

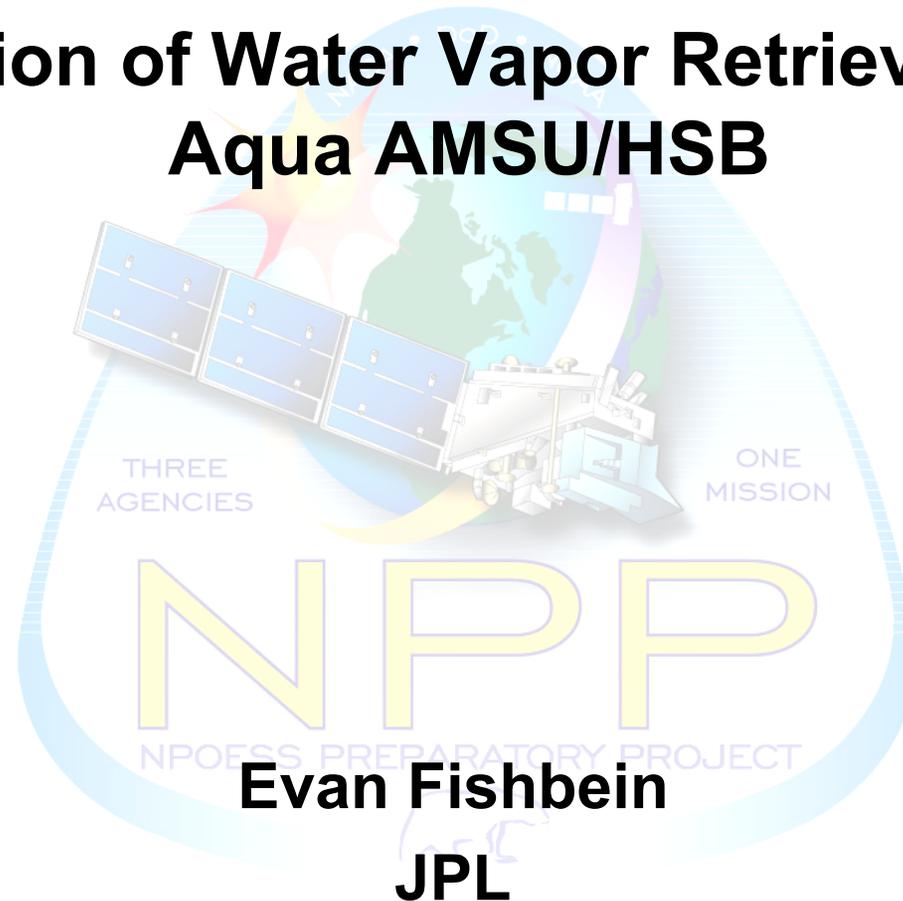


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Validation of Water Vapor Retrieved from Aqua AMSU/HSB





Motivation

- **What are the limitations of using CrIS/ATMS for climate research?**
 - Measurement requirements are lower for cloudy scenes
 - Possibility of state-correlated errors, i.e. “sampling errors”
 - High flux regimes, e.g. frontal systems and convectively unstable
 - Water vapor is expected to show largest sampling errors
 - Variability correlates with cloudiness and saturation
 - **AIRS/AMSU/HSB provide a proxy for CrIS/ATMS**
 - **Independent coincident microwave measurements facilitate assessment**
 - Dedicated radiosondes have limited sampling
 - **AMSU/HSB water vapor product must be validated**
-



Why Characterize the Aqua Microwave WV Product?

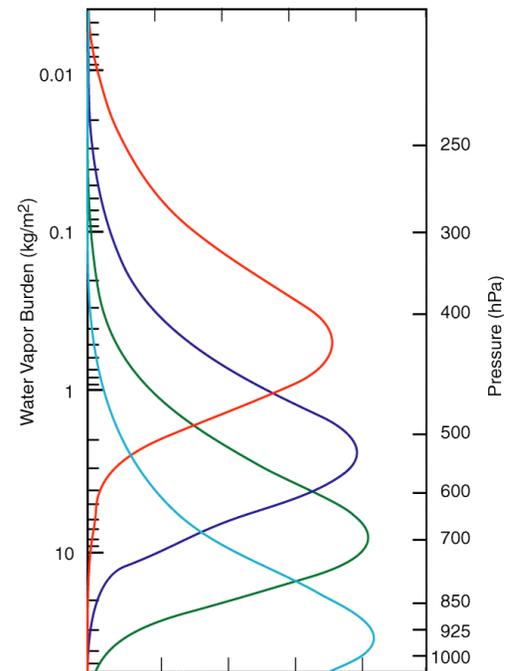
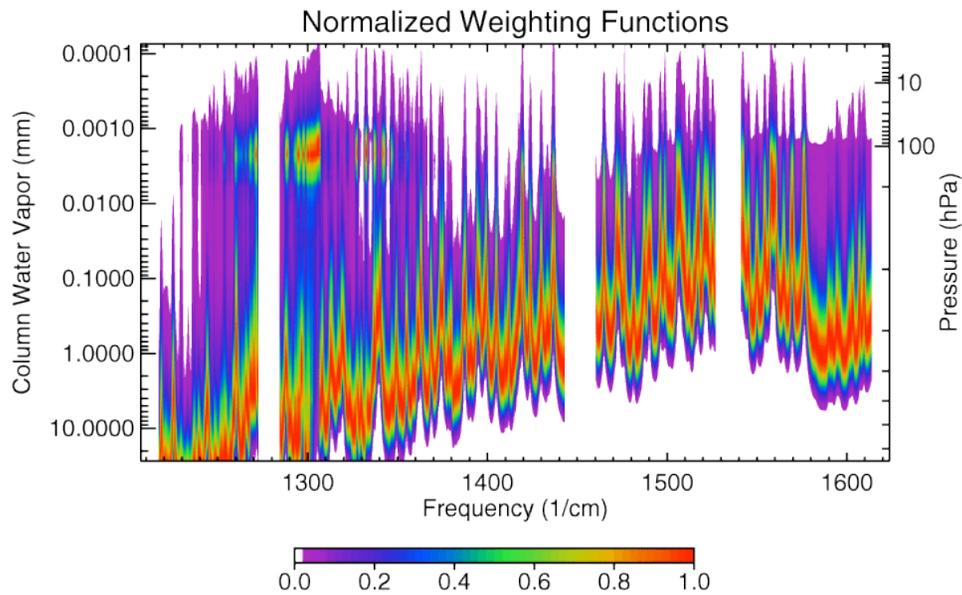
- AMSU/HSB less capable than AIRS
 - Fewer channels
 - Poorer pre-launch/post-launch calibration
 - Higher noise (HSB)
 - Poorer spatial resolution (AMSU-A)
- But, microwave and infrared radiometry have different sampling (null-space) error characteristics

