)	1.2 'Extensive consultations among our governments and key partners will be required to delineate and designate these priority seascapes.' 1.4 'Boundaries of seascapes that have already been delineated (e.g., SSME) will generally be accepted.' (ibid.)
2: 'Ecosystem Approach to Management of Fisheries (EAFM) and Other Marine Resources Fully Applied.' (p. 17)	1. 'Strong Legislative, Policy and Regulatory Frameworks in Place for Achieving an Ecosystem Approach to Fisheries Management (EAFM).'(ibid.)	1.1 'EAFM strives to balance diverse societal objectives by taking account of the knowledge and uncertainties of biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecological meaningful boundaries. EAFM principles are the following; (i) fisheries should be managed to limit their impact on the ecosystem to the extent possible; (ii) ecological relationships between harvested, dependent and associated species should be maintained; (iii) management measures should be compatible across the entire distribution of the resource (across jurisdictions and management plans); (iv) the precautionary approach should be applied because the knowledge on ecosystems is incomplete; and (v) governance should ensure both human and ecosystem well-being and equity.' (ibid.)

[10] The 'seascape approach' is a large-scale approach to marine governance designed to 'implement the principles in the *United Nations Convention on the Law of the Sea* (LoS), and to promote marine biodiversity conservation and sustainable development' (Conservation International, 2011, pp. 3-4). It is a crosscutting instrument that includes nationally authorised MPAs and aims to negotiate transboundary issues. A definition of the approach by Conservation International states that 'a seascape should be identified and selected scientifically as well as strategically. Seascapes are designated not solely on biological criteria, but should be selected based on a number of factors: social and political support for seascapes management, ecological criteria, socioeconomic criteria, governance criteria, opportunity criteria' (p. 10).

		1.6 'Solid scientific information will be needed to serve as a basis for the formulation of EAFM policies; expanded scientific research, data management and monitoring programs will be needed to help craft national as well as regional management measures.' (p. 18)
3: 'Marine Protected Areas (MPAs) Established and Effectively Managed (Including Community-Based Resource Utilization and Management).' (p. 30)	1: 'Region-wide Coral Triangle MPA system (CTMPAS) in place and fully functional.' (ibid.)	Regional Action 2: 'Complete and endorse a comprehensive map and corresponding georeferenced database delineating a region-wide CTMPAS, based on (i) extensive biophysical and socio-economic data analysis and geographic prioritization; and (ii) extensive consultation processes (including local community and stakeholder consultations within each country, and consultations among CT governments). Special collaboration and external assistance from leading institutions will be required to analyze key information not addressed in previous spatial analysis exercises, such as spatial mapping of (i) areas with climate change resilience characteristics; (ii) fisheries-based food security data; and (ii) poverty data overlaid with data on climate change vulnerability of marine ecosystems.' (p. 32)

Table 4. Key goals, targets, annotations and regional action relating to marine boundaries (code = stakeholders, existing ocean-boundaries, principles, scientific engagement, concerns, new boundary-making)

Goals and Targets

Goals and targets were analysed on the basis of their engagement with ocean boundary-making.

The results can be summarised as follows:

1. There are existing ocean boundaries in the region that need to be recognised by the framework (i.e. any conflicting delineations will require transboundary negotiations).

2. There are a number of stakeholders that will be consulted in the delineation of 'priority seascapes', including 'government', 'key partners' and 'local community and stakeholders'.

3. Goal 2, to develop an ecosystems-based approach to fisheries management (EAFM), may be inconsistent with the principles of the framework. For example, the concept of an 'ecologically meaningful boundary' may be incompatible with the suppressed premise of Principle 1 (a) i: that the framework 'should not support biodiversity conservation for its own sake' (see Table 3).

4. Scientific bases for 'the formulation of EAFM policies' and the spatial mapping of climate change data may be inconsistent with the premise that the framework should be 'people-centered'.

The goals and targets represent a distillation of the principles of the framework. They also represent a point of articulation between the discourses of international law (in the framework's principles), regional and national policies (in the framework's goals and targets) and the empirical practices that action the framework's goals (the annotations and regional actions). It is in the 'annotations to targets' of the framework that conflicts between theory (principles) and practice (annotations and regional actions) are most evident. Closer analysis of the goals and targets shows that as the aims of the framework are refined, there is a shift from the premise that the framework 'should support people-centered biodiversity conservation' (Principle 1) to discourse that highlights the balance between human and nonhuman actors in ecosystems. I suggest that, due to the high number of subsistence communities dependent on fisheries in the region, this is especially evident in EAFM goals and targets in which 'biotic, abiotic and human components of ecosystems and their interactions' are highlighted (Goal 2).

The annotations also elucidate the absence of nonhuman communities from the discourse. The absence of these groups is apparent throughout the framework's discourse, but there are two devices used in the annotations that highlight the issue. Firstly, scientific knowledge is positioned as the locus of the nonhuman (in so far as the nonhuman is rendered measurable for human goals, like food security). This is exemplified in Regional Action 2 of Goal 3, which states that:

> Special collaboration and external assistance from leading institutions will be required to analyse key information not addressed in previous spatial analysis exercises, such as spatial mapping of (i) areas with climate change resilience characteristics; (ii) fisheries-based food security data; and (iii) poverty data overlaid with data on climate change vulnerability of marine ecosystems. (p. 32)

Here, 'key information' – a euphemism for the nonhuman – needs specialist (scientific) analysis to ascertain where the resource might (as in (i) and (ii)), and might not (as in (iii)) sustain increased exploitation. The nonhuman species' own overall wellbeing is not addressed. Secondly, in the absence of scientific knowledge, Principal 2 and Annotation 1.1 of Goal 2, Target 1 deploy the precautionary principle as a proxy for the nonhuman (by which I mean it represents these groups when science cannot). The very inclusion of the precautionary principle points to vulnerabilities inherent in the framework's 'people-centered' approach, with the precautionary principle acting as an intervention to this anthropocentrism. In particular, it draws attention to the framework's ultimate reliance on the interventionist roles of legal principles and scientific data to delimit the concentration of power given to human actors.

4. Discussion

LoS has been a paradigm-shifting framework in the conceptualisation of the global oceans. Its development and impact resonates with many points from the passage quoted from Carl Schmitt's work in the introduction: the fact that LoS represented a new era of international environmental governance and a new image of the earth; the idea that 'the true' is synonymous

with the precise division of space; the ways in which, as I will argue, LoS reappropriates tenets of colonial territorialism – a *nomos* of 'seize, divide, exploit' – towards the resources of the global oceans; and lastly, that this era of ocean boundary-making is inseparable from a political transformation in which ocean space is imagined in new ways.[11] From this basis, I ask: what ontologies are evident in LoS boundary-making practices? How are these reproduced in frameworks and practices compliant to it? Analysis shows three main ontologies in the discourse of the frameworks studied: the use of land-based methods; an anthropocentric approach to conceptualising ocean space; and the omission of key biotic and abiotic marine communities. These results may be explained by the possibility that LoS has institutionalised historically normative ways of conceptualising ocean space that are then replicated in the framework's methodological approaches. These practices are then rearticulated in frameworks compliant to LoS. This is partly facilitated by compliance practices: for example, NOAA's best practice for boundary-making must work within the ocean boundaries delineated by LoS, and this almost entirely dictates how new ocean boundaries are conceived. However, evidence suggests that the replication of LoS discourse in compliant frameworks is also the result of ontologies forming a set of norms – or 'ocean logics' – that are reappropriated in noncompliant governance practices. For example, the logic of exclusion exercised towards the deep ocean in LoS (that which cannot be reasonably connected to 'land') is reappropriated in MPA boundary-making, with only 1.18% of areas beyond national jurisdiction represented.[12] The results underline the importance of the comparative analysis of ocean boundary-making frameworks and practices and, in particular, the importance of investigations into whether underlying

[11] I would add that in the context of LoS, the reference to 'exploitation' should instead be stated as 'sustainable exploitation'.

[12] MPAs make up 16.03% of national waters (39% of global oceans) and only 1.18% of areas beyond national jurisdiction (61% of global oceans) (https://www.protectedplanet.net/marine, accessed 22.3.18).

ontologies in international frameworks, such as LoS, are compatible with regional goals and whether they support the development of effective regional ocean governance frameworks and instruments.

In the Preamble of LoS, there is a (nonbinding) clause, that states: '*The State Parties to this Convention…conscious* that the problems of ocean space are closely interrelated and need to be considered as a whole…*have agreed* as follows [moving on to the operative clauses]' (p. 25). This clause is an important statement that refers to the conceptualisation of ocean space in the Convention. It contains several premises: a) that the ocean can be considered a whole; b) that the parts of this whole are interrelated; and c) that the problems related to parts can be remedied by considering them as a whole. This holism betrays an important understanding of the characteristics of the oceans, in a Convention that is ultimately and otherwise designed to separate and disintegrate this whole.

The question that logically follows the clause is: if the global oceans are conceptualised holistically, on what basis should they be delineated in ocean boundary-making?[13] What are its parts, and should these form the bases of ocean partitions? If 'the problems of ocean space' refers to the management (i.e. *nomos*) of marine resources, and if the delineations of some of those communities (e.g. species) move over space and time, then this clause is an acknowledgement that these communities cannot be considered static parts: it is an acknowledgement of the interconnectivity of such communities and of the need to consider them as a whole. This position would be allied to (and likely informed by) scientific consensus that the biotic and abiotic communities of the oceans are indeed highly interconnected at a global scale (Longhurst, 2007; Reygondeau et al., 2013; Ramstorf, 2003; England, 2009; Allison et al., 2011). The critical point here is that while LoS makes implicit reference to the

[13] I use the term 'holistically' to refer to the theory of holism: 'the tendency in nature to produce wholes (i.e. bodies or organisms) from the ordered grouping of unit structures' (OED, accessed 24.3.18).

management (‘problems’) of marine communities (‘ocean space’) and acknowledges their interconnectivity, ocean boundary-making does not represent these parts in its delineations. Instead, ocean boundary-making in LoS is constructed around *terra firma*. This may mean that through this framework, marine communities (parts) can *only* be included if considered as a whole or as static segments within delineated regions.

Legal scholar Douglas Johnston argues that land-based methods of boundary-making used in LoS were developed under a colonial territorialist approach, in which coastal seas were seen as an extension of territory or a connection between territories (Johnston, 1988). Yet the conceptual approach to boundary-making in LoS is in fact driven by ‘functional logic’ – a concept developed in *opposition* to colonial territorialism. In its most basic form, functional logic relies on the concept of consent, whereas colonial territorialism relies on a logic of force. As Johnston notes, in practice, ‘the concept of territoriality has yielded to the much greater specificity inherent in a functional approach to boundary-making’ (p. 18). Johnston elaborates on this distinction below:

> According to the functionalist approach to ocean boundary-making, the making of the boundary should be strongly influenced by the administrative reasons for the boundary in question and by the anticipated administrative problems associated with its maintenance. On the one hand, the delineation of baselines and the determination of seaward limits should be influenced by the kind of administrative responsibilities to be discharged by the coastal state’s agencies within the zone of adjacent waters, subject to the provisions of the relevant regime of coastal state jurisdiction. On the other hand, the delimitation of ‘lateral’ boundaries between neighbouring (opposite or adjacent) states should be influenced by the need for cooperative development and management by these states in transboundary and adjacent ocean areas, subject to the provisions of the relevant regime. (Johnston, 1988, p. 227)

It is on this basis – its ‘functionality’ in an institutional setting, or its facilitation of ‘administrative reasoning’ – that an ocean boundary is constructed as ‘rational’.

