



Jet Propulsion Laboratory
California Institute of Technology

Satellite-Observed Precipitation and Total Column Water Vapor in the Tropics

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329 E Atmospheric Physics and Weather

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Motivations

- Process of deep convection
- Questions
 - Does water vapor initiate the onset of deep convection?
 - What is the relationship between observed water vapor structure and observed precipitation over tropical ocean and land?

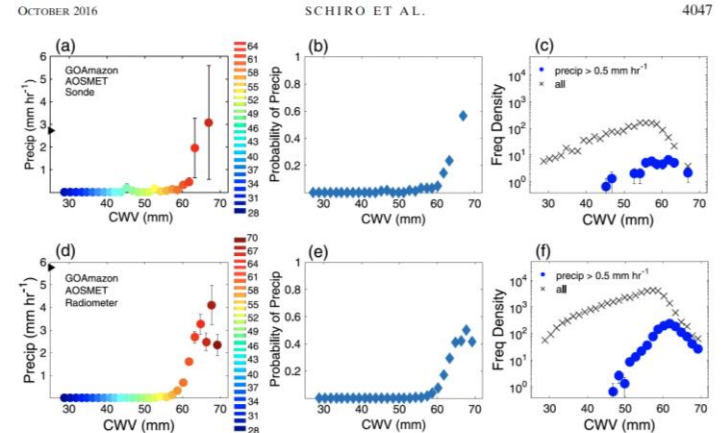


FIG. 1. The relationship between precipitation and CWV at the GOAmazon site in Manacapuru, Brazil. (a) The 1-h-average precipitation (mm h^{-1}) centered at the time of radiosonde launch conditionally averaged on CWV (mm). The mean of precipitating points

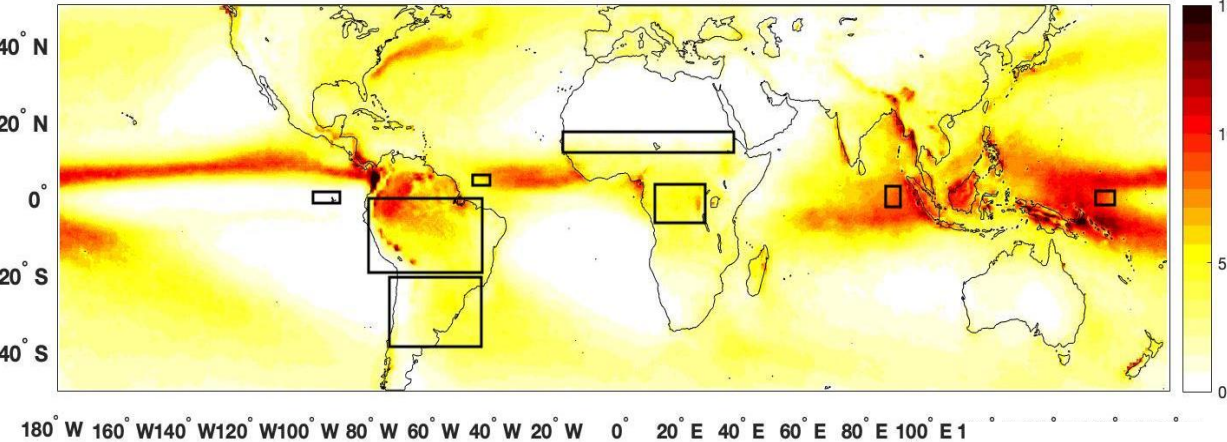
Figure 1: Schiro *et al* (2016)

Objective of My Study

- Regional Analysis
 - Relations of water vapor and precipitation in different regions over tropical ocean and land
 - Total column water vapor vs vertical profiles of water vapor on a monthly time scale
 - Occurrence of different precipitation intensities and water vapor on a daily time scale
- Major Findings
 - Strong Regional Differences: Sahel, Amazon, Niño 4, Kwajalein Island

