National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

What do instruments in NASA's A-Train reveal about regional trends in atmospheric water vapor?

Eric Fetzer, Van Dang, Stephanie Granger William G. Read, Manuel de la Torre Juarez, Fredrick W. Irion, Bjorn Lambrigtsen, Brian Kahn, and Duane Waliser

Jet Propulsion Laboratory, California Institute of Technology

2008 AGU Joint Assembly

29 May 2008

Eric.J.Fetzer@jpl.nasa.gov

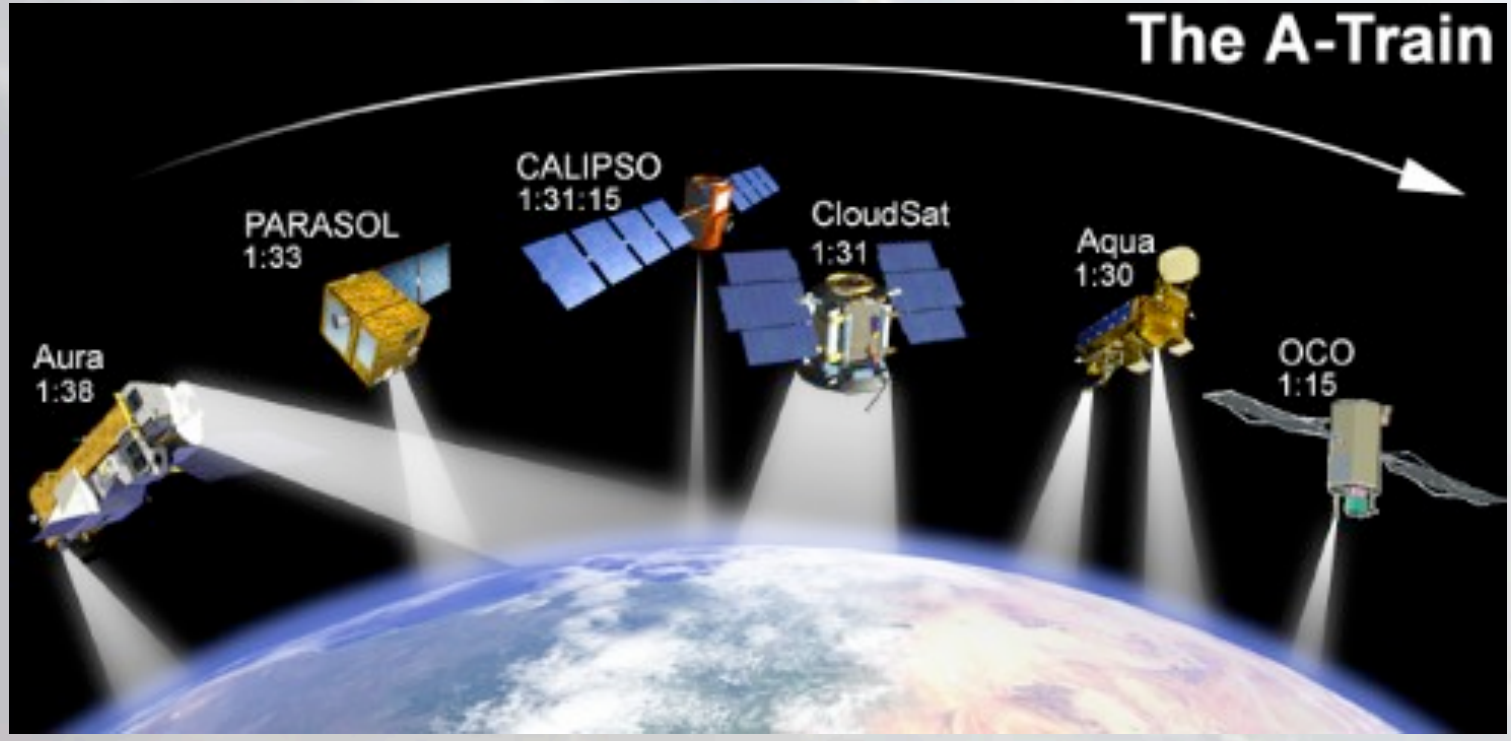
National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

The A-Train

Multiple sensors, often identical quantities:

- **Temperature, water vapor from AIRS, TES, MLS, MODIS.**
- **Total water vapor from AMSR-E, AIRS, TES and MODIS.**
- **Clouds from MODIS, CloudSat/CALIPSO, AMSR-E**



Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Today's Overview

- **Use eight-day averaged (octad) AIRS and AMSR-E data.**
- **Examine subtropics where AIRS performs well.**
- **Examine regional five-year times series of:**
  - ***AMSR-E and AIRS total water over ocean***
  - ***Height resolved temperature and humidity from AIRS.***
- **Can we find trends anywhere?**

Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

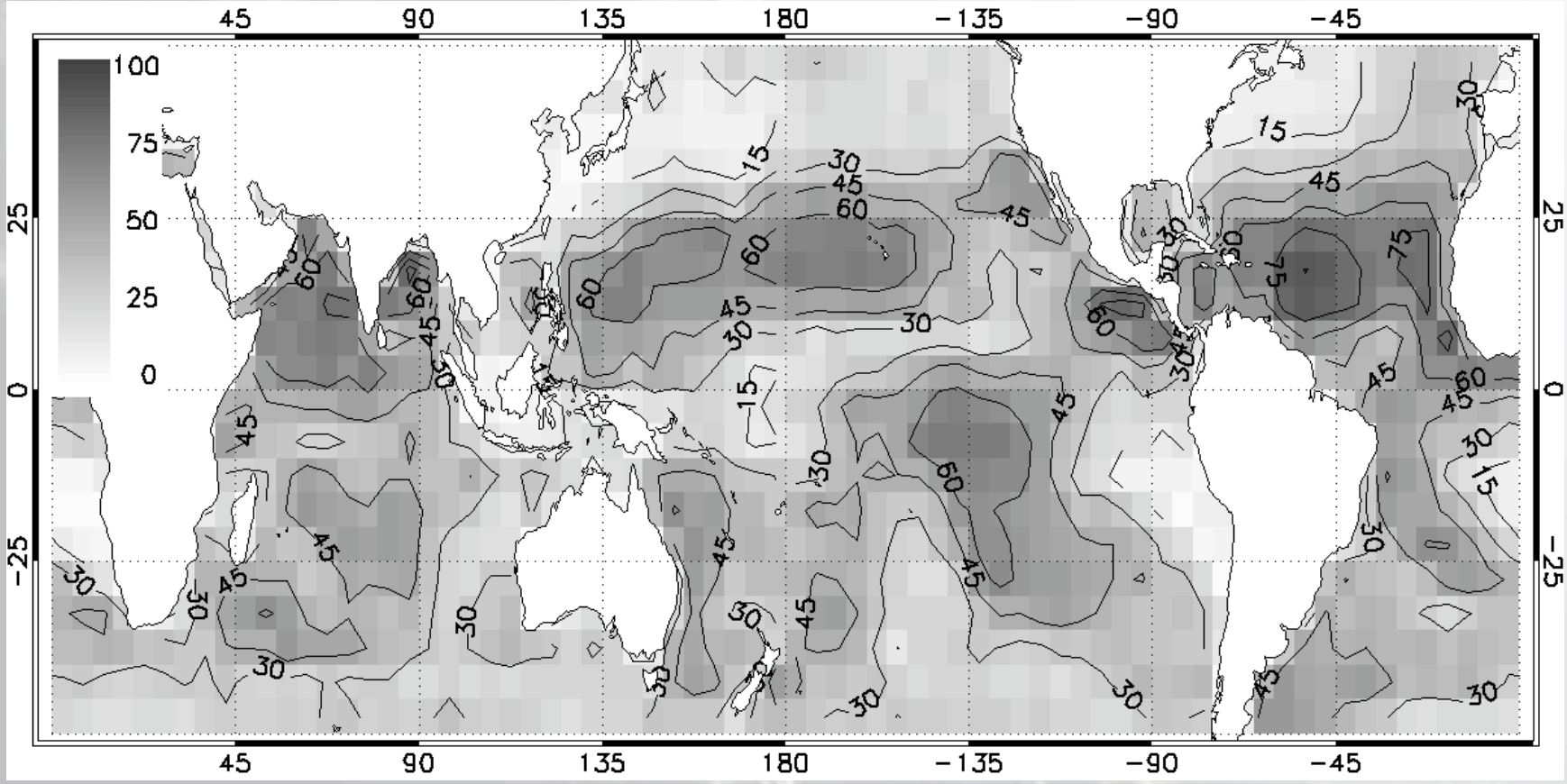
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

AIRS retrieval yields vary with location

Fraction of 'good' retrievals (percent)

25 Dec 2002 to 15 Jan 2003

From Fetzer et al. (2005)



Analogous AMSR-E yields are >90% everywhere

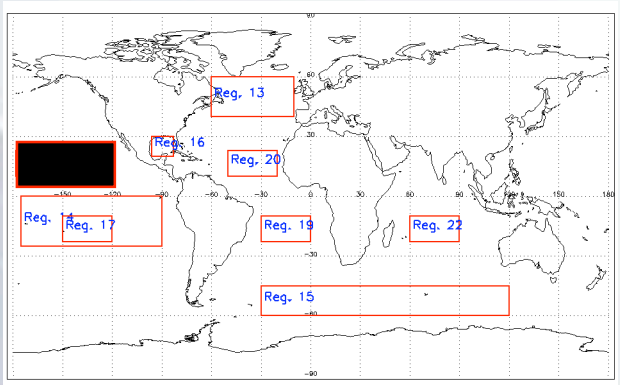
Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Plots show 5-year times series of total water vapor from AMSR-E & AIRS

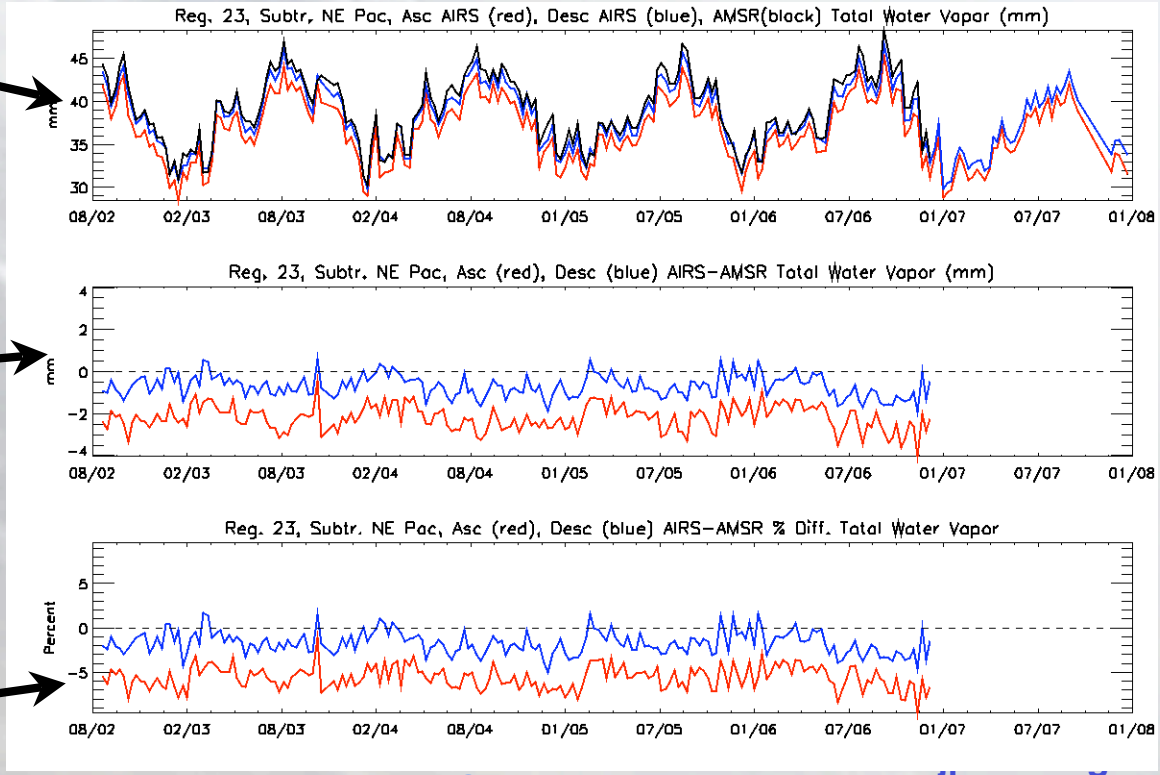
Where:



