Gravity waves in the Southern Hemisphere derived from balloon observations and the ECMWF analyses

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Outline

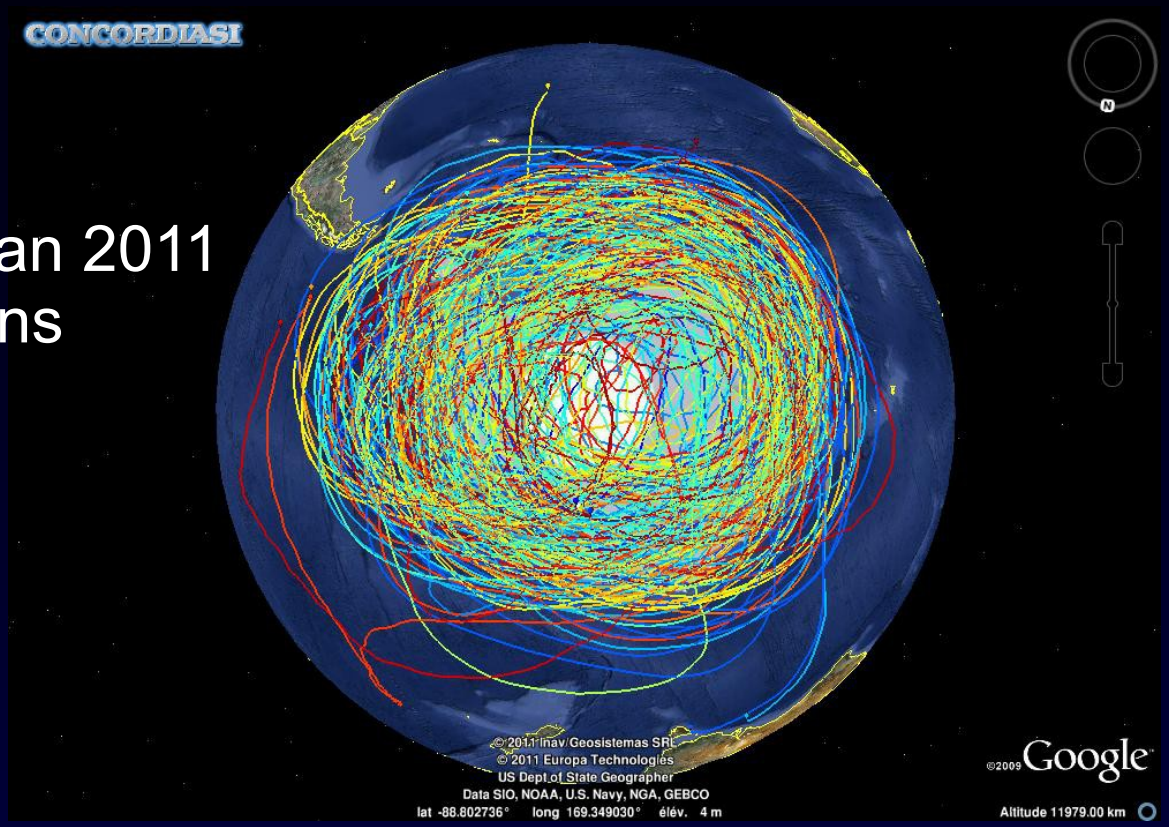
- Motivations
- Comparison between ECMWF and Concordiasi
- Discussion
- Conclusion

Motivation

- ECMWF operational analyses now have high-resolution (T1279)
- How well are the GWs resolved in the ECMWF?

Concordiasi *(Rabier et al 2010)*

Sept 2010 to Jan 2011
18 balloons



- Use for comparison
- Revisit the issue of the missing drag at 60°S

ECMWF operational analyses

- T1279 → 0.125° horizontal grid spacing
- 91 model levels from surface up to 0.01 hPa
- Available at 00, 06, 12, 18 UTC
- Satellite and conventional observations assimilated with 4DVar

Methodology

- Calculation of momentum flux:
  - Concordiasi:
    - based on *Boccara et al 2008*
  - ECMWF:
    - Resolved GWs in ECMWF