Data

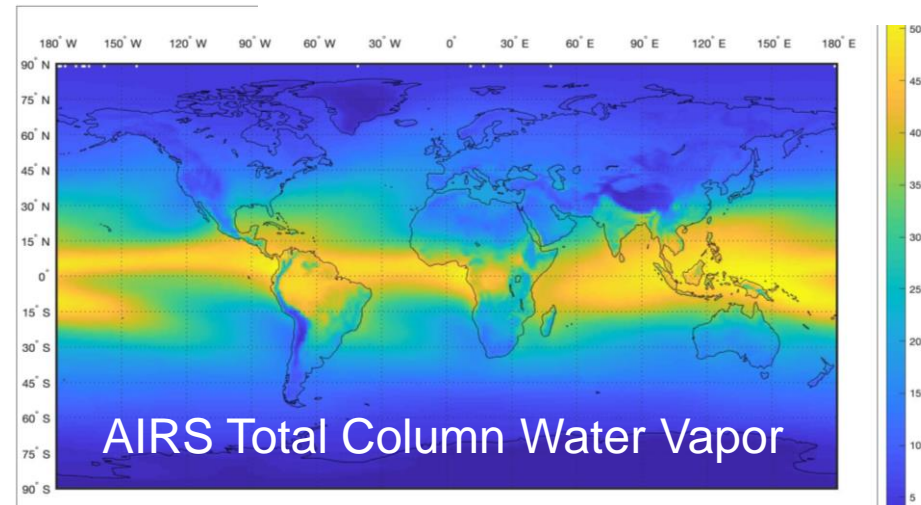
Global Precipitation Average 2003-2007



- AIRS Level 3 (Daily, Monthly)
 - Total Column Water Vapor
 - Relative Humidity
 - H2O/MMR Layers
- TRMM 3B42 (Daily)/ 34B3 (Monthly) V7
 - Precipitation

Methodology

- Evaluate regional difference
- Compare column and vertical structures of water vapor
- Compare occurrence of precipitation intensities

