ECMWF, a gravity wave resolving global model and its validation with SABER and future limb imaging instruments (PREMIER)

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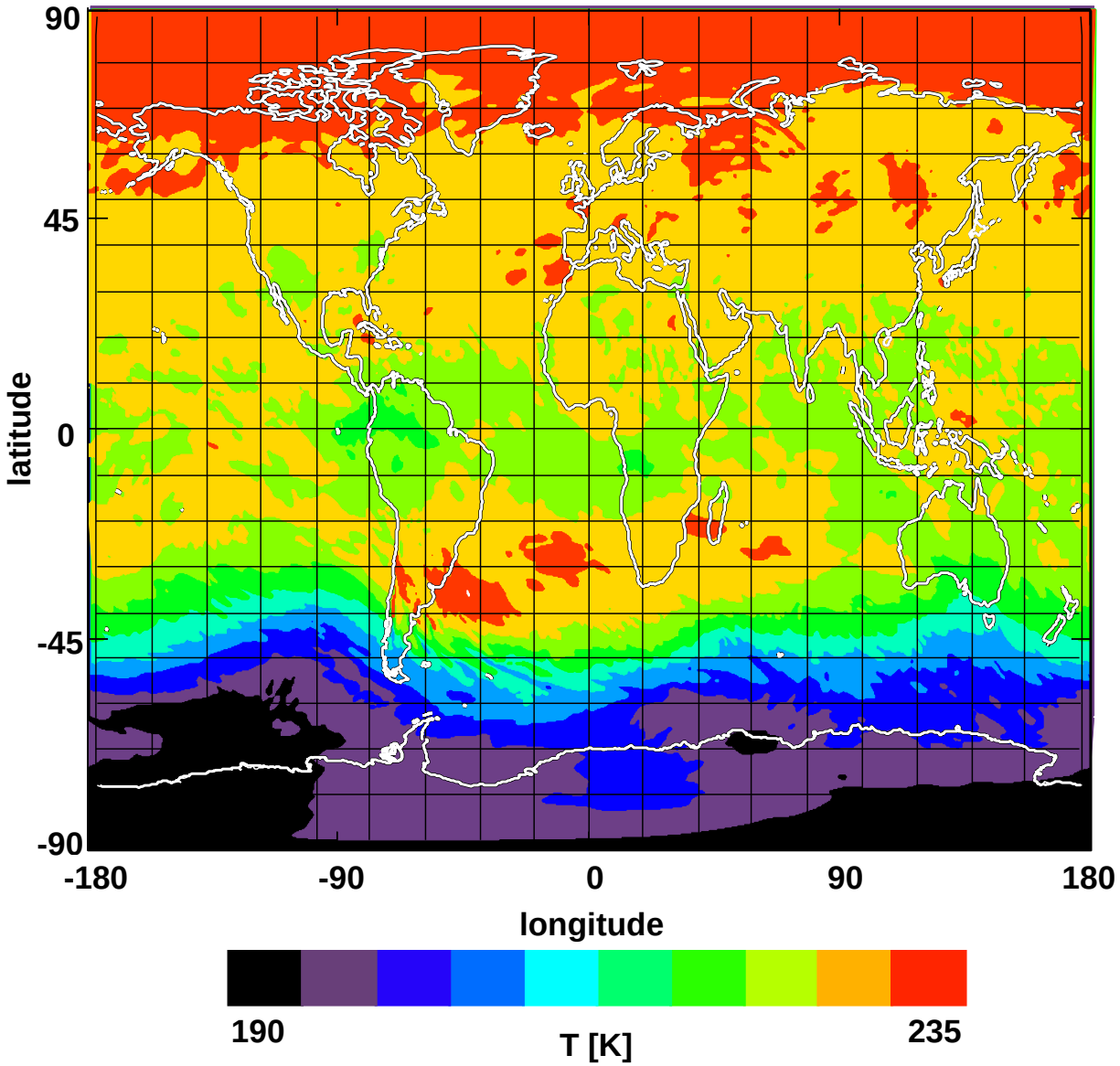
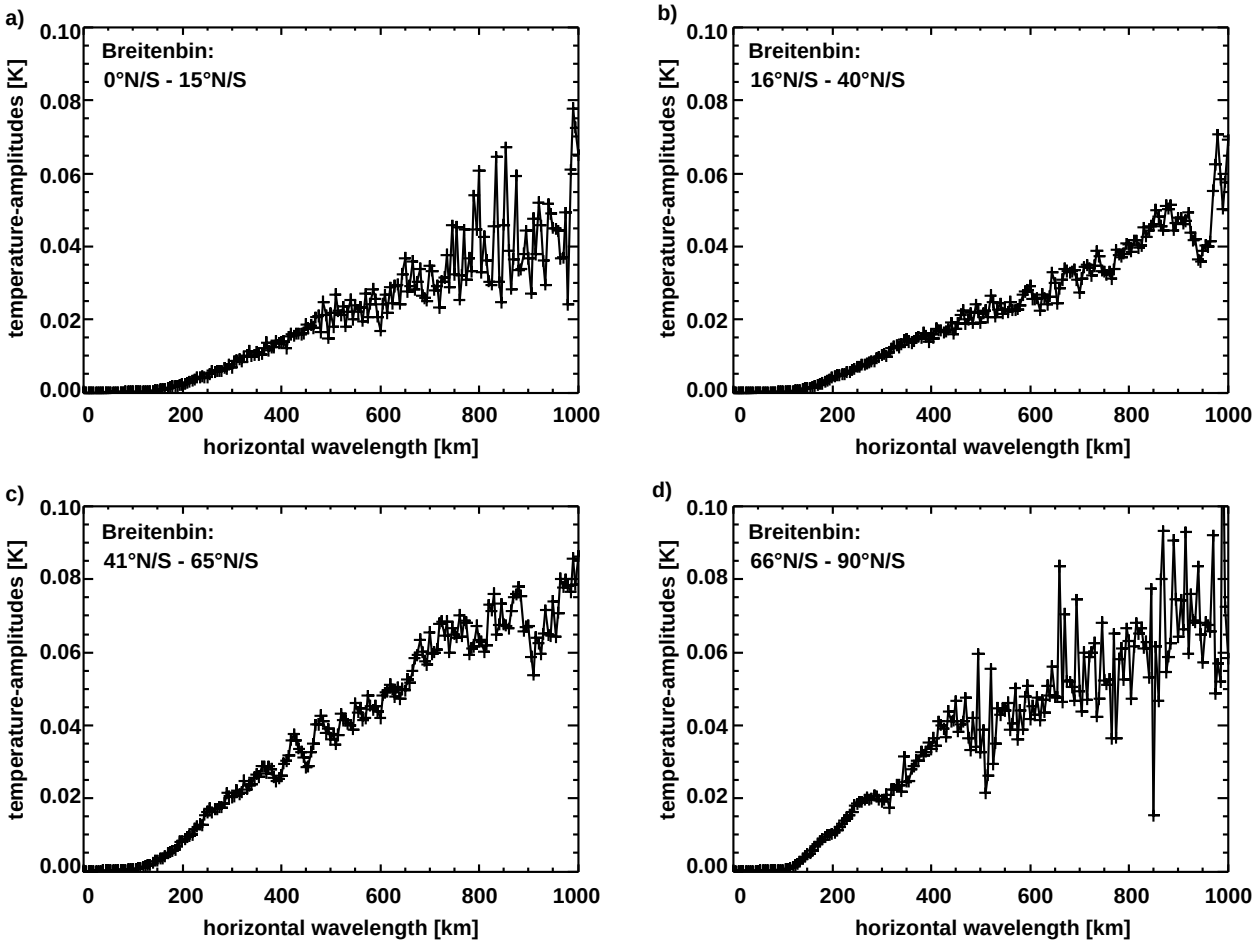
ECMWF



