Global Precipitation Climatology Project (GPCP): Status and Future

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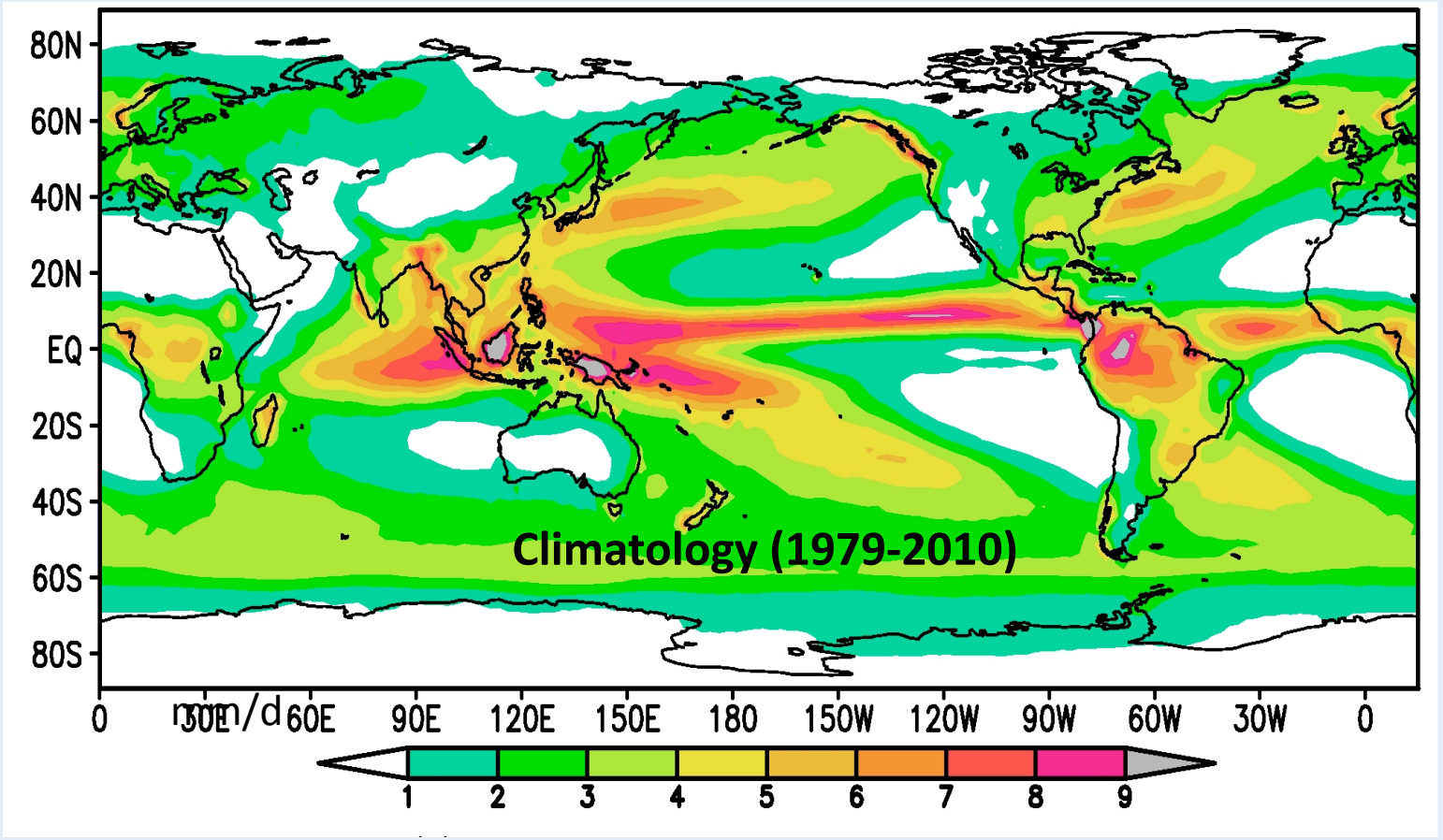
A WCRP/GEWEX Project



GPCP data used in > 1500 journal articles

GPCP Global Precipitation Products

NASA, NOAA, DWD, UMD, GMU, others

- Monthly, 2.5° Merged Analysis (1979-present)
  Adler et al. (2003), J. Hydromet; Huffman et al. (2009) GRL

  [hierarchical adjustment using microwave/geo-IR over ocean and gages/satellite over land plus additional satellite info. for high latitudes and extension back from 1987 to 1979]

- Pentad, 2.5° Merged Analysis (1979-present)
  Xie et al. (2003) J. Climate

- Daily, 1° Merged Analysis (1997-present)
  Huffman et al. (2001) J. Hydromet.

[although produced using different data sets and algorithms, products are integrated,i.e. they add up]

normally produced ~ 3 months after observation time

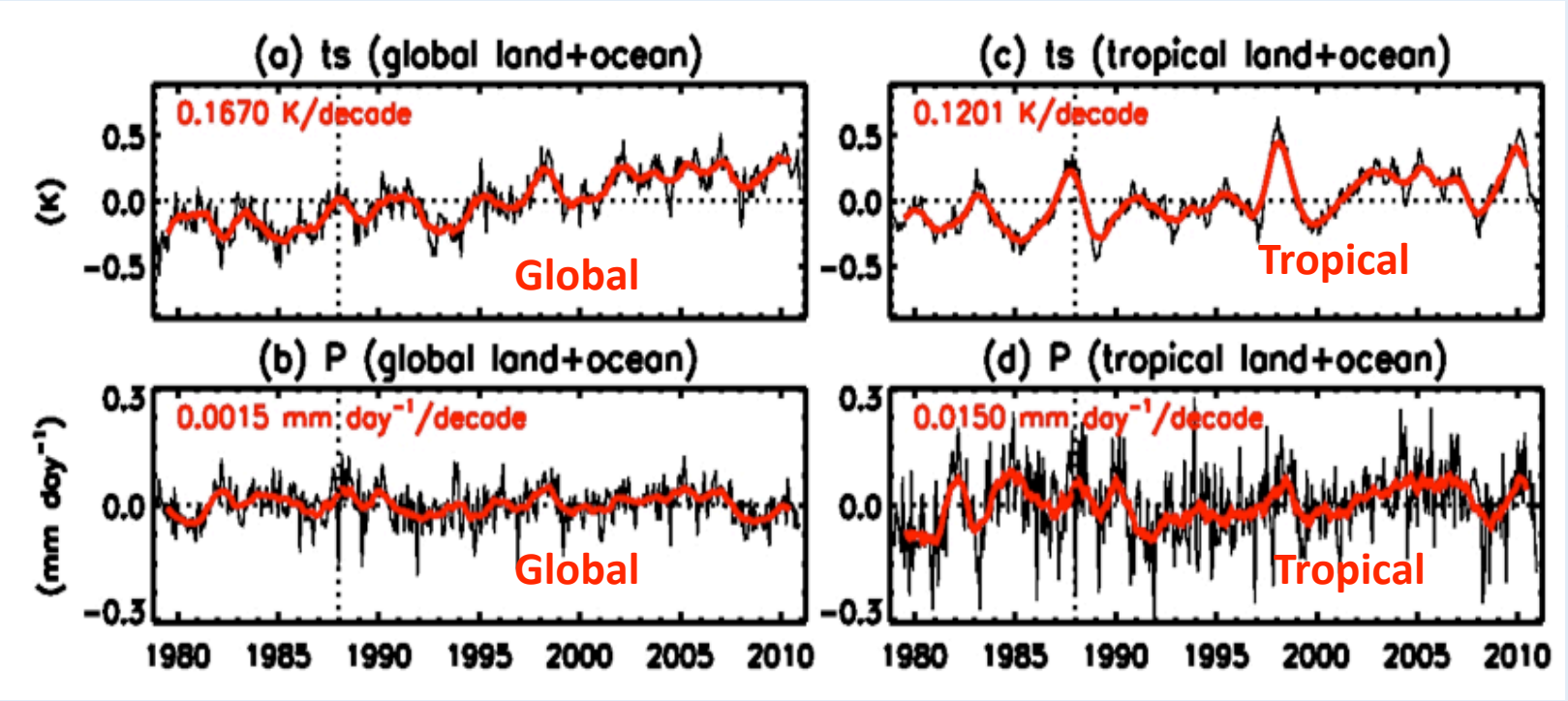
GPCP Components/People

R. Adler (GPCP Coordinator)

- Merge Center--**Huffman/Adler**, NASA Goddard/U. of Maryland
- Gauge Center—**Becker, Schneider**, German Weather Service, Global Precipitation Climatology Center (GPCC)
- Microwave-Land Center--**Ferraro**, NOAA NESDIS
- Microwave-Ocean Center--**Chiu**, George Mason U.
- Pentad/Geosynchronous Center--**Xie**, NOAA/NWS/CPC

GPCP Monthly (Recently) Extended Through 2010 (new Version 2.2)

Compared with Surface Temperature Analysis



Surface Temp.

Precip.

Time series of surface temperature (from GISS), and precipitation averaged over global and tropical land+ocean areas

Red lines denote the 13-month-running means

Global and tropical precipitation trends near zero

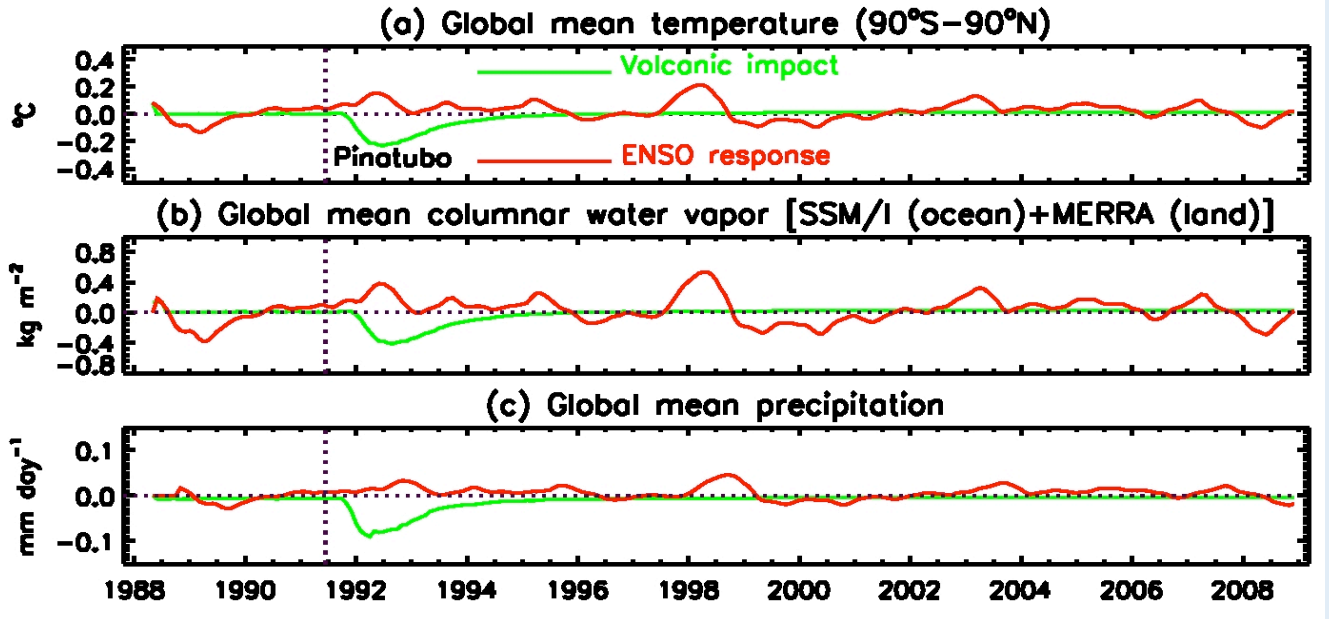
Global (1988-2008)

