Data, Errors, Models—Integration for NEWS

(A personal view, good for discussion, argument, ……..maybe)

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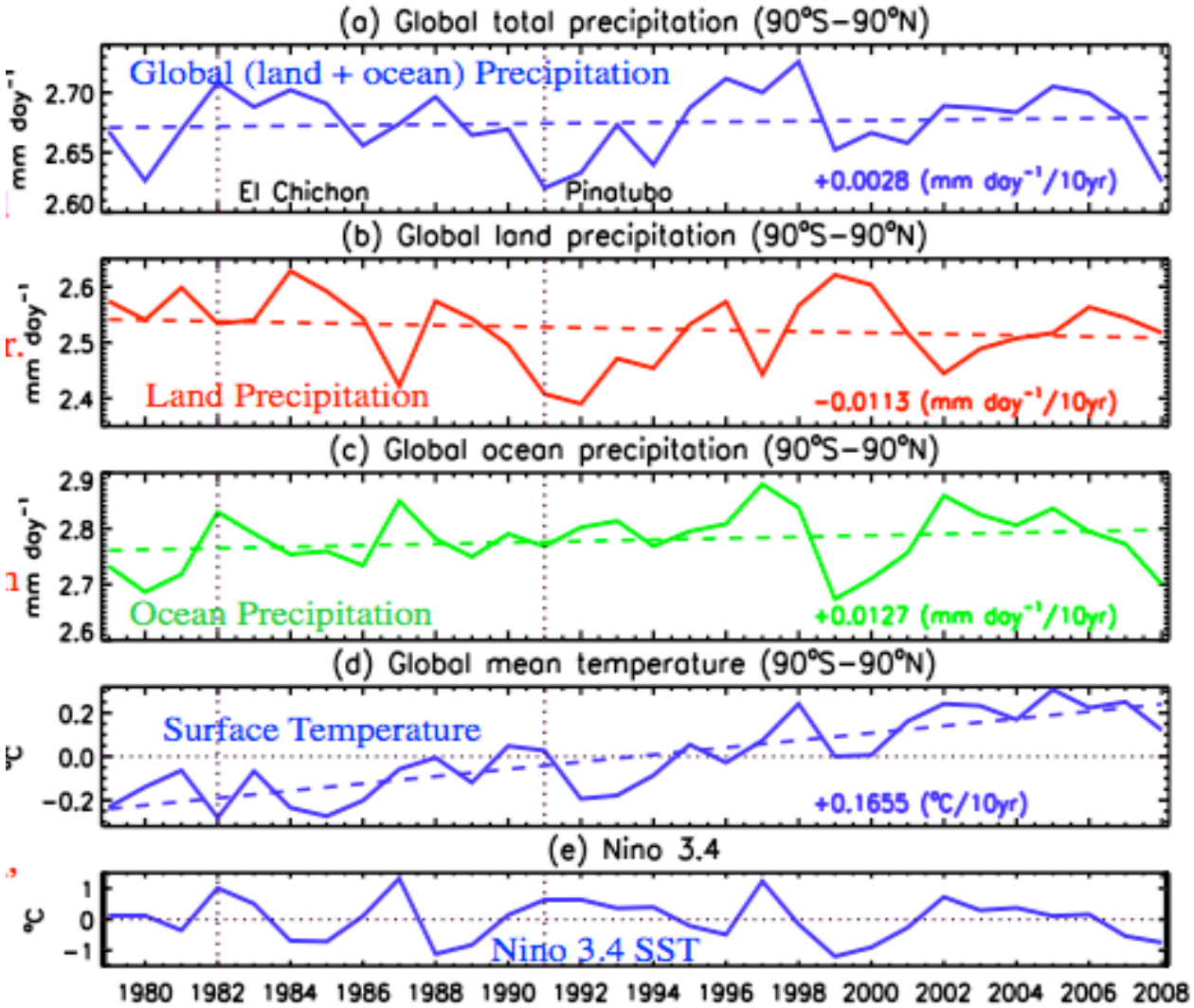


What is NEWS??

- A project to improve understanding of global (and regional) water and energy cycles at (mainly) inter-annual to inter-decadal scales (but, with an interest in "extremes"), using **primarily satellite observations**, but also other observations, and models (mainly global and regional re-analysis type [not predicting]) for process understanding and "gap filling".

(NEWS can't, and shouldn't, try to do "everything", and at all scales—it will end up too broad and much too shallow)

CONNECTIONS TO OUTSIDE of NEWS

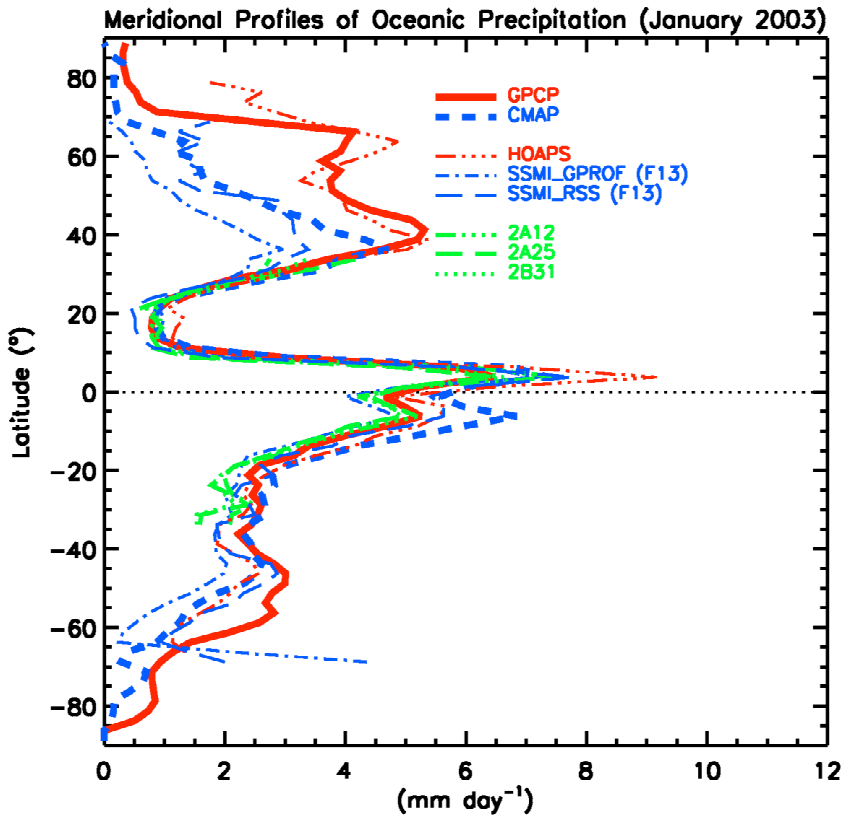
- Other NASA projects: MAP for prediction, Applied Science for "applications".
- Outside individual investigators (usually connected by scientist-to-scientist ties).
- International connection through GEWEX (and other entities)—misnamed GEWEX Radiation Panel [actually GEWEX global analysis products Panel] (Rossow has been, now Kummerow is Chair)