While functional jurisdiction in ocean boundary-making represented a radical act of diplomacy in its recognition of sovereign rights, I suggest it is also a conceptual approach that has reappropriated certain tenets of colonial territorialism. In principle, there are distinctly

colonial logics at play in the disciplining of an irrational oceanic body through 'rational' boundary-making and administrative reason. Adhering to the principles of functional logic, boundary-making in LoS is dictated by the 'administrative reasons for the boundary in question' and by the 'anticipated administrative problems associated with its maintenance' (Johnston, ibid.). This is a logic Johnston suggests stems from a postcolonial culture of 'consent':

> In the contemporary period, imperial conquest and the colonial style have given way to the principle of consent in the delimitation of international boundaries between neighbours. At sea, and to some extent in outer space, the concept of territoriality has yielded to the much greater specificity inherent in a functional approach to boundary-making. (1988, p. 18)

Yet the function (or administrative reason) behind this approach is the territorialisation of ocean space as land.[14] Despite the postcolonial underpinnings of the Convention, the reproduction and extension of territory into the sea makes ocean boundary-making – in this, its most basic form – a neocolonial act. This is true not only because LoS formally established new territories in what was, at the time, a largely postcolonial world but also because the terrestrialisation of ocean space in many ways replicates the tenets of colonisation: it imposes a conceptualisation of (ocean) space using a set of pre-existing methods developed by the (land-based) coloniser, which are designed to re-territorialise the space in the image of the coloniser's own sense of territory and to position indigenous (marine) communities as resources to be exploited by and shared between colonial (human) powers. I suggest, therefore, that the issue of 'non-consent' associated with colonialism (that the functional logic approach to boundary-making is designed to avoid) has, from this position, simply shifted from peoples to non-peoples. This is problematic because the very basis of the Convention is, in theory, the governance of

[14] LoS was established in part as the result of a sustained project concerned with more equitable maritime economies. As legal scholar Christopher Mirasola notes, 'pollution and overfishing became understood by an increasing number of developing countries as an externality of colonization by dominant marine powers' (2016, p. 46).

environmental problems. In regard to this later aim, the methods used for ocean boundary-making in LoS are designed in a way that makes it difficult to account for marine communities that have complex scientific delineations that move over space and time.

The institutionalisation of these ideas becomes especially apparent when conceptual and methodological approaches are replicated in compliant frameworks. To comply with a framework is to reproduce its politics. As mentioned above, there are parallels between the exclusion of the open ocean in LoS and the representation of the open ocean in MPAs evident in NOAA's BPBM. There are three other examples of interdiscursive discourse:

1. The use of coastal features as a reference point for the conceptualisation of MMA boundaries replicates methods for the conceptualisation of territorial seas in LoS.

2. The discourse of 'accurate' versus 'vague' in BPBM is a reiteration of the discourse of 'accuracy' in LoS – a methodological ethos positioned as facilitating administrative 'requirements' or 'purpose', yet (as I have argued) with the result of excluding competing actors.

3. The commutability of MMA and MPA concepts in BPBM as a method of streamlining administrative processes, is a replication of 'administrative reason' – the defining basis of the functional logic approach.

Writing in 1988, Douglas Johnston anticipated that:

> With further scientific and technological advances in ocean management, it may be expected that the concept of boundary maintenance inherited from the land will yield to an increasing diversity of post-settlement ocean-boundary-related arrangements. (p. 18)

That is to say, an engagement with scientific knowledge may result in ocean boundaries that are not reliant on terrestrial features for their management. The Coral Triangle is an atypical case of ocean boundary-making that may in fact embody Johnston's prediction. One might

anticipate, therefore, that ocean governance within the region would be less likely to replicate land-based discourses as a matter of compliance. However, there is still strong evidence of interdiscursivity between concepts in LoS and conceptual and methodological approaches in the CTI-CFF's RPoA. An ecosystem-based approach is one of the central aims of RPoA, which suggests a greater engagement with scientific and traditional knowledge. Yet evidence shows conflict between scientific and socio-economic concerns and perhaps irreconcilable gaps in the dual approach of being 'people-centred' and 'science-led'.

I suggest that what the CTI-CFF case shows is that despite operating within a region where territorial ocean boundaries have specifically been developed around marine ecosystems, certain land- and people-based logics evident in LoS are reproduced in the CTI-CFF framework's principles and goals, and these work against the principle aims of the framework. This suggests that even when normative boundary-making is replaced with a less land-based method, and compliance with LoS is not at issue, ocean governance frameworks can still reproduce ontological practices institutionalised in LoS that are obstructive to good governance.

5. Conclusion

There are three discursive themes evident in the results of this study: an anthropocentric approach to ocean governance; the use of land-based methods; and the exclusion of the open ocean and deep sea from ocean boundary-making in the three frameworks. Why are these three approaches problematic? Governance, after all, is mainly concerned with the wellbeing of human communities. Ecosystem-based approaches are a means to this end – that is, the sustainability of ecosystem services. The use of land-based methods seems sensible, given the main aim of the governance frameworks are – in practice, if not in theory – to equitably share the resources of the marine environment (whether for food, research, or heritage purposes) between terrestrial states. And areas beyond the continental shelf, too difficult to delineate in

relation to bodies of land, are given global commons status. What all three of these approaches assume is that ocean space *can* be delineated this way and that these regimes will not obstruct the administrative reasons for their conception. On this point, Johnston argues that:

> Baselines and seaward limits should be regarded as 'dysfunctional' when they seem to obstruct rather than facilitate the globally approved purposes which the relevant zone and regime are designed to serve. (Johnston, 1988, p. 227)

I argue there is evidence that such approaches to boundary-making *do* obstruct the functional administrative reasons for their conception. Firstly, normative ways of conceptualising and delineating ocean space in LoS conflict with the principles, goals and spatial concepts in the regional frameworks studied. Secondly, analysis of the logic in the CTI-CFF's RPoA (Table 3) suggests that the best way of protecting the sustainability of ecosystem services would be to design governance frameworks that are not anthropocentric – a 'precautionary principle' that is built into the design of such regimes.[15] The baselines and seaward limits of LoS are an institutionalisation and representation of an anthropo/terra-centric logic, at odds with the conservation goals of the framework. This is evident in the reference to priority geographies in RPoA (which are vaguely described but based around socio-economic concerns). This has the effect of undermining the goals of ecosystem-based fisheries management (RPoA).

Lastly, evidence that acts of boundary-making in normative environmental governance frameworks are still informed by a colonial territorialist approach (towards non-peoples) should call into question the extent to which the use of such methods in frameworks such as the CTI-CFF's RPoA may constitute an act of neocolonialism in a region of postcolonial nations. The traditional custodial practices of many Coral Triangle nations evidence very different spatio-temporal concepts of human-environment relations (Burns, 2019). Imposing

[15] The test of which might be not needing the precautionary principle. In the cases studied here, it indicated a weakness (the anthropocentricity) in the conservation principles of the RPoA framework.

Western boundary-making on these environments may well interrupt traditional practices in areas that could be better managed through informal, and historically more flexible, arrangements. As Johnston points out:

> legal theorists are bound to recognize that many ocean boundary issues today seem to require an examination of modern claims to 'historic rights' that were never formalized in indisputably binding and legally unchallengeable instruments. Legal entitlements sometimes evolve from sources that date back to earlier times, when 'neighbourhood' arrangements were often handled in an informal manner. (1988, p. 6.)

Since Johnston wrote, there have been many conventions developed for taking traditional rights over marine space into account under the cultural boundary concept. Yet such conventions are largely developed to accommodate the rights of traditional peoples living in developed ex-settler colonies (e.g. the US and Canada); within this statist framework, boundary-making replicates an anthropo/terra-centric approach. The Coral Triangle region has an opportunity not only to accommodate traditional knowledge but also to allow traditional ocean ontologies and management practices to inform boundary-making.

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Paper 3.

Abstract

This paper investigates the impacts of El Niño Southern Oscillation (ENSO) events in Timor-Leste. The enquiry is two-part: First, I use participatory methods to investigate ENSO related drought and flood events in two coastal field sites; second, I ask how these events both territorialise adaptive landscapes, and are delineated through adaptive practices. The research situates ENSO related environmental change in a complex postcolonial landscape of independence and state-building, but also violence and displacement. The result is a set of embodied concepts of extreme weather that cross time, space, memory, and loss.

Research results show that ENSO events territorialise by reproducing characteristics of colonial conflict, and by challenging the traditional cosmologies on which human-environment relations are based. Further, the embodiment of extreme weather events and the labour of adaptation partitions the boundaries of extreme weather events and informs decolonial geographies of climate adaptation. The subsistence practices of adult participants are retreating away from coastal areas informed by environmental knowledge of traditional lands in the highlands. Youth participants instead envision a set of coastal adaptive practices that increase resilience to climate events.

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Oceanic embodiments: Living ENSO events in coastal Timor-Leste

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1. Introduction

Environmental governance frameworks have historically conceived of environmental systems around human societies (Birnie et al., 2009; Redgwell, 1999; Cardwell and Thornton, 2015). Climate adaptation governance frameworks are no exception. Yet, such an approach terrestrialises climate events, when these are instead ocean centric (Rahmstorf, 2003; Stommel, 1958; England, 2009). This conceptual separation of climate events from their oceanic drivers bases adaptation frameworks on a fallacious spatial premise that undermines the production of long-term strategies. Using participatory research methods, this paper investigates drought and flood events that are driven by the Pacific ocean-based climate system of El Niño Southern Oscillation (ENSO). I work with participant researchers in two coastal communities in northern Timor Leste to develop a decolonial approach to local adaptation governance. I do this through an investigation of how traditional human-environment relations challenge conventionally framed adaptation governance frameworks and practices. This mode of inquiry investigates the conceptual separation of land and sea evident in conventional adaptation governance frameworks as a key problem to building coastal resilience. I look to alternative (nonwestern) human-environment relations, to see how these develop adaptive practices that better represent the dynamic characteristics of extreme weather.

There are a number of conditions effecting oceanic relations and adaptive practices at the two field sites: the historical displacement of highland peoples to coastal internment camps; extreme coastal weather events that are likened to the military violence of the Indonesian occupation; and the rationalising of these events through an animistic cosmology in which participants, and their ancestors, embody things in nature. One aim, therefore, is to elucidate shifts that have occurred in the research participants orientation towards the sea—over time and in response to both environmental and social (colonial) events. From these specific contexts, some questions may be posed: What role do ENSO events play in shifting patterns of human movement across the field sites, when displacement is experienced as 'violence'? And, how do participants' adaptive responses—adaptive concepts and practices—also form a set of agencies that do themselves act to partition drought and flood events? Results show that the interplay between ENSO events and the spontaneous adaptive practices of the two communities form a set of de/reterritorializing practices that delineate adaptive geographies around human-environment relations (which move over space and time).

