The MJO and the Asian Monsoon in 4xCO_2 SP-CAM-SOM

Acknowledgments:
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How will the MJO change in a warmer climate?

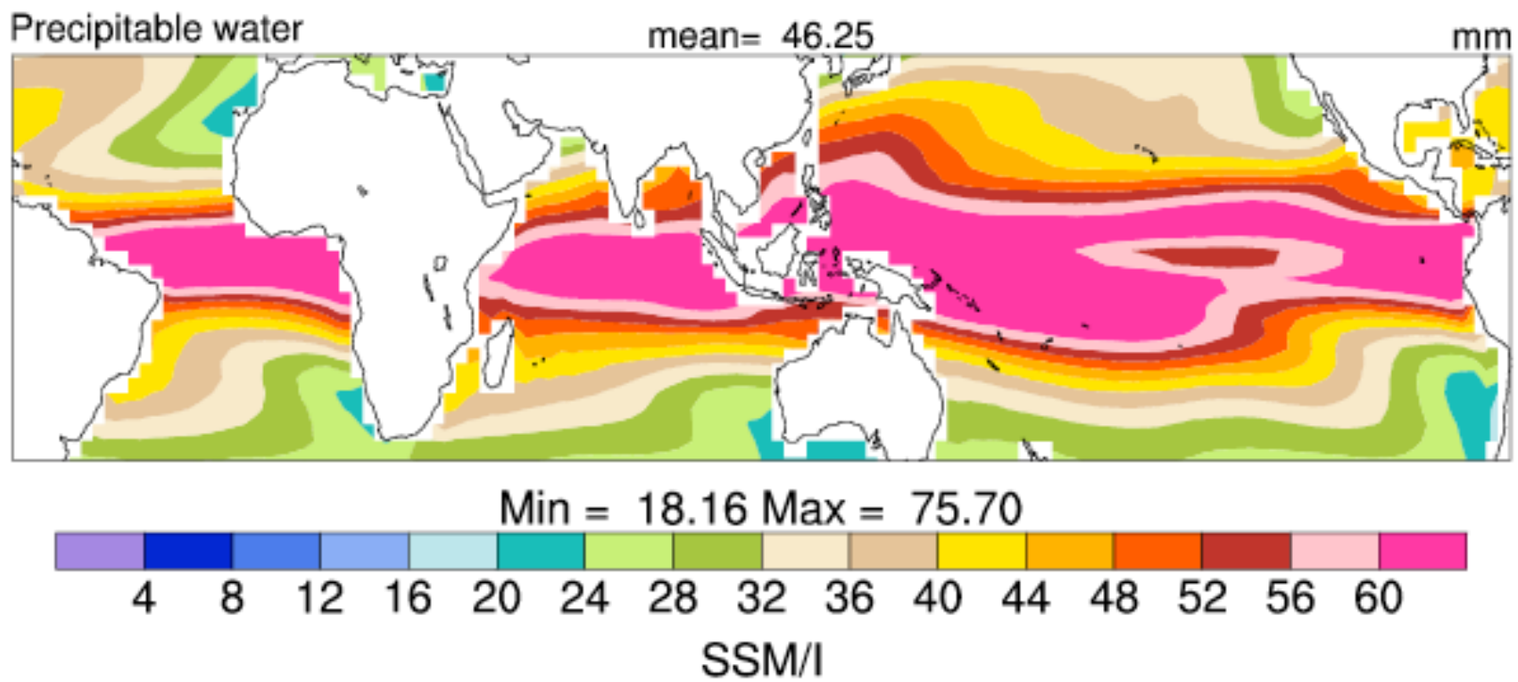
- Influence on tropical rainfall
- Coupling to the Asian Summer Monsoon
- Modulation of tropical cyclones