NEWS Approach

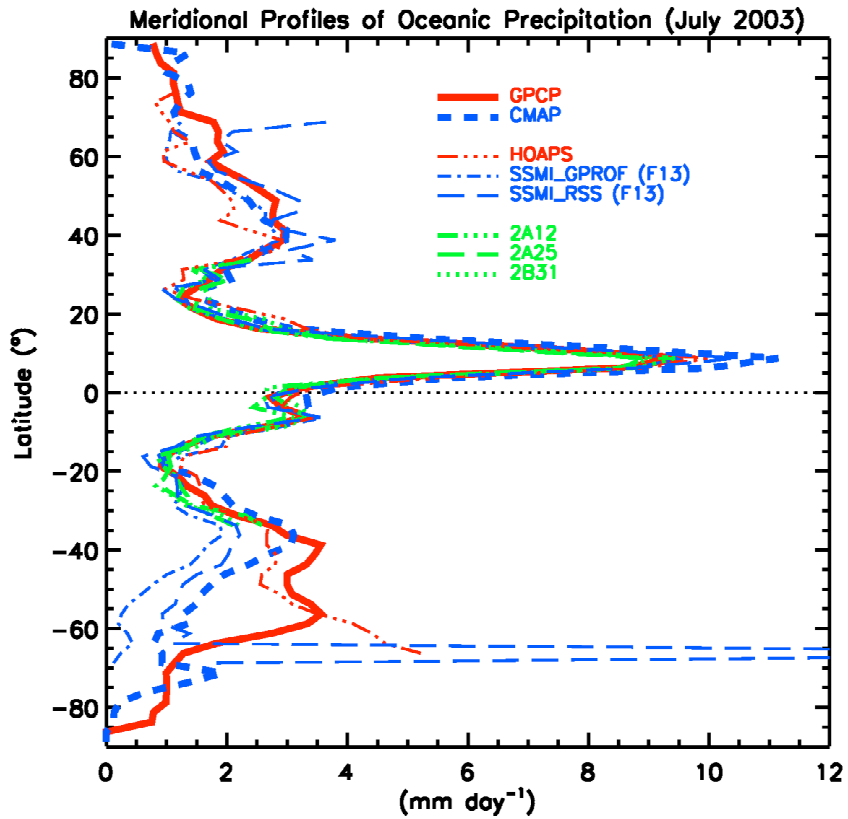
- Take advantage of wealth of satellite data sets over last 10-30 years (especially multi-satellite merged data sets [*e.g.*, precip., ocean flux, etc.]), use global re-analysis results (MERRA, LDAS) for calculation of "missing (from satellite obs.)" data and process models (e.g., CRM's) for additional understanding.
- In addition to individual PI research, NEWS goal is to combine efforts on larger "problems". The idea is that the whole would be larger than the sum of the parts. Result is working groups and these "team" efforts are the main focus of this meeting.
- NEWS focus should be on global down to "large regional-continental" scales, but with some glimpses into local variations for "extreme" events.
- For example, estimation of mean, or climatological, water budget at global and continental scales will force a NEWS "tentative consensus" at that level (and point to areas needing additional attention).
- This first "mean state" step should lead to examination of the mean seasonal cycle, where mean storage can be estimated (partly from satellite data). Then inter-annual (to inter-decadal) variations can addressed and a connection made to occurrence of extremes.

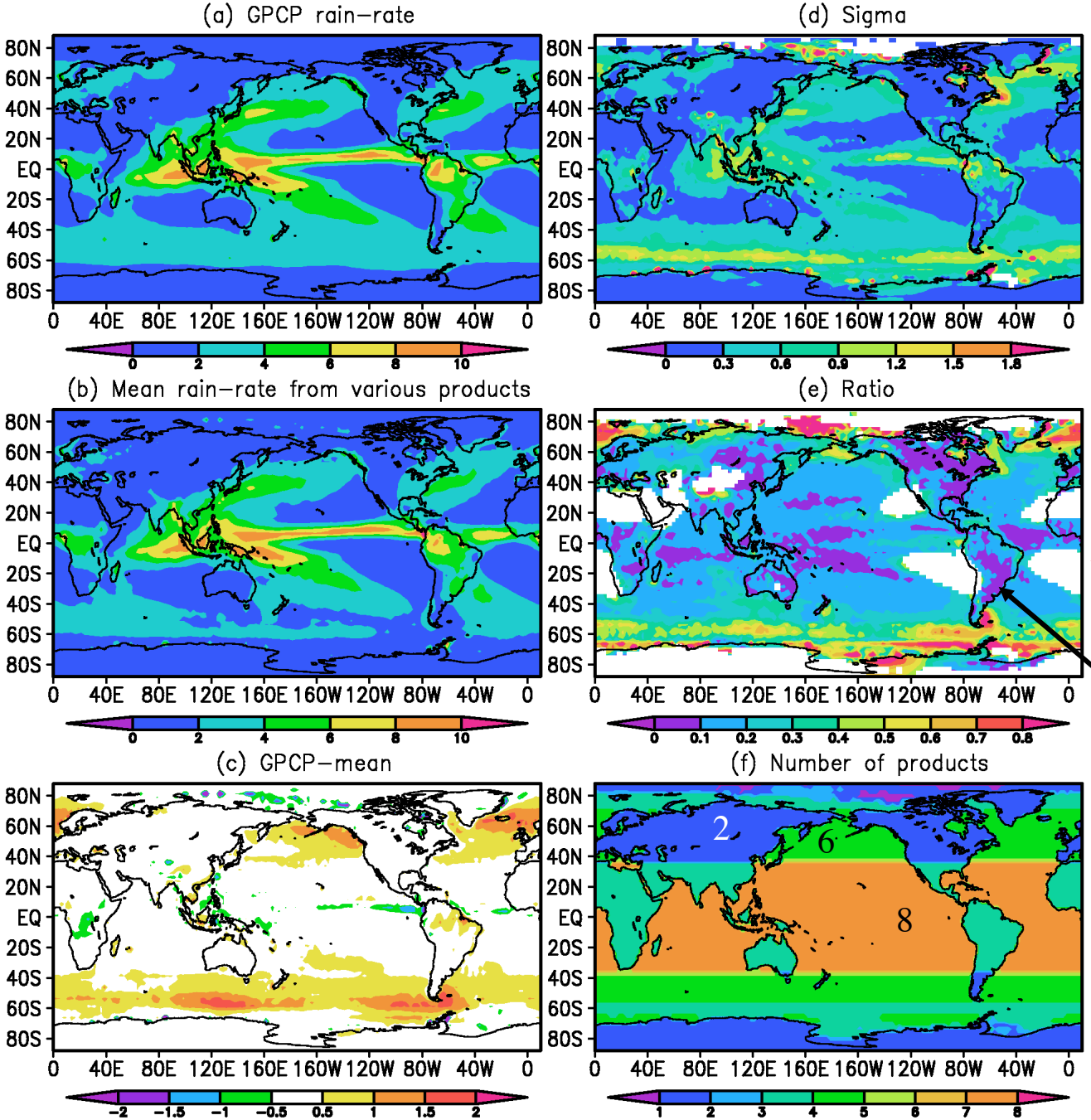
Zonal Mean Inputs (Ocean) for Individual Months