Surface Temp. (Amplitude ~ .2C)

Water Vapor (~ 7%/C for ENSO, ~6%/C for volcano)

Precipitation (~ 2%/C for ENSO, ~4%/C for volcano)

Inter-annual (ENSO and Volcano)

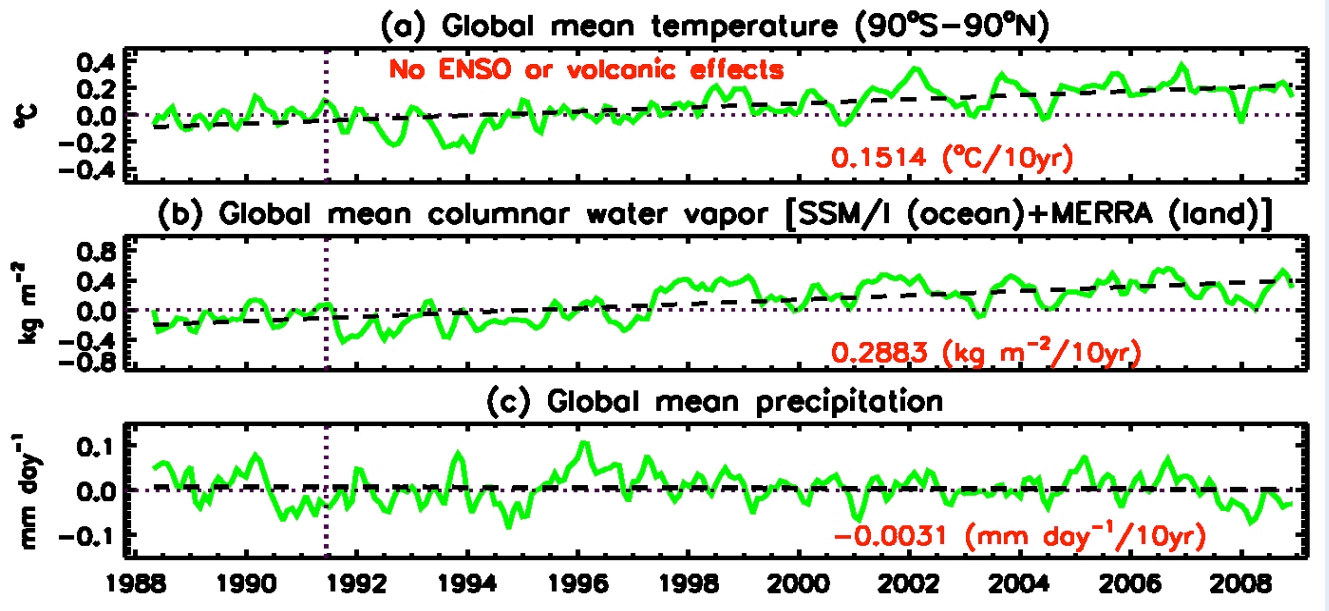


Trends

Surface Temp. (.15 C/10yr)

Water Vapor (~ 7%/C, taking into account MERRA trend bias)

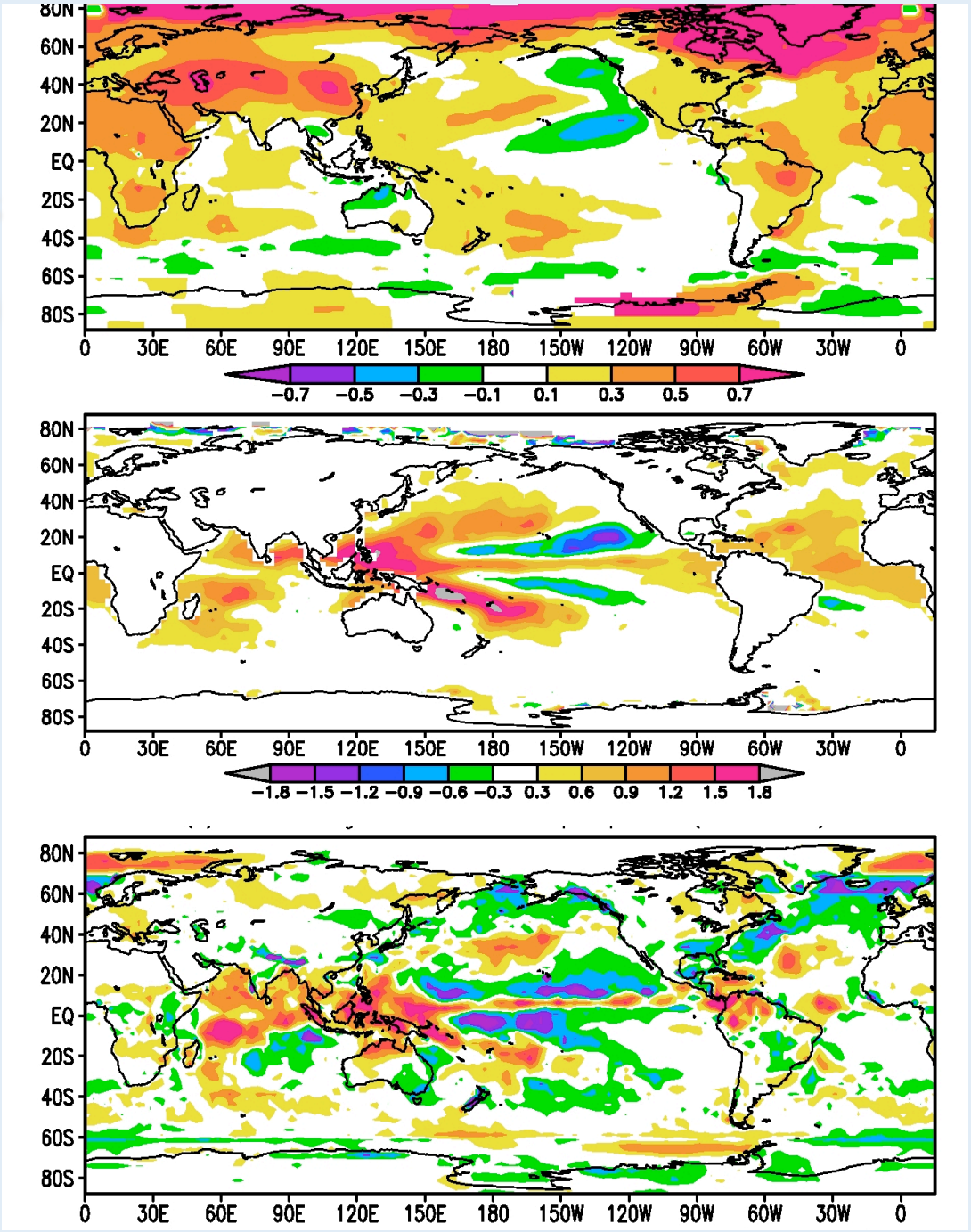
Precipitation (~ 0%/C)



Gu and Adler

Trends

(1988-2008)



Surface Temperature from GISS

°C/decade

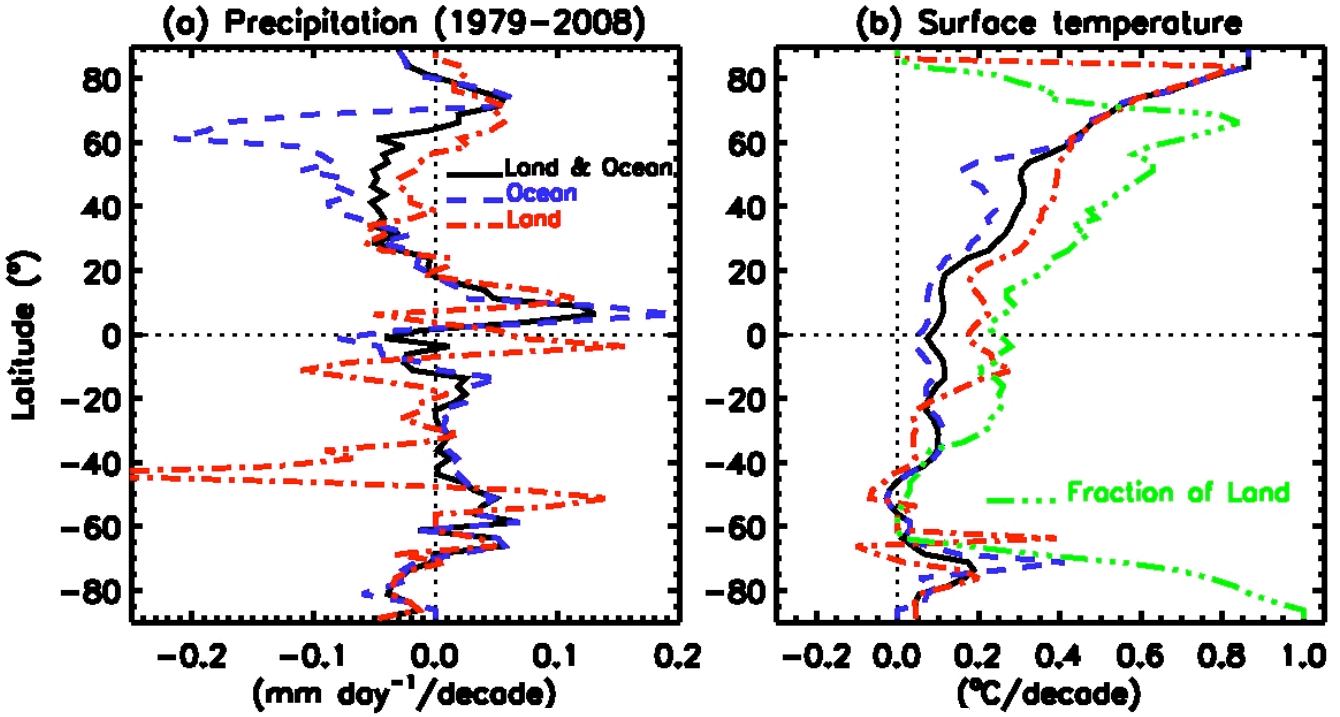
Water Vapor from SSMI (ocean)

mm/decade

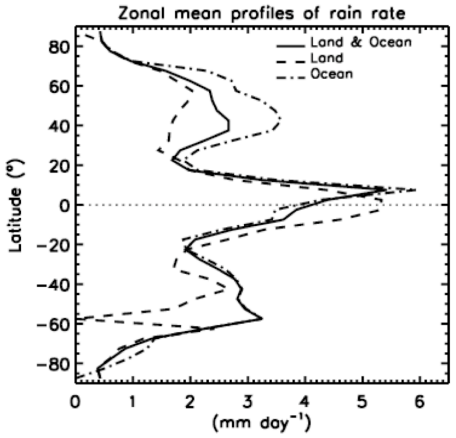
Precipitation from GPCP

mm/d/decade

Linear Changes [Trends] (1979-2008)

