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

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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

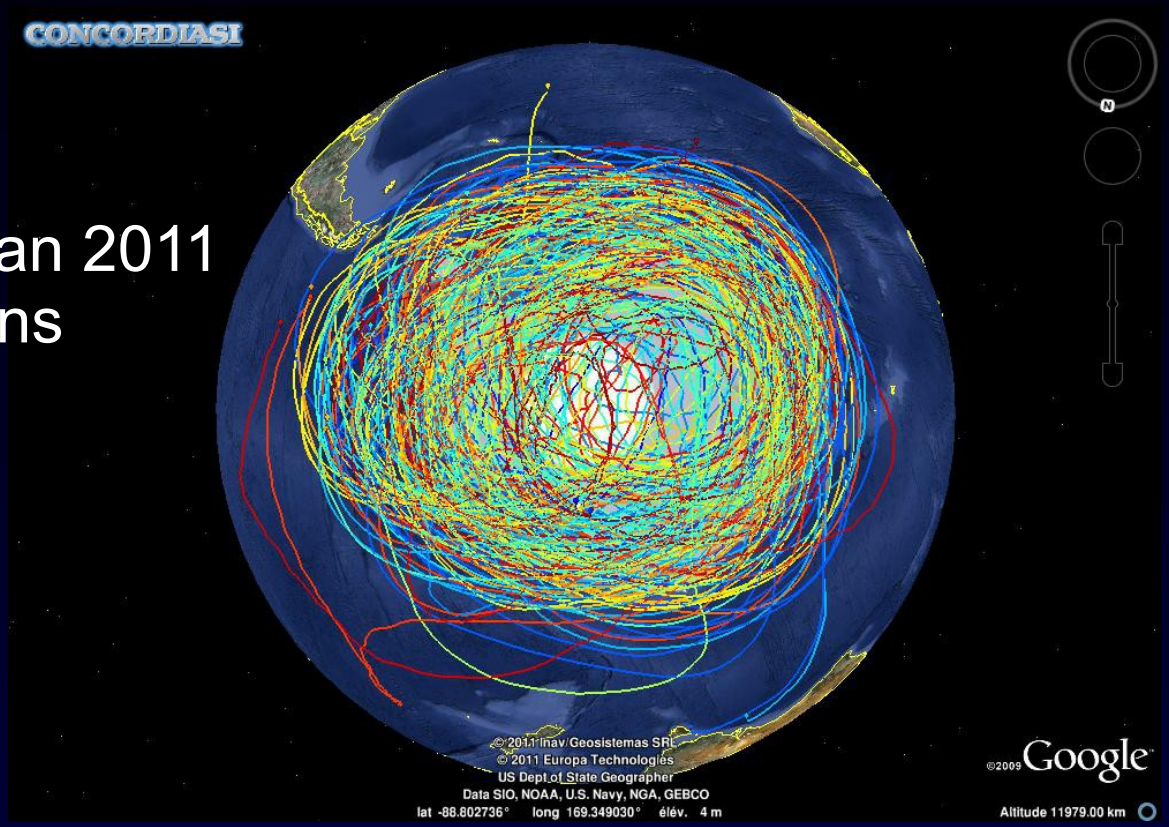
- Similar to operational analyses

but…

