



Comparison of GPS and AIRS TPW

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Overview

- Motivation
- Instrument Essentials
- Matched Data Set Preparation
- Results
- Conclusions



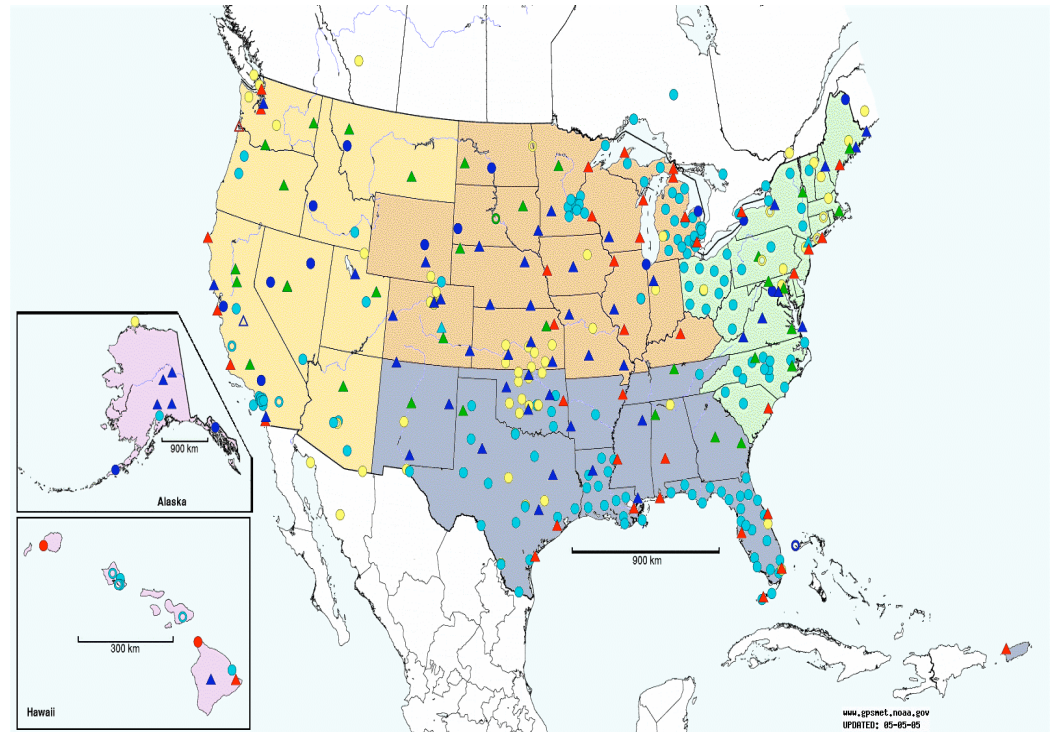
Motivation

- AIRS was designed to advance satellite sensing of water vapor significantly
 - Forerunner of improved operational sounders, including CrIS, IASI, HES
- Validation of AIRS water vapor products essential
 - Permit use of products for hydrology, climatology
 - Provides additional confidence in quality of water vapor channel radiances for NWP data assimilation

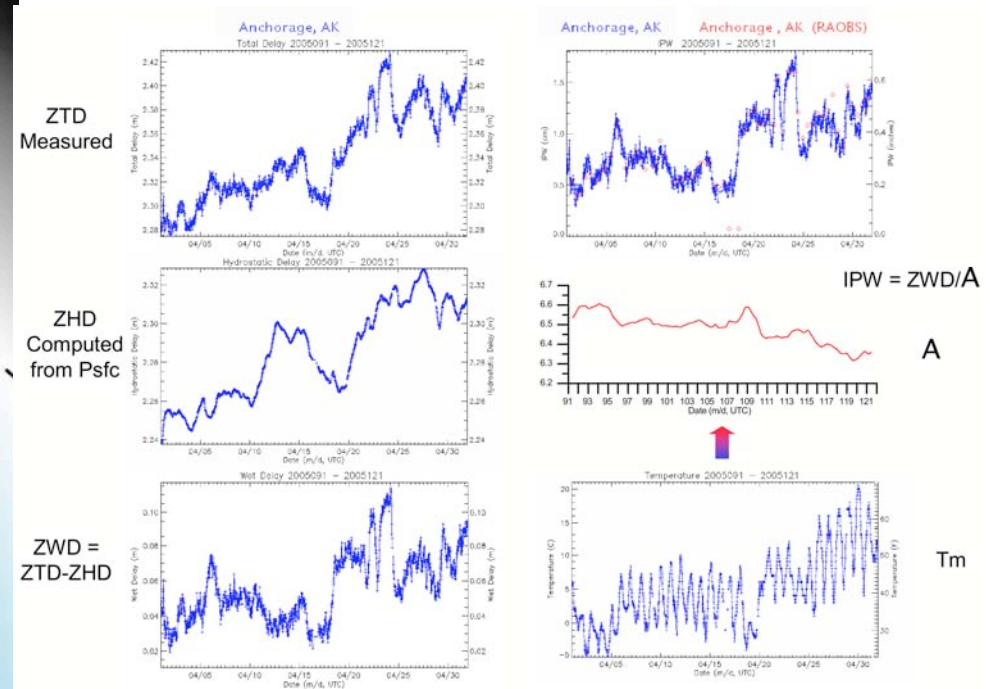
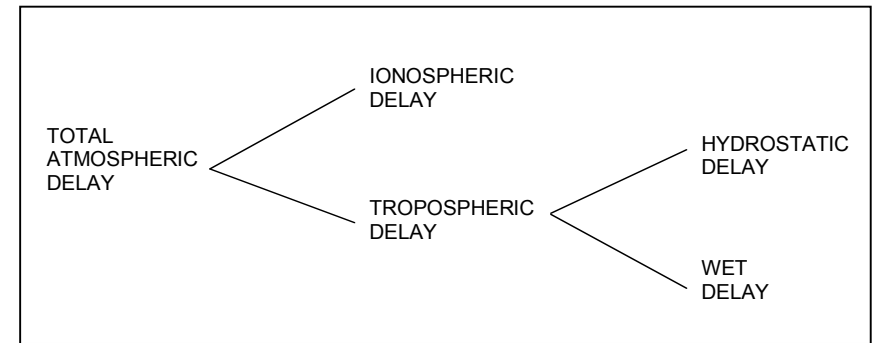
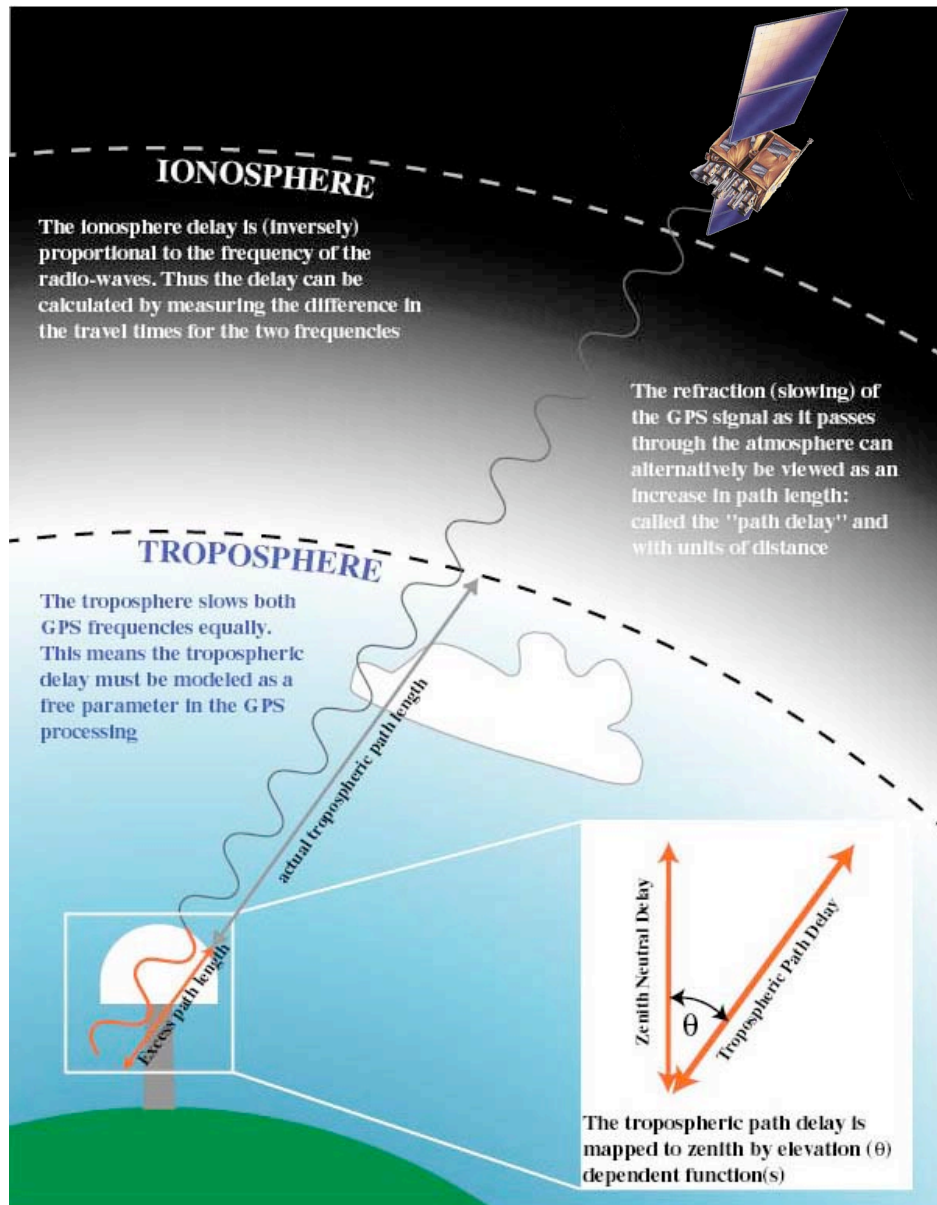


