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## Comparison between non orographic gravity wave drag parameterizations used in QBOi models and Strateole2 constant level balloons

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Gravity Waves (GWs) parameterizations from 14 General Circulation Models (GCMs) participating to the Quasi-Biennial Oscillation initiative (QBOi) are directly compared to Strateole-2 balloon observations made in the lower tropical stratosphere from November 2019 to February 2020 (phase 1) and from October 2021 and January 2022 (phase 2). The parameterizations span the 3 leading edge techniques used in GCMs to represent subgrid scale non-orographic GWs, the two globally spectral techniques developed by Hines (1997) and Warner and McIntyre (1999) respectively and the "multiwaves" approaches following Lindzen (1981). The input meteorological fields necessary to run the parameterizations offline are extracted from the ERA5 reanalysis and correspond to the instantaneous meteorological conditions found underneath the balloons. In general, the amplitudes are in fair agreement between measurements of the momentum fluxes due to waves with periods less than 1 hr and the parameterizations. The correlation of the daily values between the observations and the results of the parameterization can be around 0.4, which is statistically significant elevated considering that we analyse around 1200 days of data and quite good considering that the parameterizations have not been tuned: the schemes used are just the

standard ones that help producing a Quasi-Biennial Oscillation (QBO) in the corresponding model. These correlations nevertheless vary considerably between schemes and depend little on their formulation (globally spectral versus multiwaves for instance). We therefore attribute this agreement to dynamical filtering, which all schemes take good care of, whereas only a few relate gravity waves to their sources. Except for one parameterization, significant correlations are mostly found for eastward propagating waves, which may be due to the fact that during both Strateole 2 phases the QBO phase is easterly at the altitude of the balloon flights. On the other hand, statistical properties, like pdf of momentum fluxes seem better represented in spectral schemes with constant sources than in schemes ("spectral" or "multiwaves") that relate GWs to their convective sources.

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