Issue	Microwave	Infrared
Surface	Emissivity dependent on soil and vegetation moisture, composition and texture Linear dependence of Planck (T/E separation difficult) Large view angle, polarization and wind-dependence Large radiometric contrast over ocean	Emissivity weakly dependent on moisture and texture. Nonlinear Planck facilitates T/E separation Emission is mostly Lambertian Ocean emissivity weakly dependent on wind and emissivity and close to unity
Clouds	Weakly sensitive, except for precipitating clouds	Strong sensitivity to clouds
Field of View	Large radiometric contribution from antenna side-lobes FOV filling of calibration targets	FOV has sharp boundaries Calibration targets fill FOV



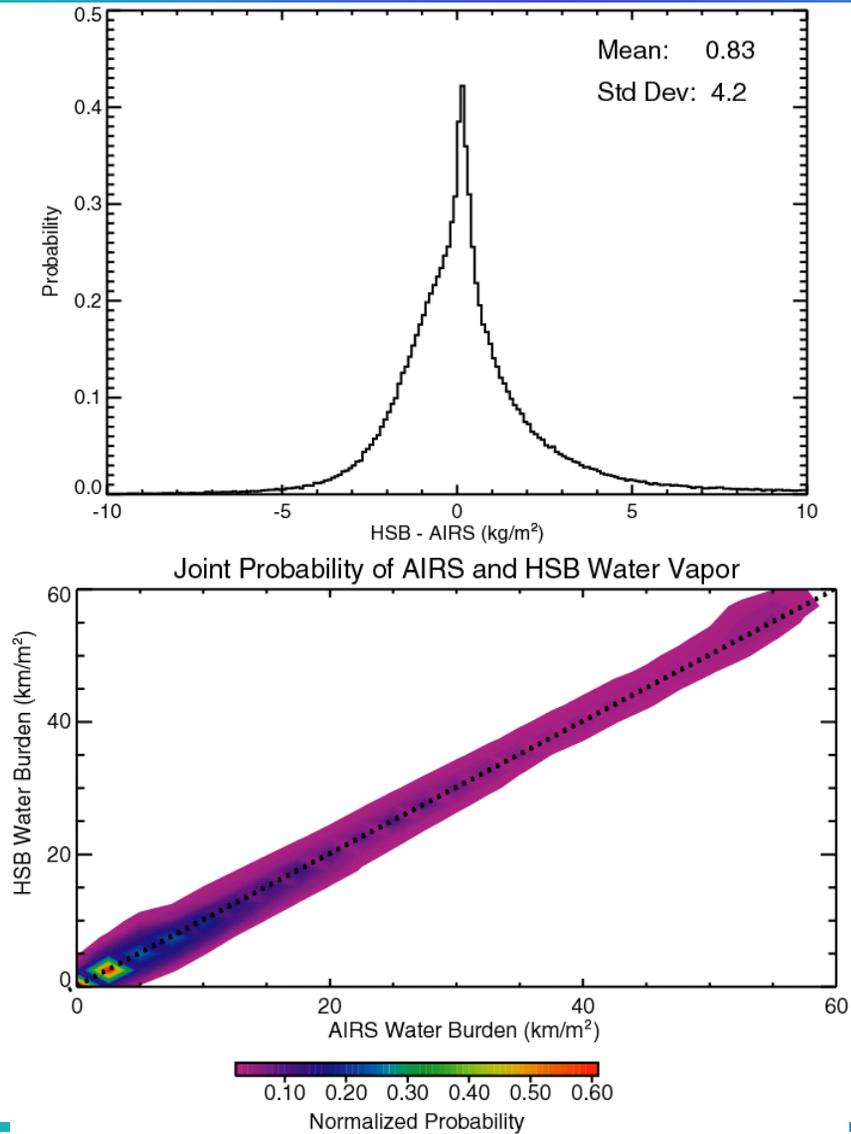
Instrument Characteristics

	HSB	AIRS
Vertical Range	Surface to 0.2 kg/m ² 400 hPa	Surface to 0.04 kg/m ² 150 hPa
Vertical Resolution	3 – 4 km ~3 degrees of freedom	1 – 2 km ~8 degree of freedom