- Frozen version of the model and +35 years of data
- T255 → 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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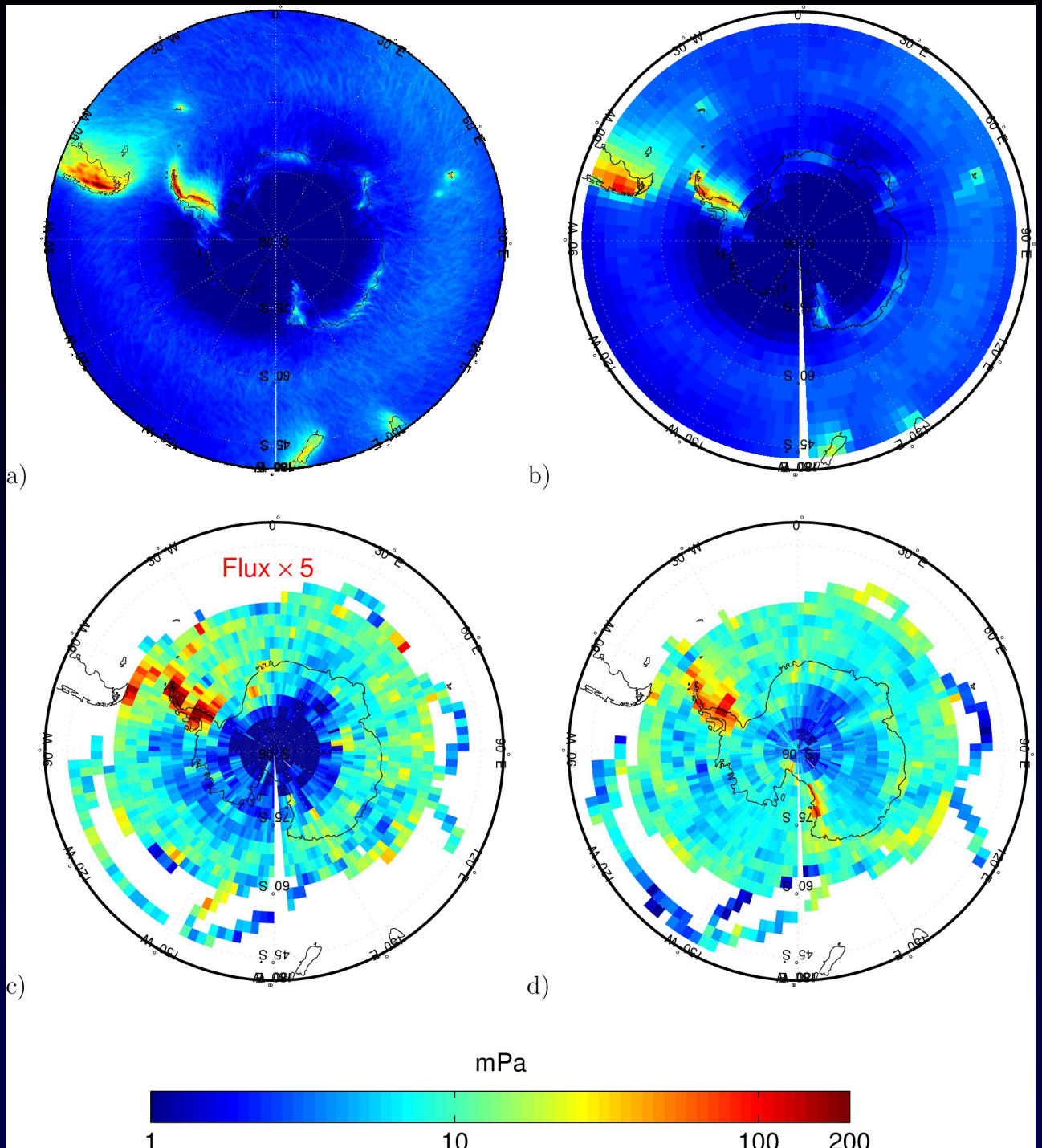
EOA momentum flux *(Jewtoukoff et al 2015)*