Research evidences participants' retreat from both fishing, and coastal agriculture in response to the increased severity and frequency of extreme weather. Adaptive practices across adult livelihood groups increasingly rely on traditional environmental knowledge (TEK) of the highland environments (participants' pre-occupation traditional lands). Anomalous flood and drought events have complex, deeply personal, effects on human-environmental relations. Yet, alternative ways of conceiving and experiencing environmental relations also allows for adaptive practices to be developed around the discontinuities of shifting resources. This results in an inherently sustainable approach to adaptation, but also one that is gradually displacing the communities from the coastal environment. Research found this response was limited to adult participants, many of whom contextualise environmental change with reference to their traditional lands. Youth participants instead envision a set of adaptive practices aimed at increasing coastal resilience, informed less by traditional knowledge, and more by the technological approaches taken by international aid agencies.

Below is a section setting out the theoretical bases of the research, which draws from work on territorialisation to propose a decolonial approach to adaptation. Following this is a methods section ('Encountering Timor') that discusses the methodological contexts and challenges of the research, and the co-development of research design and methods. A results section is organised around case studies of two field sites. These concentrate on drought and flood events which are the main adaptive concerns of the two communities. A discussion section contextualises the results within the main theoretical aims of the paper. The section that follows reflects on the strategic and ethical reasoning for decolonising adaptation geographies.

2. Theoretical framings

Much of the current literature on human-environment relations draws from process philosophy and theories of explanation that favour an understanding of the world as nonessentialist and 'in flux'. Through philosophies of immanence and nonrepresentation, and concepts such as emergence, vitalism, and dynamism, scholars have rethought the material makeup and relational characteristics of earthly matter, in the context of contemporary political life and environmental change. One

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of the key problems identified is the question of how to reconceptualise governance regimes to more meaningfully reflect these relational ontologies.

Environmental anthropologist Andrew Vayda's concept of 'progressive contextualization' (1983) draws from this literature. It is an event-based approach that uses inductive reasoning to 'diagnose' the spatialities of environmental events. Vayda suggests starting at the epicentre of the event and investigating via 'progressively wider or denser contexts … [that trace] the causes and effects of these activities outwards' (p. 265). This is an approach that typifies the logic used in 'diagnosing' adaptation concerns around the impacts of an extreme weather event. The problem with this approach is that a) the conceived epicenter of the impacts is anthropocentric (I would argue this is still the case with the ecosystem-based approach where impacts may also be conceived around ecosystem services), and b) it rejects systems thinking (and consequentially, scientific representations) that would instead situate such an 'epicenter' as connected to—but also on the periphery of—a larger system.

The concepts of territory and territorialisation, as they are developed by Gilles Deleuze and Félix Guattari and consequent works, provide an alternative theoretical framework to Vayda's that reconstitutes human-environment relations as dynamic, heterogenous and decentred. I suggest this way of viewing human-environment relations is closer to the traditional cosmologies evidenced in this paper. For example, geographer Stuart Elden notes that while in Western societies social relations are organised around territory (which he sees as logically prior to territorialisation), traditional societies instead organise territory around social relations (2010). I would add that in animistic cultures, such as the Timorese, social relations are inclusive of many nonhumans such as ancestral spirits, animals, and water, which further decentres the human from concepts of territory. I also suggest the concept of de/reterritorialization (Deleuze & Guattari, 1984) is particularly well suited to climate change analysis because it reflects the coupled relationship between the deterritorialising effects of extreme weather, and the reterritorialising effects of adaptive practices. I draw here from social theorist Andrea Brighenti (2010a, 2010b), who argues that traditional concepts of territory are conceived around bodies (specifically the movement of bodies), to suggest that the adaptive practices of the research participants do to some extent delineate (through bodily movement) the boundaries of climate events.

My theoretical approach is also informed by geographer Sarah Whatmore's concept of the more-than-human (2002, 2011). The more-than-human reconfigures material relations between human, body and ecology by asking what, in the way of the nonhuman, has been 'left out' of various 'human' environments (Whatmore, 2002, p. 110). To some extent, this process works both ways. The hard sciences have often left out the human (or separated them dichotomously from nature). Arguably, recent work around the concept of the Anthropocene can be seen as a corrective to this, but an anthropocentric one that does not address the land/sea dichotomy. The continued relevance of Whatmore's concept is that is can also account for what is 'left out' of various 'non-human' environments across the land-sea divide. The more-than-human has informed a small body of work on marine environments. Geographers Kimberley Peters and Christopher Bear have argued that the sea is, as Peters puts it, 'a more-than-human nature, co-fabricated with human life' (2014, p.178; Bear, 2014). Informed by this work, I use the term more-than-human to provide a specific focus that aims to; a) connect oceanic environments to terrestrial ones through a recognition of their shared material relations; and b) to describe a spatial approach that conceives of adaptive landscapes 'from the sea', a distinction that might be termed (in the context of this article) a more-than-human oceanography.

My approach builds on geographer Jessica Lehman's work towards considering the ocean as an actor, 'one that exercises agency, enrolls others, and is enlisted itself to actively and dynamically shape reality' (2013, p. 485). Lehman's position draws from theorist Bruno Latour's concept of 'following' nonhuman actors as a method for their conceptual inclusion in the social (Latour, 2004). By framing the oceanic in this way, Lehman points to a dilemma: if Nature is conceptually marginalised from the Social (as Latour suggests), the global oceans are perhaps most representative of this, and most challenging to bring into Latour's social 'collective'. Sometimes, though, disruptive events force such opposing concepts (as Nature and Society) into closer proximity, revealing their many connections, and thus facilitating their interrogation. Lehman's focus on the tsunami as facilitator of oceanic agencies exemplifies this. Yet, I suggest that climate change is also such a phenomenon; global climate is driven by coupled ocean-atmosphere circulation (e.g. ENSO events), and contemporary climate change challenges the conceptual boundaries of nature, human, and territory. When anomalous climate events occur, they pierce the conceptual separation of natural and historic time, and natural and human space. The materialities of the events enter our communities, our homes, and our lungs, breaking the illusion that nature is somehow external to the spaces occupied by human bodies. The global oceans are a central *agent* in this climate collective, but more than this, they are a *force* of materialities that territorialise not only adaptive geographies (e.g. 'forced' migration), but I would suggest the binaries of nature/society, land/sea in Westphalian political thought.

These theoretical framings support the development of a decolonial approach to adaptation geographies: a revised approach to understanding territory and territorialisation in the context of environmental change that is based on Deleuzo-Guattarian readings but takes care to investigate and represent material and immaterial, human-ecological connections. This presents a theoretically framed approach that pushes back against adaptation governance frameworks and practices that are developed around static boundary-making practices. This approach also runs counter to Vayda's method on two points: I suggest progressive contextualization would better represent climate events if contextualisations were also followed back again (not just 'outwards', as Vayda puts it, but also 'inwards') to elucidate the emergent relations between the 'cause' of Vayda's causal reasoning, and other actors in the event under analysis [1]; secondly, I suggest that the inclusion of non-human agencies in this diagnostic method might decentralise the human, and as a result delineate climate events differently. This translates into an empirical approach that allows the material relations guiding de/reterritorialising practices to form the basis of adaptation geographies.

3. Encountering Timor

Situated in the Indonesian Archipelago, Timor-Leste comprises the eastern half of the island of Timor (Fig. 1). The now independent nation has a long history of colonisation and occupation. It was a colony of Portugal from 1702 until the overthrow of the *Estado Novo* regime in 1974. As Portugal began the process of decolonisation, regional anxieties about a new leftist state emerged and led to support for an Indonesian invasion, and consequent occupation from 1975 to 1999 (See Hägerdal, 2012; Fox and Soares, 2003; Gunn, 2005). It is estimated that, during the period of Indonesian occupation, between 102,800 and 183,300 Timorese died as a result of conflict, famine, and illness—with Indonesian forces accountable for 70% of the deaths (Steinberg, 2001, pp. 1–15). Independence was restored in 2002 following 2 years of transitional administration by the United Nations. Anti-independence

[1] This idea draws for Bruno Latour's concept of 'circulating reference' (1999). Like Vayda, Latour's research event can, from a point of departure, be traced 'out' across space and time (or as geographer Doreen Massey puts it, from the field to the lab). The main difference being, that circulating reference promotes a mode of investigation that can be followed back again, forming an ongoing series of relations to and fro that are emergent (produce new characteristics) across space and time.

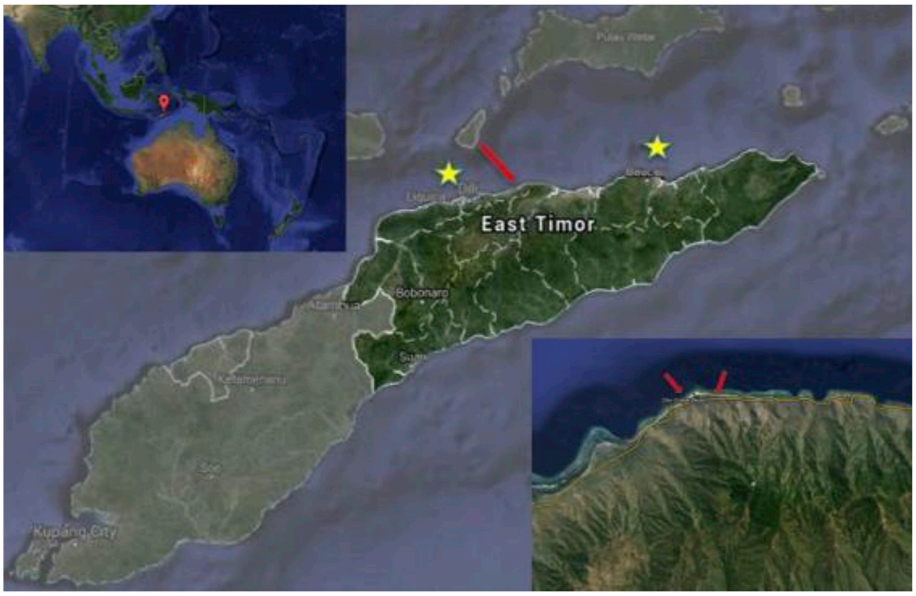


Fig. 1. Geographic location of Timor-Leste (red arrows indicate field sites).



Fig. 2. Residential Areas of the Field Sites.

groups remain active, following a series of conflicts and violent events by paramilitary groups in 2006 (Benetech Human Rights Data Analysis Group, 2006; Kiernan, B., 2007).

Timor now maintains a constitutional democratic system of parliamentary government, with a highly decentralised system of local government (Constitution of the Democratic Republic Of Timor Leste, 2002). After independence, the governance structure was organised around the boundaries of districts (now municipalities), sub-districts (now administrative posts), *sucos* (roughly based around the boundaries of pre-colonial kingdoms), and *aldeias* (village level). Governing representatives at the *suco* and *aldeia* level are referred to as *Chefe du Suco,* and as *Chefe Aldeia*.

Because of Timor's colonial histories, the impact of violence and displacement on traditional environmental knowledge (TEK) is important to research design. As the Timorese are traditionally an oral-based peoples, displacement from traditional lands has heavily impacted the retention of ancestral knowledge (Stead, V. 2012): experiences of violence have resulted in memory loss related to post-traumatic stress disorder (Silove and Liddell et al., 2014; Silove and Bateman et al., 2008) and the loss of family members during periods of conflict, has hindered intergenerational knowledge sharing. [II] Past conflicts are also responsible for an almost complete destruction of official documents and reports across the nation. The lack of meteorological data, for example, has resulted in Timor Leste now being heavily reliant on regional scientific reports produced by foreign research bodies to guide environmental governance (Pacific Climate Change Science Programme, 2014). These contexts present a number of methodological challenges. They draw attention to the importance of colonial contexts in adaptation research, and what geographer Emilie Cameron calls the 'remarkable oversight' in adaptation studies of colonialism's impact on environmental relations (2012, p. 104). On this basis, they also highlight the importance of ethnographic work that

supports local and traditional knowledge, self-determined environmental governance, and the reestablishment of local environmental records.