      → Correlation u'w'
    - base state: 15 first zonal modes

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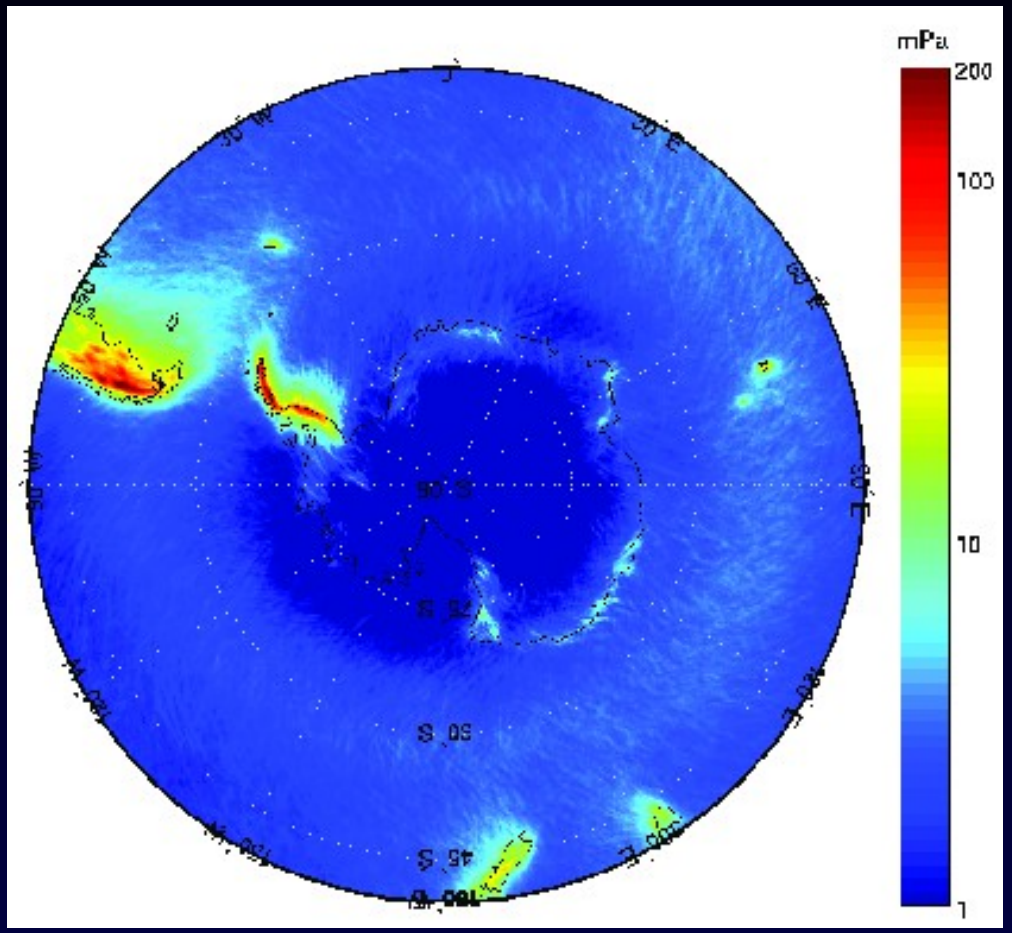
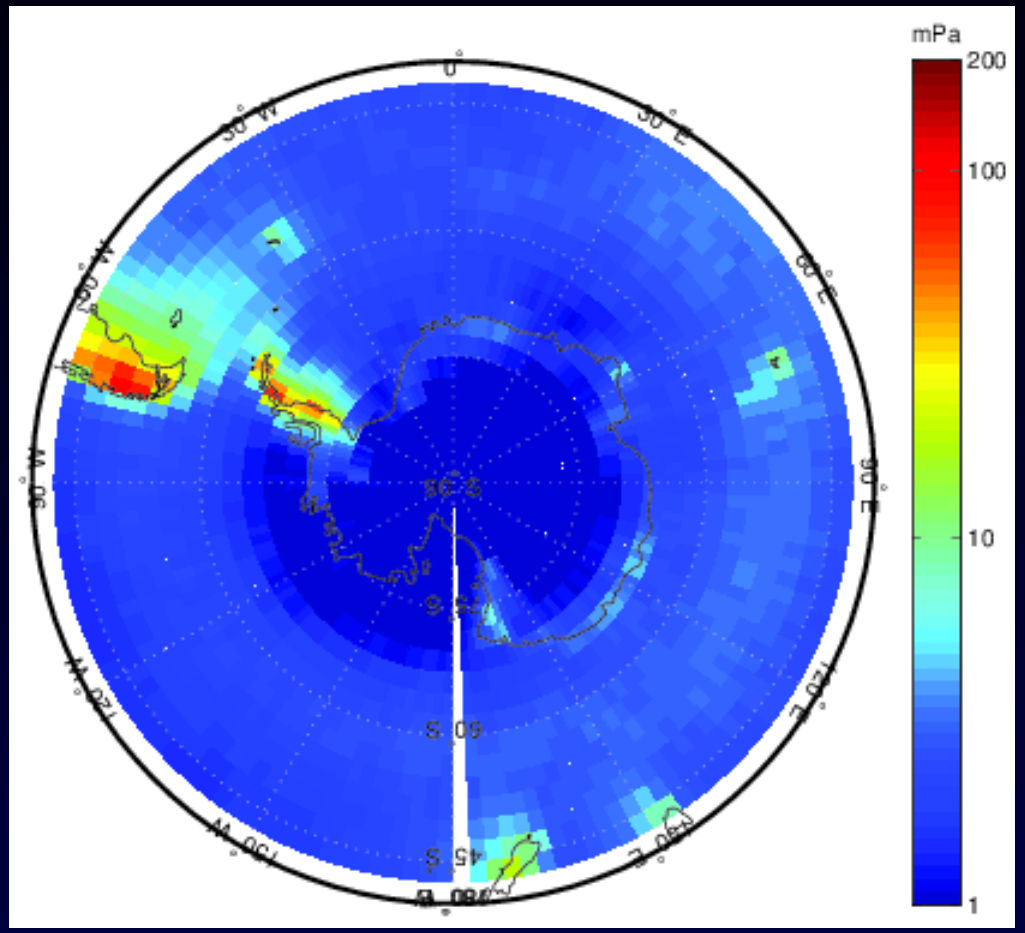
Momentum flux