January 2003



July 2003



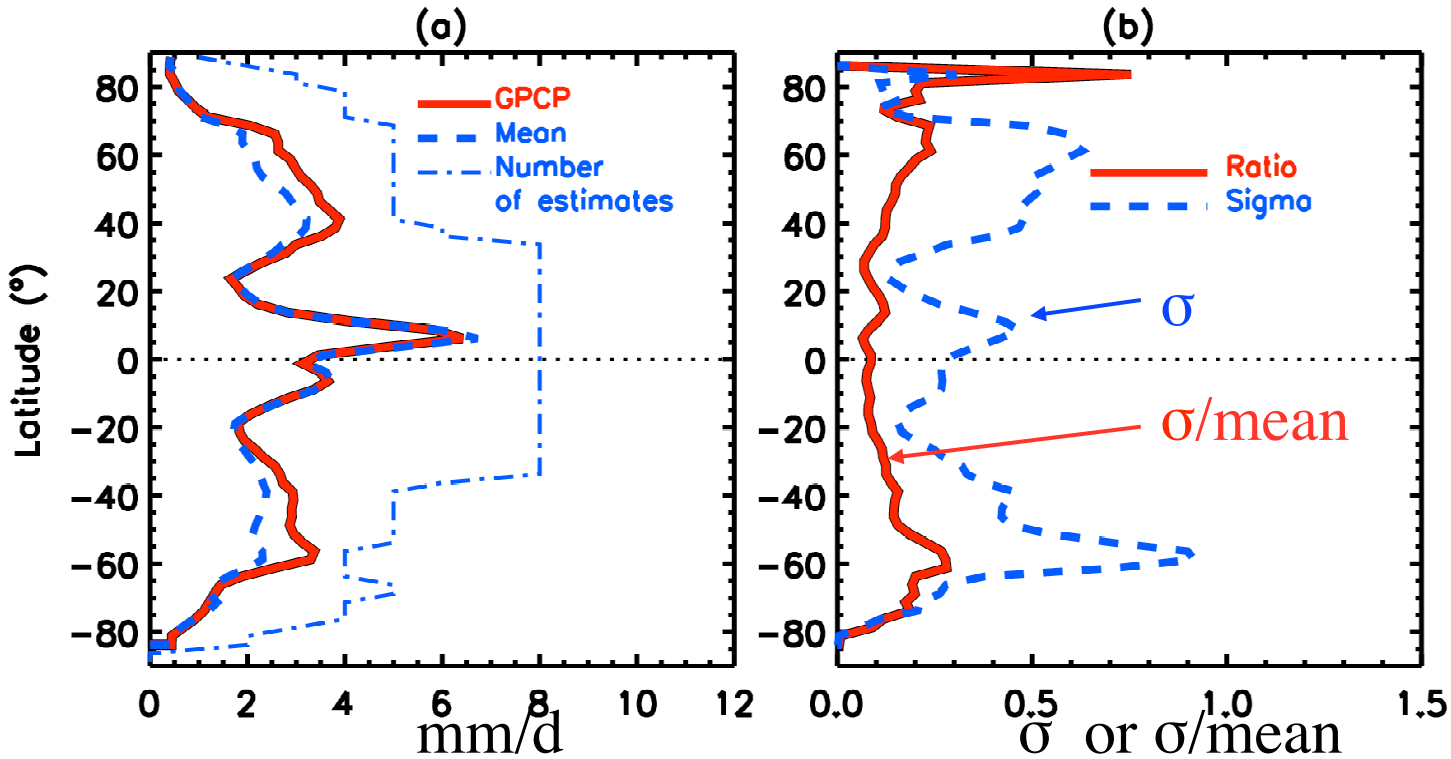


Results for 10 year "Climatology"--entire seasonal cycle

σ/mean

Used to supply errors for GPCP estimates for regional water budgets for working group

Zonal Means (Ocean)



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

- GPCP and composite similar in magnitude in deep tropics, GPCP higher in mid-latitude maximum
- σ higher in mid-latitude for same rain rate; *i.e.*, % bias error larger in mid-latitude (~ 15% at 40° vs. ~10% at 0-15°)

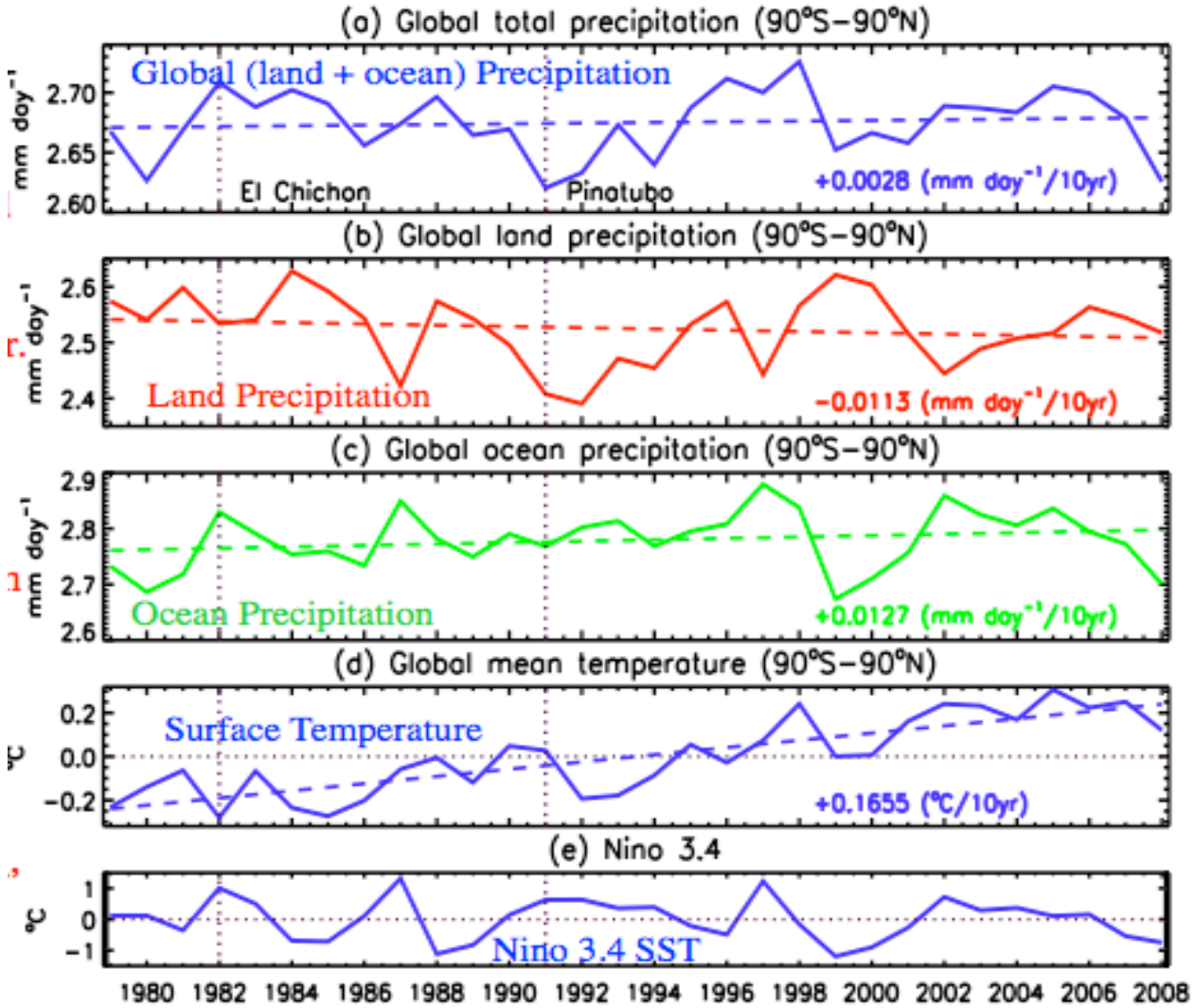
Global (90°S-90°N) mean rain rates (mm day^{-1}) and bias (mm day^{-1}) during 1998-2007

	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 may be upper bounds due to regional averaging of errors and inclusion of still questionable input estimates]

