1 Radar, 8 Reanalyses, 3 Ocean Basins

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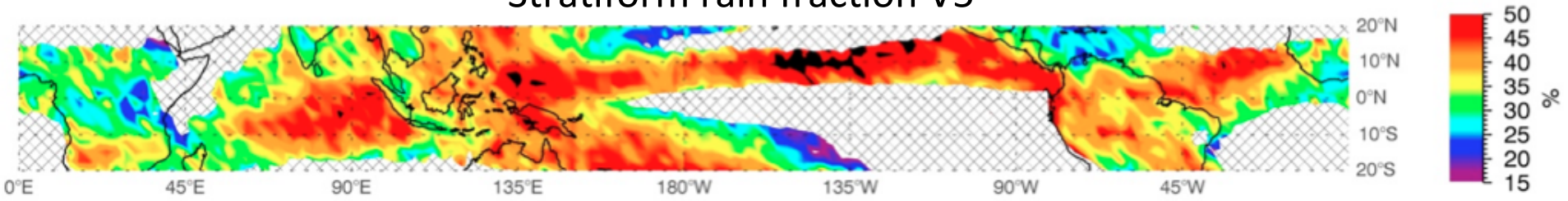
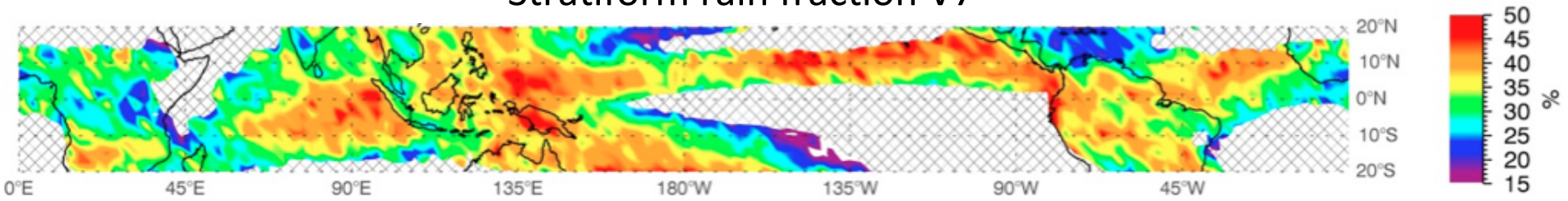
1 radar

Stratiform rain fraction V5



Stratiform rain fraction V7

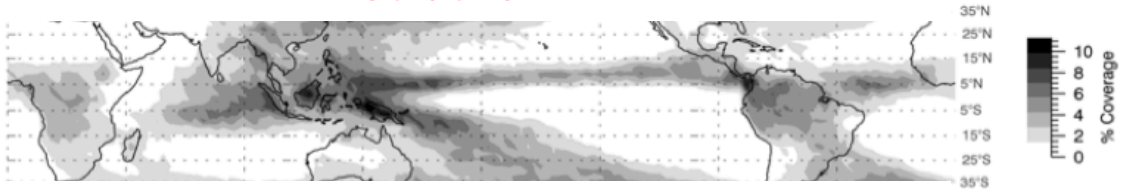


TRM PR tropics-wide (20°N-20°S) stratiform rain fraction decreased from 40 to 38% between V5 and V7 with some geographical variability (e.g., small increases over Africa and other land areas, bigger decreases over ocean esp. in the central Pacific).

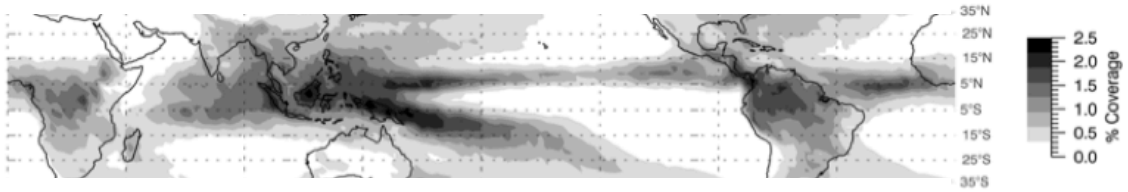
Funk et al. (2013)