ECMWF
0.125°



Momentum flux

ECMWF
2.5°



mPa

200

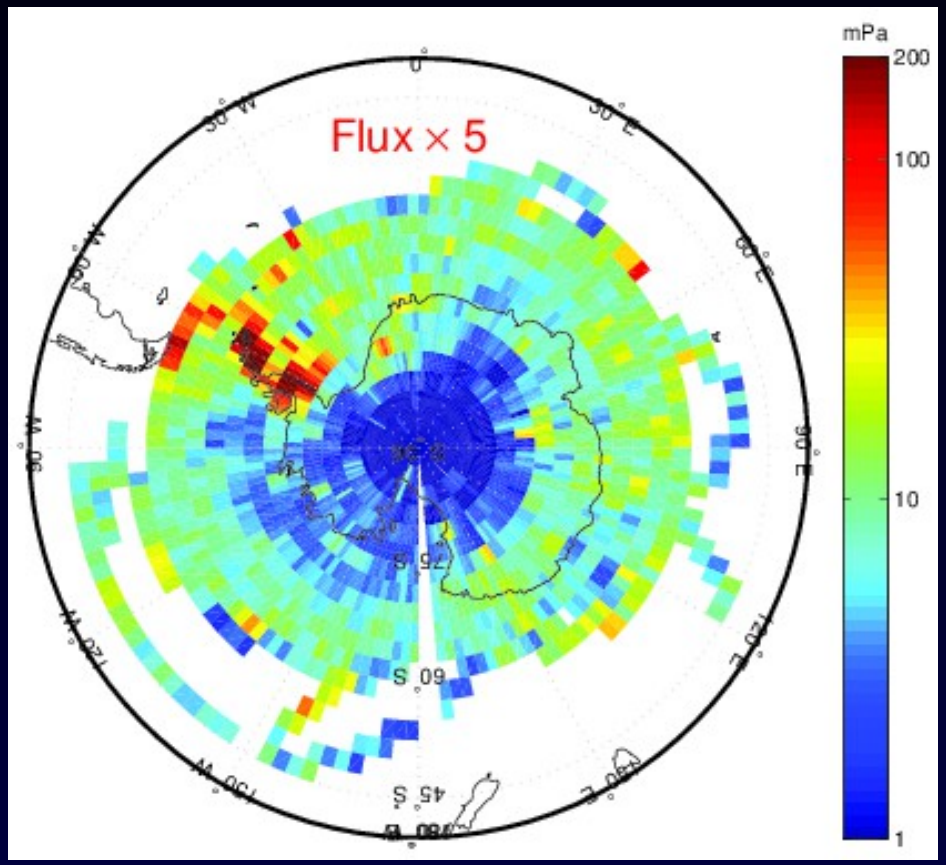
100

10

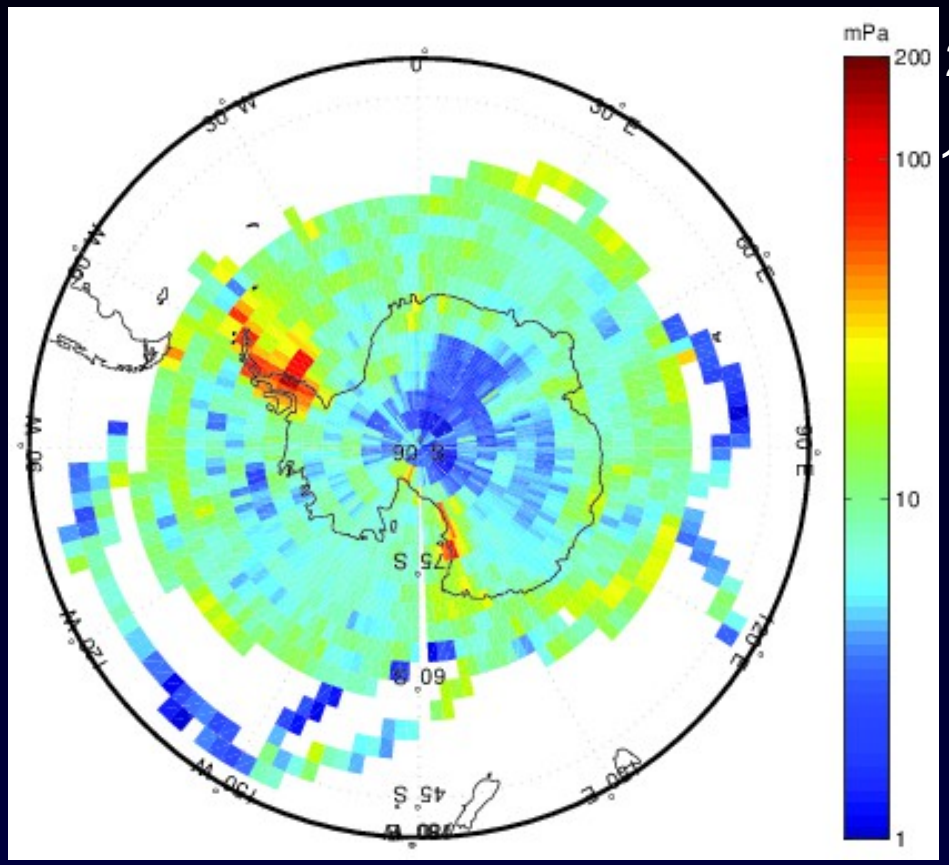
1

Momentum flux

ECMWF
F=1.8mPa



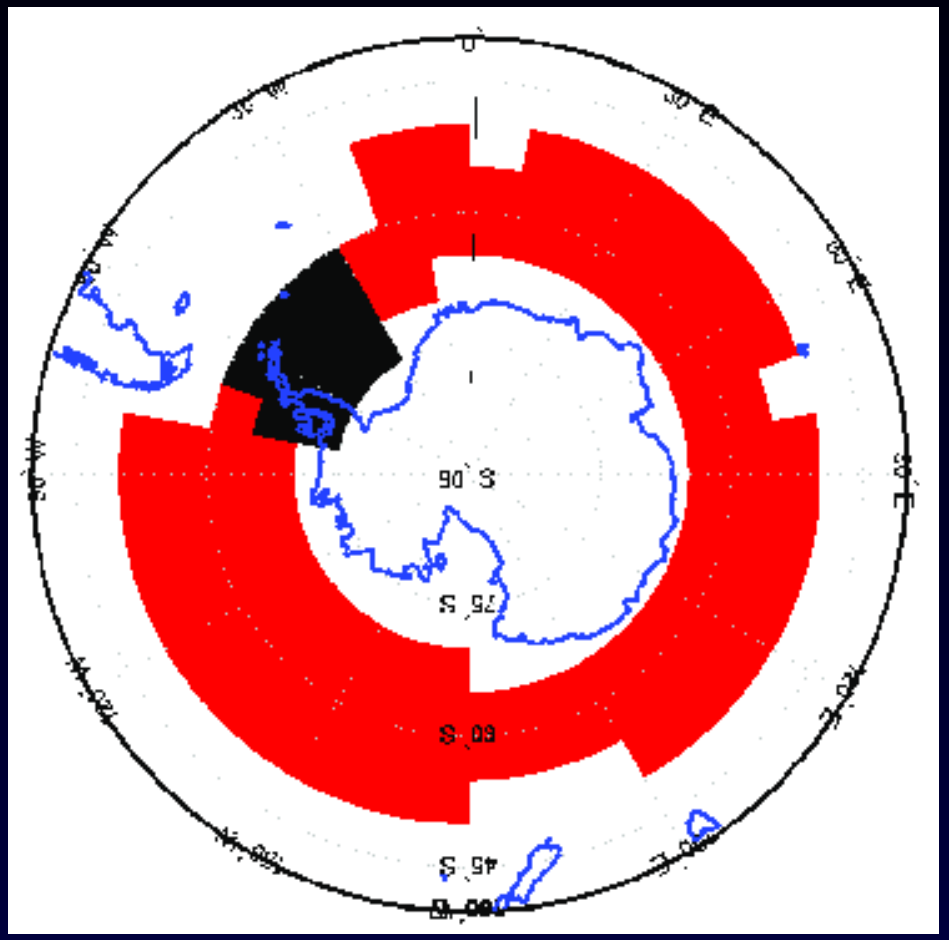
