# Comparison of stratospheric $H_2O$ profiles from an airborne microwave radiometer with the ECMWF humidity product

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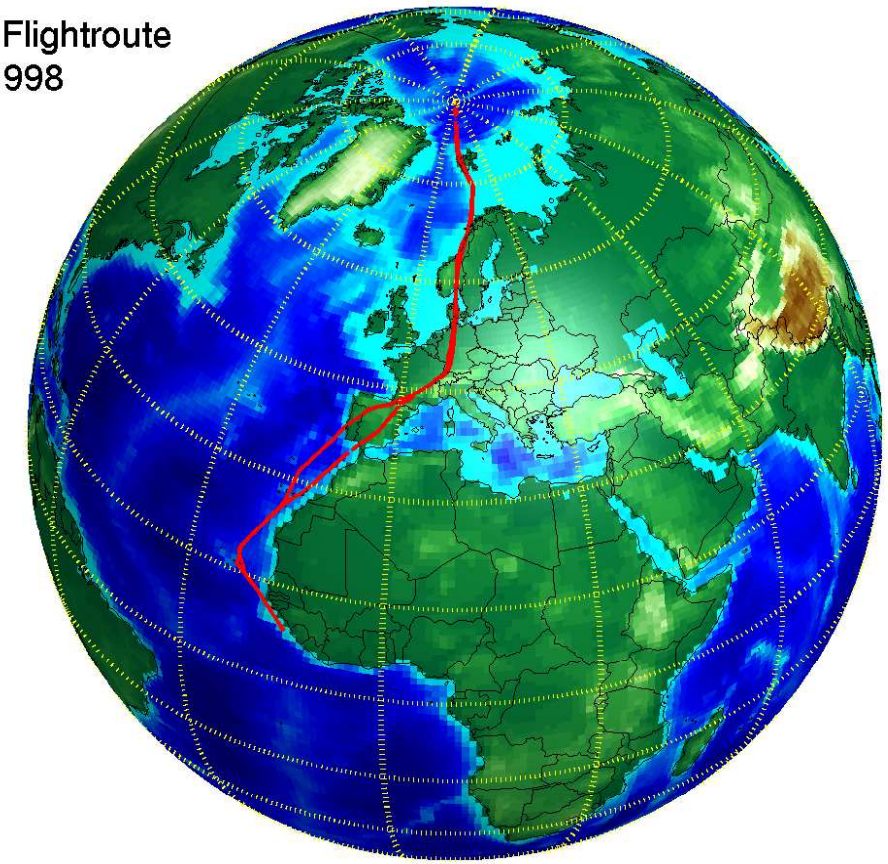
June 20, 2005

Bredbeck Workshop 2005

# Airborne water vapor measurements near 183 GHz

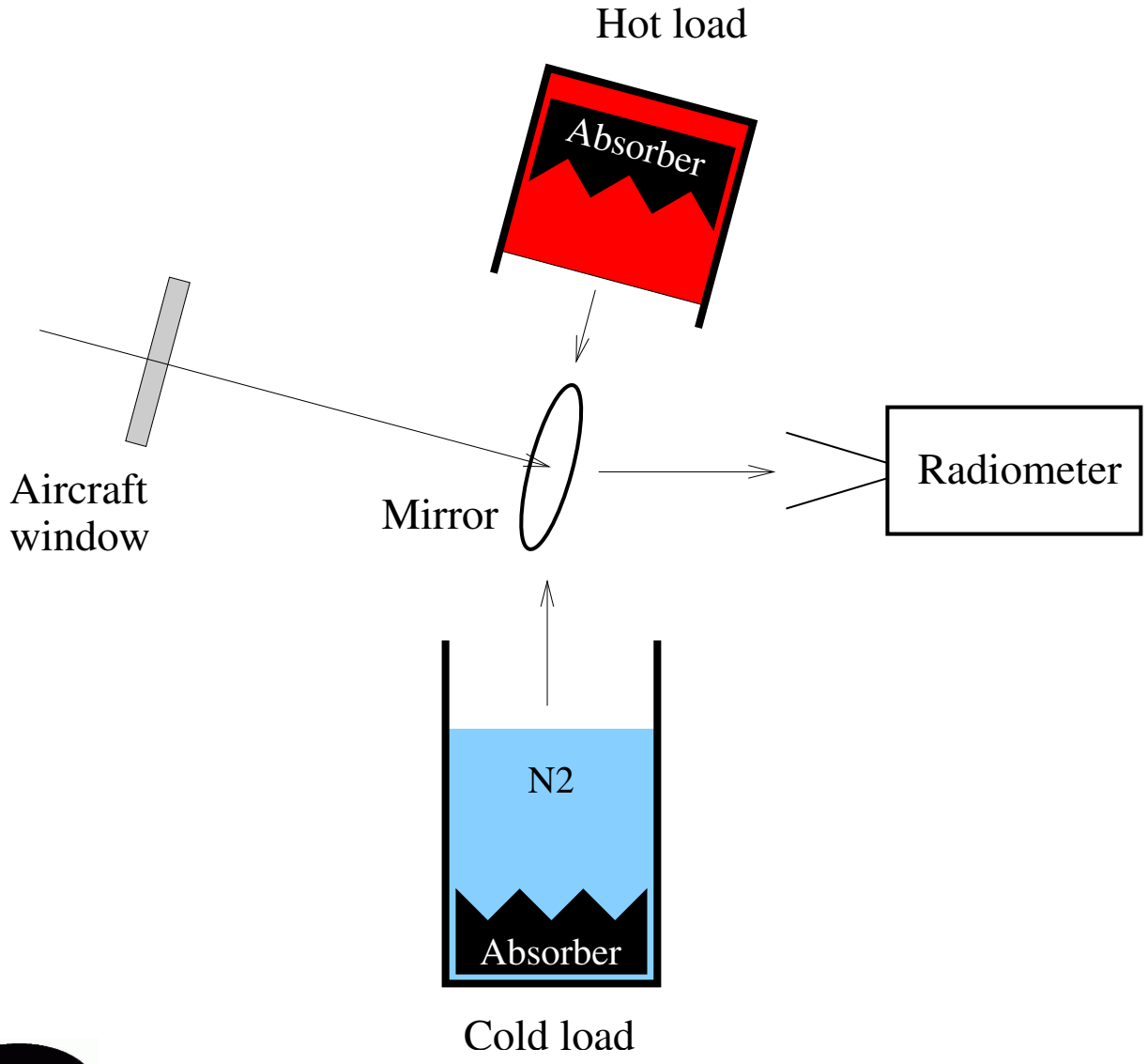

- AMSOS instrument operates from the Swiss Air Force's Learjet .
- Measurement: Water vapor spectra around 183.3 GHz.
- Product: $H_2O$ profiles from 15-60 km along the flight track.

# Flight campaigns 1998–2004

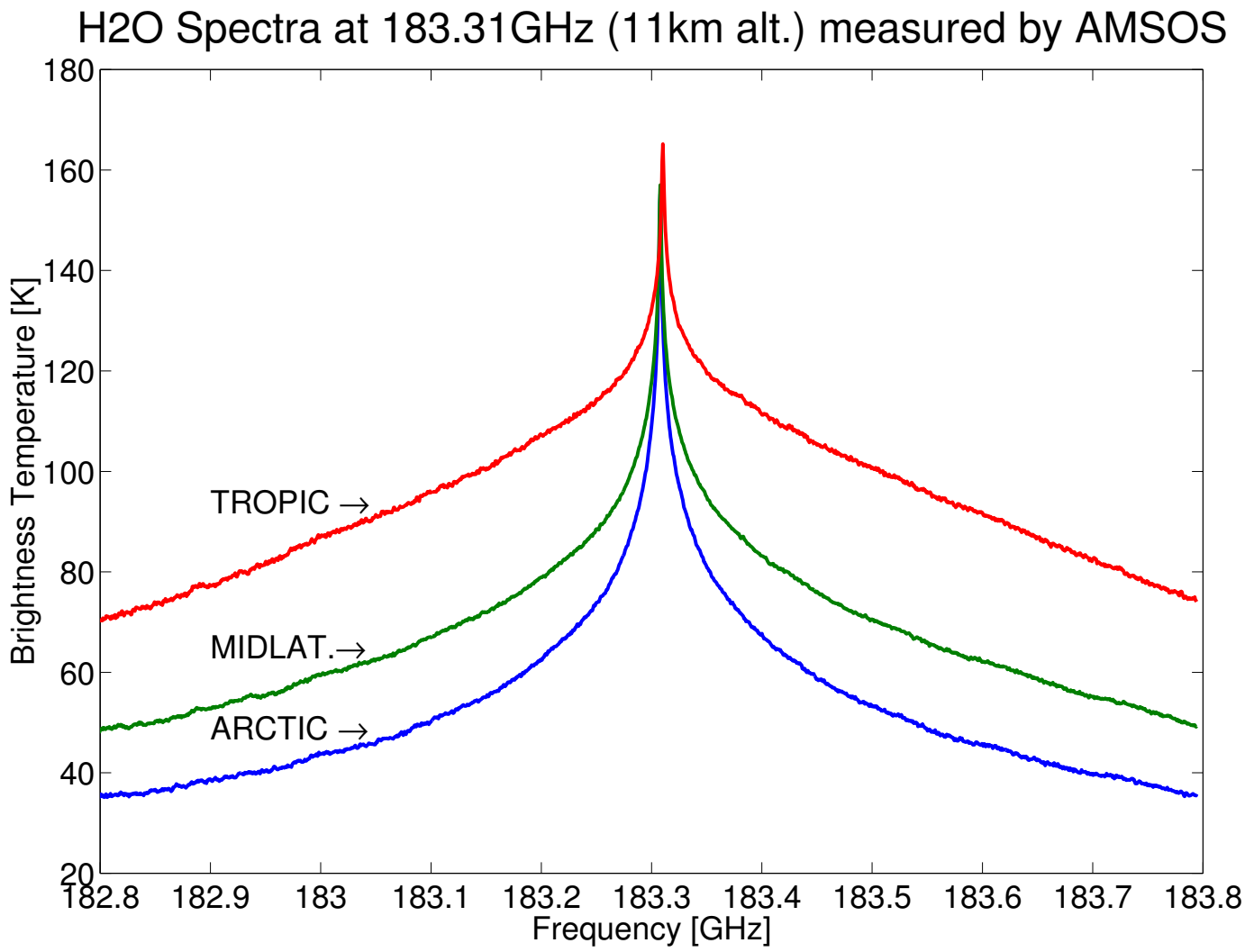



- One campaign per year since 1998.
- Typical flight route covers most of the northern hemisphere.
- Took part in major campaigns like THESEO2000/SOLVE, LAUTLOS. Will also take part in SCOUT-O3 activities.