Why GPS for AIRS Validation?

- Accurate column IPW
 - (But no insight on vertical distribution)
- All CONUS Coverage
 - Over 300 stations
- Operational, with 30 minute refresh
- Can accumulate statistically significant data sets quickly and easily



GPS-IPW Measurements



September 26, 2008

Atmospheric Science Team Meeting,
Greenbelt, MD



Data Set Preparation

- **Period of Study April – October 2004**
- **Initial Spatial Window is 0.5 degree by 0.5 degree**
- **Later 0.25 by 0.25 degree match-up also were studied**
- **Temporal Window is half hour**
- **A (GPS-AIRS) IPW match-up is formed when there are un flagged values of:**
 - (a) GPS IPW**
 - (b) AIRS IPW**
 - (c) GPS Surface Pressure**
 - (d) AIRS Surface Pressure**

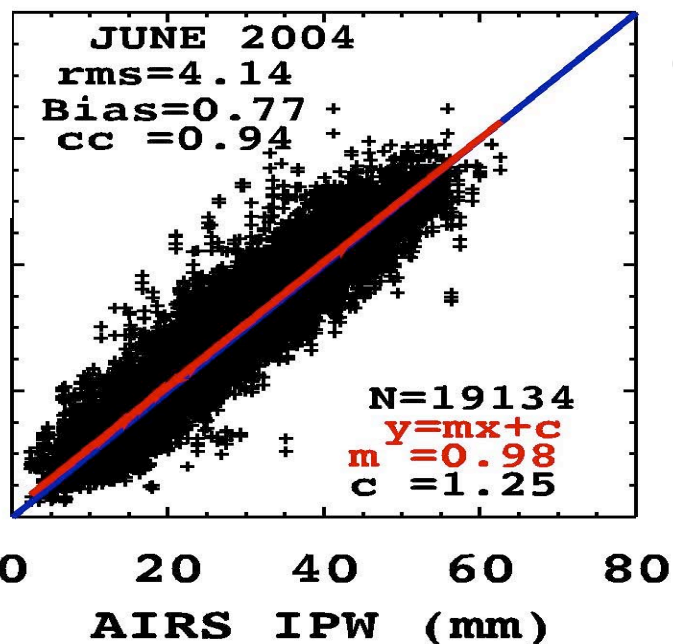


Data Set Preparation

- **AIRS data from JPL had two Quality Flags**
 - (a) QBOT = 0 flag
 - (b) QMID= 0 flag
- **The values “0” indicates high confidence i**
- **QBOT =0 flag is more stringent than QMID =0 flag**
- **Generally the match-up with QBOT=0 is a subset of those with QMID=0 data**
- **The specific criteria for QBOT and QMID flags are detailed in Susskind et al. (2006, JGR Special issue on AIRS)**