Concordiasi
F=9mPa

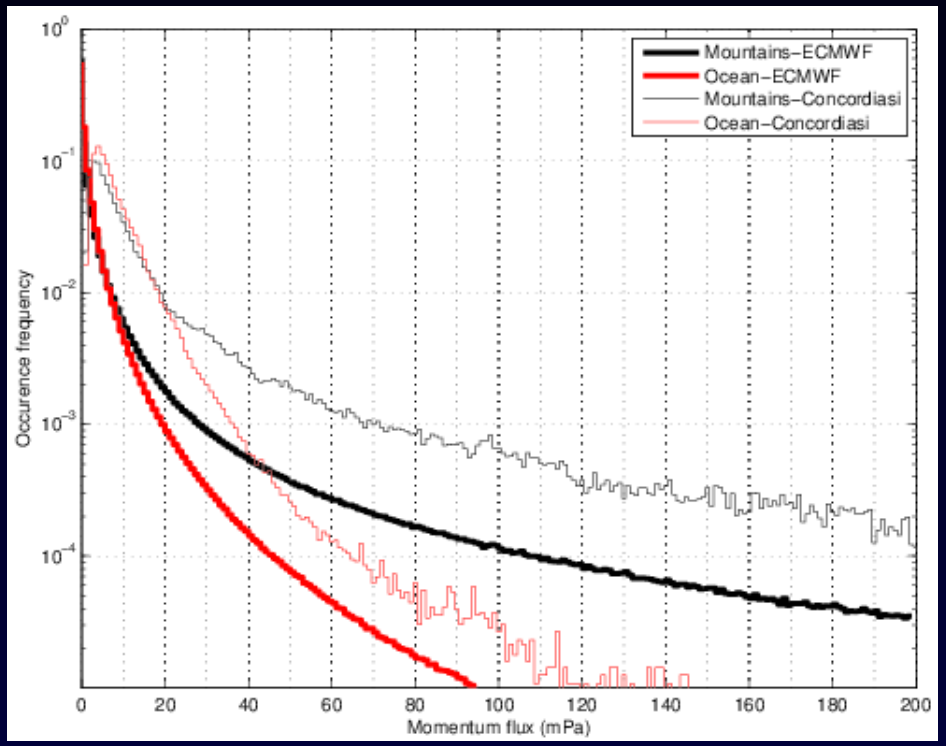


mPa
200
100
10
1

- Good geographical agreement, but factor 5 in amplitude
- Higher contrast between Plateau and the rest in ECMWF