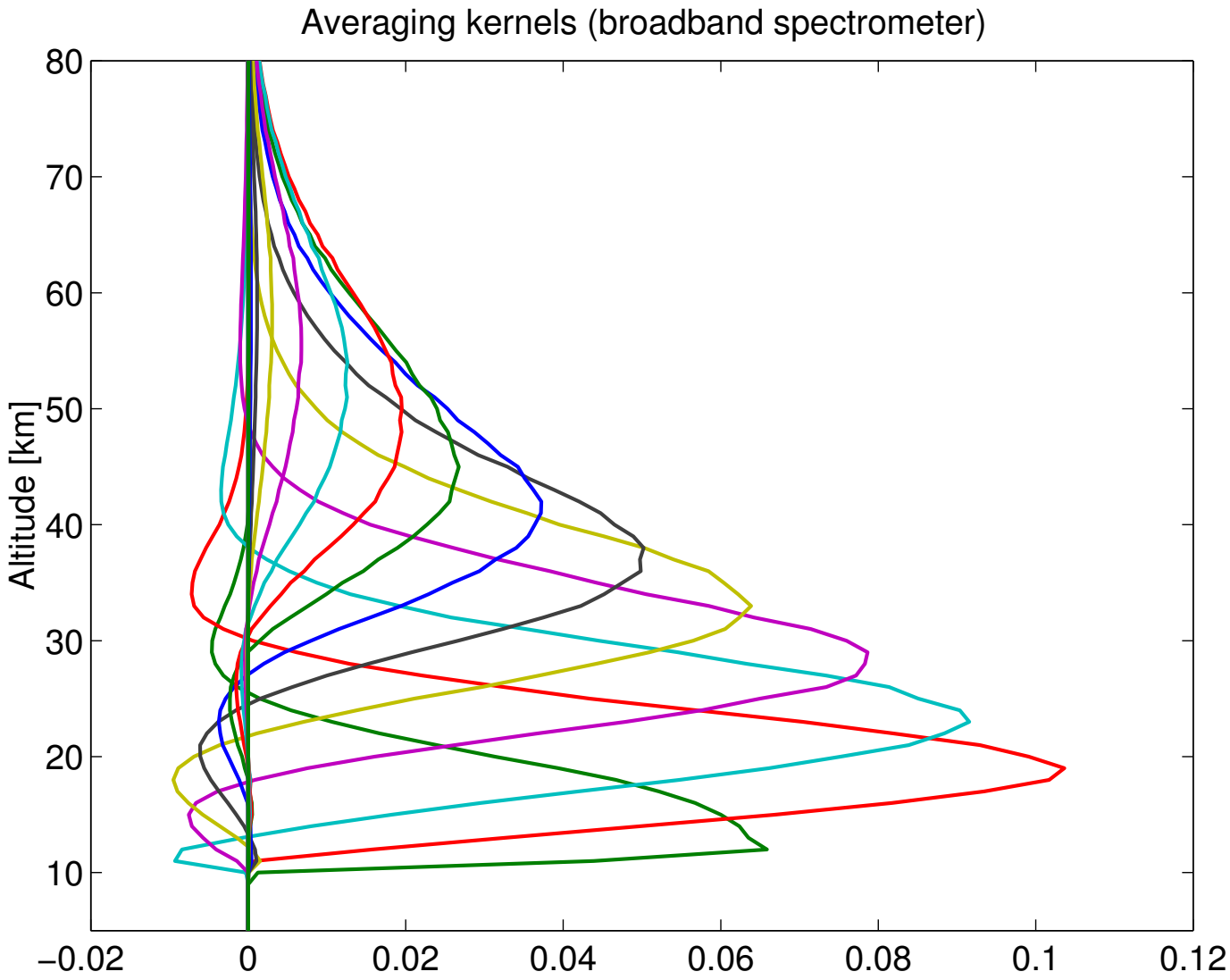
# Measurement principle of the AMSOS radiometer



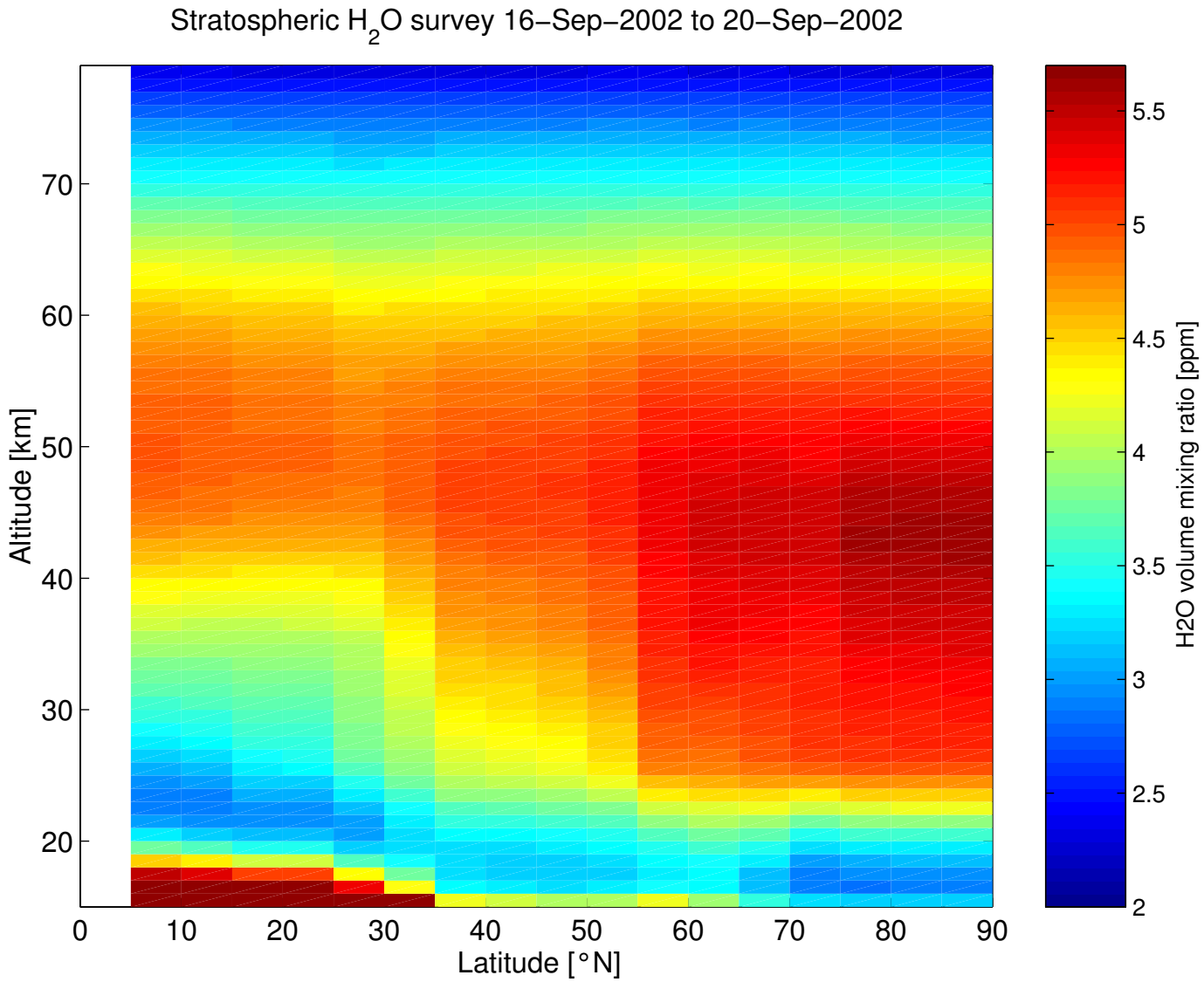
# Water vapor spectra in the upper sideband (183 GHz)



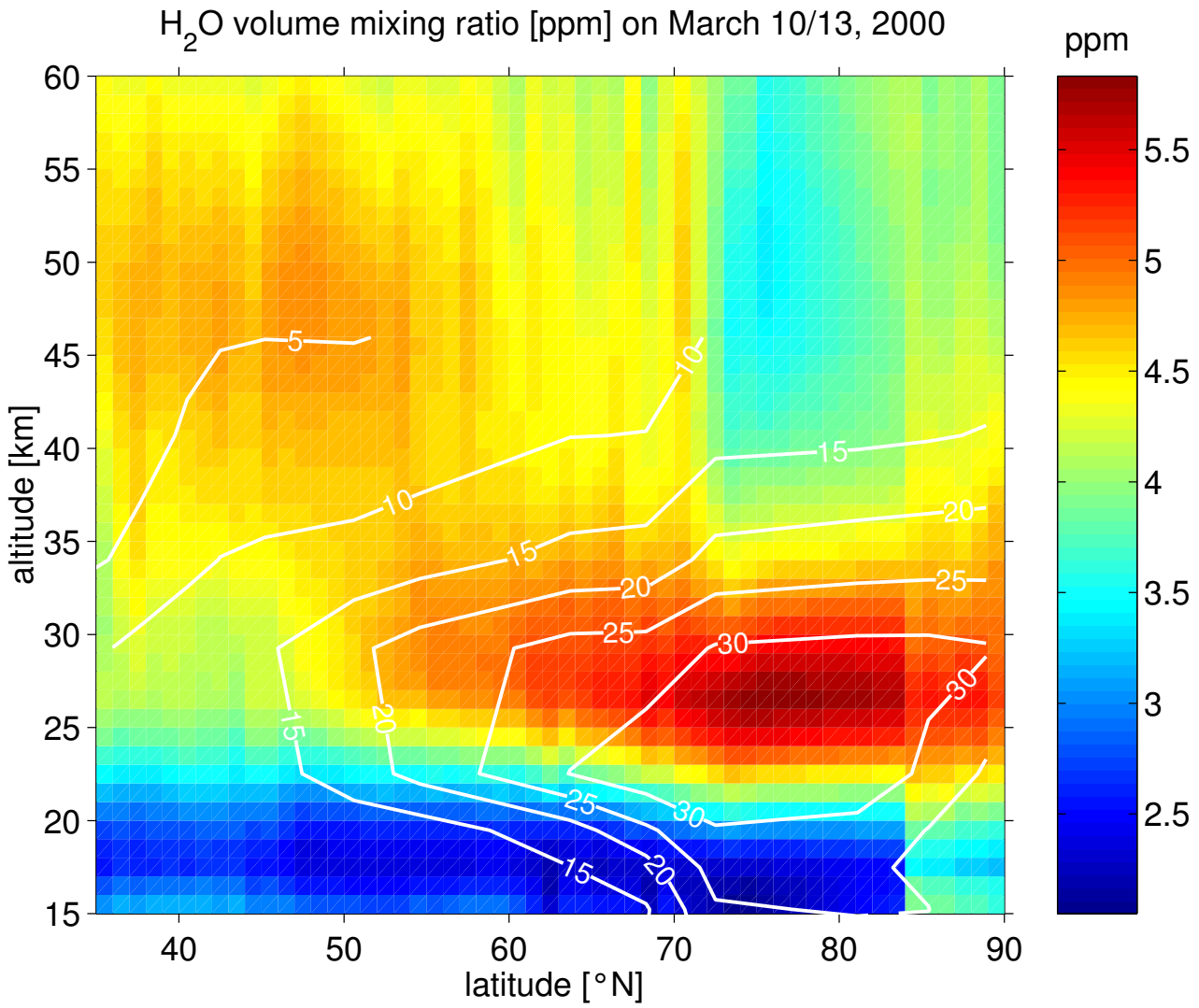
# AMSOS vertical resolution



# AMSOS measurements September 2002



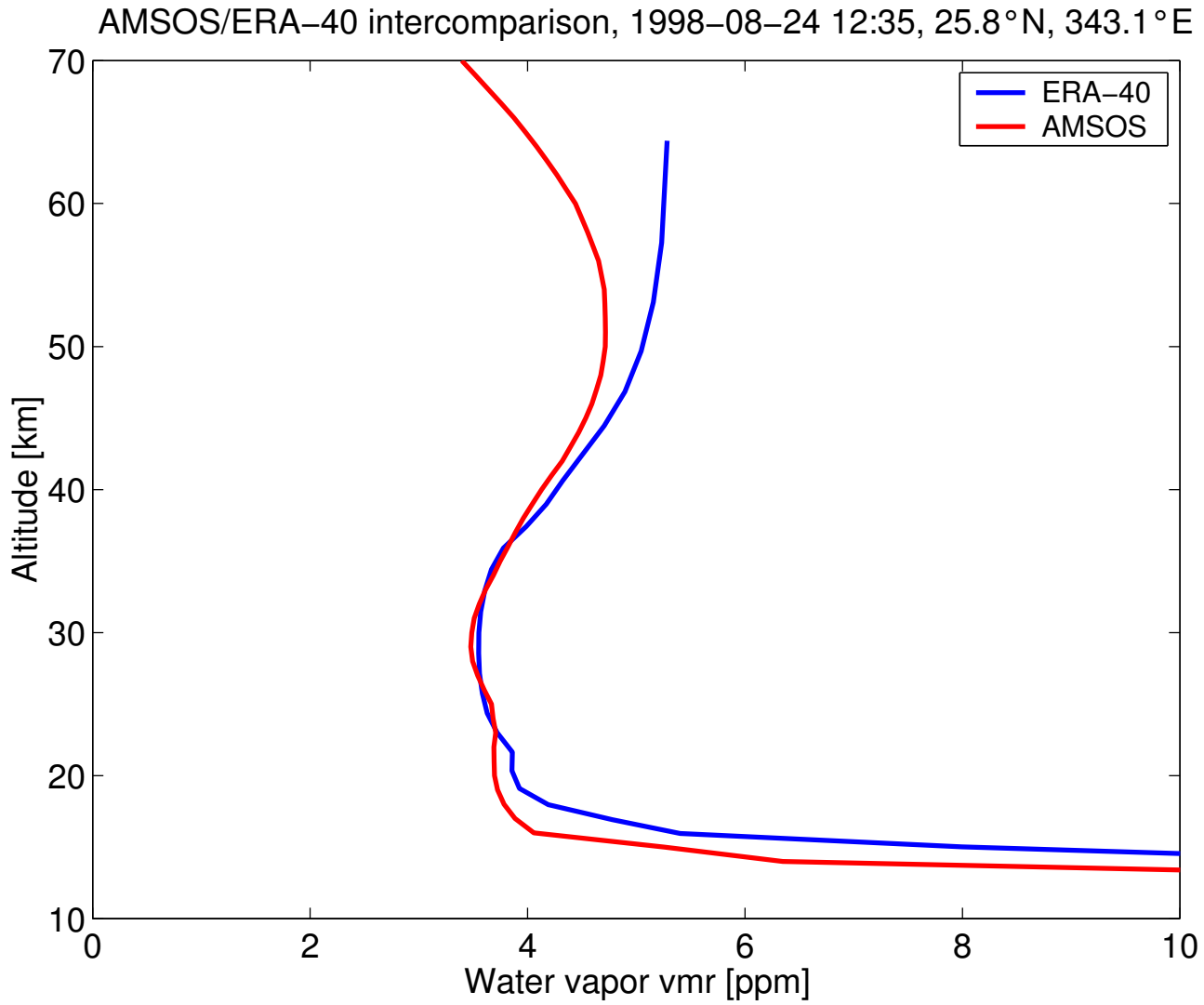
# $H_2O$ measurements in the polar Vortex (March 2000)