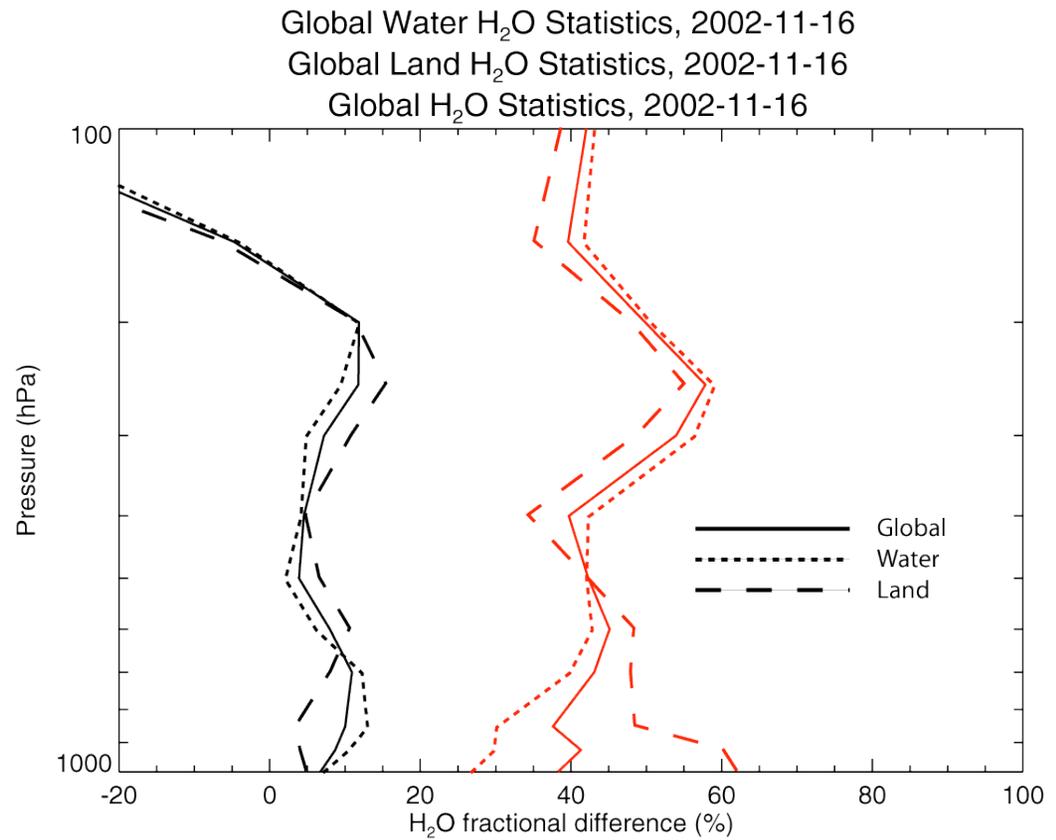
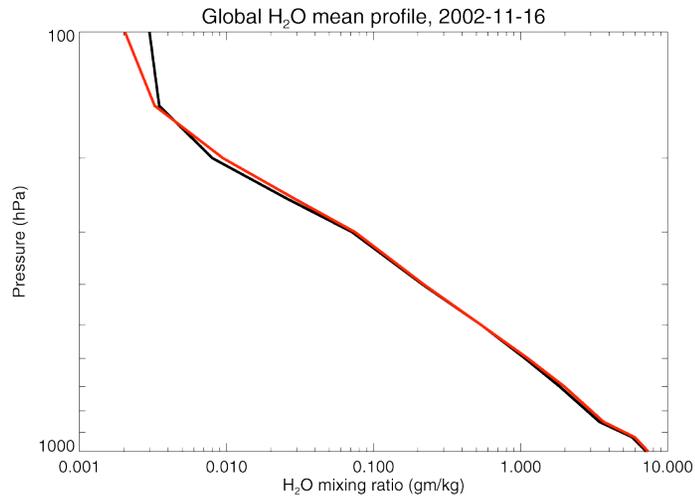


