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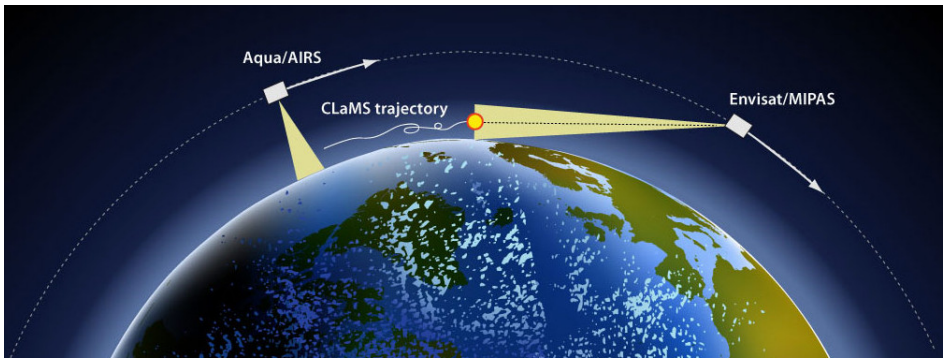
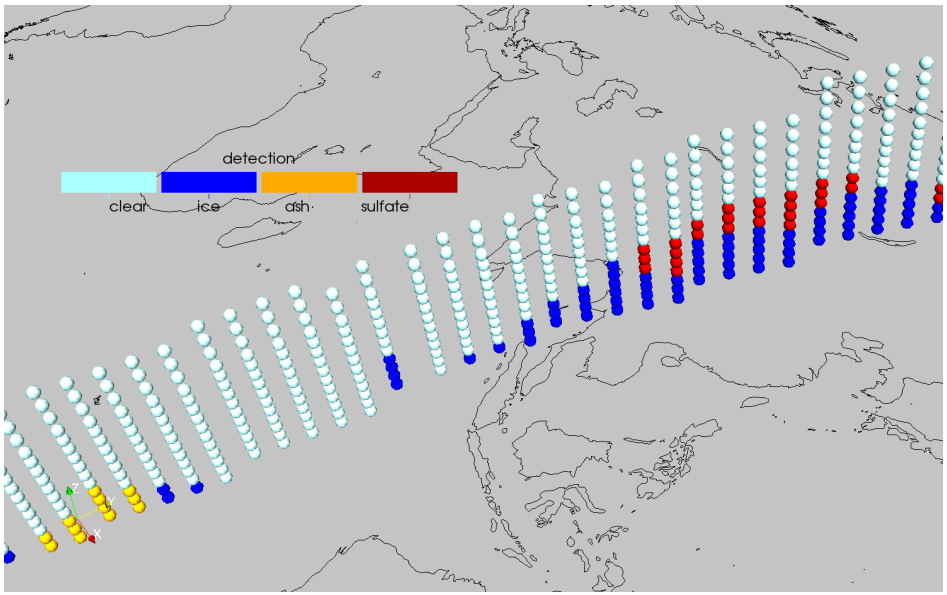
Aerosol detection with IR limb measurements in the troposphere and stratosphere