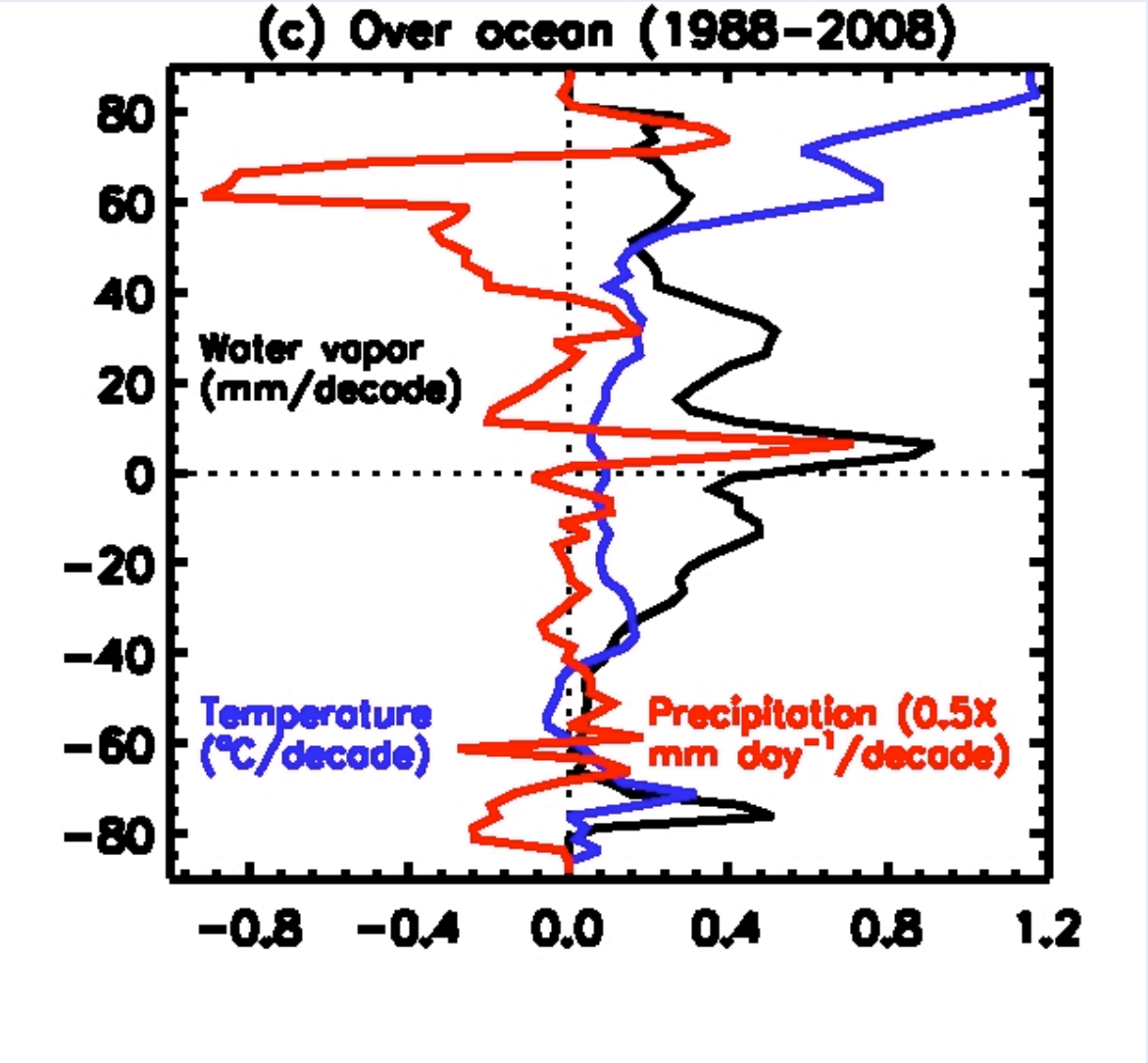


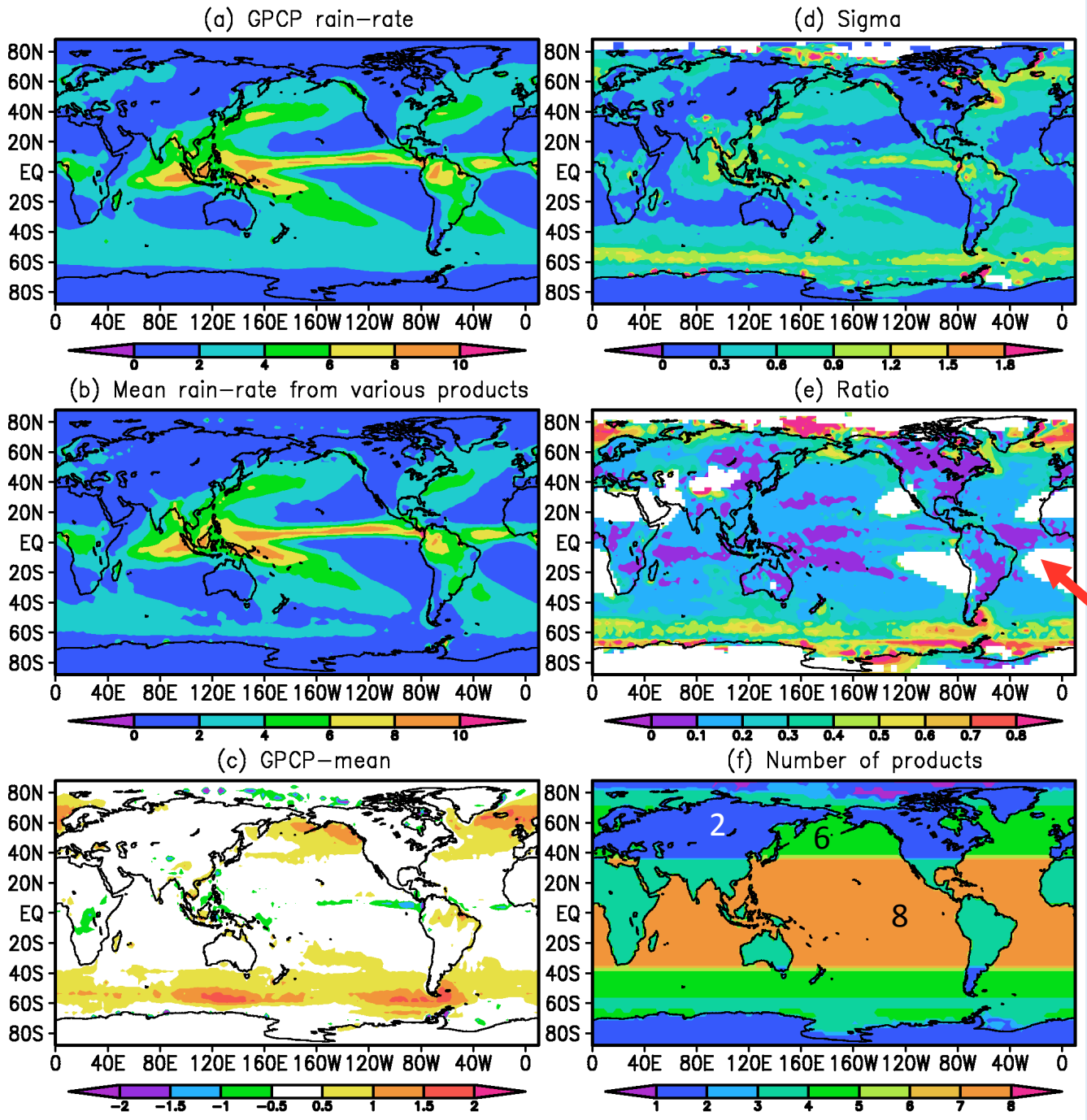
Mean Precipitation →



Updated from Adler et al. 2008, JGR

Zonal Trends in Temperature, Water Vapor, and Precipitation over Ocean





Estimating Bias Errors for GPCP Climatology

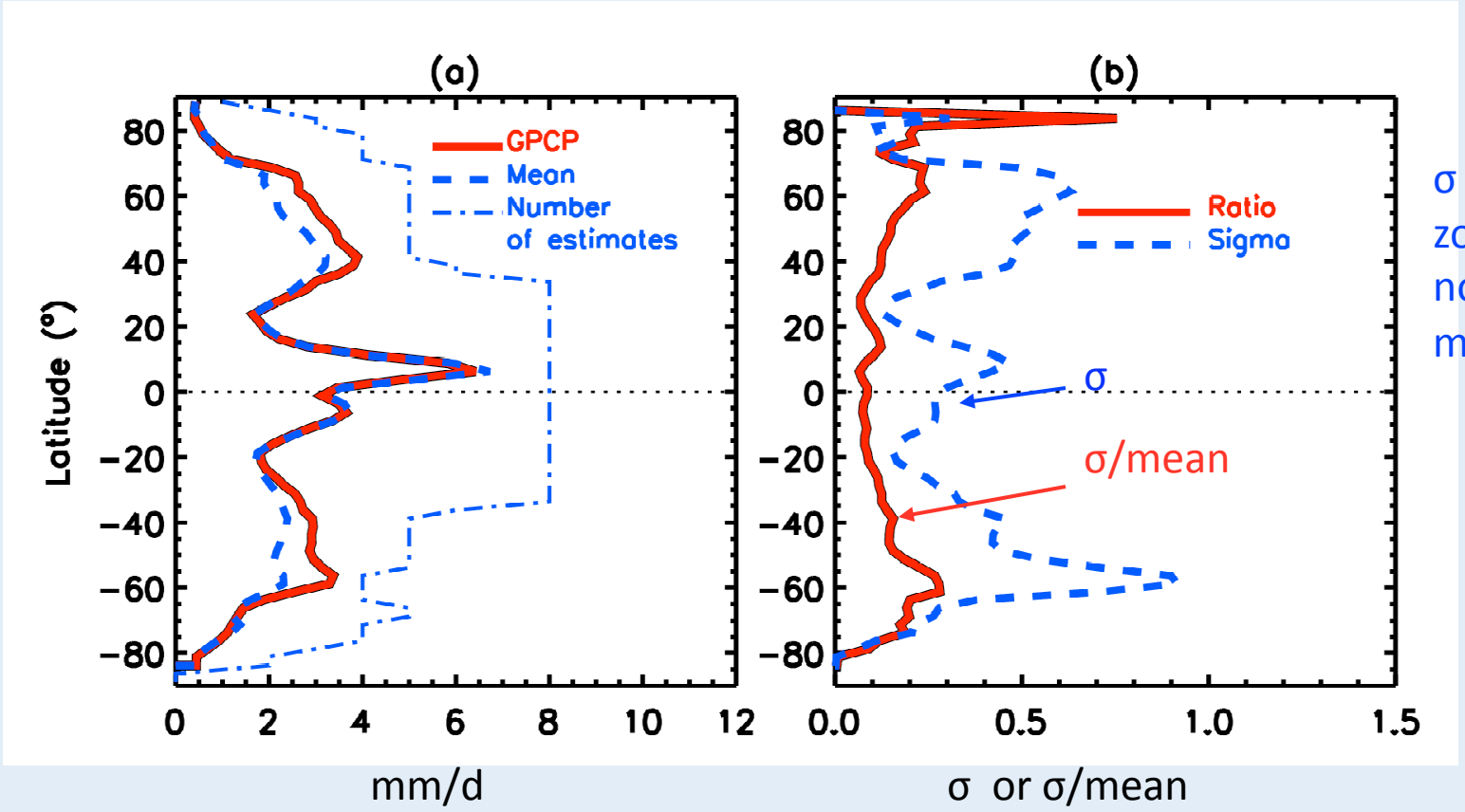
Using Variation among satellite estimates

Results for 10 year "Climatology"--entire seasonal cycle

σ/mean

Adler et al., 2011 (accepted-JAMC)

Zonal Means (Ocean)



σ here is σ of zonal means , not zonal mean of σ's.