Experiment design

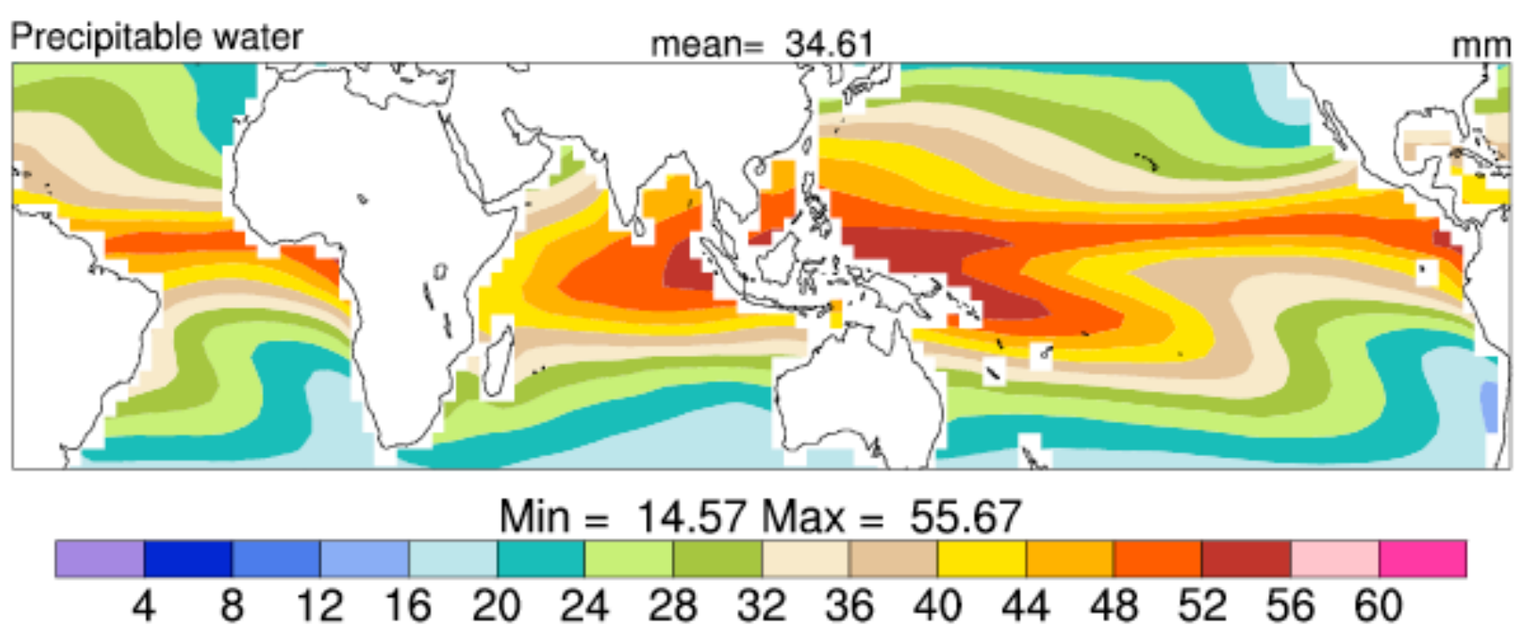
- **SP-CAM-SOM**
  - **"SOM" = "slab ocean model"**
  - **No ocean dynamics. SST is predicted**
- **Q-fluxes determined from SSTs observed in the current climate**
  - **Ocean heat transports consistent with obs SSTs in current climate**
  - **Neglects changes in ocean currents**
- **45-year spin-up with CAM-SOM, followed by 5-year simulation with SP-CAM-SOM**
- **Caution: SOM may not behave like coupled model.**