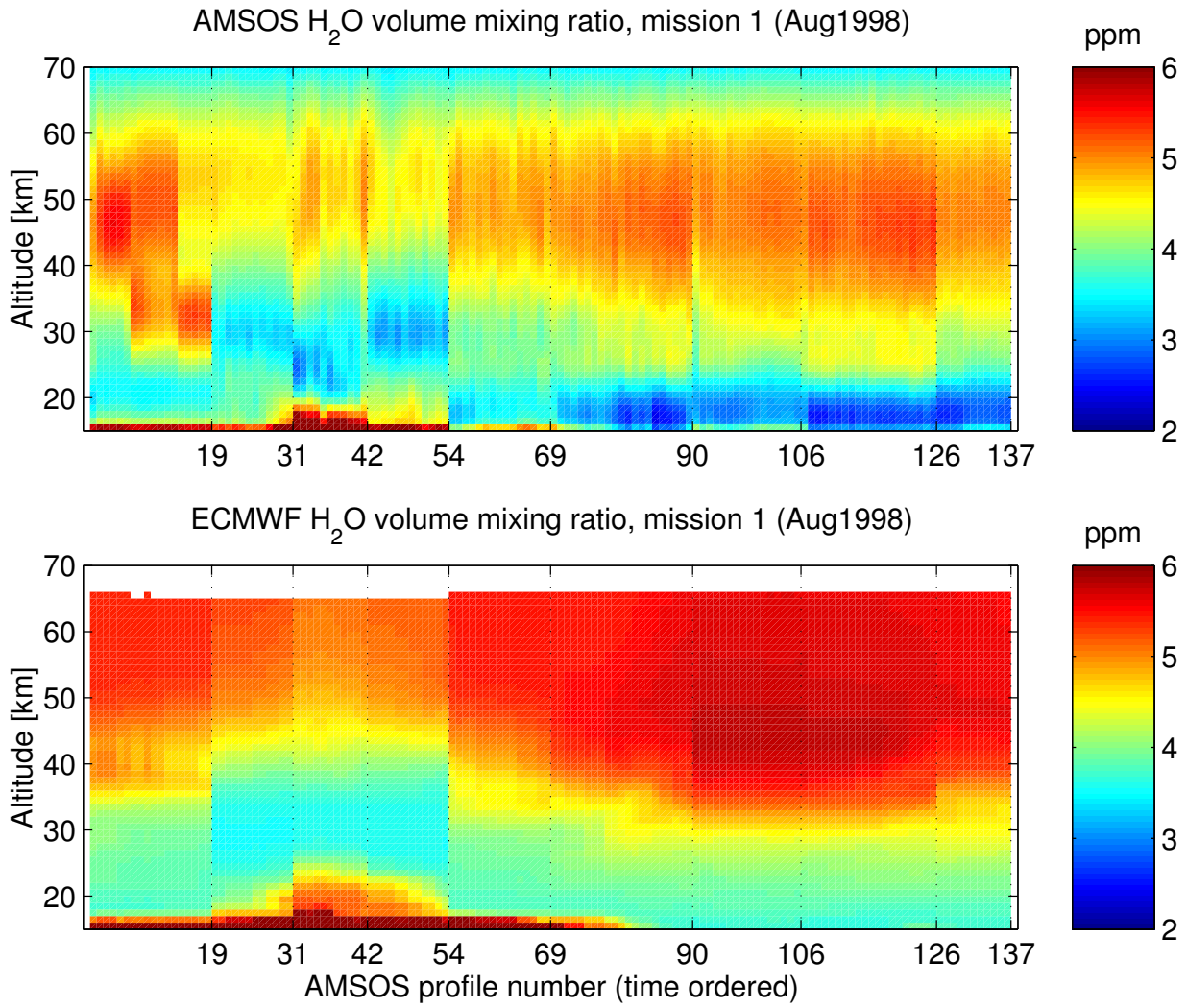
# ECMWF humidity product

- $H_2O$ volume mixing ratio can be derived from ECMWF specific humidity.
- Assimilated water vapor in the troposphere.
- Parameterized water vapor (methane oxidation and transport) in the stratosphere.
- Good vertical resolution and altitude range since ERA-40 dataset.

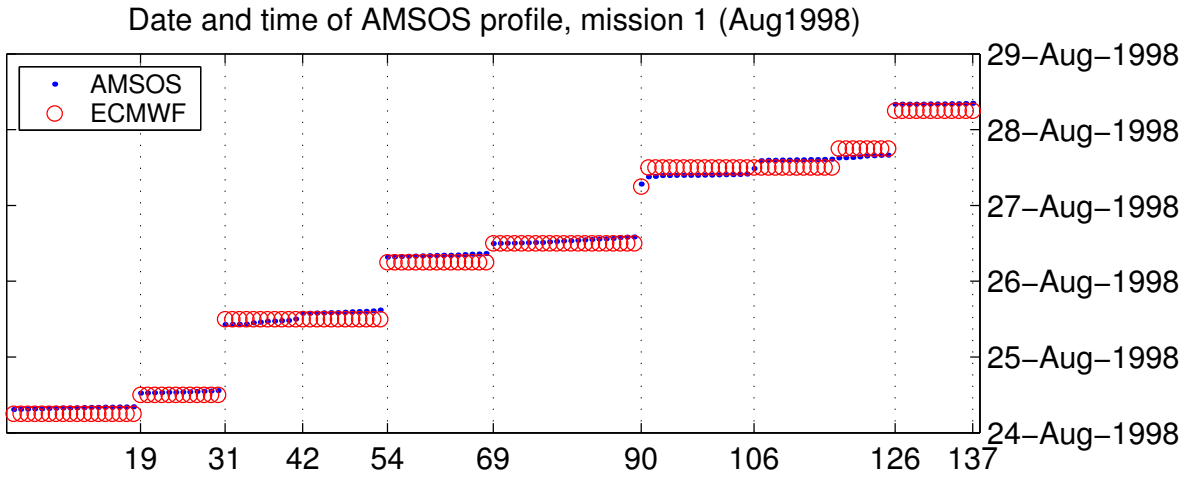
# AMSOS/ECMWF intercomparison (single profile)