V7 rain types

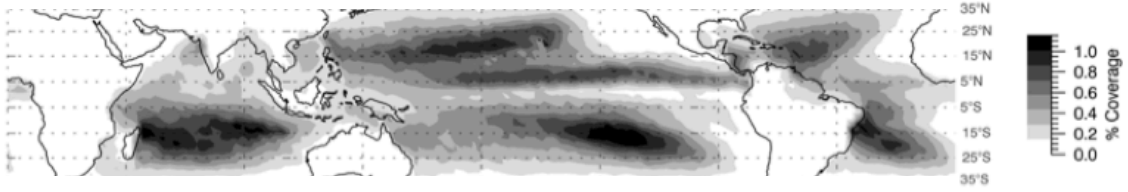
Stratiform



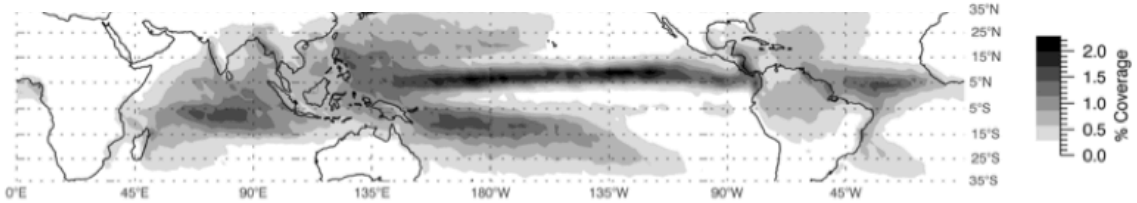
Convective



Shallow, isolated



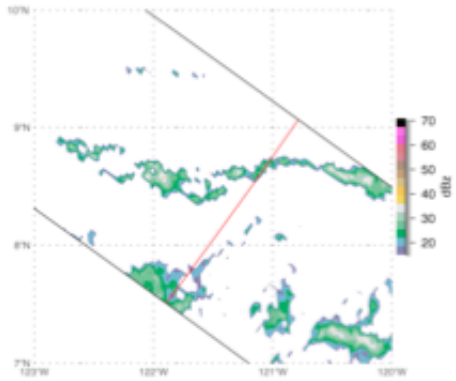
Shallow, non-isolated

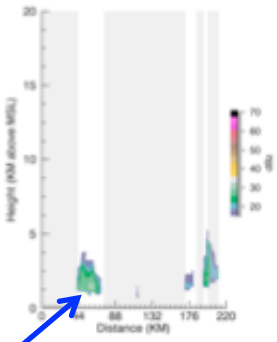


V7 stratiform rain fraction changes over ocean largely due to reclassification of shallow, non-isolated rain (which was introduced in V6) from stratiform to convective.

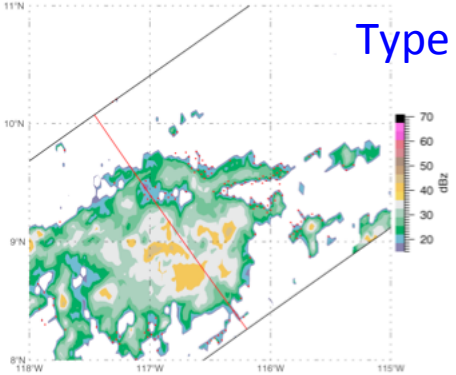
Funk et al. (2013)

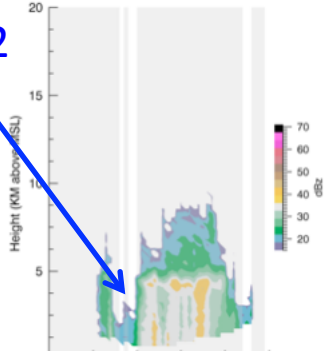
What is shallow, non-isolated?





