# Spatial Patterns of Global Precipitation Variability and Change during 1901-2010

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**Objectives:**

- Quantify and compare precipitation variations/changes on interannual-to-decadal/interdecadal-to-trend scales using observations and model outputs;

- Examine/discriminate the effects of *anthropogenic forcings [greenhouse-gases (GHG), aerosols]* and *internal variations/modes [El Nino-Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), Atlantic Multidecadal Oscillation (AMO)]*;

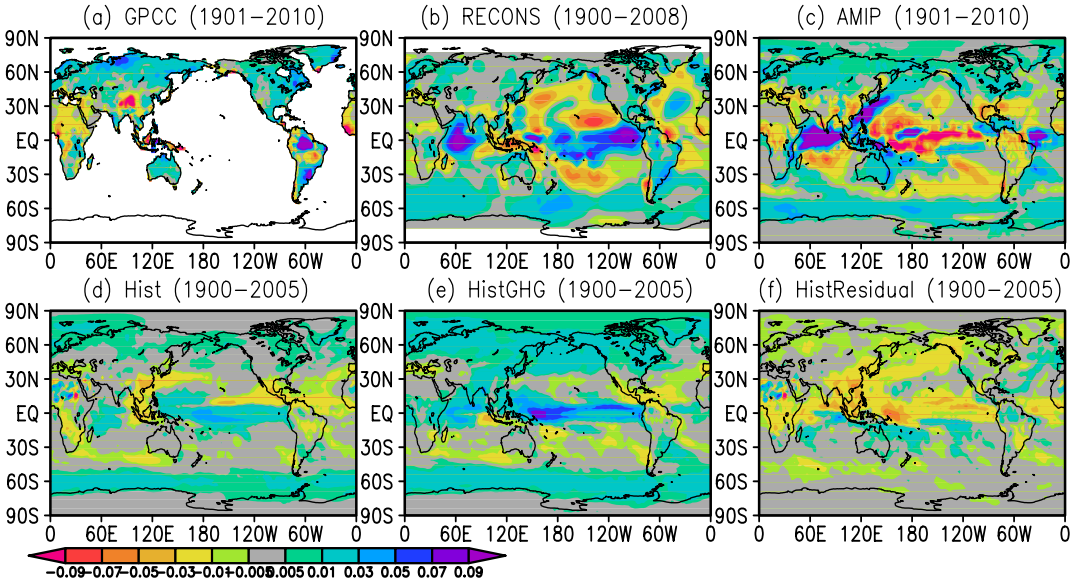
- Assess the capabilities of climate models (CMIP5/AMIP5 and reanalysis products) in simulating forced responses and reproducing observed precipitation variability and change

**Observations and Model Outputs:**

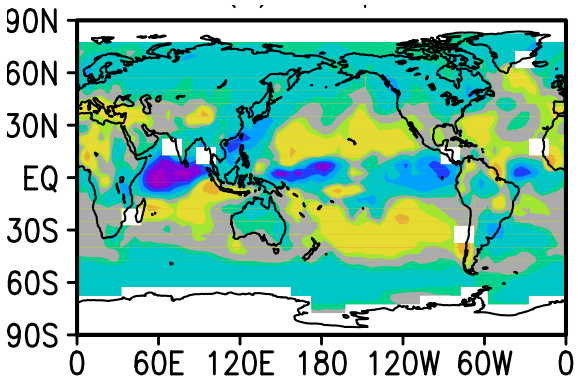
- GPCC full data reanalysis of monthly land precipitation (1901-2010);
- NOAA/CICS-Smith reconstructed monthly (land+ocean) precipitation (1900-2008);
- CMIP5 historical simulations (full radiative forcings, GHG-forcing only, natural forcing only)
- AMIP5 simulations (forced by observed SST & sea ice extent, and full historical radiative forcings)

- GPCP monthly (land+ocean) precipitation analysis for the satellite era (1979-present)