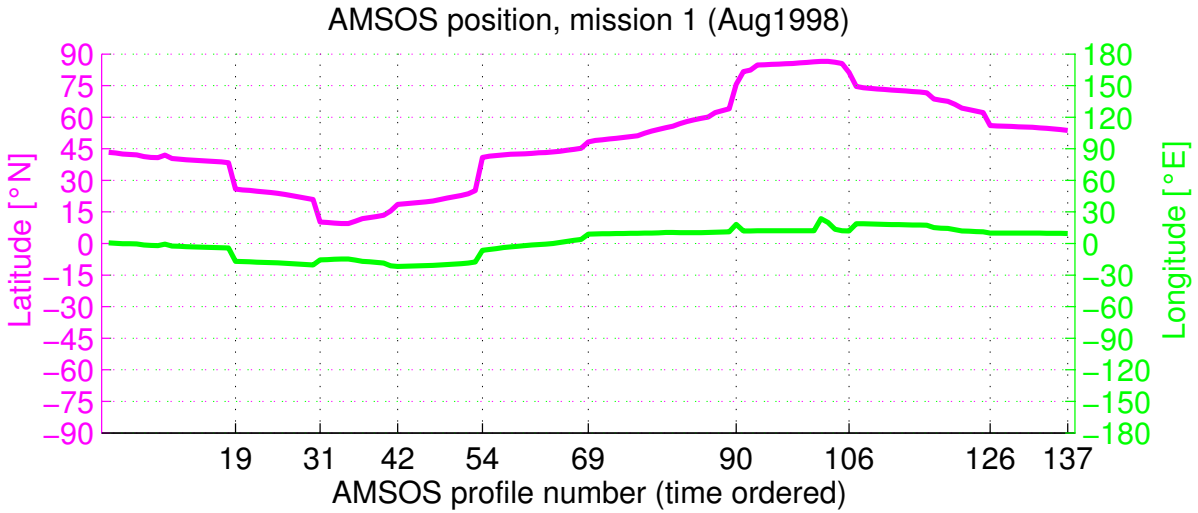


# Mission 1 (Aug 1998): AMSOS vs. ECMWF

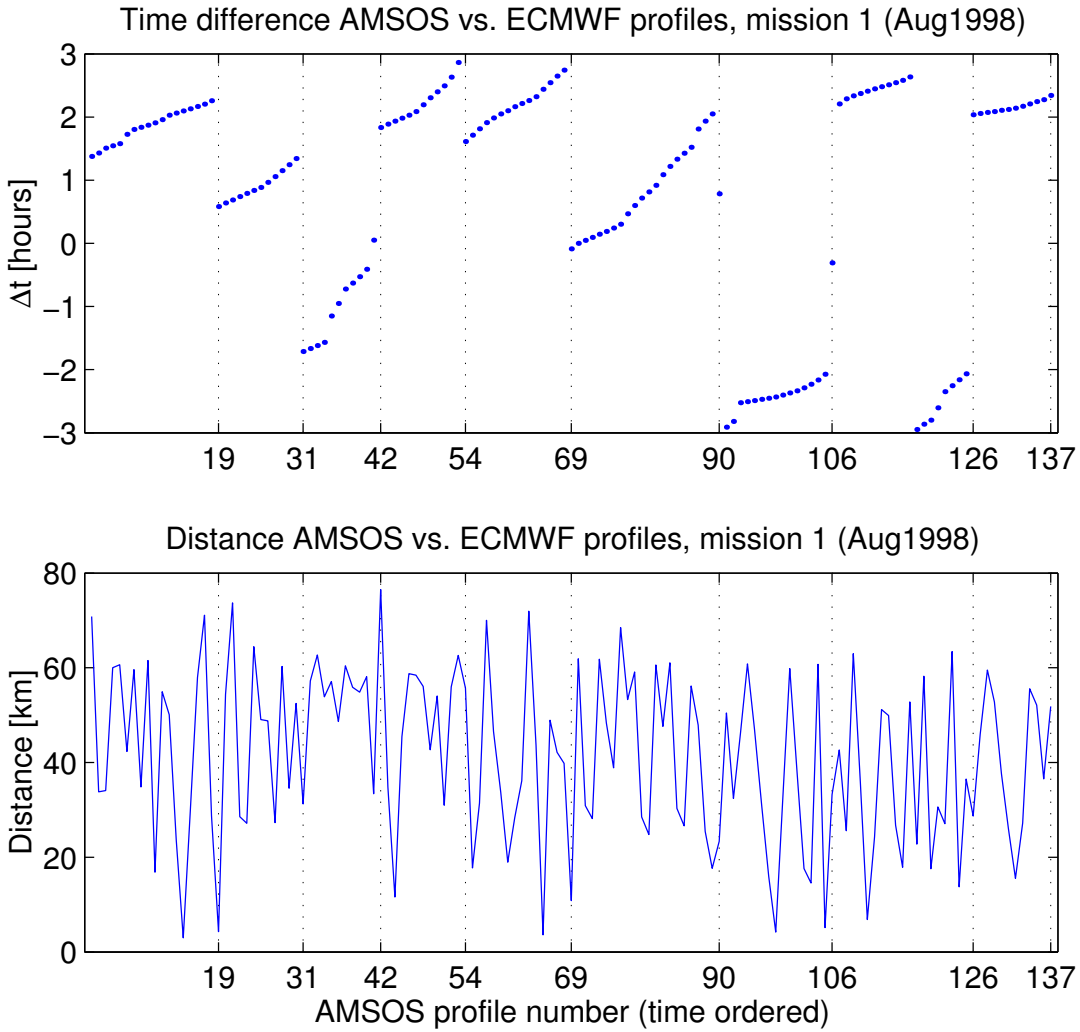


# Mission 1 (Aug 1998): time & position

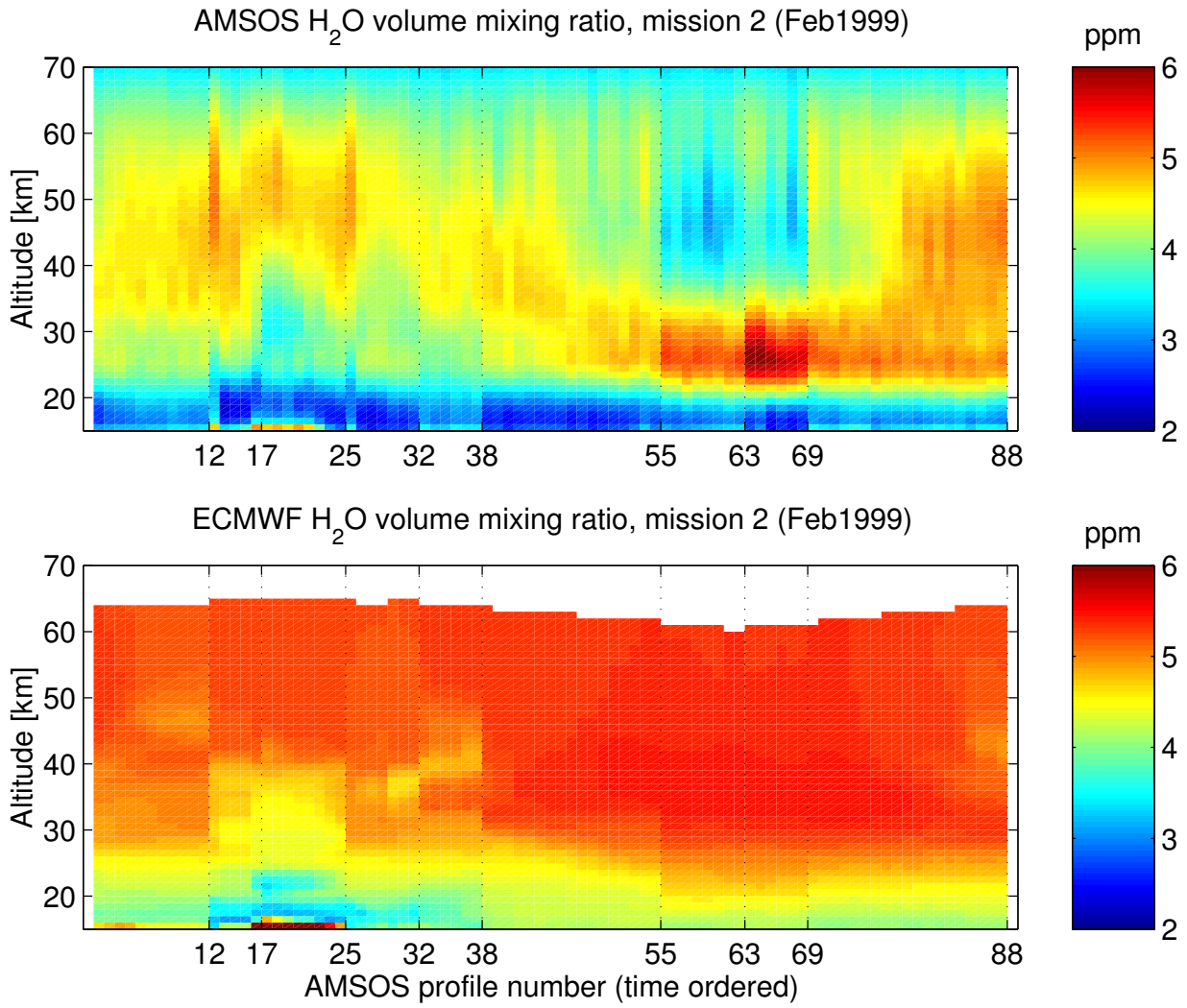


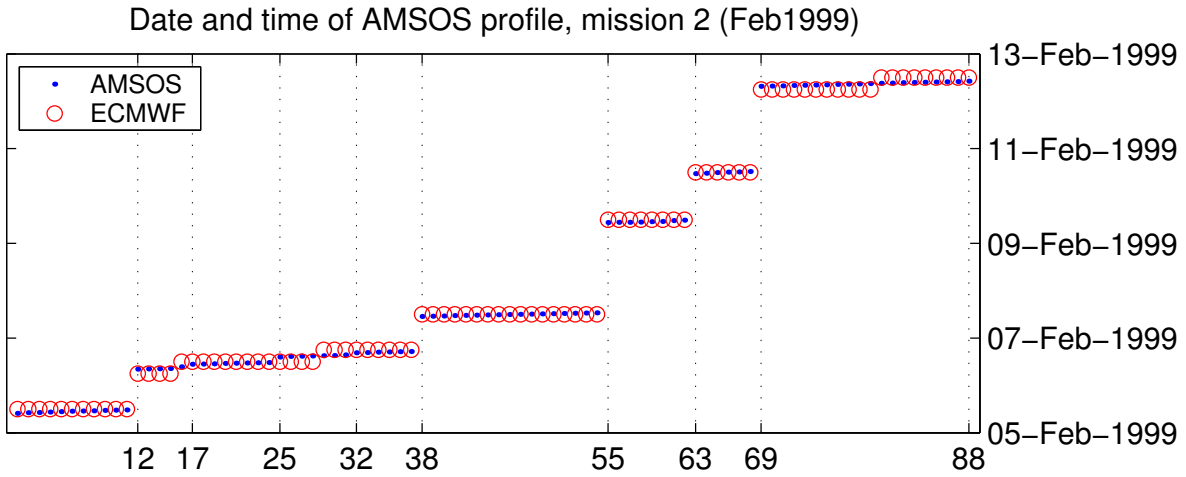
# Mission 1 (Aug 1998): ECMWF profile availability