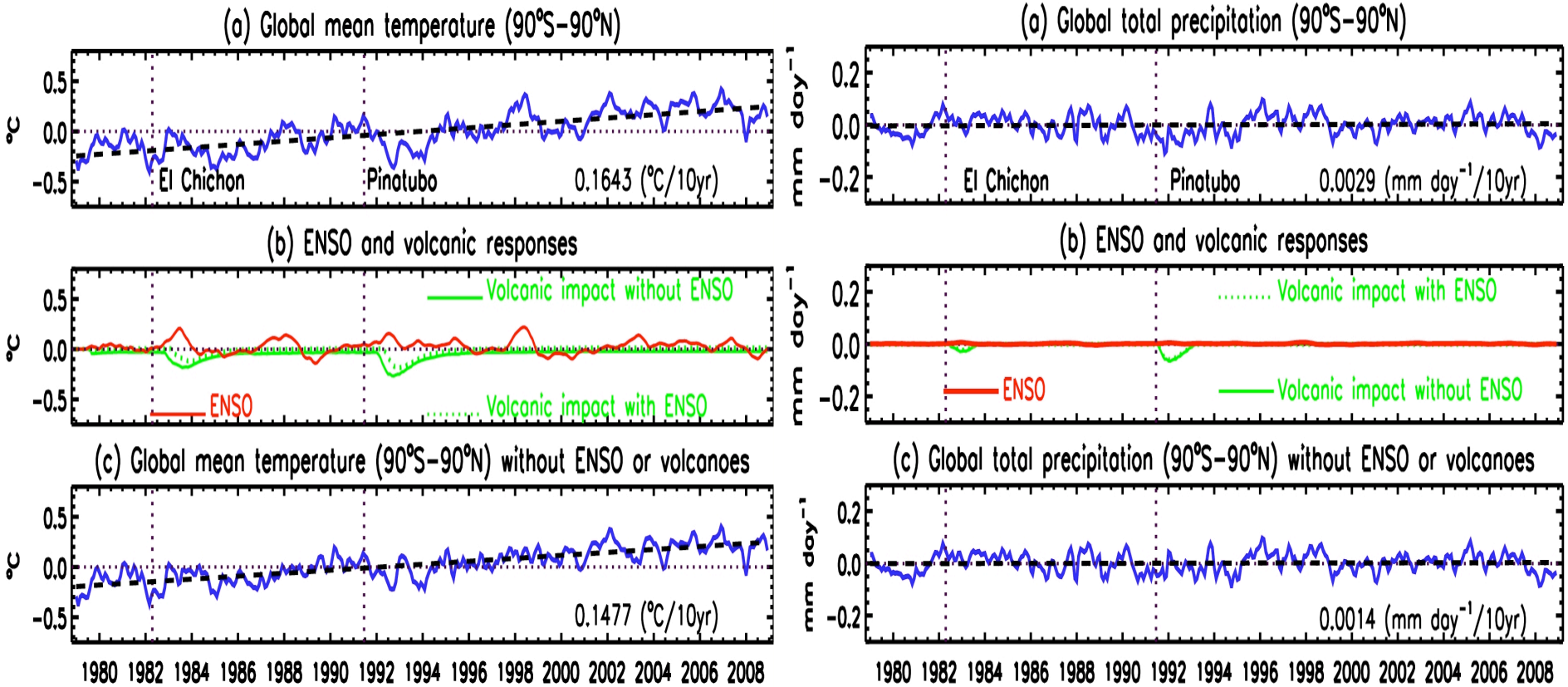
Global Precipitation and Global Temperature

- 2008 near record low global (land + ocean) precipitation; trend very near zero, despite global warming during period.
- Near compensation of ocean and land inter-annual variations leaves slight residual of warmer and wetter years during El Ninos. 2008 was La Nina year.
- Peak temperature in 1998 associated with peak precipitation and El Nino; since '97-'98 surface temperature level and precipitation varies with ENSO.
- Is post-'98 period different?



