

# Experimental dataset of sandwiched baroclinic flow over a bottom conical plate

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## I. OVERVIEW

This dataset comprises time-resolved, two-component horizontal velocity fields from twelve experiments in a rotating, differentially heated fluid annulus. The experiments were conducted at the GFDLab, University of Oxford.

The working fluid was seeded with neutrally buoyant Pliolite particles. An illumination system, consisting of three annular LED light sheets at fixed heights ( $h$ ) from the bottom plate, was used to light specific measurement planes. A corotating camera, aligned with the axis of rotation and mounted above the annulus, recorded particle images to eliminate mean background rotation.

The image sequences were processed using the multi-step cross-correlation approach in the PIVLab toolbox in MATLAB (<https://www.pivlab.de/>) to compute the two-dimensional, two-component (2D2C) velocity vectors, which constitute the primary data in this repository.

## II. DATASET CONTENTS

TABLE I. Parameters for the cases studied

File	Rotation rate ( $rad\ s^{-1}$ )	Heating power (W)	Temperature contrast ( $^{\circ}\ C$ )	Number of fields	Duration
0p05rads.tar.xz	0.050	206.7	12.3	1000	
0p08rads.tar.xz	0.080	206.7	11.7	1000	
0p13rads.tar.xz	0.13	206.7	12.0	1000	
0p18rads.tar.xz	0.18	206.7	12.4	1000	
0p30rads.tar.xz	0.30	206.7	12.6	1000	
0p41rads.tar.xz	0.41	206.7	12.7	1000	
0p56rads.tar.xz	0.56	206.7	12.5	1000	
0p80rads.tar.xz	0.80	206.7	12.5	1000	
1p14rads.tar.xz	1.14	206.7	12.2	1000	
0p13radsP106W.tar.xz	0.13	106	10.3	1000	
0p18radsP106W.tar.xz	0.18	106	9.0	1000	
1p14radsP106W.tar.xz	1.14	106	8.8	1000	

The compressed dataset contains 12 files delivered in .tar.xz format with filenames and the experimental conditions shown in TABLE I.

- Contents in each archive:

Three NetCDF (.nc) files, one for each measurement height (distant from the flat bottom):

Level 1:  $h = 0.12$  cm

Level 2:  $h = 0.18$  cm

Level 3:  $h = 0.23$  cm

- Data in each .nc file:

Grid Coordinates: 1D arrays for  $x$  (size: nx) and  $y$  (size: ny).

Time Vector: 1D array  $t$  (size: nt).

Velocity Data: Two 3D arrays (size: [ny, nx, nt]) for the horizontal velocity components  $u$  and  $v$ .

TABLE II. Parameters for the cases studied

Variables	Dimension	Size	Unit	Description
$x$	1D	nx	m	Positions of 2D field grid points in x-direction
$y$	1D	ny	m	Positions of 2D field grid points in y-direction
$t$	1D	nt	s	Time stamps for velocity field
$dt$	1D	nt-1	s	Time difference for subsequent velocity fields
$u$	3D	[ny,nx,nt]	$\text{m s}^{-1}$	Horizontal velocity in positive x-coordinate direction
$v$	3D	[ny,nx,nt]	$\text{m s}^{-1}$	Horizontal velocity in positive y-coordinate direction

An exemplary MATLAB code is provided in the repository for reading the data and plotting vorticity. Run MATLAB script ‘main.m’, which call the function ‘readNetCDFVariable’ to generate vorticity contour plots for the selected cases and height levels.

### III. MOVIES

Supplementary movies include examples for animations of the relative vorticity field for  $Ro_T = 5.41$  and  $Ro_T = 0.03$ . The movies are played at 80 times the original recording speed.

### IV. ACKNOWLEDGMENTS

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