EOA
0.125°

EOA
2.5°

EOA
balloon
sampled

Concordiasi

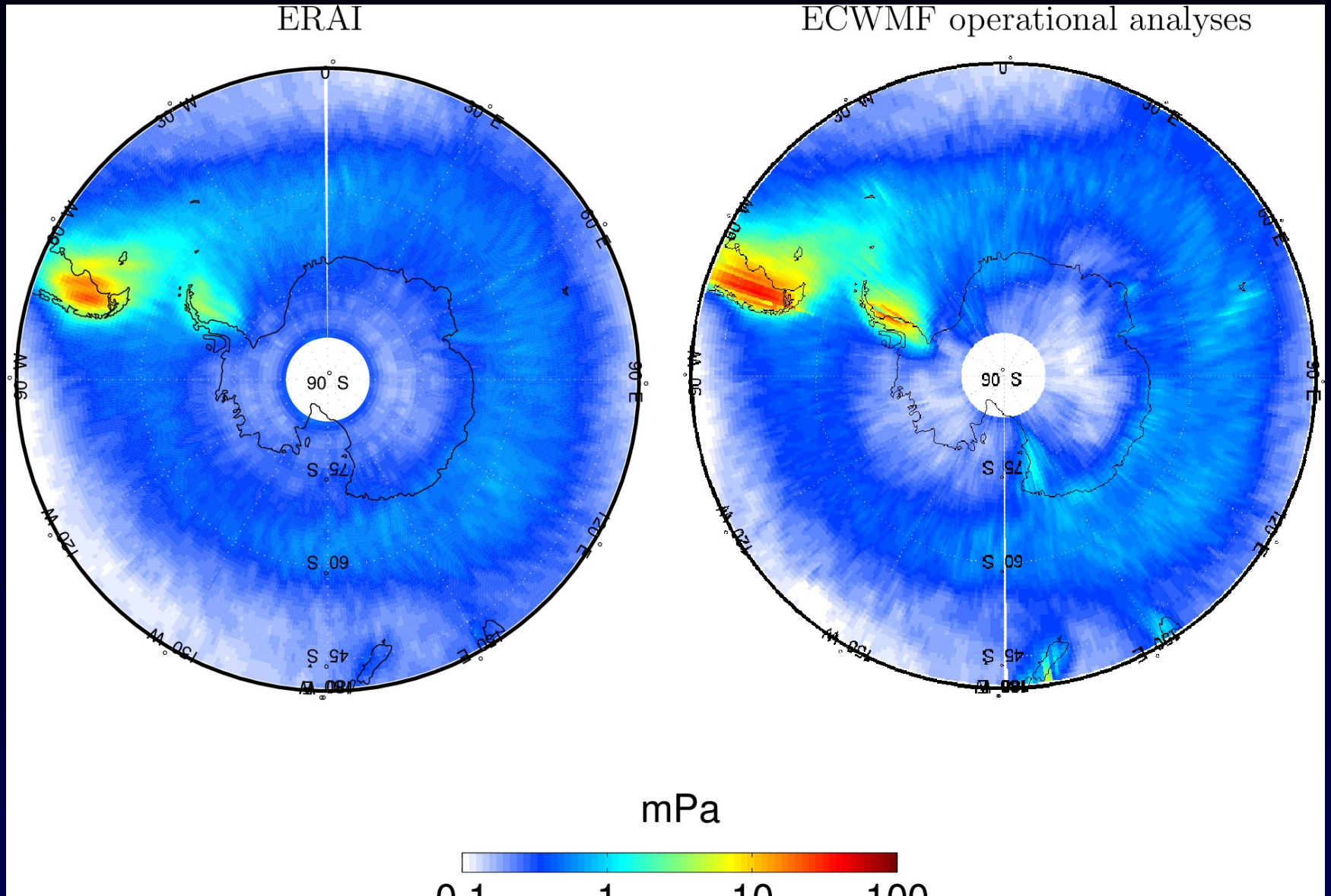


EOA vs Concordiasi