10 June 2015 | S. Griessbach, L. Hoffmann, R. Spang, M. von Hobe, R. Müller, M. Riese

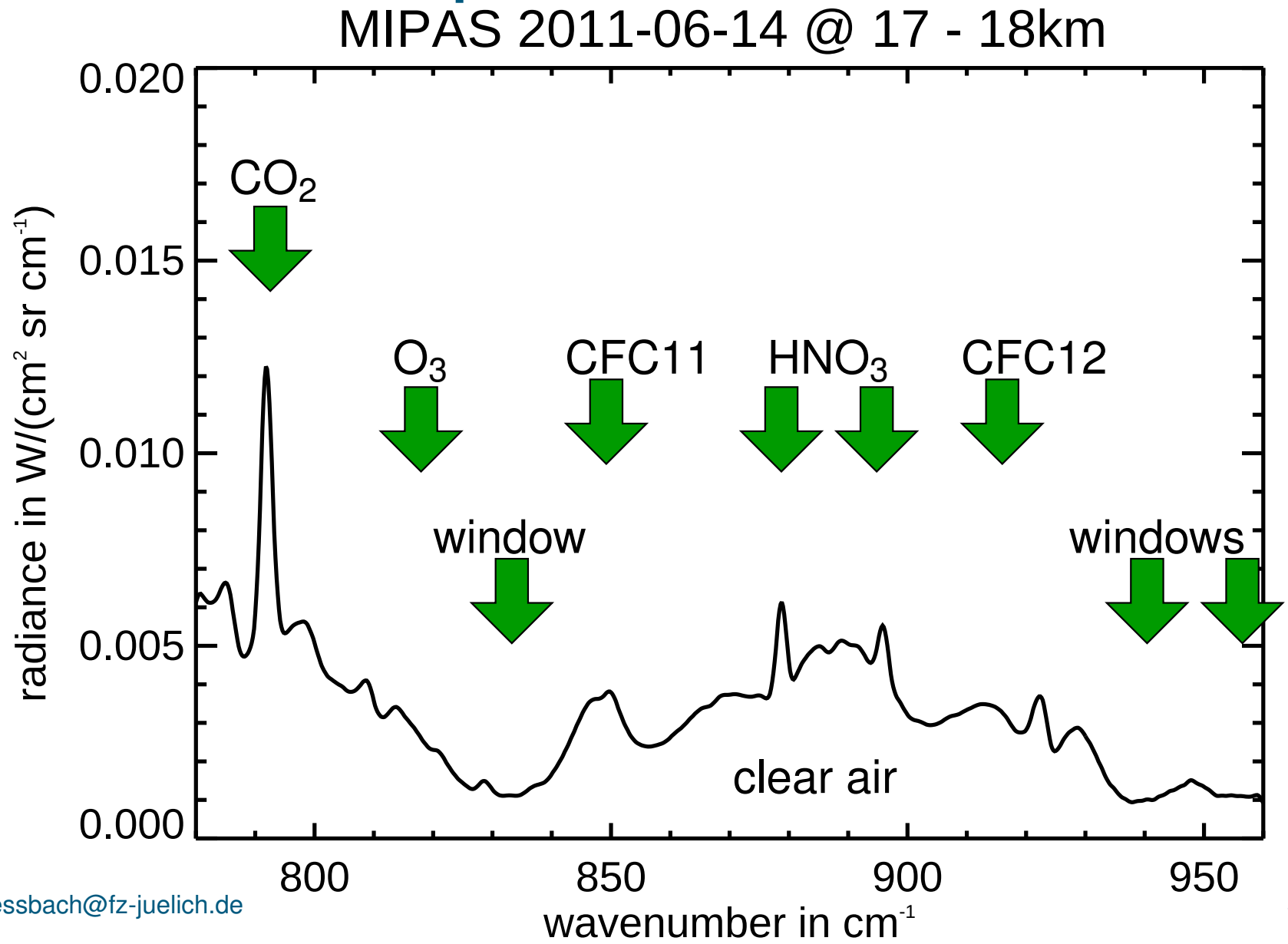
Envisat MIPAS



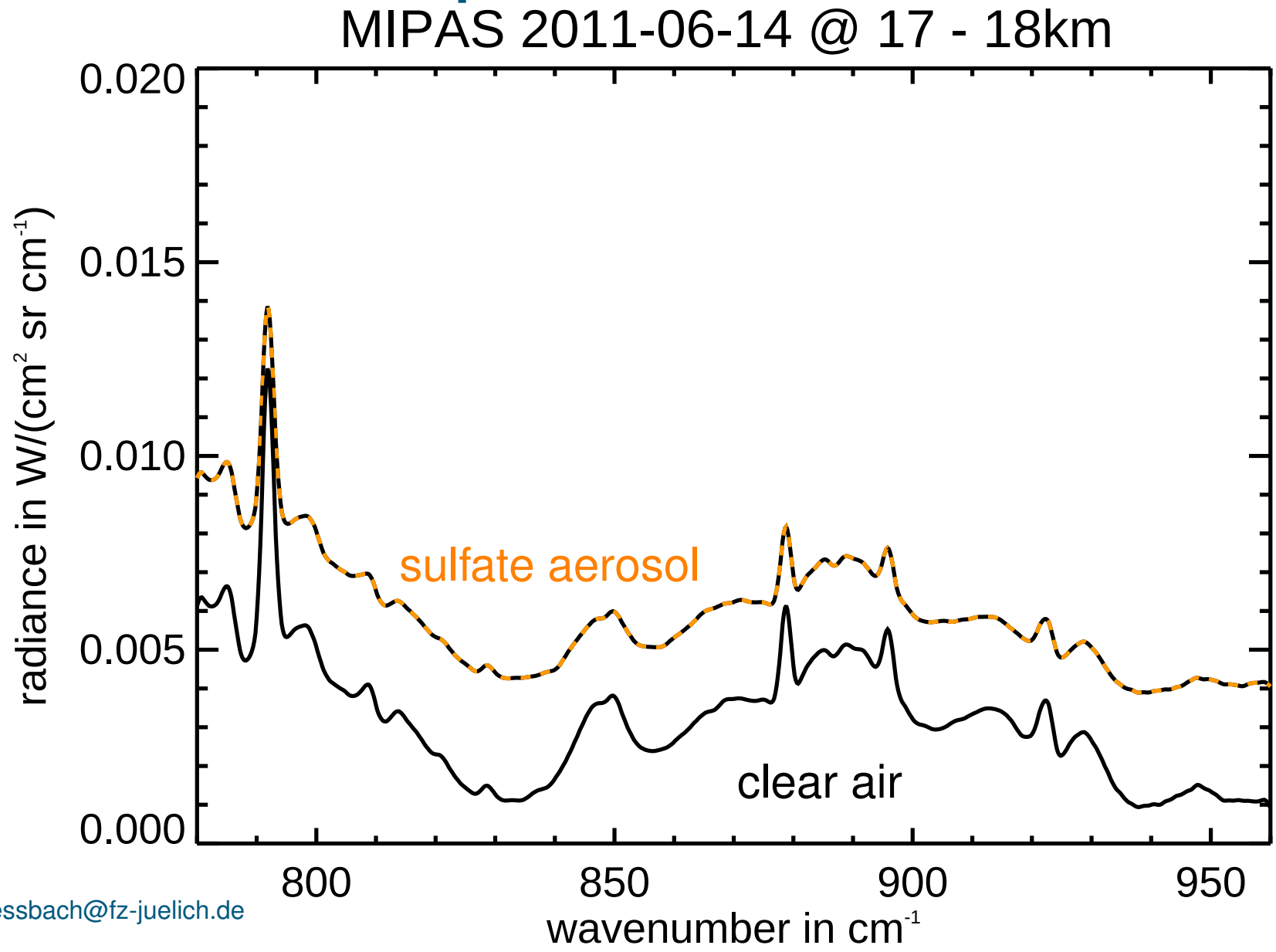


- Envisat MIPAS: 2002 – 2012
- infrared limb sounder $4 - 16\,\mu$m ($2410 - 685\,\mathrm{cm}^{-1}$)
- 14 orbits per day
- global coverage day and night
- high spectral resolution: $0.0625\,\mathrm{cm}^{-1}$
- limb geometry: 5 – 70 km
- 1.5 km vertical sampling in the UTLS