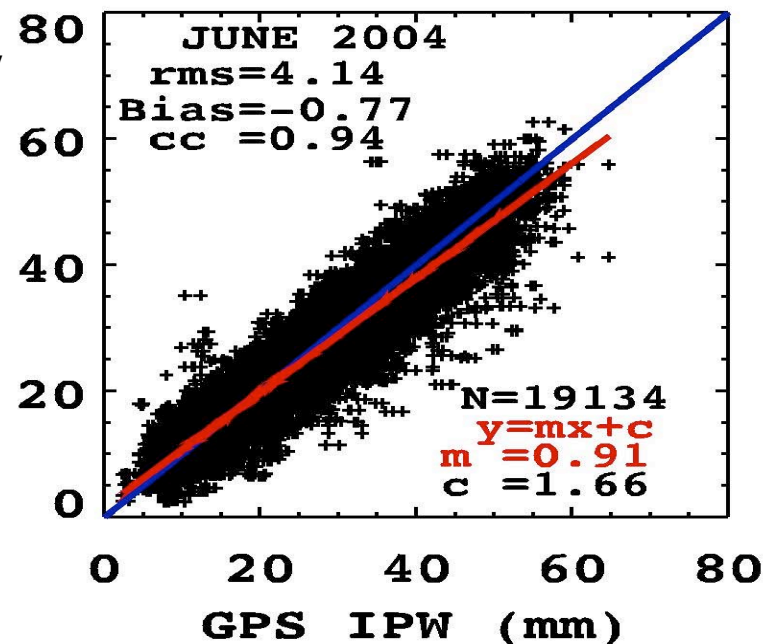


GPS IPW

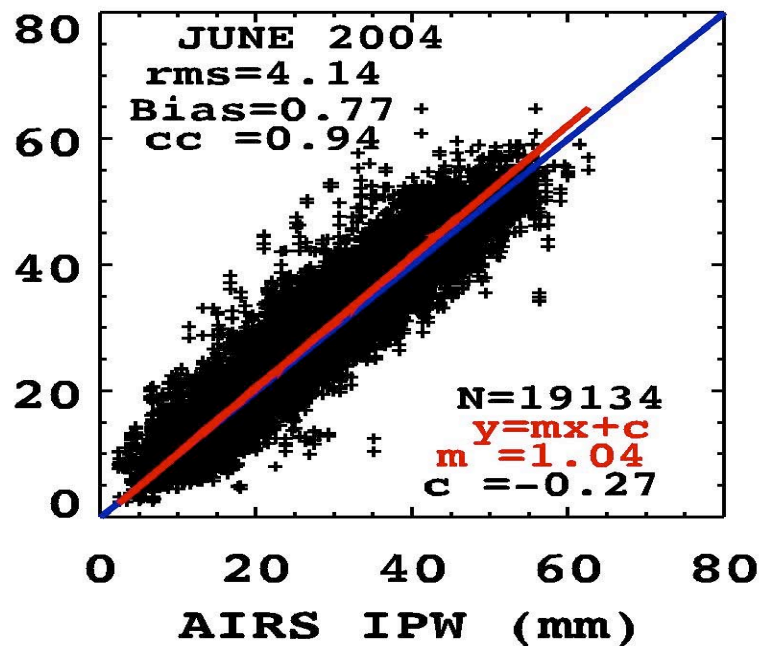


Ordinary

AIRS IPW (mm)



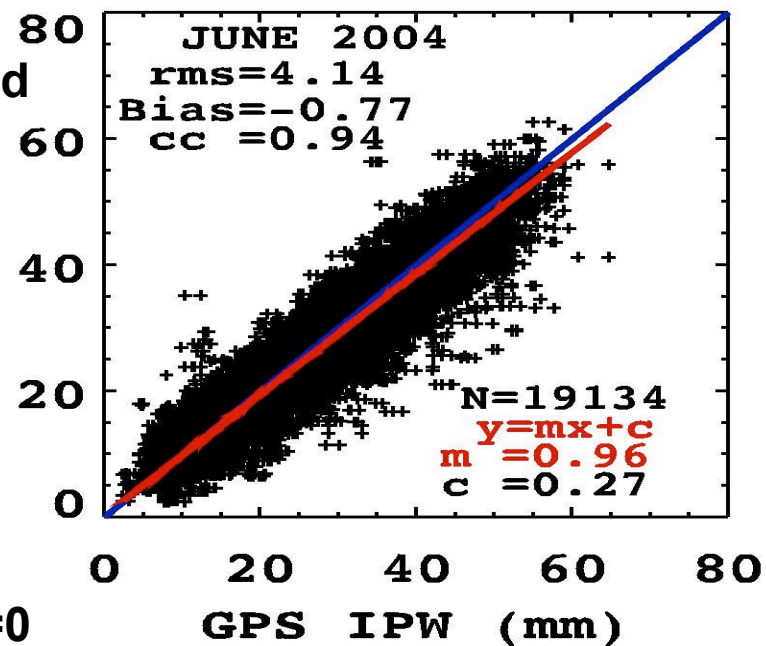
GPS IPW (mm)



Rotated

AIRS IPW (mm)