Annual Mean Precipitable Water

SpSOM4xCO2

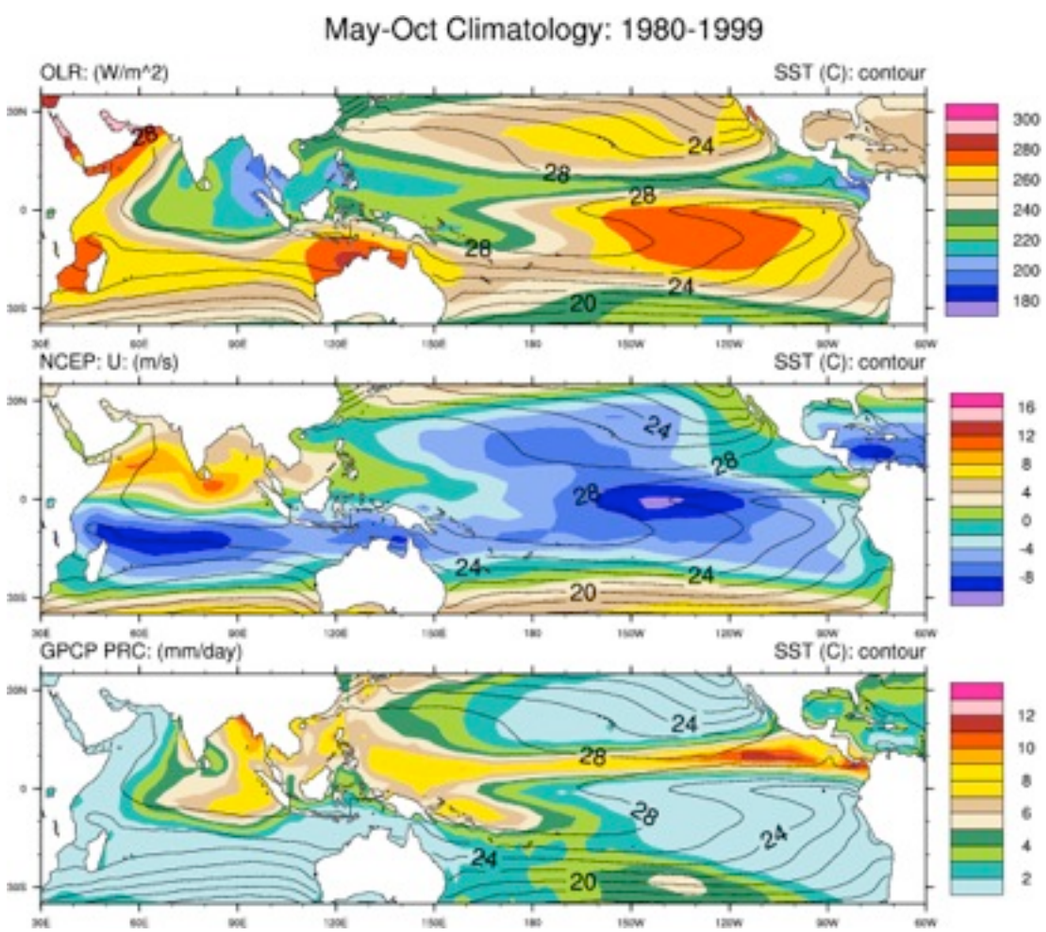


SSM/I

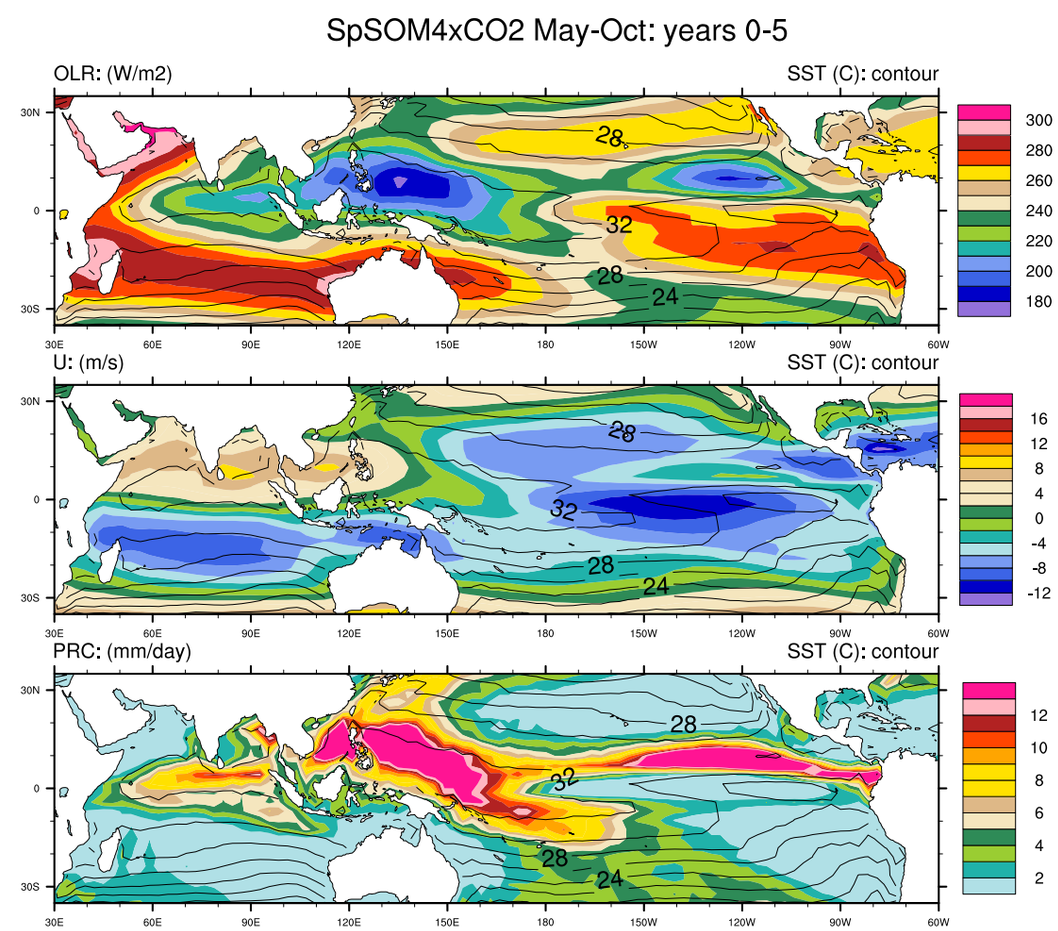


May-Oct

OBS



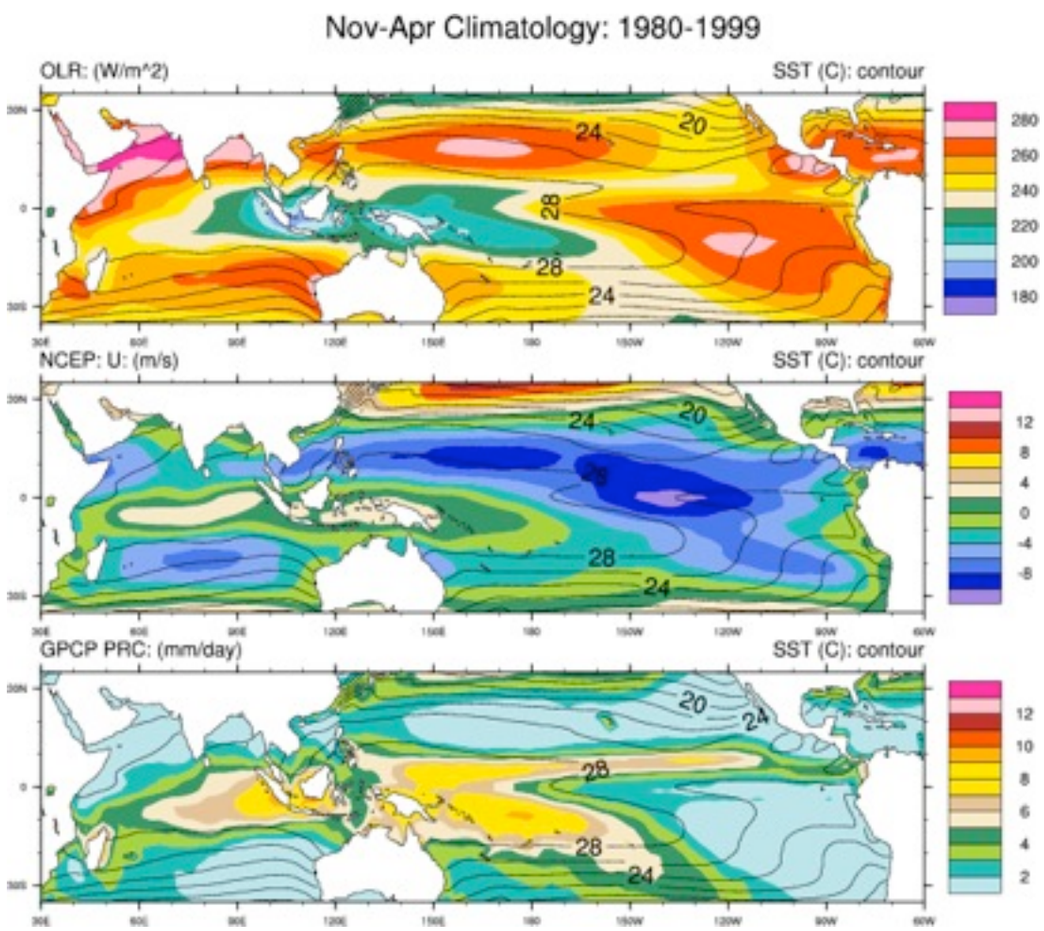