AIRS Daytime (red)
AIRS Nighttime (blue)
AMSR-E combined (black)
<u>In mm</u>

AIRS-AMSR-E Daytime (red)
AIRS-AMSR-E Nighttime (blue)
<u>In mm.</u>

AIRS-AMSR-E Daytime (red)
AIRS-AMSR-E Nighttime (blue)
<u>In percent.</u>

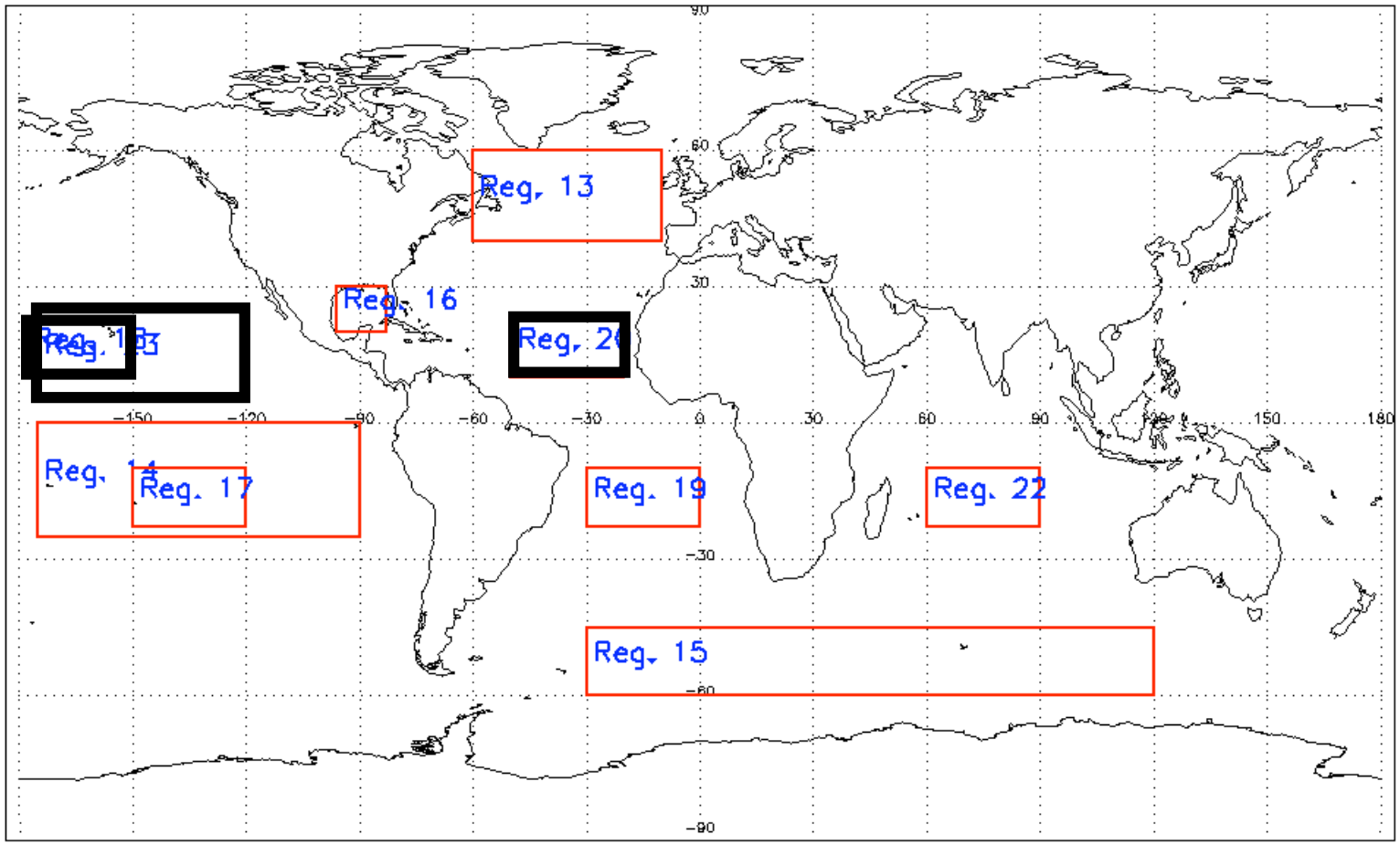


Date: Sep 02-Mar 08

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Ocean Regions of Interest
Northern subtropics first



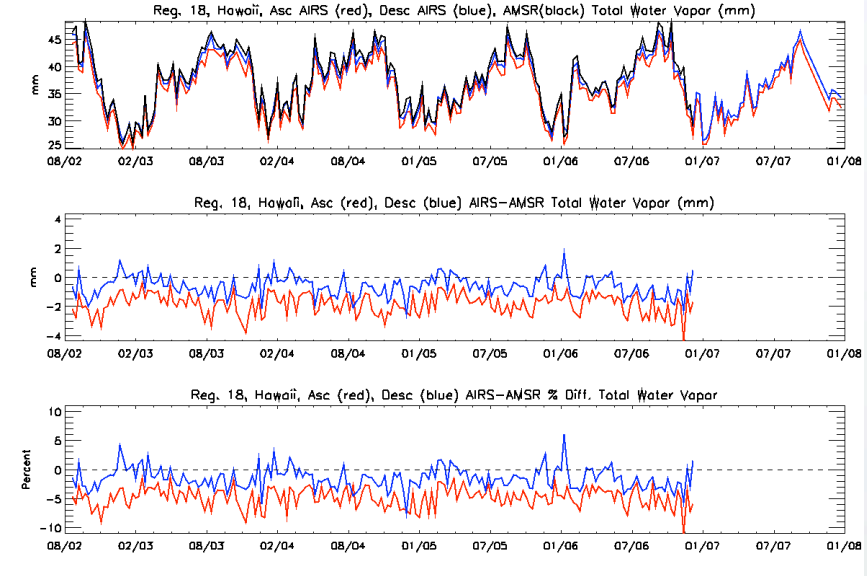
Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