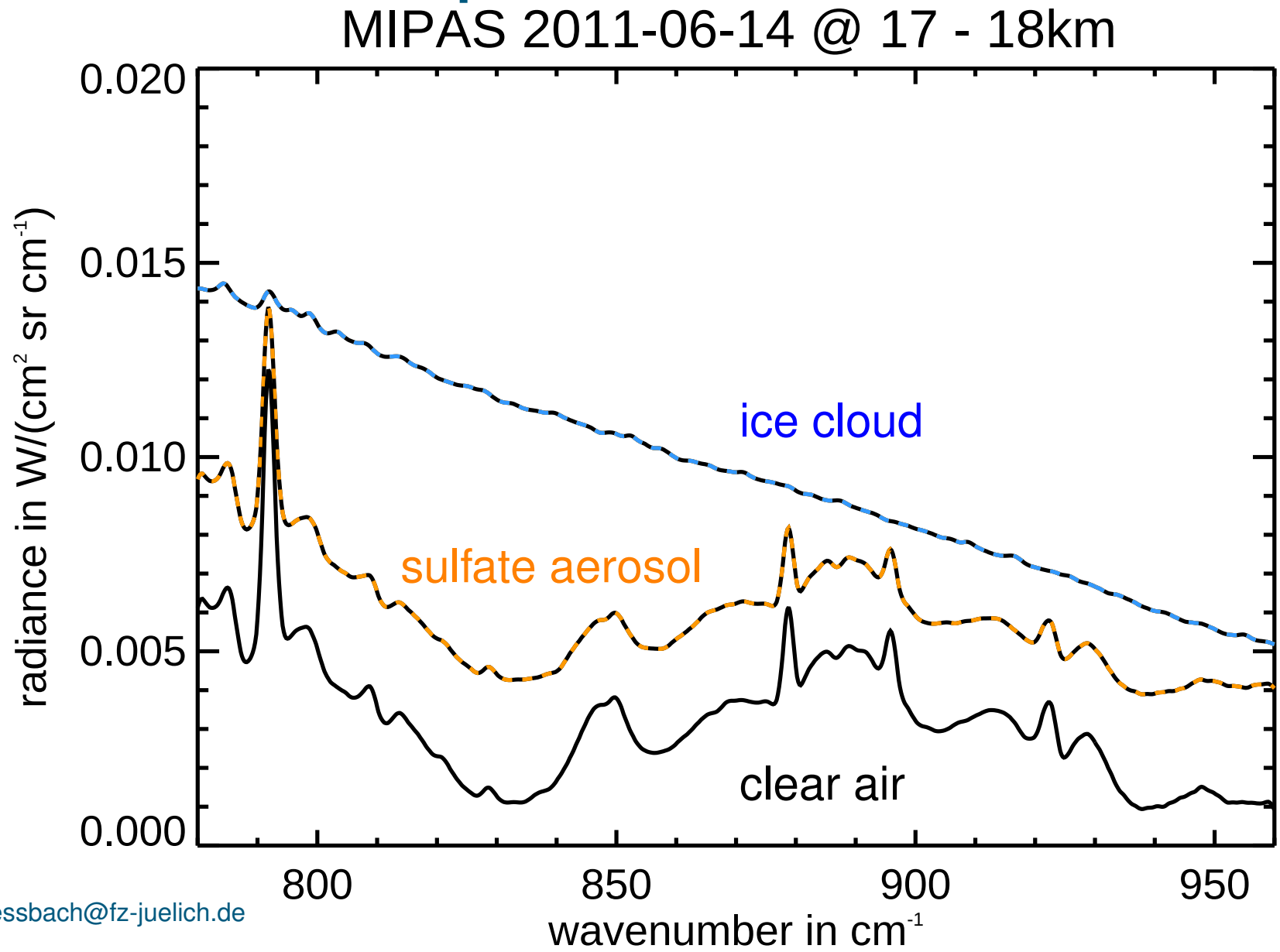
IR limb emission spectra



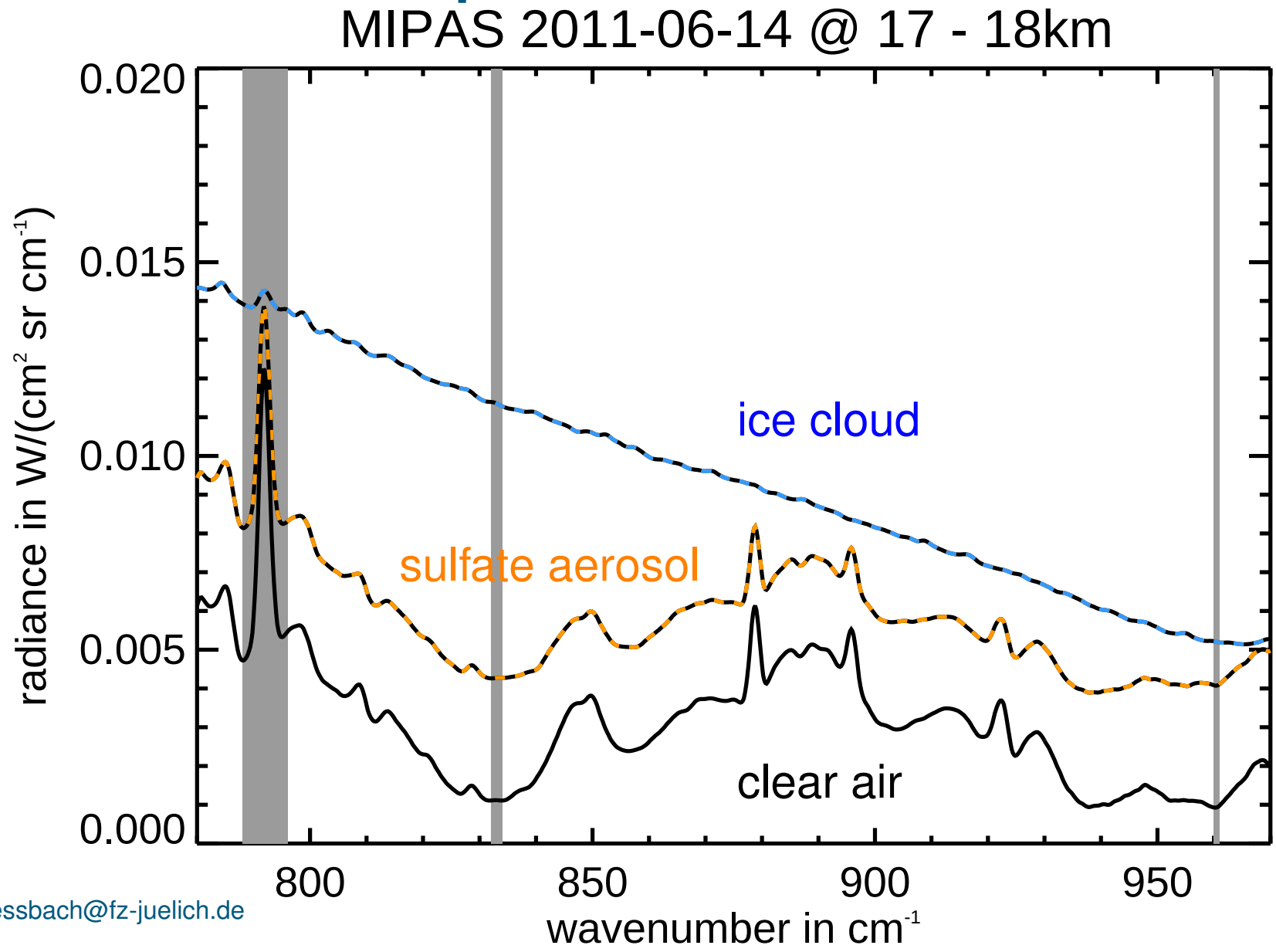
IR limb emission spectra



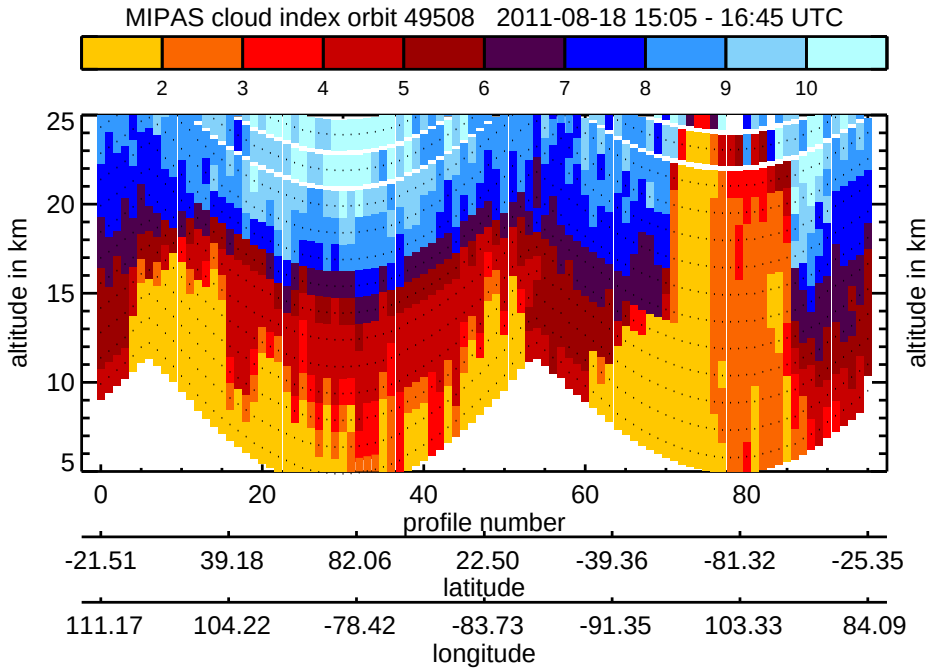
IR limb emission spectra

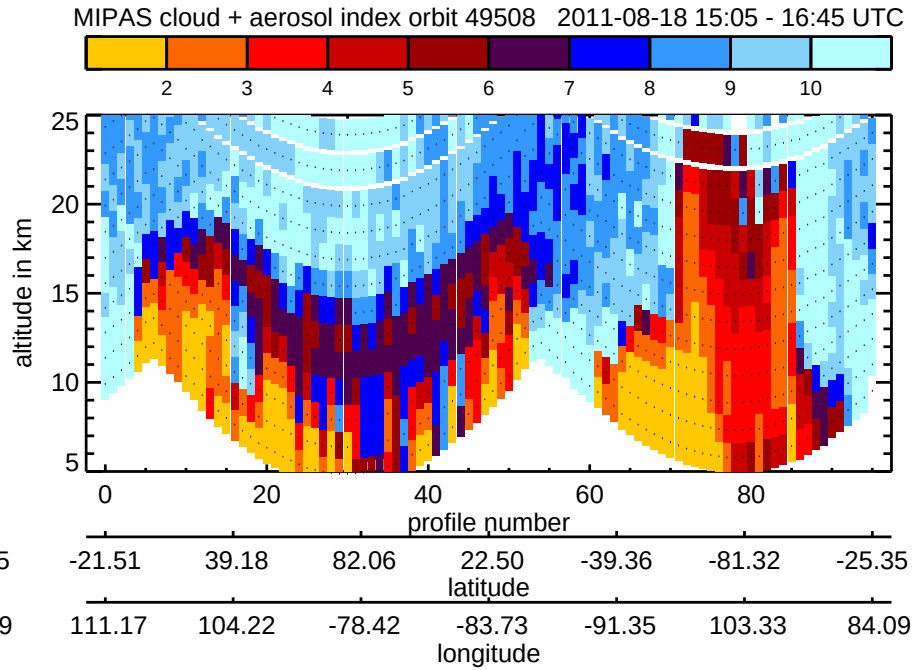