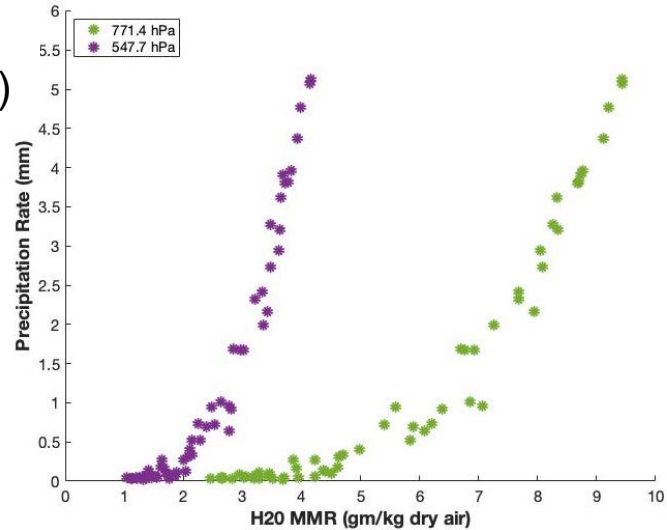


Previous Findings

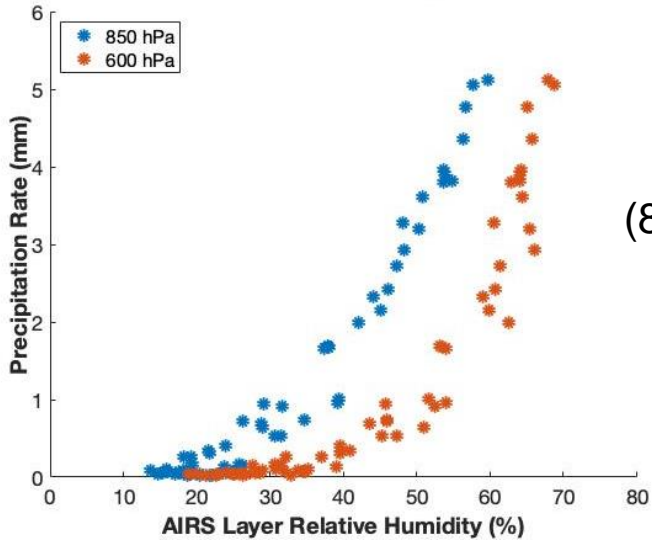
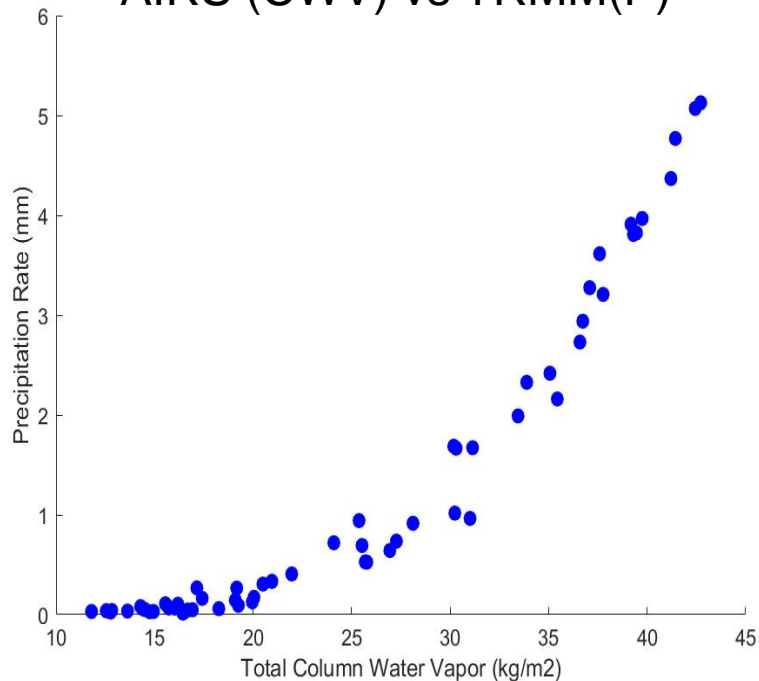
- Total Column Water Vapor vs. Precipitation
- Water Vapor Mixing Ratio (H₂O MMR) vs. Precipitation
- Relative Humidity (RH) vs. Precipitation

Sahel

P vs. H2O Layer
(771.4 and 547.7 hPa)



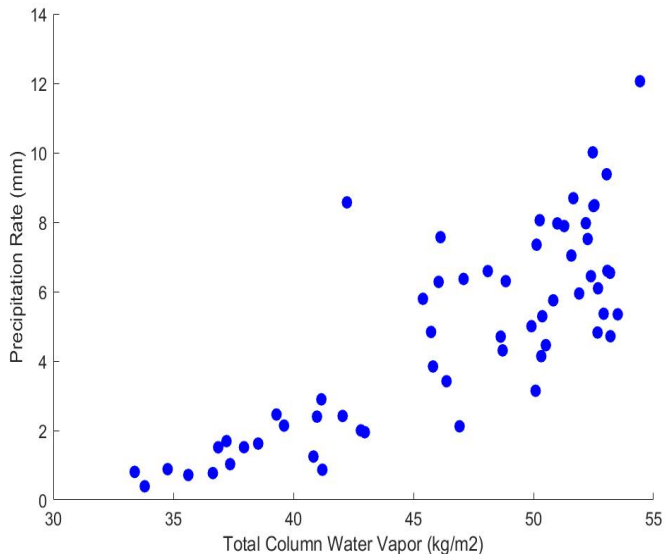
AIRS (CWV) vs TRMM(P)