Intermittency

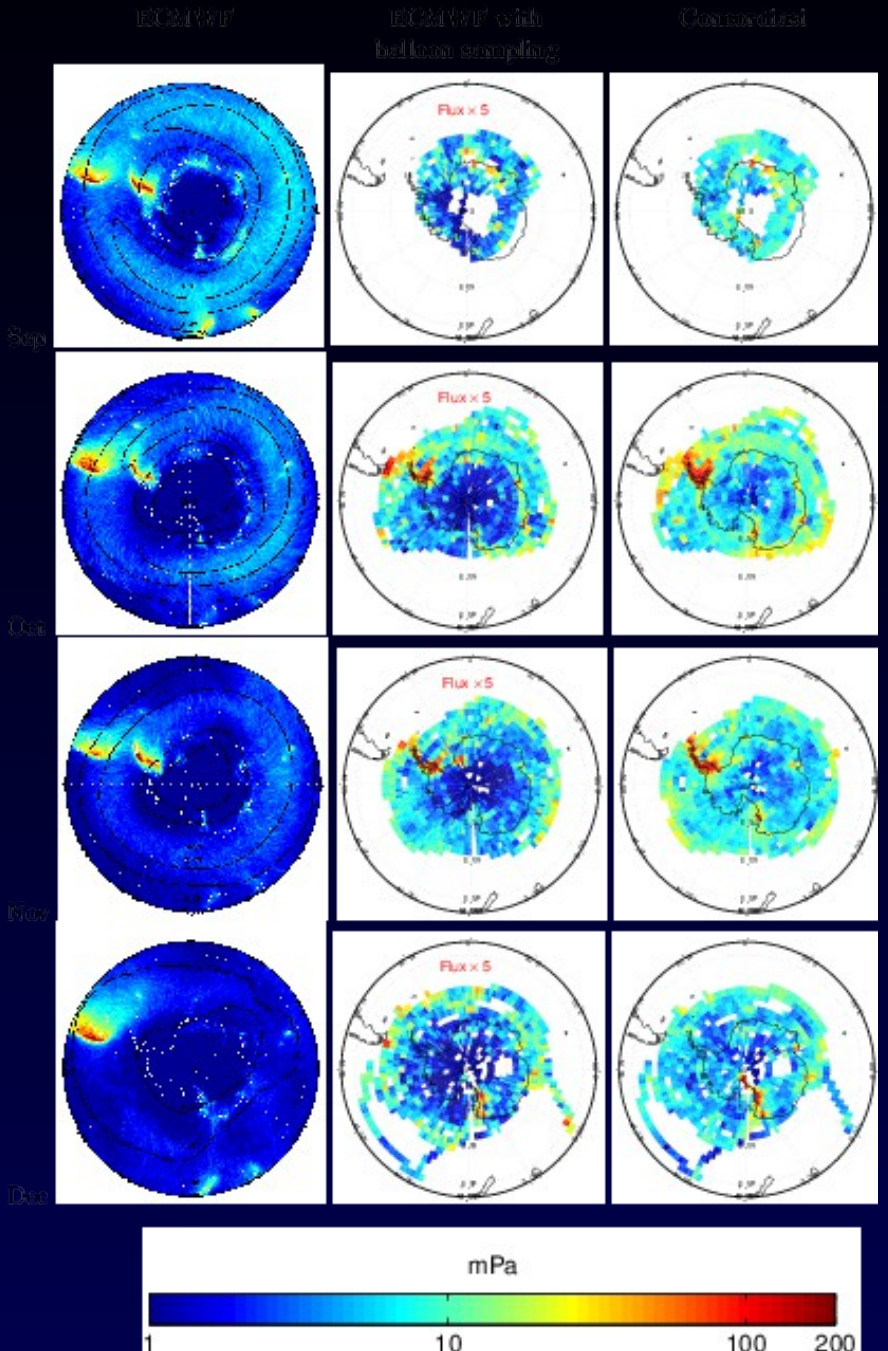




- More intermittency over mountains (consistent with *Hertzog et al. 2012*)
- Mountains: 64-86% of total flux due to the 10% largest wave events
- Ocean: 29-55% 10%