IR limb emission spectra



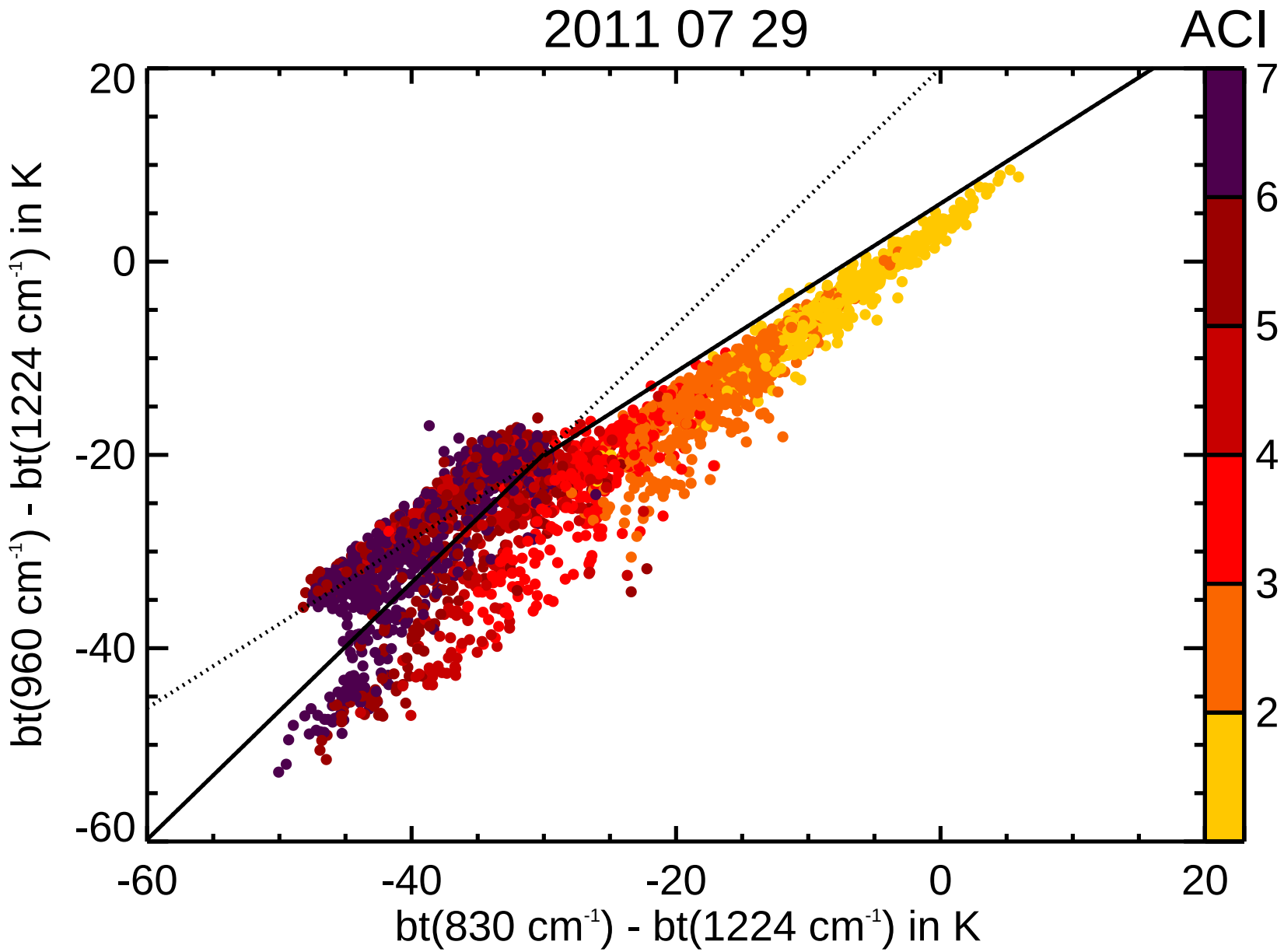
Cloud Index versus Aerosol-Cloud Index



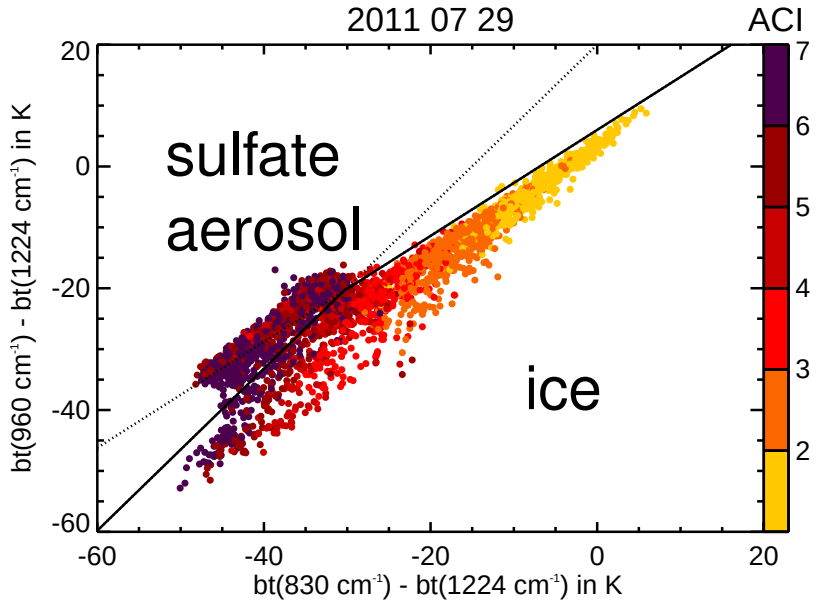


Aerosol-Cloud index values lower 7 indicate aerosol and clouds.