- 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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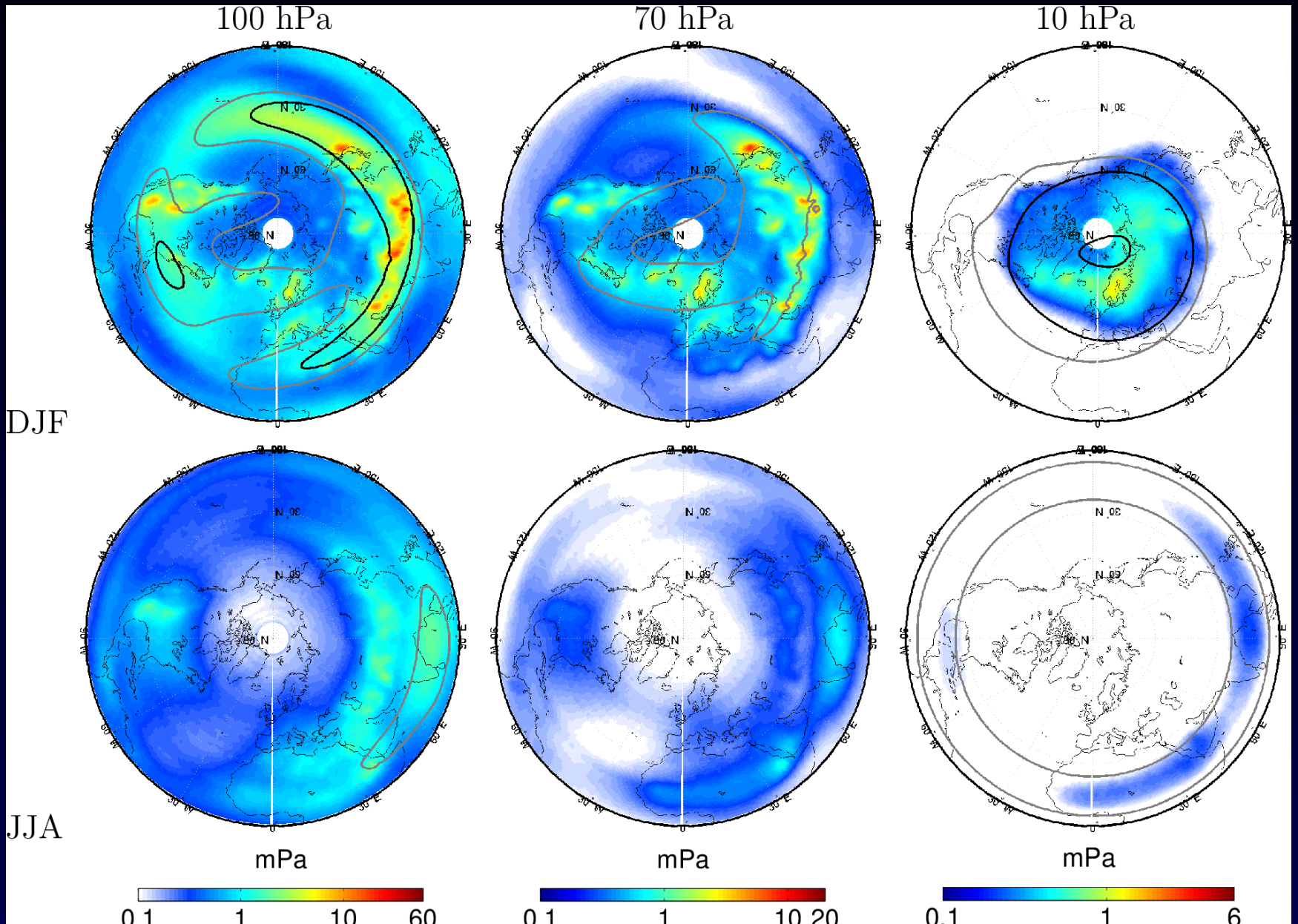