3.1. Locating the field

Reconnaissance for field sites focused on the northeast coast of Timor-Leste in the district of Manatuto. Of consideration was the relative lack of environmental research that has been conducted in the district, the vulnerability of low-lying coastal areas to flood, drought and tidal inundation, the potential for community participation, and the availability of supporting data and literature. Initial meetings were held with the *Chefe Aldeias* of Fatumeta and Behali in June 2013 (See Fig. 2). We discussed the proposed research aims of the project, participatory methods, including a period of consultation for research design, and an estimate of the time commitment needed from research participants. We also discussed the history and demographics of the villages (including language and literacy), and designed a list of potential research participants. The project aims were then discussed with the *Chefe du Suco,* an important step in gaining local participation, in shaping the project around community needs, and in aligning the project with local and district environmental governance.

There were some challenges with language identified at this stage. The two official languages of Timor Leste are Portuguese and Tetun. The traditional language of the area is Galoli (some participants also spoke Dadua). While most residents at the two field sites speak both Galoli and Tetun, approximately 15% of residents in Fatumeta and Behali have moved to the area from the capital Dili in the post-independence era and do not speak Galoli. Most residents that were over 60 and traditional to the area, however, did not speak Tetun. The decision was taken to use Tetun as the main research language, not because a majority of total participants spoke Tetun (as this was roughly also true for Galoli) but because no one translator had both Galoli and English (which I required). A second translator was used when required to translate Galoli to Tetun. This was far from ideal, but was a decision taken to avoid undertaking the majority of the work with two translators.

Because of the introduction of compulsory formal schooling to the area in 1982 (under the Indonesian occupation) most residents under 45 were literate. Yet, most residents over 60 (both those traditional to the area, and those that had moved to the area from another district) had oral-based knowledge and had not been subject to reeducation programmes under the Indonesian regime. This required a number of strategies, including: reading relevant information to groups and individuals during meetings in which written information was distributed; organising literate participants to be available to repeat and clarify this information at a later date to illiterate participants; the reading of information to illiterate participants, and the recording of oral consent where written consent forms were required, prior to interviews, focus groups, and workshops.

The research concept was initially presented to residents and *Chefe Aldeias* of both communities at a town meeting. Information, including a sample consent form, was then distributed in the Tetun language to further detail the proposal, and give potential participants time to decide (the steps outlined above were taken for illiterate attendees). There were several reasons why the project gained participation from the two communities. First (and maybe foremost) it gained the interest of the *Chefe du Suco* and the two *Chefe Aldeias*, each of whom expressed both serious concerns regarding the impacts of increased extreme weather events on the area, and frustration with central environmental governance. This resulted in various statements at the initial public meeting following my presentation giving their support and asking that members of the communities participate in the research. These requests appeared to be, for the most part, simply complied with. An understanding of why this occurred developed over the research as I observed (what I guessed to be a post-independence) 'culture of participation' built up through interactions with the United Nations, international peacekeepers and aid bodies, and the vast number of NGOs now working in the area.

Secondly, however, individual participants also expressed serious concerns about anomalous weather events, wanted to know why they were happening, and wanted support in adapting subsistence practices. While climate change was a familiar concept, the idea of a system (such as El Niño Southern Oscillation) being linked to drought and flood events was of much interest (the most common request made by participants was for copies of visuals that explained the coupled ocean-atmosphere system through which these events occur). The main interest for individuals in research participation was, therefore, in the investigation of adaptation practices, and the co-production of a local adaptation plan of action. The expectation by most, however, was that after participatory data collection, I would provide analysis and conclusions.[2] The process of building participatory research practices (past straightforward data collection) was met with both enthusiasm and disinterest.

3.2. Research design and method

I designed research methods in consultation with the two *Chefe Aldeias*, and a group of 5 community representatives. Informed by geographer Janet Nackoney et al's 'participatory process' (2013), potential research participants were nominated by the community representatives to create a distribution across different socio-economic groups. The process was sensitive to the investment of time by research participants, which would be time spent away from subsistence practices on which the communities rely. To address this concern, two intensive research stages were developed and carried out over a two-week period at each site. Table 1 of the distribution of research participants, shows a relatively even number of men (21) to women (22). The inclusion of a higher proportion of elderly participants (making up approximately one third of the total) provided a focus on local and traditional knowledge, place of origin, and pre-Indonesian histories. The distribution of participants also shows that over three quarters of participants were born on traditional lands.

Methods included a combination of individual and group interviews (43), participatory mapping workshops (3 – including 1 youth workshop), livelihood focus groups (5), observation of the main livelihood practices, seasonal calendars (4), and historic timelines (2). These were informed by participatory research with rural indigenous populations on the delineation of agricultural zones (Nackoney et al., 2013) and resource shortages (Cronkleton et al., 2010). Participatory mapping methods were informed by research on the impacts of environmental change on rural, subsistence communities (Jankowski, 2009), and the development of adaptive strategies in such communities (Kalibo and Medley, 2007) to investigate how drought and flood events are partitioned through the discontinuity of land use and natural resources. Mapping and interview methods were informed by arguments against positioning the subject as passive (Whatmore, 2002). Participants actively engaged with interview data in the mapping workshops where it was used to cross check and consolidate data on natural resources and adaptive practices. This was, in turn, informed by Dydia DeLyser and Daniel Sui's defense of mapping as a practice that is more-than-representational—the idea that 'today's maps are not simply used as illustrations [but] … are increasingly used as the medium to tell stories' (2014, p. 295). This was important to an investigation of environmental histories, as it allowed the cross-referencing of spatial and historical data. The approach was also designed to facilitate discussion of place-based knowledge, when travelling to the site in question was not possible. [III]

Interviews had three foci: socio-environmental histories; environmental change; and custodianship of subsistence resources. The first

[2] This expectation was, again, something I tied to the experience of post-independence interventions by various government/nongovernment organisations.

Table 1
Distribution of research participants.

Variable		Fatumeta	Behali	Total
Number of Participants	Male	12	10	21
	Female	11	12	22
Age of Participant	Under 18	3	3	6
	18–30	2	2	4
	31–40	5	4	9
	41–55	5	4	9
	56–70	3	4	7
	Over 70	5	5	10
Birthplace	Behali		5	5
	Fatumeta	3		3
	Mountain village	18	17	35
Livelihood	Wood harvester	2	7	9
	Fisherman	4	3	7
	agriculture	10	12	22
	weaver	8	12	20
	brewer	0	1	1
	Home duties	10	12	22
	Government	2	1	3
	Student	3	3	6
Education	literate	17	5	10
	illiterate	6	17	33
	primary school	5	5	10
	secondary school	5	5	10
	university	2	0	2

was investigated through oral histories and traditional stories; the second through impacts on livelihoods and property; the third through the identification of resources under custodianship (e.g. cultural keystone species and groundwater), everyday practices, and relationships to place. Once nominated, participants were approached to discuss the possibility of an interview. The details of the project were reviewed, and the process of written or oral consent for interviews discussed in detail. A separate consent process was followed in relation to child participants (facilitated by the Principal of the state school in Fatumeta), whereby written or oral consent was received from parents or guardians prior to youth interviews or workshops. All interviews were recorded on an audio device and guided by a questionnaire for comparison of data. Meteorological data was also used for comparative purposes where possible. [3]

Mapping workshops aimed to record the location and condition of key infrastructure, as well as natural, cultural, social, and economic resources. Focus groups were created to map economic and cultural resources specific to livelihood and cultural groups (e.g. fishing resources and women's cultural sites). Participants discussed access to resources, and the impacts of extreme weather events on these resources. Key historical data was added (e.g. boundaries of the communities under Indonesian occupation), as well as relevant data from interviews (e.g. the location of particular landmarks and places of origin). Participatory mapping methods relied on a combination of satellite images and GIS. Land use extended approximately two kilometers south of both villages (Figs. 3, 4, 6, 7), and areas used for fishing extended approximately eight kilometers west of Fatumeta (Figs. 5 and 6). This necessitated large base maps produced using satellite images, sourced from Google, at a scale of 1:200 ft. The use of satellite images was informed by geographer Janet Nackoney's use of this method to provide 'real world reference to locations of features on the ground … [and] a more efficient assessment of where ground data were needed' (2013, p. 172). While Nackoney transcribed data from hand drawn maps onto the satellite images (due to cloud cover), hand drawn data was instead entered onto the satellite images directly by participants, then transferred in the production of GIS images.

Historical timelines were completed at each site (Table 3) for the period 1980–2013. Participants discussed significant environmental events, hazards, impacts, and coping mechanisms. Seasonal calendars (Table 2) also traced weather events and subsistence practices by comparing a 'normal' year against observed changes. The information was recorded across a 12-month calendar and focused on the following features: seasonal and inter-seasonal rainfall over the wet and dry seasons; storm activity; storm surges and king tide events; planting and harvesting times for all regular crops; and fishing practices. Areas affected by events were added to the base map, along with associated degrees of concern. Both these methods were drawn from local climate adaptation projects in order to gain a better understanding of the scope and success of different methods in the local setting (Coral Triangle Initiative, 2013; The; Worldfish Center, 2012).

Youth workshop methods (based on those from The Worldfish Center, 2012) investigated intergenerational knowledge, including how participants imagined future land and seascapes. This was conducted over two sessions: the first involved 25 participants aged 14–17 years. Participants worked in groups to produce maps of future land/seascapes and areas of environmental concern. Youth participants were also involved in the resource mapping workshops, whereby participants cross-checked hand-drawn data produced in adult workshops, and were able to add data and make amendments. This method accounted for the different areas of land use used by youth participants for play, which were often outside areas of adult livelihood land use. A focus group of 6 youth participants was interviewed as a final stage to investigate environmental relations, as well as understandings of extreme weather events.

4. Results

Flying into Dili, the small north coast capital of Timor-Leste, involves an approach over the nation's notoriously impenetrable mountainous interior. It is a geography that has significantly shaped Timorese coastal relations. As anthropologist Andrew McWilliam (2007) notes:

> Timorese populations have tended to maintain an inward land-based orientation. Travel and movement beyond the highlands and mountains has been limited and circumscribed and it follows that there are no cultural traditions of *merantau* or long-range seafaring on Timor, unlike many other island societies across Indonesia (2002, pp. 6–7).

While Timor Leste does have coastal villages, these were mostly established during the Portuguese and Indonesian eras to exercise control over indigenous populations (Barnett and Campbell, 2010). The villages of Behali and Fatumeta are such examples, built in 1980 as internment camps for peoples forcibly displaced from their traditional lands under Indonesian occupation (interviews 2, 20). According to interviewees, this was a strategic act to disconnect residents of Timor-Leste's highlands from resistance fighters, and to relocate populations closer to Indonesian controlled infrastructure, such as electricity and roads (interviews 2, 19).