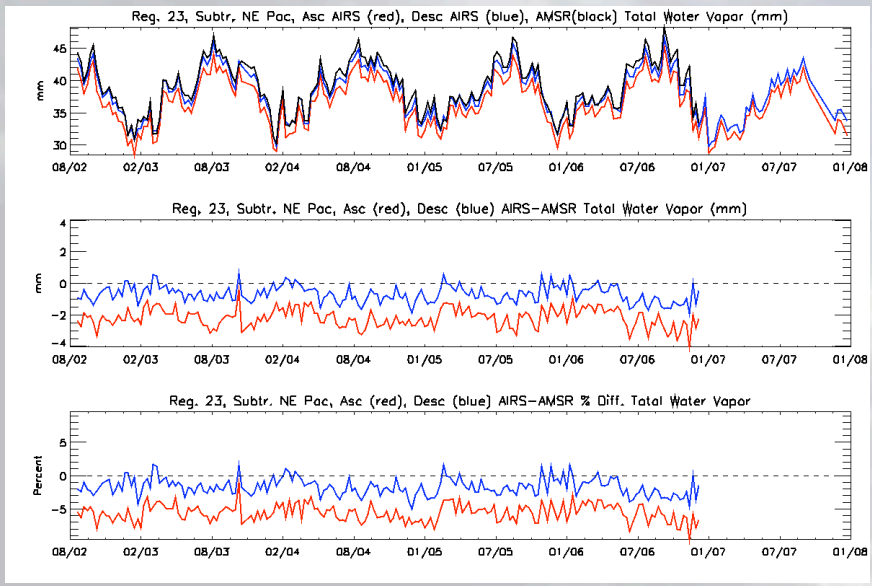
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Northern Subtropical Ocean

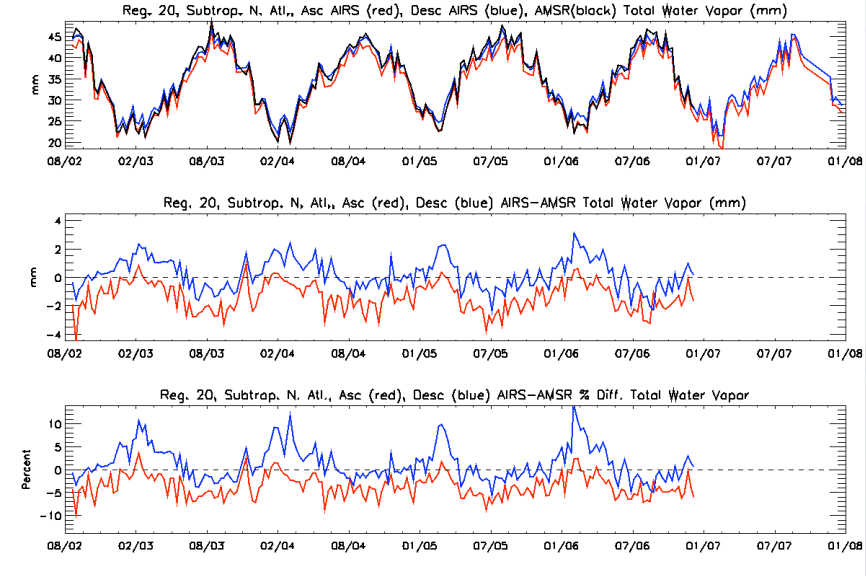
Hawaii



Subtropical NE Pacific (just shown)