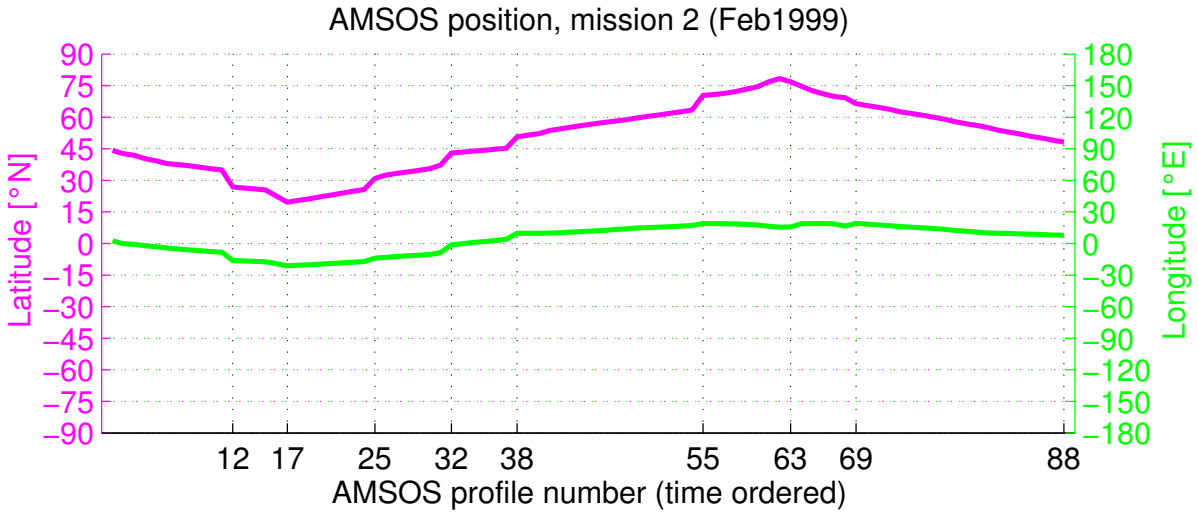


# Mission 2 (Feb 1999): AMSOS vs. ECMWF



# Mission 2 (Feb 1999): time & position



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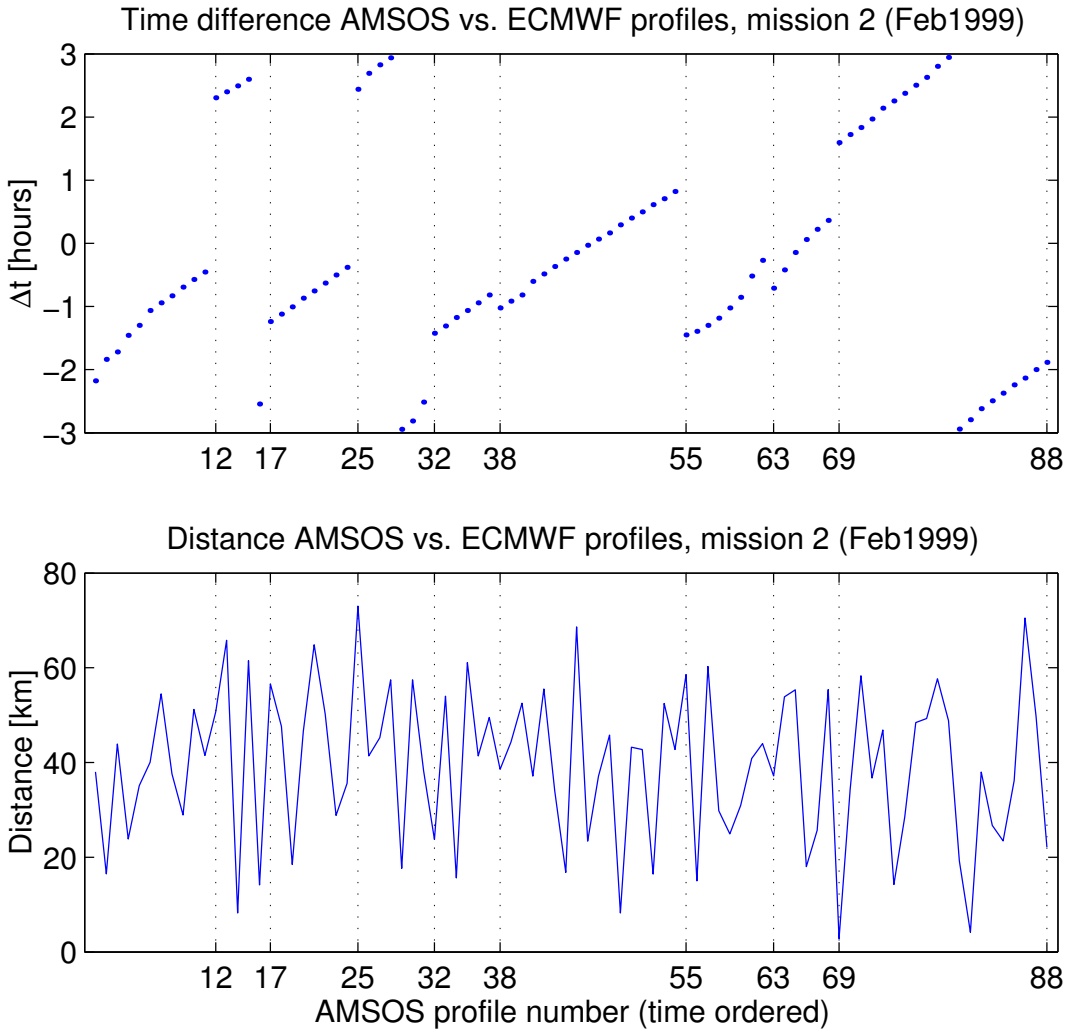
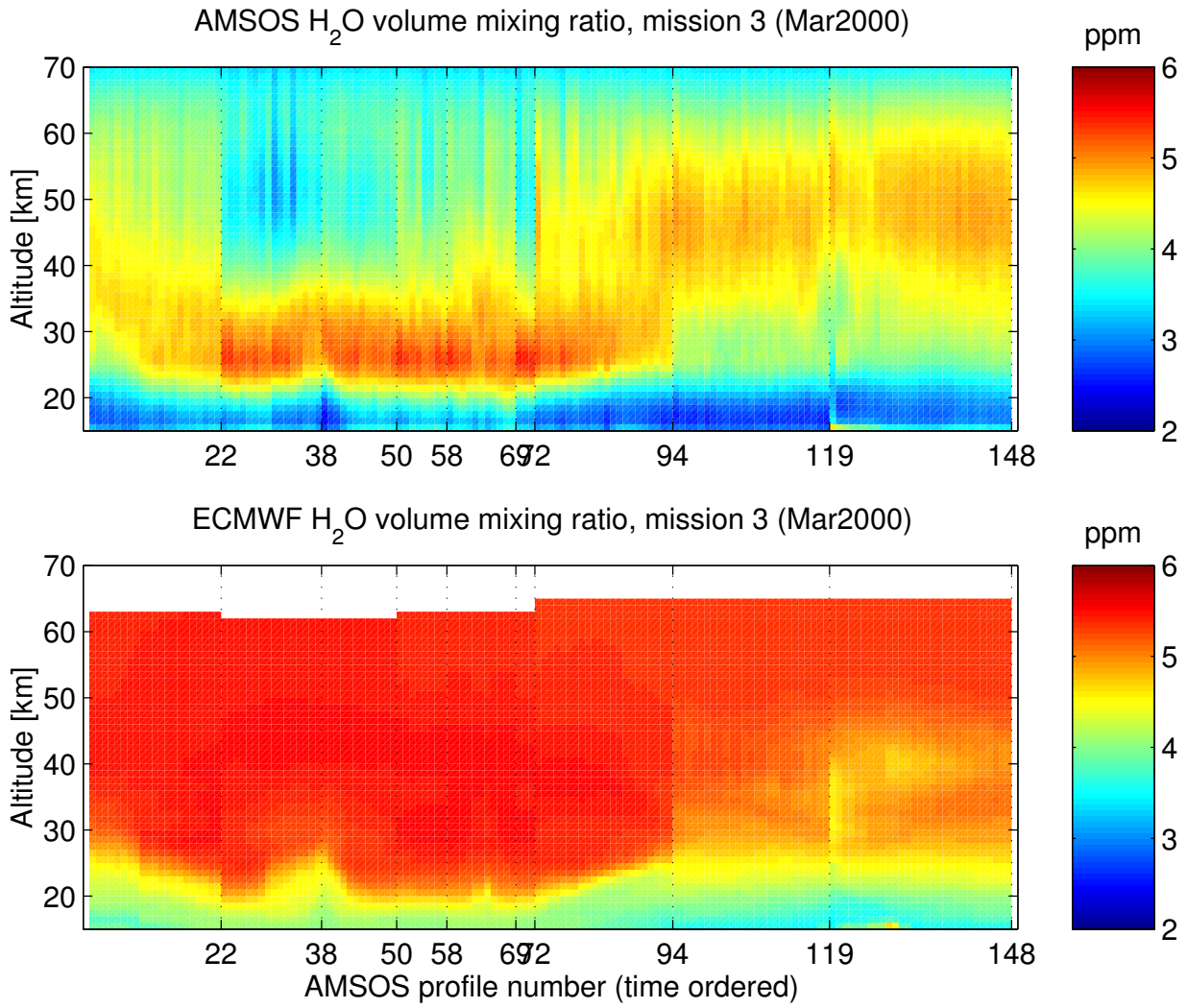
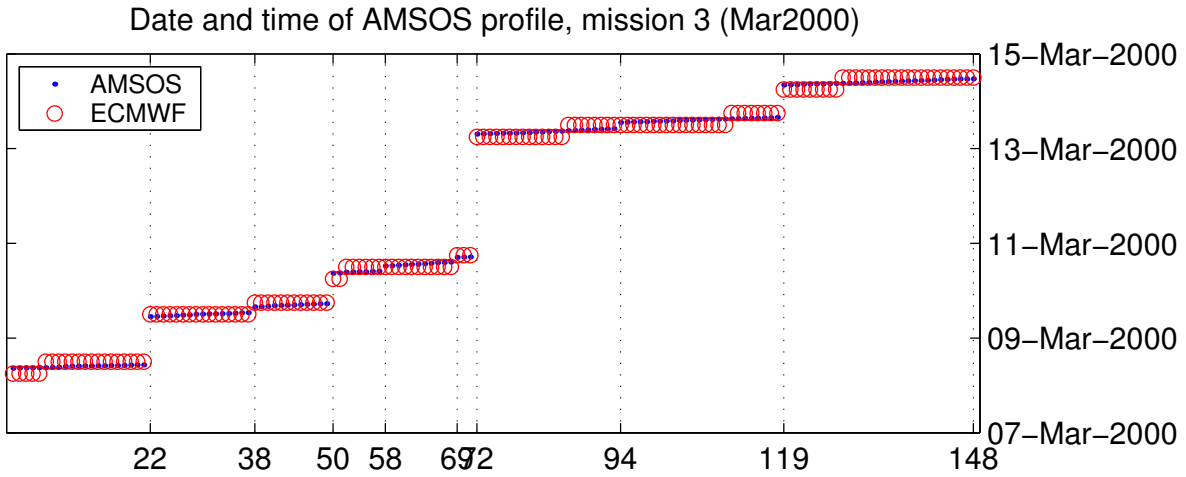
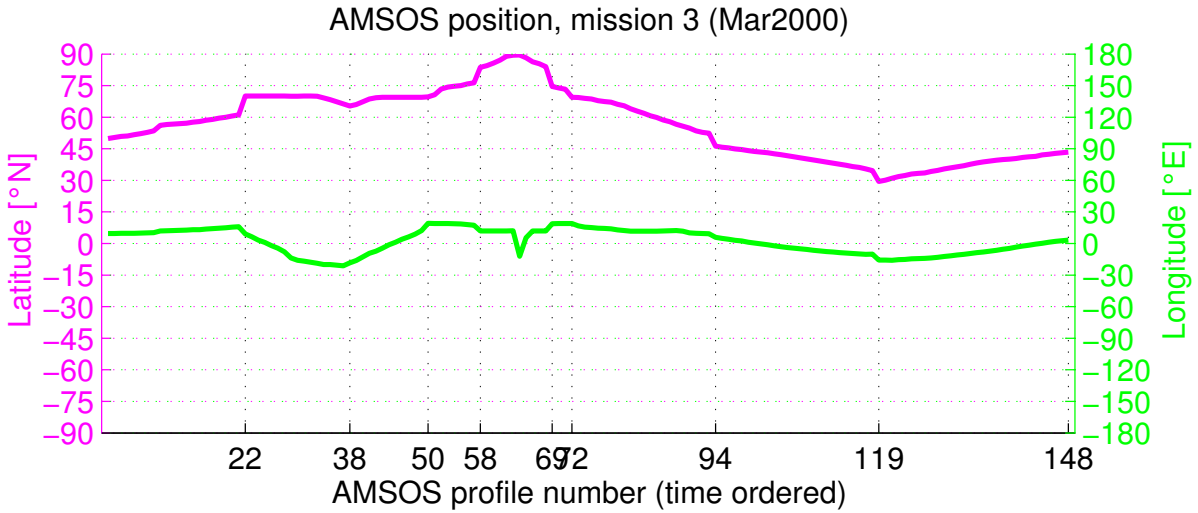