Surface Temperature

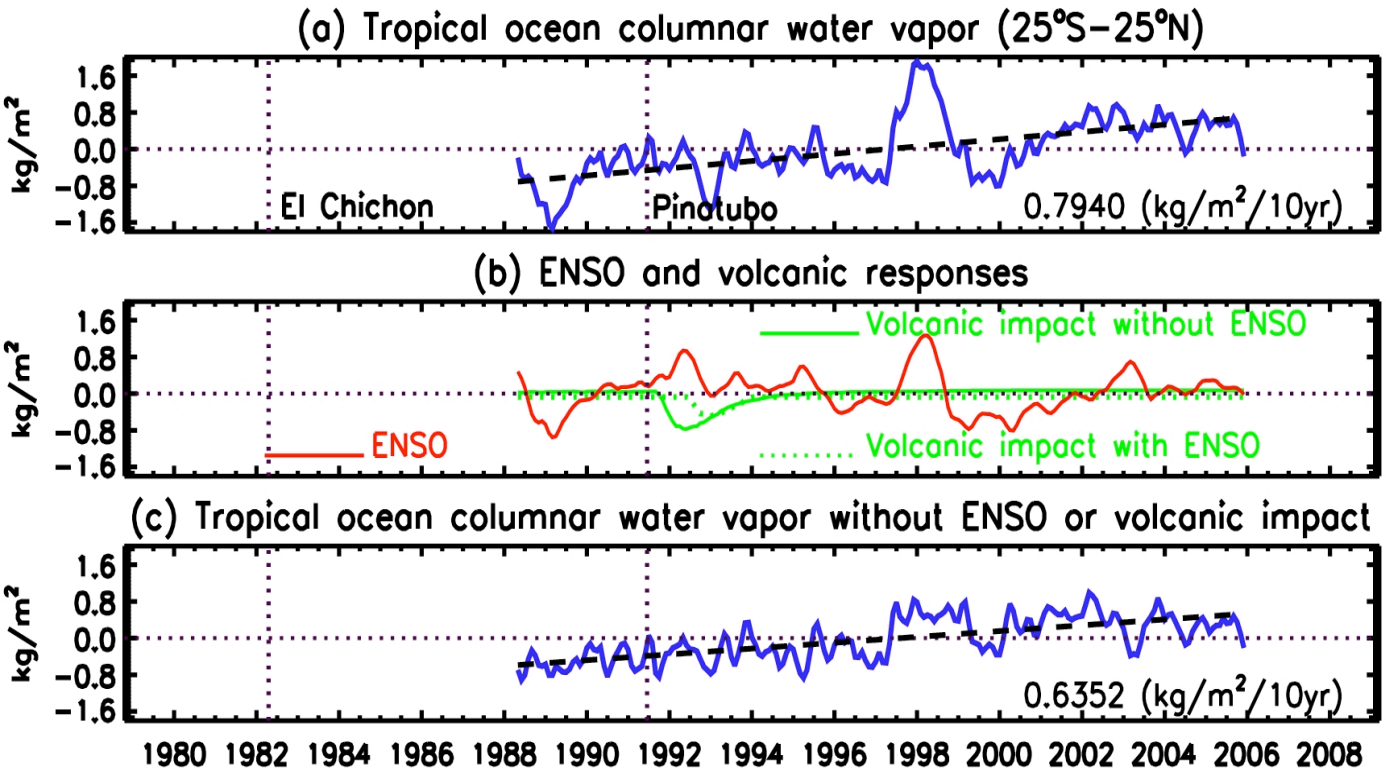
Surface Precipitation



Temp. has obvious trend and noticeable ENSO signal, precip. doesn't

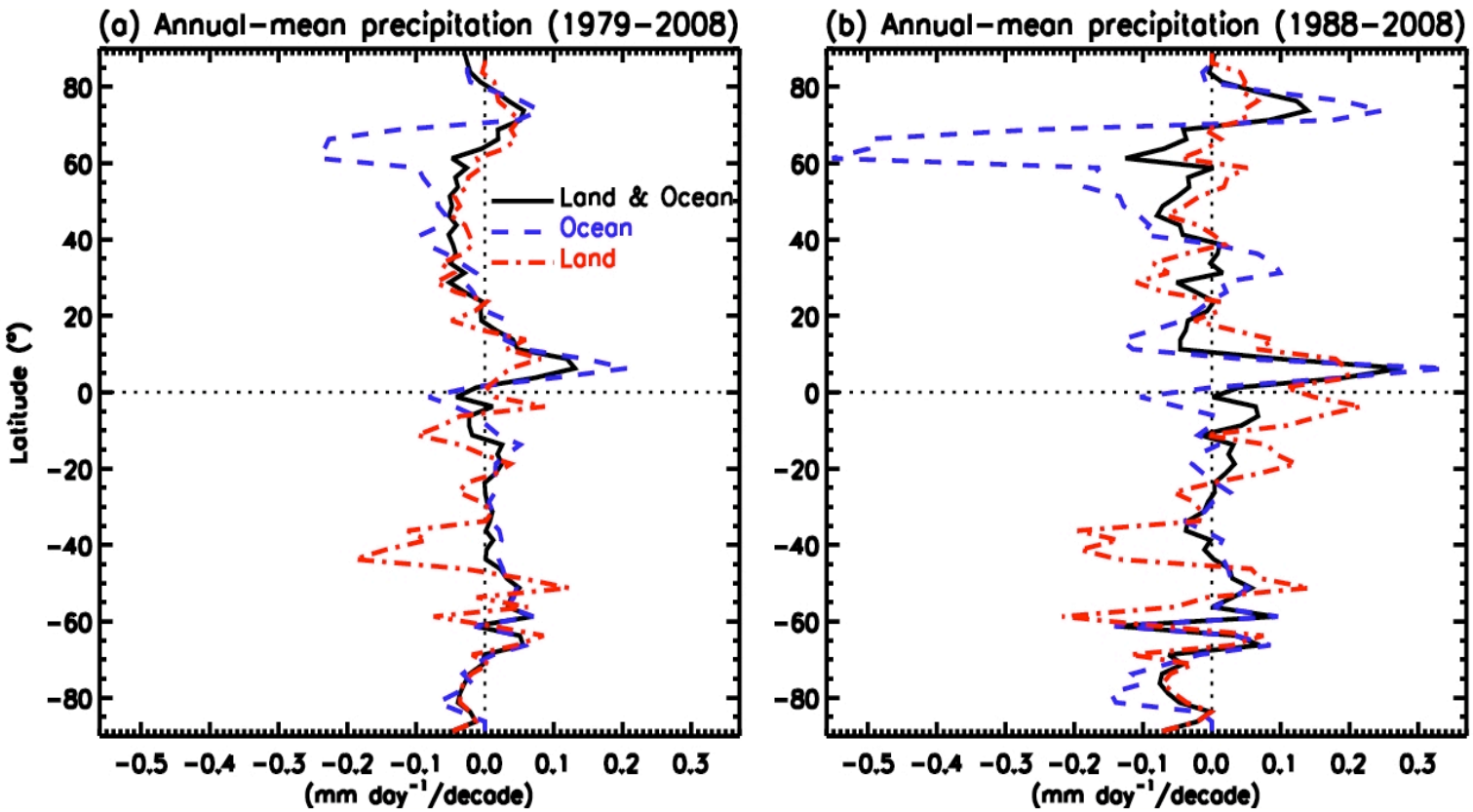
2007-08 low temps. and precip. partly due to La Nina, partly other?

Water Vapor—Oceanic Tropics



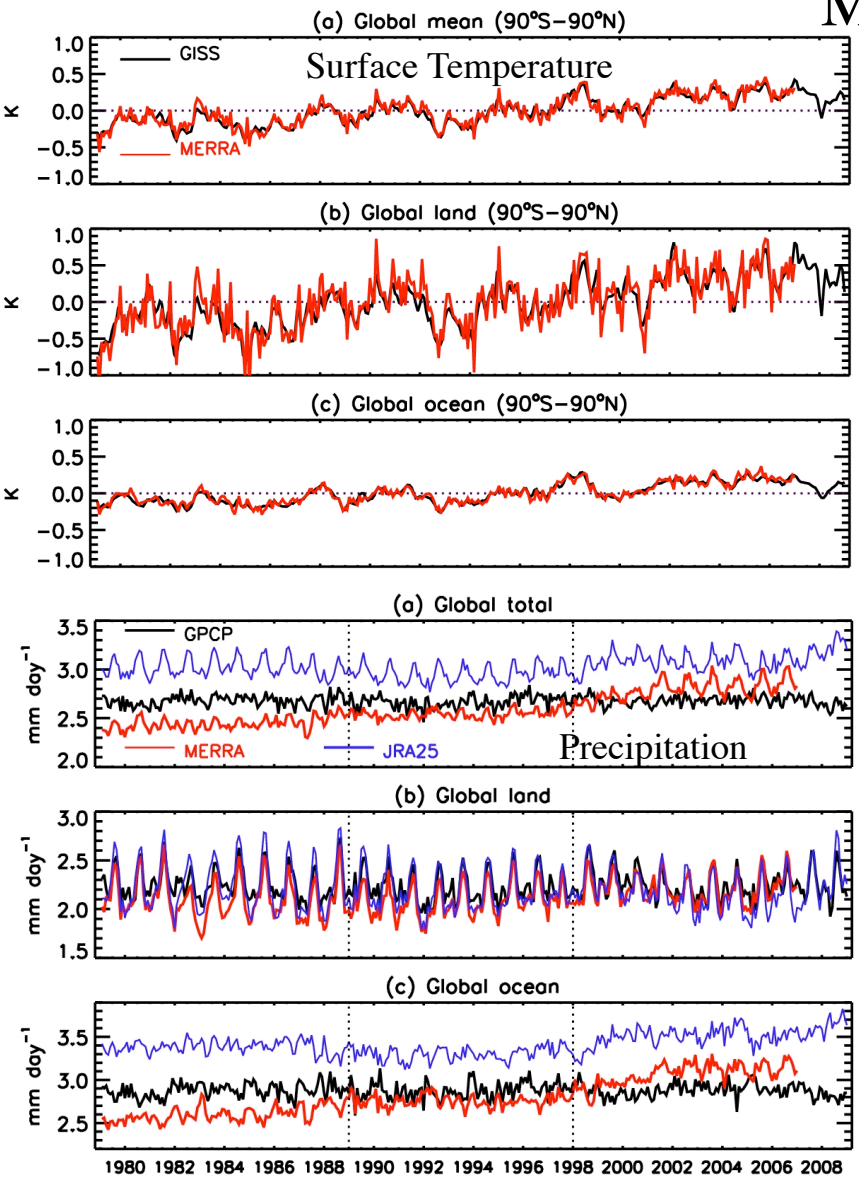
Water vapor (over ocean) has strong ENSO signal and trend—but period after ‘98 nearly flat