Because the area in which both villages lie is traditionally marginal land, it has not previously been included in land management practices. An elderly resident (born circa 1920 in an agricultural highland village called Mussium) recalls that 'the area was used for fishing. There were four fishing huts … but it was not a village. It didn't have a *Chefe Aldeia*' (interview 17). This means that the lands (and coastal waters) were not under traditional custodianship, or subject to customary law (Barnett and Campbell, 2010). It suggests the land was not suitable for agriculture (the main subsistence practice of the Bauhau subdistrict in which both villages lie). This is further supported by evidence that single crop agriculture has had limited success in the coastal environment, where land is more exposed to extreme weather. While residents

[3] Some meteorological data of the area was recovered from offices in Baucau by Australian peacekeepers, after the systematic burning of towns and villages by anti-independence groups in 1999, through which most records were lost. These are now held by the National Directorate of Meteorology and Geophysics, Dili.

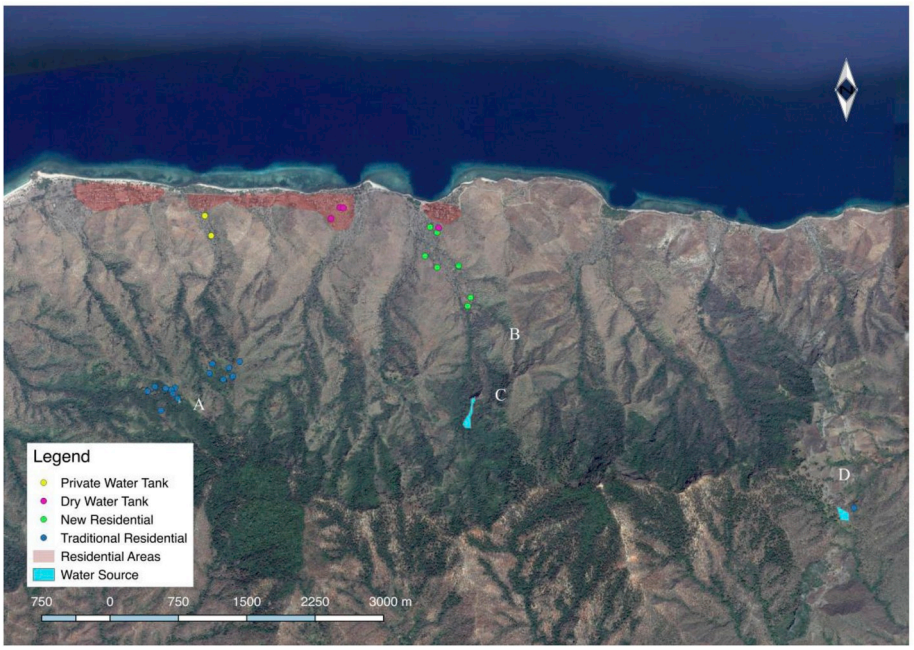


Fig. 3. Location of Water Sources: (A) seasonal water source; (B) seasonal water source; (C) seasonal water source; (D) perennial water source (based on the research participants hand drawn data from mapping workshops. See Table 1 For distribution).

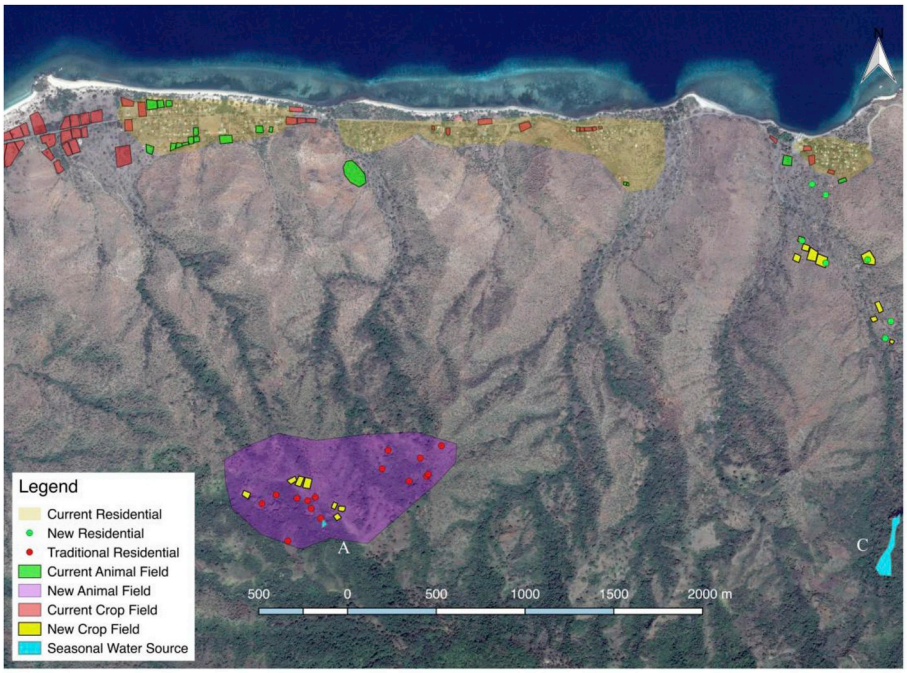


Fig. 4. Fatumeta: Changed Agricultural Practices (based on the research participants. hand drawn data from mapping workshops. See Table 1 For distribution).

have made many adaptations to the coastal environment (e.g. fishing as a subsistence practice), it is not surprising that in a post-independence landscape residents of both villages display an increasing socio-economic focus on the interior, evidenced through the reestablishment of highland practices (such as highland agriculture and hunter/gatherer practices), and participants' referencing of places of origin as a way of contextualising the coastal environment.[4] It is a development that illustrates what McWilliam calls 'a widespread Timorese disinterested orientation towards the sea' (2007, p. 8)'

This dis/orientation is intensified by extreme weather events. Those of most concern to the communities of Fatumeta and Behali relate to rainfall, with research evidencing changes to seasonal rainfall at both sites (Table 2). Residents agree that the wet season (December to April/June) is becoming increasingly unreliable, and that the height of the dry season (June to August) is hotter and dryer. As this coincides with high winds in August, the communities are increasingly subject to dust storms at this time of the year. Fatumeta is experiencing stronger windstorms from January to March, and June to July, with correlative increased damage to crops, housing, and animal stocks. And, both

[4] Many elderly participants, for example, use highland climate as a benchmark by which to understand the coastal climate, and environmental change (interviews 1, 2, 4, 6).

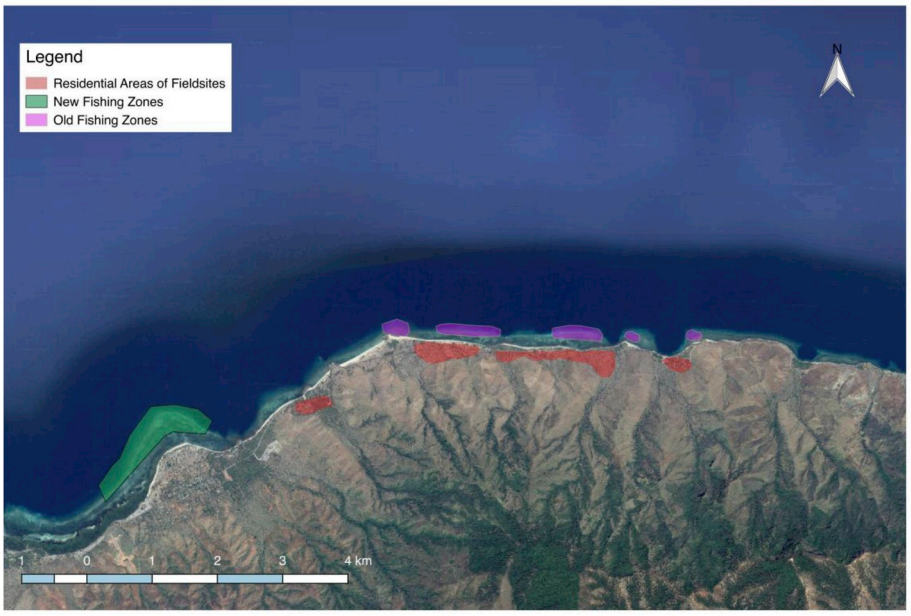


Fig. 5. Changed Fishing Zones (based on the research participants hand drawn data from mapping workshops. See Table 1 For distribution).

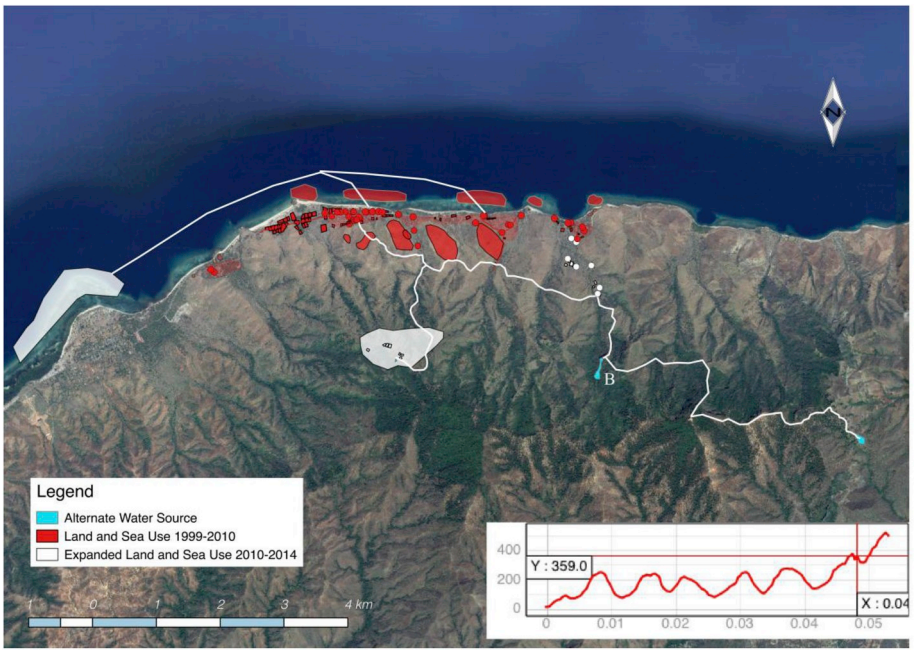


Fig. 6. Overview of Expanded Land and Sea Use (inset shows elevation of walking path between the village of Fatumeta and point B) (based on the research participants' hand drawn data from mapping workshops. See Table 1 for distribution).

communities experience an increase in the intensity of storms during the wet season.

The historical timelines conducted by research participants showed a relationship between ENSO phases (the La Niña and El Niño phases) and extreme weather events (Table 3). [5] Research also evidenced more flooding over the wet season, *during* El Niño phases (1982, 1986, 1992, 2006: See Table 3); as well as very severe flood events at the height of the wet season during a *weak* La Niña phase (2012, Barnett and Campbell, 2010). Most locally observed changes at the two field sites are in line with observed and projected regional climate data. These include changes to rainfall, and increased intensity and longevity of heatwaves (Pacific Climate Change Science Program, 2014, 2011; Kirono, 2010; Lasco & Boer, 2006). The evidence of environmental change that was specific to local research (i.e. not reflected in regional data) includes: the delaying of the wet season by 2–3 months in El Niño years; greater rainfall during the wet season of El Niño years; and heavier rainfall in the year following an El Niño event leading to flooding (e.g. 2005/6, Table 3) [6] Each village has a distinctly different

[5] The two phases of ENSO are La Niña, typically associated with increased rainfall in the western Pacific, and El Niño, typically associated with drought conditions in the western Pacific.