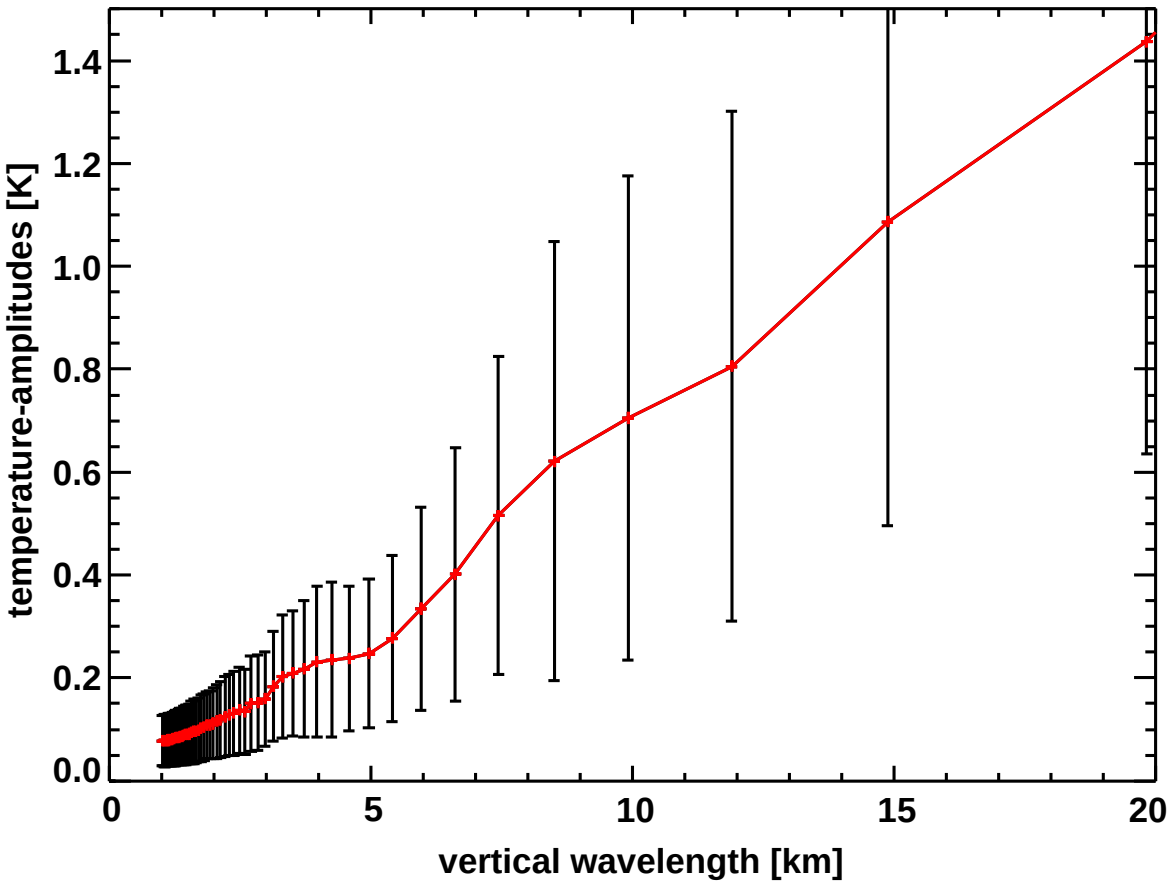
- T799, N400, 91 hybrid levels
- 0.25 ° horizontal resolution
- 500 m vertical resolution
- Altitude-range: up to 80 km
- shown: 10.08.2006 at 28 km