Seasonal variations

Filtering of the low phasespeed GW after Nov



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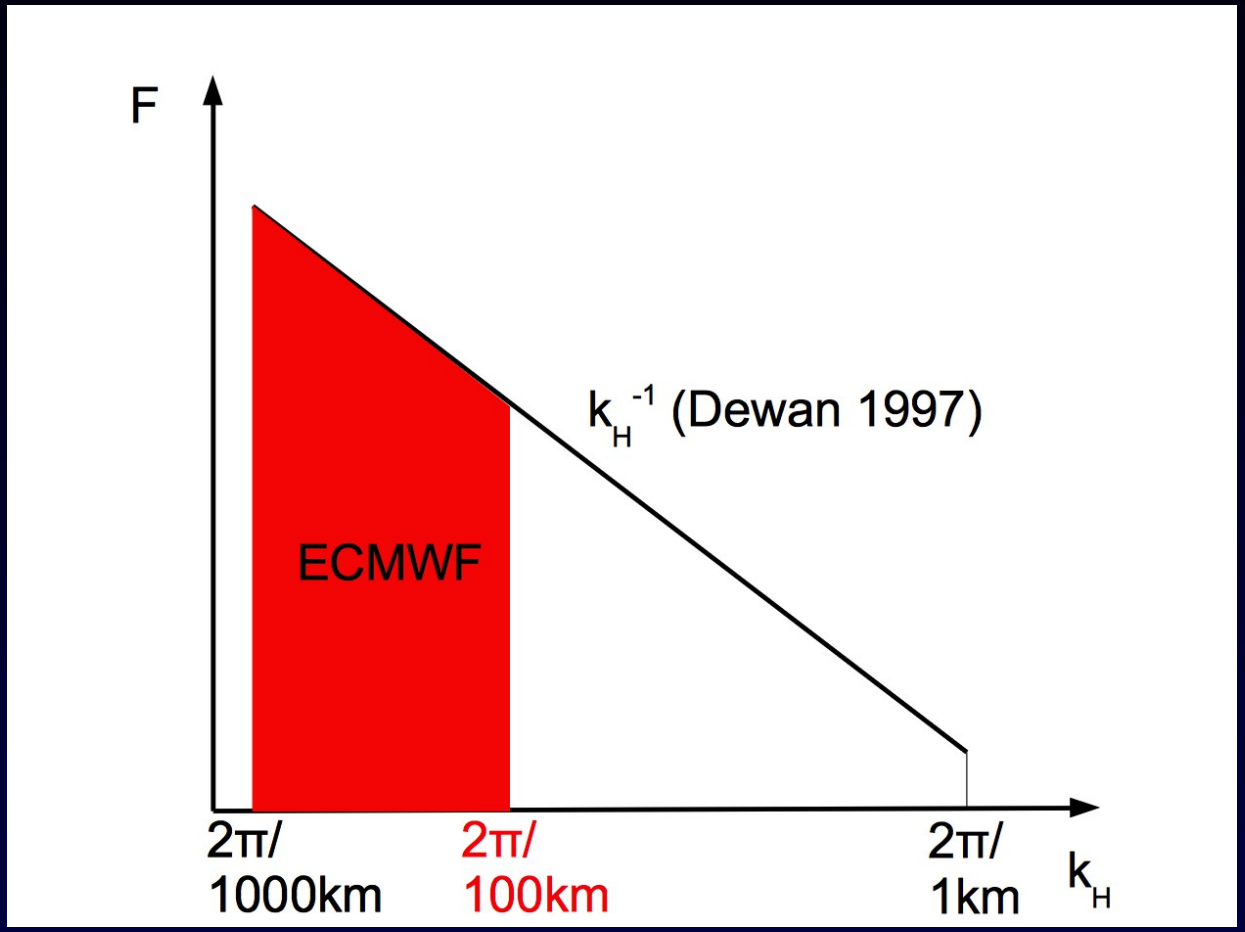
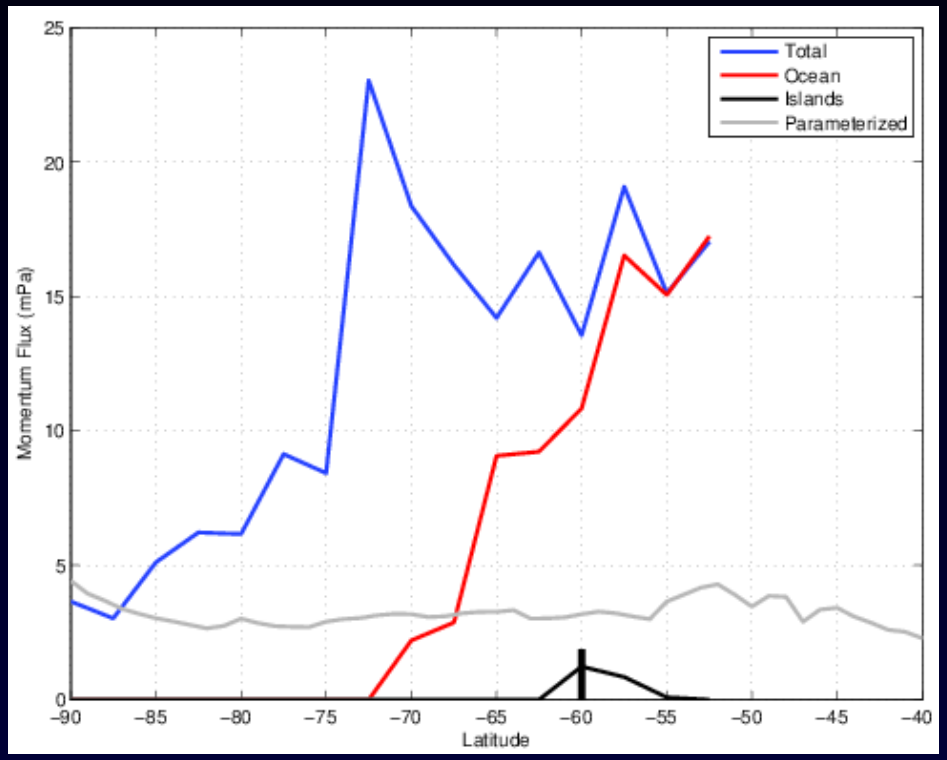
Discussion



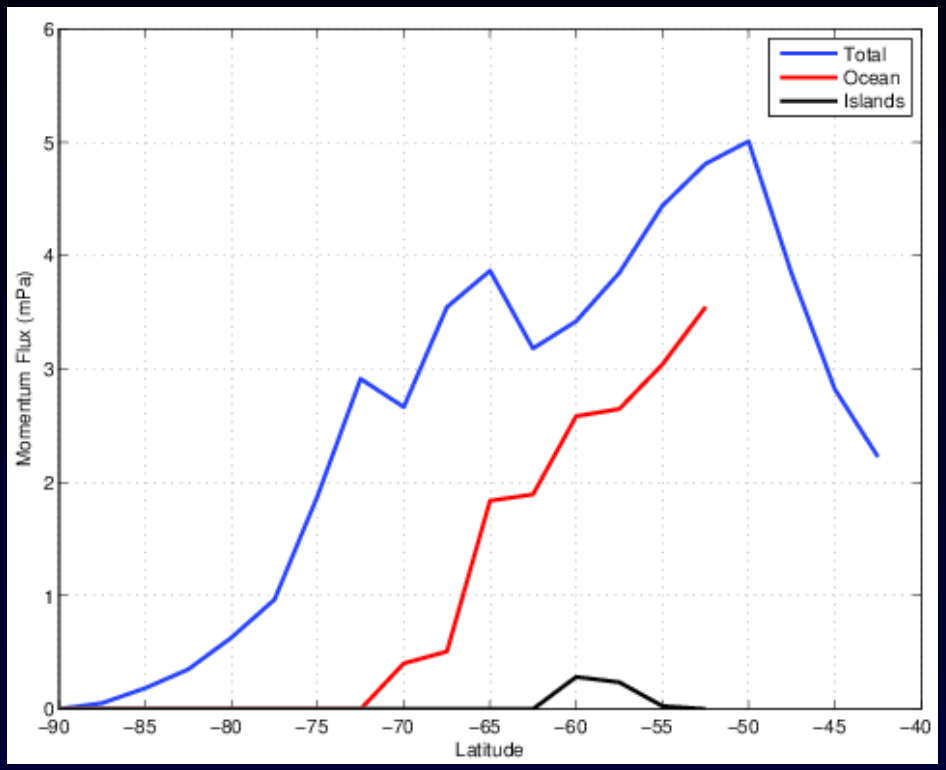
- Factor 5 in ECMWF: resolution explains a factor 3 + numerical diffusion