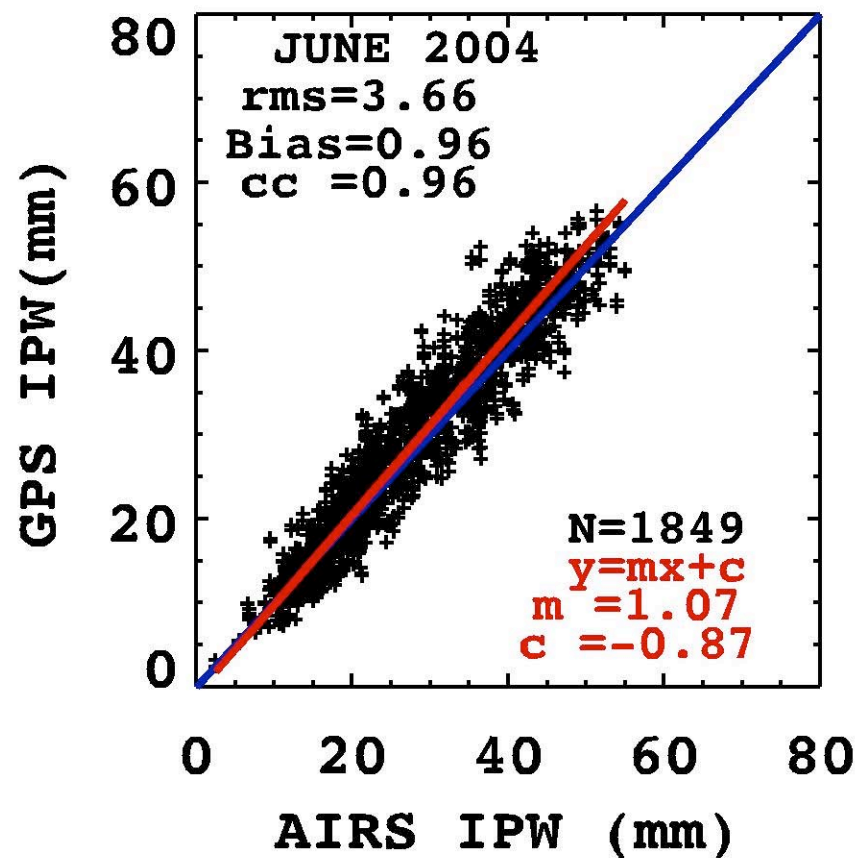
QMID=0



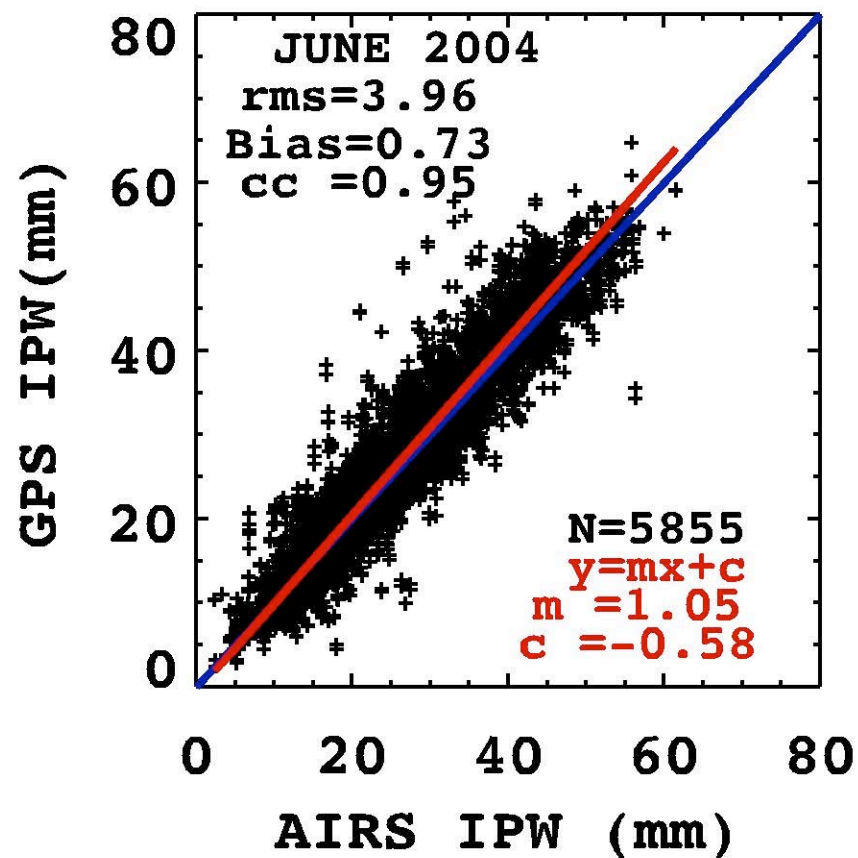


1/4 degree match-ups

QBOT=0



QMID=0





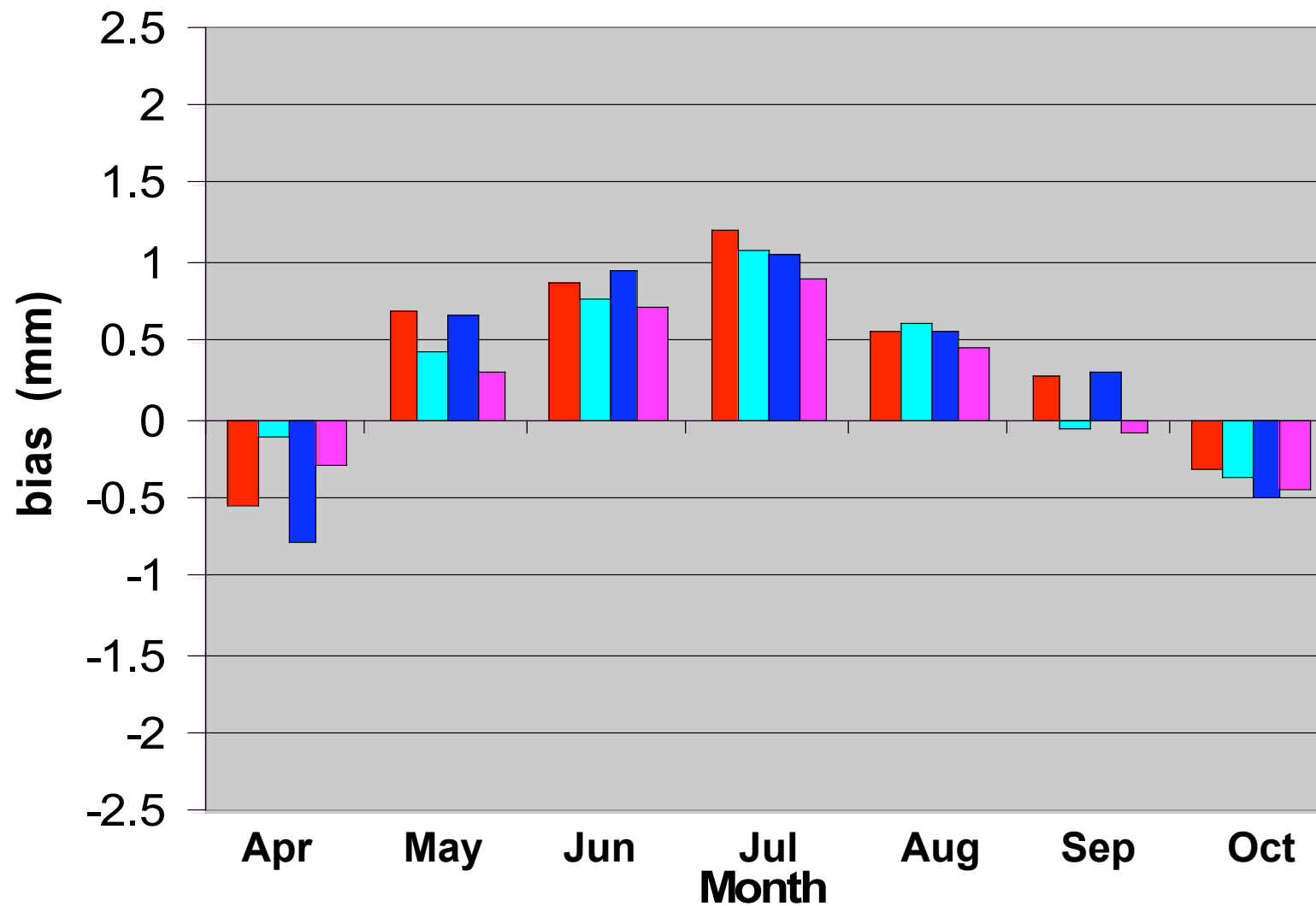
(GPS-AIRS) bias as a function of time

1/2, QBOT=0

1/4, QBOT=0