SpSOM4xCO2



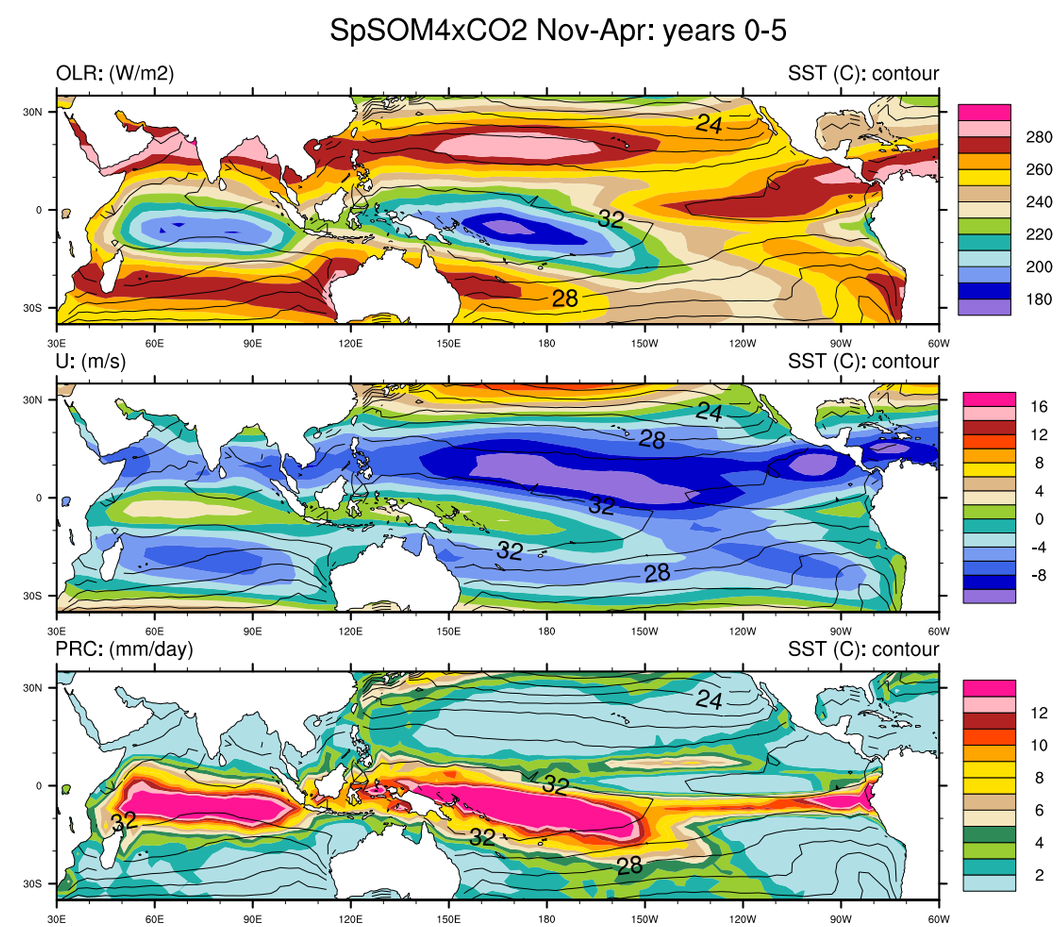
- more high cloud
- weaker monsoon westerlies
- enhanced subtropical easterlies
- eastward shift of IO/WPac precip.