[6] Increased rainfall during the wet season of El Niño years is consistent with records of other northern areas of Timor Leste, including Baucau (the neighbouring district to the east of Behali) and Oecussi (an enclave in West Timor).

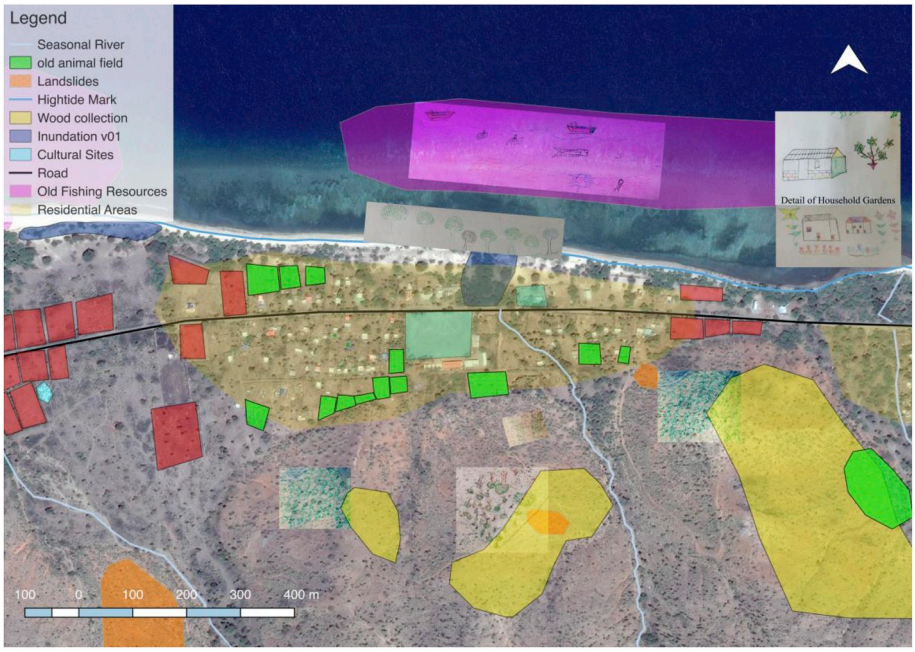


Fig. 7. Youth Mapping Workshop (based on the research participants' hand drawn data from mapping workshops. See Table 1 For distribution).

set of adaptive concerns: Fatumeta is more exposed to storms, and suffers from drought linked to lower rainfall and a prolonged dry season. Alternately, Behali is experiencing an increase in heavy rainfall during the height of the wet season that leads to flash flooding, and devastates the communities' infrastructure and resources. The remainder of this section discusses these drought and flood events, and the key adaptive concerns for each site.

4.1. Drought events in Fatumeta

Fatumeta's water supply consists of 6 water tanks that are located in the village and fed by nearby springs. Access to water tanks is based on a system of class, constructed around men's histories of participation in the resistance movement (1974–1999). On this basis, two of the tanks supply a small number of private homes, and at the time of research had no history of being exhausted over the course of a dry season. The four remaining tanks are for public use and in a 'normal year' (as defined in the Seasonal Calendar, Table 2) supply the village for most of the dry season (June to October/November). When research began in June '13 (the beginning of the dry season), however, the three public tanks were empty. Many residents, therefore, did not have access to water resources in the village and had to collect water from alternate sources (Fig. 4.; Interviews 4 and 5). This involves a return trip on foot of approximately 6–20 kms (4–8 h) over mountainous terrain. Up to 50 kg of water are carried on the return trip, which would last an average family one day. Fig. 4 shows four alternate water sources used in anomalous years for the collection of domestic water. Source A. is a seasonal source on the site of a, now uninhabited, traditional village. B. and C. are seasonal sources, and those most commonly used for water collection. When B. and C. are dry (typically by July), water is collected from source D., which represents a perennial source approximately 9 kms from the main area of the village.

Farming practices in Fatumeta have been severely affected by changes in rainfall and temperature, which have led to failed and damaged crops, and reduced feed for domestic animals (Table 2). Planting practices are the worst affected, as farmers can no longer rely on the start of the wet season. One participant states that:

> Rainfall is difficult to predict; different from when I moved here originally … Now I depend on looking for clouds on a daily basis to try and prepare or plan [for planting and harvesting] (Interview 1).

Anomalous rainfall has led many farmers to abandon their usual farming practices and plant spontaneously. Yet, as there is no clear pattern to changed rainfall, crops continue to fail. Table 2 shows that in Fatumata, planting and harvesting of their main crops—cassava, sweet potato, beans, and maize—has been disrupted by rainfall and temperature anomalies in November and December, and an increase in the intensity of wind storms in June and July. [7] With the increased unreliability of rainfall, residents are responding in a number of ways. For example, Fig. 4 shows a trend in new housing being built into the highlands, closer to water sources B. and C. As crops in coastal fields fail under drought conditions, new crop fields have been established closer to water sources A, and C. And, a new grazing area has been developed near water source A (Fig. 5). [8] These new land use areas also offer better protection from windstorm events.

Adding to the difficulties facing subsistence practices in the village, fishermen are also struggling with changed marine conditions. Livelihood focus groups evidenced reduced catch in the 'Old Fishing Zones' shown in Fig. 6. This is likely a result of reef damage from storm surges, local trade in coral, and increased runoff (of soil and other nutrients) onto the reef from areas of erosion caused by deforestation, and exacerbated by drought. Fishermen now travel between 4 and 8 kms west to fish. As traditional fishing boats are not motorised, this represents a significant increase in distance and time spent to access fish stocks. Fishermen were also very concerned about the risk from increasingly dynamic sea conditions, particularly as some fishermen can't swim, and no fishermen are in possession of safety equipment such as life jackets.

An overview of changed land and sea use in Fatumeta is represented in Fig. 7, showing the enormity of changes in access to resources over a period of 4 years. This change can best be articulated as an increase in

[7] In response to these changes, farmers in Behali are experimenting with planting and harvesting cassava and maize at different times of the year, by either planting spontaneously to coincide with anomalous rainfall, or to test theories of changed rainfall patterns (i.e. later rainfall in June, or earlier rainfall in September).

[8] While the water source A is not accessed for irrigation, participants state that there is more reliable rainfall in this area.

Table 2
Seasonal calendar: Fatumeta and Behali (based on seasonal calendar workshops).

Fatumeta	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Rain	2	2	3	3	3	3	3	3	2	2	0	1	0	0	0	0	0	0	0	0	2	0	2	2
Temp	2	2	2	2	2	2	2	2	2	2	3	3	3	3	4	4	4	4	4	4	2	3	2	2
Wind	2	4	1	3	1	3					0	4	3	4	4	4								
Swell/Surge	3	4	3	3	0	3															3		3	
Plant																					a, b		c, d	d
Harvest							c				b					d								
Behali																								
Rain	3	3	3	3	3	3	2	2	2	2	0	1-0	0	1-0	0	0	0	2	2	2	2	2	2	2
Temp											3	3	3	3	4	4	4	4	4	4				
Wind											2	4	2		3		2							
Swell/Surge	3	3	3	3	3	3																		
Plant													*		*		a-i	a-i				d		a
Harvest	b	e		d			d				b	b, g	b	b, g	b, g	g								

Normal year	Abnormal year	Key changes

(0 = none, 1 = mild, 2 = moderate, 3 = strong, 4 = extreme)
(a = cassava, b = sweet potato, c = beans, d = maize, e = banana, f = mangoes, g = oranges, h = coconut, i = guava)
(* = fields are prepared for planting)

the time spent and distance travelled to reach alternative resources, alongside patterns of movement away from the coast in residential housing, farming practices, and wood and water collection. Anthropologist Sandra Pannell has noted a similar case of coastal retreat in the far eastern Timorese district of Lautem, where communities are supplementing failing coastal agricultural practices with more traditional sets of hunter-gatherer practices in highland forests, stating that this 'enables local people to deal with chronic environmental uncertainty' (2011, p. 222).

Fig. 8 shows the environmental impacts mapped in adult workshops, combined with key features from maps produced in youth workshops. This comparison shows a difference in environmental relations between adult and youth participants, with the later imagining a more resilient coastal community, over a retreat to traditional lands. Key map features produced by youth participants overlapped with—and in many cases appeared to respond to—environmental impacts. These included: reforested hillsides to the south of the village (presently slopes eroded from wood collection and prone to landslides), the planting of coastal vegetation to inhibit tidal surges, and fluvial vegetation to stabilise seasonal river banks; regeneration of fish stocks in the old fishing zones; successful production of crops in old crop fields; and the successful planting of household gardens (see inset detail). What these imagined land and seascapes show—in contrast to adult interviews and workshops—is an absence of reference to highland areas, an investment in coastal adaptive strategies, and the restoration of crops and fish stocks (representing a reversal of environmental change). Another important feature of youth maps was the emphasis on, and integrity of, the football field and church grounds. These are important sites of play for youth participants, and are currently under threat from tidal inundation. This seems consistent with findings in Thornton and Manasfi (2010) regarding Mathare peri-urban adaptation where first generation participants are evidenced as adopting coping strategies for environmental change, while the second generation gives these strategies more institutional framing.

4.2. Flood events in Behali

The smaller village of Behali, which lies to the west of Fatumeta, has been subject to a series of devastating flood events. These have occurred due to a combination of geography, colonial engineering, and the increased intensity of heavy rainfall events. An increase in the intensity of rainfall events (not the frequency of events) is in line with climate change projections for Timor Leste (Pacific Climate Change Science Program, 2011; 2014). Typically, periods of heavier rainfall would occur in Timor during a La Niña phase of the El Niño Southern Oscillation, when warmer sea-surface temperatures move to the Western Pacific. Yet, the seasonal calendars and historic timelines produced in workshops in Behali show that the worst flood events are in fact occurring during the shorter wet seasons of El Niño years.

The geography of Behali makes the area in which the village is situated extremely vulnerable to flooding. Fig. 9 shows that the town is situated in a basin at the bottom of a crescent shaped catchment area of steep mountain faces, all of which funnel rainfall directly towards the village. The road that runs along the northern edge of the village is raised and acts as a wall that traps flood waters in the village. On the northern side of the road is an area increasingly subject to tidal inundation during December and January, coinciding with the height of the wet season. During a flood event, therefore, the village is often facing two fronts of water—one from the sea and one from the mountains. Describing a flood event in December 2012, one participant recalls that:

> The flood … damaged all of our plants. There was no warning prior to the flood. We were at the neighbours … and then there was heavy rain and wind. The children came running to the house to tell us that it had started flooding. We started digging [trenches] to drain the water (interview 24).

Another participant states that it was approximately ten minutes between the point children first noticed the flooding, and the submersion of the village under approximately 1.5 m of water. All the domestic animals were drowned, many of the corrugated iron roofs were damaged, and residents were evacuated to Fatumeta by the military (interview 23). Rather than understanding these events as driven by external weather events, research participants understood the flood as originating inside the village, around a Portuguese era culvert that runs under the main road (see Fig. 9, and Culvert A, Figs. 8, 9). The culvert pre-dates the establishment of the village, its main function to divert water from one of three seasonal rivulets away from the road. During heavy rainfall, it is the first point at which flood waters collect, with rubbish accumulation and the changed intensity of rainfall exacerbating the problem.