# Mission 3 (Mar 2000): AMSOS vs. ECMWF



# Mission 3 (Mar 2000): time & position



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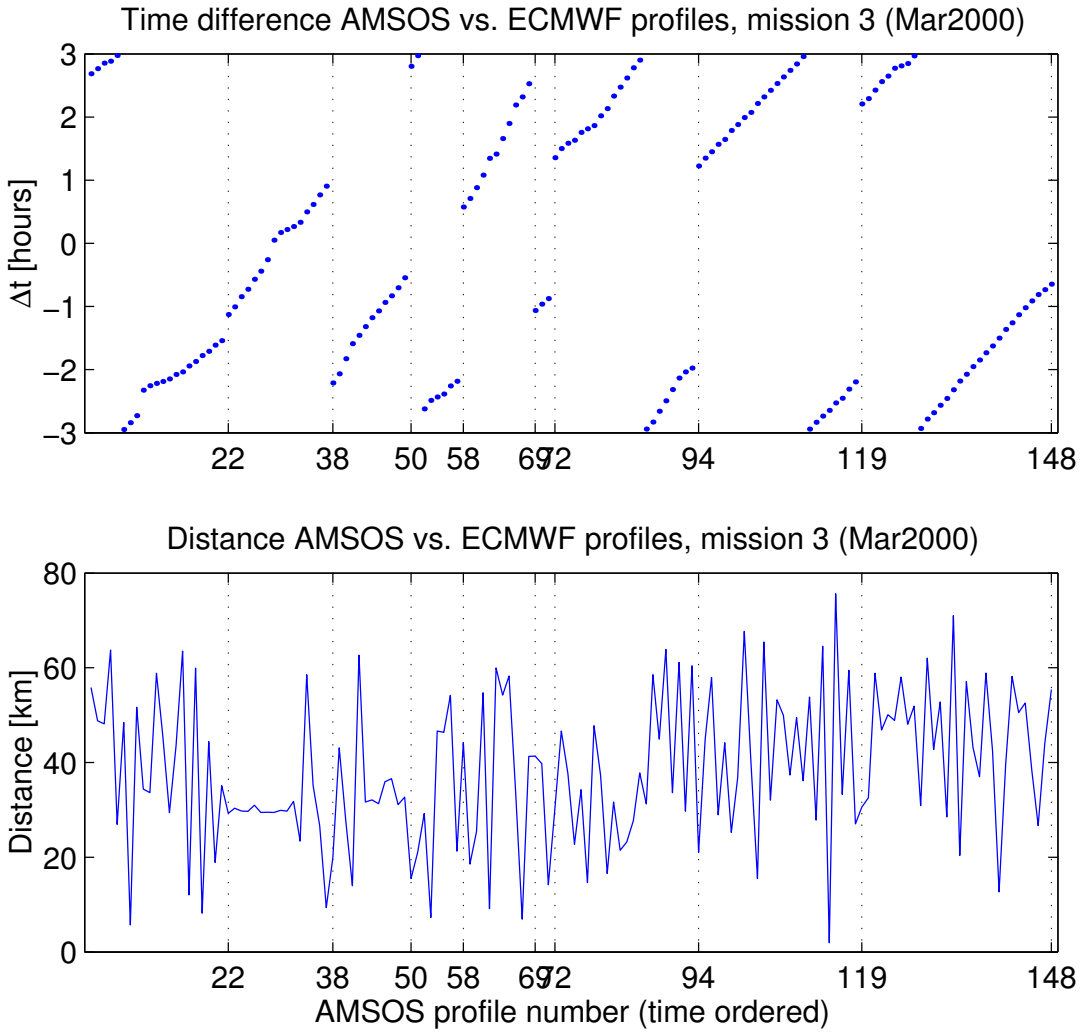
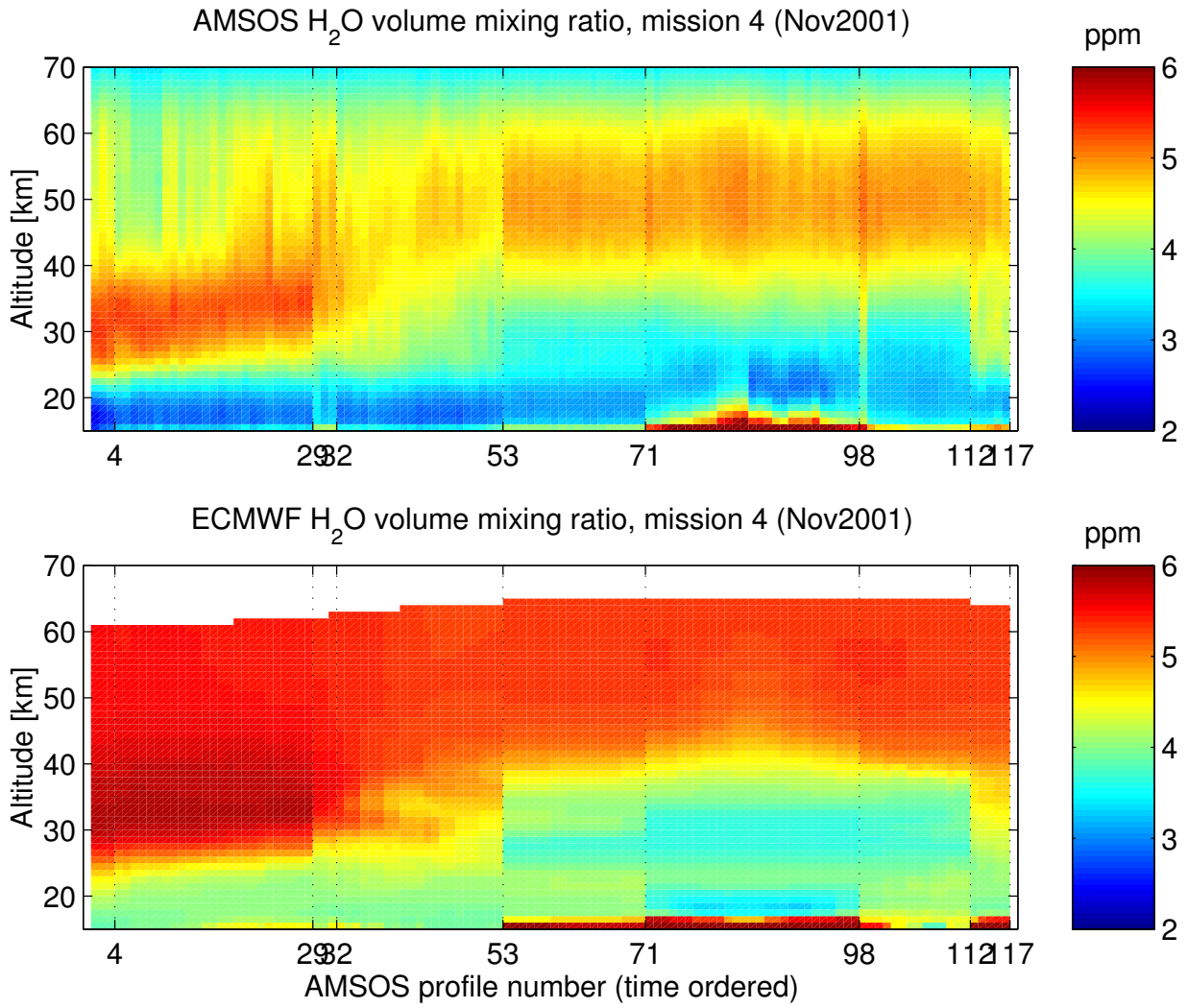
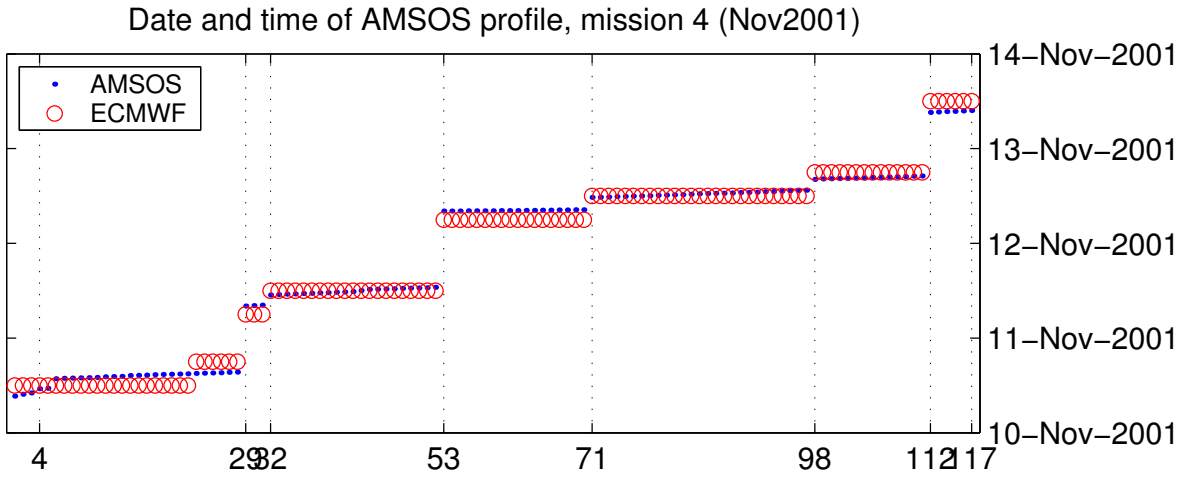
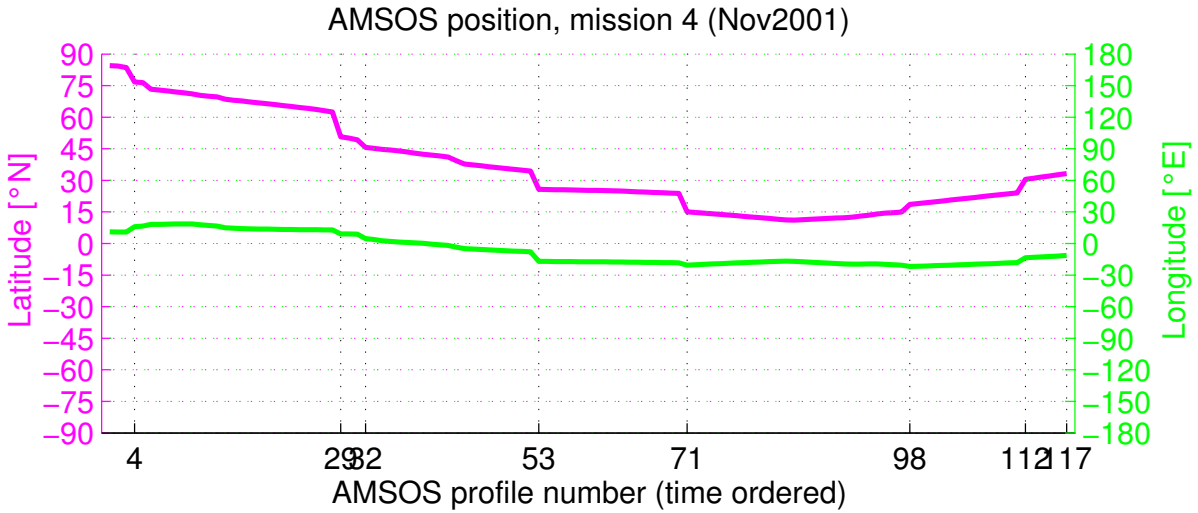