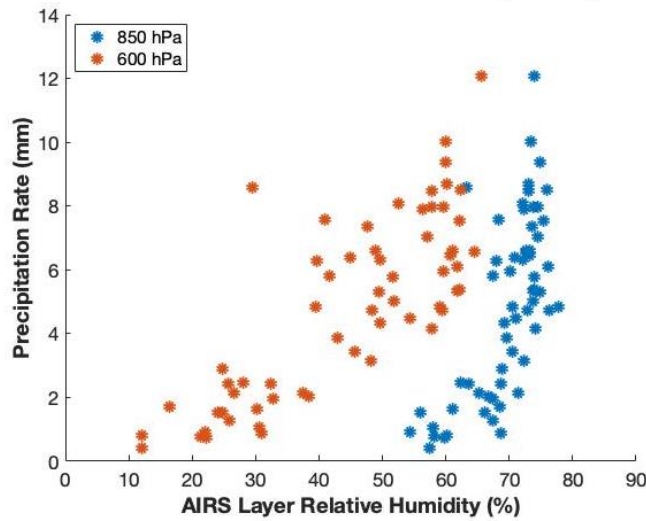
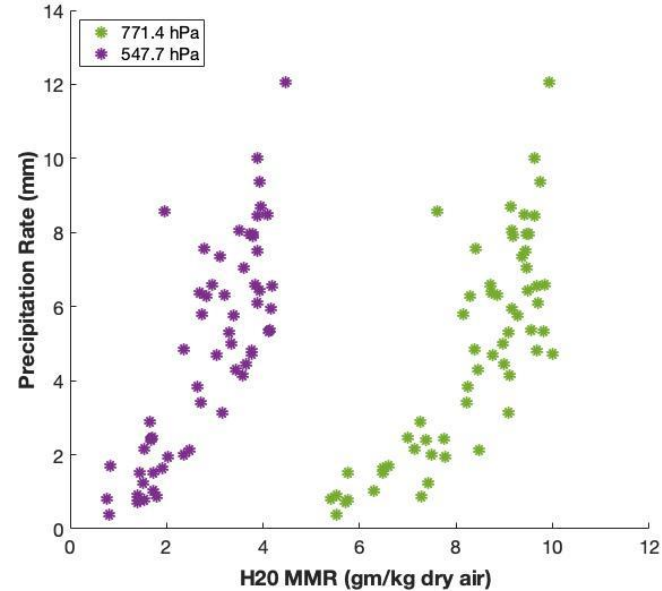
P vs RH
(850 and 600 hPa)

Kwajalein Island

AIRS (CWV) vs TRMM(P)



P vs H2O Layer (771.4 and 547.7 hPa)



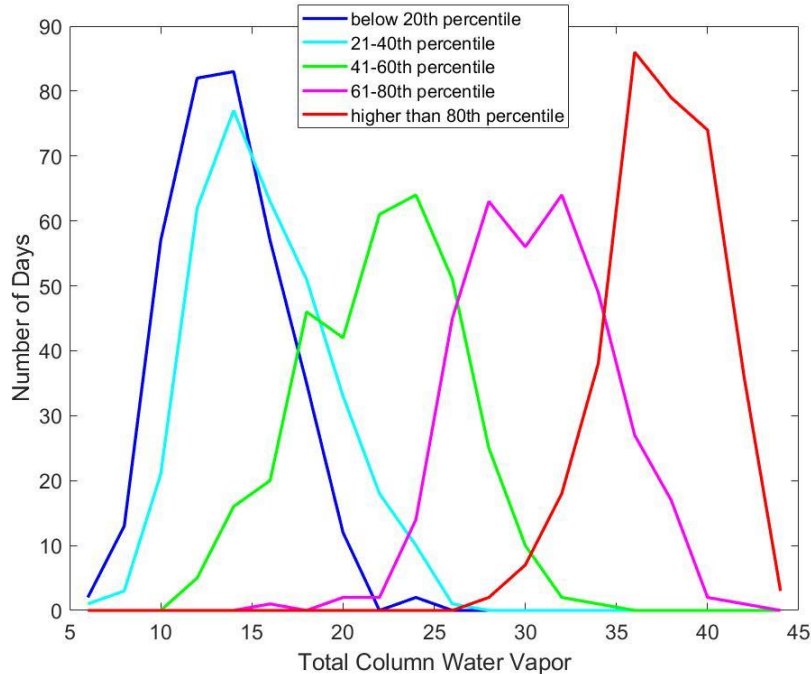
P vs RH (850 and 600 hPa)