Nov-Apr

OBS

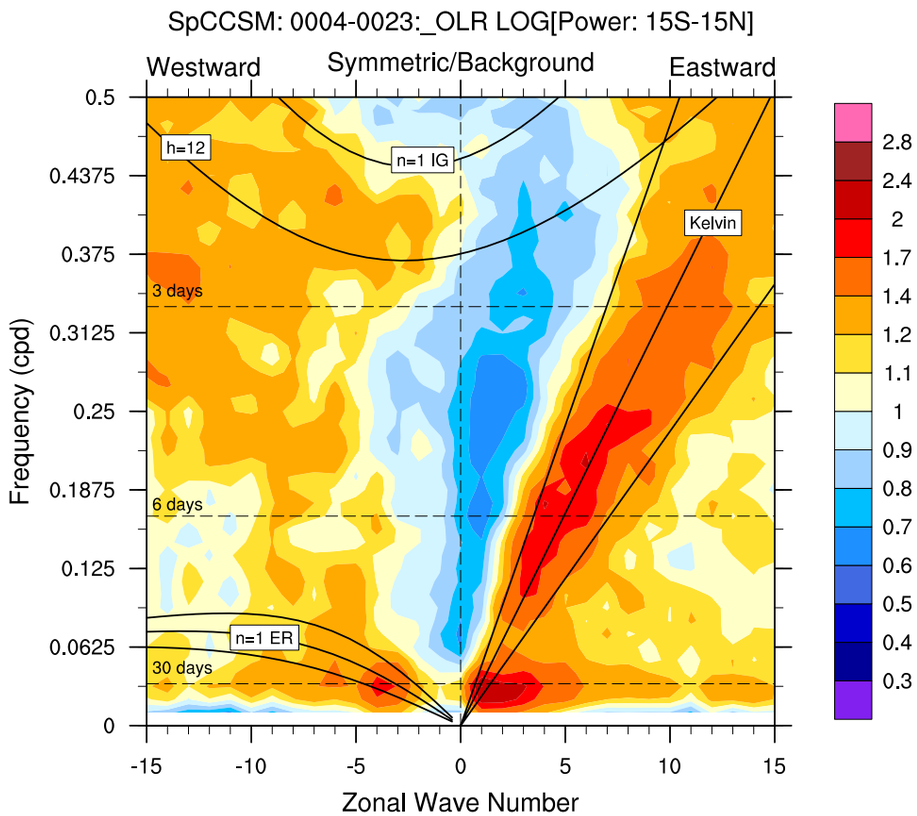


SpSOM4xCO2



- **more high cloud**
- **zonal expansion of warm pool westerlies**
- **NH ITCZ shrivels**

SpCCSM



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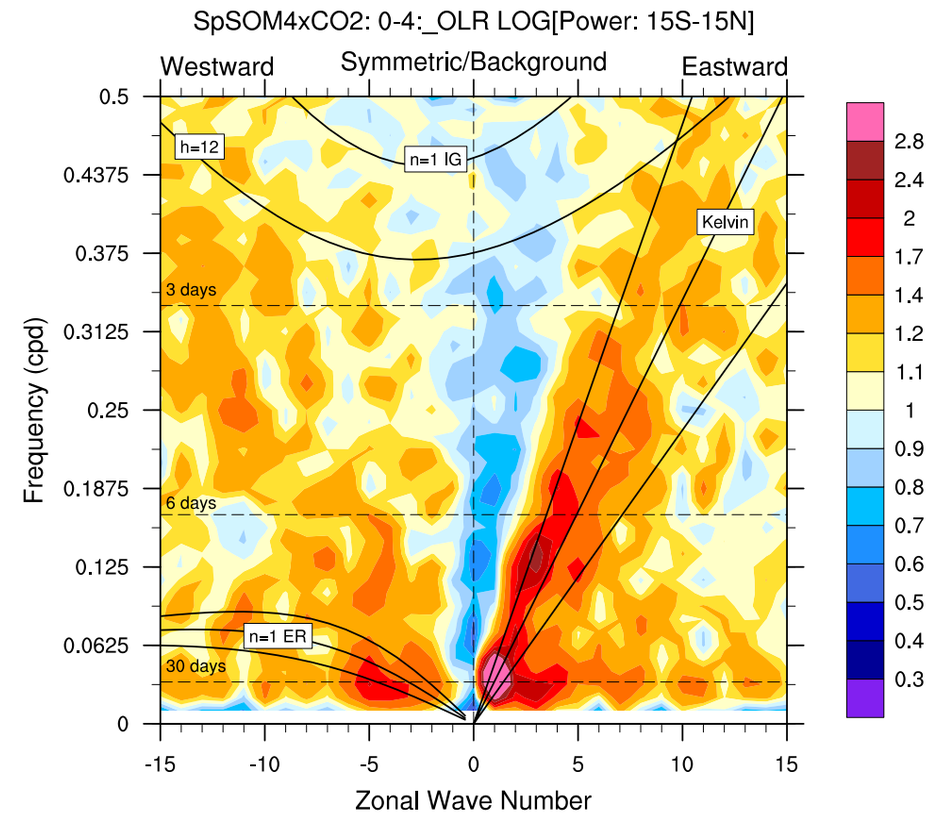