Horizontal wavelength



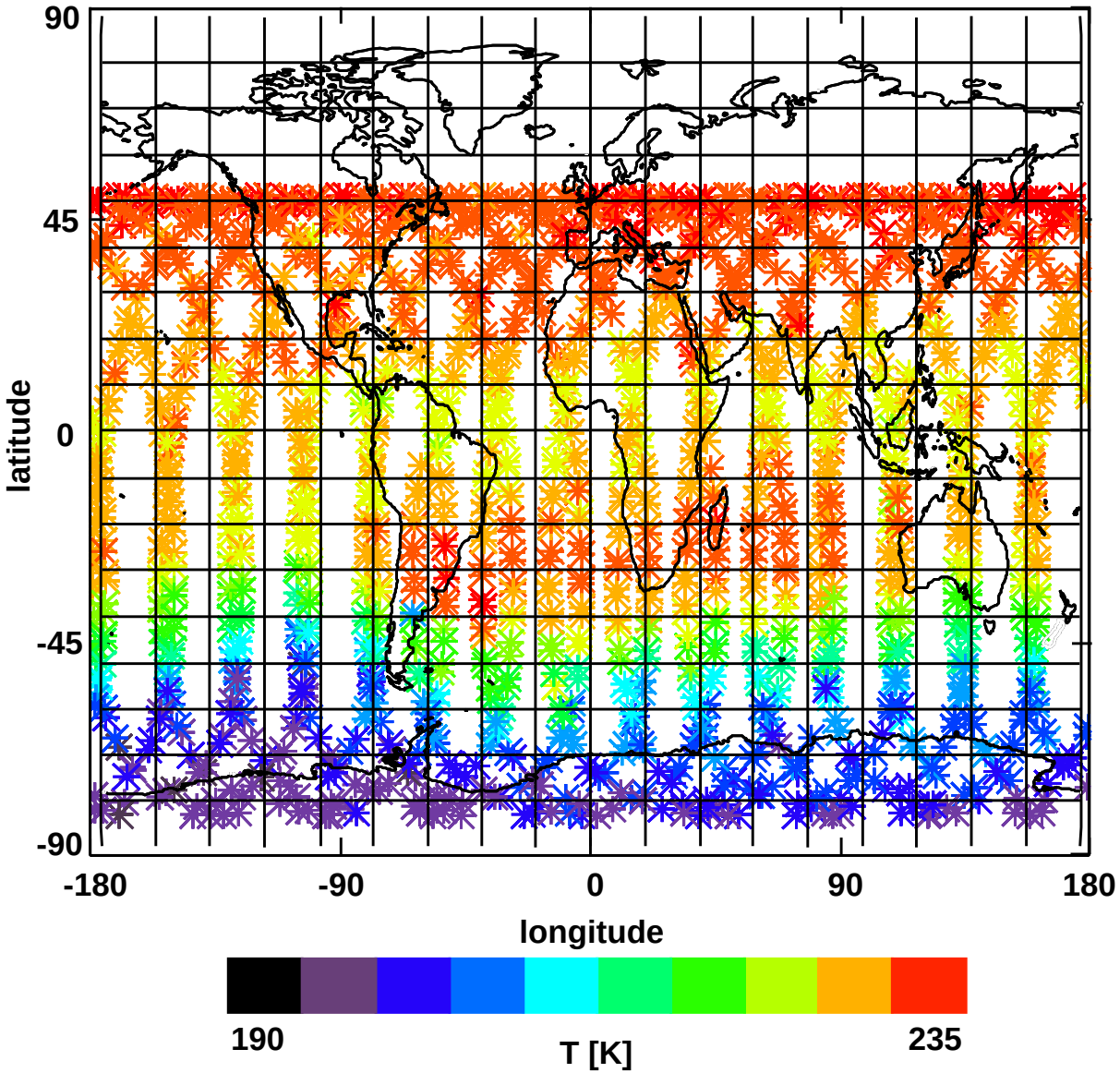
- waves with horizontal wavelength > 200 km are resolved

Vertical wavelength



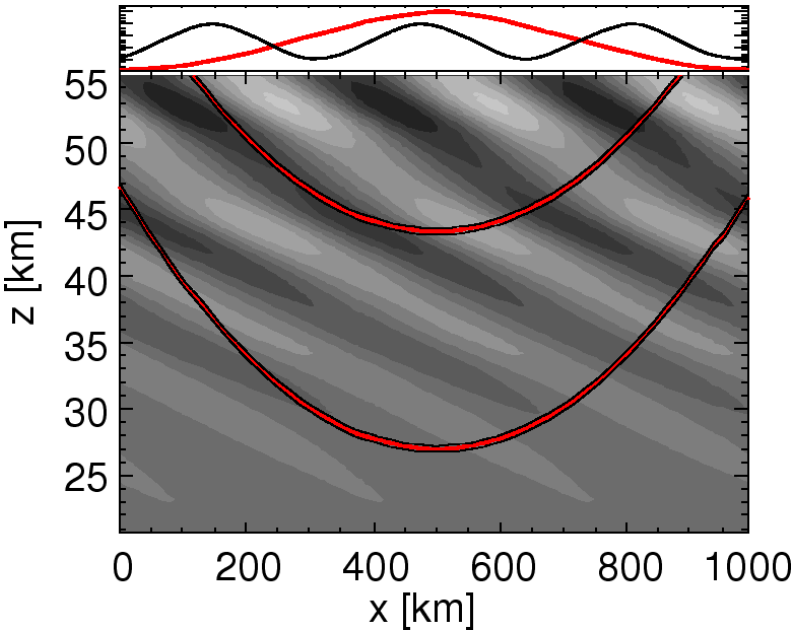
- waves with vertical wavelength > 1 km are resolved

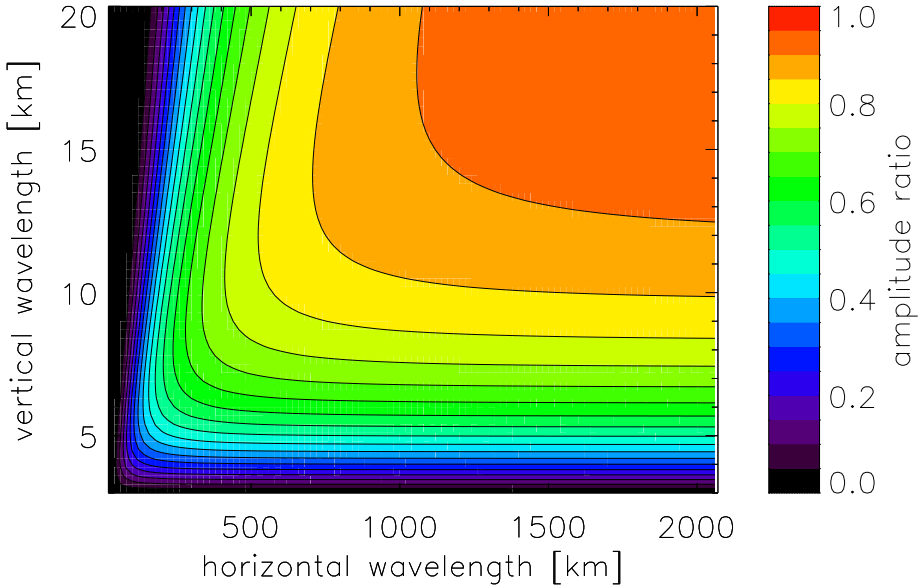
SABER



- along track
  $350 - 550\,\mathrm{km}$
- vertical resolution
  $\approx 400\,\mathrm{m}$
- Altitude-range:
  $15 - 155\,\mathrm{km}$
- orbit inclination: $74.1\,^\circ$
- orbit altitude: $625\,\mathrm{km}$
- $\approx$ 14 orbits per day
- shown:
  10.08.2006 at 28 km