Global AIRS vs AMSU/HSB Properties, Total Precipitable Water





Global ECMWF / HSB Properties, Profiles





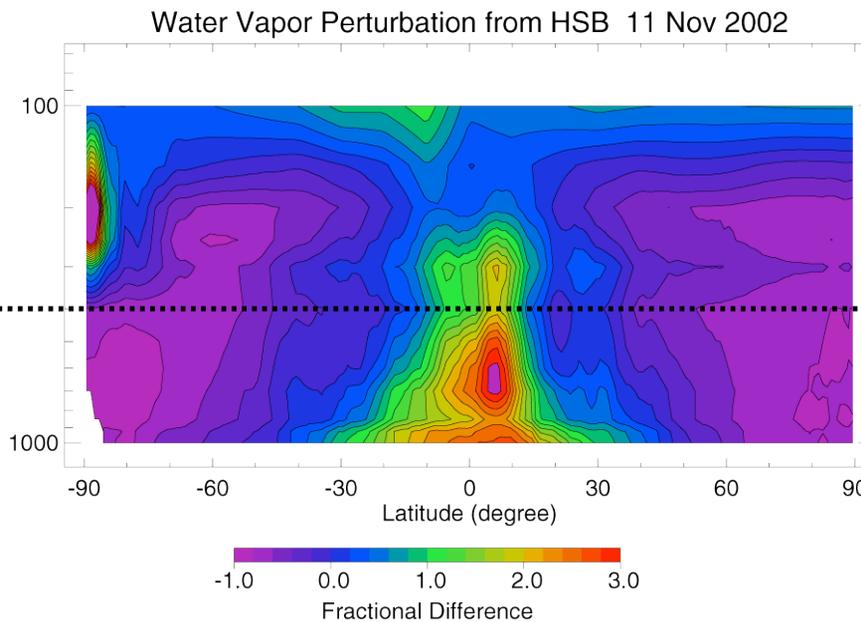
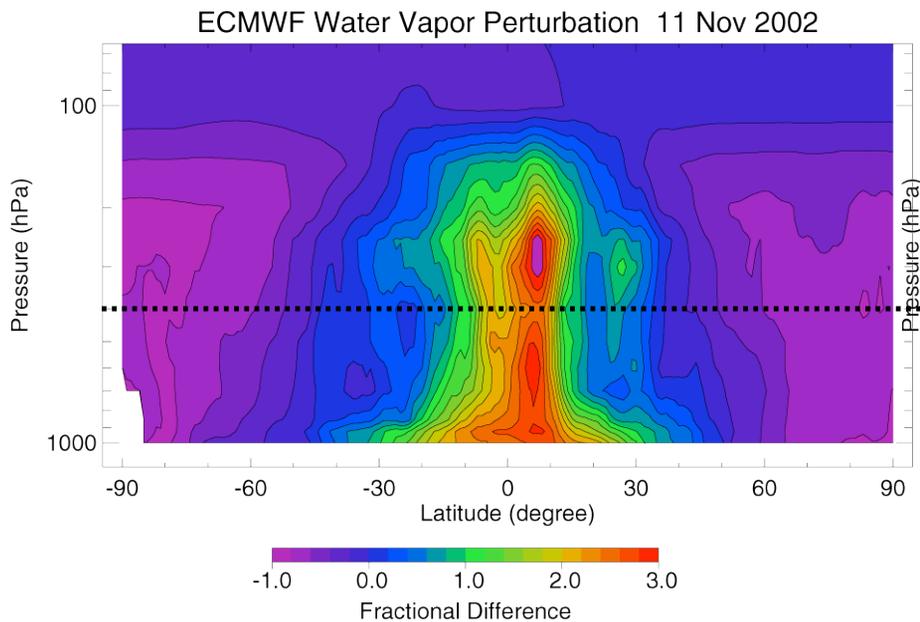
ECMWF / HSB Zonal Cross Sections

11 Nov 2002 1200 UT Analysis

11 Nov 2002 L3 Maps

3 days of data

Ascending & Descending

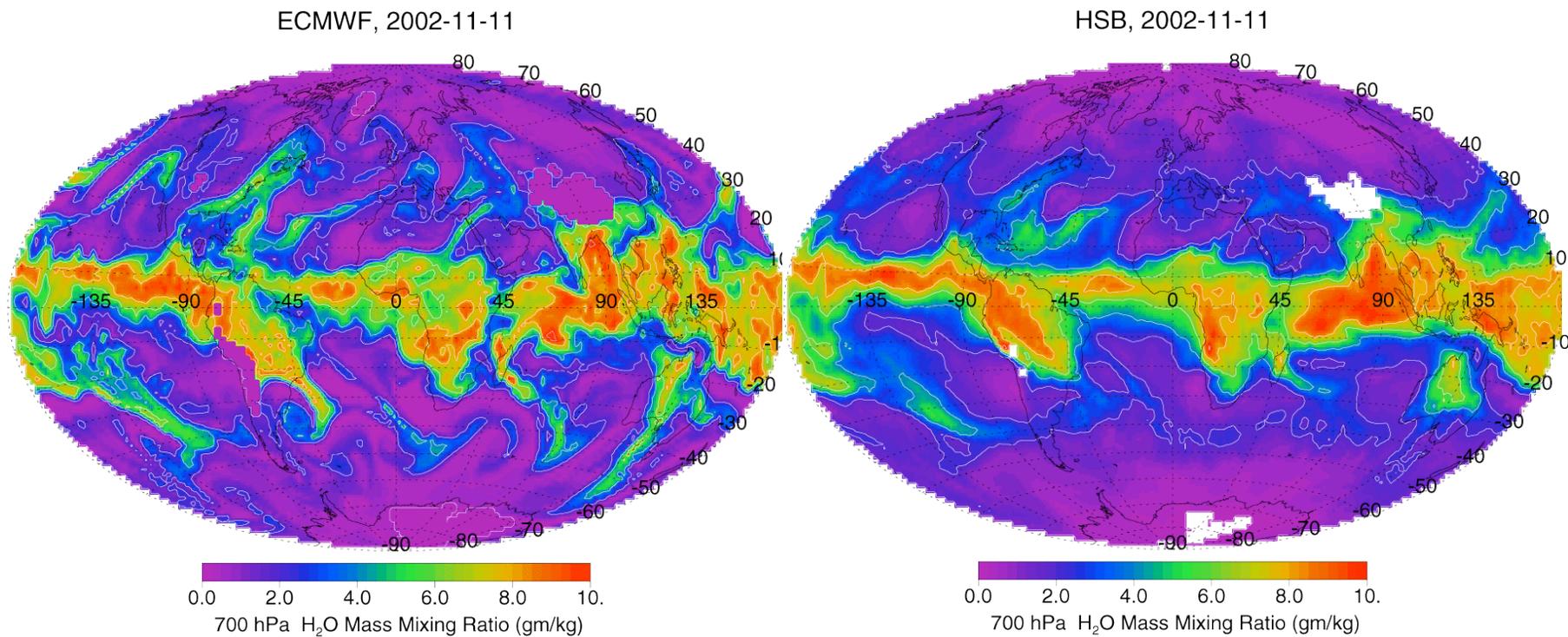




ECMWF / HSB Global Maps

L3 Maps (2 days of data, ascending & descending)

