

Comparison between non orographic gravity wave parameterizations used in QBOi models and Strateole 2 constant level balloons

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This document describes how to run the 12 parameterizations used in the article and compare the outputs to the Strateole 2 Observations.

Funding information

Getting the files

To run the models parameterizations in offline mode and compare with daily values of momentum fluxes measured during strateole 2, download the file `offline_v9_Strateole_QBOi_Open.tar`, on the web page:

```
wget https://web.lmd.jussieu.fr/~flott/DATA/offline_v9_Strateole_QBOi_Open.tar.gz
```

Then gunzip and do `tar -xvf offline_v9_Strateole_QBOi_Open.tar`

In the directory, `offline_v9_Strateole_QBOi_Open`:

run subdirectory

contains the scripts that compile the programs, link to the input dataset and produce various outputs. The Makefile certainly needs to be adapted to the computer.

To launch predictions for Strateole-2 phase 1, launch: `./laun_ph1ball_gwd_era5.sh` For phase 2, `ph1→ph2`.

prog subdirectory

contains all the fortran routines that launch the parameterizations used in 11 QBOi model, except WACCM. Namely:

laun_gwd_era5.f90: Main program loading input data in netcdf format and calculating drag and momentum fluxes at the balloon place.

preci_gwd_LMDz_QBOi.f90: LMDz Multiwaves routines predicting gwdrag from precipitation

gwsat_Modnam.f90: the globally spectral scheme using the ?'s scheme version by J. Scinocca.

hinesgw6g_plus_subs.f HDS scheme

gw_ussp_core.f90: The WMI scheme with amplitude keyed to precipitation used in some UMGA7gws runs.

gwwcalc.f90: Multiwave scheme developed for HadGEM2 at YONSEI's university

hourly_ph1(2)

contain all the input data for phase 1 and 2 respectively.

STRATEOLE2 hourly values of momentum fluxes are in

`ALL_STRATEOLE2_Balloon_ph1_1day15min.nc`

and

`All_STRATEOLE2_Balloon_ph1_1hrs15min.nc`

for the waves with periods between 1day and 15mn and between 1Hr and 15 mn respectively.

ERA5 reanalysis and forecast products, which include winds temperature, cloud liquid and ice water, diabatic heatings, precipitation, surface log pressure, over a $5^{\circ}\times 5^{\circ}$ domain centered at the balloons drifting locations are in

`Input_ERA5_data_all_variables_balloons_ph1.nc`.

For phase2, `ph1→ph2`

output_ph1(2)

contains output subdirectories

Netcdf: contains the output of the schemes in netcdf format on the vertical column and over the $5^{\circ}\times 5^{\circ}$ domain over which the ERA5 data are provided. There is one netcdf dataset by balloons flight each contains output from all the schemes.

Balloon_alt After post processing by the python scripts `launch_script_obs.py`, are extracted the MFs at balloon flight altitude.

python_script

A serie of Python scripts to compare the outputs of the scheme to the balloon data and produce curves and statistics: correlations, pdfs

launch_script_obs.py: Reads the balloon flight data of MFs and averaged over 1day and write them in text format (ending with '.dat') and stored in **output/Balloon_alt/obs_output_Balloon_altitude/**

launch_prediction_eachB_ysei.py: extract from the prediction the values of the MFs at the balloons place and altitude. Results stored in text format (".dat" in **Balloon_alt/Pred_output_Balloon_altitude/**).

The next python scripts are cosmetic in the sense that they use the above two datasets to make plots of timeseries balloon averaged values, evaluate correlations, and histograms.

timeseries_obs_pred_plot_all.py Produces a lot of time series for each model and flights.

As a result, you can visualize timeseries of each flight here:

output_ph1/Balloon_alt/figure_timeseries

Histograms here: **output_ph1/histo**

Scatter plots and correlations here **output_ph1/correlation**

For phase 2, change ph1 in ph2.

At these stage, if everything went right wen you have just launched the two initial scripts, but WACCM is not there.

WACCM

Here are idl routines launching the WACCM code in this language. Launch idl

```
IDL > .r beresflux_offfast.pro
```

```
IDL > BERESFLUX Chose strateole phase, its done when you have done both...
```

xmgrace

Alternative to calculate the diagnostics, now including WACCM, using fortran programs and xmgrace, the programs permit to combine statistics over the 2 phases of Strateole2. Just go in the directory and launch or read the README.sh file to produce the figures of the paper once the daily timeseries associated with phase 1 and 2 are produced.

Overleaf

Texmaker file including all the references, figures, and texfiles to compile this version of the ms.