While the residents of Behali do not maintain traditional custodial practices over the water cycle, many research participants made sense of flooding through traditional beliefs. Participants understood these events as connected to, and indeed driven by, the ancestral landscape through an interplay between human acts, agential things, and ancestral ghosts (interviews 1, 27; historical timeline, livelihood workshops). This cosmology does not separate the internal and external world: flooding is seen as a direct manifestation of poor human-ancestral relations. One adaptive response has been to improve these relations through the identification of key points in the flood-scape where forces are seen to converge, such as the perceived points of entry, activity, and extent, of the flood waters. Bottles of holy water are used as place markers. The culvert is a central point, with other key areas identified along waterways (e.g. areas where flood water broke the banks), and in people's homes or gardens (e.g. marking the height of the flood waters). These points become the focus of traditional and appropriated practices aimed at improving environmental relations.

It is also significant for the participants that the culvert, around which the flood events are understood as originating, is a structure of colonial engineering. One participant contextualised the increased intensity of the flood events as a post-independence problem, yet one that is likened to experiences of colonial violence. The devastation caused by recent flood events is set in opposition to the progress of state building, and described as a series of trials that result in 'moving forward and then moving back' (interview 20). In addition, environmental events have at times coincided with violent attacks on the communities, or the community's recovery from these attacks. For example, the para/military conflicts in 2006 coincided with the recovery from severe storms in 2005, and flooding in 2006. This has strengthened associations between military and environmental violence for many participants (Table 3).

Tidal inundation in Behali was also identified as a matter of concern. Like flash-flooding events, inundation coincides with the height of the wet season and increased storm activity in December and January. Inundation threatens two cultural sites, as well as an *acadera* tree plantation (used for weaving), and an area of sea turtle breeding (Figs. 8, 9). [9] While there are many similarities between the scale, timing, and characteristics of storm surge and flash-flooding events, there is no evidence that participants interpret tidal flooding within the same custodial landscape, or with the same degree of concern for human-ancestral relations. And, while the events are evidenced as part of post-independence environmental change (and therefore might be associated with flood events of the same period), they are instead explained with reference to the changing character of *tasi feto* (the North Sea) (historical timeline workshop, Behali; livelihood focus groups: fishing, wood collecting, farming, women's traditional crafts). This points to an understanding of the sea as a self-contained entity that is connected to, but also distanced from the messy relations of rain water. It is a conceptual distance that for me felt disproportionate to the width of the road, which was (when these events coincide) the only object separating tidal and flash flooding (Figs. 8, 9).

The development of adaptive practices that favour the relocation of crops and livestock to the highlands, over the construction of seawalls, or the moving of crops to higher areas on the western side of the village, also points to a logic of retreat from the sea, consistent with the adaptive practices that have developed in Fatumata. The perceived safety and reliability of the highlands are well evidenced in adult interviews and workshops. During flood events, many residents in Behali have taken refuge in the same areas they used to hide from Indonesian forces, reinforcing ideas of the coastal environment as hostile, and the highlands as a safe place. (interviews 23, 24, 27). In her work in eastern Timor Leste, anthropologist Sandra Pannell finds a similar parallel between the

[9] *Acadera* tree plantations are an important primary resource used for fencing, small-scale commercial brewing, and the production of traditional woven products that are sold (via NGOs) to international retail markets.

Table 3
Historical timeline of extreme weather events (based on historical timeline workshops).

Event date	1982		1986		1992		1999		2005		2006		2012		2013	
Season	wet		wet		wet		dry		dry		wet		wet		dry	
ENSO Phase	-very strong El Niño		moderate El Niño		moderate El Niño		moderate La Niña		weak El Niño		weak El Niño		weak La Niña		weak La Niña	
Weather event	-heavy rain -flood -landslide		-flood		-heavy rain -flood		-fire		-lightening storm -less rain		-heavy rain -flood -landslide		-flash flood (December)		-unseasonal rainfall (June to August)	
Impacts: Behali	-crop loss		-flooding inside houses > 1 m -animal loss		-flooding inside houses > 1 m -animal loss				< 5 crop/tree loss		> 10 animal loss -flooding inside houses > 1 m -animal loss		-flooding inside houses > 1 m		-delays in planting/harvesting	
Impacts: Fatumeta	- water pipes blocked		-water pipes blocked		-flooding inside houses > 1 m						-water pipes blocked		-water pipes blocked			
Contributors	- rubbish in waterways - Portuguese culvert		-rubbish in waterways - Portuguese culvert				-low rainfall (May to September)				-rubbish in waterways		-rubbish in waterways		-weak La Niña cycle	
Adaptive practice											-refuge in the mountains		-evacuation -rebuilding		-refuge in the mountains	

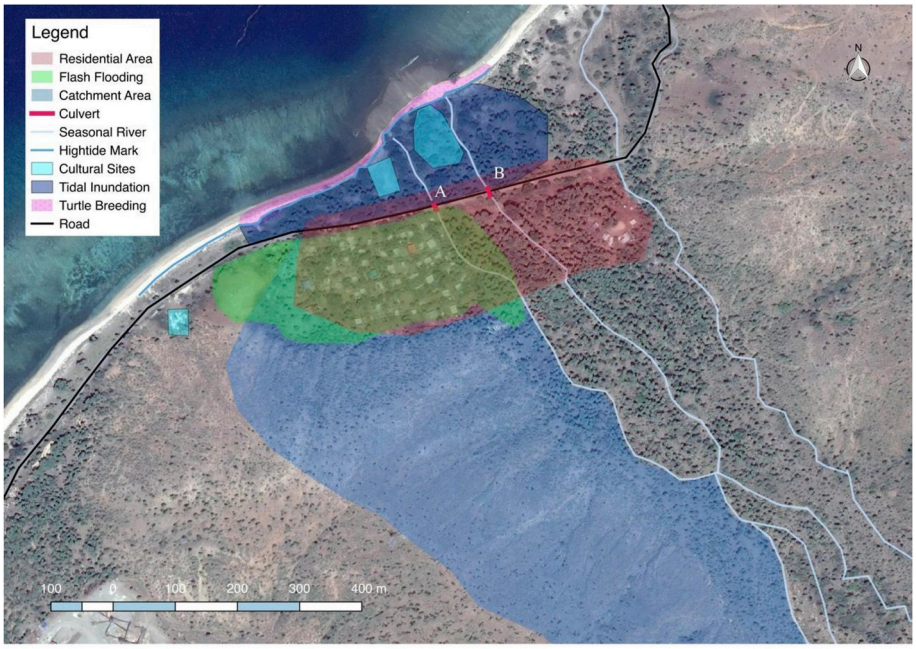


Fig. 8. Behali Flash-Flood Event (based on the research participants hand drawn data from mapping workshops. See Table 1 For distribution).



Fig. 9. Portuguese-era culvert, Behali (photograph taken by the author 2013).

reemergence of highland hunter-gatherer practices as an adaptive response to environmental change and experiences of the Indonesian occupation that, for so many Timorese has been 'mediated by their experience of 'running to the forest' and 'hiding in the mountains''(p. 230).

5. Discussion

There are two main defining features of adaptive practices in Fatumeta and Behali: the reduction of distances between residential areas and subsistence resources; and a retreat to highland areas perceived as safer, more reliable environments. This section will discuss these features in relation to two questions: how do ENSO events territorialise land and seascapes in Fatumeta and Behali?; and how do adaptive practices also embody and delineate these events? [10] These questions investigate the de/reterritorialising processes of climate impacts and adaptive responses. In the context of the research, I interpret

[10] I use the term territorialisation with reference to the concepts of de/re-territorialisation as defined by Gilles Deleuze and Félix Guattari (1984). Through this concept acts of colonial and environmental violence are positioned as events contributing to a deterritorialisation—a breaking down of —place-based culture and identity. The embodiment and partitioning of environmental events might also be positioned as acts of reterritorialisation—a reconstruction of—place-based culture and identity. Deleuze and Guattari conceive of physical territory as a reference point for the fluid and ongoing relationship between these two states.

these to be constituted through a coupled relationship between the deterritorialising effects of extreme weather, and the reterritorialising acts of adaptation (conceptualised through human-environment relations and bodily movement).

5.1. Territorialisation of the adaptive environment

Anthropologist Judith Bovensiepen (2014) describes the animistic cosmology of the Timorese as one of 'collapsed bodily boundaries', where nonhuman things in nature are conceived as not only a part of human society, but as agents in that society, and where nonhuman things can be embodied by people and vice versa (p. 133, 2014). Environmental change, therefore, represents not only a physical territorialisation of the land and seascape, but of people's community, bodily and spiritual relations. This is reflected in participants understandings of environmental change, with the two main rationales centred around environmental relations. Participants understand anomalous weather events as caused by interruptions in custodial practice and, consequentially, the independent agencies of ancestral beings.

Research evidenced particular materialities within drought and flood events—such as dust, heat, and floodwater—that articulate ancestral relations and their territorialisation of the coastscape. Drought events produce a fine dust that is evidenced as one of the most debilitating everyday effects of drought conditions—penetrating and persisting in every structure, body, and object for the duration of the event. Higher temperatures during the dry season of El Niño events have the effect of both confining and displacing people. They reduce people's ability to work (this was mentioned by women in particular who are unable to care for their children in their homes during the day) and they force subsistence practices inland, and closer to source springs. Floodwaters are comparably invasive, entering people's homes, destroying property and livelihoods, and displacing people and practices to the highlands. Participants query the logic of the floodscape, using markers at points of convergence by way of analysis, in efforts to understand the cause of the event. These materialities are described by interviewees as occupying the communities in similar ways to their internment during the Indonesian era. Extreme weather events dictate where people can go, what they can do—and when—and occupy their very bodies, reproducing the effects of physical and psychological violence experienced under colonial occupation. These environmental events constitute a deterritorialisation of the postcolonial land/seascape that is ongoing, and made sense of in militarised terms.

Yet, these events are rationalised within traditional frameworks, where the meetings of ancestral spirits and custodial elders define environmental conditions. The particular focus of these relations in Timor Leste is the custodianship of groundwater. The systems of underground rivers in Timor are part of a complex network of relations believed to control rainfall and groundwater. As anthropologist Lisa Palmer explains, traditional concepts of the water cycle are organised around a number of 'source springs', each entrusted to a traditional owner who, as custodian, maintains a sacred totem house (*uma lulik*) at the site of the spring and performs regular ceremonies and sacrifices to ensure the health of that spring (2011, pp. 144–145). Fatumeta's water is supplied by such a source spring (Fig. 4. Source A) and managed by female elders who maintain an *uma lulik* at the site. Corresponding with Palmer's accounts, the spring is described as highly responsive to human acts—even if these acts are performed unconsciously. One participant states that:

> The water at the [source spring] is dangerous, because when people go there to collect the water, rain always falls. If visitors to the sacred place walk home calmly then rain will fall normally. Yet if people run from the sacred site this encourages storms and heavy rainfall [leading to the danger of flash floods] (interview 5)

This illustrates a complex set of relations in which a person's bodily actions can control environmental events. When anomalous events occur, therefore, people's actions are called into question. This is increasingly so as extreme weather events become more frequent and more intense.