West of Africa

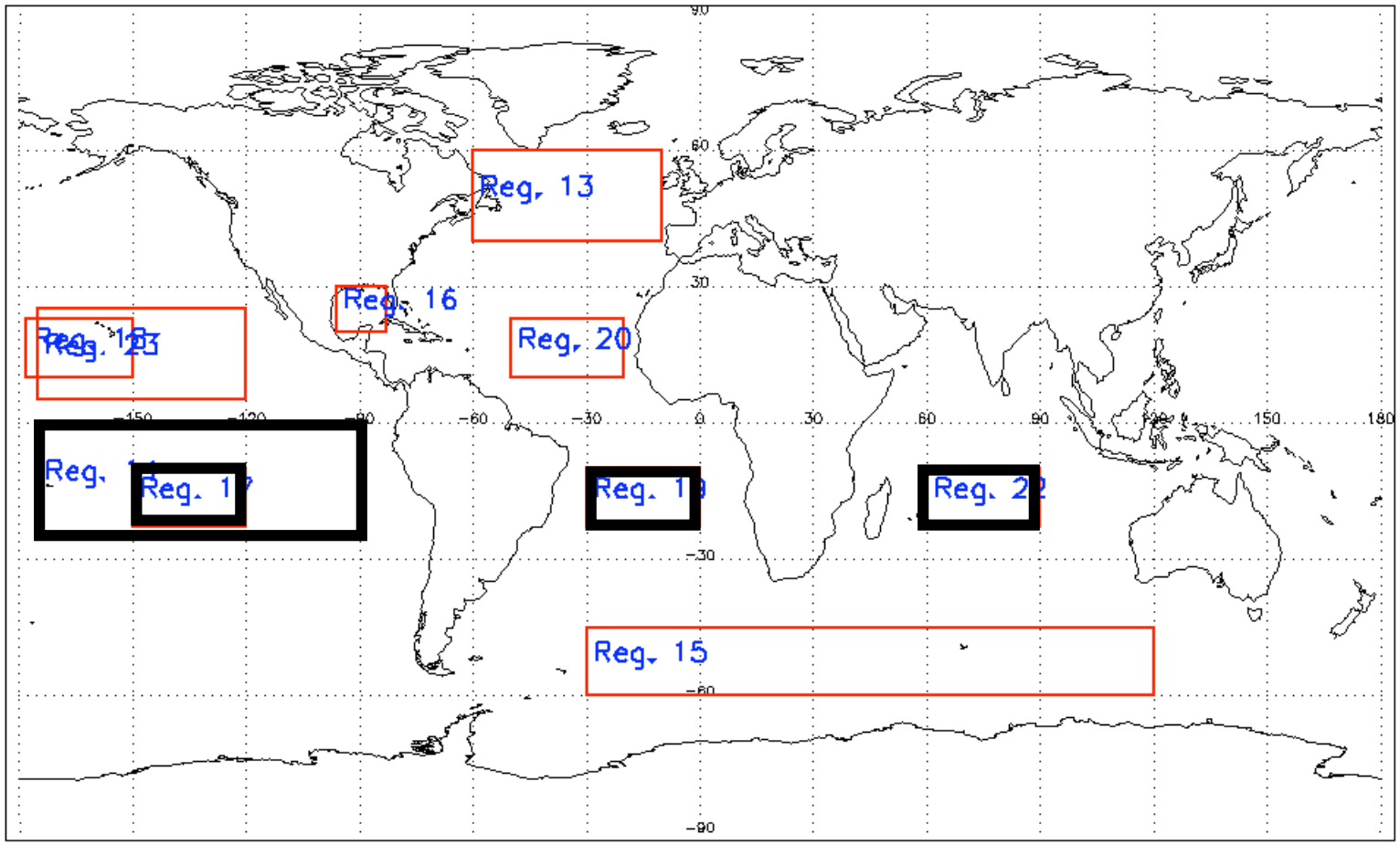


Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Southern Subtropical Ocean



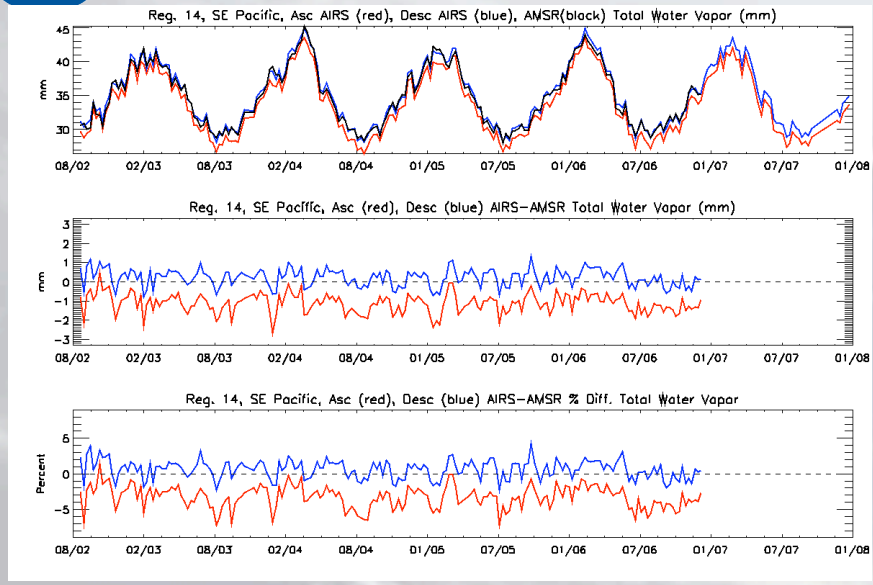
Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

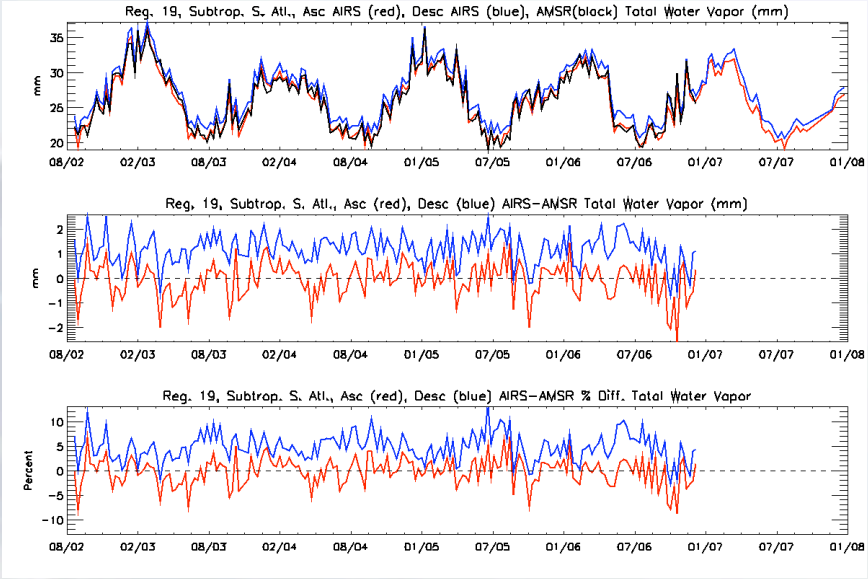
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Southern Subtropical Ocean