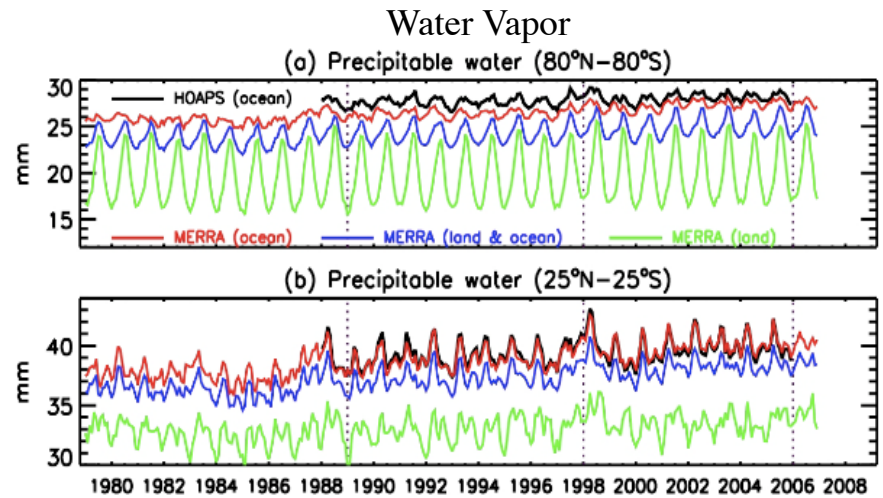
Trends in Zonal Precipitation



Large increase 0-10N, decrease in mid-latitudes, weak signal in S.H.

MERRA!





- MERRA surface temp. follows obs. (both ocean and land), including trends—no surprise
- Water vapor also follows obs. (both land and ocean), including tropical trend—not much of a surprise
- Precipitation a problem, with false ocean trend due to model adjusting to different data sources. Even ocean annual cycle is function of stream. Land precip. "good".
- What MERRA variables can we use as gap filling? Where? When?

Summary and Issues

- Lots of good individual PI driven research—even on integration-type topics.
- Some good starts via Working Groups at larger-than-one-PI-type research.
- Should we, and can we, move toward consensus results? Is that an important element of NEWS? If so, we need to define what are the questions—as a group. (partly already done by Working Groups)
- Climate (Water and Energy Budget) Group has good start (and is probably best example), but still needs to fully integrate to get consensus on means—then on to seasonal, inter-annual and inter-decadal—lots of work!
- Issue 1—What are the major topics/questions to be addressed by Working Groups. Right now that happens in an ad hoc manner. Do we need to be more organized in the definition process?
- Issue 2—Each of us wants and needs to do individual PI research—it's what we are funded for. How do we devote significant time/money to do group work at a meaningful level?

Extremes in Daily Precipitation – Climate is More than Averages

Science issue: Determine recent climatology of extremes in precip as a first step in characterizing the satellite-era record and seeking fluctuations /trends

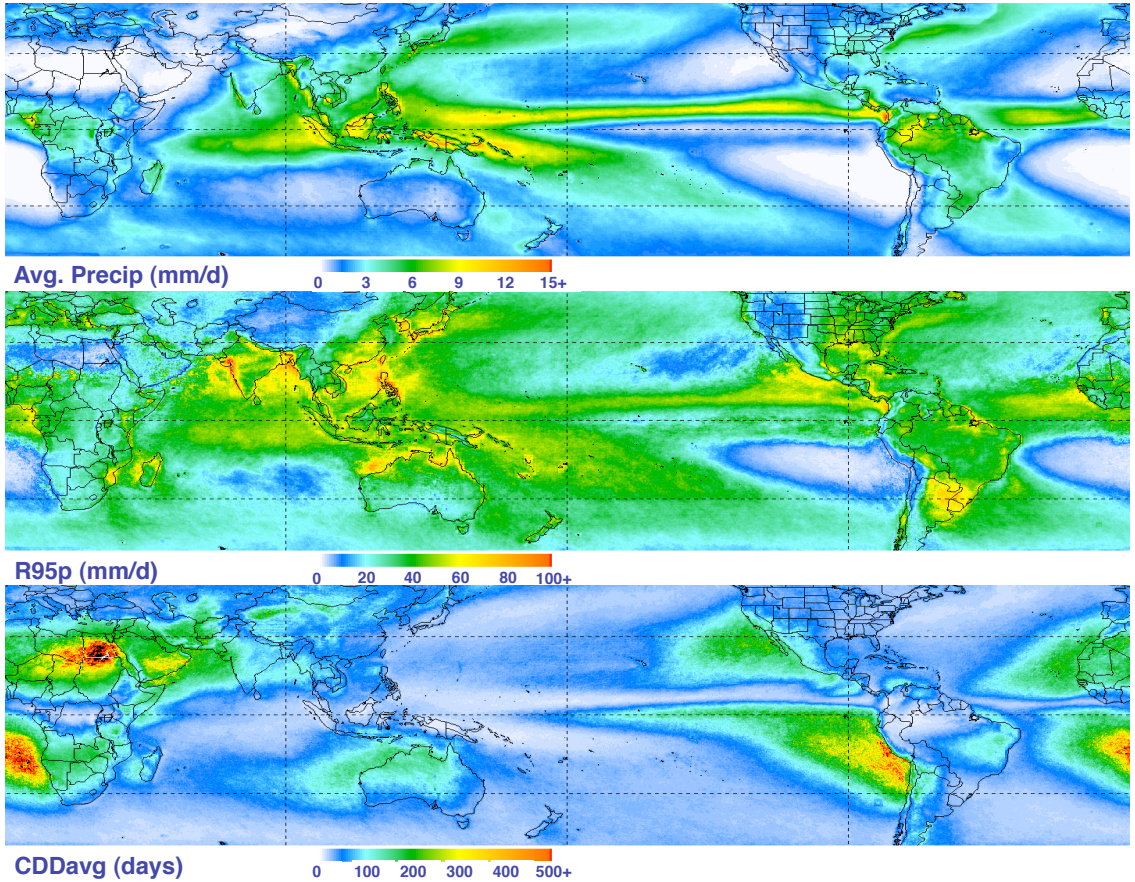
Approach: Test a range of definitions of "extreme" with high quality satellite data sets and gauge validation

Satellite-based data: TRMM Multi-satellite Precipitation Analysis (TMPA) 3-hr data

Project status: With funding by NEWS and PMM, G.J. Huffman (SSAI; GSFC), R.F. Adler (UMD; GSFC)

- Developed 11-year climatologies for several standard "extremes" variables
- Demonstrated reasonable behavior against 6 years of gauge data for various climate zones
- Worked to select stable definitions of "extreme"; generally parameters depending on a few values are less stable than those using more data
- Beginning to examining seasonality of "extremes" parameters

Huffman, G.J., R.F. Adler, D.T. Bolvin, E.J. Nelkin, 2008: Validation and Analysis of Precipitation Extremes in the TMPA. 4th Workshop of the IPWG, 13-17 October 2008, Beijing, China, http://www.isac.cnr.it/~ipwg/meetings/beijing/4th-IPWG-Proceedings-web-March-2009.pdf, 154-161; http://www.isac.cnr.it/~ipwg/meetings/beijing/pres/Huffman.ppt.