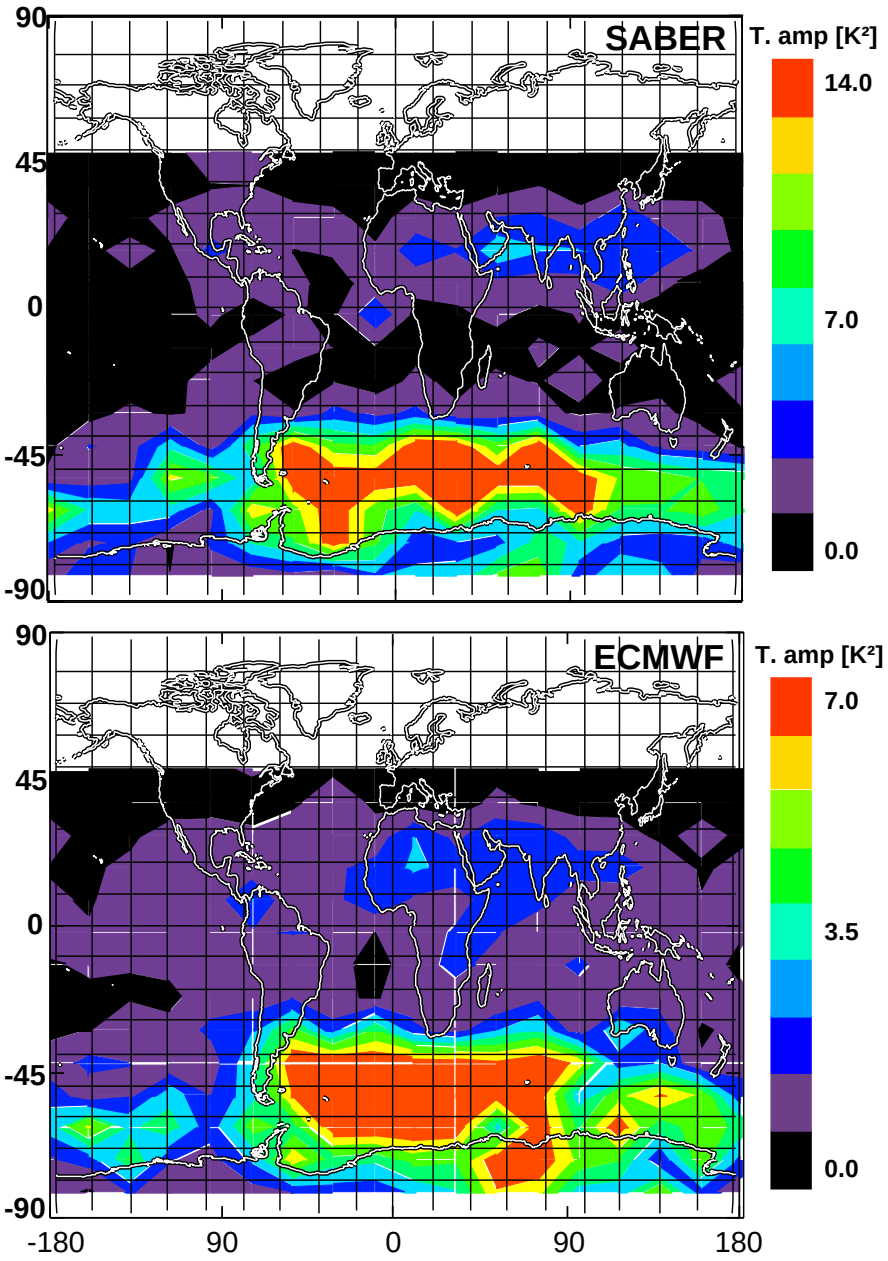
Sensitivity-function

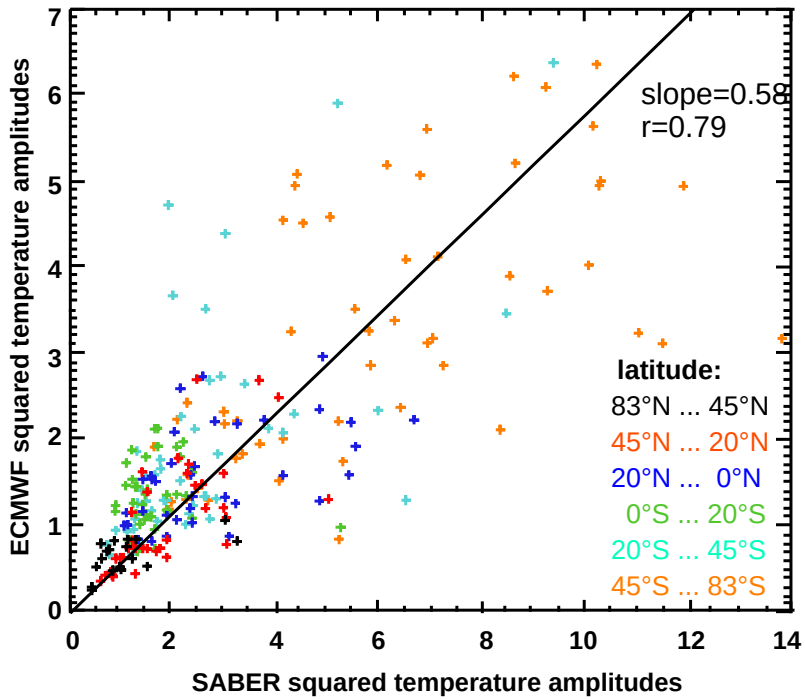




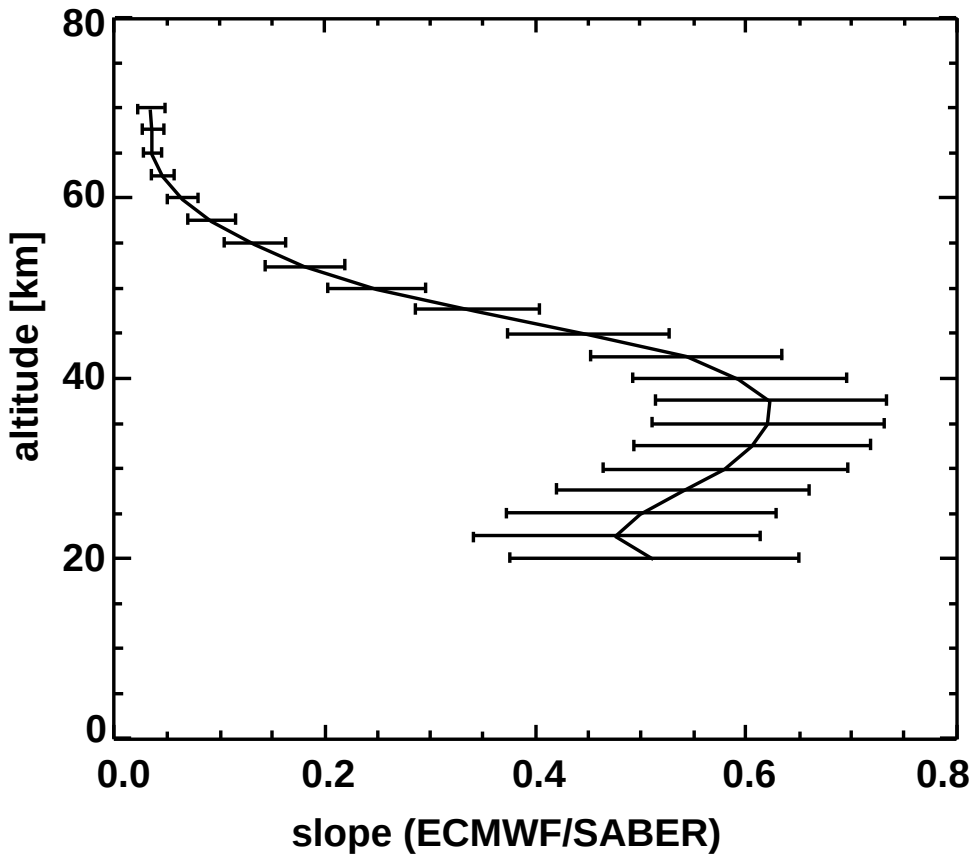
- IR - limb sounder can resolve waves with horizontal wavelength $> 200\,\mathrm{km}$ and vertical wavelength $> 5\,\mathrm{km}$

⋆ Preusse et al. (2002)