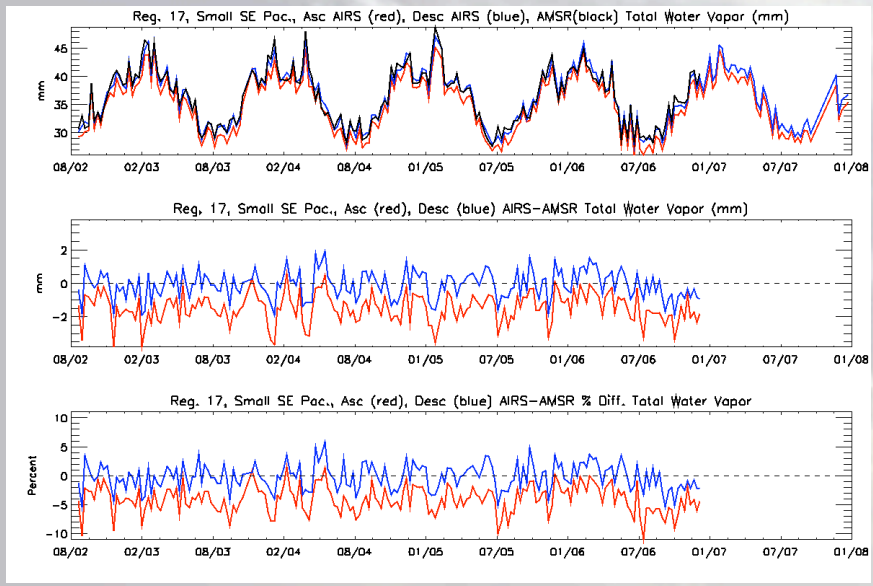
Subtropical SE Pacific



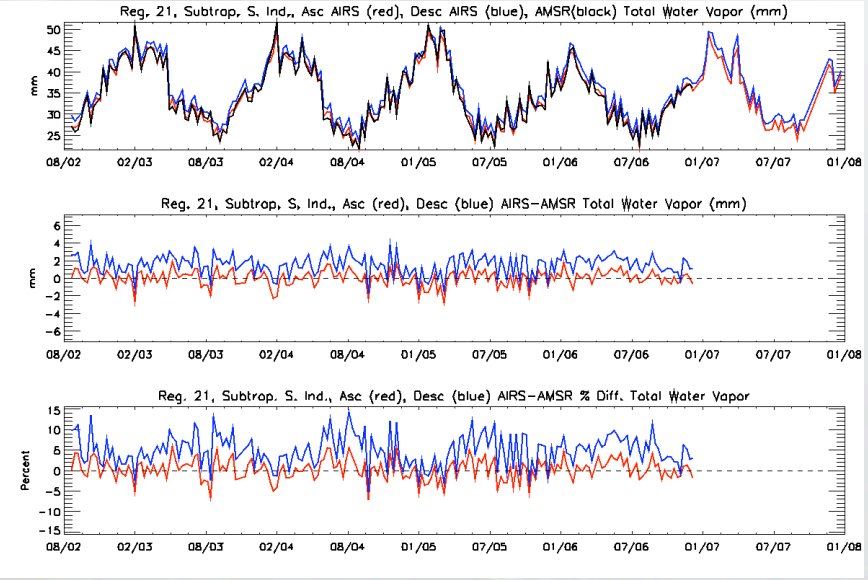
S. Atlantic



Limited SE Pacific



S. Indian



Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Summary of Subtropical Total Water Vapor

- **AIRS daytime is always drier than AIRS nighttime by ~3%.**
  - ***This may be an artifact of reflected shortwave IR by clouds.***
    - Testable by looking at scan angle dependency.

- **AIRS-AMSR-E difference:**
  - ***varies with location, hemisphere***
    - at most a few percent absolute.
  - ***varies with season***
    - related to changes in cloud cover (sampling effects).

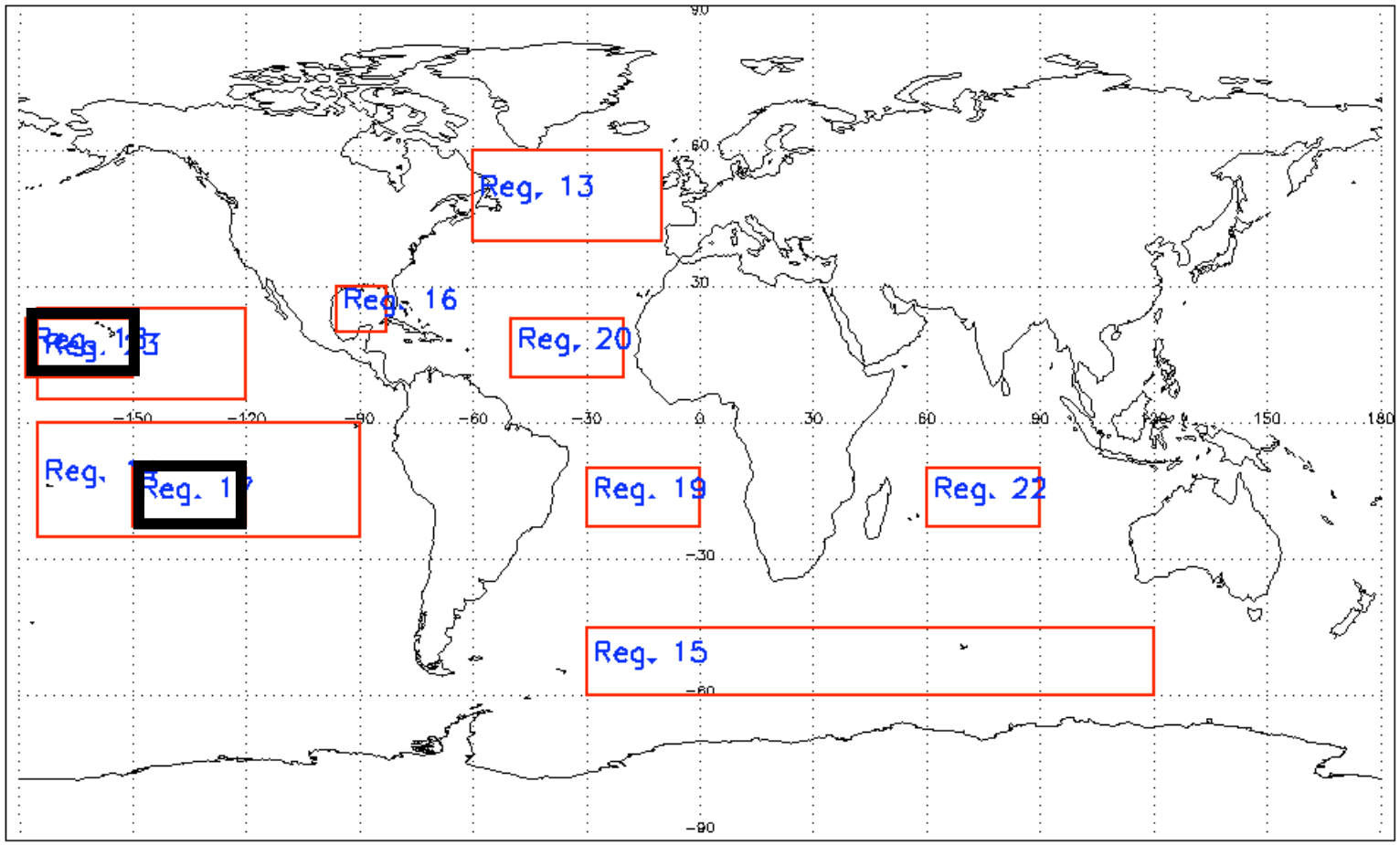
- ***Conclusion*: View <u>local</u> trends with caution because of AIRS day-night differences and AIRS-AMSR-E biases**
  - ***Note: true AIRS-AMSR-E bias is indeterminate from this study.***

Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Height-Resolved AIRS Temperature and Water Vapor: Subtropical Pacific



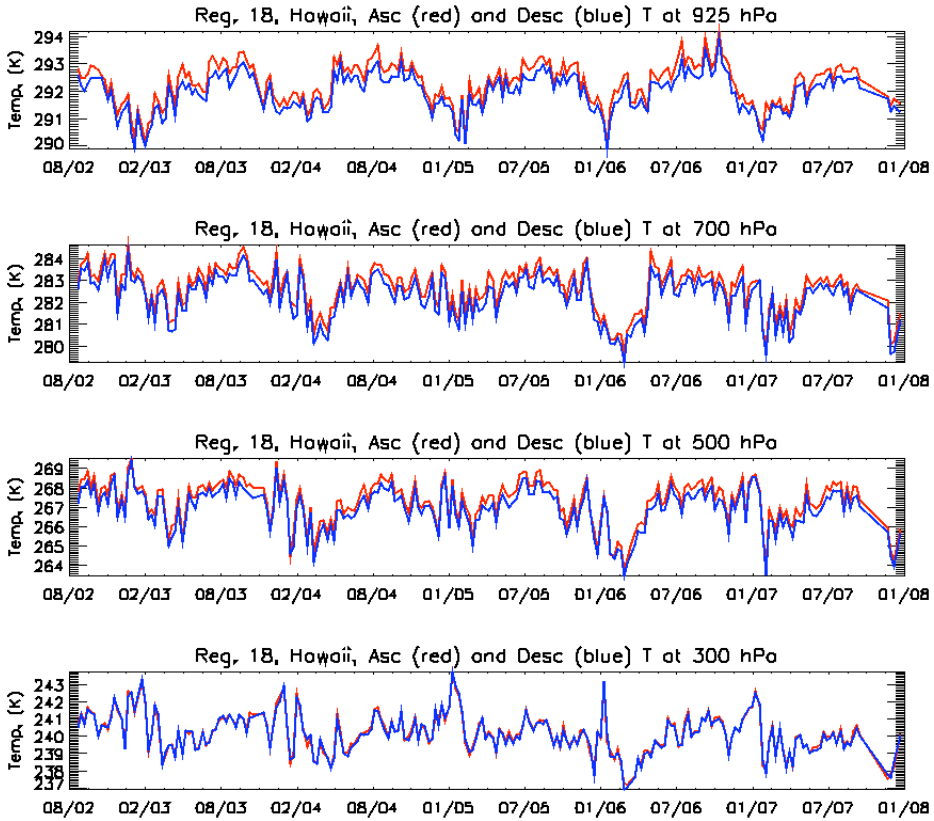
Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

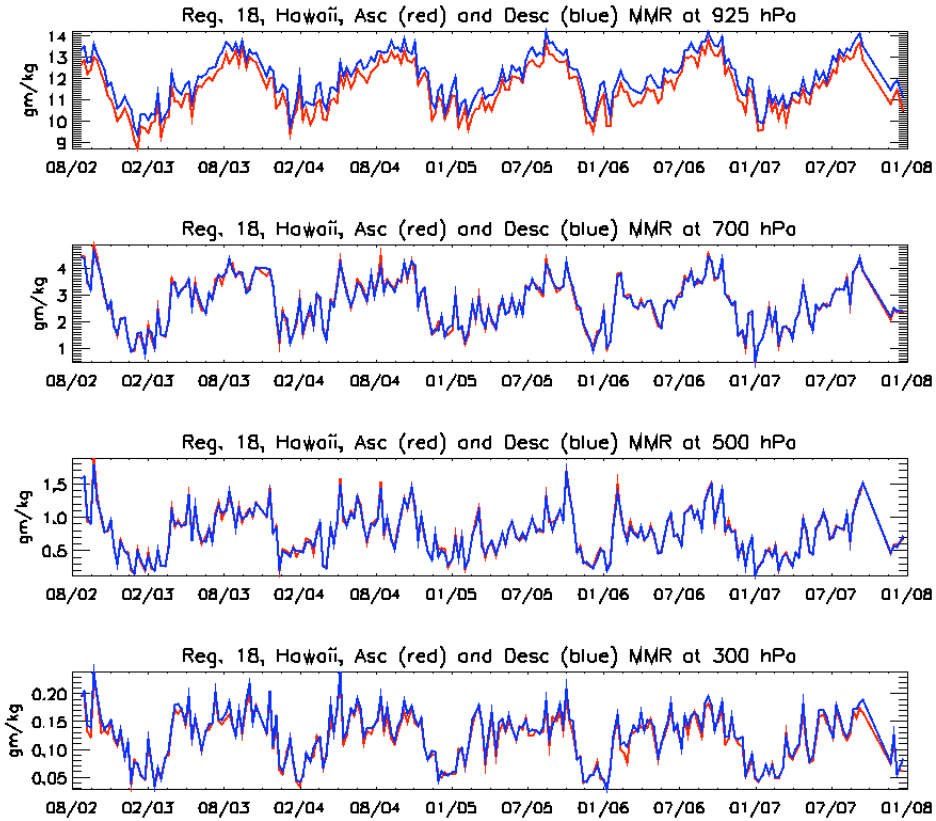
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Hawaii