# Mission 4 (Nov 2001): AMSOS vs. ECMWF

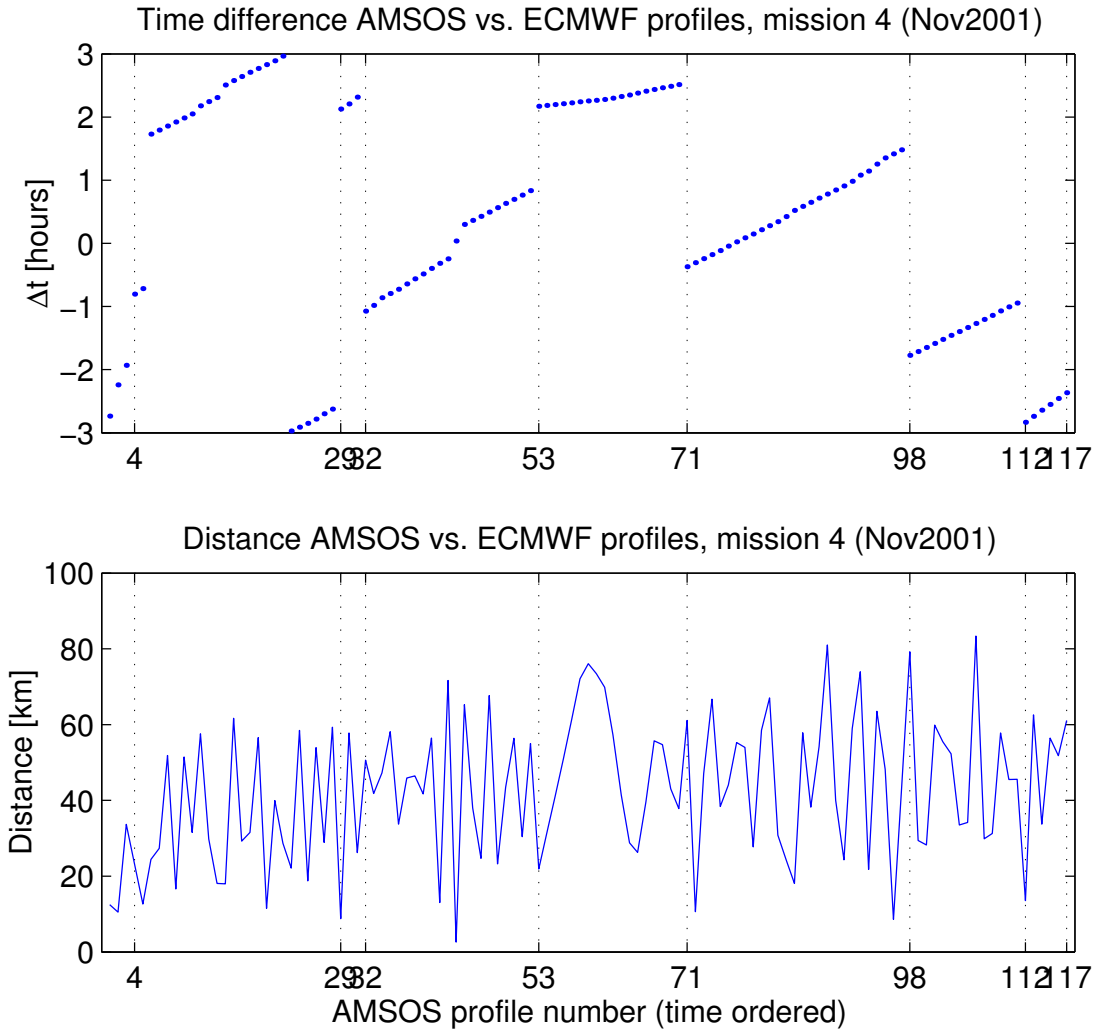


# Mission 4 (Nov 2001): time & position

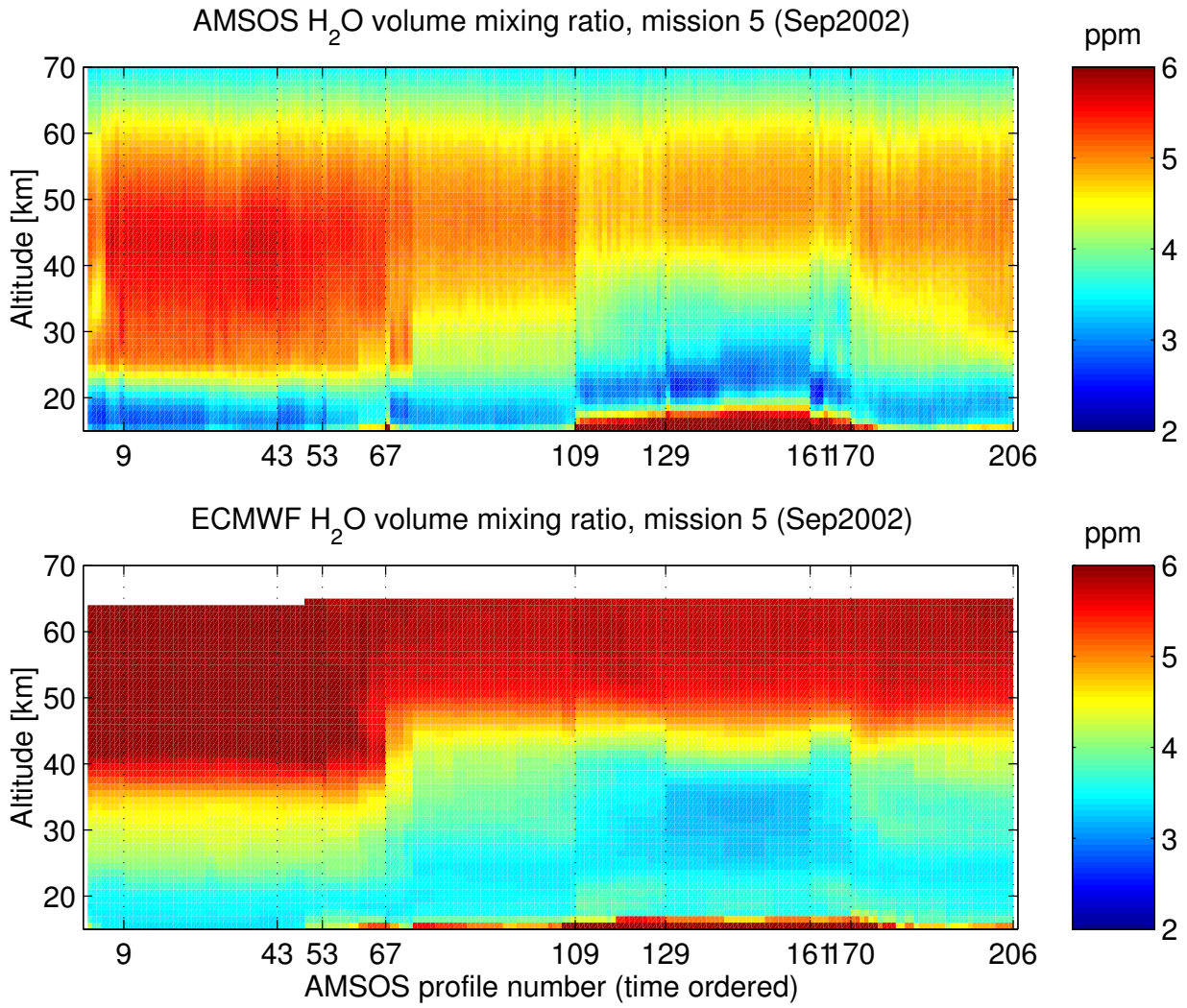


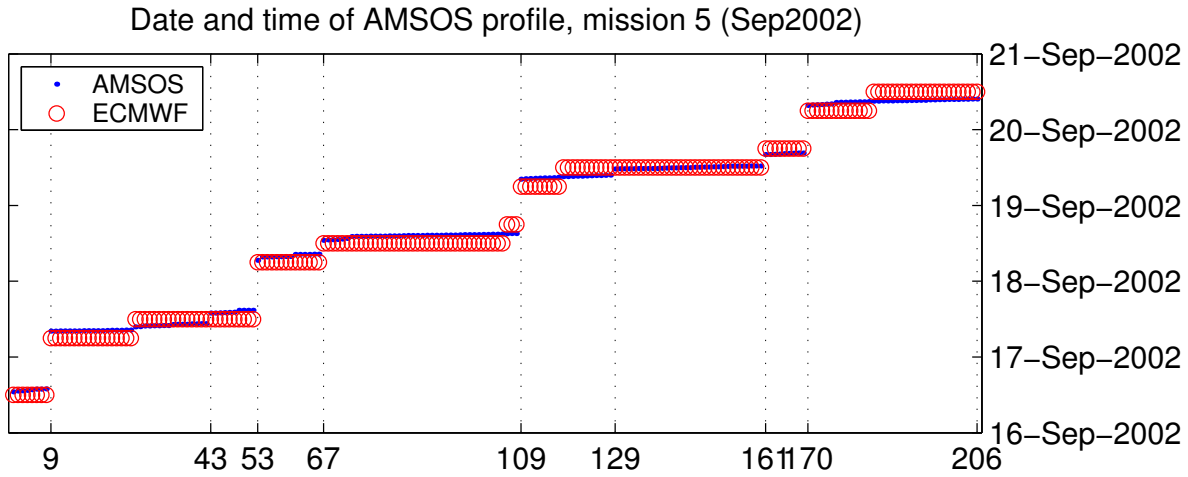
# Mission 4 (Nov 2001): ECMWF profile availability