σ higher in mid-latitude for same rain rate; *i.e.*, % bias error larger in mid-latitude (~ 15% at 40º vs. ~10% at 0-15º)

Global (90°S-90°N) mean rain rates (mm day^{-1}) and bias (mm day^{-1}) during 1998-2007

	Rain rate (P)	Adjusted domain-mean bias (σ)	Ratio ($\frac{\sigma}{P} \times 100\%$)
Land & Ocean	2.64 (GPCP) 2.45 (composite)	0.25	9.48%
Land	2.12 (GPCP) 2.03 (composite)	0.16	7.54 %
Ocean	2.87 (GPCP) 2.64 (composite)	0.29	10.14 %

[These error estimates are upper bounds due to regional averaging of errors and inclusion of still questionable input estimates]

Adler et al., 2011 (accepted-JAMC)

GPCP Version 3

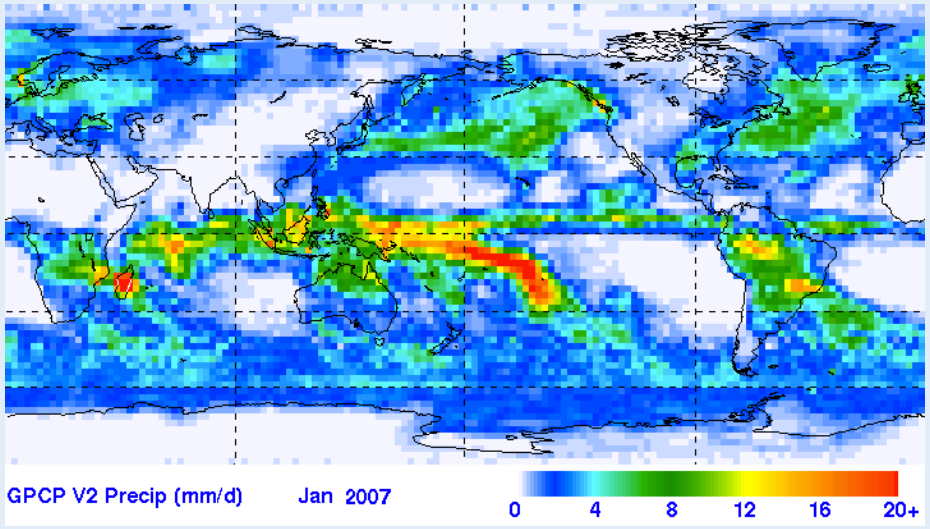
- New GPCP Version 3 will have:

  * Monthly--0.5° resolution, GPROF microwave algorithm applied to SSMI, SSMIS data as satellite calibrator (1979-present)

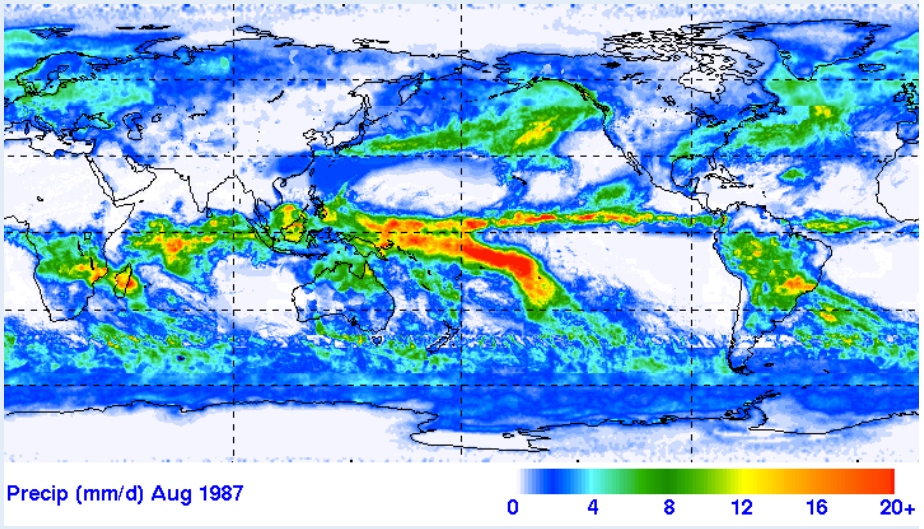
  * Daily—0.5° resolution (1998-present; possibility of extension back in time). [Pentad for whole 1979-present period]

  * 3-hr—0.25° (1998-present) to match with ISCCP and SRB products

Version 2



Version 3

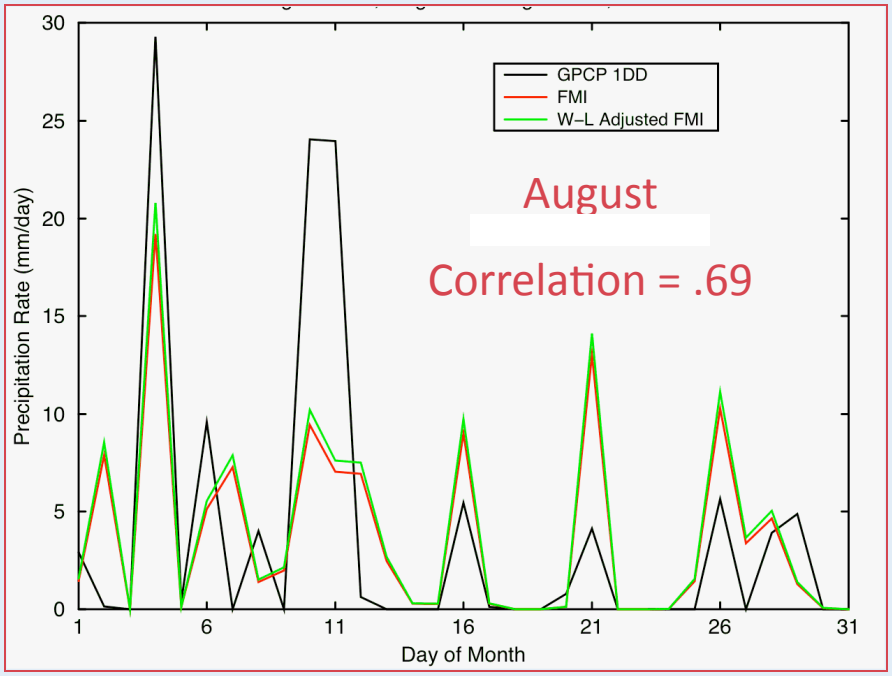


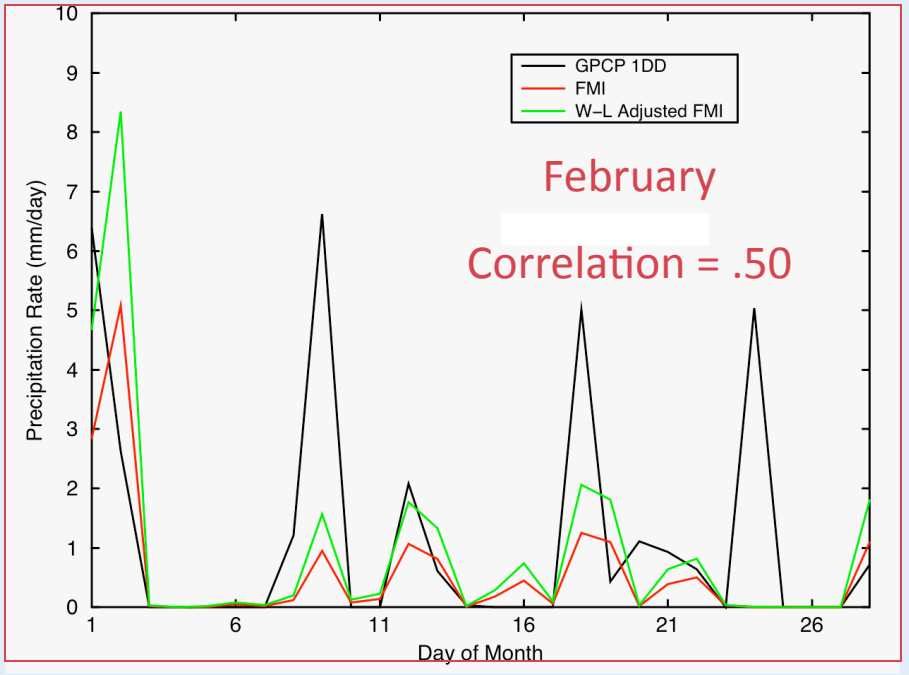
Summary

- GPCP products, widely used by the community, are generated by a multi-institution, international cadre of scientists (overworked and underfunded)
- NOAA is supporting adaptation and transfer of the current GPCP Version 2 production system for continued operational processing at NOAA/NCDC—a classic case of "research to operations"
- New Version 3 GPCP development underway with higher time and space resolutions; part of GEWEX integrated global data set effort; hopefully to start production in 2012

High Latitude Precipitation Info. (1997- Present)

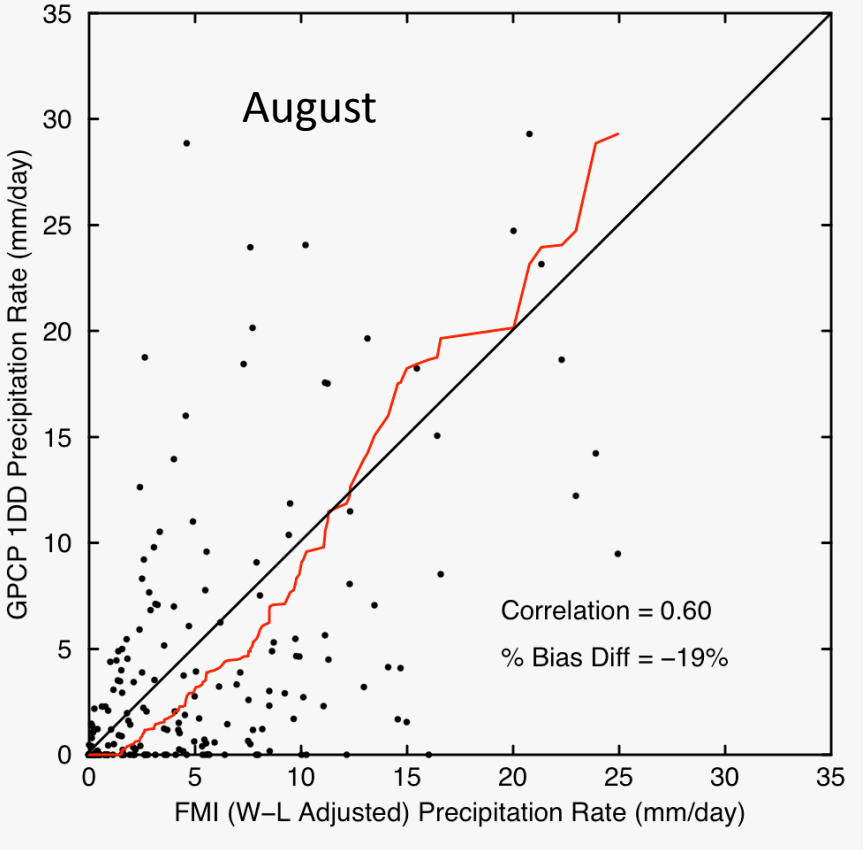
Validation of GPCP Daily 1°lat. x 2°long. Over Finland