Occurrence of Precipitation Intensities: Land vs. Ocean

- 5 Groups of precipitation intensities based on percentiles

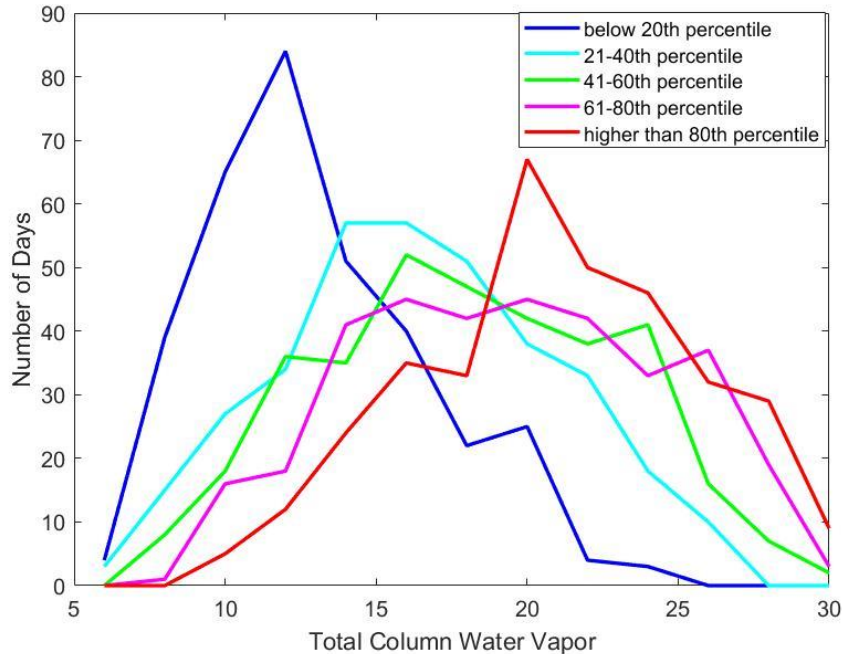
Groups	Percentiles
Group 1	Below 20 th
Group 2	21-40 th
Group 3	41-60 th
Group 4	61-80 th
Group 5	80 th and higher

Sahel



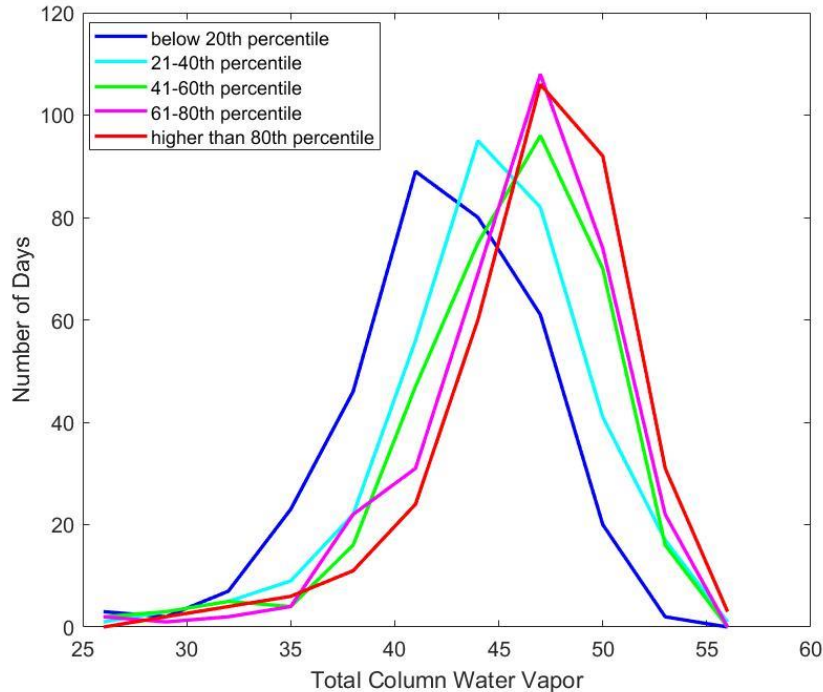
- Extreme sensitivity to water vapor
- Distribution is well-separated based on water vapor
- Highest CWV peak: 36