Source of missing drag at 60°S

October Concordiasi



ECMWF



- NGWs at 60°S: same order of magnitude as the Peninsula
- OGWs at 60°S: not more than 2.5mPa
- Suggests that the missing drag comes from NGW (consistent with *Hendricks et al 2014*)

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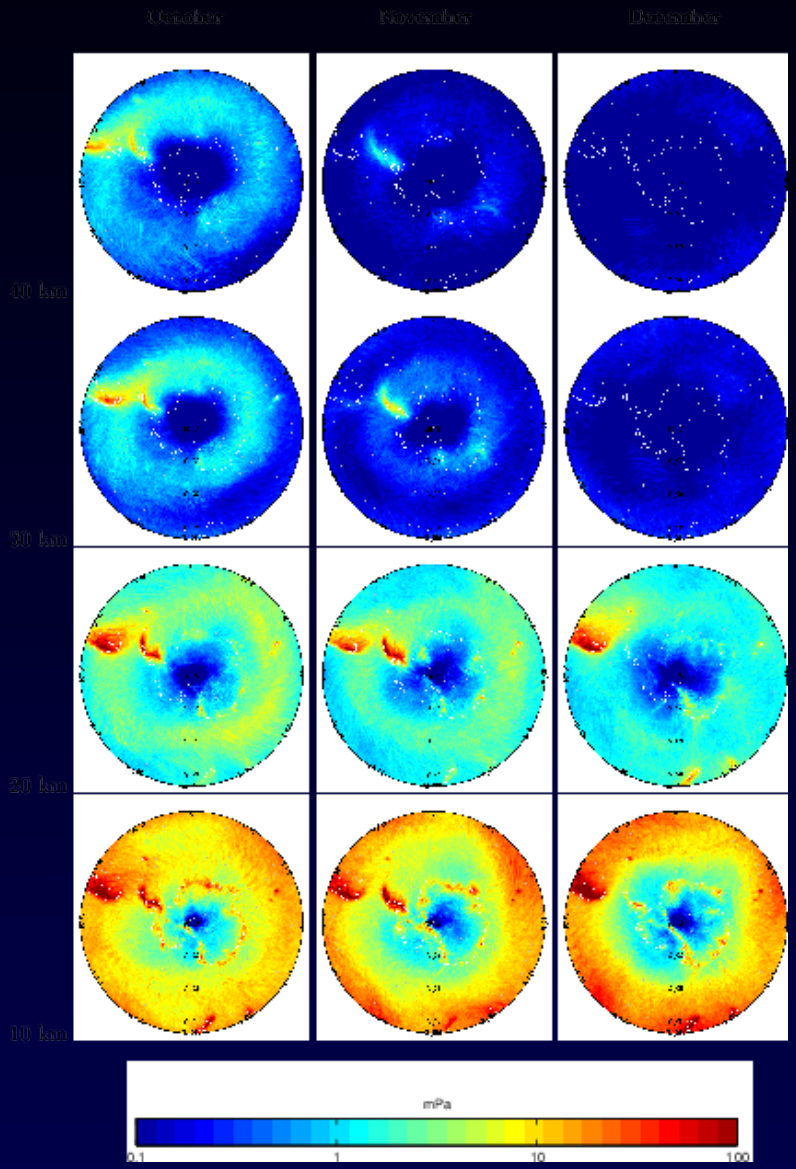
Conclusion