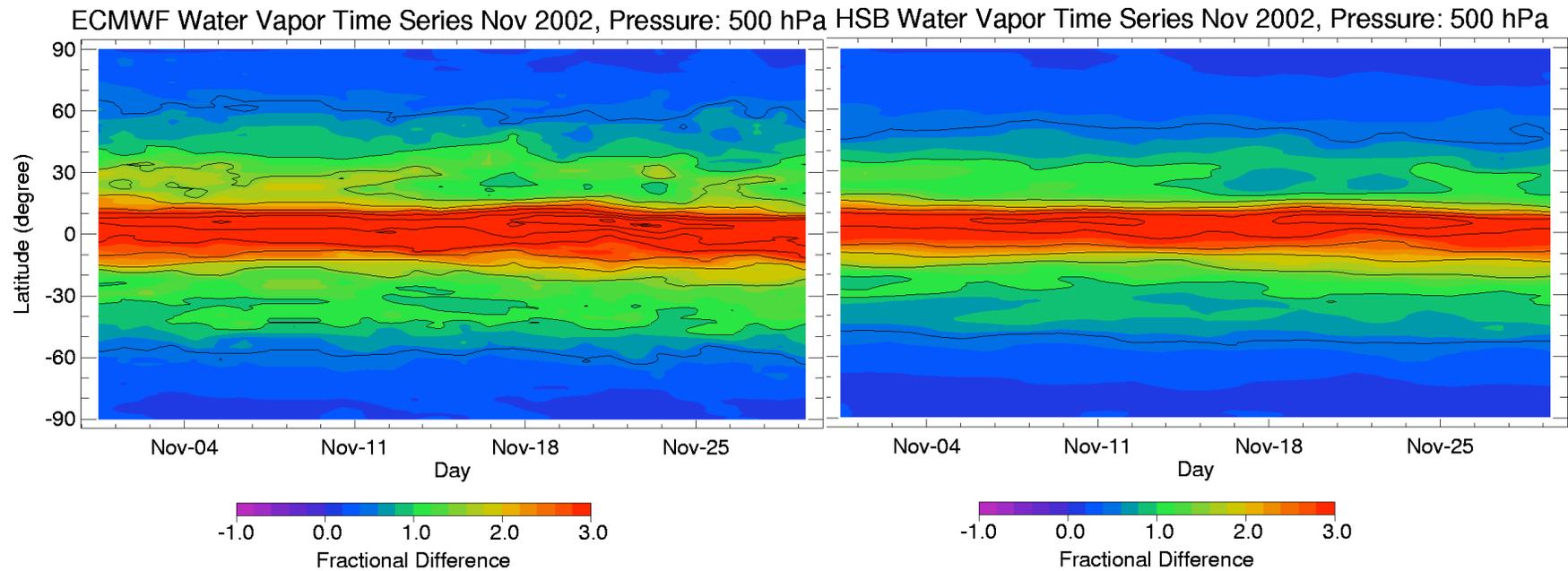
11 Nov 2002 700 hPa





ECMWF / HSB Time Series

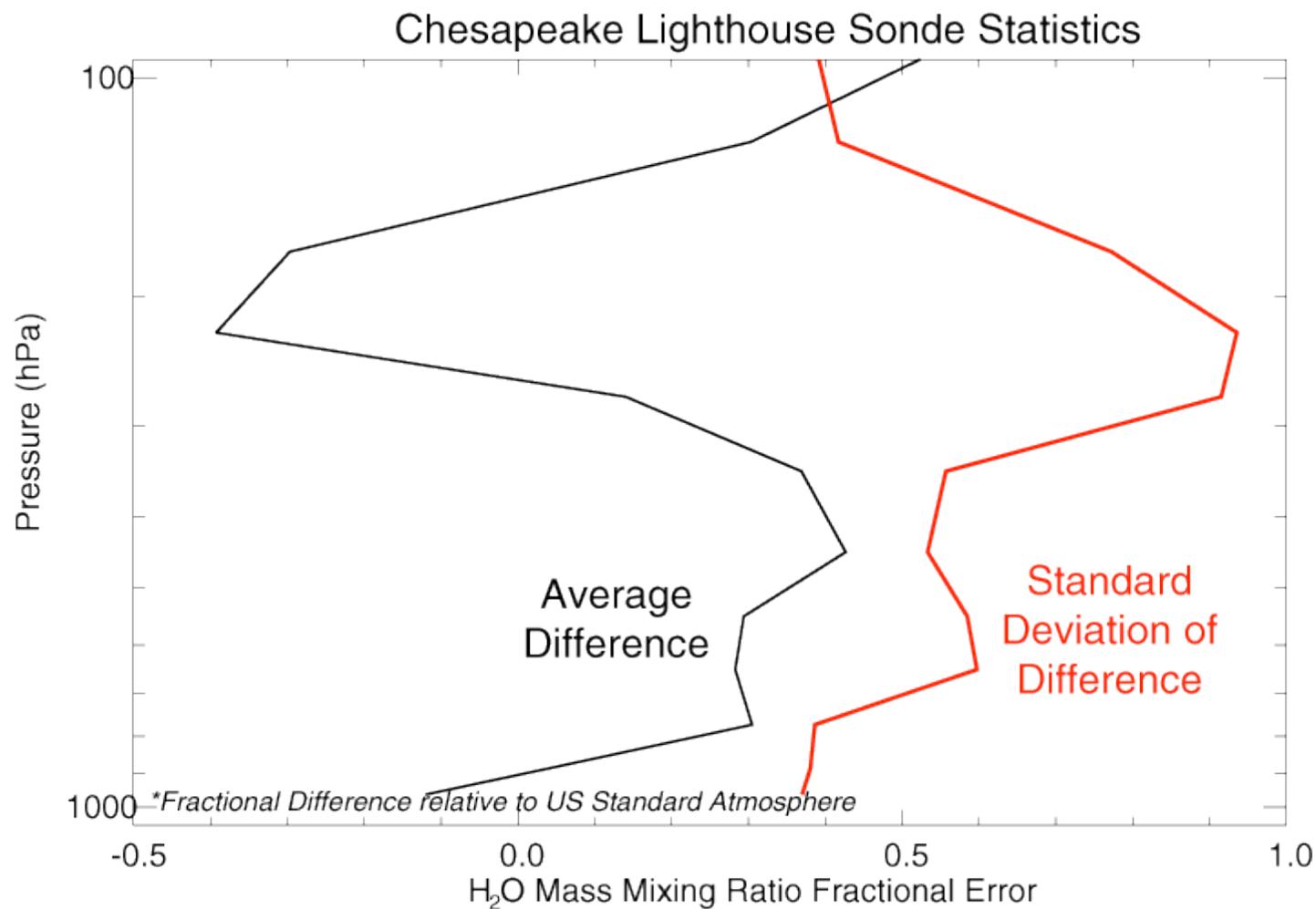
- Time Series from 1200 UT Analyses / L3 Maps
- 500 hPa