1/2, QMID=0

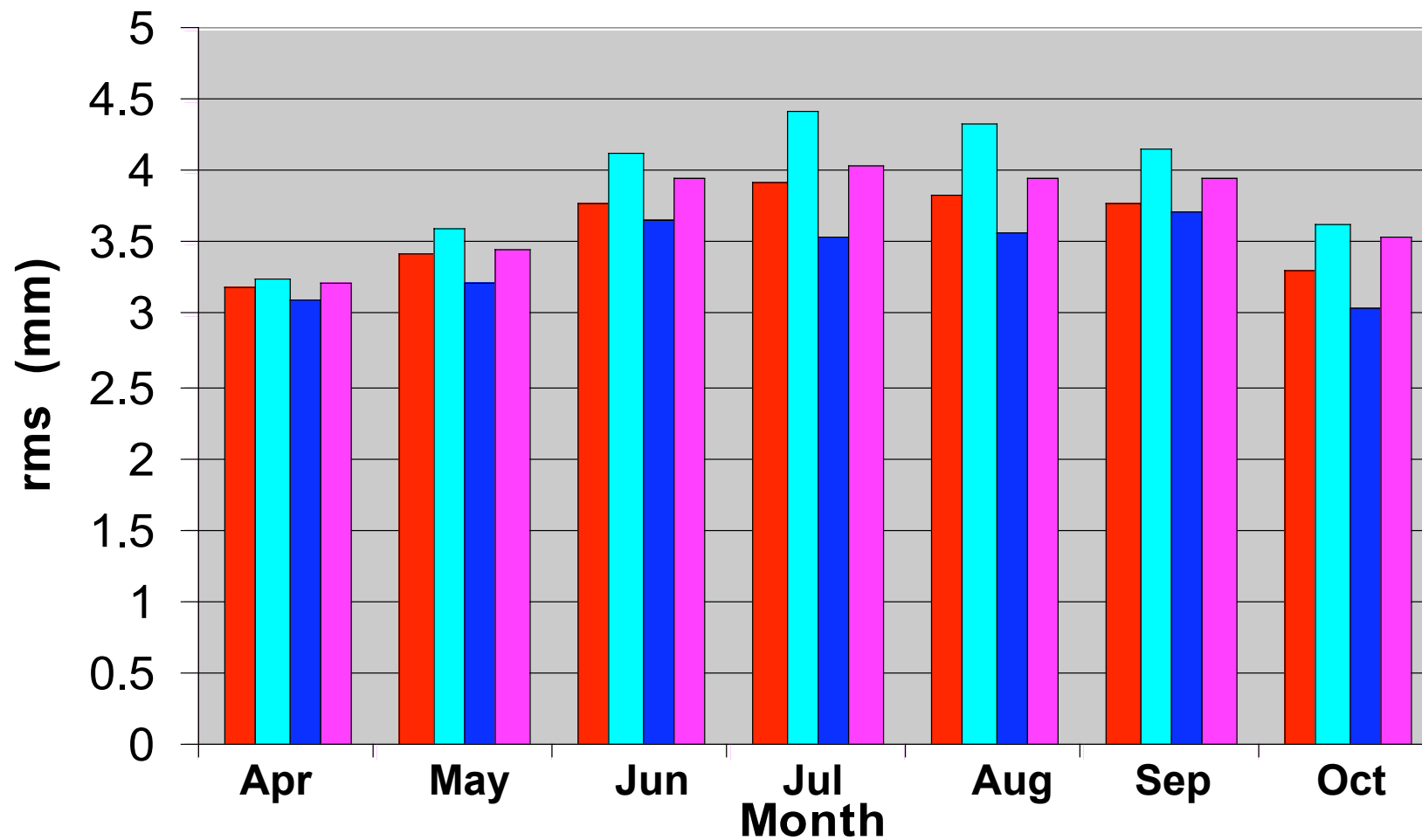
1/4, QMID=0

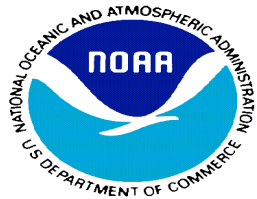




(GPS - AIRS) rms as a function of time

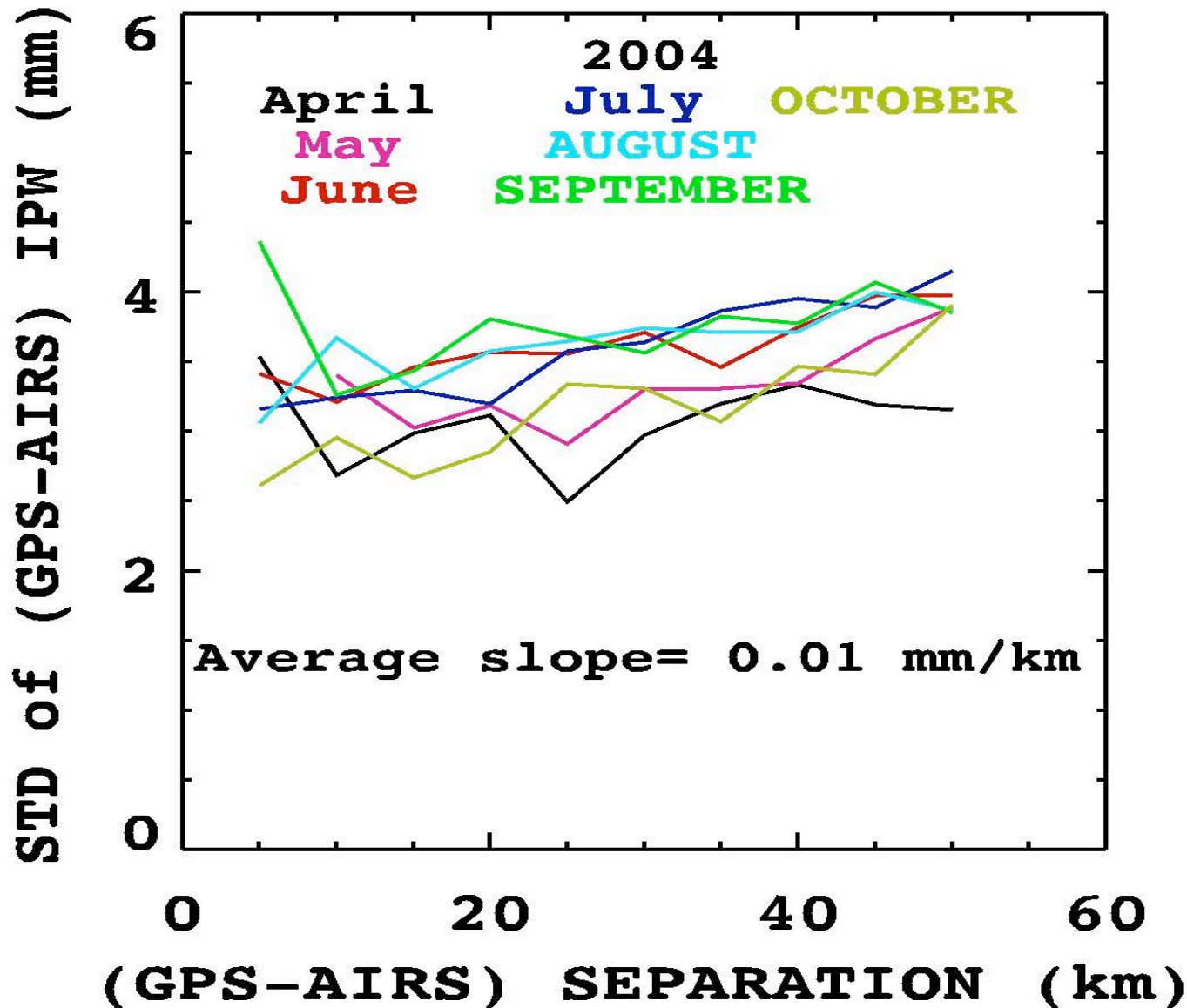
■ 1/2, QBOT=0 ■ 1/2, QMID=0 ■ 1/4, QBOT=0 ■ 1/4, QMID=0