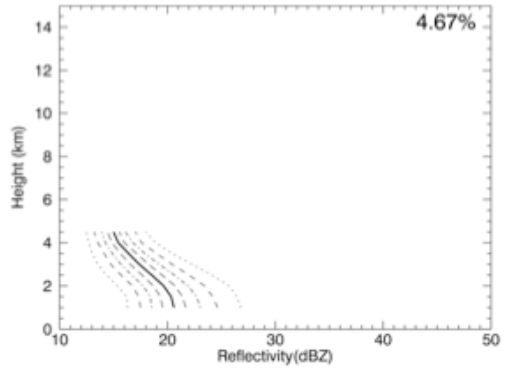
Type 152





Type 292 (Convective)

Type 152 (Stratiform)

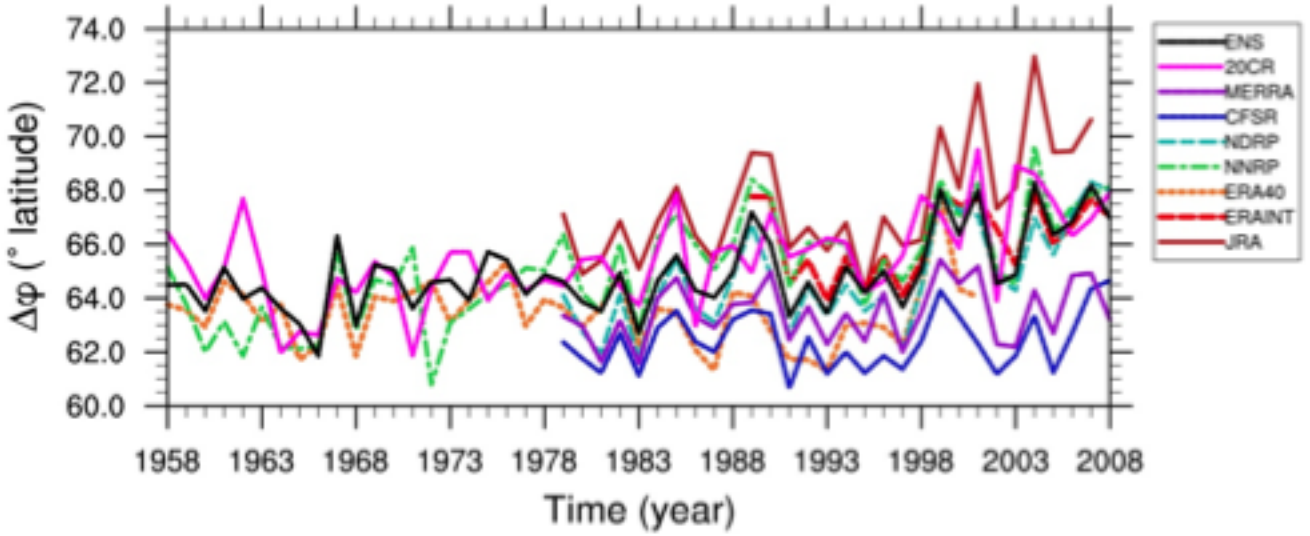


2A23 definition: Echo no higher than 1.5 km below the 0°C level and adjacent to non-shallow echo

Funk et al. (2013)

8 reanalyses

Data Set	Source	Data Range	Resolution	Analysis Output Resolution[a] Horizontal	Pressure	Temporal
JRA	JMA	1979–2007	T106L40	1.125° × 1.125°	23 levels	6-hourly
ERAINT	ECMWF	1989–present	T255L60	1.5° × 1.5°	37 levels	6-hourly
ERA40	ECMWF	1957–2002	T159L60	2.5° × 2.5°	23 levels	6-hourly
NNRP	NCEP/NCAR	1958–present	T62L28	2.5° × 2.5°[b]	17 levels	6-hourly
NDRP	NCEP/DOE	1979–2008	T62L28	2.5° × 2.5°[b]	17 levels	6-hourly
CFSR	NCEP	1979–present	T382L64	0.5° × 0.5°	37 levels	1-hourly
MERRA	NASA	1979–present	2/3° × 1/2°, L60	2/3° × 1/2°[c]	42 levels	3-hourly[d]
20CR	NOAA/CIRES	1871–2008	T62L28	2.0° × 2.0°[b]	24 levels	6-hourly



Hadley cell width trends depend on period and data set.