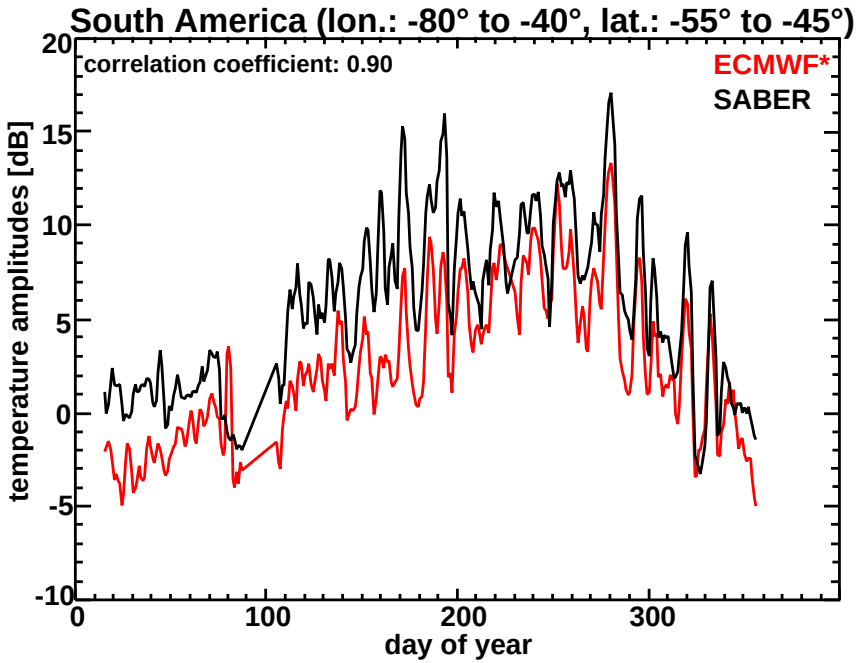


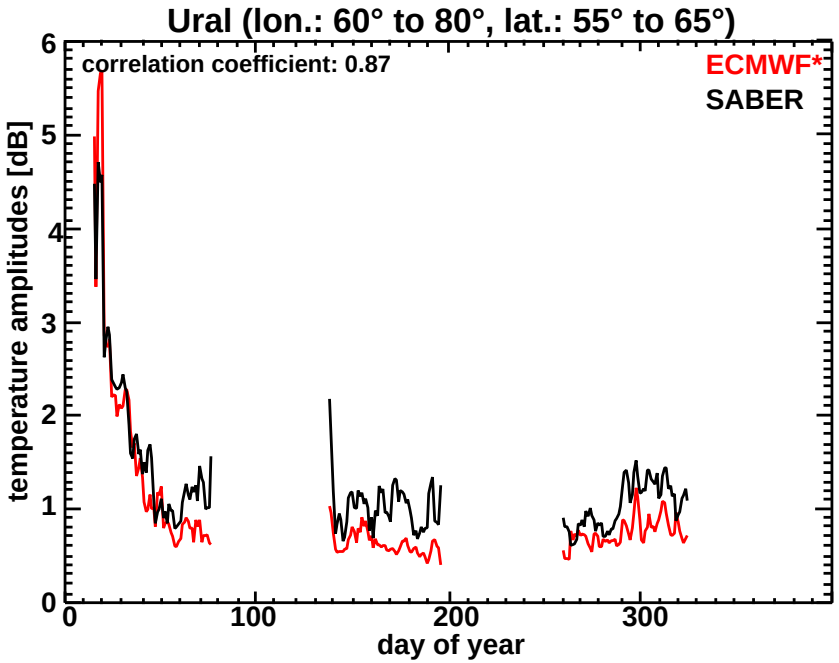


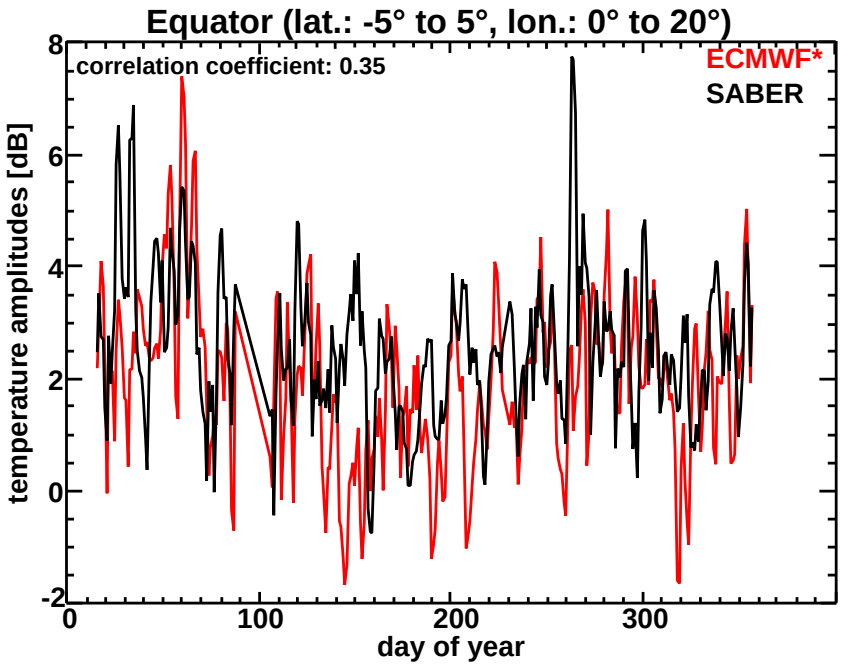
- estimate of background-temperatures
  → Kalman-Filter
- estimate of temp. amplitudes, vertical wavelength and phases
  of the two dominant wave compounds
  → MEM/HA



- wave amplitudes are too low (factor of two)
- over 40 km altitude GWs are strongly damped by Rayleigh friction