The New Aerosol Filter

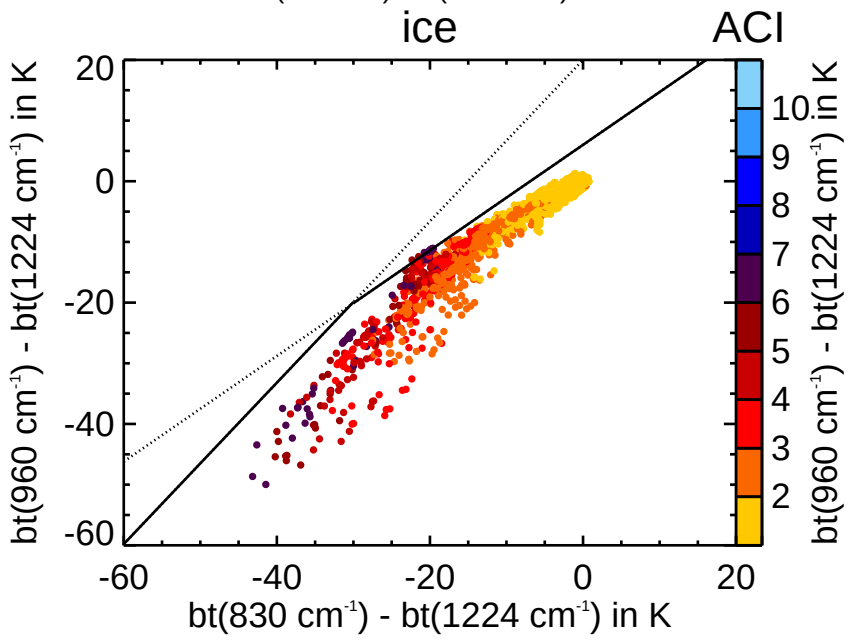


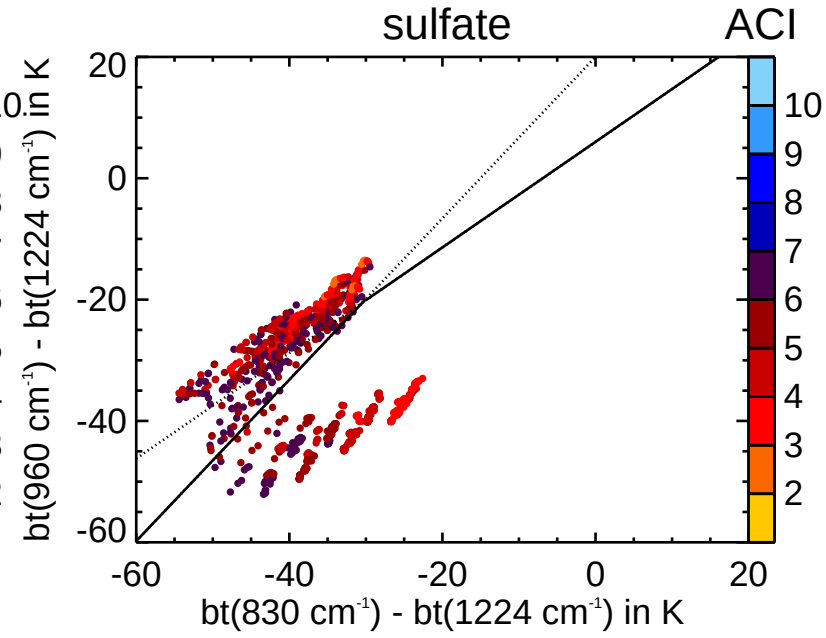
The New Aerosol Filter



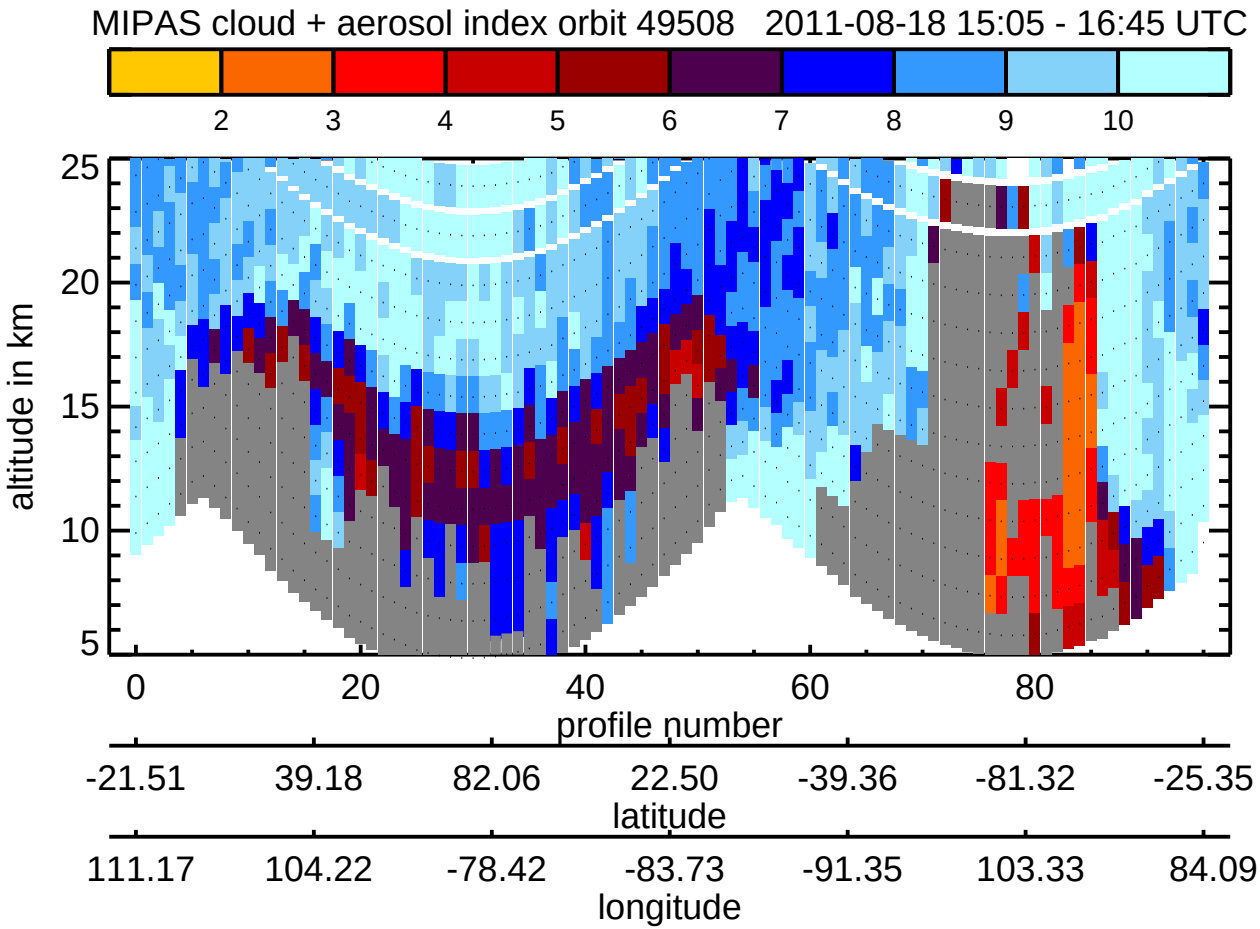
MIPAS measurements

Simulations



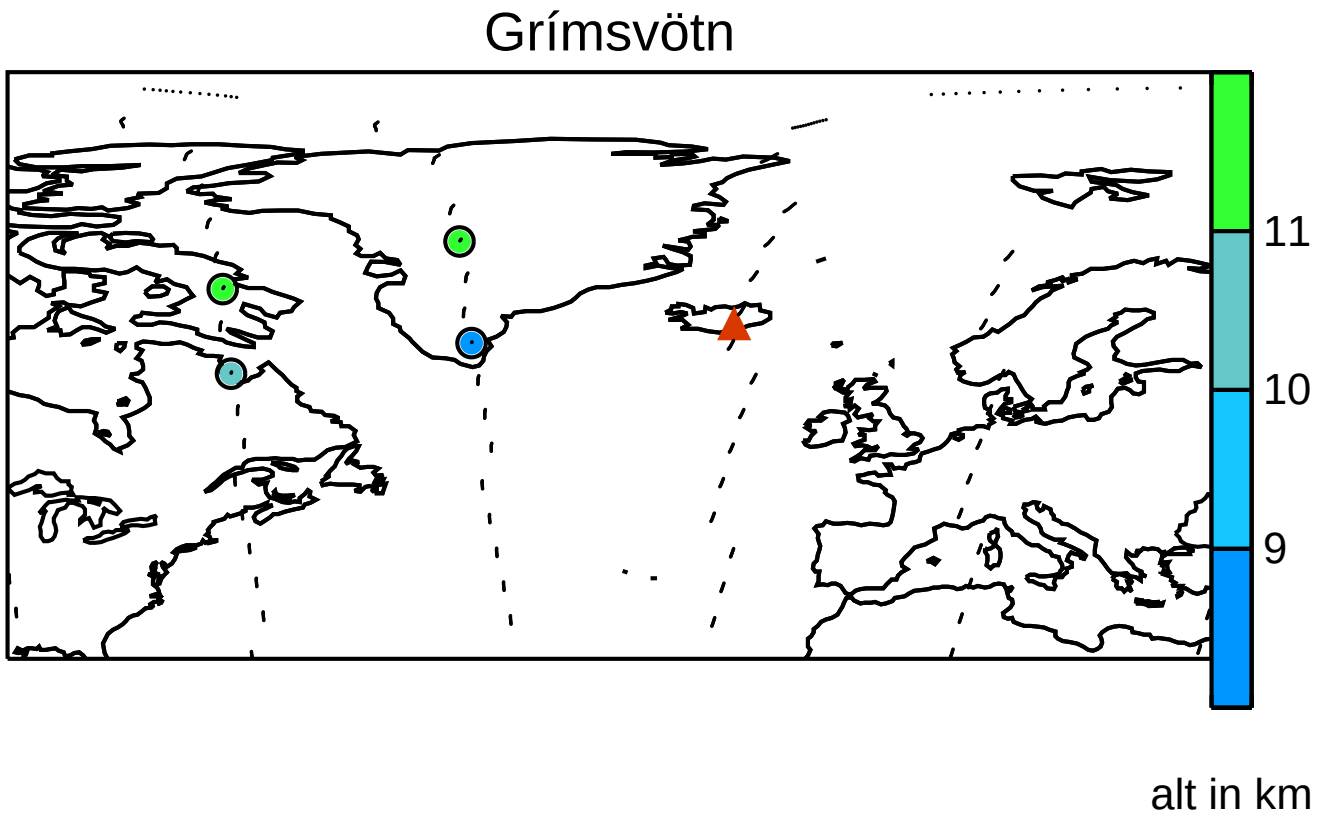


Aerosol Detections



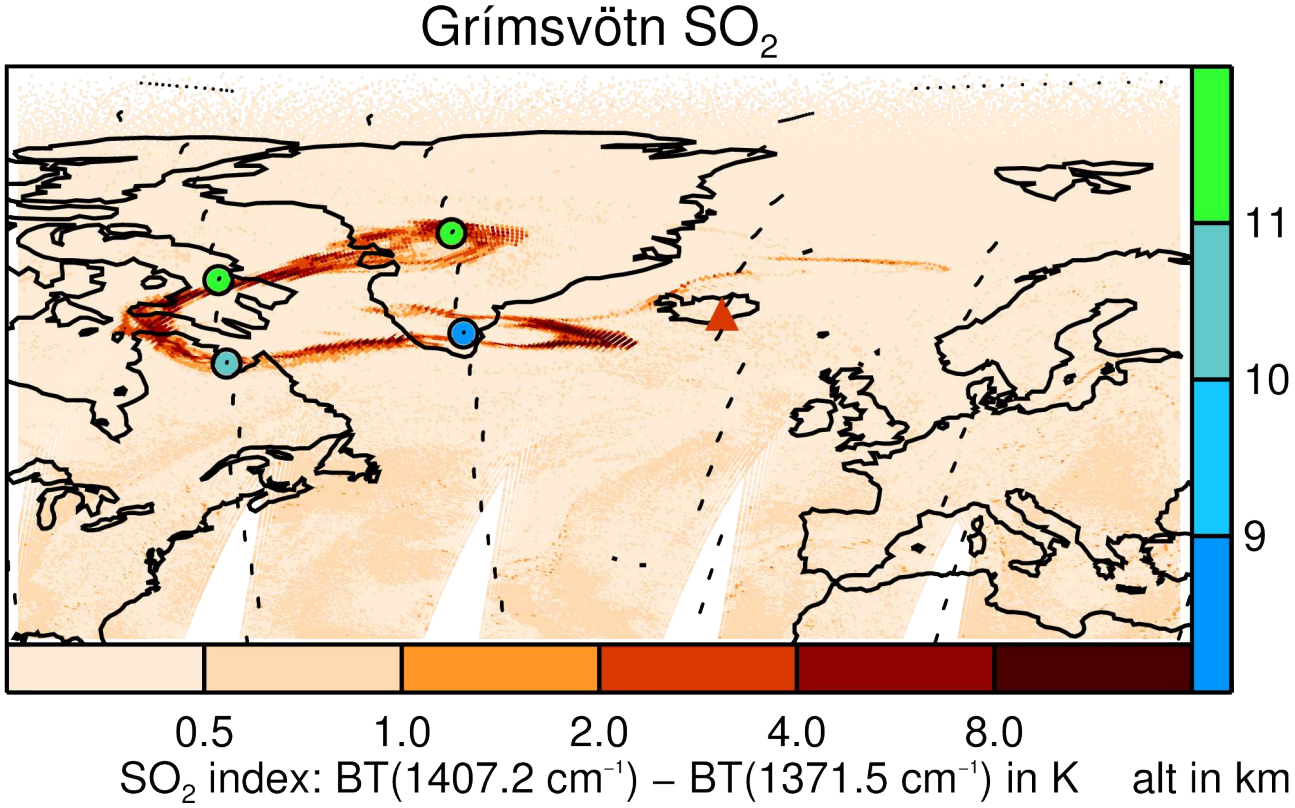
grey: ice, optically thick
blue: clear air
dark red/purple: sulfate aerosol
orange/red: NAT/STS PSCs

Method Verification - Location



MIPAS sulfate aerosol detections for Grimsvötn eruption in May 2011 in Iceland.