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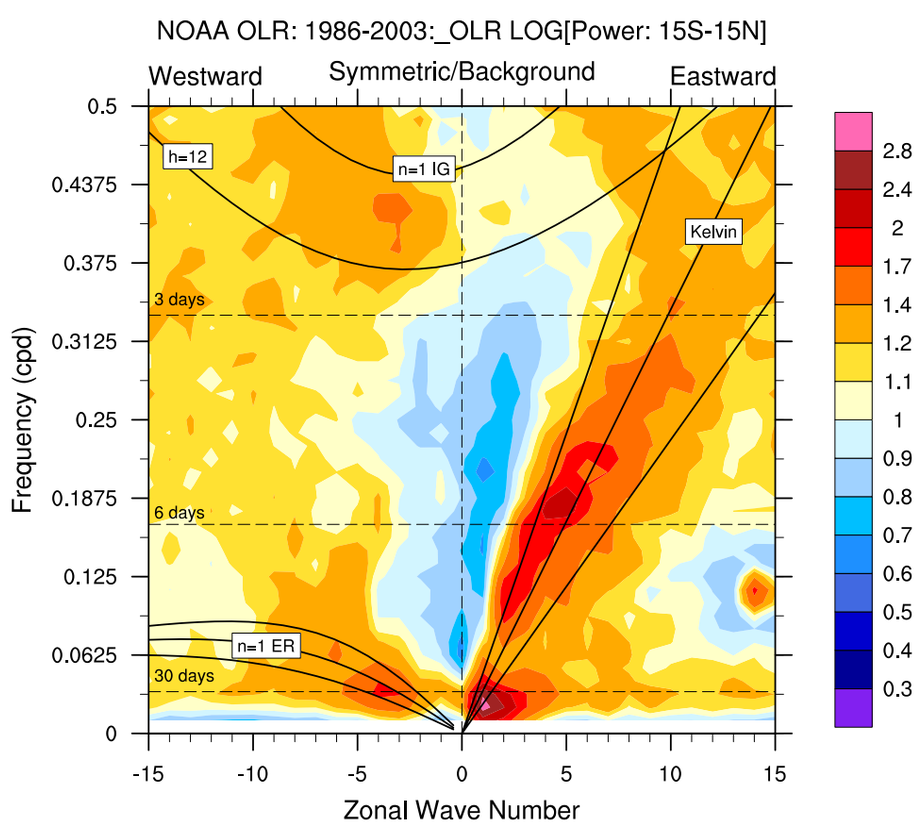
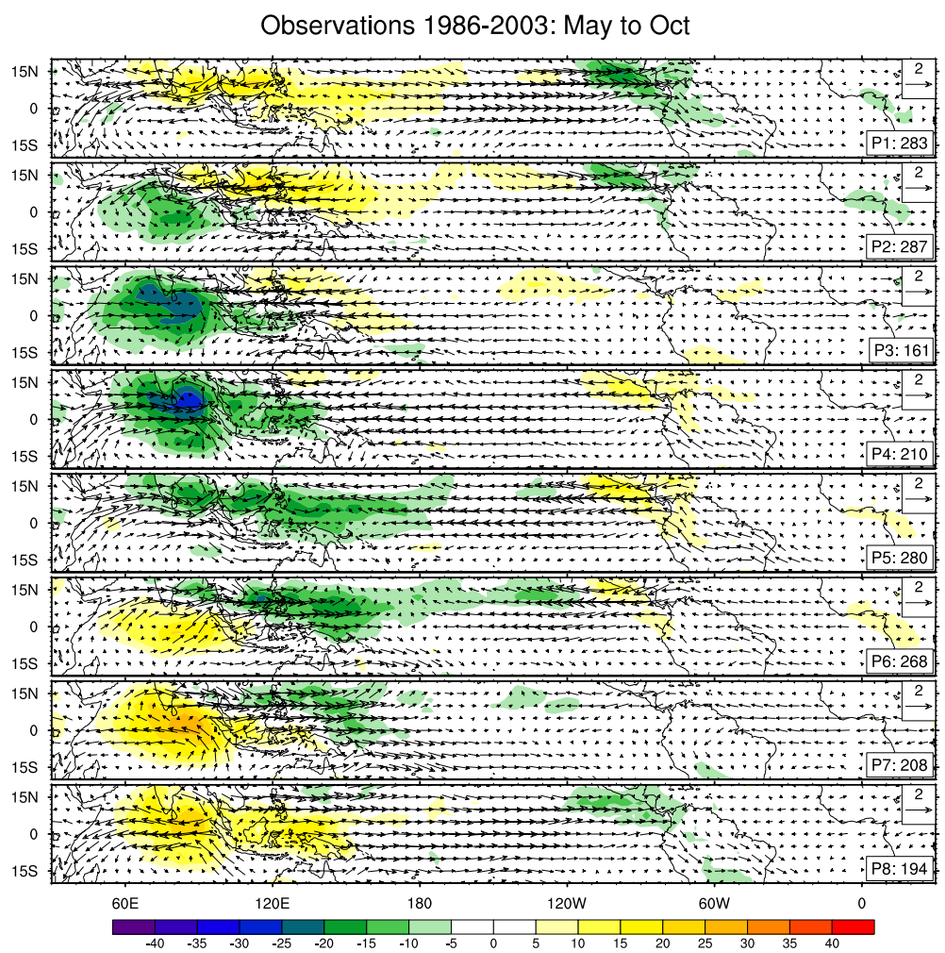