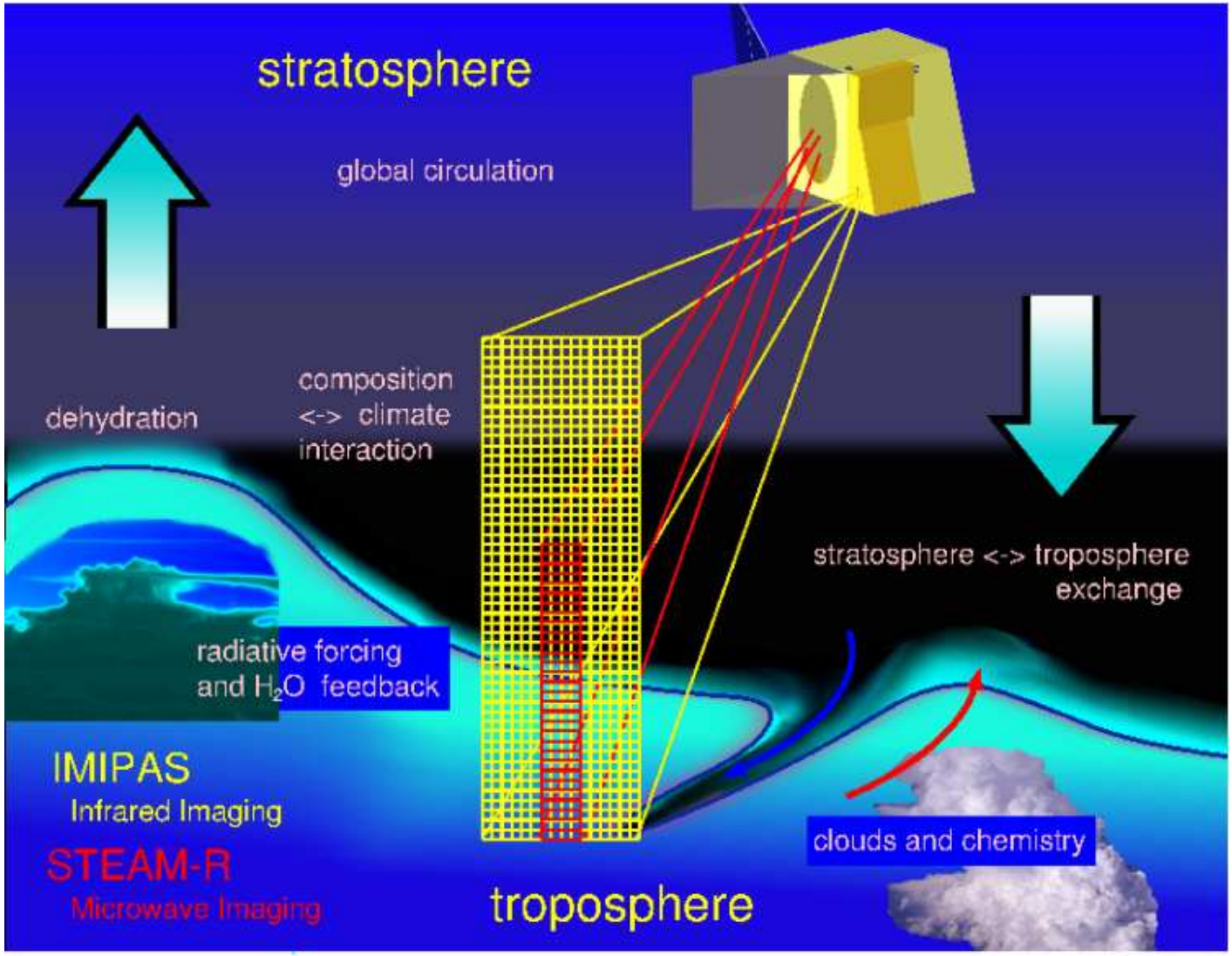


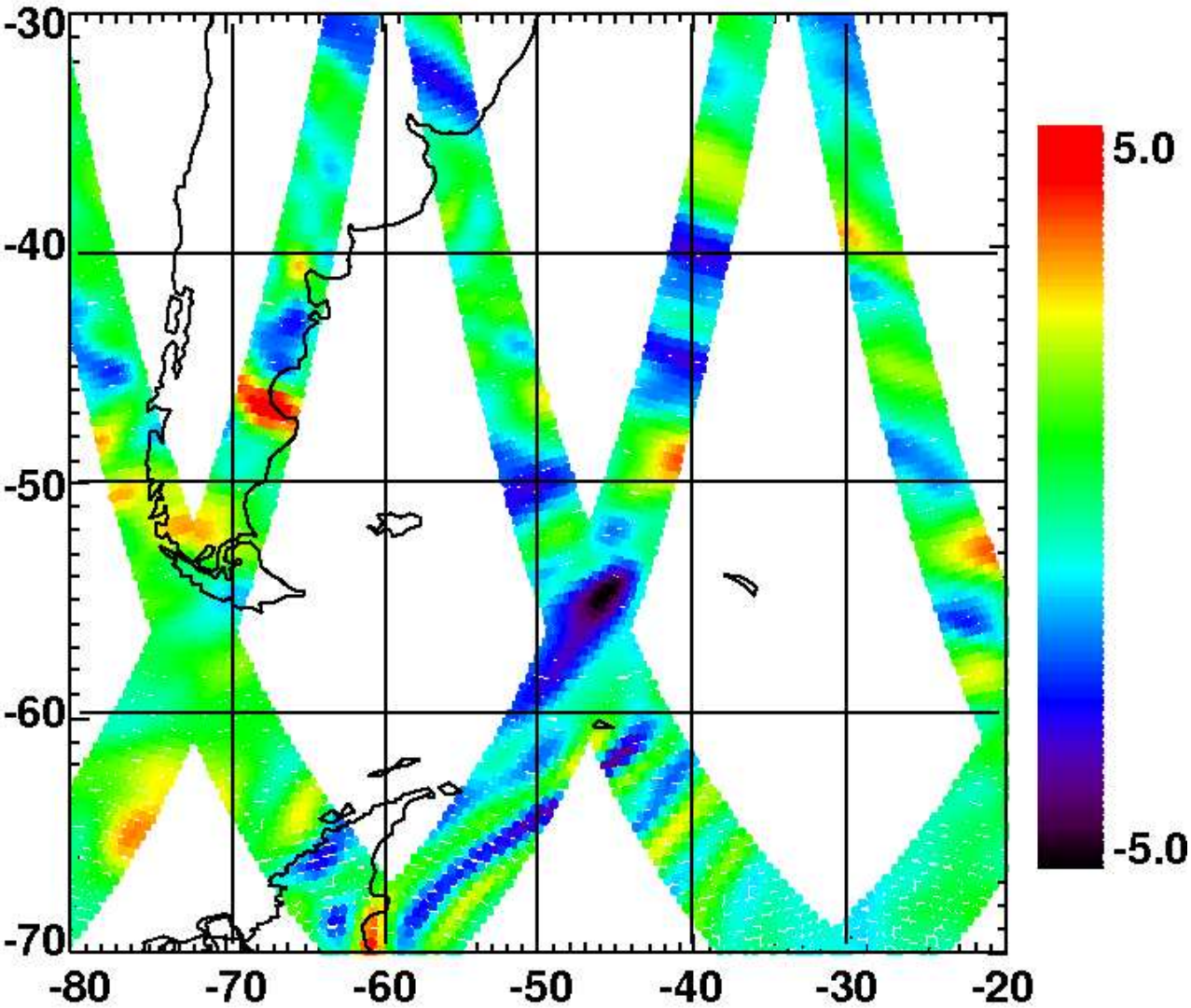


- local time-series at 28 km altitude
- mountain-waves are well represented in the model data
- ECMWF temperature amplitudes are too low
- convection not well reproduced

⋆ Schroeder et al. (2009)