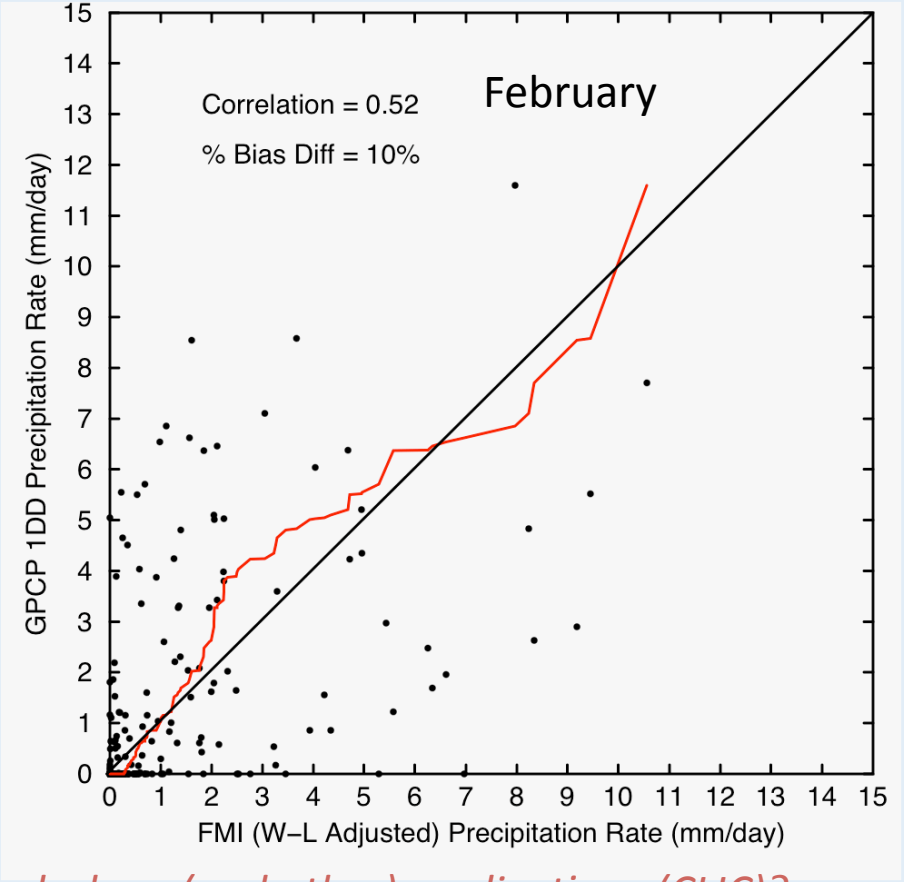




Gauge data is off by 6 hrs. from satellite day (00Z-00Z)

Validation of GPCP Daily 1°lat. x 2°long. Over Finland

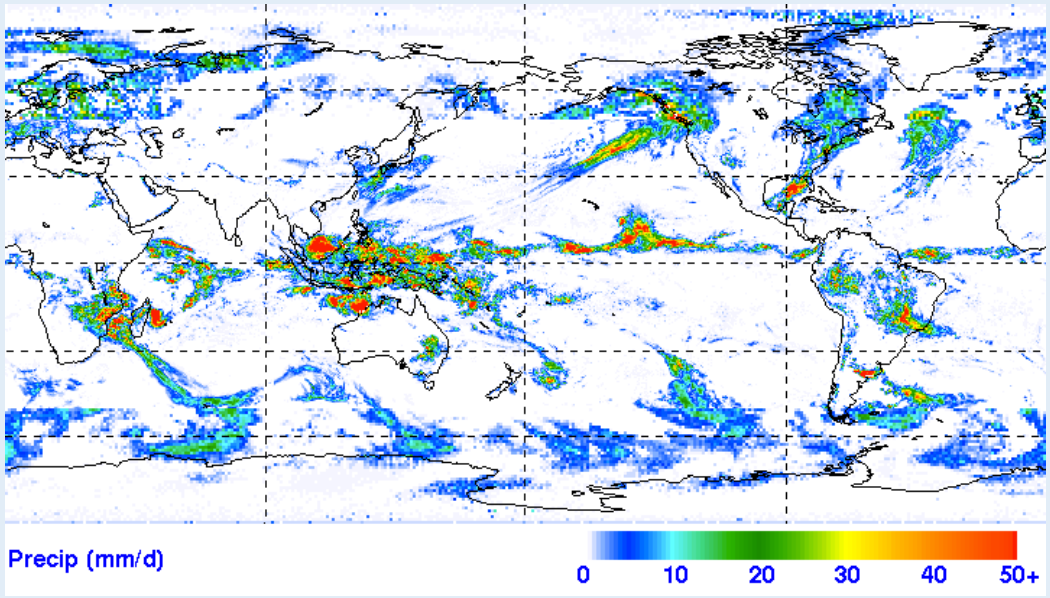




Value of such data at high latitudes for hydrology (and other) applications (CLIC)?

Bolvin, D.T., R.F. Adler, G.J. Huffman, E.J. Nelkin, J.P. Poutiainen, 2009: Comparison of GPCP Monthly and Daily Precipitation Estimates with High-Latitude Gauge Observations. *J. Appl. Meteor. Climatol.,* 48, 1843-1857.

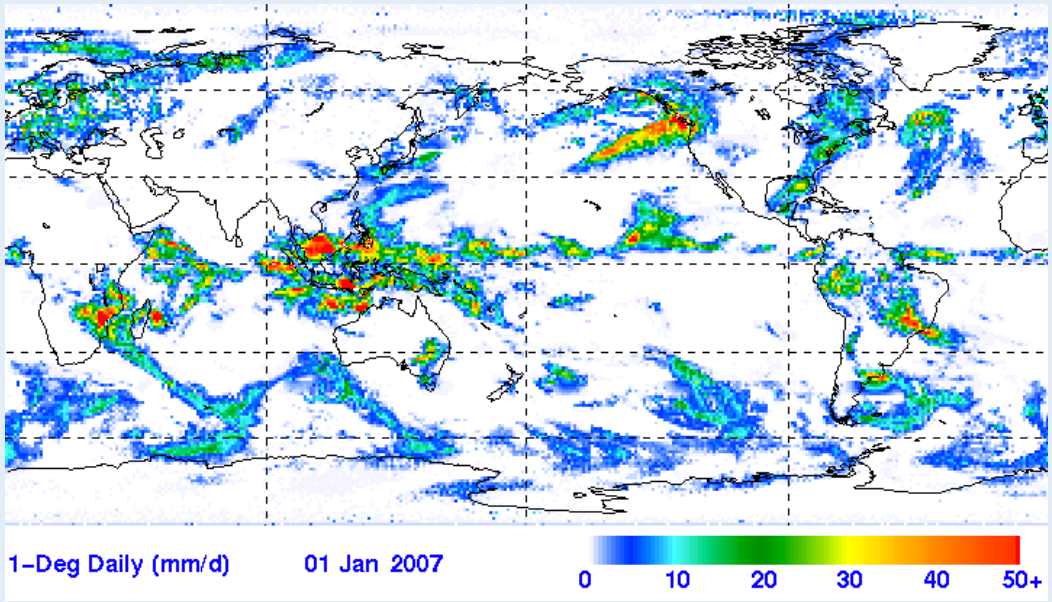
Daily---Example GPCP Version 3 Compared to Version 2.1



Version 3

Mostly microwave 50°N-50°S [1998-present] 0.5° resolution

1 January 2007

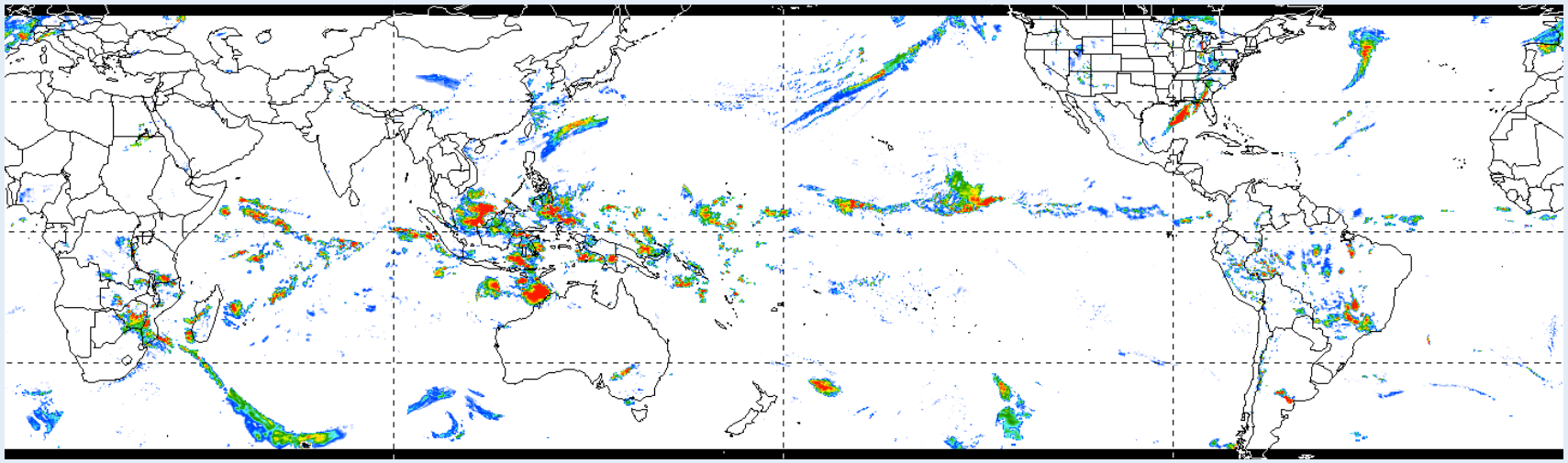


Version 2.1

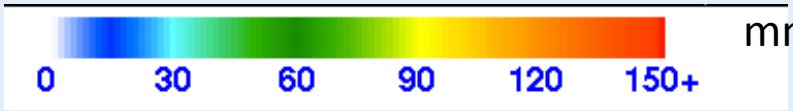
IR adjusted by microwave 40°N-40°S 1.0° resolution

Polar regions (>60°) the same in both versions

Example GPCP Version 3 3-hr Product (50N-50S)