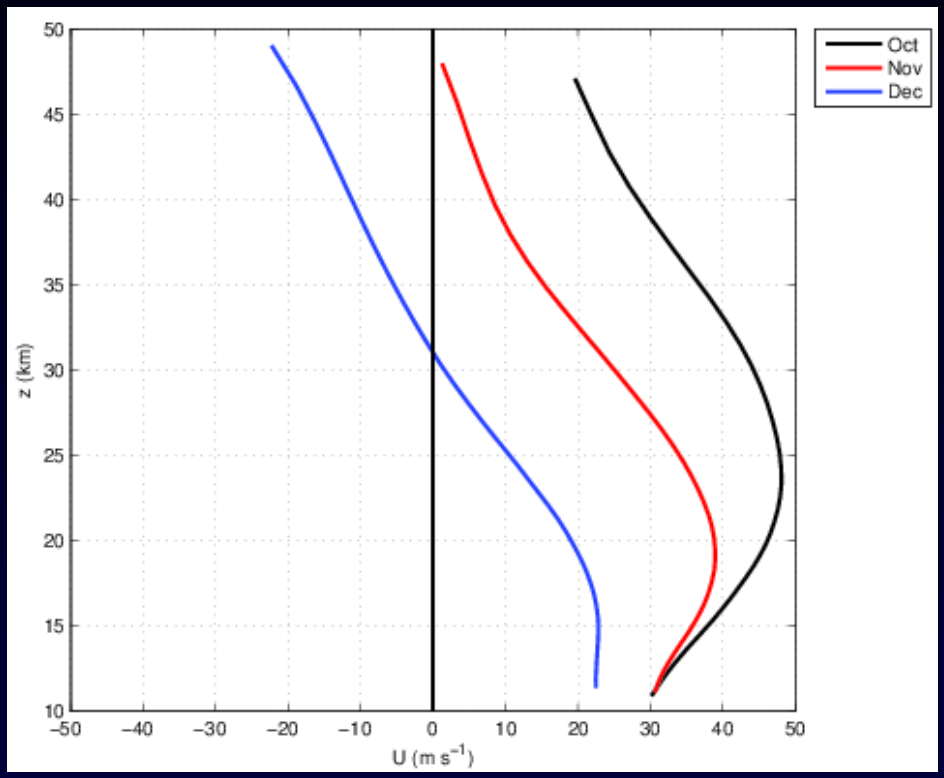
- ECMWF can be used to study the spatial, seasonal and interannual variability of GW
- Factor 5 on the amplitude mostly due to the resolution
- Contrast 3X greater in ECMWF
- Missing drag at 60°S probably related to NGWs

Jewtoukoff, Hertzog, Plougonven, de la Camara, Lott, 2015 (J. Atmos. Sci.)

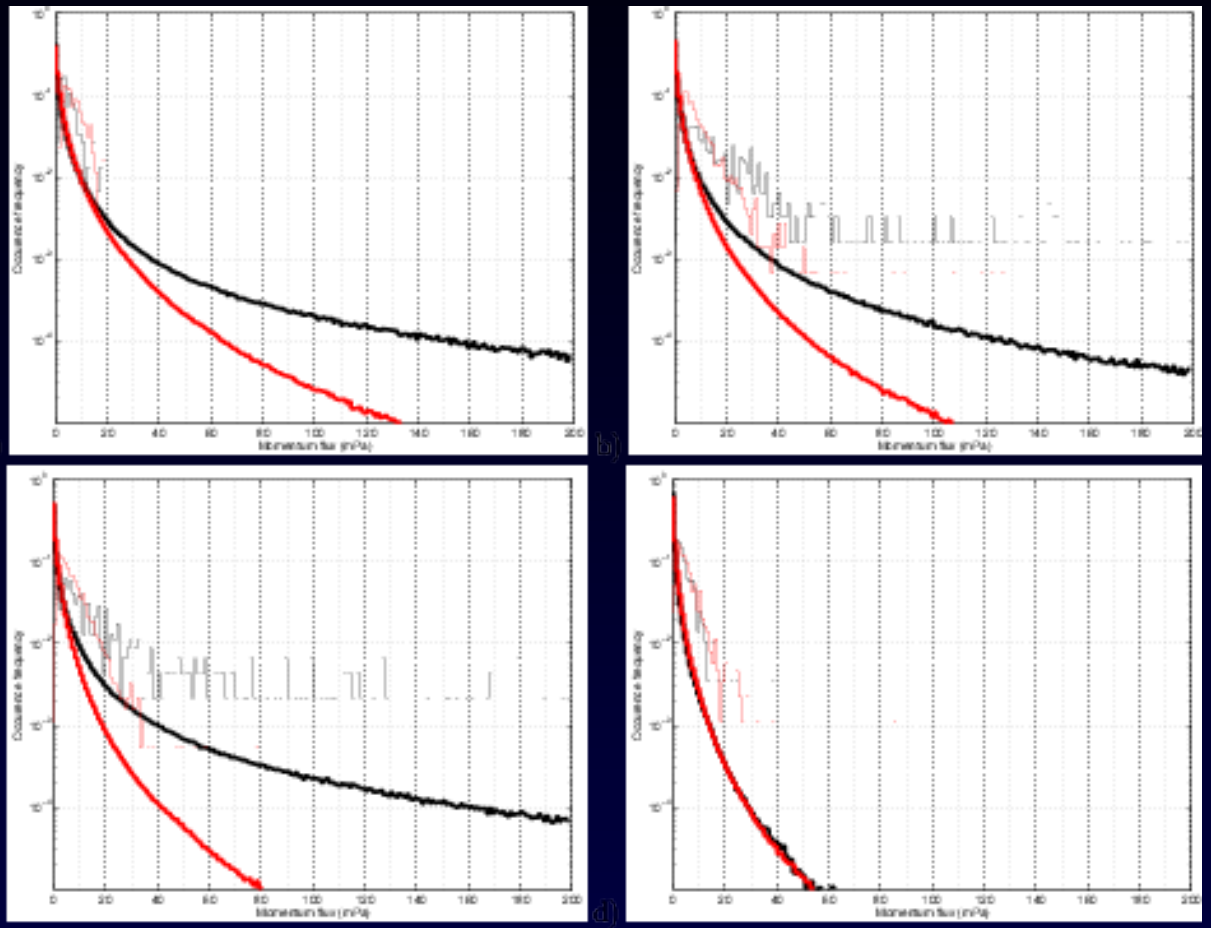

Thank you

Filtering by the wind





Seasonal variations



Effect of lateral propagation

30 km

20 km

10 km