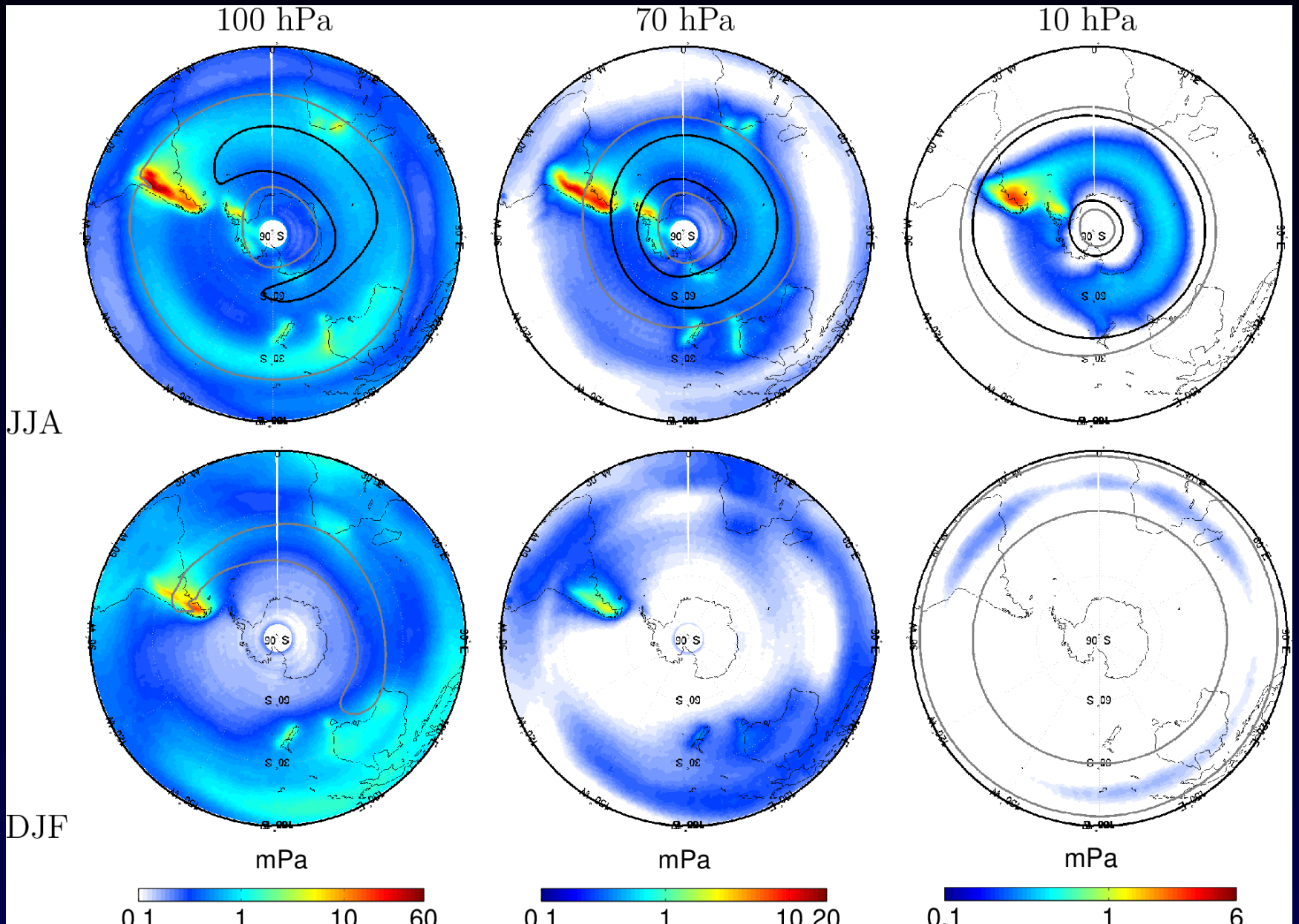
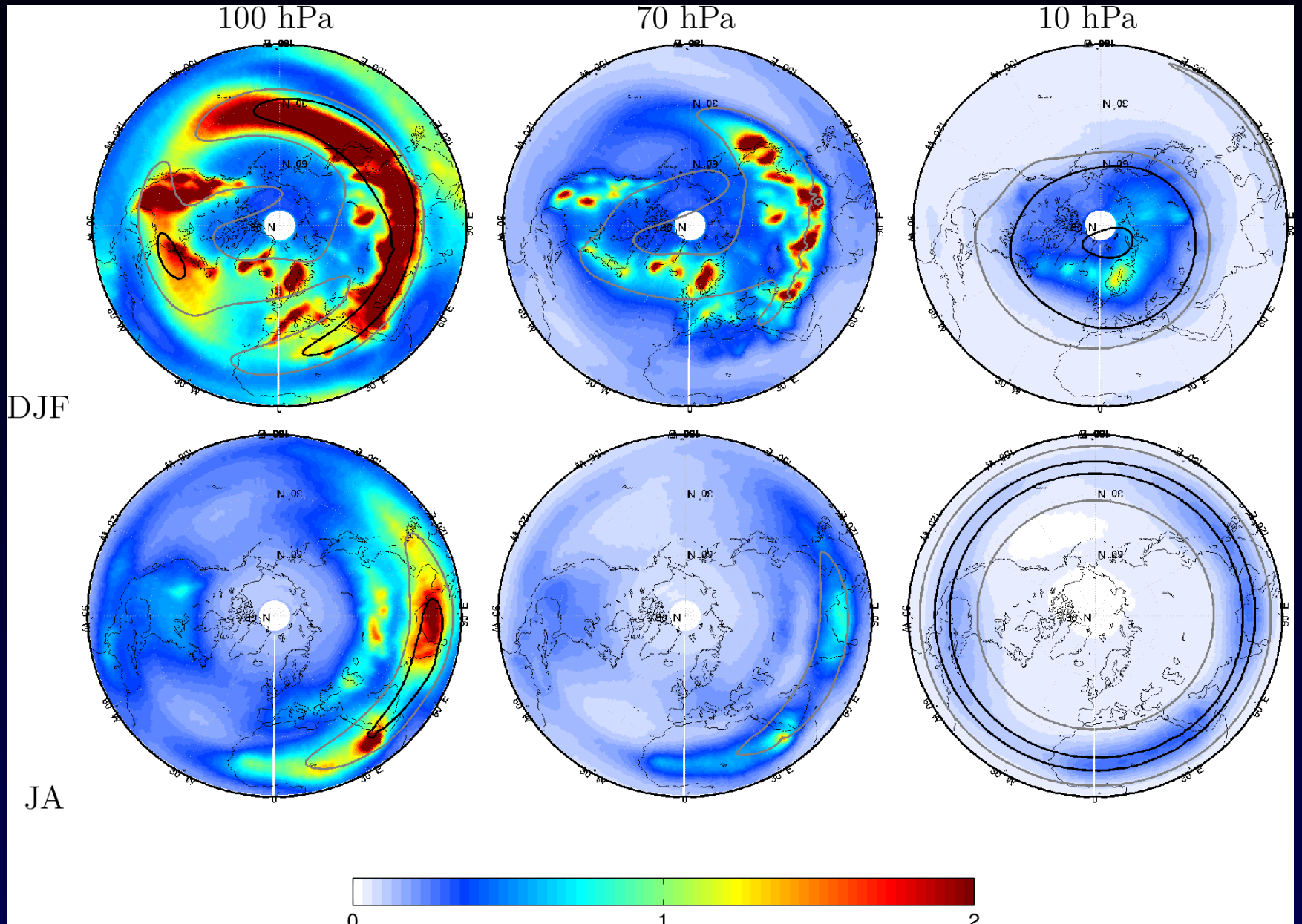
1979-2010 GWMF Northern Hemisphere