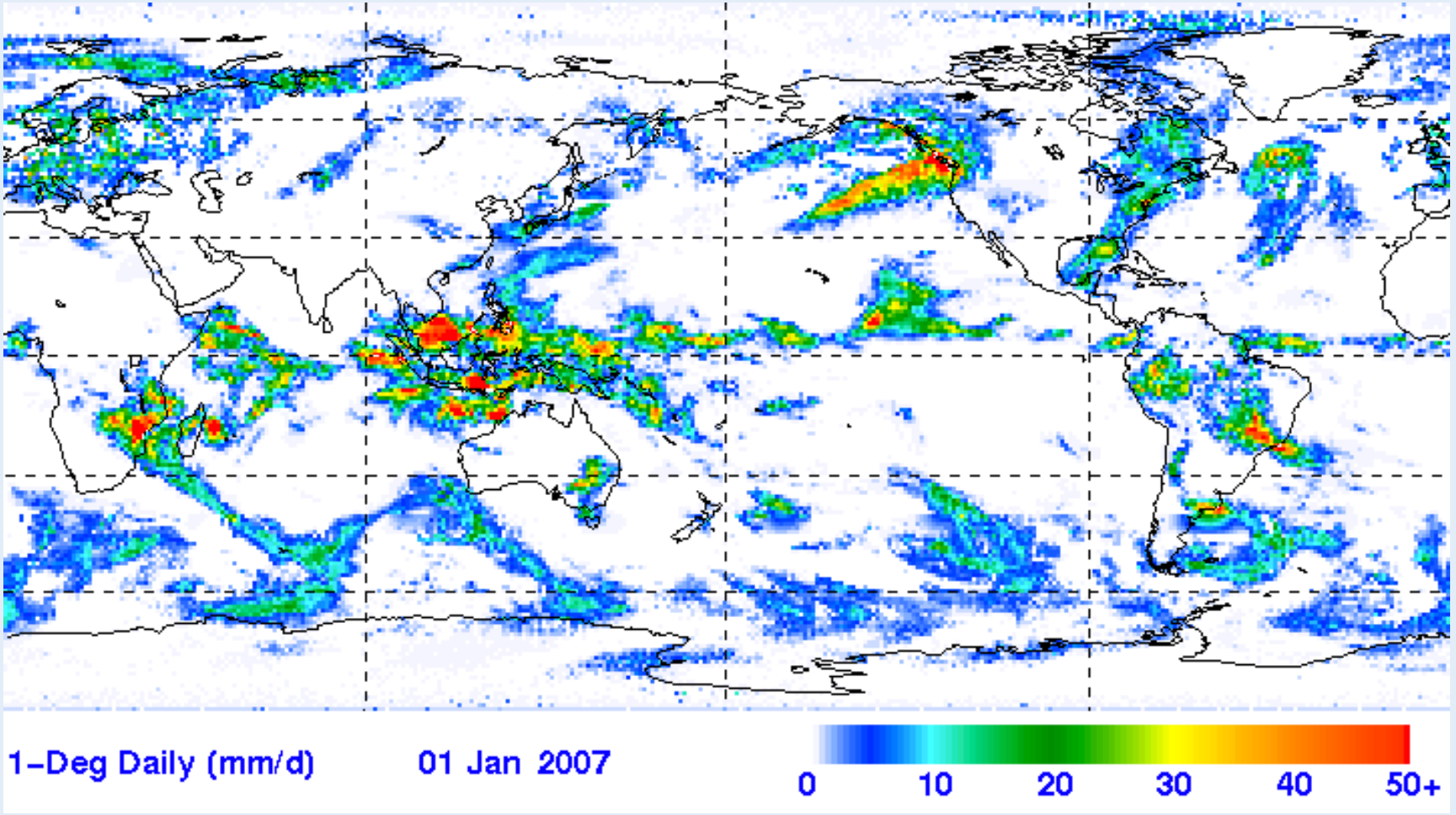


January 1, 2007 00 GMT



Example of GPCP Daily Precipitation Analysis—Globally Complete

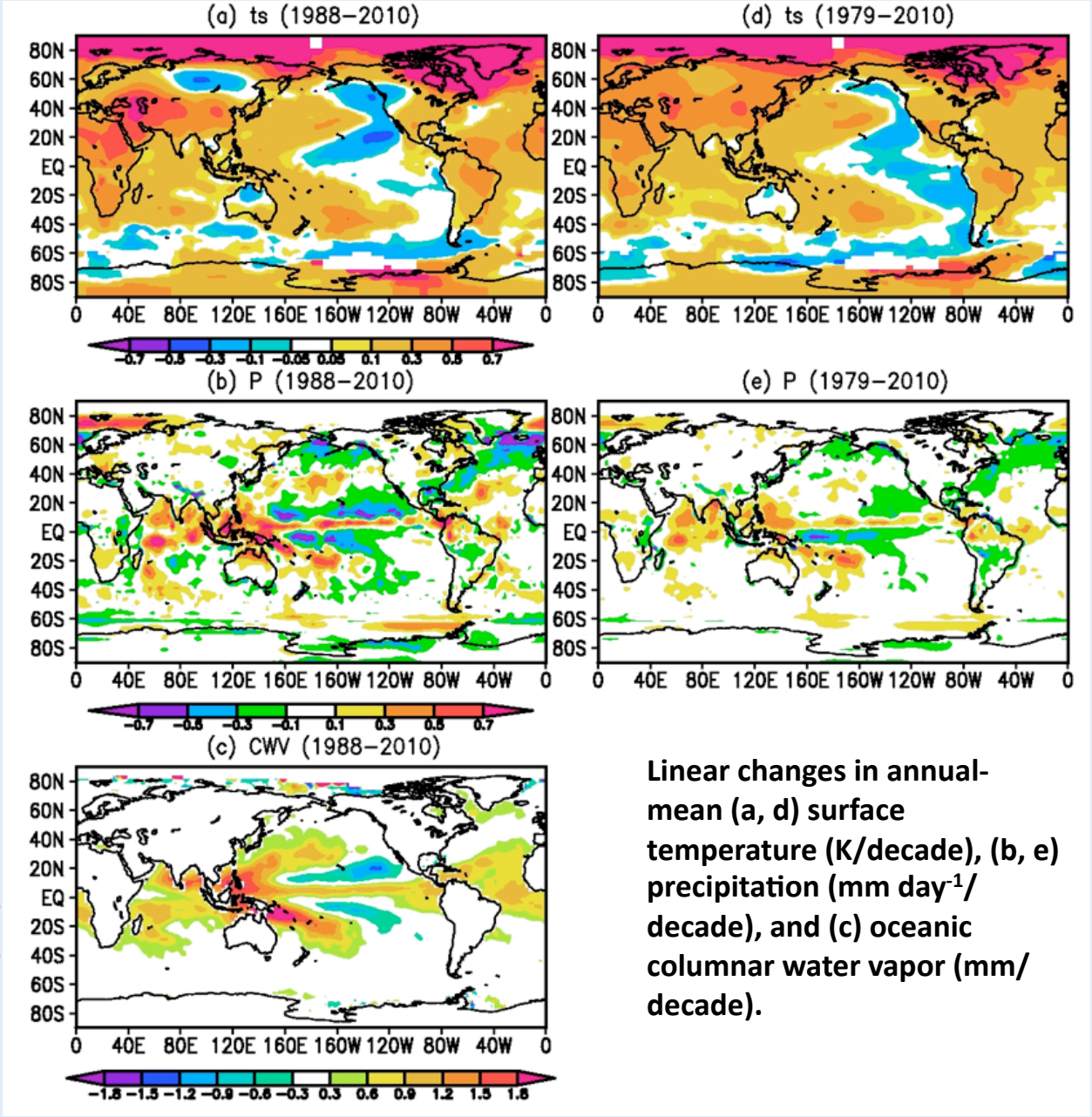
1998-Present



Surface Temp.

Precip.

Ocean Water Vapor



Linear changes in annual-mean (a, d) surface temperature (K/decade), (b, e) precipitation (mm day^{-1}/ decade), and (c) oceanic columnar water vapor (mm/ decade).

Trend Maps of Surface Temperature, Ocean Water Vapor and Precipitation through 2010

GPCP Tropical Ocean Precipitation (1979-2008)

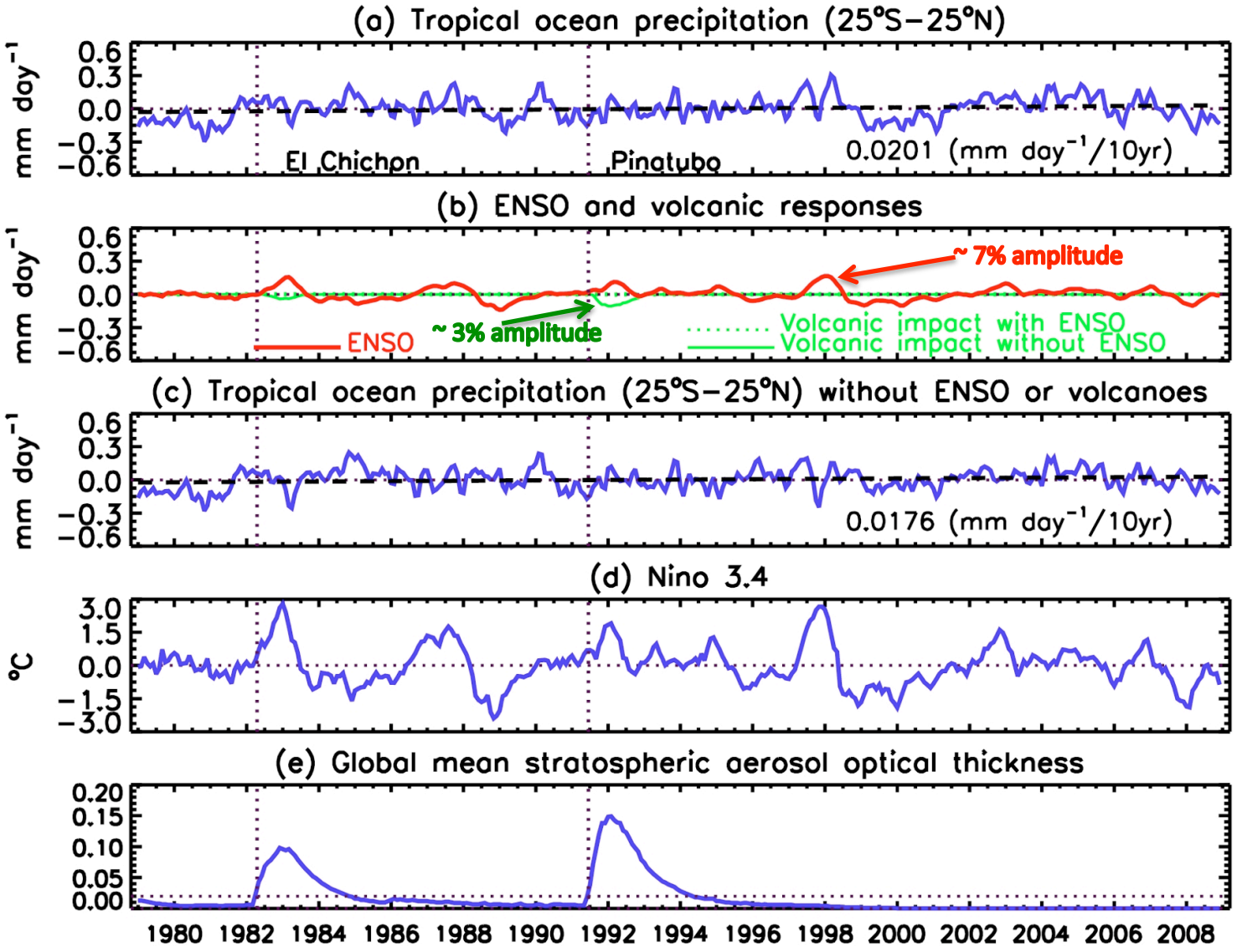
Original Data-3 month running smoother

ENSO and Volcano Signals (Gu et al. 2008 technique)

Residual after ENSO/volcano effects removed Trend?

Nino 3.4 SST anomaly as ENSO index

Global stratospheric aerosol as index of volcano



GPCP Tropical Land Precipitation (1979-2008)