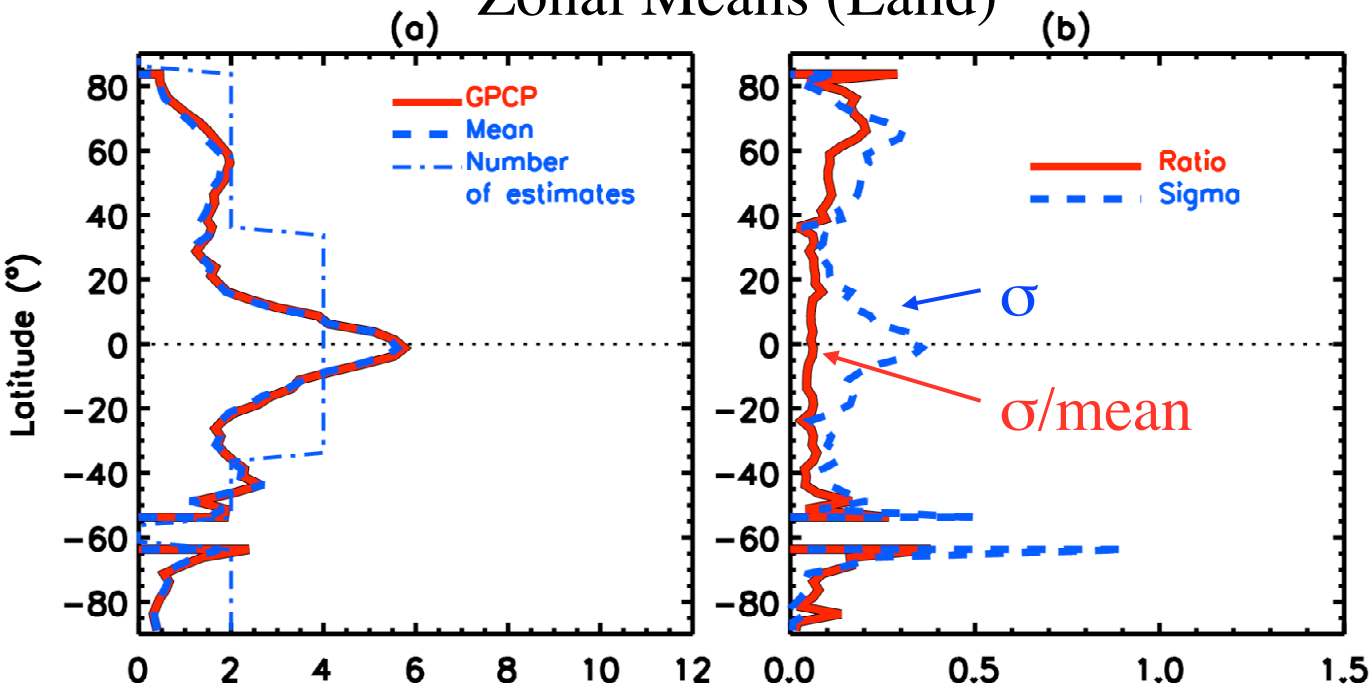


Example "extremes" in daily precip from the TMPA for 1998-2008: rain rate for the 95th percentile (R95p; middle); average longest run of dry days in a year (CDDavg; bottom). Although closely related to the avg. precip (top), there are important and interesting differences, such as the R95p maxima on the southern coast of Mexico and in South America's la Plata basin, and the small CDDavg gradient in the SPCZ.

Method for Global Mean and Bias Error Calculation--Precipitation

- Potential input products: GPCP, CMAP, GPROF (ocean), RSS (ocean), HOAPS (ocean), TRMM [PMW(ocean), Radar (land & ocean), Combined (land & ocean)].
- Selection of products to be included uses a zonal mean test (land and ocean separate) on individual months
- ***GPCP is used as "first guess"; only products with zonal means (for individual months, ocean and land separately) +/- 50% of GPCP are included in remainder of analysis***
- Composite mean is computed and dispersion of products (equate to bias error estimate) is σ among products; assign to GPCP

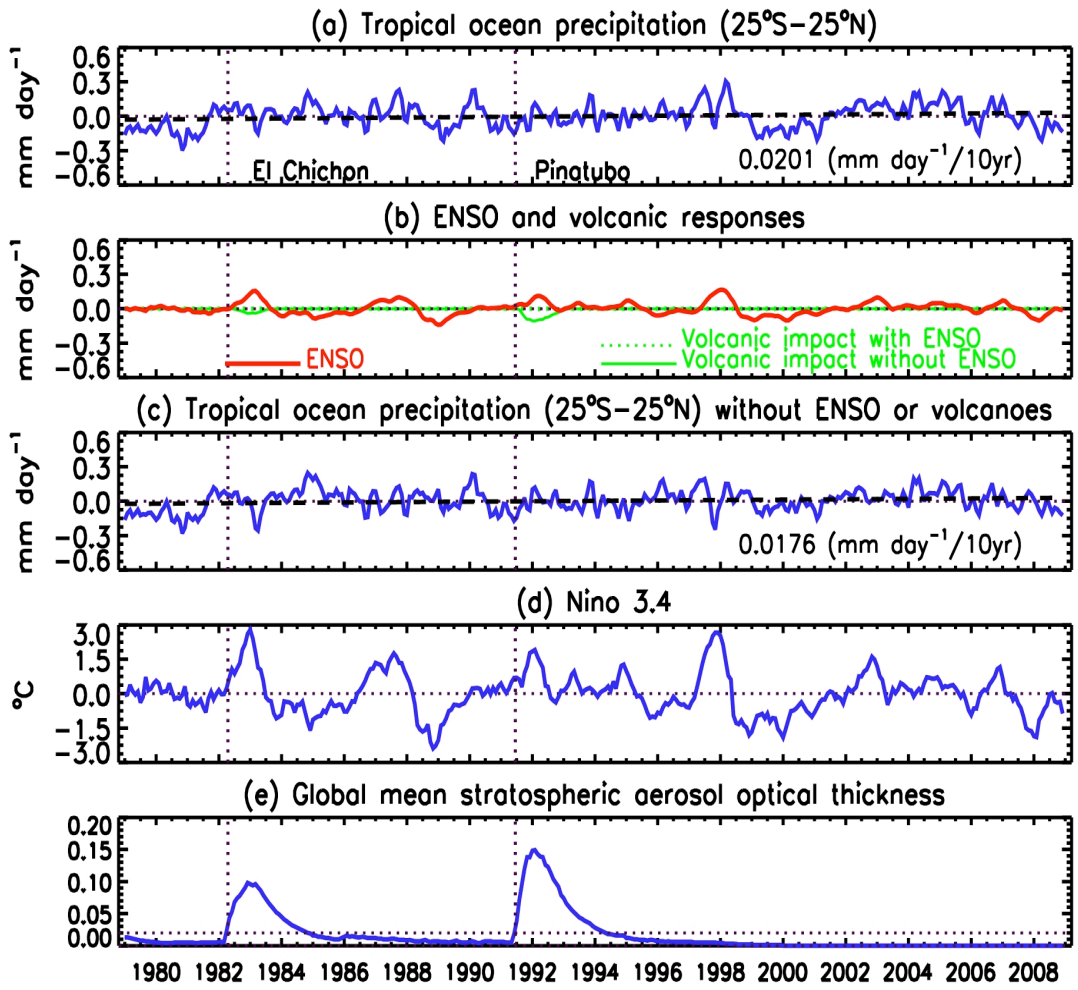
Zonal Means (Land)