Yet, water systems are also perceived to have an agency and political will of their own. An historical example is given by Palmer of a drought in 1999 that hindered the Indonesian occupation of certain coastal areas, and was understood by local communities in Behau as ancestral involvement in the resistance (Palmer, L. 2011). This belief that the ancestral landscape can act independently is very important because contemporary environmental change can also be understood as an attack on the communities *by* ancestral spirits. This suggests that while custodial practices are seen to maintain good ancestral relations, there are limits to their influence. Most importantly, while responses to extreme weather events are influenced by histories of colonial violence (e.g. concepts of resistance and defense used to make sense of events) these acts of environmental violence signify a breakdown in ancestral relations, indeed an act of ancestral violence, that *coincides* with what the vast majority of Timorese feel is the great victory of independence (1999).

In summary, the ancestral landscape is experienced as controlling extreme weather events, either in response to the discontinuity of custodial practice, or as an unexplained act of violence. Understanding these events through an animistic worldview in which humans cannot be separated from natural actors positions the communities of Fatumeta and Behali as simultaneously responsible for, and victims of, climate change. From this standpoint, the communities themselves are inseparable from climate drivers like temperature and rainfall, and the materialities of dust, heat and floodwater that follow. Yet, this also means they are somehow complicit, *as* these materialities, in the deterritorialisation of the adaptive environment in which they live.

5.2. Delineation of ENSO events through adaptive practices

Adaptive geographies at the two field sites can be broadly defined by two features: greater distances between residential areas and subsistence resources; and the coastal retreat of subsistence livelihoods such as grazing and agriculture. These geographies are further defined through two main practices: walking and fishing. These practices evidence the communities increased area of land/sea use, and are distinctive in their elevation, distances away from the coast, and closeness to traditional resources (see Fig. 6). The way each practice is embodied not only gives insight into human-environment relations, it produces them, and in so doing forms a reterritorialization of the adaptive landscape around these relations.

Walking practices act to partition changing hydrographies by tracing the path of rainfall and groundwater underfoot. Paths take form around seasonal and subterranean rivers, following them uphill in the reverse direction of flow from lowland to highland. They are punctuated by water tanks, pools, and springs, which form a series of checkpoints. It is a physical and psychological practice that, through the embodiment and exchange of bodily heat and water, marks the periphery of the drought event. Anthropologist Lye Tuck-Po's study of Batek hunter-gatherers in Malaysia contemplates walking practices as 'a set of culturally developed adjustments to constraints on climate, environment and geography' (2008, p. 22). As is the case in Fatumeta, the walking tracks used by the Batek are defined by the time and distance between the village and resource; the resource is reached via a number of short cuts that 'carve' out the shortest route. The path's form also shapes the psychological experience of walking. As Tuck Po notes, one cannot think of the journey forward without also thinking of the journey back (p. 26). Yet, at the same time, the concepts of path and movement are closely related. Indeed, the act of walking *creates* the path (Tuck Po, p. 23). These practices are closely related to concepts of territory and territorialisation. As Andrea Brighenti notes:

> …most First Nation cultures reject the image of their land as a

> bounded entity, regarding it as a composition of paths, trails, zones … For nomad hunters, the territory is in the first place a potential for movement…land is neither owned nor occupied, but rather crossed. (2010b, p. 219)

Yet, the act of walking does more than trace movement, or the parameters of the drought. For the research participants it is an act of emergence where forces come together, through foot and earth, to generate the resource itself. The radical connection between a custodian and the water cycle means that the way one moves, also moves water. In this sense, walking delineates water resources because it is an act of both following water, and—in the custodians' case—being followed by water.

Fishing practices share many of the adaptive characteristics of walking practices in the two field sites. That is, changed fishing practices are a complex assemblage of environmental relations, played out in the pursuit of a critical resource that is shifting, retreating, and (by some accounts) disappearing. The decreased fish stocks near the village mean fishermen are now travelling further (both away from the village and out to sea) in search of reliable fishing areas, and spend more time overall fishing than previously (Figs. 6 and 7). Geographer Jessica Lehman's work on fisherfolk in Sri Lanka observes similar adaptive practices in response to ocean warming and a decrease in fish stocks (2014, Figs. 3 and 5, pp. 251–252). The fishing routes in this study also respond to coral reef damage that has occurred as a result of ocean warming and changes in rainfall (nutrient runoff), and to changed sea conditions from increased storm activity.[11] In these contexts, new fishing routes act to delineate the boundaries of environmental change over space; yet, the reduced capacity to fish due to rougher seas also delineates environmental change over time through an absence of fishing; with shorter fishing seasons and a growing retreat from the practice altogether (Table 2).

All these conditions meet in the bodily practice of fishing. The journey itself is more physically demanding, requiring the negotiation of deeper and more dynamic waters, and the longer distance between village and resource. Where industrial fishing technologies act as prosthetic extensions of the body (replacing the need to enter the water), traditional fishing techniques are characterised by low technologies such as free diving with spears, nets and torches. Like water gatherers, fisherman are physically immersed in these changed conditions, delineating changed marine conditions through their bodily movements.

The changes in walking and fishing practices evidenced through this research constitute what Thomas Thornton and Nadia Manafsi call 'spontaneous adaptation … a blind process that can be viewed as 'rational' only in hindsight'. [12] The logic of spontaneous adaptive practices is that they can follow dynamic resources in a changing environment. Yet, it is not simply the action of moving, but the interactions with material communities along the way that establish these practices as part of the event itself. The importance of changed walking and fishing practices to the process of conceptualising adaptive geographies is that they trace the discontinuity of resources (spring water, fertile agricultural land, and fish stocks), and by so doing also delineate the materialities of rainfall and temperature to which these resources respond. I suggest it is on this basis that such practices engage with materialities of climate that cross the land-sea divide, and work to delineate the terrestrial boundaries of ENSO events. It is an approach that is in opposition to the terra/anthropocentric geographies of conventional adaptation approaches. Yet, it is also a method of delineation, one that reflects the environmental relations of the research participants, and on this basis I suggest should inform the conceptualisation of local adaptive geographies in governance frameworks for developing, postcolonial regions.

6. A decolonial approach

Conventional adaptation frameworks are typically conceptualised around a human-terrestrial centre. I have suggested that this is a fallacious concept: climate systems are ocean centric, and it would be more representative of human-environment dynamics to conceptualise human communities on the periphery of climate systems such as ENSO. Yet, rather than 'recentering' geographies of adaptation around oceanic communities, the aim of the research outlined in this paper is to conceive of an adaptive geography that gives greater weight to the spatialities of human-environment relations—relations that *connect* oceanic and terrestrial environments. [13] These more dynamic ways of conceptualising ENSO events are made possible because they are informed by traditional animistic beliefs that allow for a conceptualisation of temperature and rainfall as embodied communities. By experiencing extreme weather events as both internal and external forces, the participant communities connect and respond to the much larger ocean-based systems with which they are living. I suggest that this occurs, whether the oceanic components are part of the conceptualising of the event or not, for the reason that participants make the spatialities of the event (discerned through careful observation, experiment, and traditional environmental knowledge) central to their adaptive approach.

This speaks in favour of a decolonial approach to adaptive strategies. This conception of environmental relations does not seek to make climate events fit, spatially, around human communities or preexisting management regimes. Instead, the communities are adapting around the changed environment. It is important to note, however, that while there might be strategic reasons to do so—for example the inherent sustainability of the approach—this may not be entirely due to 'better' ways of understanding human-environments relations. A subsistence community is entirely reliant on local resources and, one could argue, has no choice but to adapt around the delimitations of these resources. Furthermore, a more fluid (i.e. characterised by greater movement) adaptive approach is also problematic in a postcolonial context, where human movement is associated with the violence and loss of displacement.

I argue, however, that there are also strong ethical reasons for letting traditional ecologies form the bases of adaptation geographies in postcolonial nations. First, the geopolitics of greatest vulnerability to climate change overlays the geopolitics of postcolonialism—that is, both are concentrated in polar and equatorial regions. The parallels drawn between the violence of extreme weather, and the violence of colonialism highlight the importance of decolonising adaptation governance frameworks and practices. Secondly, traditional peoples have radically different ways of understanding human-environment relations, and of delineating those relations. An approach that reflects these relations in its boundary-making practices may be easier to implement. On this point, the territorialising practices of the research participants offer a methodology for delineating adaptation geographies around the discontinuity of subsistence (but potentially other) resources. Importantly, this approach also responds to an ethical dilemma: International and regional governance frameworks can impose methods of boundary-making and systems of governance that are incompatible with the geographies of traditional ecologies. They are, by definition, interventionist projects that exacerbate the complexities of self-determination, and worse, impose Westphalian epistemologies of nature

[11] Changes in temperature and rainfall effecting reefs include ocean warming and increased sediment deposits as a result of drought related forest dieback, deforestation, and the increased intensity of heavy rainfall events (Pacific Climate Change Science Program, 2011; 2014).

[12] Thornton and Manasfi advocate for autonomous, local, adaptation, which they argue is often neglected in favour of 'planned' adaptation 'fueled by a progressivist, 'techno-fix' bias' (p. 133).

[13] While temperature is not a community of 'things', heat can still form a link between things of a common temperature.

which in itself is implicitly neocolonial. While international aid seems unavoidable given current climate change projections, I argue strongly for a reconceptualisation of adaptive geographies that are not simply 'informed by' traditional environmental knowledge, but whose spatialities are built around traditional human-environment relations.

7. Conclusion

El Niño Southern Oscillation is a coupled ocean/atmosphere system in the equatorial Pacific, centred around an area of the open-ocean and deep-sea many thousands of kilometers from Timor Leste. Yet, the parameters of the system are not sufficiently illustrated through its oceanic or atmospheric boundaries, nor through terrestrial events like flood and drought. The participatory research outlined in this paper suggests that through the embodiment of the material communities that make up ENSO events, human communities become an extended part of the oceanic system. In animistic terms, the bodily boundaries between human/land and nonhuman/ocean break down. From this position, adaptive practices elucidate relational connectivities that act to partition a more-than-human oceanography.

Reading the adaptive landscape through local and traditional concepts is an act of decolonisation that challenges the legitimacy of expert knowledge, and responds to a long history of devaluing local and traditional knowledge and practices by colonisers and occupiers. More recently, though, it is the Western institutional involvement in transitional governance and international aid that have undermined the validity of traditional knowledge among research participants; and it should be considered to what extent institutionalised Westphalian epistemologies of nature could constitute a form of cultural violence that undermines the development of effective institutional approaches to adaptation. The closer, more embodied, engagement with the environment evidenced by research participants shows a conceptual and strategic agility to respond to environmental change. I suggest the strength of this approach is the flexibility with which it takes nonhuman agencies into account. The advantage is in the recognition of a radical connectedness and dynamism in human-nonhuman relations that shapes the territorialisation of the adaptive environment.

These emerging relations are distinct from what anthropologist Peter Rudiak-Gould has called 'promiscuous corroborations'; his analysis that Marshallese Islanders use climate events and climate science to corroborate already existing biases or beliefs (2013). Climate events in coastal Timor Leste are instead disrupting and challenging environmental relations that have been fundamental to acts of post-independence self-determination Yet, the appropriation of new ideas into traditional frameworks is one shared aspect of the two settings. Ancestors can be playing politics with the groundwater *and* the drought is connected to El Niño Southern Oscillation. These are sets of concepts that are not necessarily comfortable with one another in Western science, that in an institutional setting might be irreconcilable. Yet, here they are active contexts embodied in everyday practices that redefine the adaptive landscape in terms of new social, spiritual and material relations.

Declaration of interests

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