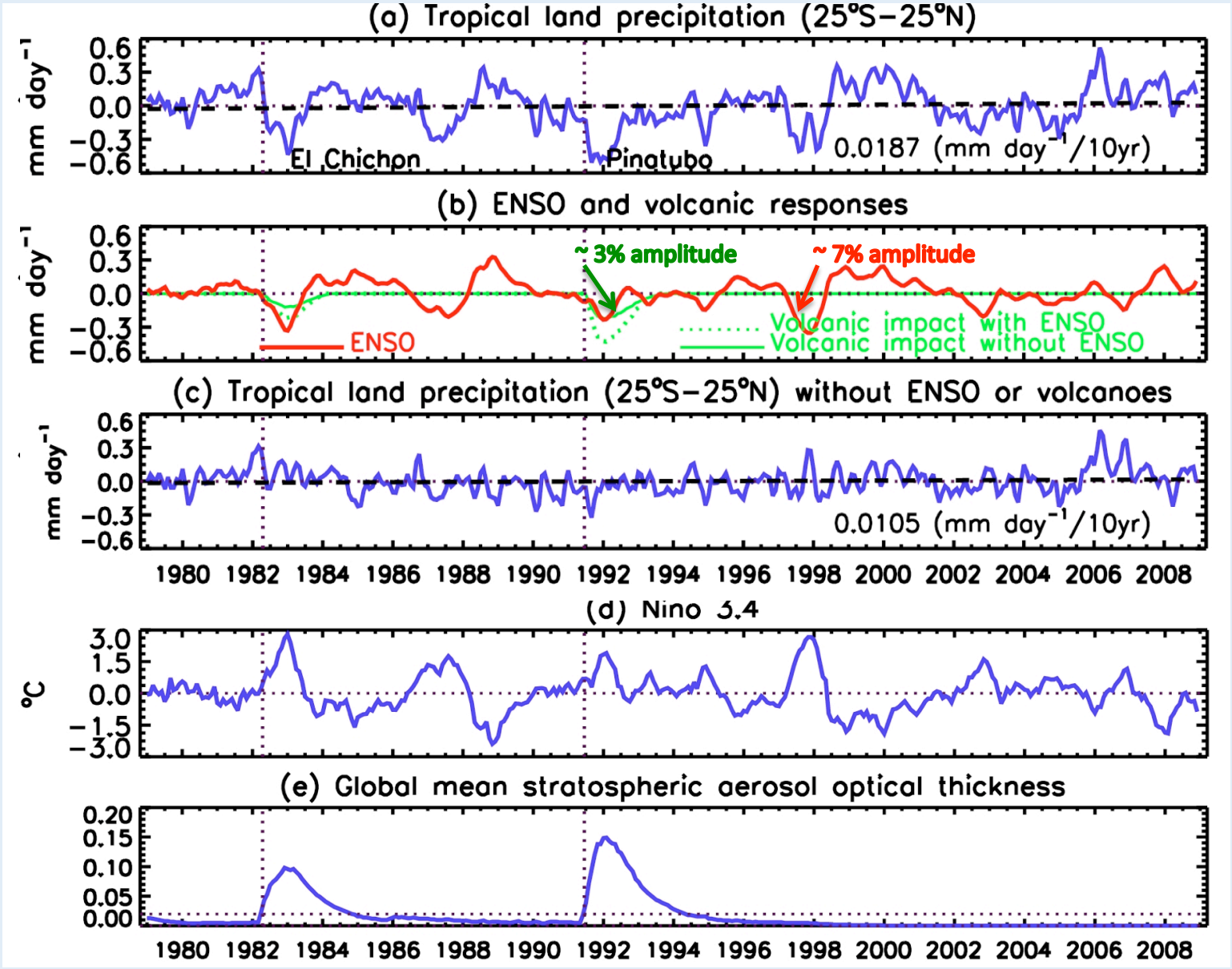
Original Data-3 month running smoother

ENSO and Volcano Signals (Gu et al. 2008 technique)

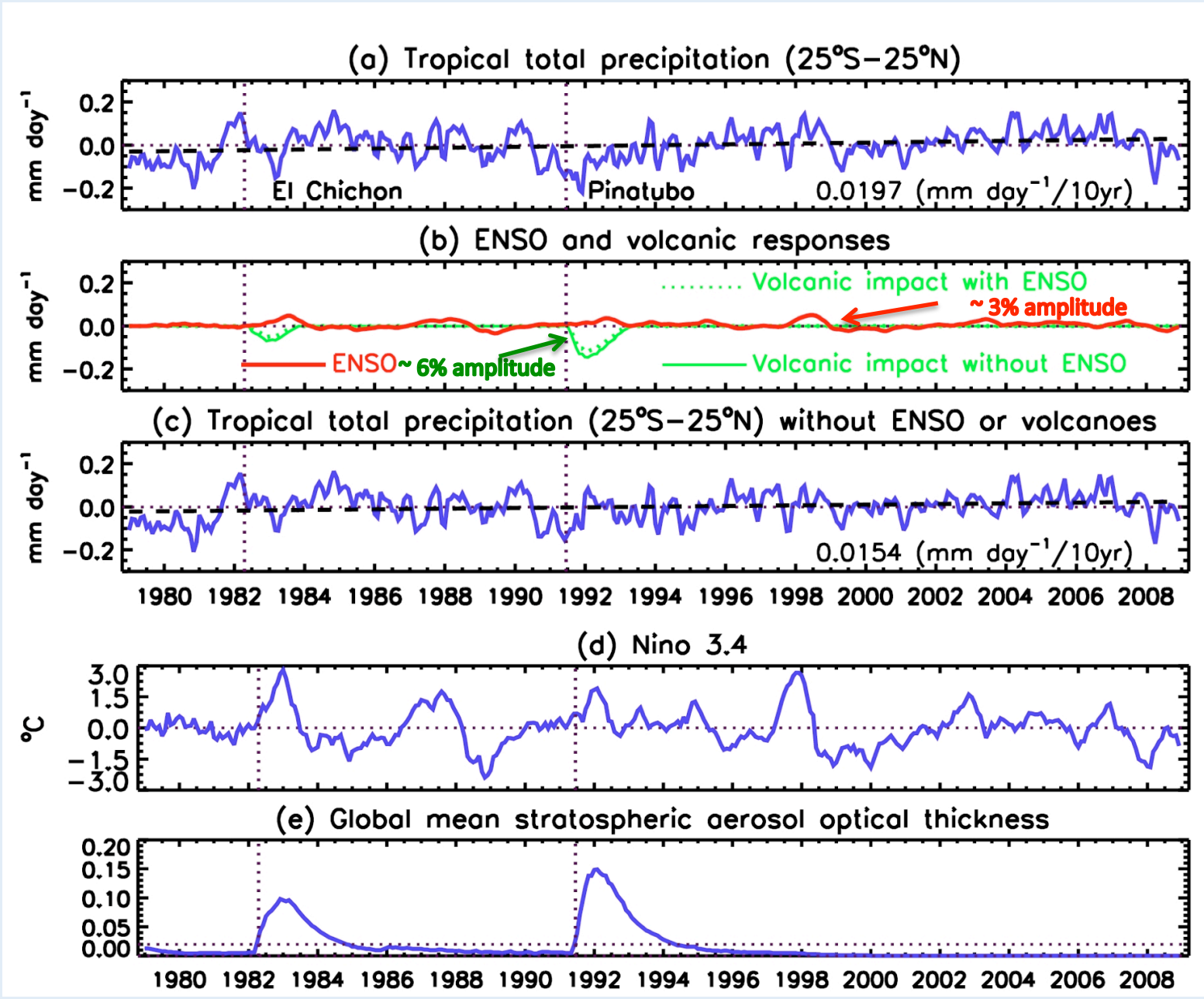
Residual after ENSO/volcano effects removed Trend?

Nino 3.4 SST anomaly as ENSO index

Global stratospheric aerosol as index of volcano



Tropical Land + Ocean Precipitation



Tropical Surface Temperature and Precipitation (Land + Ocean)

TEMPERATURE
ENSO and Volcano Signals

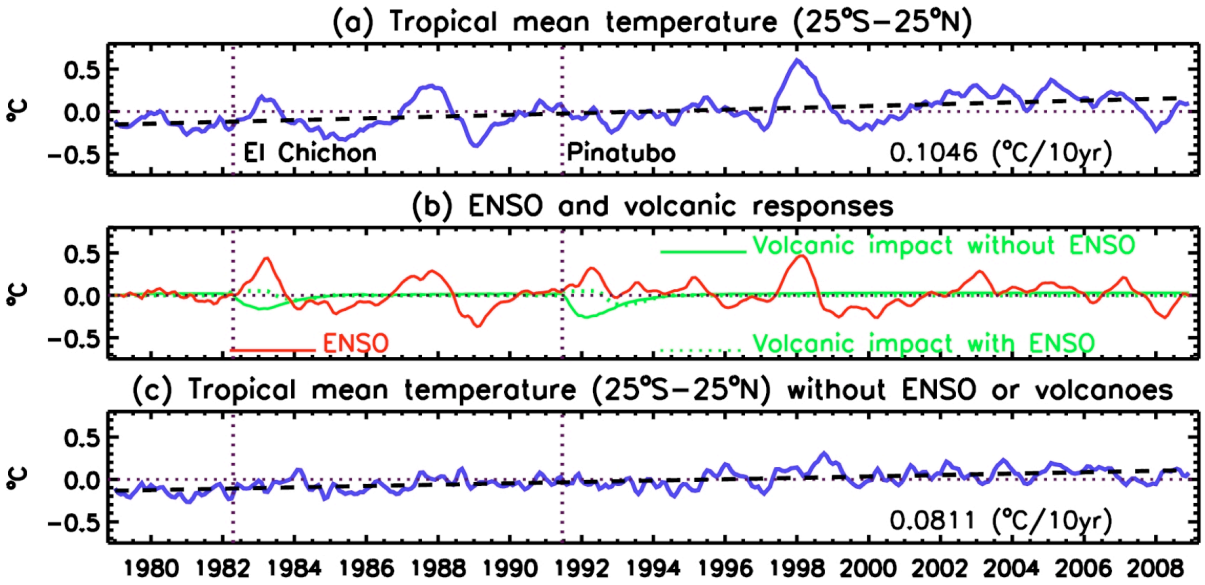
TEMPERATURE
Trend

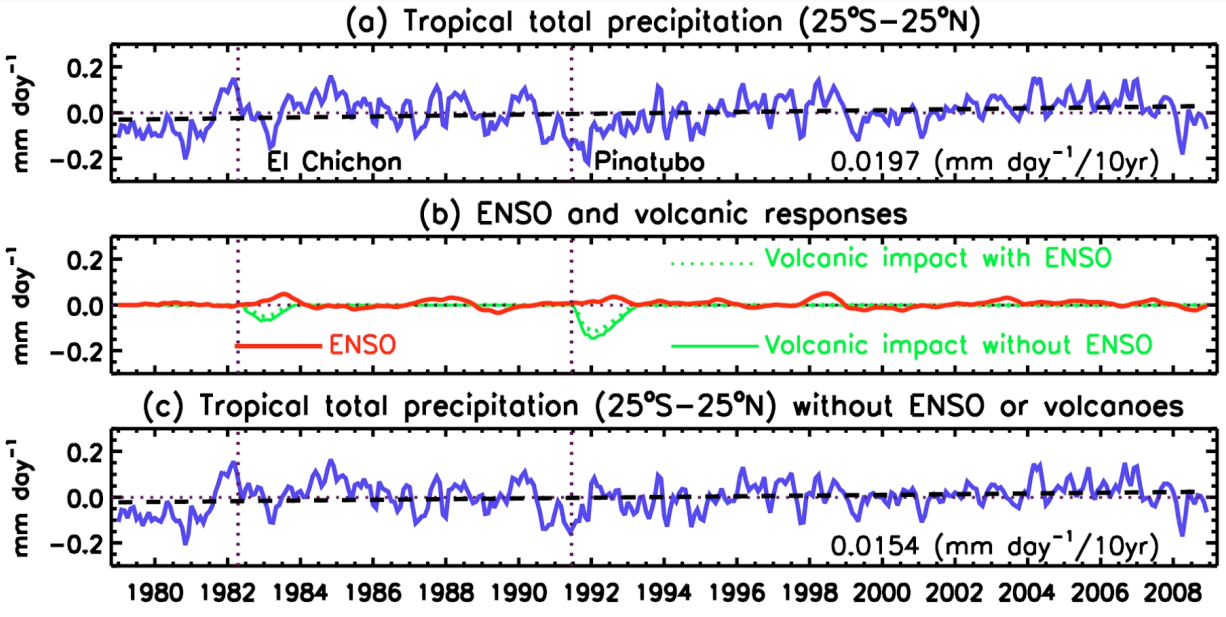
TEMPERATURE—ENSO larger than volcano, positive trend