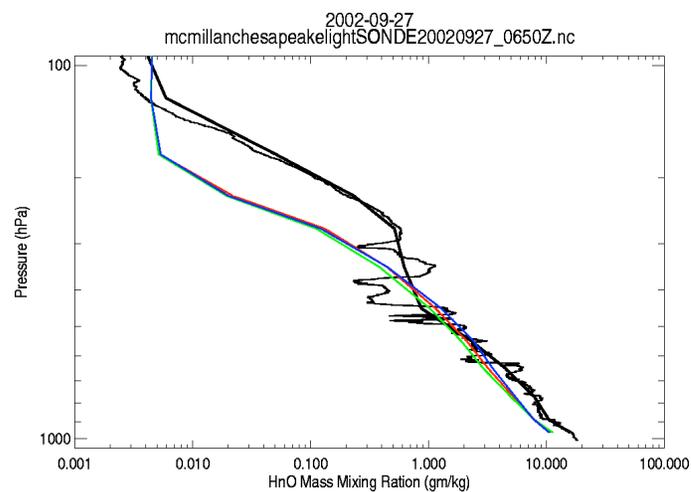
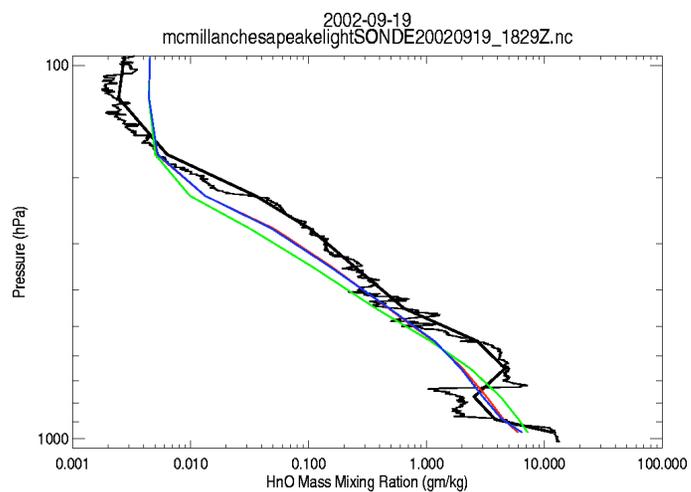
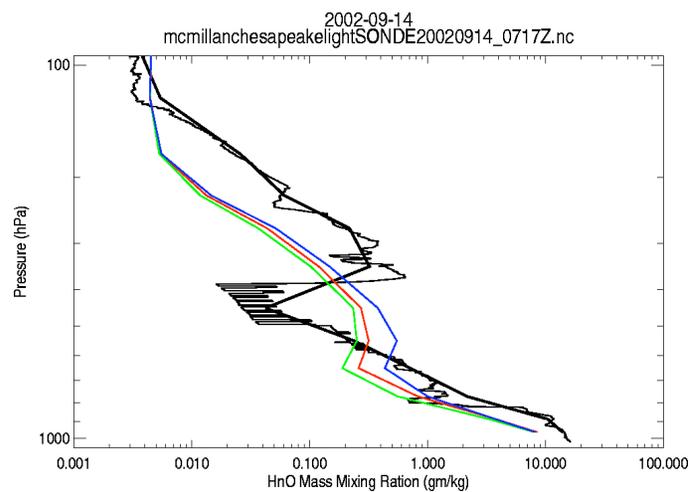
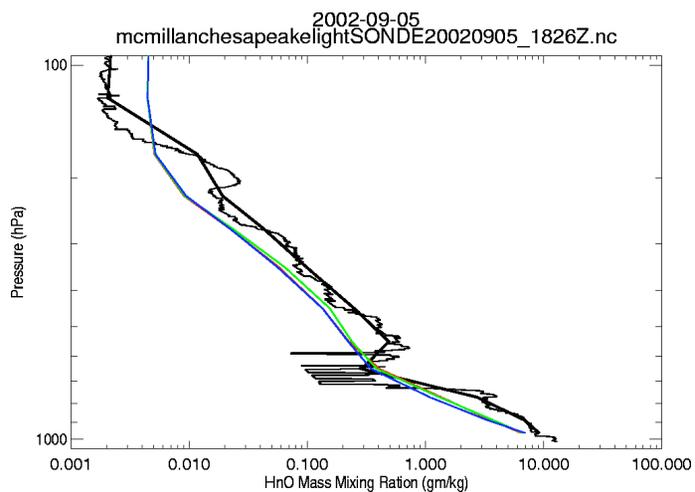
Radiosondes – Chesapeake