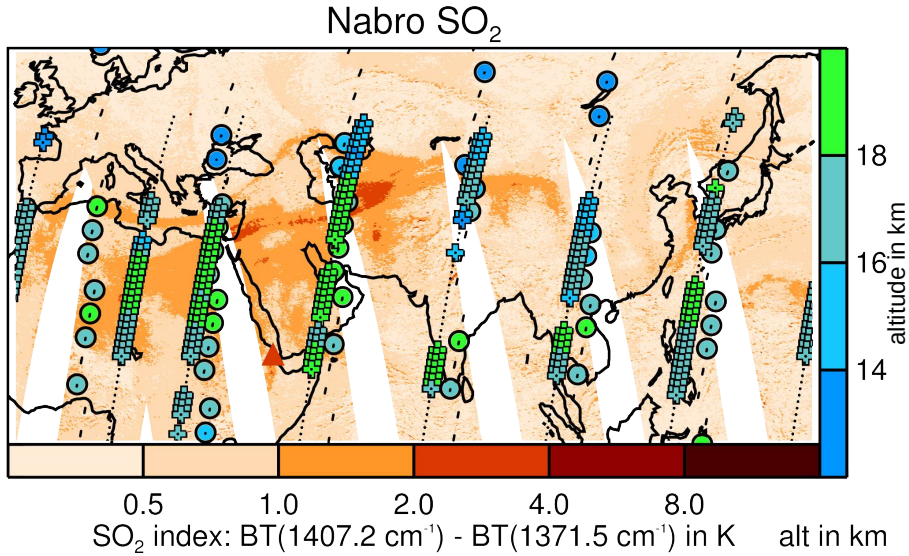
Method Verification - Location



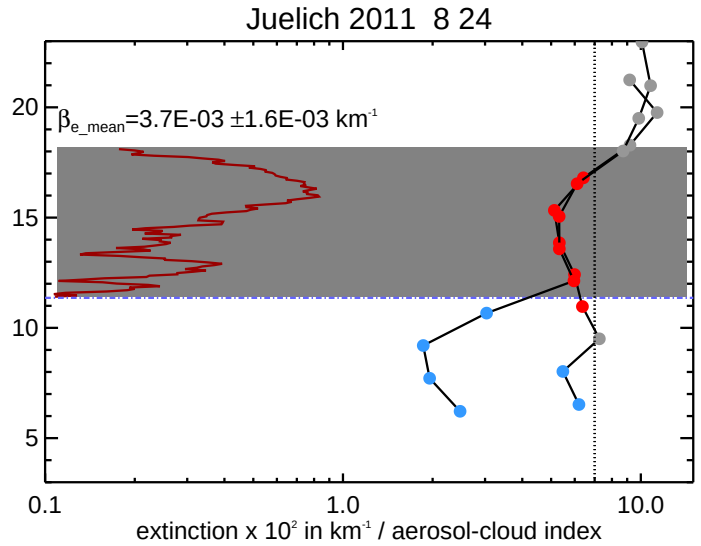
Comparison of MIPAS sulfate aerosol and AIRS SO_2 nadir measurements.[1]

[1] Griessbach et al.: Infrared limb emission measurements of aerosol in the troposphere and stratosphere, Atmos. Meas. Tech. Discuss., 8, 4379-4412, doi:10.5194/amtd-8-4379-2015, 2015

Method Verification - Altitude



Lidar data by courtesy of J.-P. Vernier

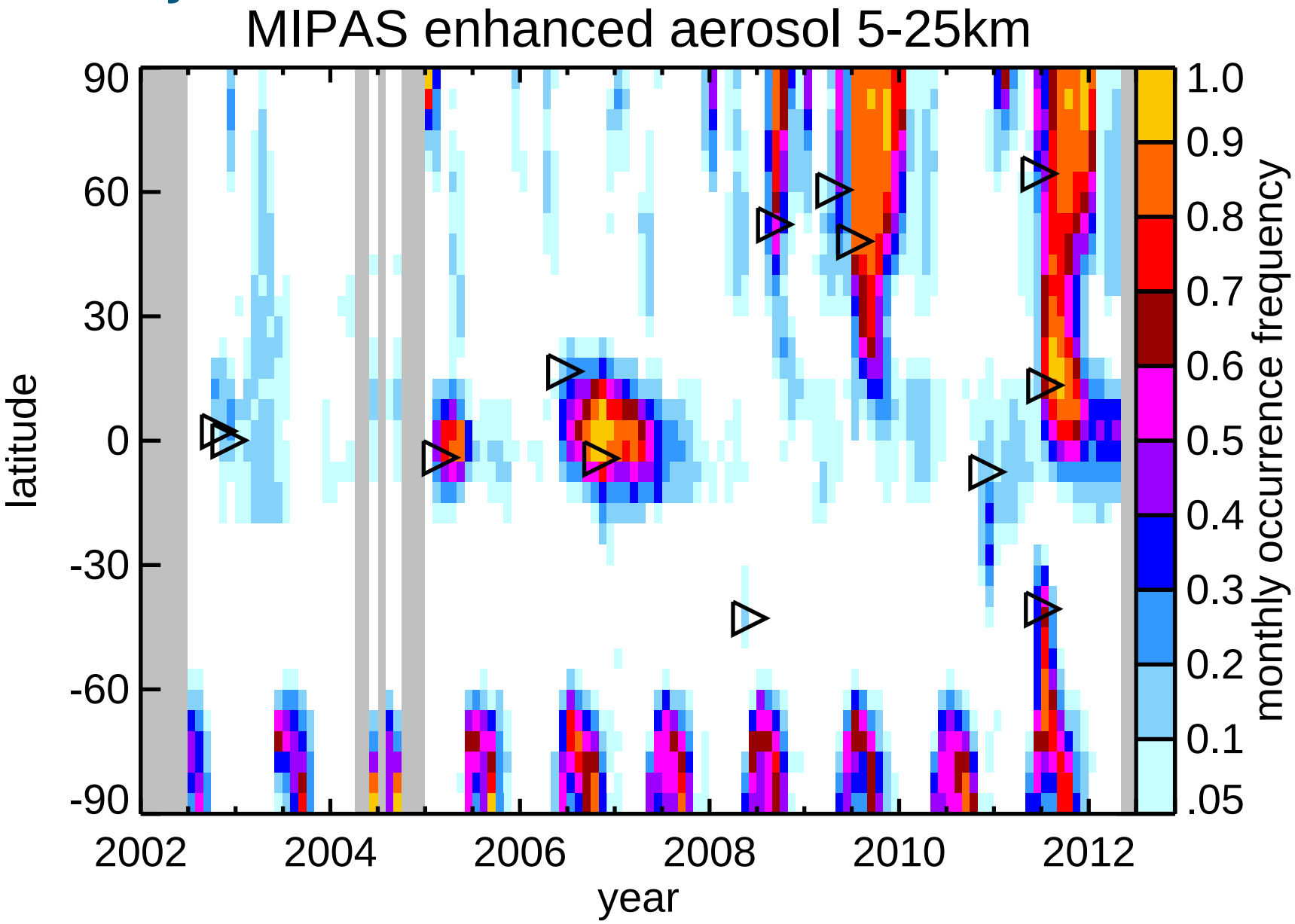


P. Achtert, C. Rolf, P. Seifert

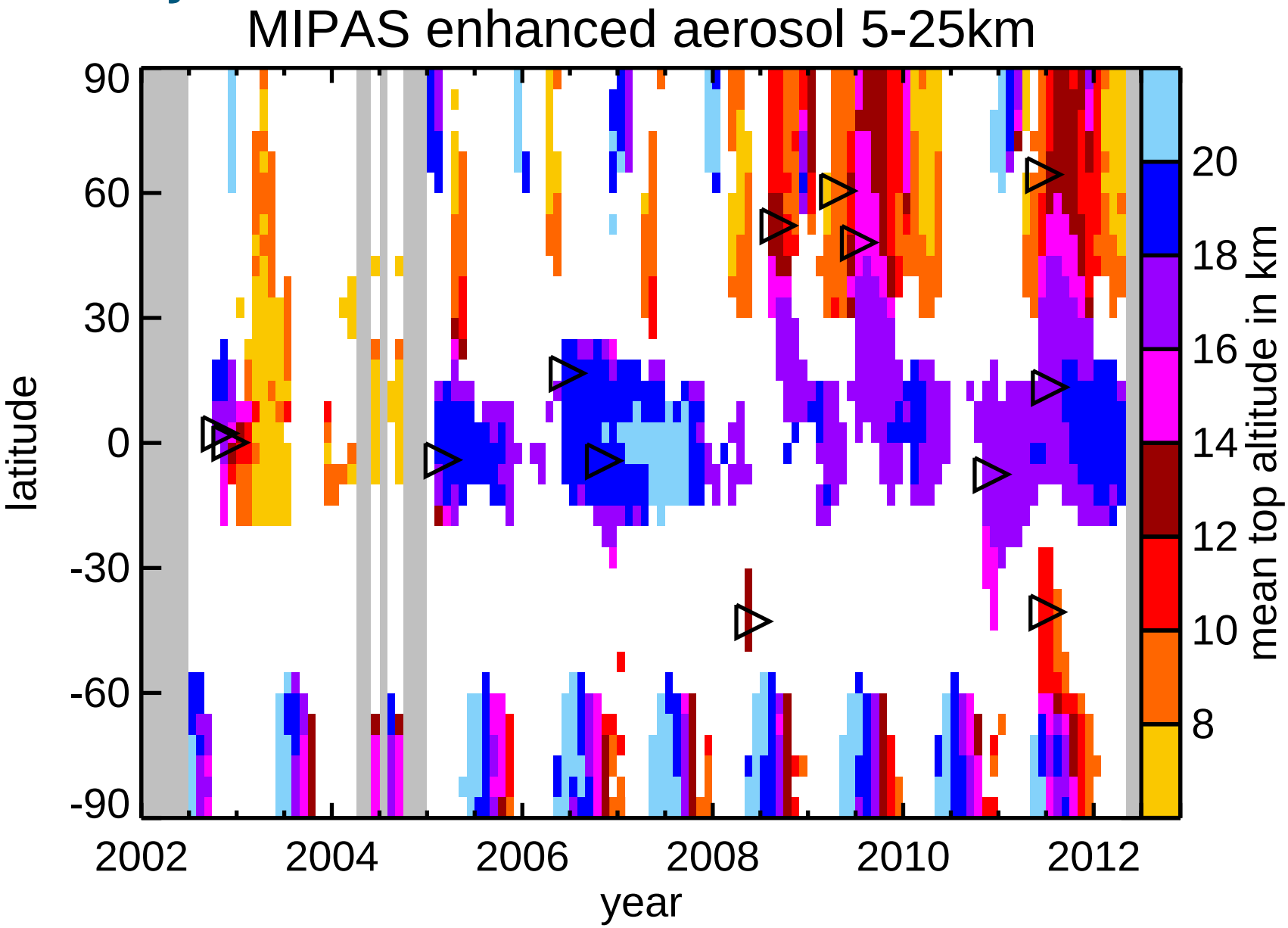
- 1146 – 1234 matches with CALIPSO between 0-50 N and 06–08/2011
- top altitude +1 km – -2.5 km, median -0.6 – -0.9 km
- 85 % underestimate top altitude
- bottom altitude -0.5 – -1.0±1.0 km