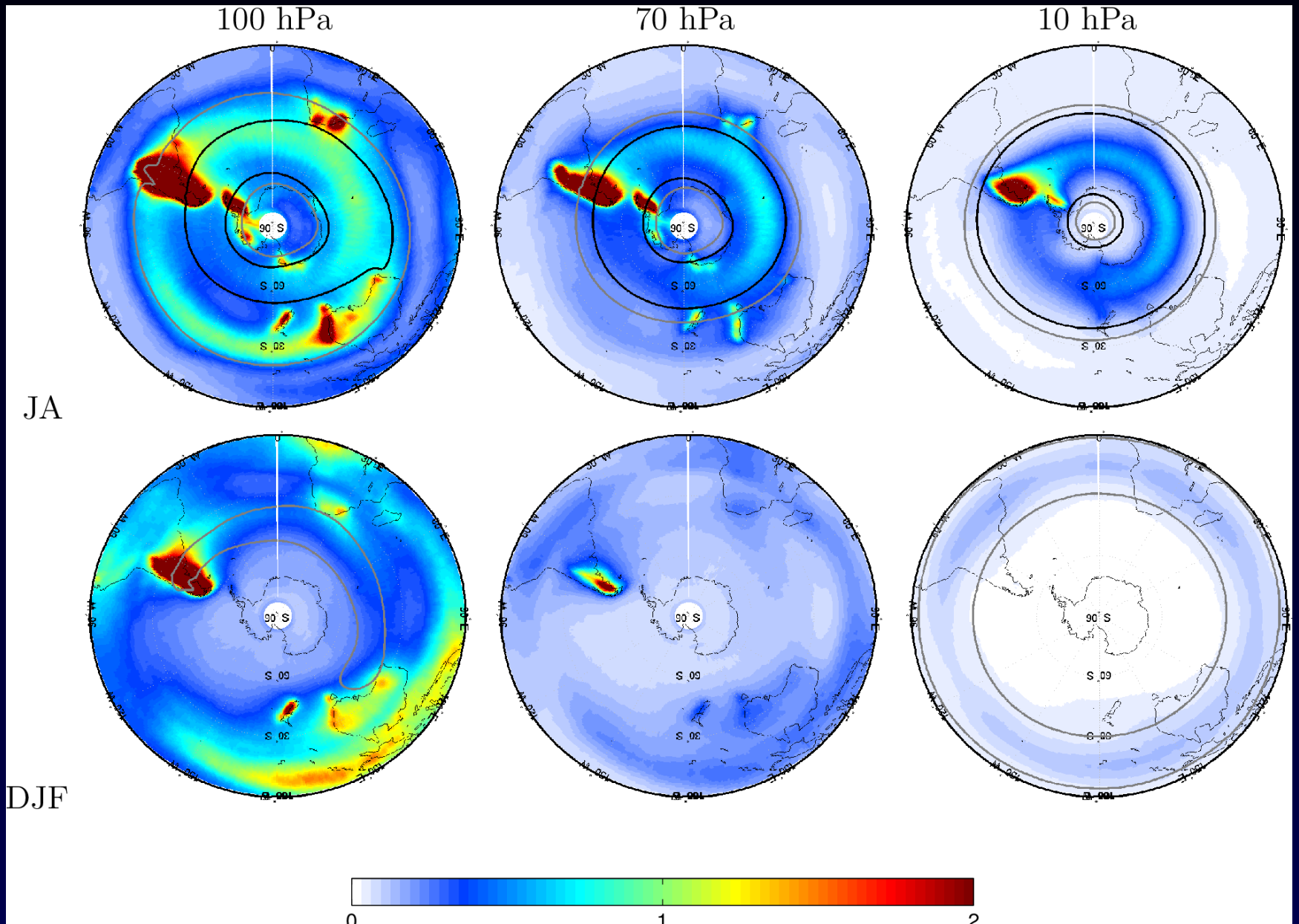
1979-2010 GWMF Southern Hemisphere