- Statistics from all Sondes



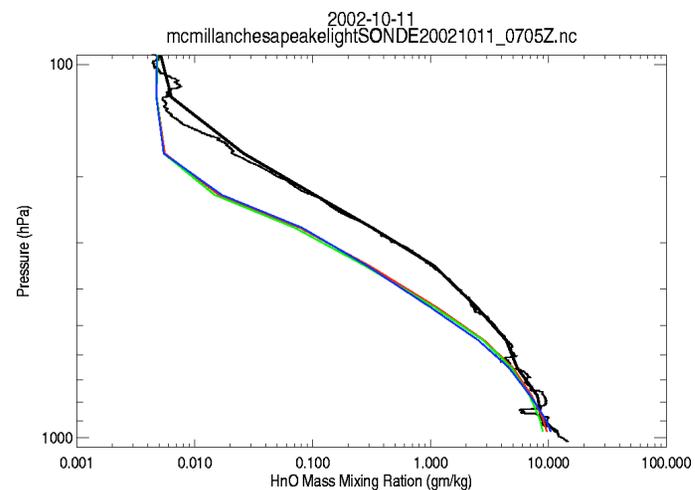
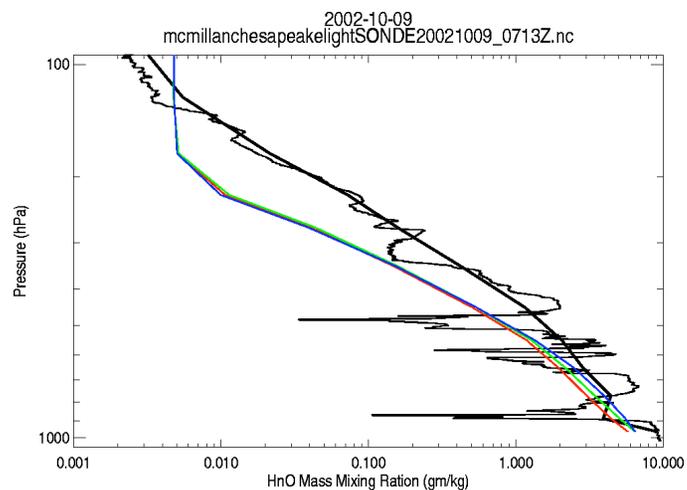
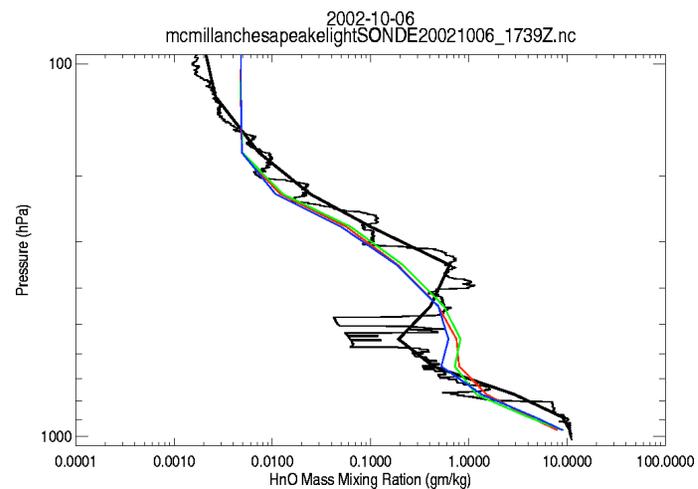
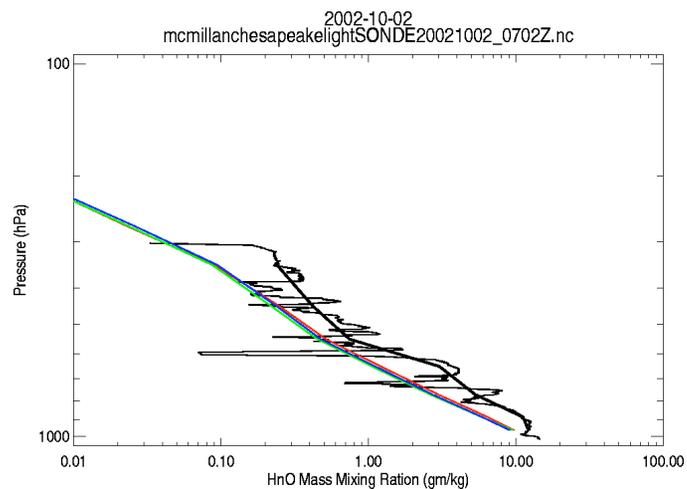