Southern South America



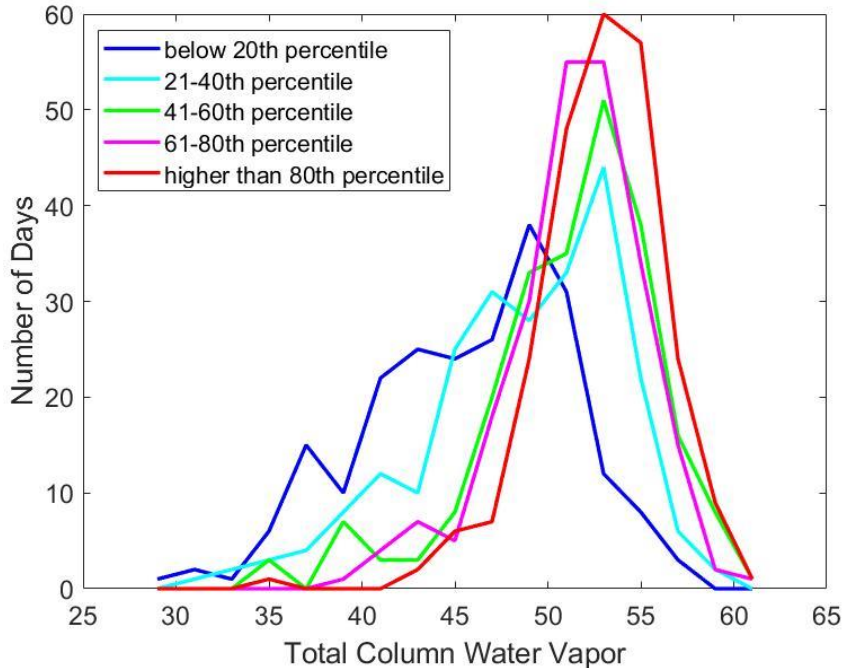
- Occurrence of precipitation is less sensitive to water vapor
- Precipitation intensity can occur at a high or low range of water vapor
- Highest CWV peak: 21

Atlantic Ocean



- Little sensitivity to changes in water vapor
- Highest CWV peak: 47

Niño Four



- Little sensitivity to changes in water vapor
- Sensitivity in the lowest 20th percentile
- Highest CWV peak: 53

Conclusions & Future Work

- Variability over tropical ocean and land
 - Niño 4, Kwajalein Island, Sahel, Amazon
- Column vs Vertical Structure
 - We observed the boundary layers and free tropospheric layer
- Occurrence of Precipitation Intensities
 - Land: high sensitivity to changes in water vapor
 - Ocean: low sensitivity to changes in water vapor
- Future Works
 - Calculate rate of change in precipitation intensity in response to largest amount of water vapor
 - Finer spatial resolution
 - Role of topography- land-sea-air interactions

Acknowledgments

Q & A

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 - ❖ Family
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- Q&A



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