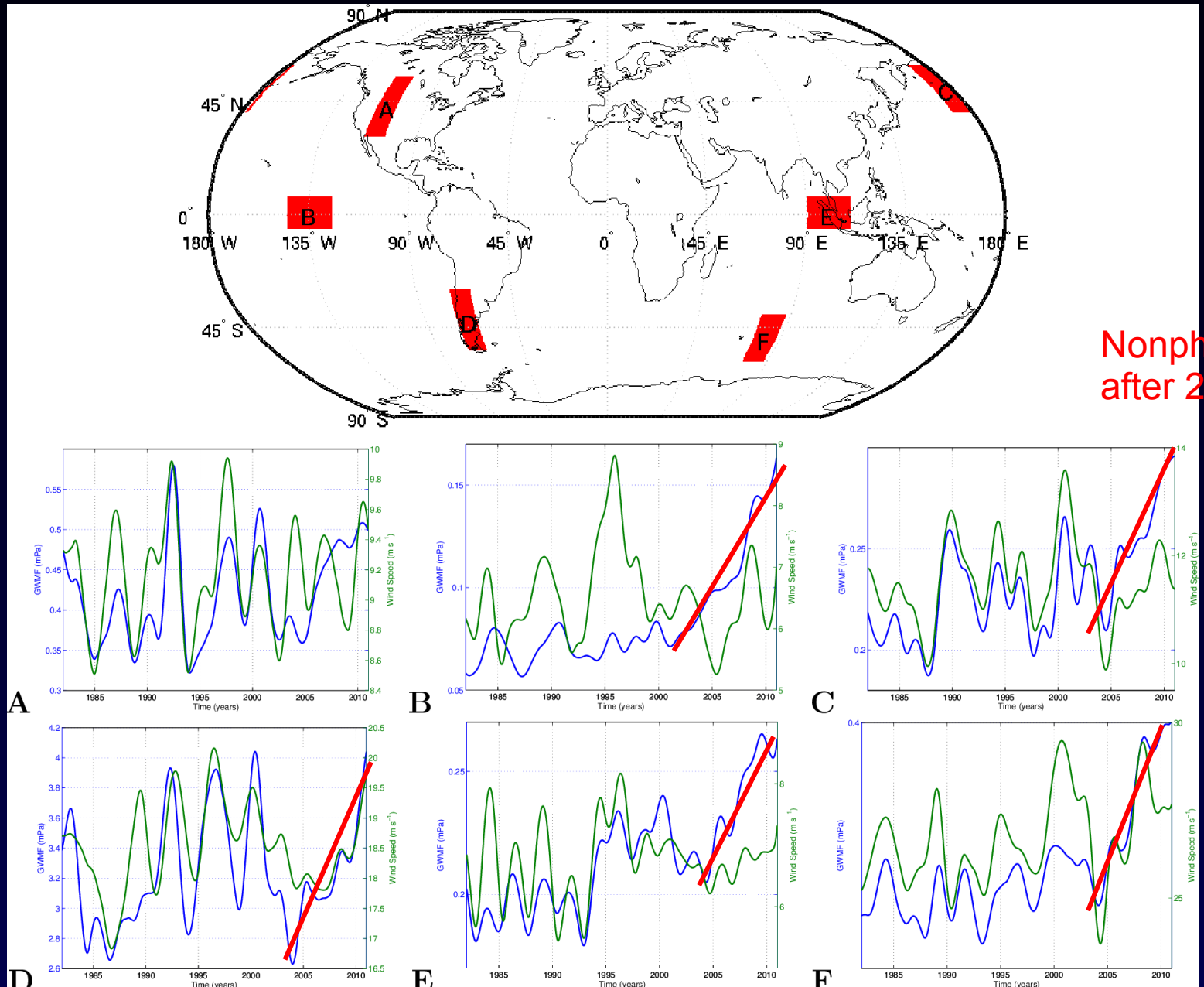
1979-2010 normalized STD Northern Hemisphere