PREMIER

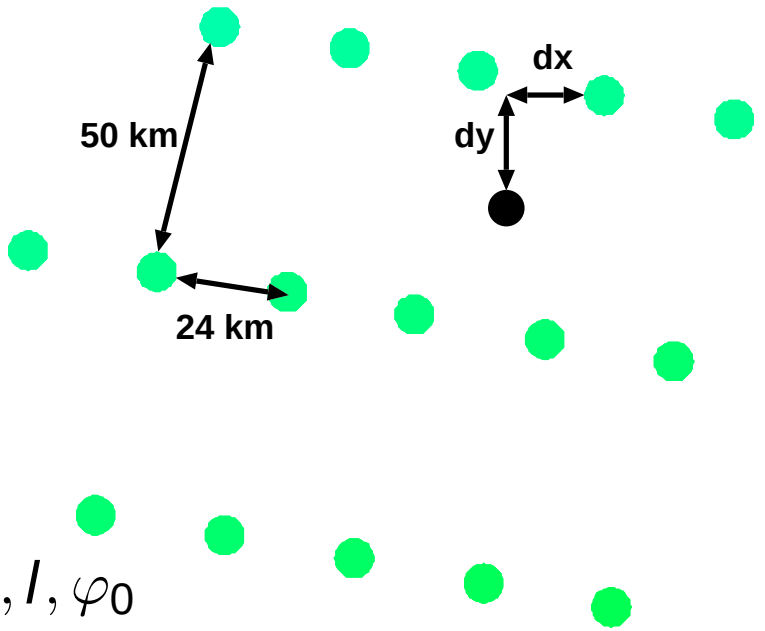

stratosphere
global circulation
composition
<-> climate
interaction
dehydration
stratosphere <-> troposphere
exchange
radiative forcing
and H_2O feedback
IMIPAS
Infrared Imaging
STEAM-R
Microwave Imaging
clouds and chemistry
troposphere