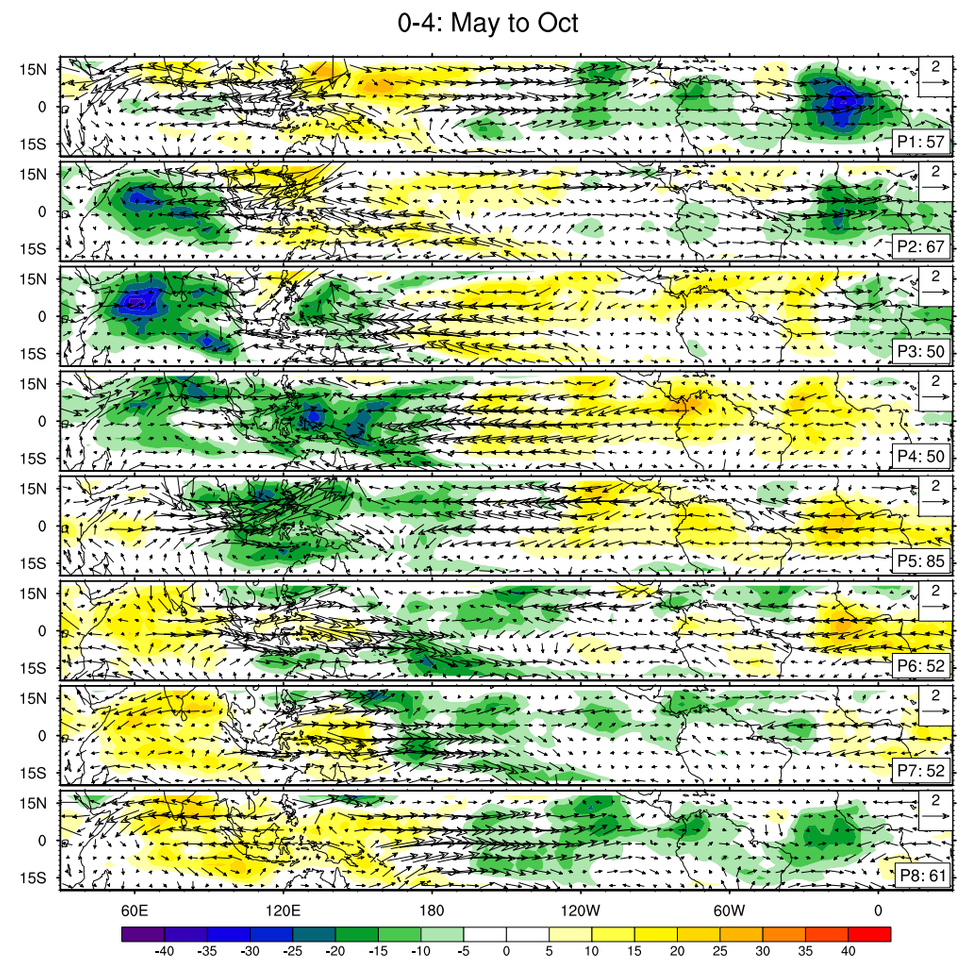
- **Stronger MJO**
- **Faster Kelvin wave**