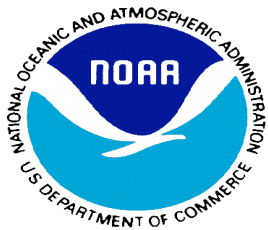




Stdev of IPW diff Vs Separation

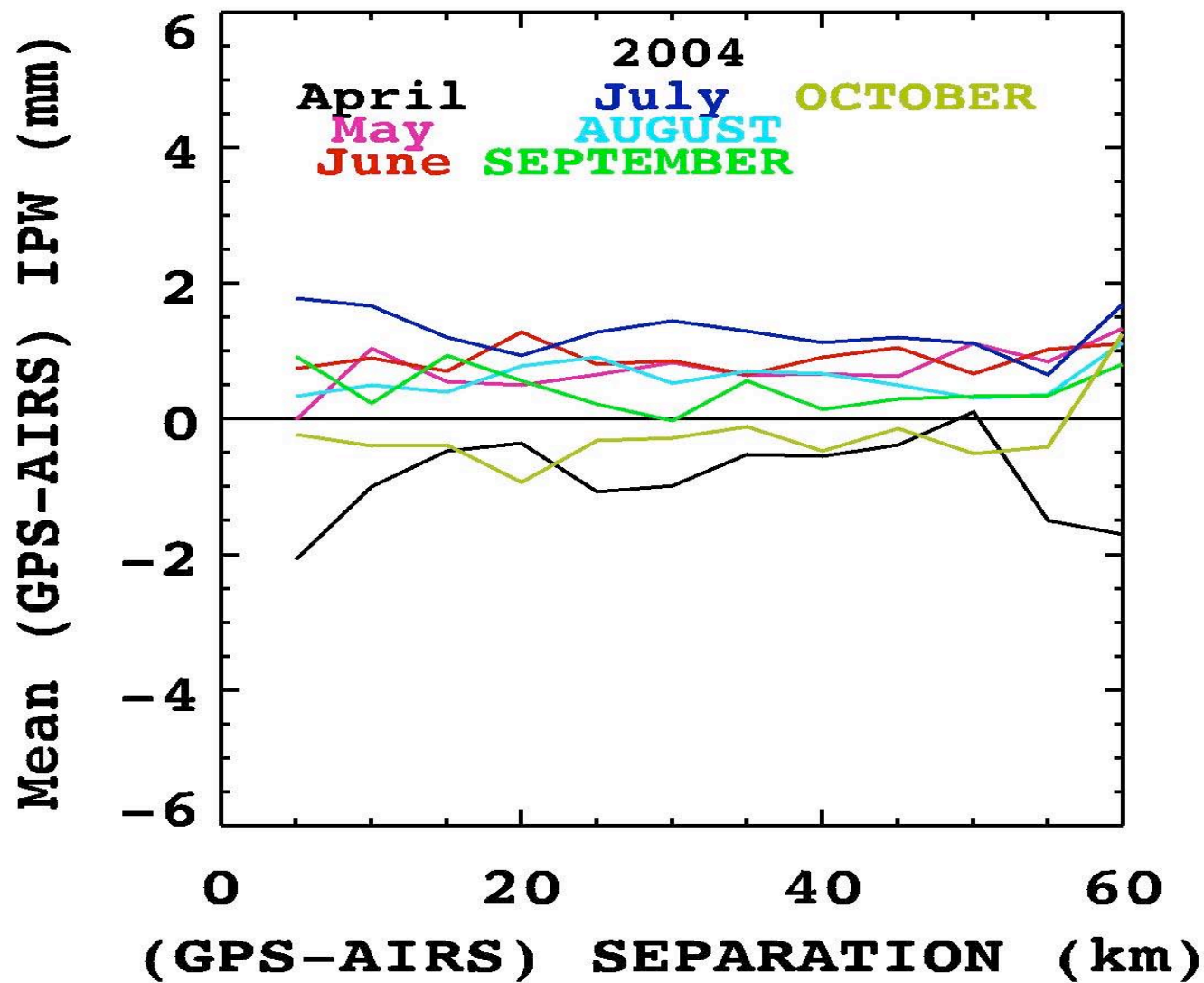
QBOT=0





Mean IPW difference Vs Separation

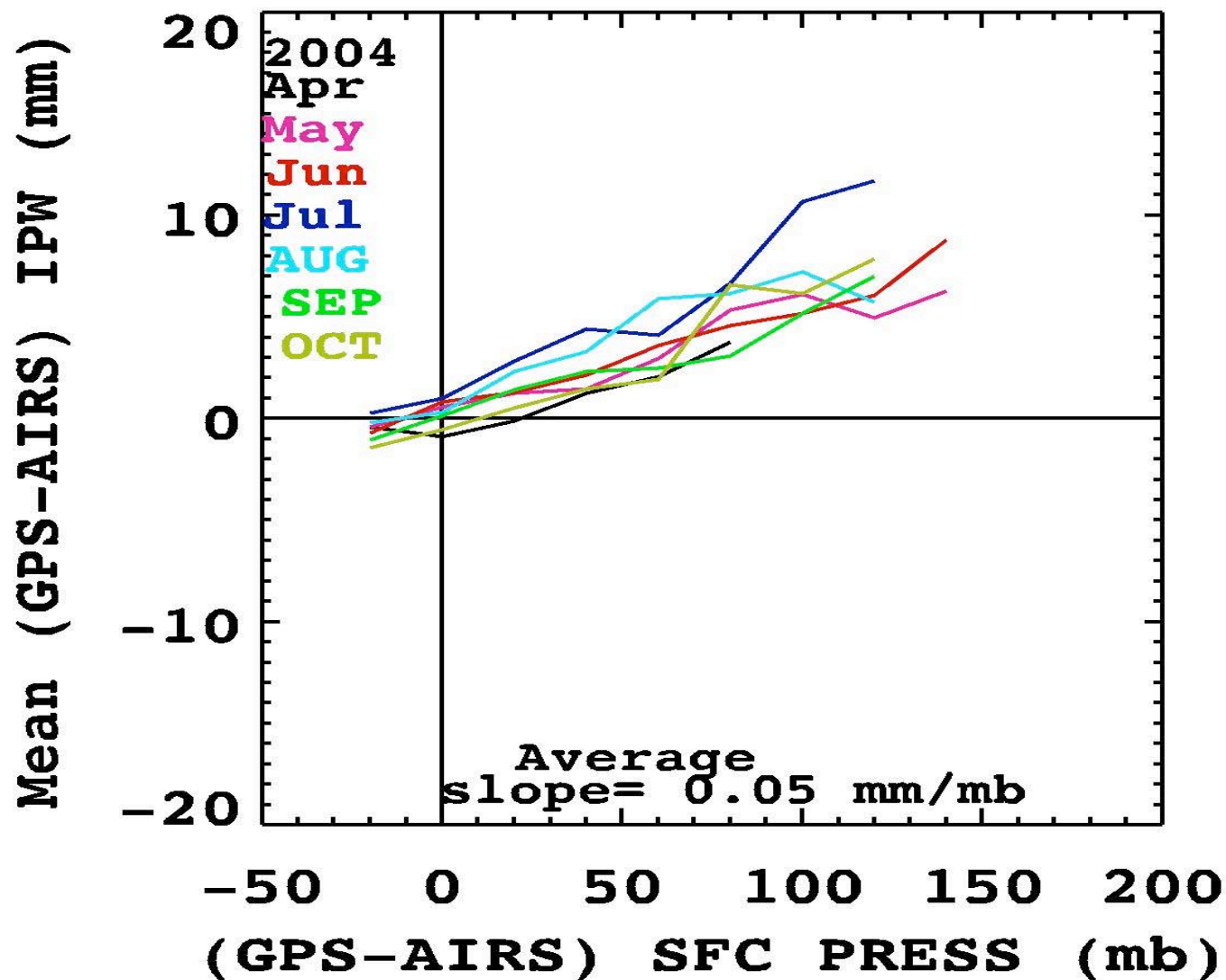
QBOT=0





Mean IPW difference Vs Mean surface pressure difference

QBOT=0





Surface pressure difference based adjustment to AIRS IPW

- The average slope and intercept values from the previous chart used for corrections to AIRS IPW based on the surface pressure differences between the two measurements
- Some typical (GPS-AIRS) bias values in mm units given in the table for QBOT flag data with and without adjustment