PRECIPITATION—ENSO muted, smaller than volcano, near zero trend

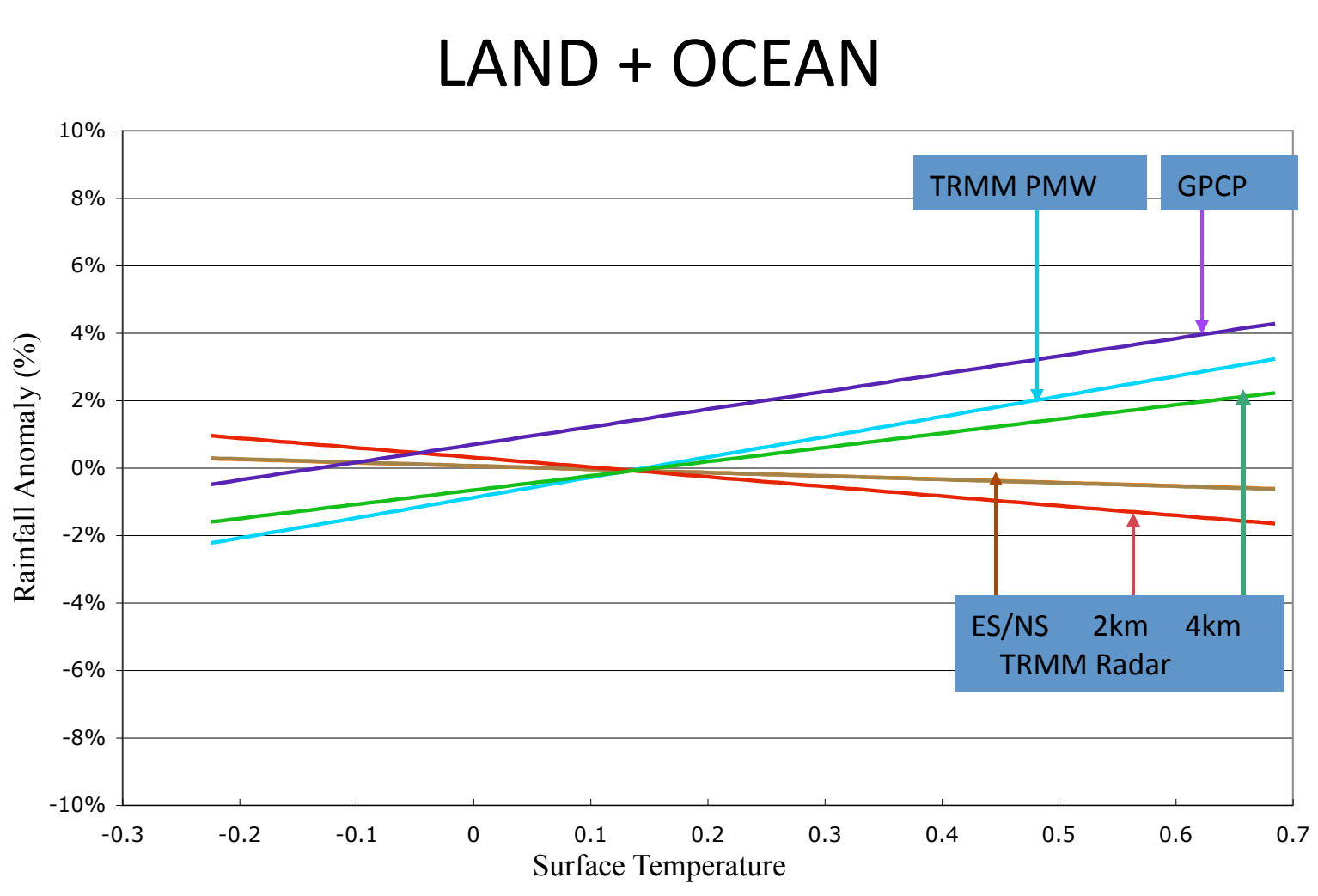
PRECIPITATION
ENSO and Volcano Signals

PRECIPITATION
Trend





Inter-annual Anomalies (25°N-25°S) Of Rain and Surface Temperature for TRMM Era (1998-2006)



TRMM passive microwave and radar at 4km confirm GPCP ~5%/C relation; TRMM radar (surface to 2 km) does not confirm P-T relations

Wang et al. 2008 (JGR)

Global Surface Temperature and Precipitation (Land + Ocean)

TEMPERATURE
ENSO and Volcano Signals

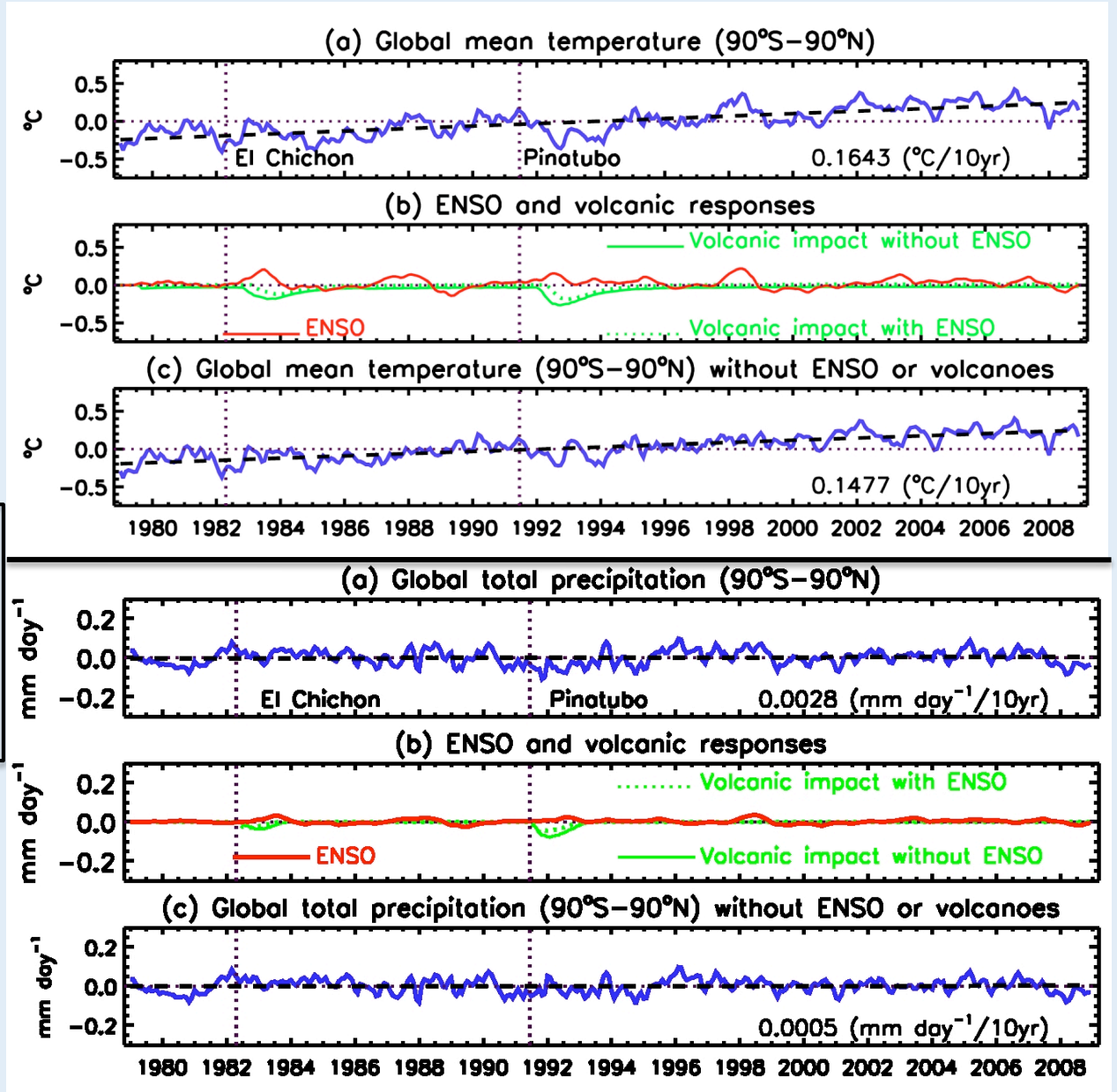
TEMPERATURE
Trend

TEMPERATURE—ENSO same amplitude as volcano, positive trend

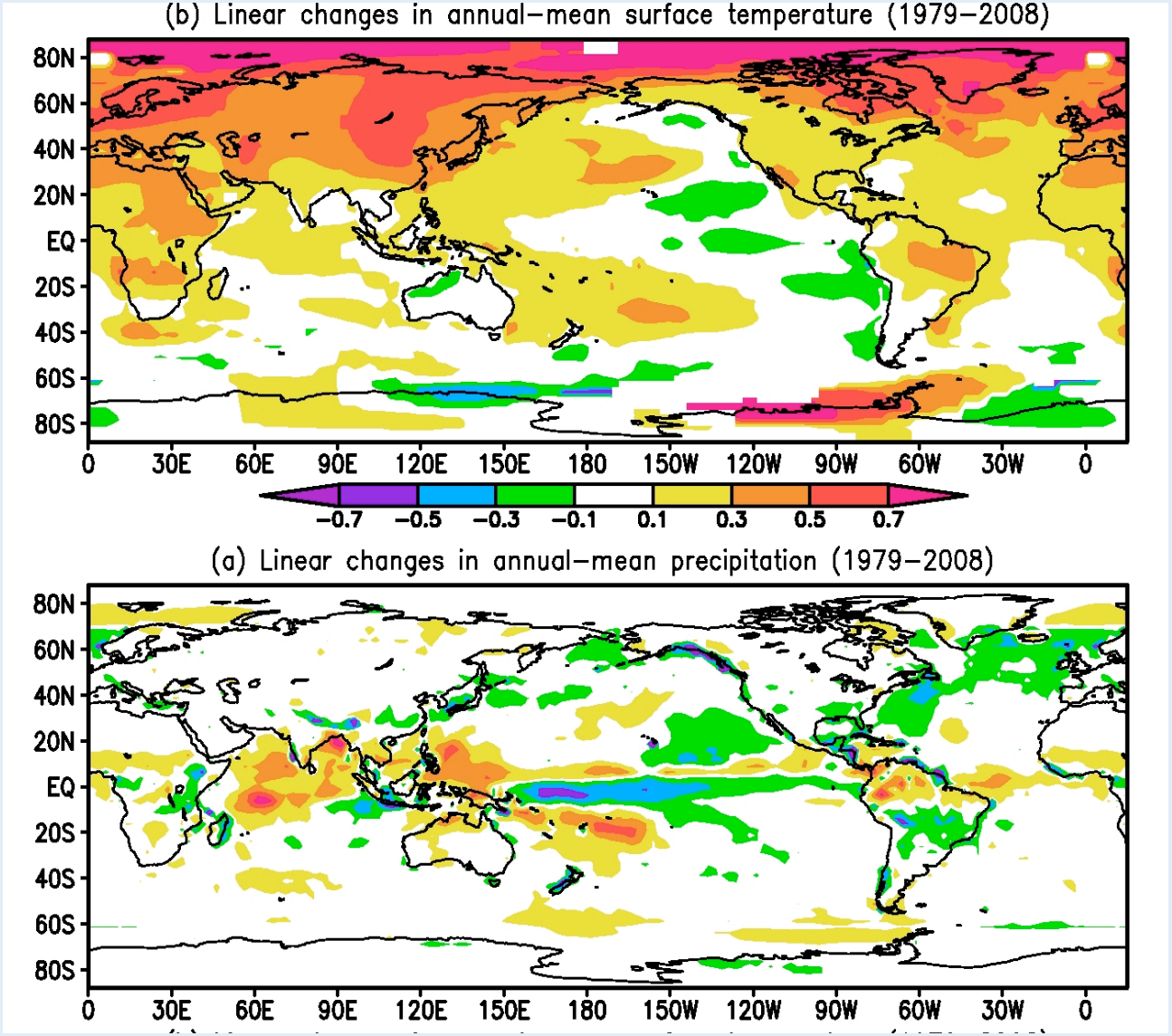
PRECIPITATION—ENSO very muted, smaller than volcano, zero trend

PRECIPITATION
ENSO and Volcano Signals

PRECIPITATION
Trend



Linear Changes [Trends] (1979-2008)



Surface Temperature from GISS

°C/decade

Precipitation from GPCP

mm/d/decade

Updated from Adler et al. 2008, JGR