Global gravity wave distributions from limb-sounding satellites, ECMWF and ray-tracing modelling

Peter Preusse
Manfred Ern, Isabell Krisch, Cornelia Strube
Peter Bechtold (ECMWF)
Byeong-Gwon Song (Yonsei), Hye-Yeong Chun (Yonsei)
Momentum flux errors

- Expect HIRDLS GWMF to be lower than ECMWF (≈ factor 2-3)
- Statistical errors HIRDLS small
- In future: comparison including observational filter
Analysis of ECMWF data

- Subtract global-scale waves
- Split into analysis cubes 2° x 2° x 10km
- 3D wave fit => Ampl., k
Very good match at winter mid and high latitude
Subtropics in ECMWF follow wind rather than convection
ECMWF: No wave background in tropics, summer hemisphere in HIRDLS this is real, not noise!
Raytracing from S3D

- Full 3D data ⇒
- Full 3D wave vector
- allows for launching rays
- Back-tracing: source at or above lowest point
- Forward-tracing: upward propagation, dissipation incl.
Global backtraces

Preusse, ACP, 2014
Almost all ECMWF convective GWs from tropopause

Convection is parameterized in ECMWF

Updrafts not represented in GCM core (only net effects couple to core)
Propagate ECMWF upward

GW 30km; Launch 12km
GW 30km; Launch 25km
HIRDLS

03-07

08-12

Jan 2006

GW 30km; Launch 12km
GW 30km; Launch 25km
HIRDLS
Propagate ECMWF upward

GW 30km; Launch 12km  GW 30km; Launch 25km  SABER

Jan 2009  12-16  17-21

SPARC, 18 May 2016 – p. 9
Sources, filtering and dissipation

- Wind filtering in lower stratosphere removes 1st and 3rd peak
- 12km, 25km launch consistent, 45km strongly reduced
Processes responsible?

Zonal mean: 50N - 70N, alt: 45 km

Model damping

Sources?

LA = 45 km
LA = 35 km
LA = 25 km
LA = 12 km

Momentum flux [mPa]

January 2009
General features reproduced

- **Stable vortex:**
  - Upper edge of jet $\rightarrow$
  - Max. of neg. acceleration

- **Rebuild Phase:**
  - Short peak of positive acceleration
Summary

- ECMWF good representation
  - for orographic GWs, GWs from jets
  - for altitudes <40km
- Upward projection by ray-tracing
- Still we need better global observations
- GLORIA demonstrates abilities in Polstracc/GW-LCycle/Salsa (PGS) campaign (→ Poster 10)