Stachnik and Schumacher (2011)

3 ocean basins

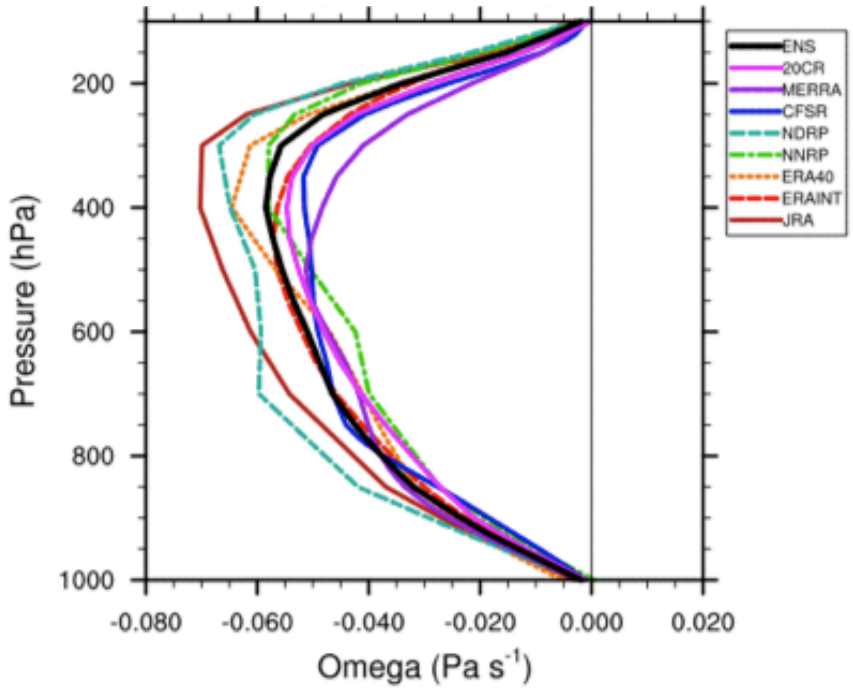
- **Pacific Ocean:** Delineate the impact of shallow convection on the east-west differences of the large-scale circulation in the Pacific Ocean and how this varies during El Niño

- **Indian Ocean:** Quantify the moisture pathways that help initiate and propagate MJO convection in the Indian Ocean

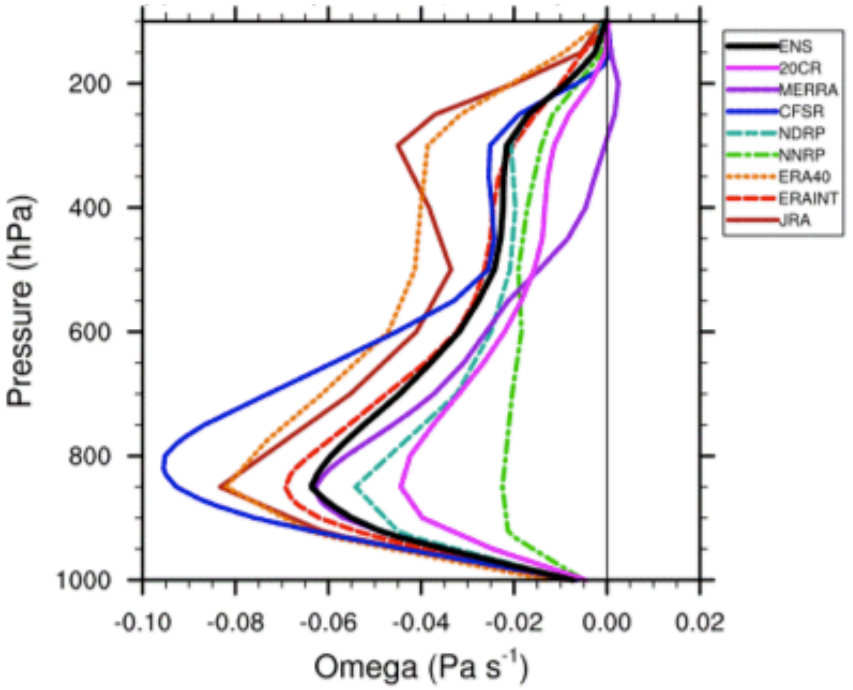
- **Atlantic Ocean:** Determine the role of Amazonian precipitation and deep convective heating on the strength of the Atlantic Ocean surface wind and SSTs

Pacific Ocean vertical motion

West Pacific



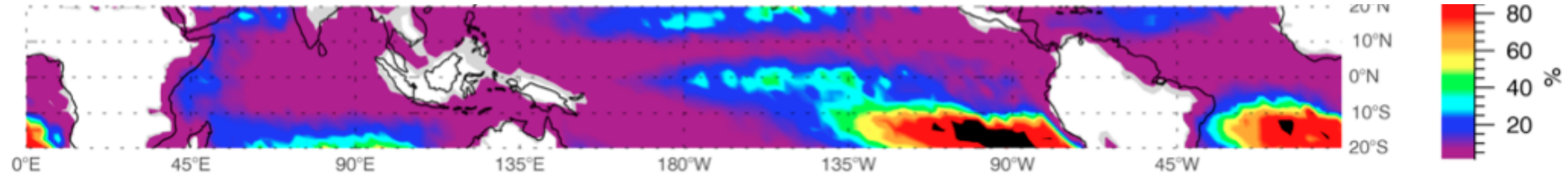
East Pacific



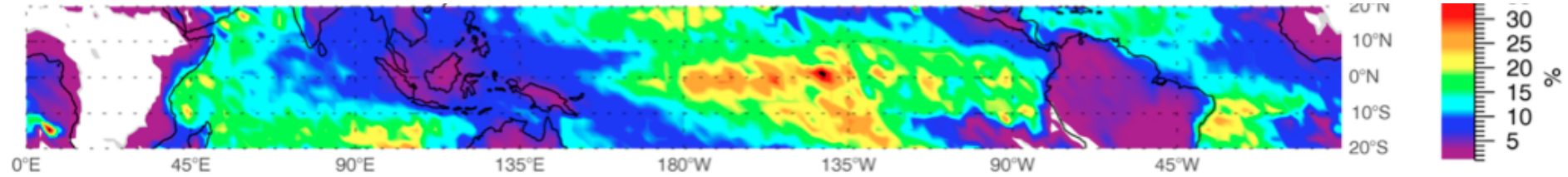
Reanalyses show top-heavy vertical motion in west Pacific and bottom-heavy vertical motion in east Pacific (with more variability in east Pacific), even though stratiform rain fraction is similar.

Role of shallow convective clouds?

Shallow, isolated rain fraction

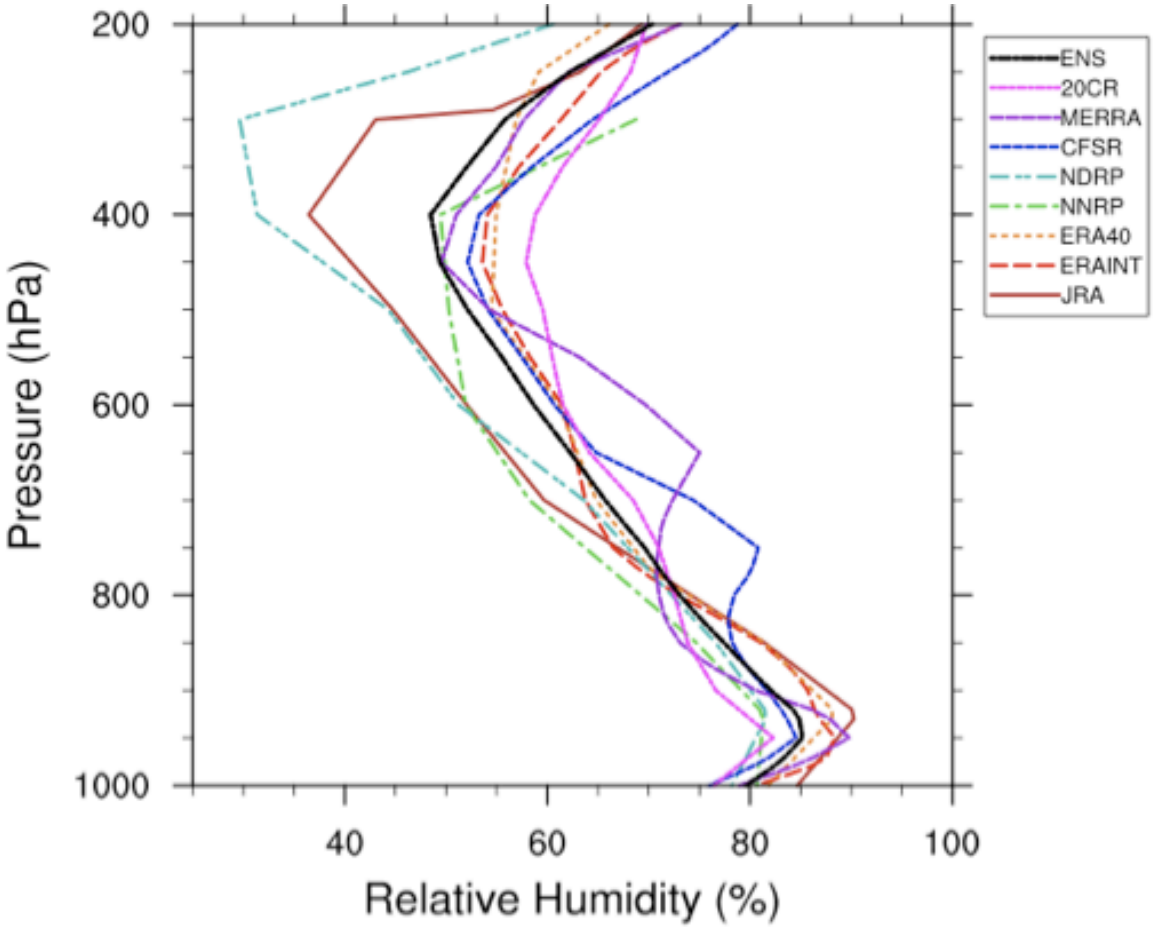


Shallow, non-isolated rain fraction



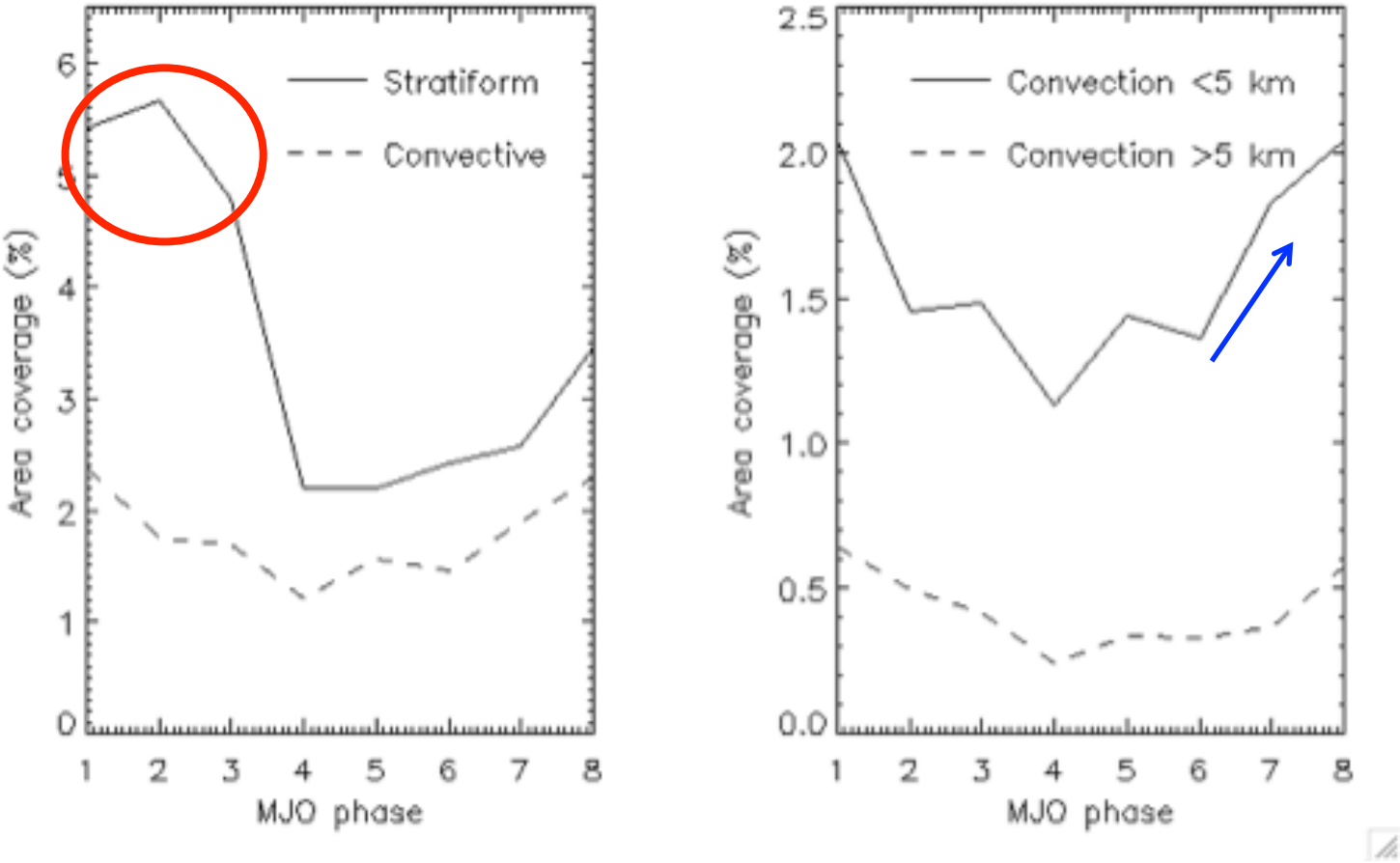
How does shallow convection (esp. non-isolated) over central and east Pacific relate to the low-level vertical motion maxima seen in reanalyses? How does this relation change during El Niño?

Indian Ocean relative humidity



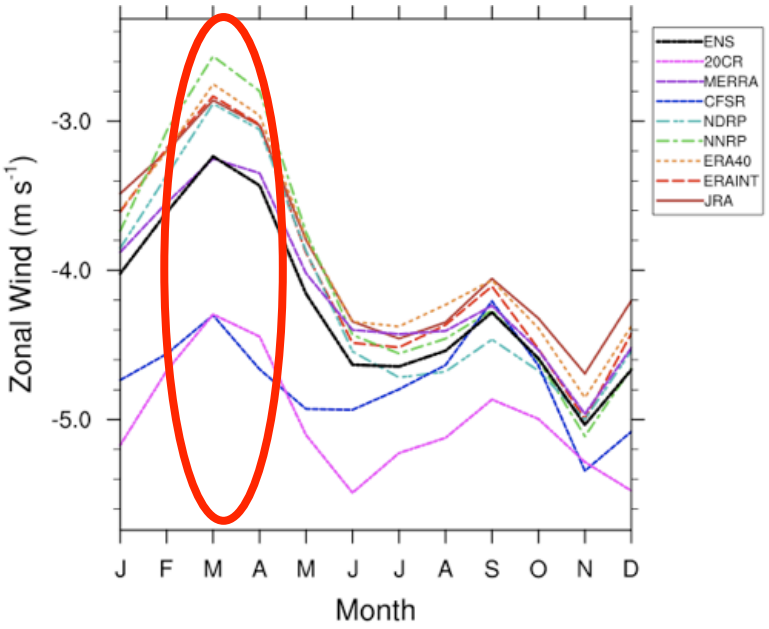
MJO initiation is thought to be dependent on mid-level relative humidity, however, reanalyses show large variations above BL.

Role of shallow-to-deep transition?