May-Oct

OBS

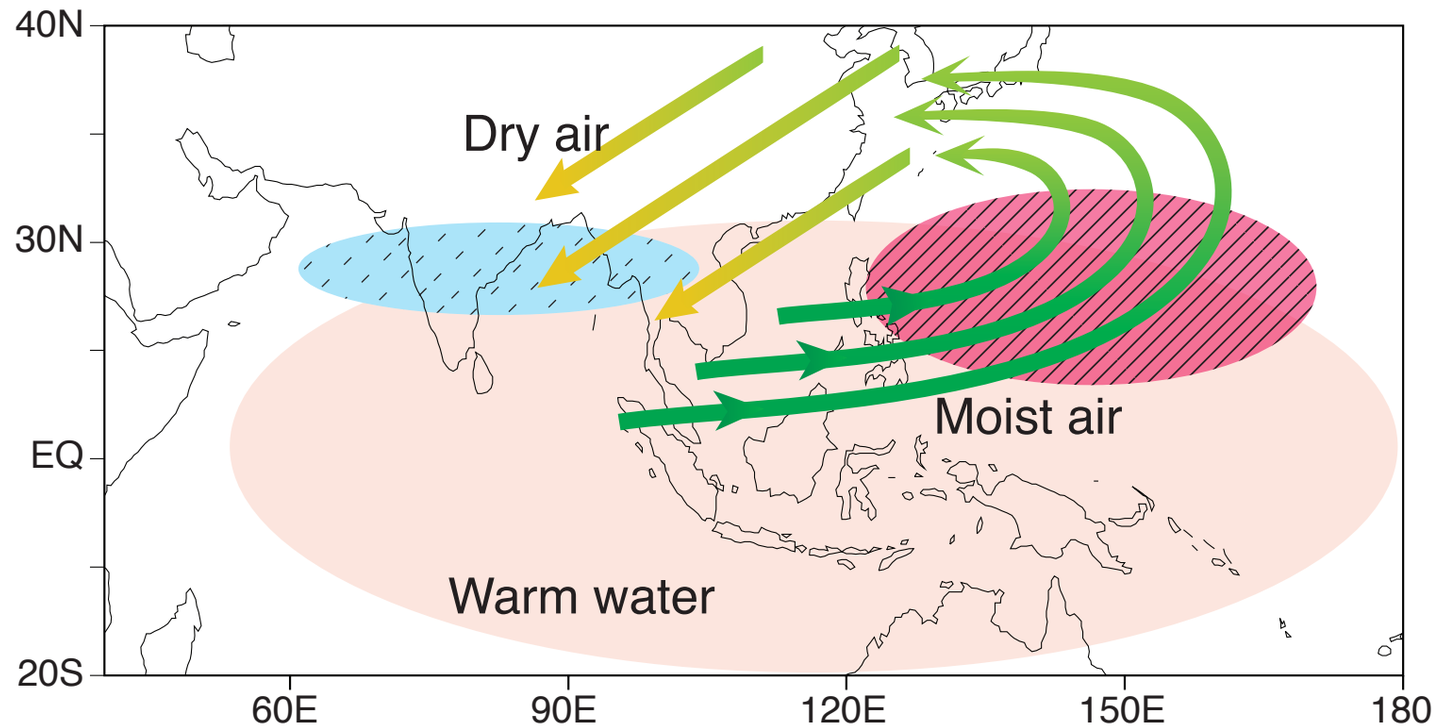


SpSOM4xCO2



- **MJO produces rain at all longitudes**
- **Zonal extent of active convection increased**

A connection with observed trends?



The rise in SST over the tropical Indian Ocean and western Pacific (pink oval) increases moisture transport (green arrows) towards the western Pacific (red oval) resulting in increased rising motion and rainfall. This circulation change drives a northeasterly wind (green-yellow arrows) bringing dry, cold air from the north, reducing monsoon convection and rainfall over India (blue oval).

Work by H. Annamalai, Jan Hafner, K. P. Sooraj, and P. Pillai, U. Hawaii.

Wetter east, drier west?

"The team's examination of monsoon-related measures from 1949 to 2000 in a range of climate products draws a remarkable picture.

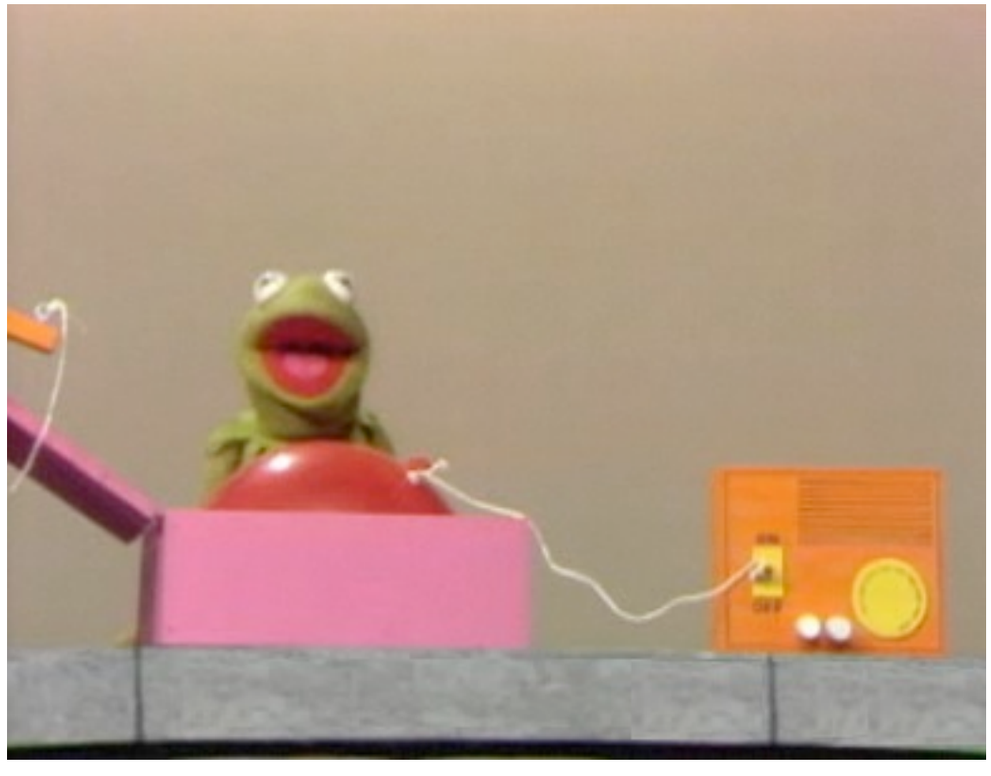
Even though the SST increased more in the Indian Ocean, sea level pressure (SLP) there rose instead of falling, the climatological southwesterly low-level monsoon winds weakened, and rainfall over India decreased by 10% from 1951 to 2000.

By contrast in the tropical western Pacific, SLP has dropped, and the low-level westerlies and cyclonic circulation have strengthened."

Work by H. Annamalai, Jan Hafner, K. P. Sooraj, and P. Pillai, U. Hawaii.

Summary

- **The MJO becomes stronger in the 4xCO_2 SP-CAM-SOM.**
- **MJO rainfall extends much further east in the 4xCO_2 SP-CAM-SOM.**
- **The zonal width of MJO rainfall increases in the 4xCO_2 SP-CAM-SOM.**
- **The Asian summer monsoon becomes much weaker in the 4xCO_2 SP-CAM-SOM.**
- **Very intriguing, but use of the SOM reduces confidence in the results.**

What happens next?

- **Complete ongoing analysis of SOM results**
- **Perform much longer 4xCO_2 simulations with a true ocean model**