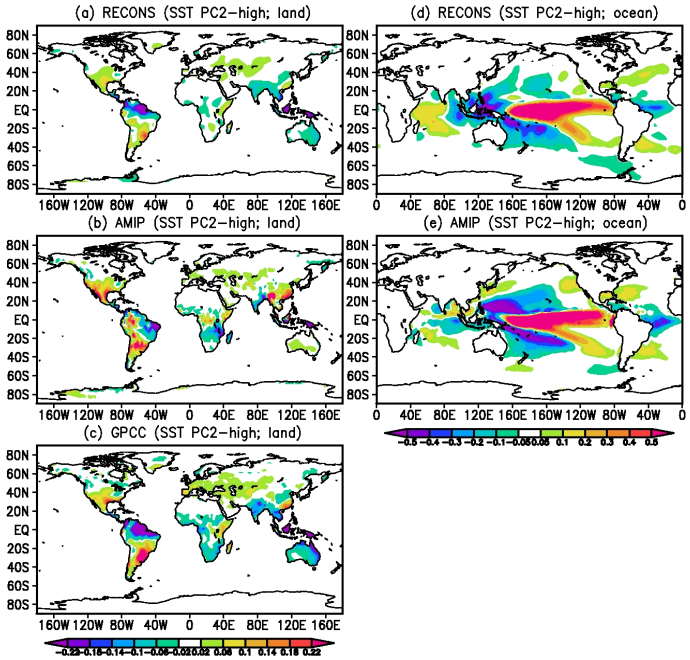
## Precipitation trends in observations and simulated by models