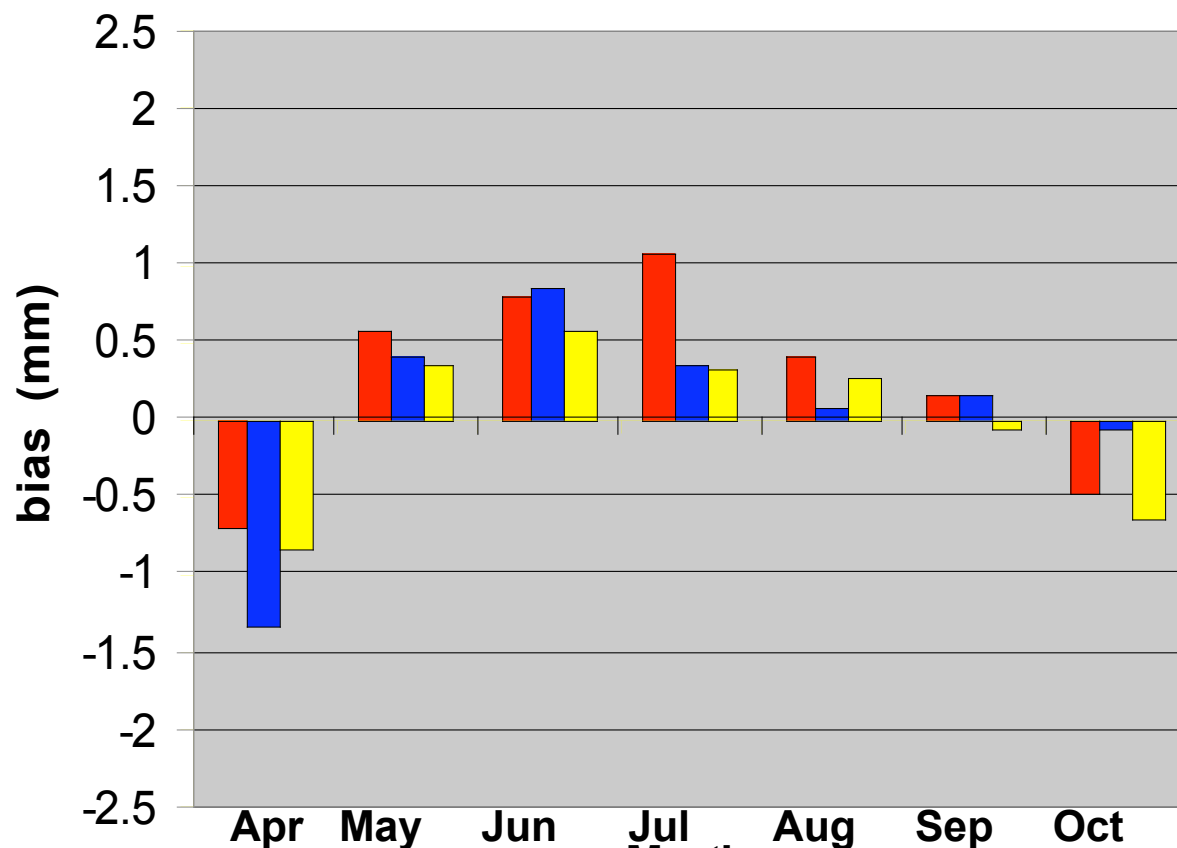
Month	QB	QBadj
May	0.70	0.35
Jun	0.87	0.51
Jul	1.21	0.42
Aug	0.58	0.35



Surface pressure difference based correction to AIRS IPW

(GPS-AIRS) bias as a function of time

- 1/2, $\text{deltap} \leq 20$, QBOT=0
- 1/2, $\text{deltap} \leq 0.5$, QBOT=0
- 1/2, sfp adjusted



September 29 2006

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Summary

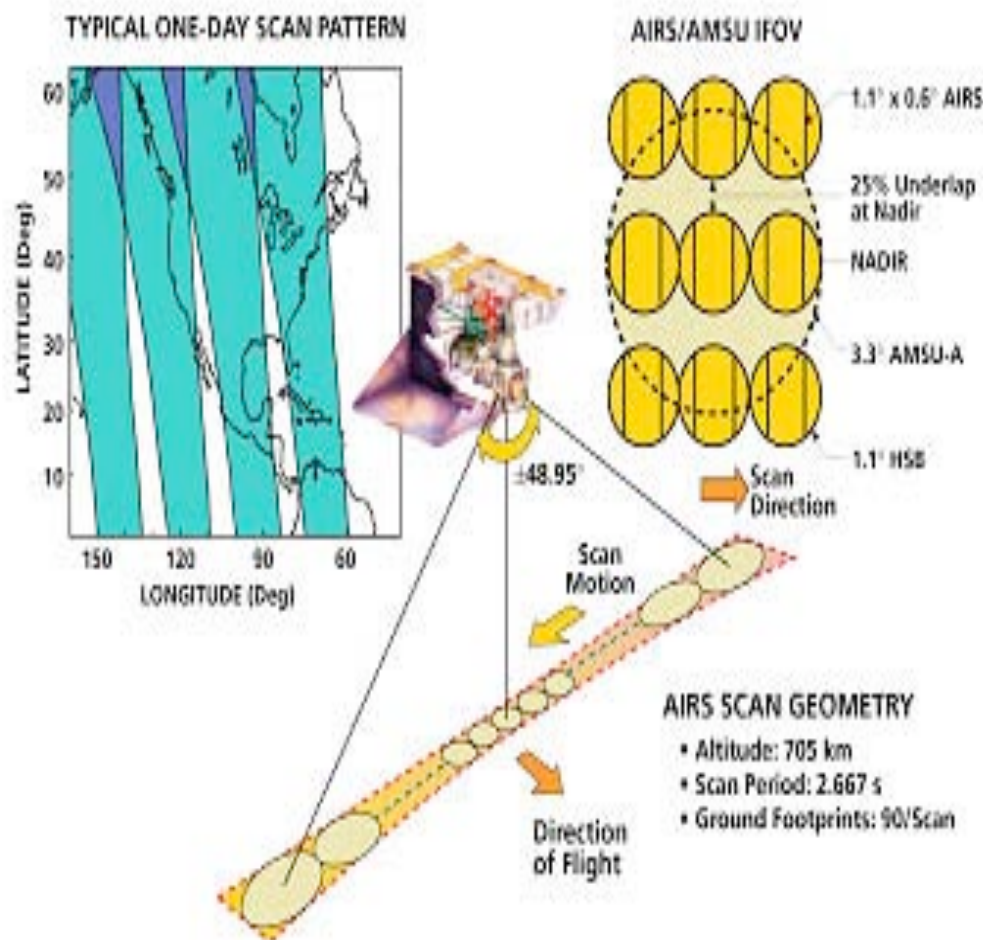
- AIRS and GPS data show remarkable agreement in Integrated Precipitable Water (IPW)
 - (a) Confidence in AIRS Retrieval algorithm;
 - (b) Confidence AIRS water vapor channel radiances
 - (c) GPS IPW can be used as a validation tool for any satellite based IPW retrievals (for example CrIS, IASI, HES, etc.) – IFF GPS IPW network is there
 - (d) Quick and repeatable sanity check
- Seasonal dependency evident in GPS-AIRS bias and rms differences
- The delta sfp affects delta IPW. This dependency can be used for partial bias correction.