Temperature at 925, 700, 500 & 300 hPa
day = red night = blue



Water vapor at 925, 700, 500 & 300 hPa
day = red night = blue



Eric.J.Fetzer@jpl.nasa.gov

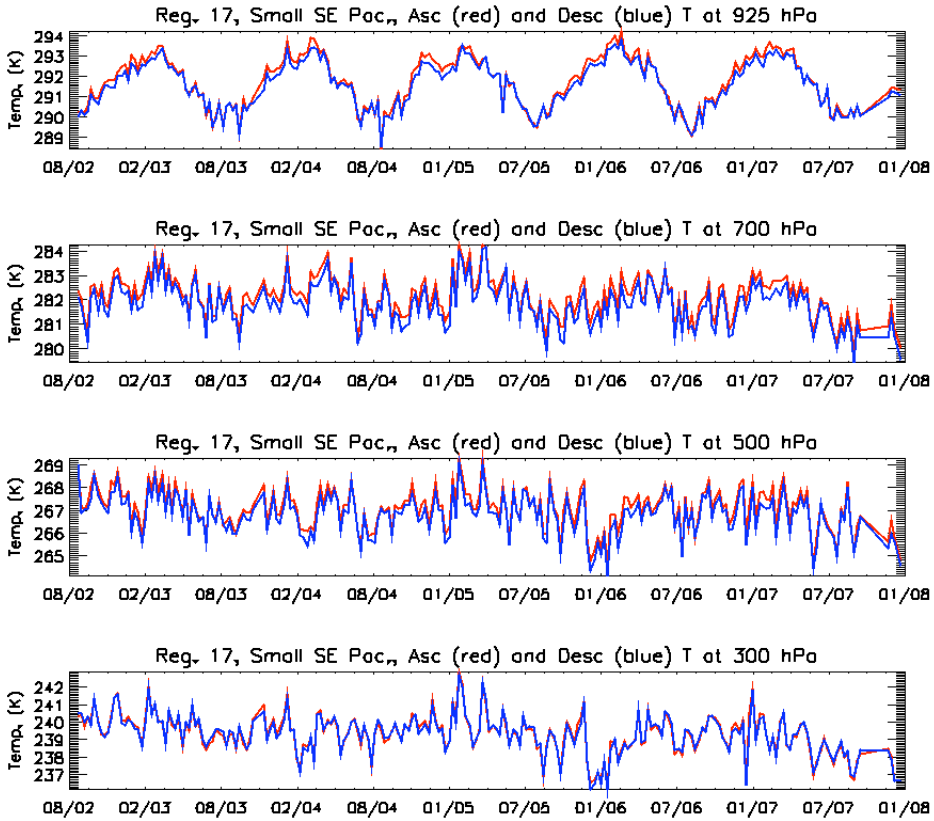
National Aeronautics and
Space Administration

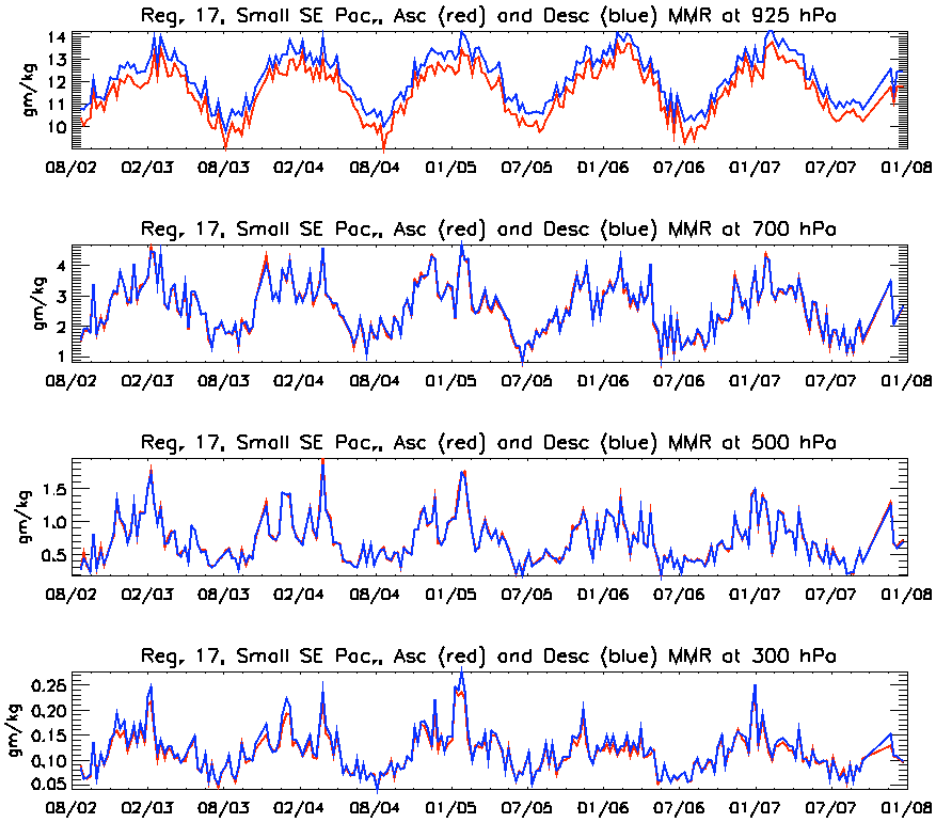
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Subtropical SE Pacific

Temperature at 925, 700, 500 & 300 hPa
day = red night = blue

Water vapor at 925, 700, 500 & 300 hPa
day = red night = blue





Eric.J.Fetzer@jpl.nasa.gov

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Summary of Height-Dependent Temperature and Water Vapor from AIRS

- **AIRS regional trends should be viewed cautiously given day-night differences.**
- **Monthly to interannual periods look very interesting**
  - ***generally much large than day-night difference.***
- **Co-varing clouds and water vapor is most interesting**
  - ***but beyond the scope of this talk.***

Eric.J.Fetzer@jpl.nasa.gov