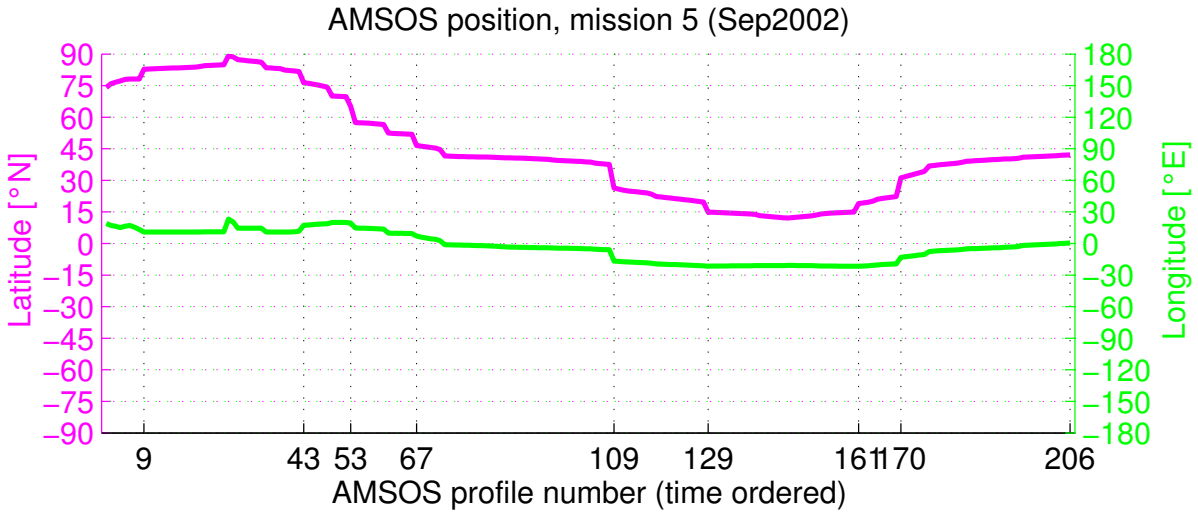


# Mission 5 (Sep 2002): AMSOS vs. ECMWF

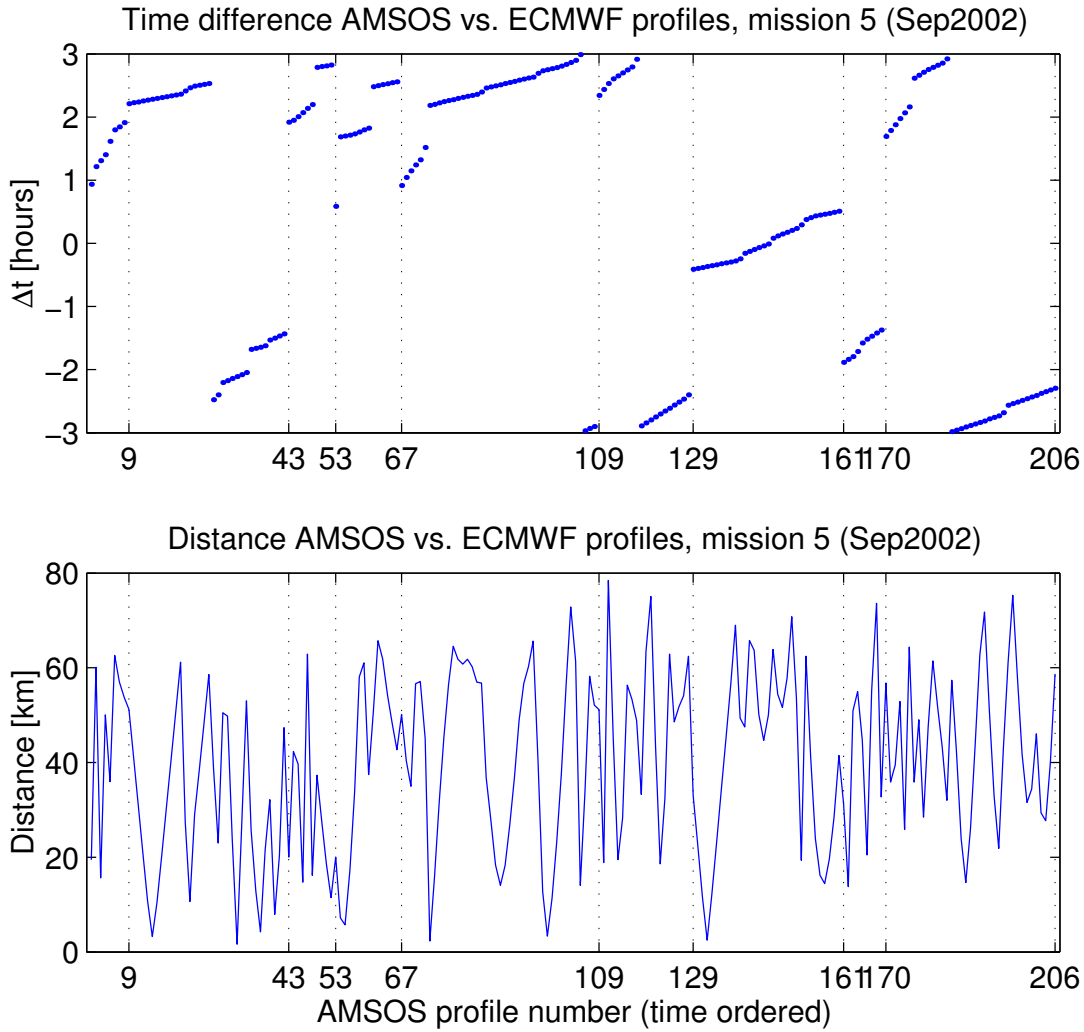


# Mission 5 (Sep 2002): time & position

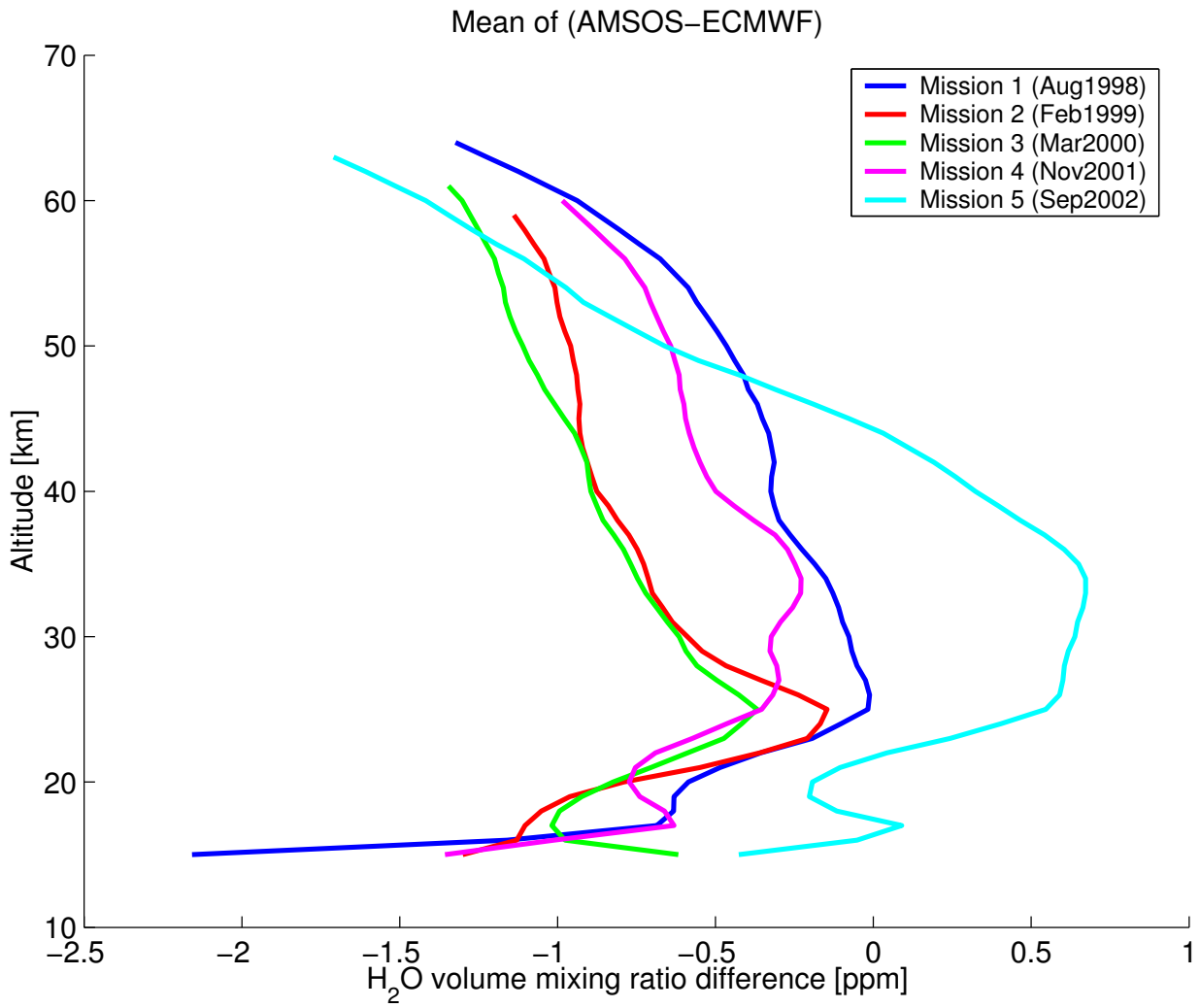


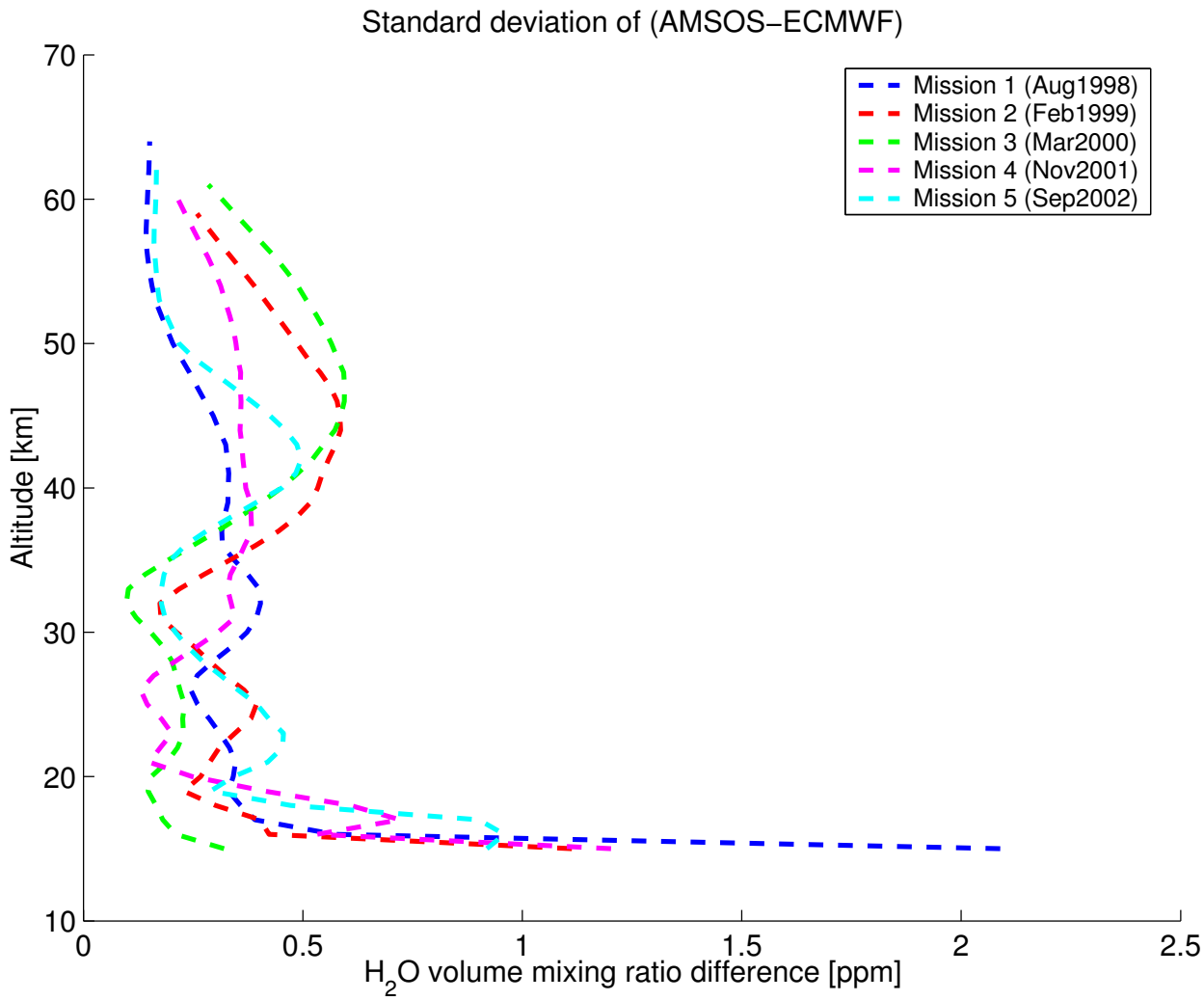
# Mission 5 (Sep 2002): ECMWF profile availability



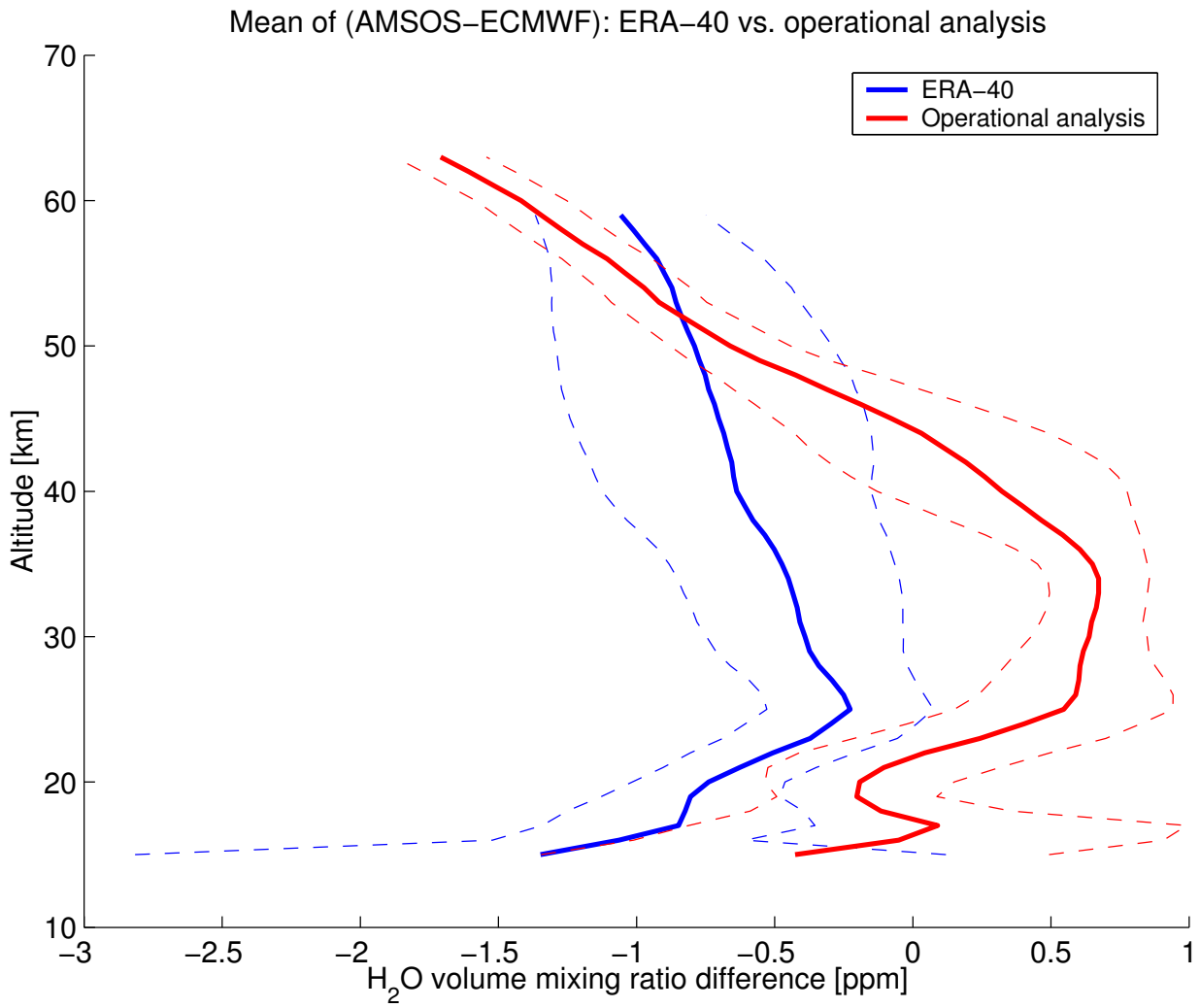
# Mean difference by mission



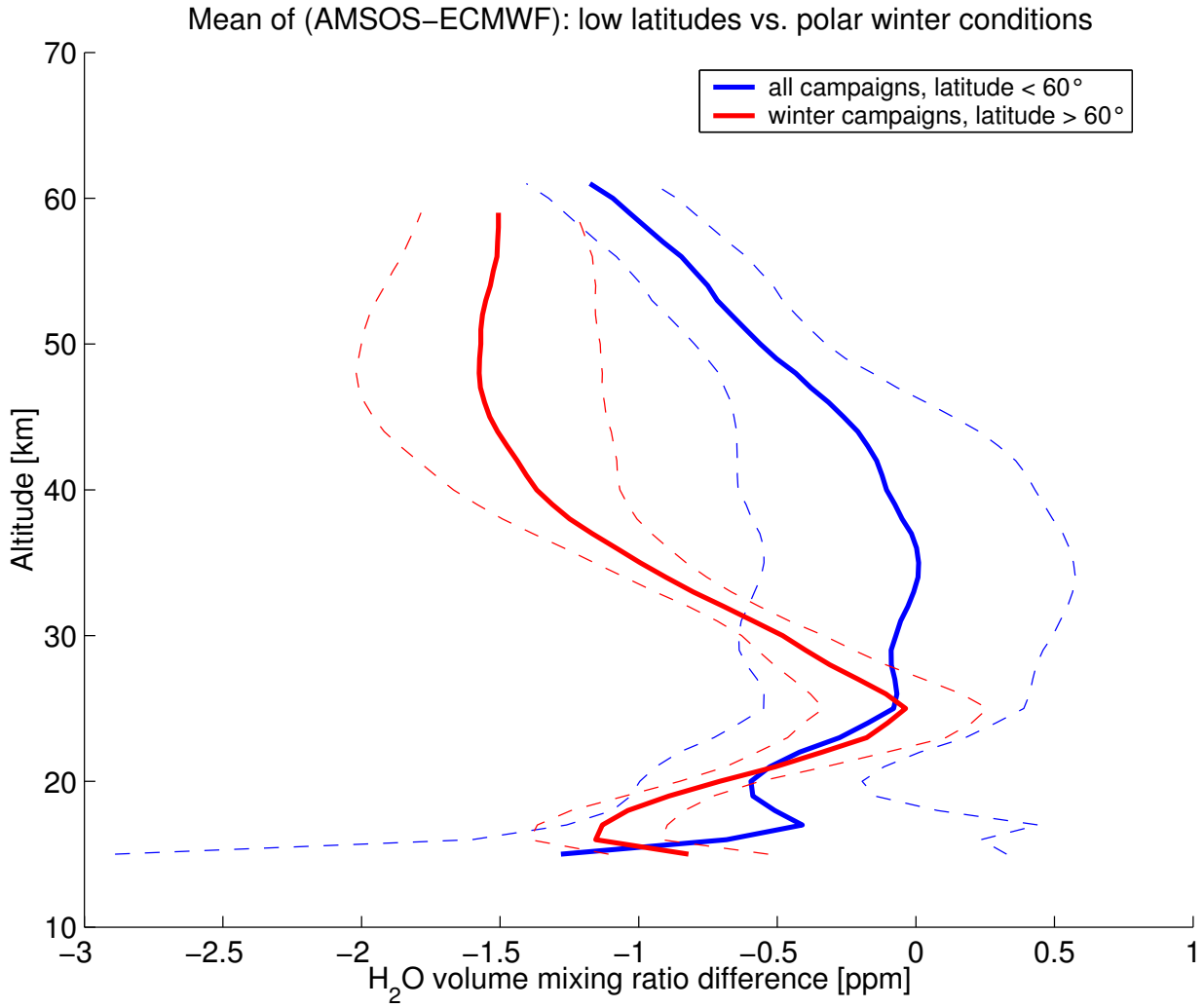
# Standard deviation by mission



# Effects of ECMWF model versions



# Latitude-dependent effects (polar vortex)



# Conclusions

- AMSOS measurements and ECMWF humidity product agree well in the lower stratosphere. Small-scale horizontal structure is well-resolved.

- Systematic deviation in the upper stratosphere. ECMWF probably does not model removal processes for stratospheric $H_2O$ well.

- Strong deviation inside and near polar vortex. Potential problem with ECMWF vertical transport?

- Quality of agreement has a strong correlation with ECMWF model version.