Back-up Slides

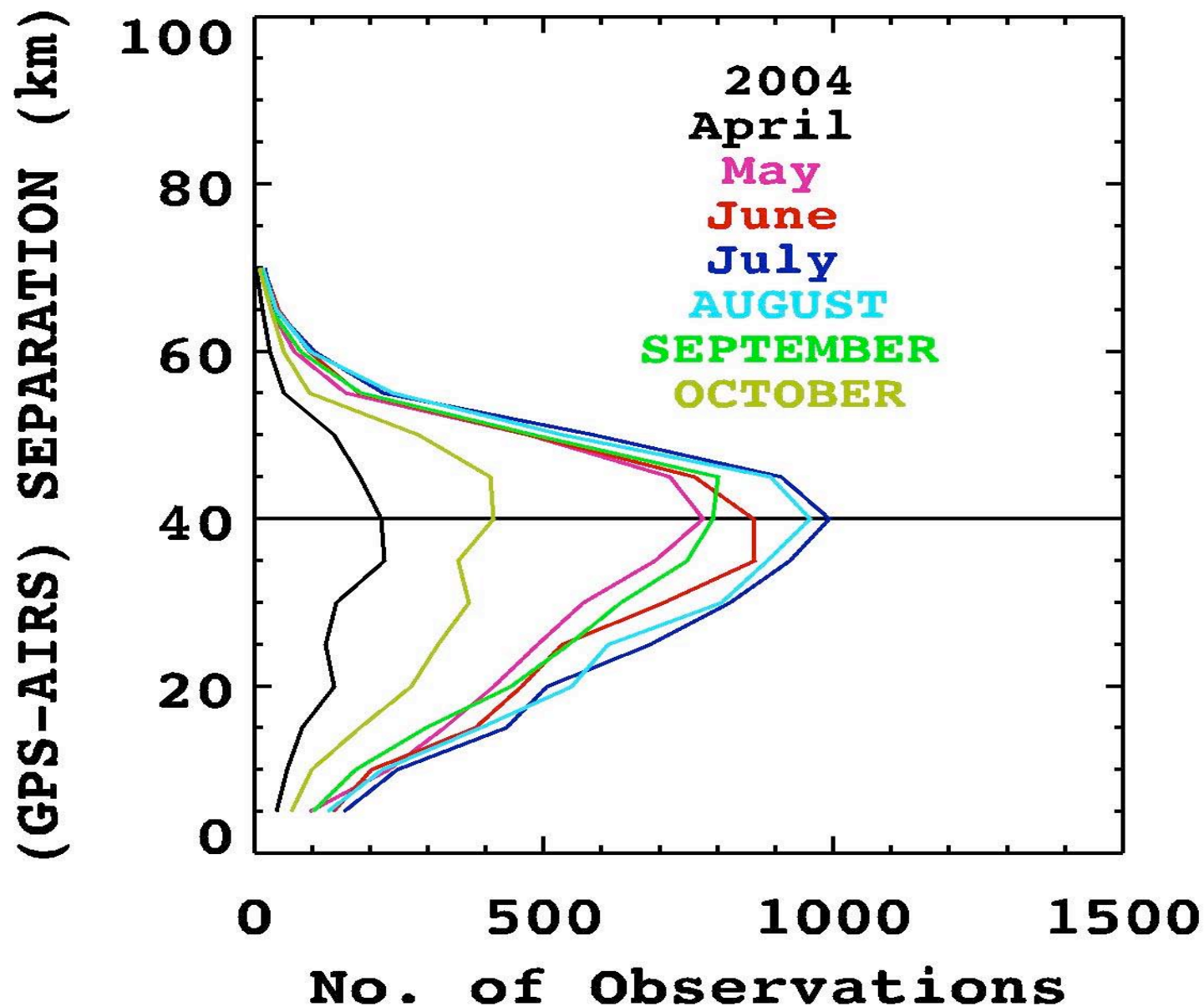


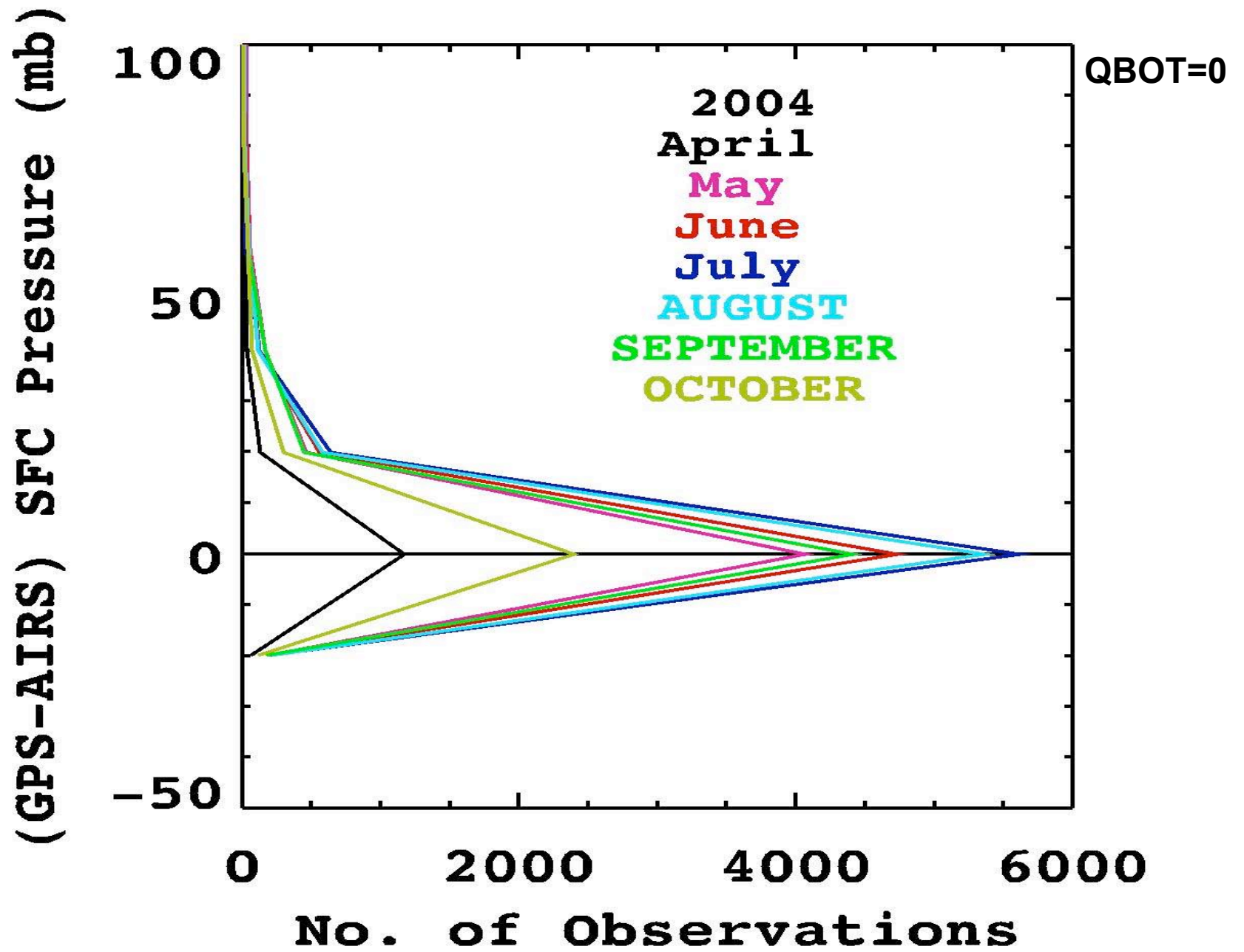
AIRS

- **EOS AQUA MISSION**
AIRS, AMSU-A
and HSB
- **Coverage (vert. S-40 km)**
- **High resolution**
1km (vertical trop.)
3-5 km (vertical strat.)
13.5 km (horizont)
- **Temp., humidity, SST,**
O₃, CO, CO₂, CH₄, N₂O,
SO₂, fr cloud, etc.



Courtesy: Aumann et al. (2003)





Greenbelt, MD