Validation of the gravity waves in ECMWF analyses using balloon observations and interannual variability of the gravity wave momentum fluxes

Valérian Jewtoukoff,
Albert Hertzog, Riwal Plougonven,
Théophile Allard, Alvaro de la Camara,
François Lott

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Motivation

- ECMWF operational analyses now have high-resolution
- How well are the GWs resolved in the ECMWF?
- How about ERAI?
- Interannual variability of the GWMF in ERAI?
Outline

- Data
- Validation of ECMWF products
- Interannual variability of the GWMF
- Conclusion
ECMWF operational analyses (EOA)

- T1279 → 0.125° horizontal grid spacing
- 91 model levels from surface up to 0.01 hPa
- Available at 4 times/day
- Satellite and conventional observations assimilated with 4DVar
ERAI reanalyses

- Similar to operational analyses

  but...

- Frozen version of the model and +35 years of data
- T255 $\rightarrow$ 0.75° horizontal grid spacing
- 60 model levels from surface up to 0.1 hPa
Concordiasi (Rabier et al 2010)

Sept 2010 to Jan 2011
18 balloons

- Relatively good spatial covering
- Well adapted for GW
- Use for validation
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EOA momentum flux (Jewtoukoff et al 2015)

EOA 0.125°

EOA 2.5°

EOA balloon sampled

Concordiasi
EOA vs Concordiasisi

- Good geographical (+seasonal) agreement, but factor 5 in amplitude
- Higher contrast between Plateau and the rest in EOA due to filtering method
- Good overall agreement + truncation factor
ERAI vs EOA (Oct-Dec 2010)
ERAI vs EOA

- Good overall agreement + truncation factor
- Can be used to study the interannual variability of the GWMF
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1979-2010 GWMF Northern Hemisphere
1979-2010 GWMF Southern Hemisphere

[Images of atmospheric maps at different pressure levels (100 hPa, 70 hPa, 10 hPa) for JJA and DJF seasons, showing variations in pressure distribution.]
1979-2010 normalized STD
Northern Hemisphere
1979-2010 normalized STD
Southern Hemisphere
GWMF filtered times series at 70hPa

Nonphysical bias after 2000-2005
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Conclusions

Jewtoukoff et al 2015, JAS

● ECMWF products can be used to study the spatial, seasonal and interannual variability of GWMF

● Truncation factor on the amplitude
Conclusions

- STD: 2 configurations:
  - winter: orography + storm tracks
  - summer: convection / monsoon
    + stratospheric winds

- STD decreases with altitude

- Limitations of ERAI: probable changes in assimilated observations after 2000
Thank you
Truncation factor

- Factor 5 between EOA and Concordiasi: resolution explains a factor 3
- Factor 8 between ERAI and EOA: