

Some features of the diurnal cycle over the tropical Pacific

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Why the diurnal cycle?

Model Development & Testing:

- fundamental, forced mode of variability (Yang & Slingo 2001)

Model Evaluation:

- persistent model biases (e.g., double ITCZ)

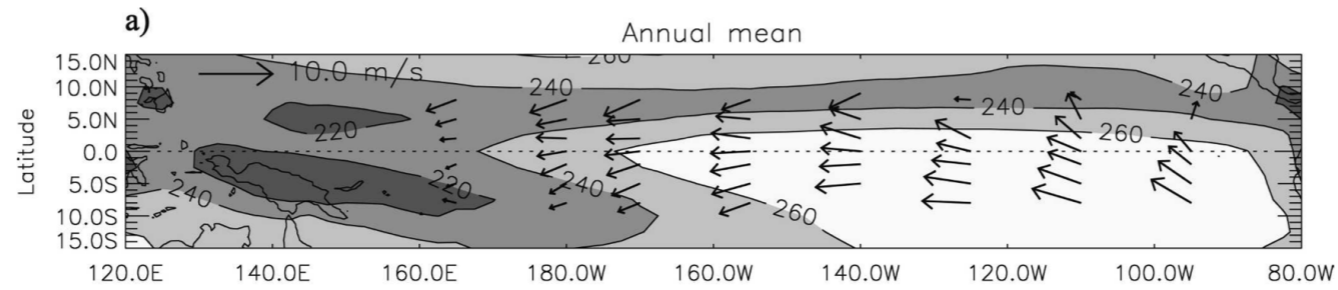
Develop understanding

- Some features of diurnal variability are not fully understood
 - ❖ *“Away from the influence of continents, the cause for the observed diurnal cycle of precipitation over the open ocean remains debatable, not well known, and currently under discussion.” -Nesbitt & Zipser, 2003*
- spatial pattern of v wind diurnal cycle (Deser & Smith, Ueyama & Deser)

Questions

- Does CAM5 produce a reasonable diurnal cycle of winds & convection?
- Are the diurnal cycle of winds and convection linked? (toward Stevens & Bony 2013)

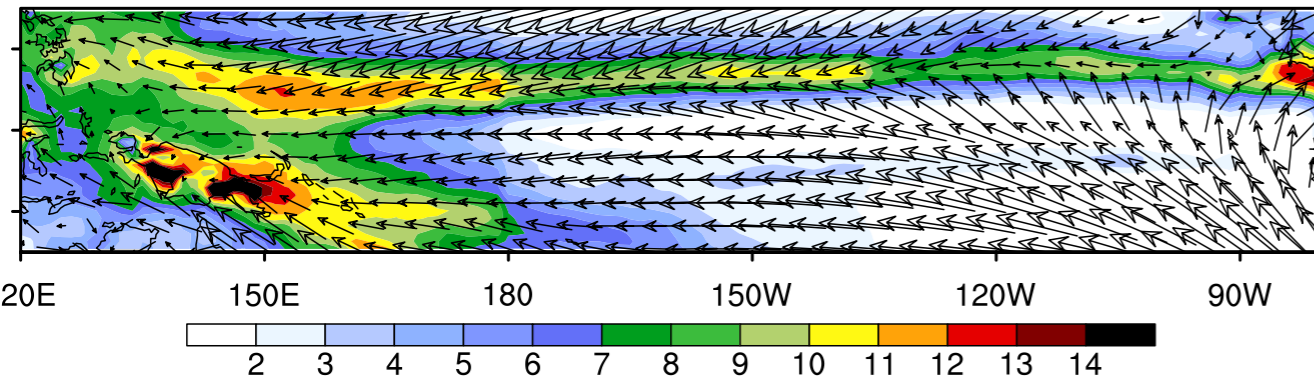
Mean wind



TAO bouys, Ueyama & Deser 2008

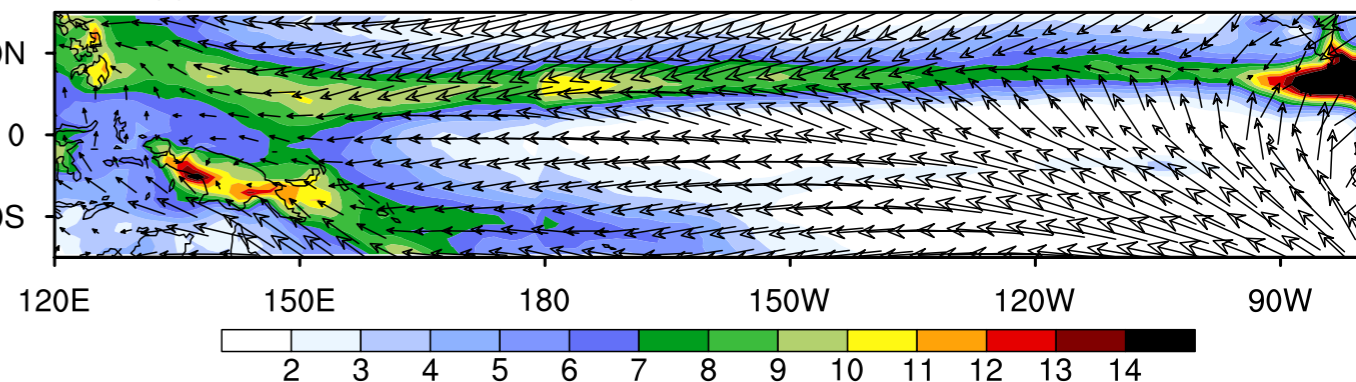
WIND993

LOCAL TIME: 00



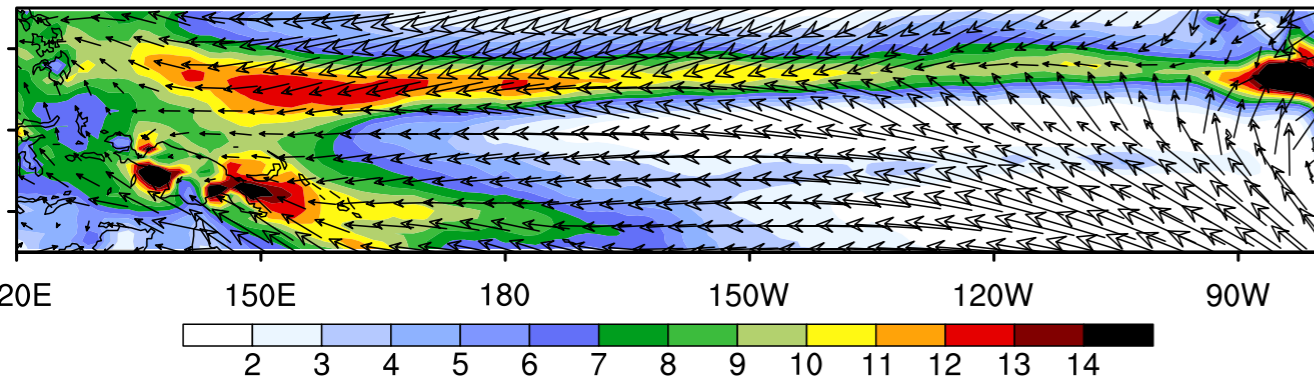
WIND993

LOCAL TIME: 12



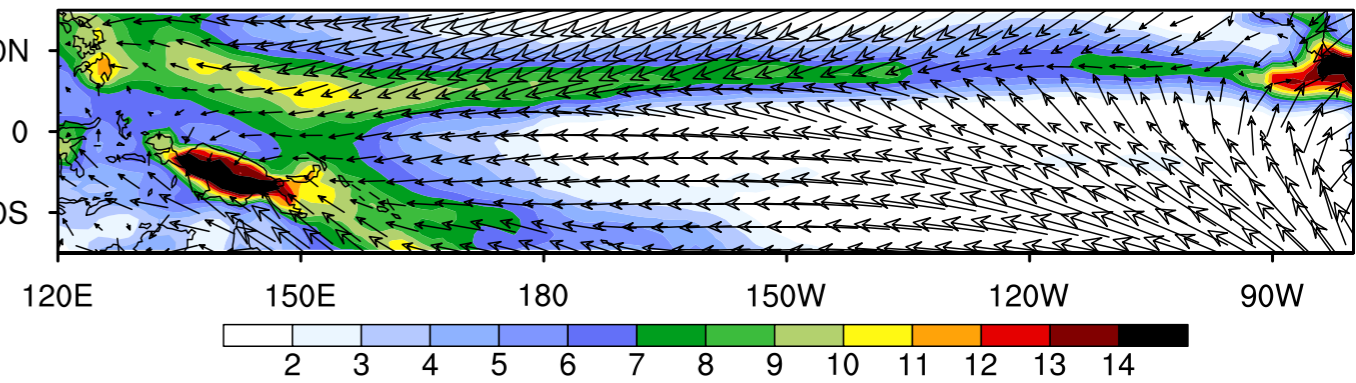
WIND993

LOCAL TIME: 06



WIND993

LOCAL TIME: 18



The ~~boring~~ *exciting* & important details

SIMULATIONS

- ▶ CAM5 1deg FV
- ▶ CAPT hindcasts — approximately follows Transpose AMIP II protocol
 - ❖ *4 sets of 20 5-day hindcasts that start at 0UTC each day*
- ▶ SST is daily — no diurnal cycle.

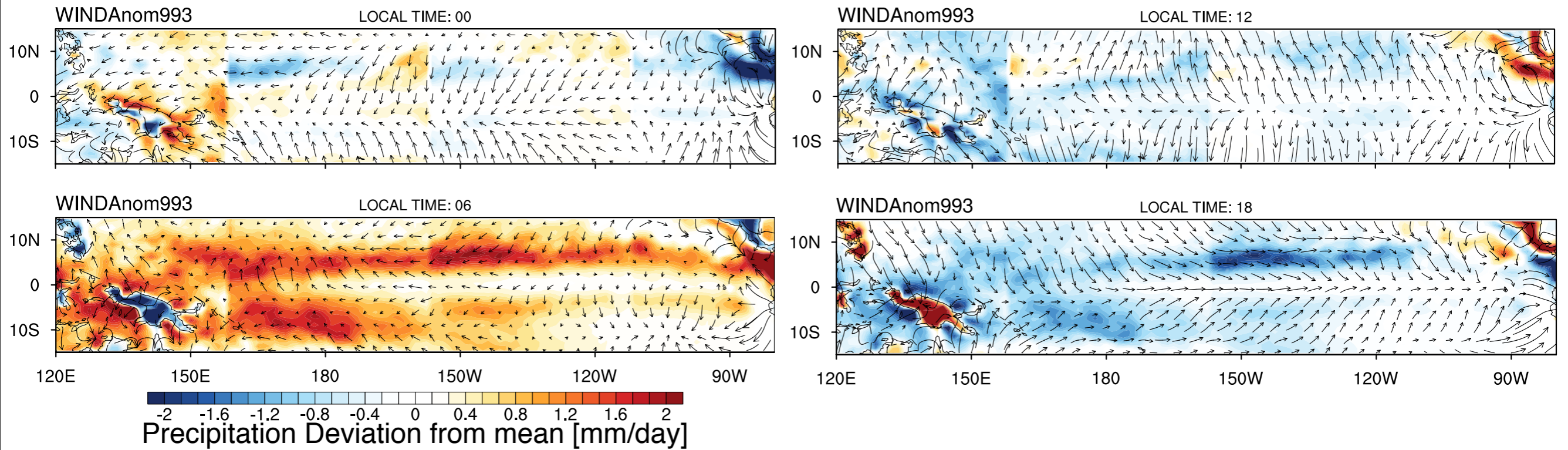
DATA

- ▶ State variables saved hourly. Others 3-hourly averages.
- ▶ About 1.4TB all said.
- ▶ Post processed into ensemble mean hindcast for each “season”

SAMPLING

- ▶ 3-hourly averages “resolve” the diurnal cycle, but require averaging/binning when converting to local time (for maps this can look like artifacts)

Deviation from mean wind through the day



Amplitude & Phase at TAO locations

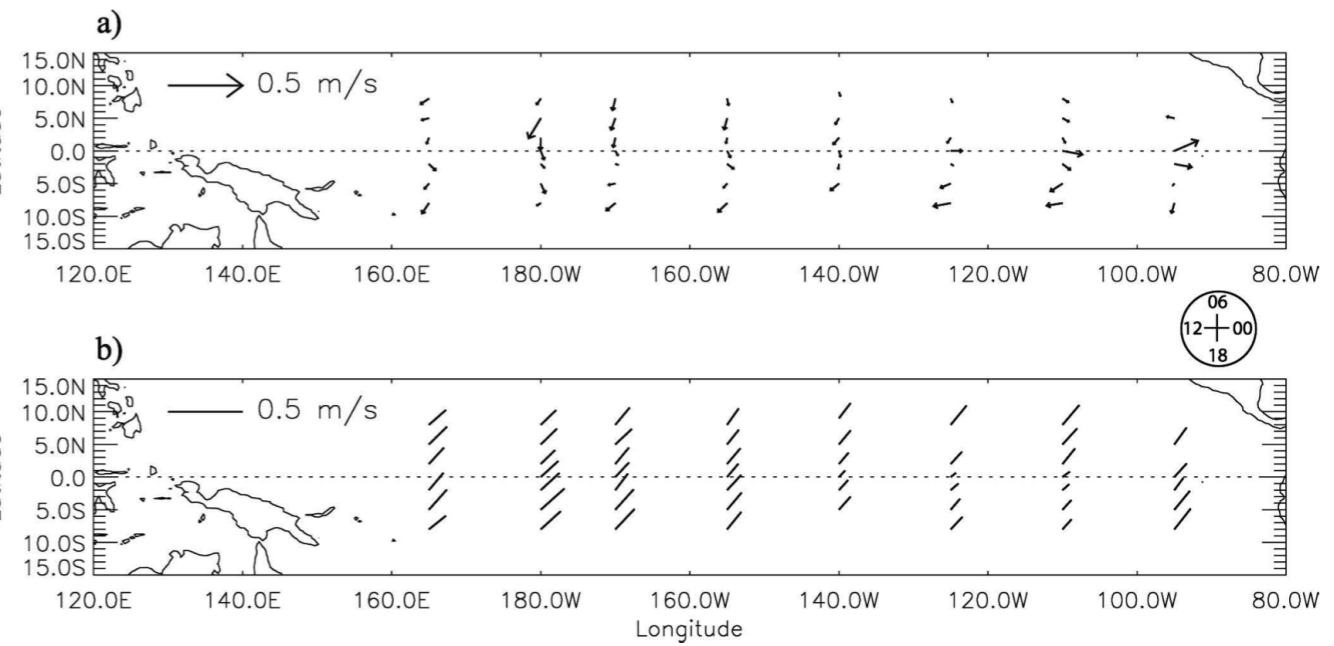
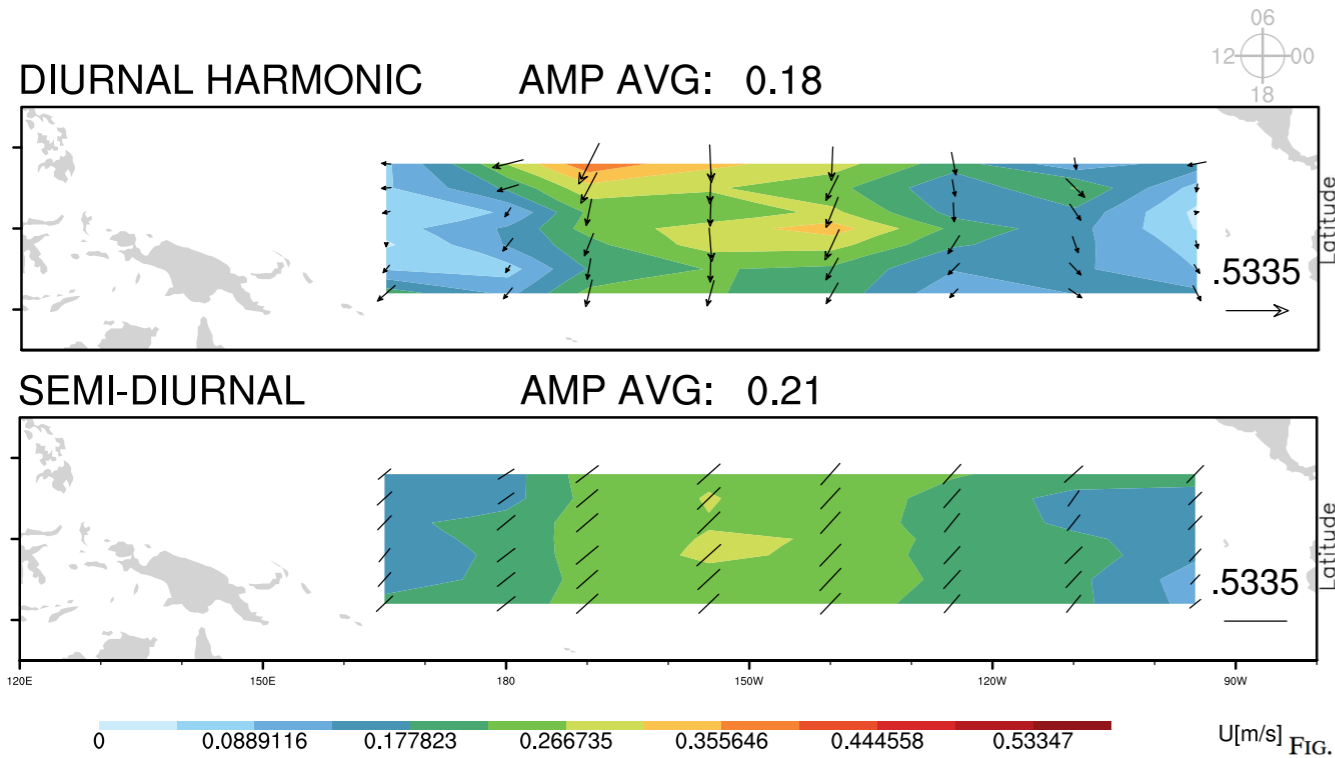
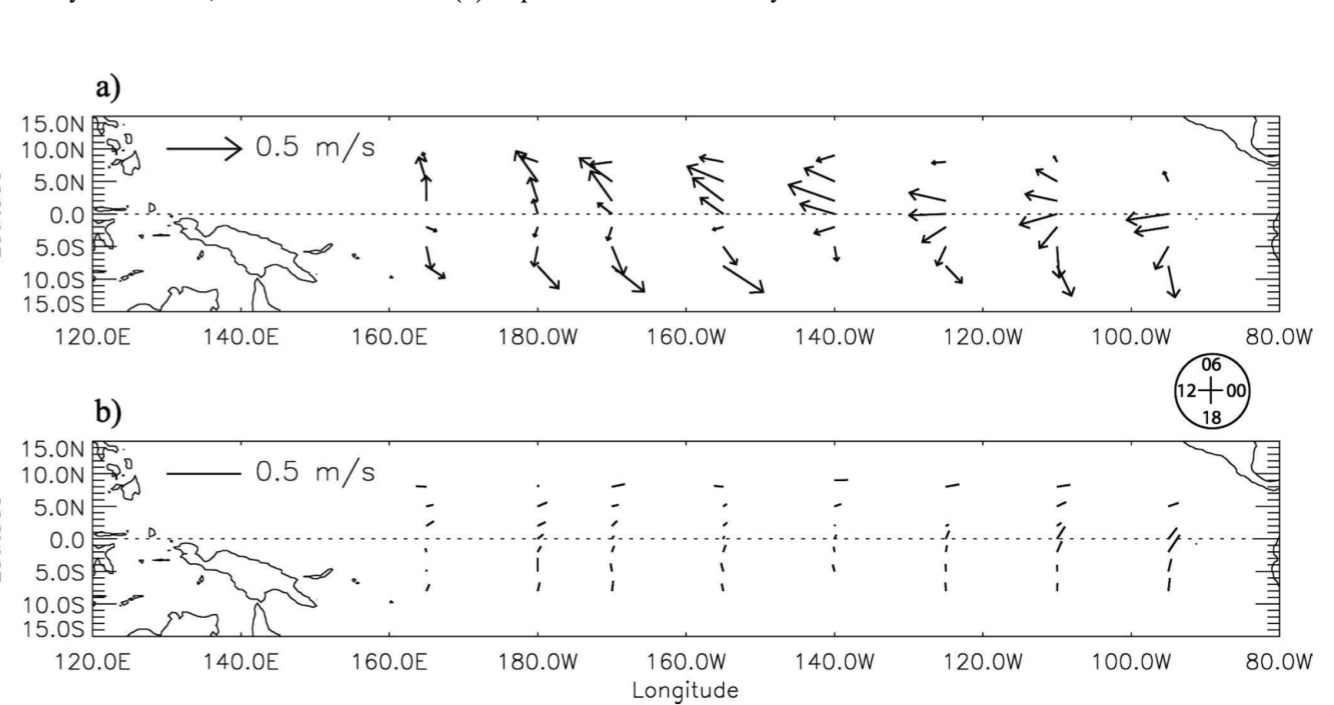
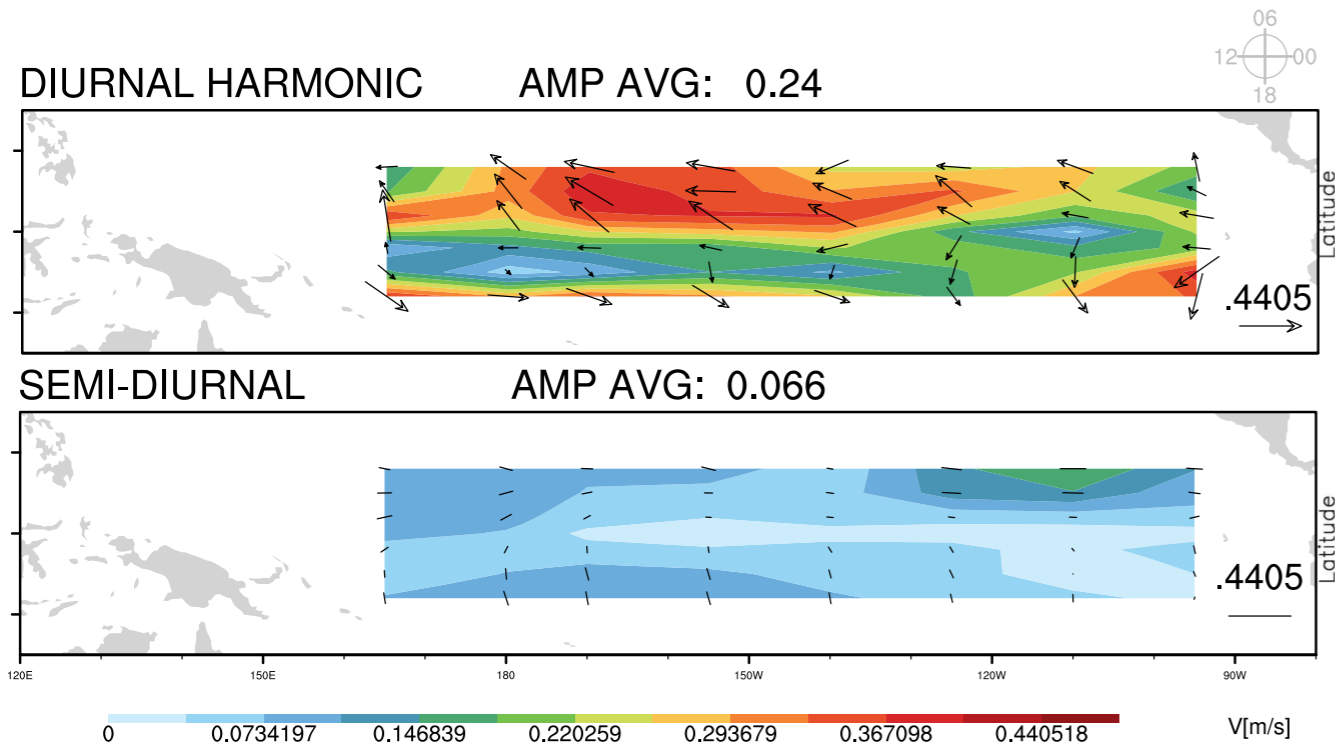
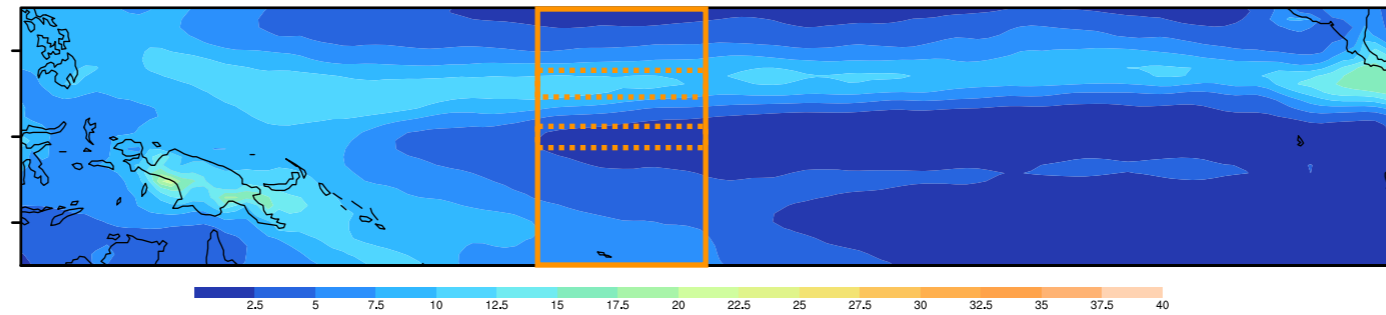


FIG. 2. Annual mean amplitudes and phases of the (a) diurnal and (b) semidiurnal harmonics of the zonal wind. The length of each vector represents amplitude of the corresponding harmonic (scale at top-left corner of both panels) and the direction represents the LT of maximum westerly wind anomaly (clock at middle right). For example, an arrow pointing due north in (a) implies maximum westerly wind anomaly at 0600 LT, and a vertical bar in (b) implies maximum westerly wind anomalies at 0600 and 1800 LT.

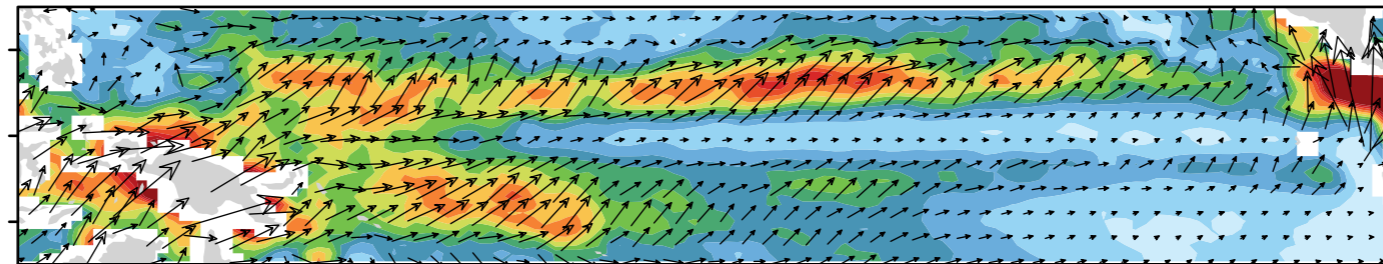


Precipitation

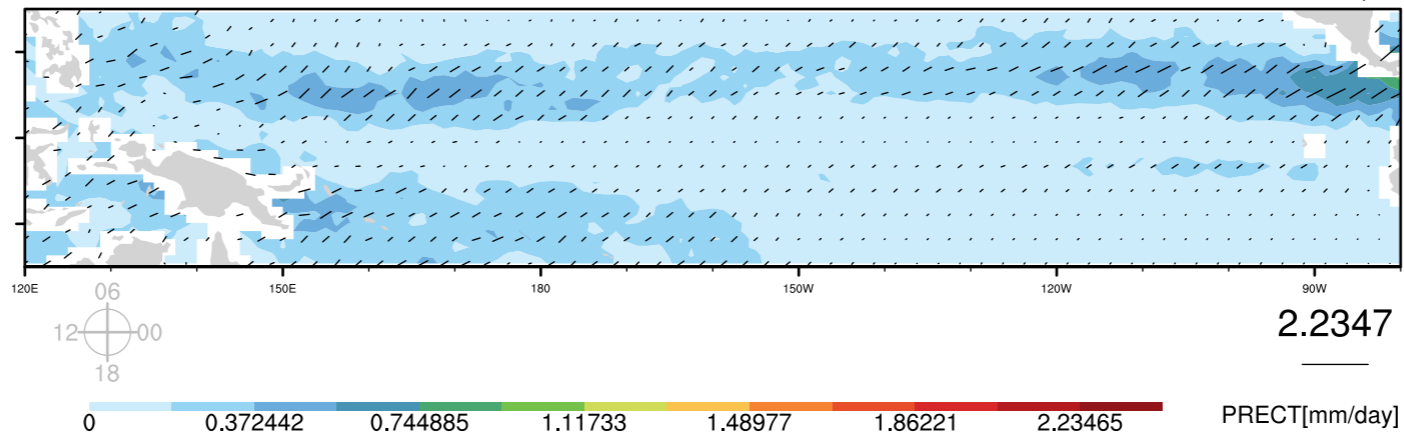
MEAN PRECIPITATION [DOMAIN AVG: 5.2 mm/day]



DIURNAL HARMONIC AMP AVG: 0.8

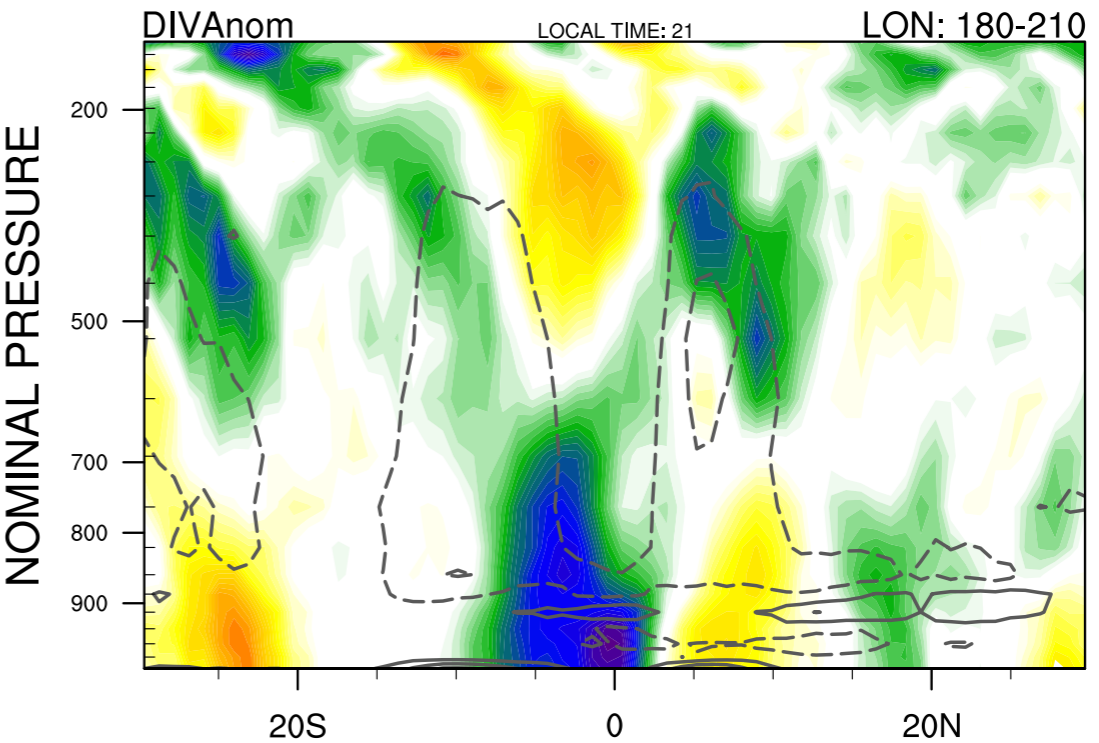
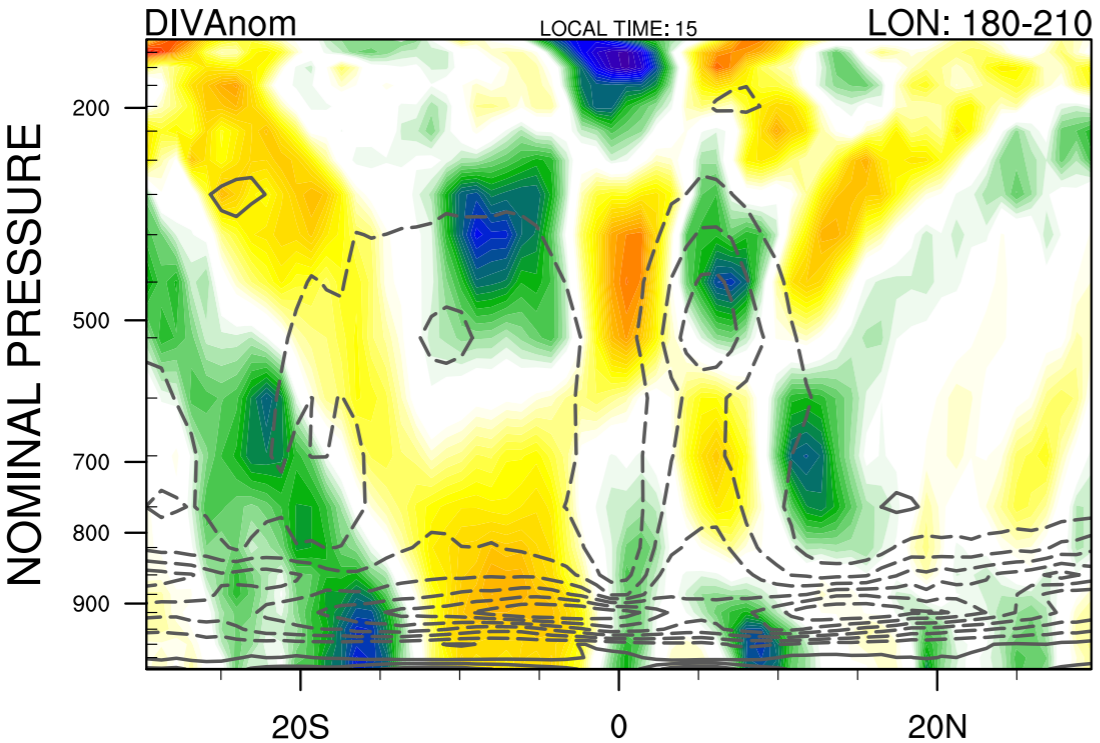
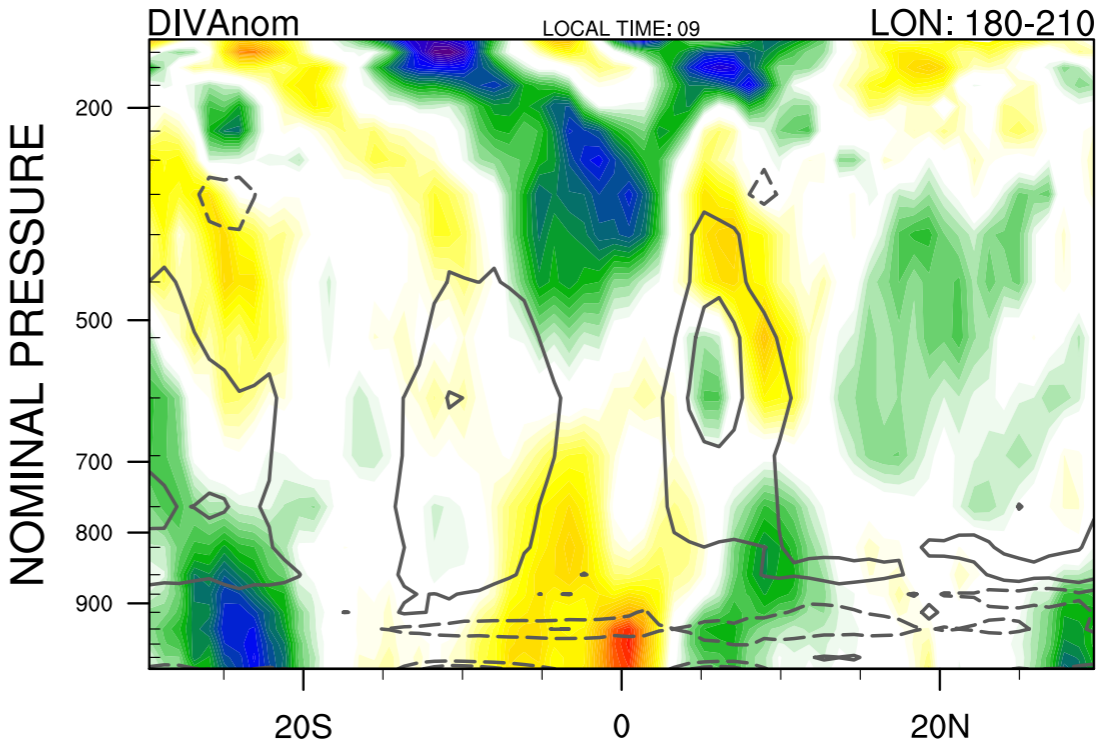
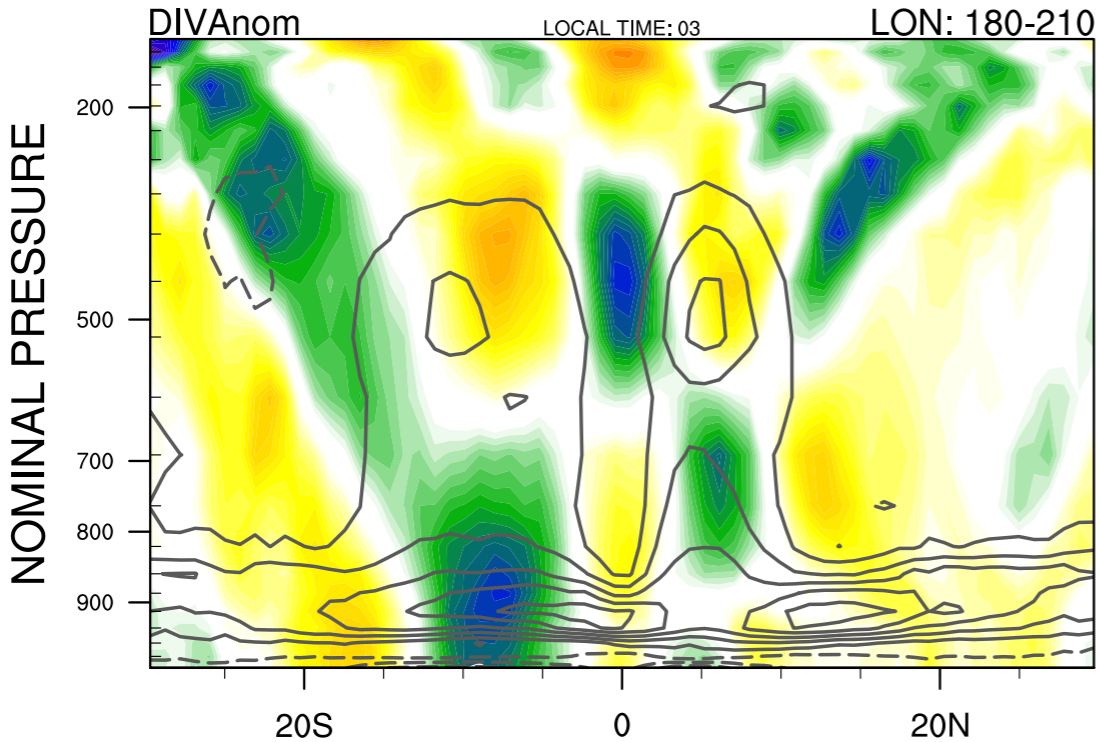


SEMI-DIURNAL AMP AVG: 0.18



PRECIP[mm/day]

Divergence & moist-physics heating



LATITUDE

LATITUDE

CONTOUR FROM -1.5 TO 1.5 BY .273

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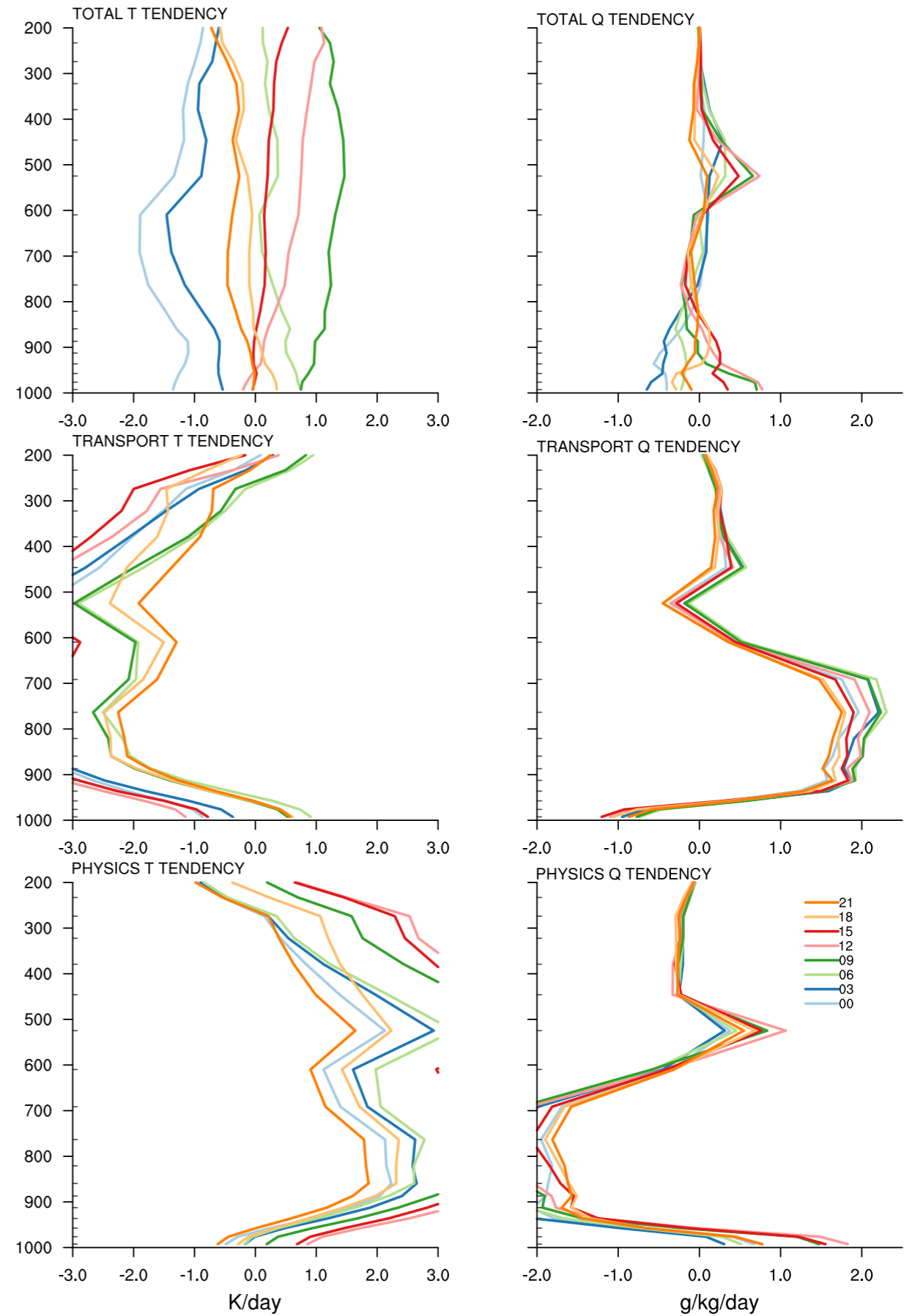
-0.096 -0.064 -0.032 0 0.032 0.064 0.096 [10e5 X 1/s]

-0.096 -0.064 -0.032 0 0.032 0.064 0.096 [10e5 X 1/s]

T & Q tendencies

IN ITCZ

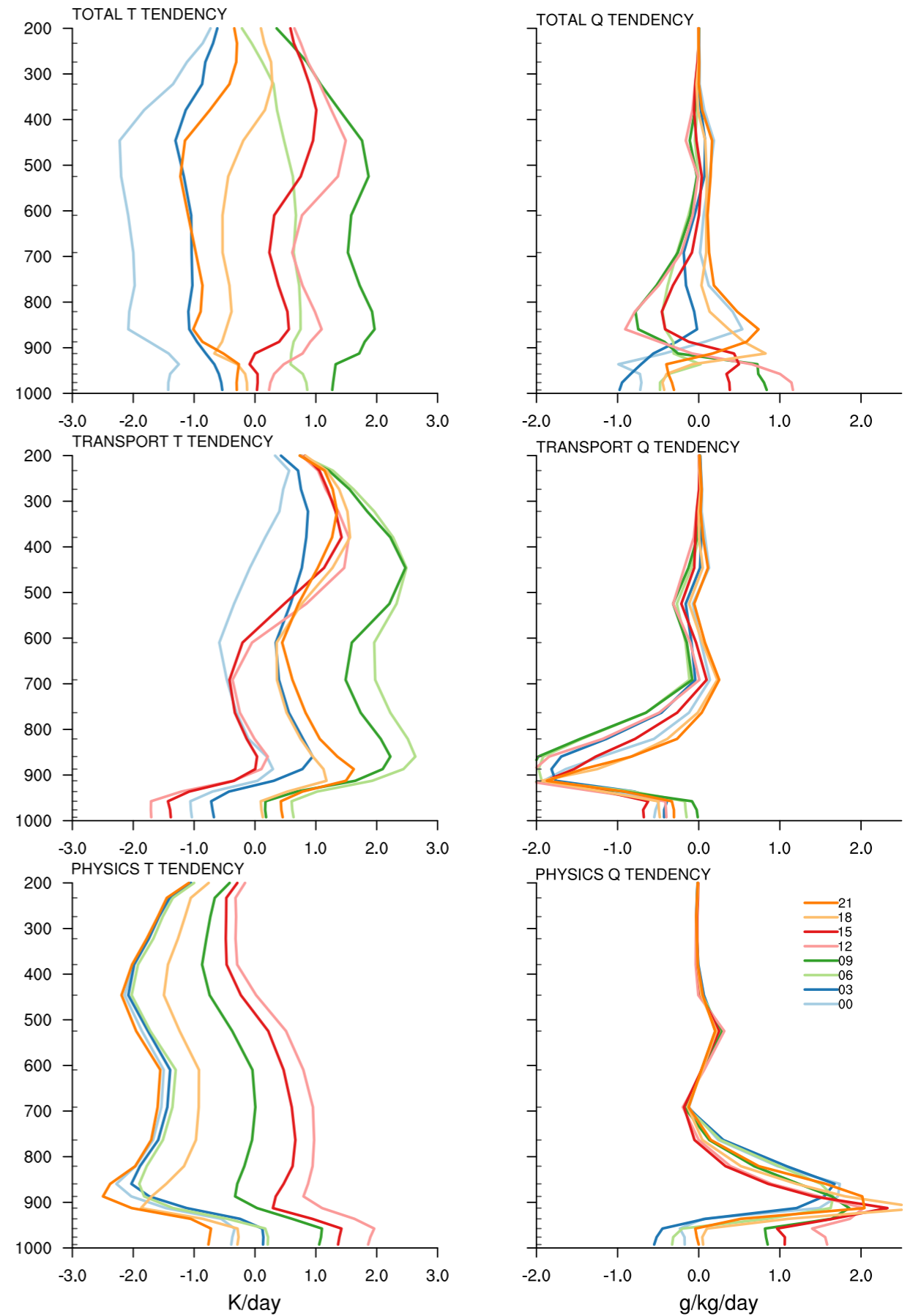
5n8n_180e200e



T & Q tendencies

ON EQUATOR

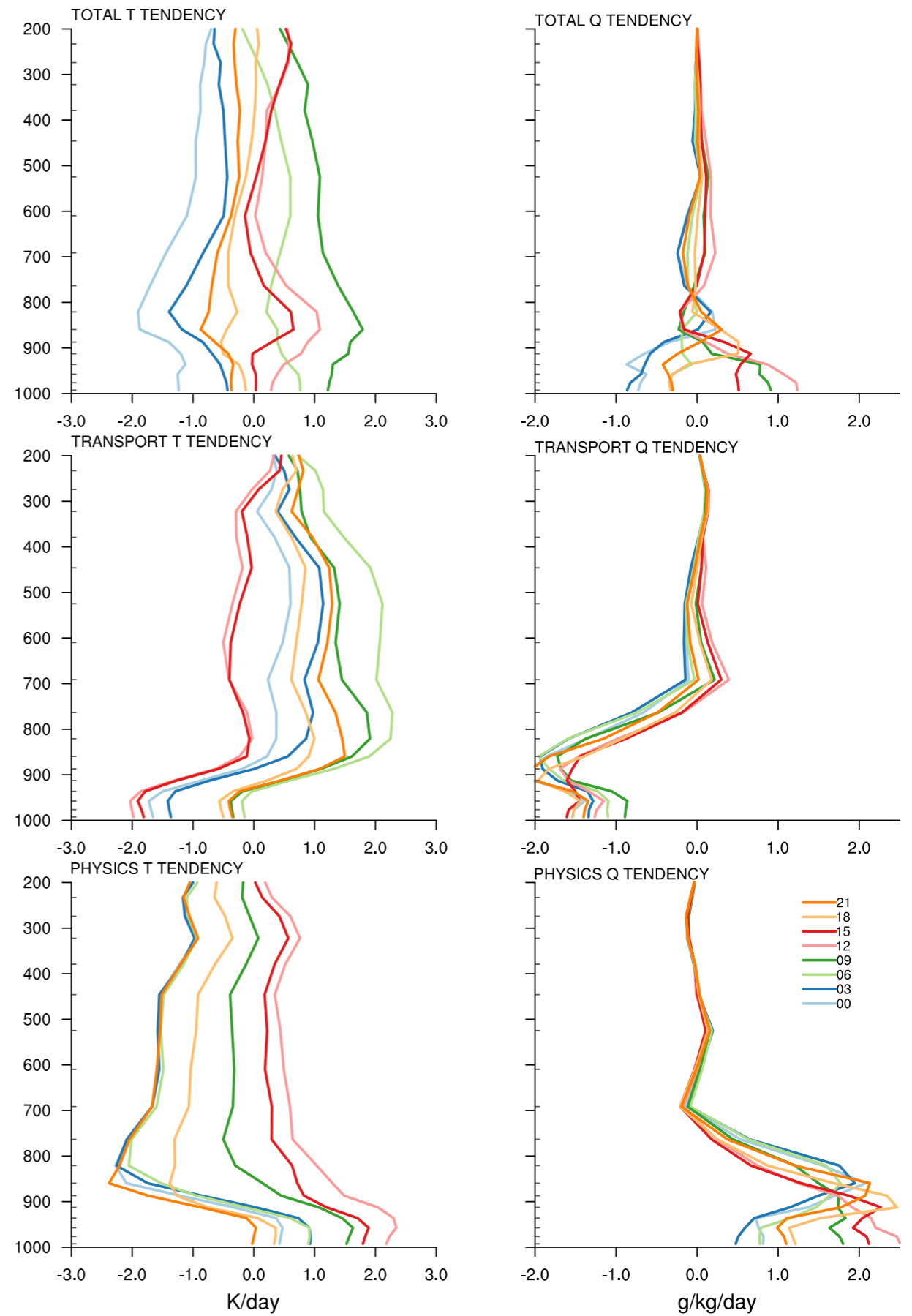
2s2n_180e200e



T & Q tendencies

TRADE WIND INFLOW

12n15n_180e200e



where to go next?

CAM5 seems to have reasonable diurnal phasing of winds and precipitation in the deep tropical Pacific (away from continents).

Focus on vertical structure

Detailed temperature and moisture budget analysis

- ▶ Fine-grain the terms (separate radiative, convective, microphysical effects)
- ▶ Identify links between moist physics and circulation
- ▶ Account for seasonality

Sensitivity experiments

- ▶ Include diurnal cycle of SST
- ▶ “COOKIE” like experiment