- 24 km across track
  → 14 columns
- 50 km along track
  → ≈12500 scenes/day
- 0.5 km vertical
  → 5 km-54 km

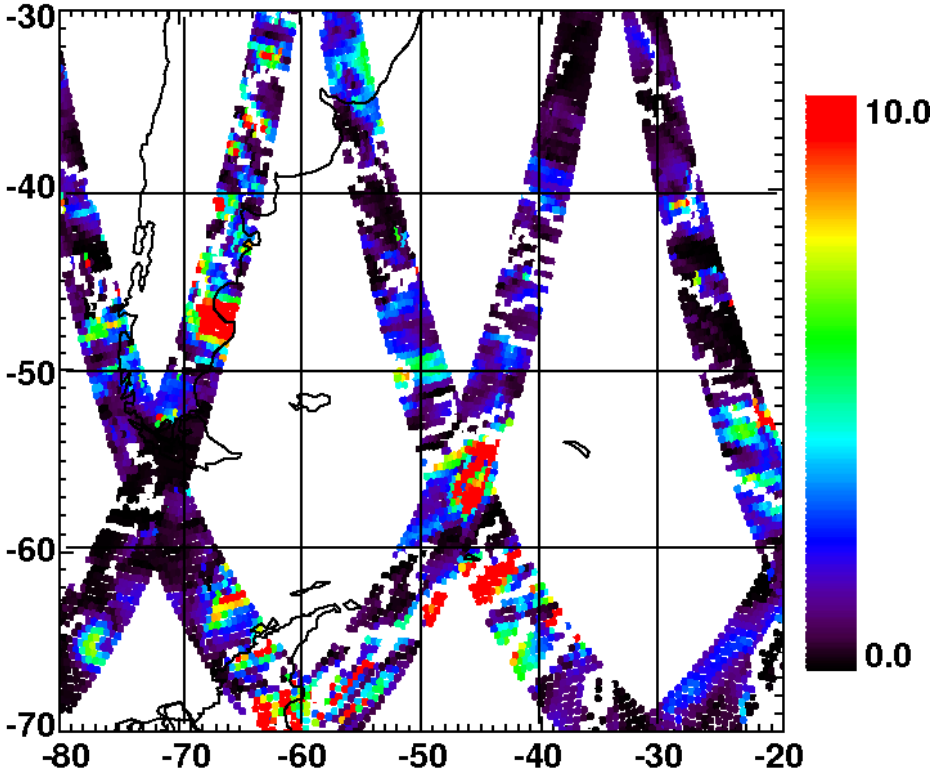
How to receive momentum flux

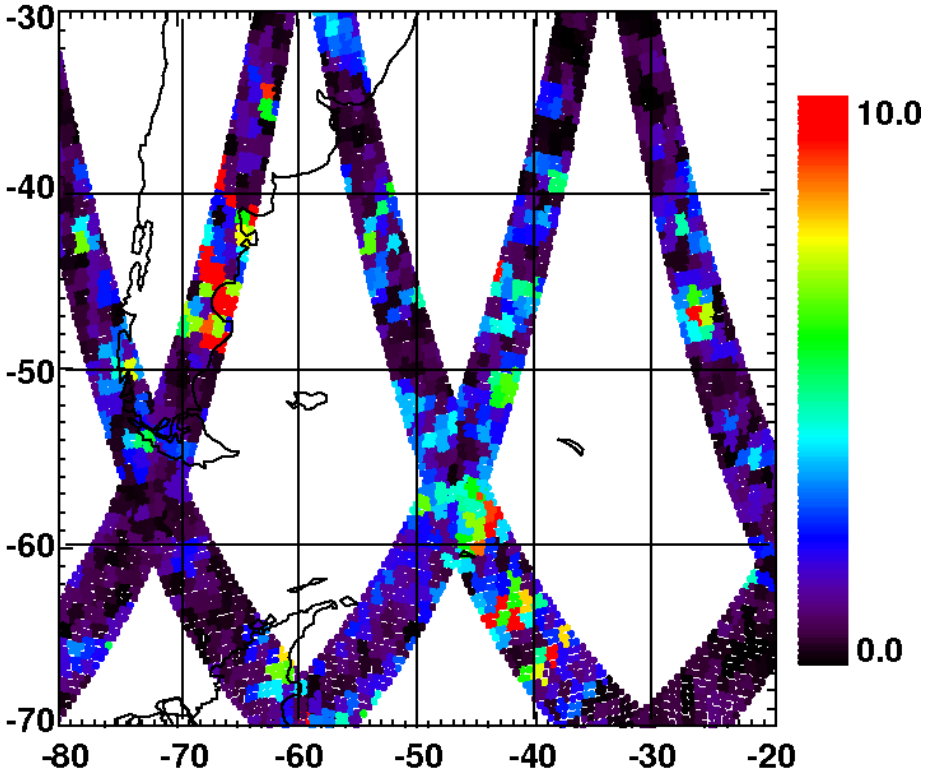
- $(F_{px}, F_{py}) = \bar{\varrho} \cdot (\overline{u'w'}, \overline{v'w'})$ $\rightarrow$ ECMWF
- $(F_{px}, F_{py}) = \frac{1}{2} \varrho \frac{(k,l)}{m} \left(\frac{g}{N}\right)^2 \left(\frac{\hat{T}}{T}\right)^2$



- using last square fit do determine k, l, φ_0
  $\varphi_i = kx_i + ly_i + \varphi_0$

Momentum Flux





- left: via temperature data
- right: via wind data

Summary

- ECMWF can well resolve GWs over mountain regions and the edge of the Antarctic polar vortex, but the ECMWF temperature amplitudes are too low
- ECMWF data can be used to determine momentum flux on PREMIER measurement grid
- Both procedures of MF calculation show similar results