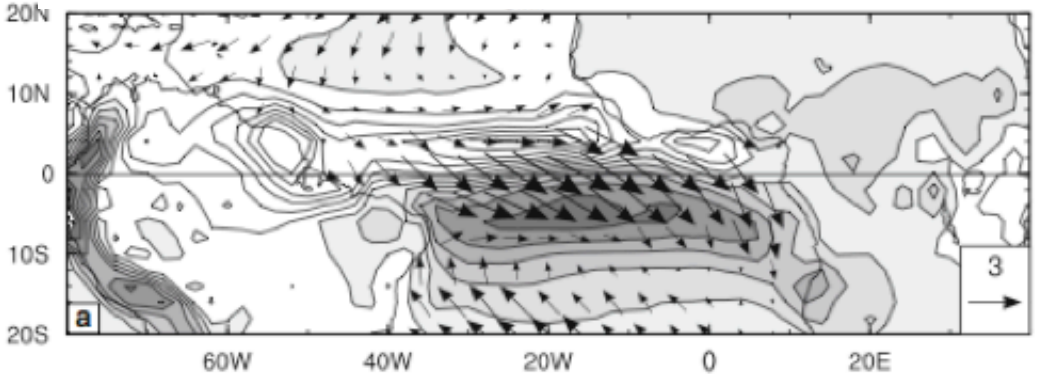


MJO active over Indian Ocean in phases 1-3. PR convection < 5 km ramps up a phase earlier than convection > 5 km before active MJO.

Atlantic Ocean surface winds



CMIP MAM wind and precip biases



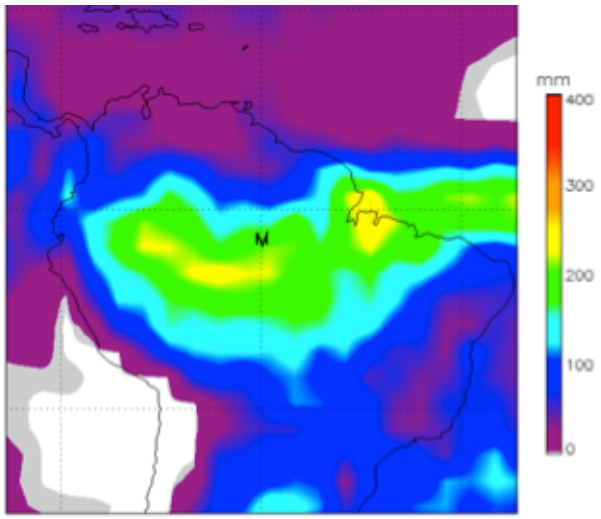
Richter and Xie (2008)

Reanalyses show surface easterlies over the Atlantic, but IPCC coupled (and to a lesser extent uncoupled) models show westerly bias on the order of the surface wind magnitude.

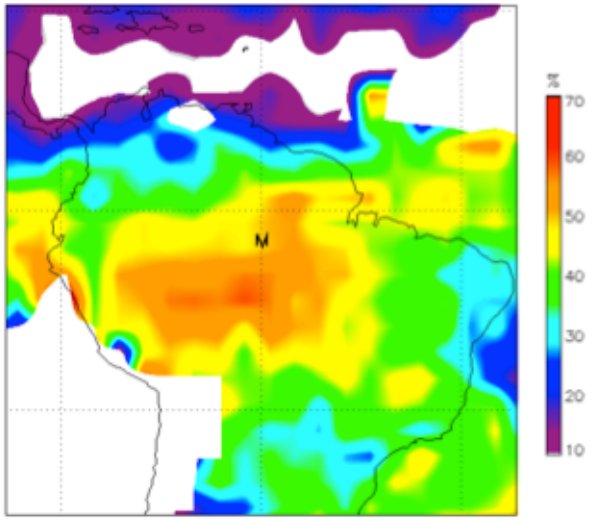
Role of Amazon precip/latent heating?

February and March

PR monthly rainfall



PR stratiform rain fraction



A dry bias in Amazonian rainfall is postulated to cause models to have a weaker Walker circulation and thus weaker trade winds.

DOE/Brazilian/German field deployment is planned in the central Amazon 2014-15 to examine aerosol-cloud-precipitation interactions (**GOAmazon**, ACRIDICON) and GPM validation (CHUVA).

Wrap-up

- 1 radar: The TRMM PR tropics-wide stratiform rain fraction has decreased to < 40 % largely because of the reclassification of shallow, non-isolated echo that shows a maximum in the Pacific ITCZ
- 8 reanalyses: A number of new reanalyses exist to explore the relationship between TRMM-observed convection and the large-scale circulation
- 3 oceans: Interesting questions abound over the data sparse tropical oceans including differences in E/W Pacific convection and large-scale omega, MJO initiation over the Indian Ocean and large-scale moisture, and Atlantic wind and SST GCM biases and their link to Amazonian heating