Individual Radiosondes – Chesapeake





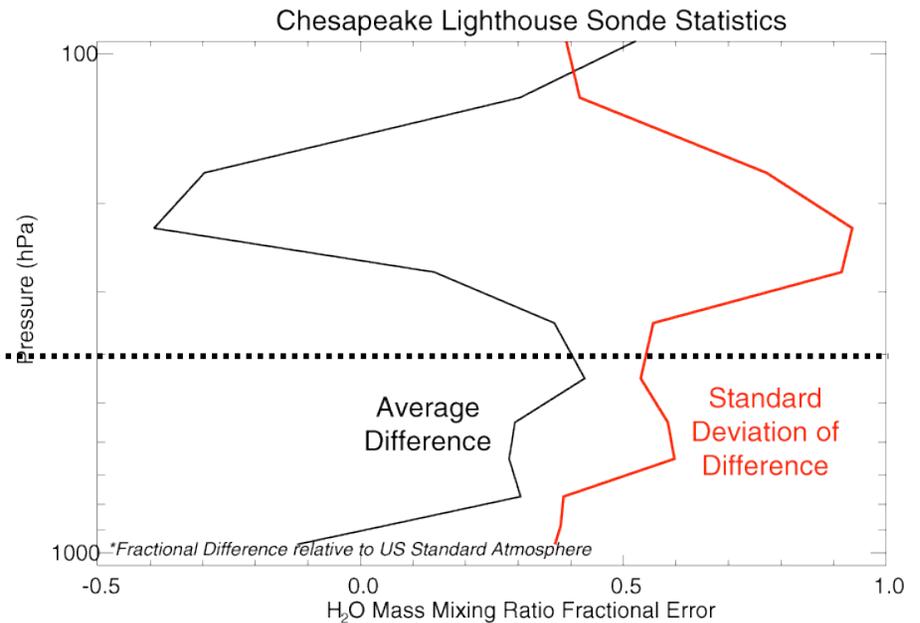
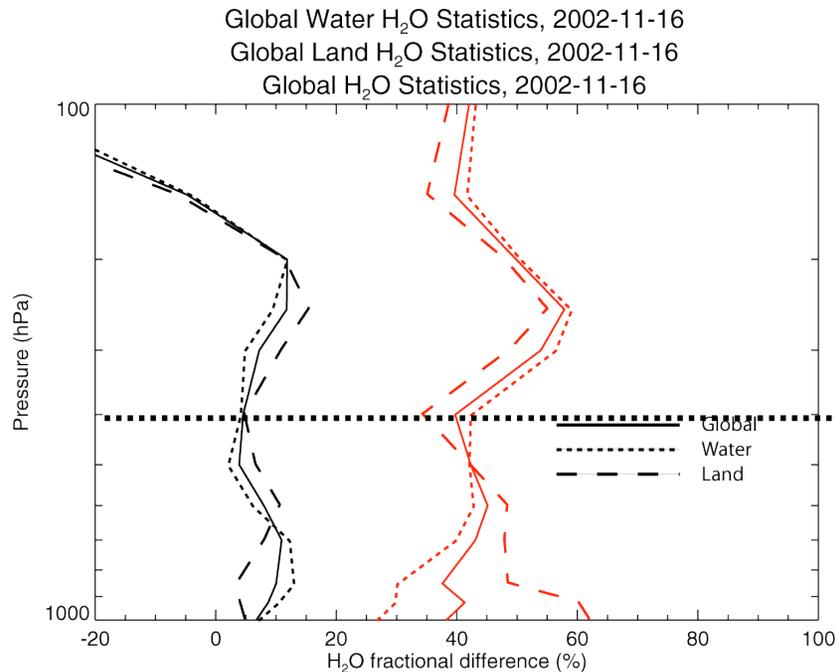
Individual Radiosondes – Chesapeake





ECMWF Radiosonde AMSU/HSB Comparison

- **ECMWF – AMSU/HSB biases are smaller in region of sensitivity**
 - Correlated errors
- **ECMWF – AMSU/HSB standard deviation also smaller**
- **Indicative of overly-stiff a priori covariance matrix**





Conclusions

- **Comparison with ECMWF**
 - Both capture equator to pole transport of moisture in frontal systems
 - Both show corresponding features and coincident timing in zonal means
- **Radiosonde Comparisons**
 - Adjacent AMSU/HSB profiles are more alike than radiosonde profile
- **Summary**
 - Accuracy ~ 20%
 - Precision ~ 40%
 - Possible over-dampening in OE retrieval
- **Additional Works**
 - Additional analyses with other dedicated RS-80/90 radiosonde launch sites