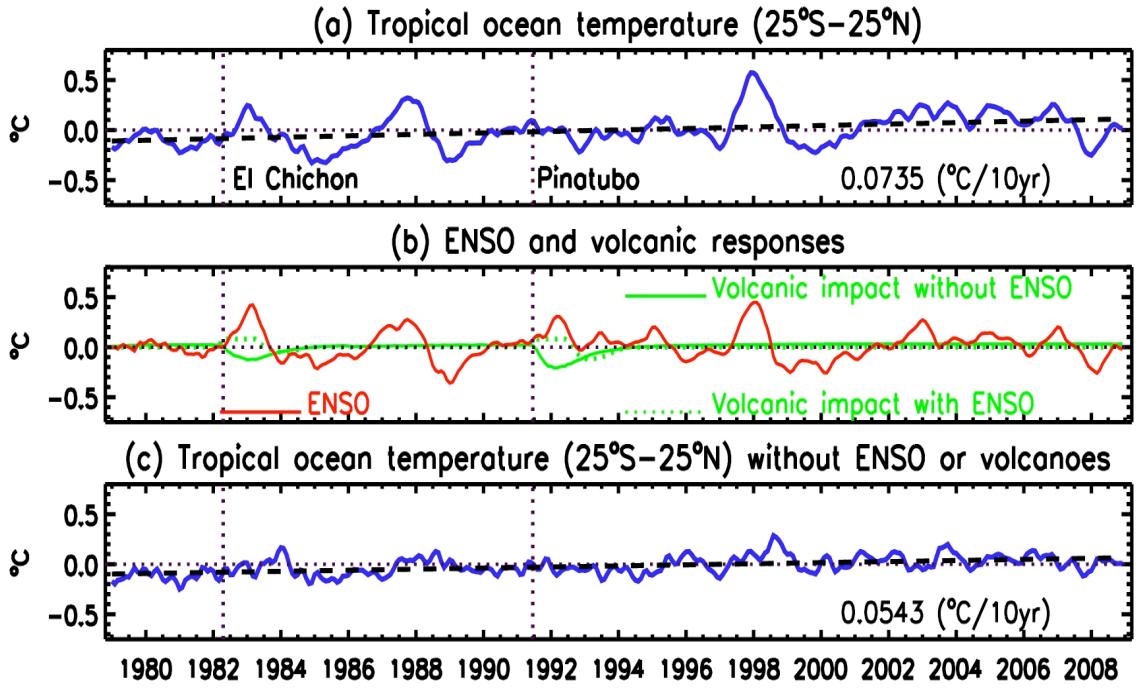


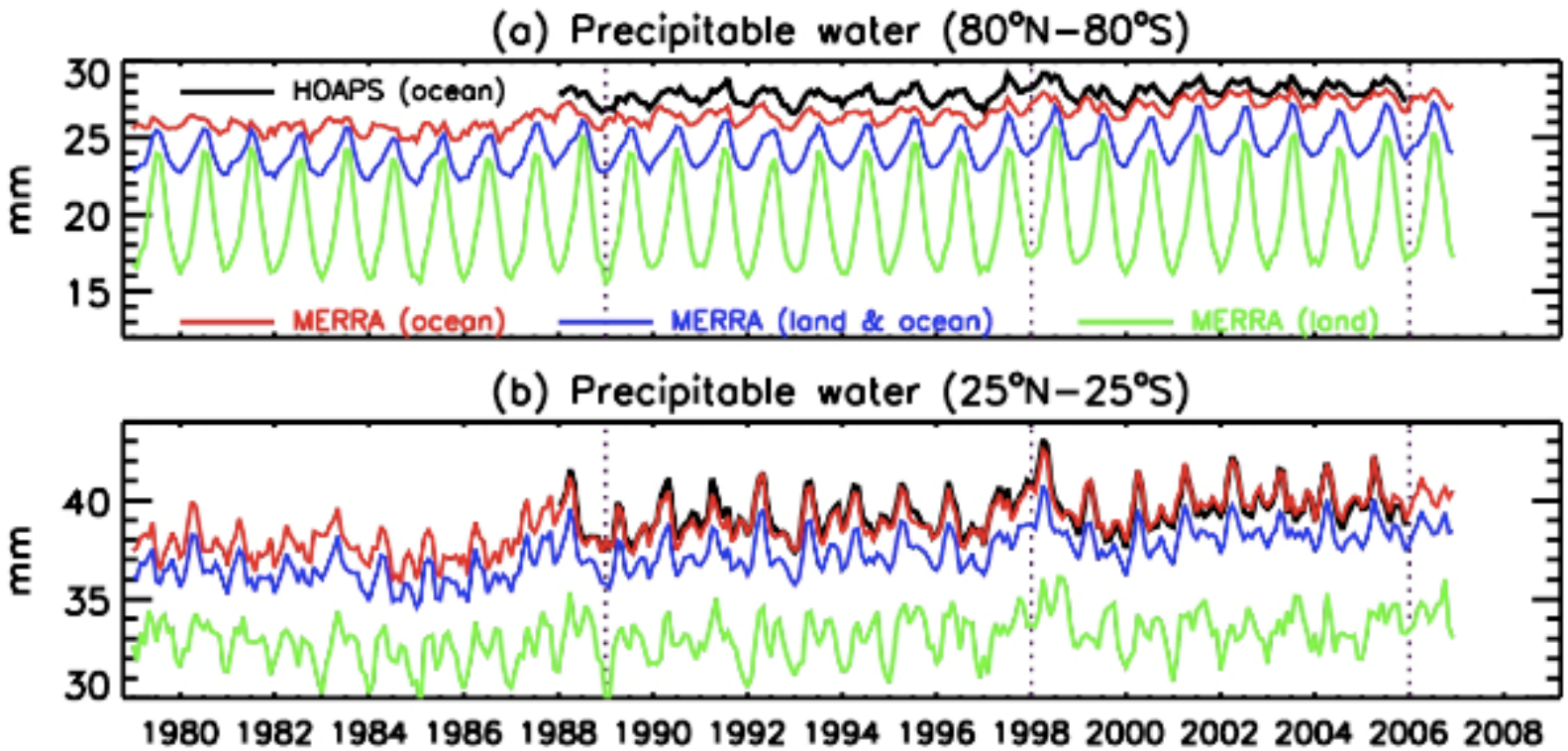
mm/d σ or σ/mean

- GPCP and composite <u>very</u> similar in magnitude at all latitudes-- finer scale variations exist.

- σ higher in mid-latitude for same rain rate; *i.e.*, % bias error larger in mid-latitude (~ 15% at 40-50ºN vs. <10% at 0-15º)


(a) Tropical ocean precipitation (25°S–25°N)
mm day⁻¹
0.6
0.3
0.0
−0.3
−0.6
El Chichon
Pinatubo
0.0201 (mm day⁻¹/10yr)
(b) ENSO and volcanic responses
ENSO
Volcanic impact with ENSO
Volcanic impact without ENSO
(c) Tropical ocean precipitation (25°S–25°N) without ENSO or volcanoes
0.0176 (mm day⁻¹/10yr)
(d) Nino 3.4
°C
3.0
1.5
0.0
−1.5
−3.0
(e) Global mean stratospheric aerosol optical thickness
0.20
0.15
0.10
0.05
0.00
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008


(a) Tropical ocean temperature (25°S–25°N)
°C
0.5
0.0
-0.5
El Chichon
Pinatubo
0.0735 (°C/10yr)
(b) ENSO and volcanic responses
Volcanic impact without ENSO
ENSO
Volcanic impact with ENSO
(c) Tropical ocean temperature (25°S–25°N) without ENSO or volcanoes
0.0543 (°C/10yr)
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008


(a) Precipitable water (80°N–80°S)
HOAPS (ocean)
MERRA (ocean)
MERRA (land & ocean)
MERRA (land)
mm
30
25
20
15
(b) Precipitable water (25°N–25°S)
mm
40
35
30
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008