## Composite GHG-related precipitation trends



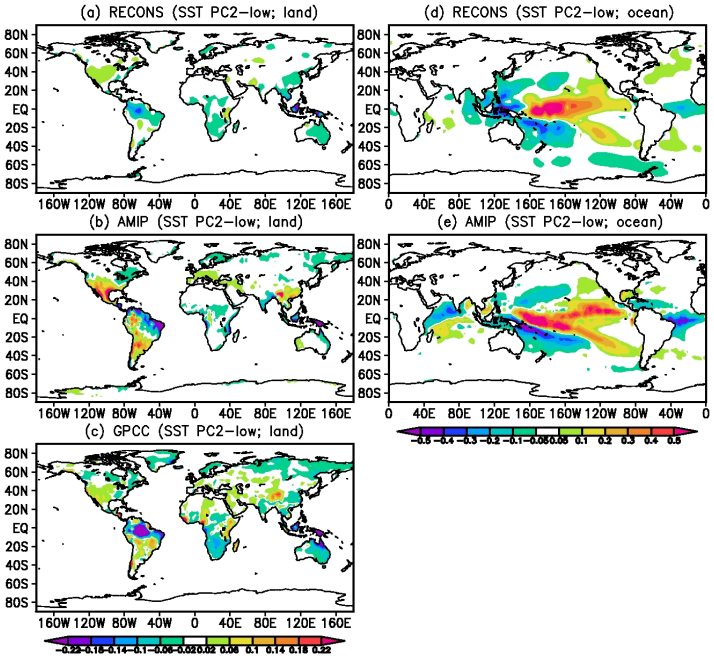

## ENSO-related precipitation anomalies



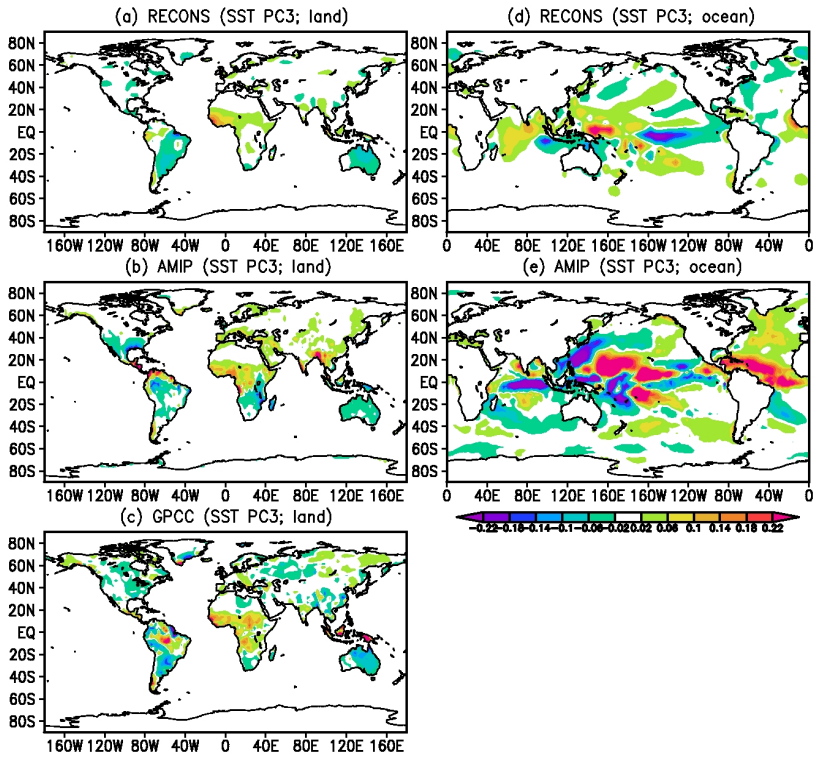

**For both ENSO and PDO,**

- Consistency over land, though with differences in intensity;
- Differences in spatial structures over tropical ocean

## PDO-related precipitation anomalies



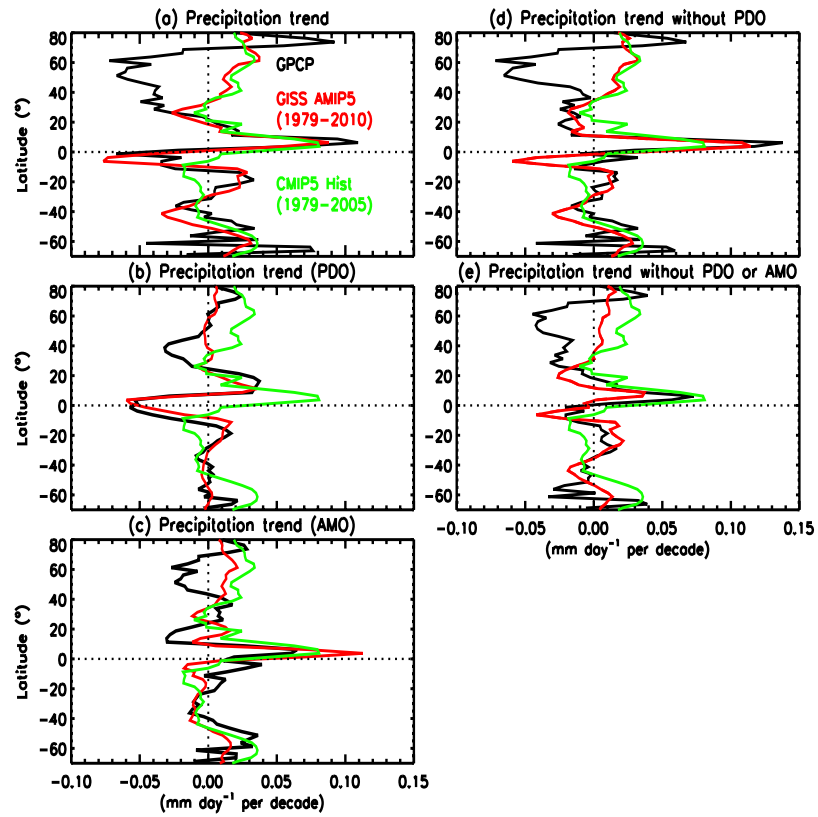
## AMO-related precipitation anomalies




- Consistency over land, including West Africa, North America and part of South America, Australia, etc;
- Large discrepancy over ocean, not only in the Indian Ocean and Pacific, but also in the Atlantic

***Relevant work using GPCP and model outputs:***

***PDO's contributions to precipitation trends during 1979-2012***




- Long-term precipitation changes/trends during 1979-2012 are dominated by two mechanisms: anthropogenic GHG and PDO

## Potential collaborations:

Evaluate models' capabilities of simulating and predicting global precipitation variations on the longer-than-seasonal time scales using satellite and gauge based precipitation measurements. This will primarily be based on examining and identifying the variations related to internal physical modes, including (various flavors of) ENSO, PDO, AMO, etc, and also on assessing and identifying the likely effects of anthropogenic factors (GHG and aerosols).