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

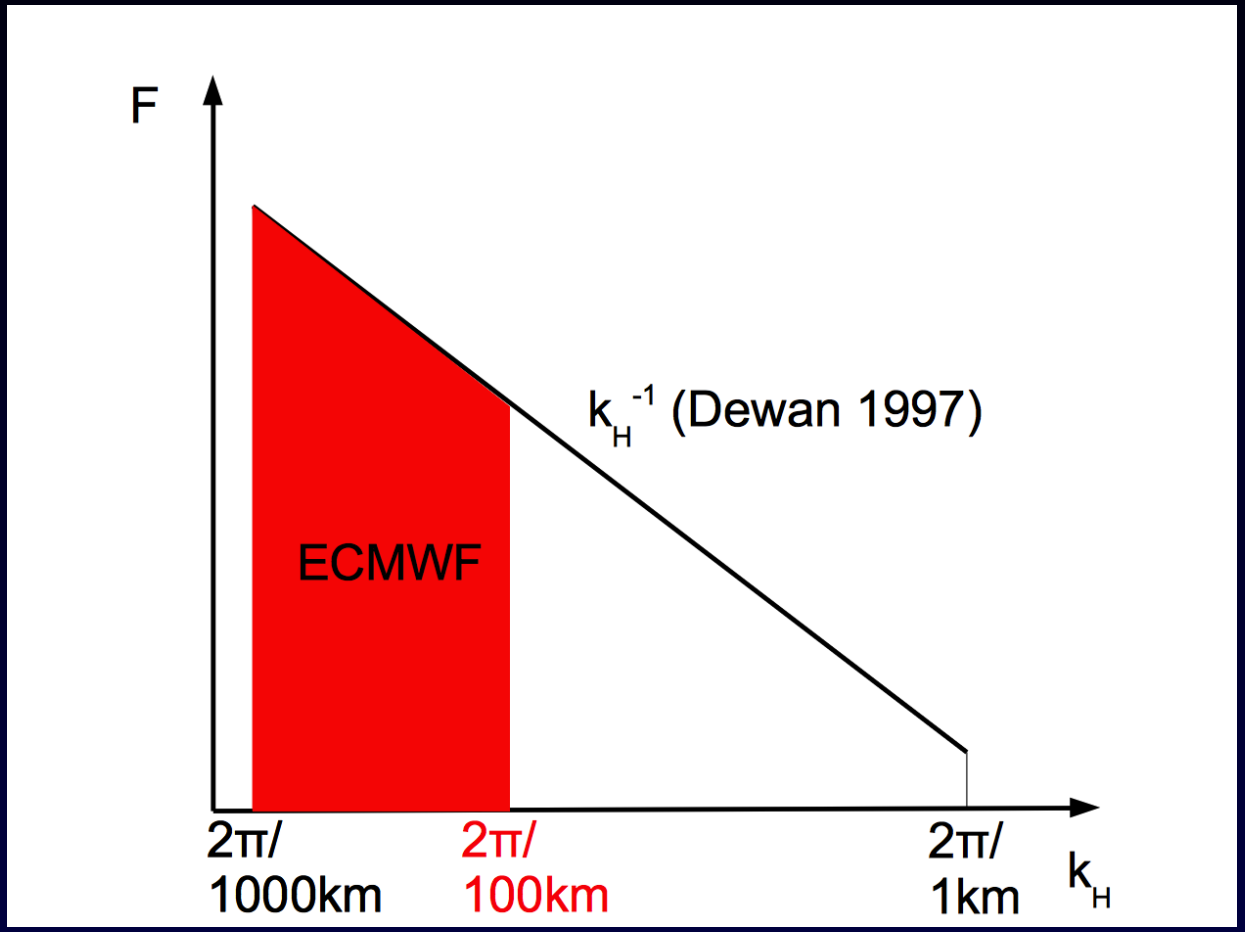
  summer: convection/monsoon

  +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: 5