- 34(L) + 7(J) + 2(E) matches between 08/2011–02/2012
- top and bottom altitude differences depend on aerosol extinction

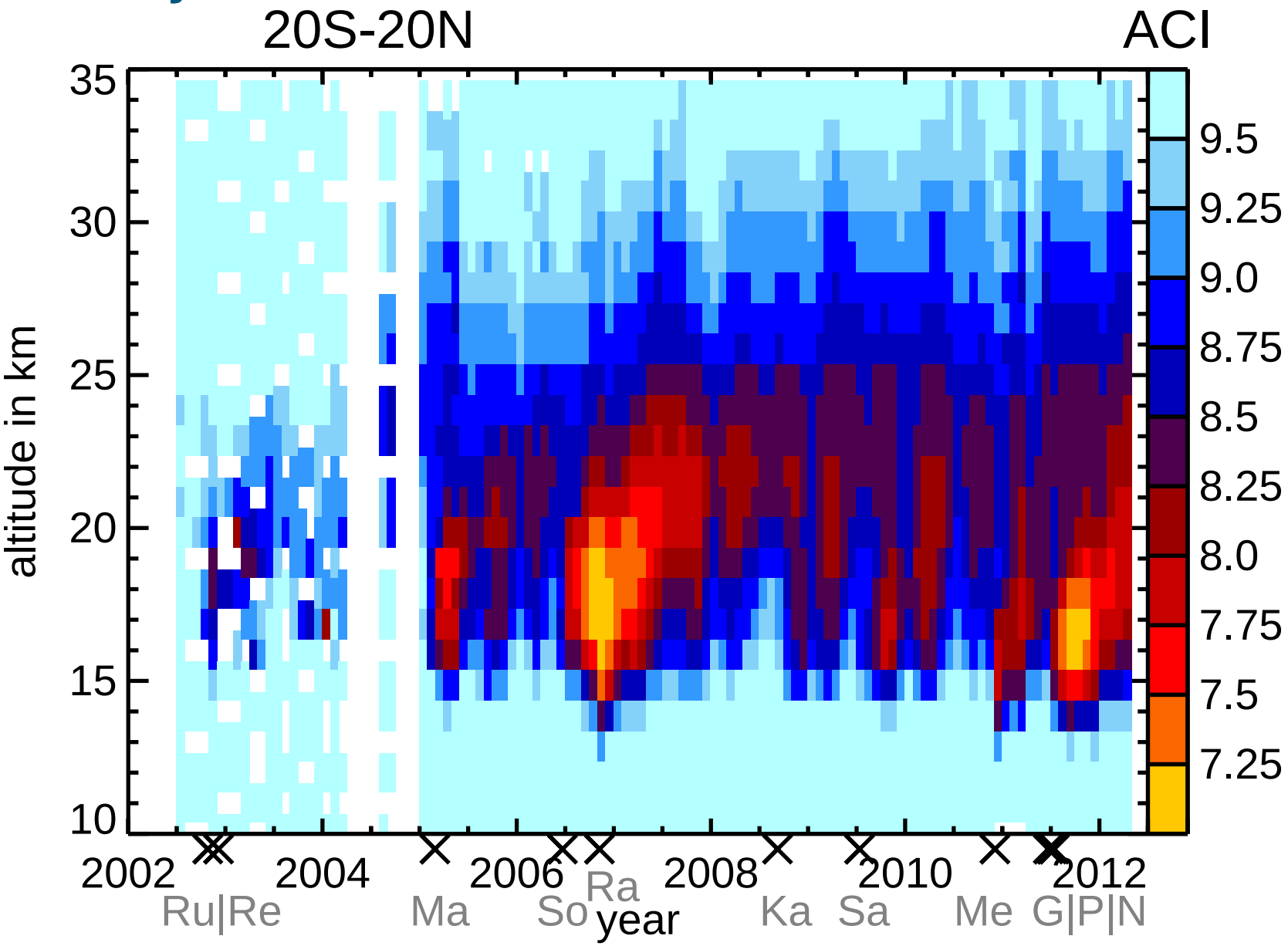
Ten years MIPAS aerosol observations



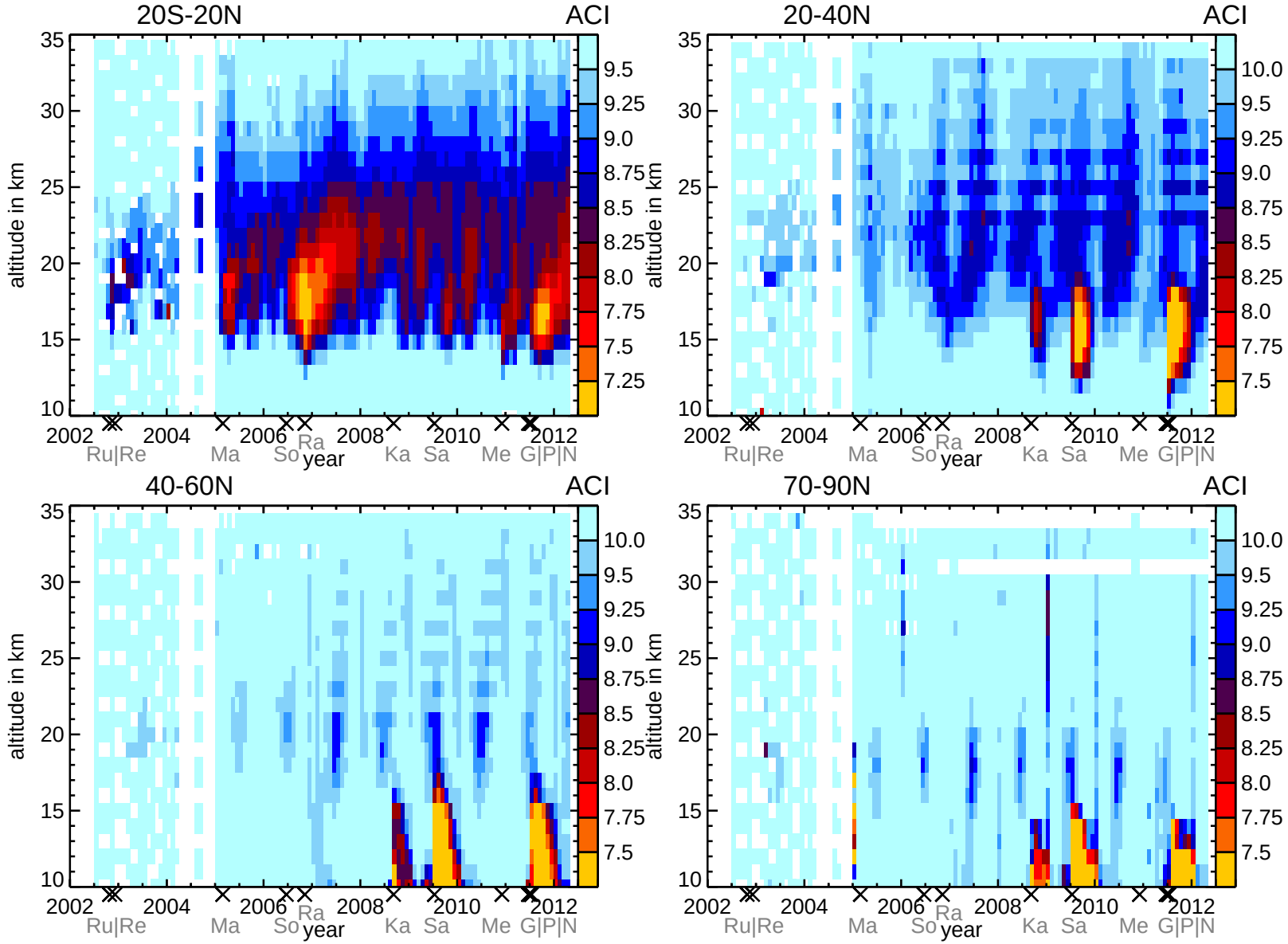
Ten years MIPAS aerosol observations



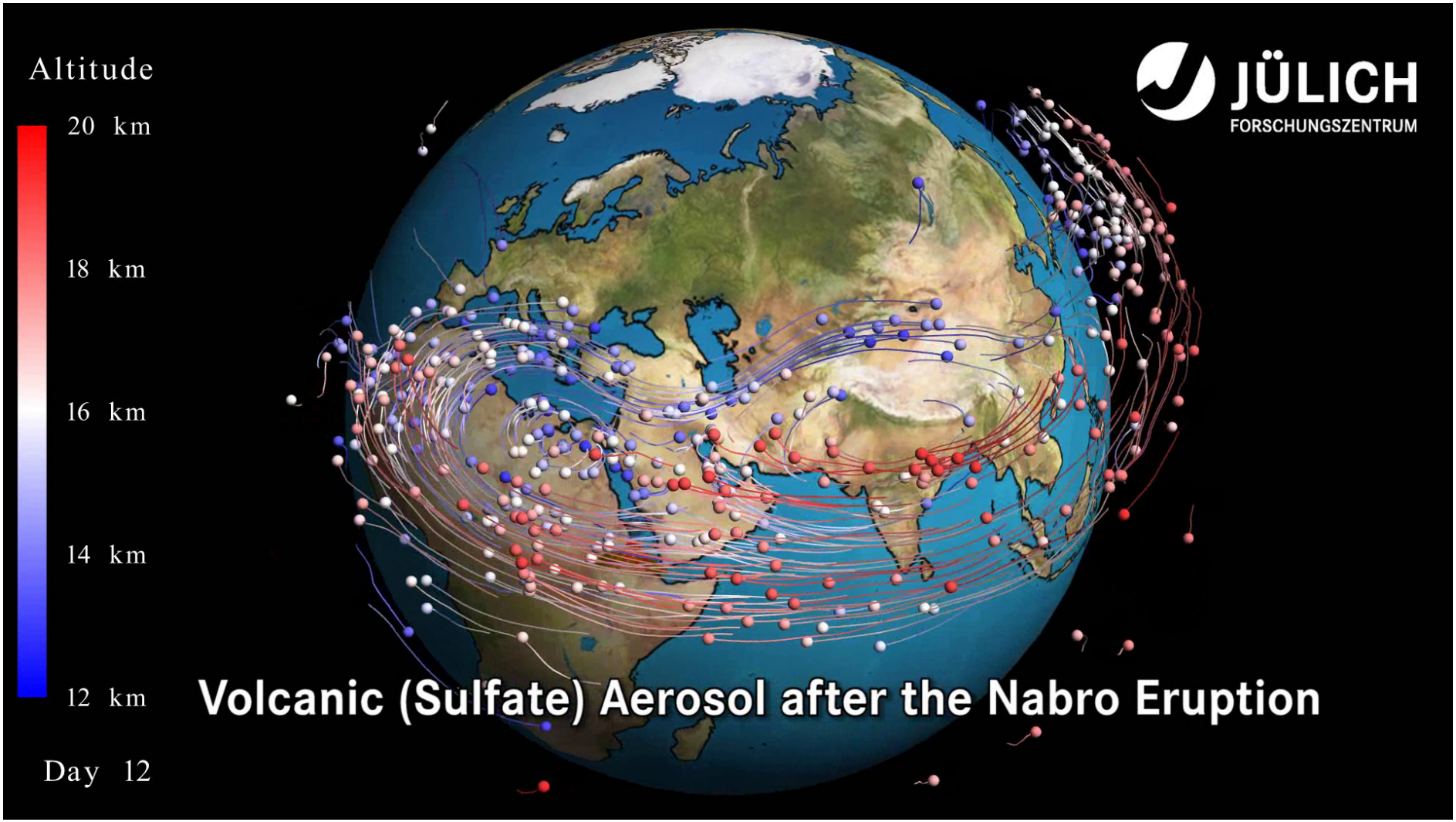
Ten years MIPAS aerosol observations



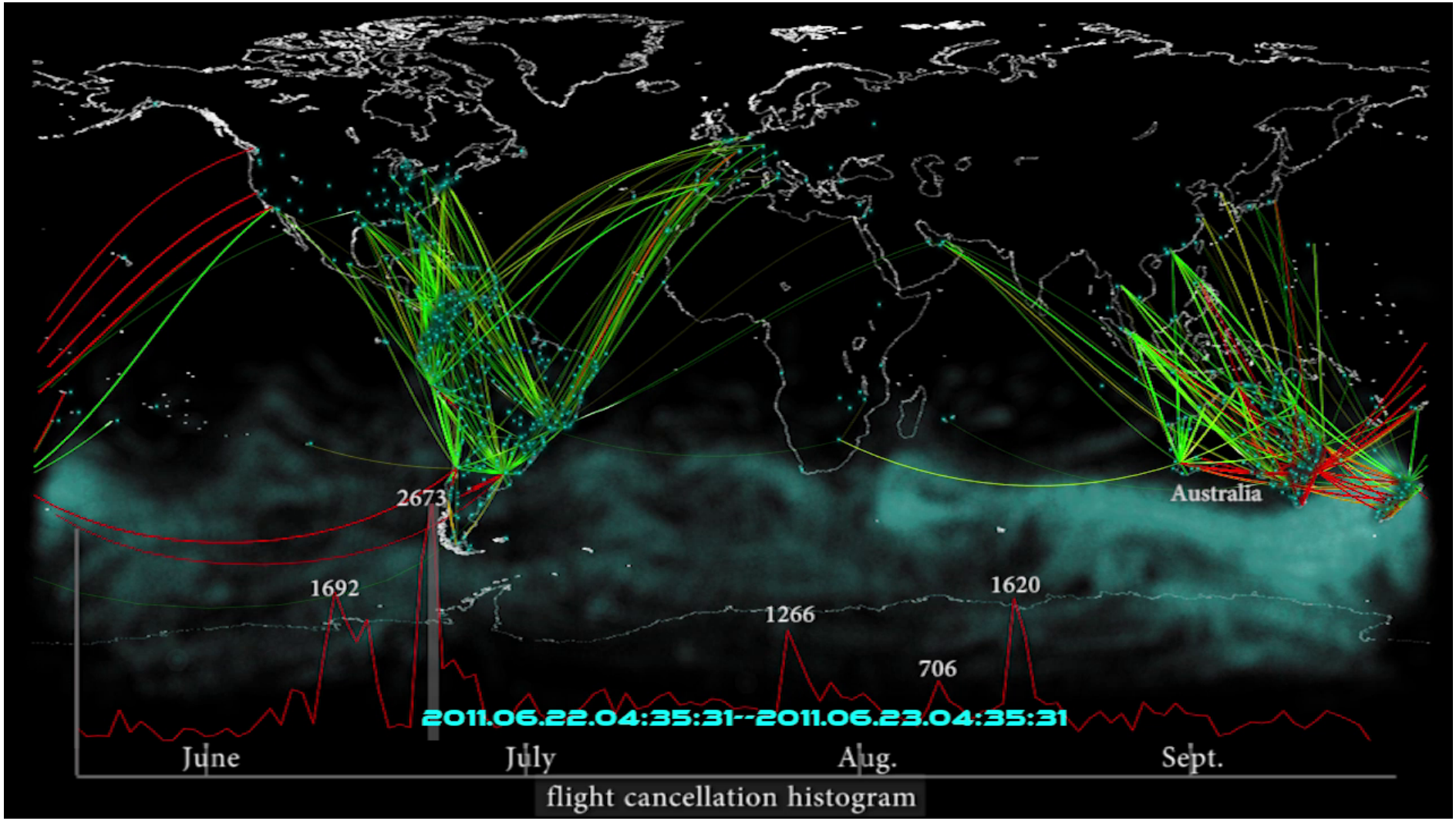
Ten years MIPAS aerosol observations



Reconstruction of volcanic plumes: Nabro



Puyehue-Cordón Caulle



Volcanic ash and aircraft corridors (IEEE VIS contest)
http://www.viscontest.rwth-aachen.de

Summary

Detection Method:

- 1: improved aerosol detection method
- 2: discrimination between ice and aerosol
- good agreement with AIRS, CALIPSO and lidar
- method applicable to other IR-limb instruments e.g. GLORIA

Ten years MIPAS measurements:

- vertically resolved daily global coverage at day and night
- mainly volcanic aerosol, but also mineral dust and wild fires

Outlook:

- aerosol extinction and size retrieval in upper troposphere and stratosphere

Other aerosol