Weekly to Decadal Predictability of Northwest Indian Ocean Rim Precipitation and Implications for Seasonal Drought Forecasting

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Overview

1. Regions of interest and important climate modes
2. Influences on weekly to interannual time scales
   - General understanding and unanswered questions
     1. Madden-Julian Oscillation
     2. El Niño-Southern Oscillation
3. Influences on decadal and longer time scales
   - Uncertainty associated with long-term variability
     1. Pacific Decadal Variability
     2. Long term trend in Pacific sea surface temperatures
4. Seasonal forecasting

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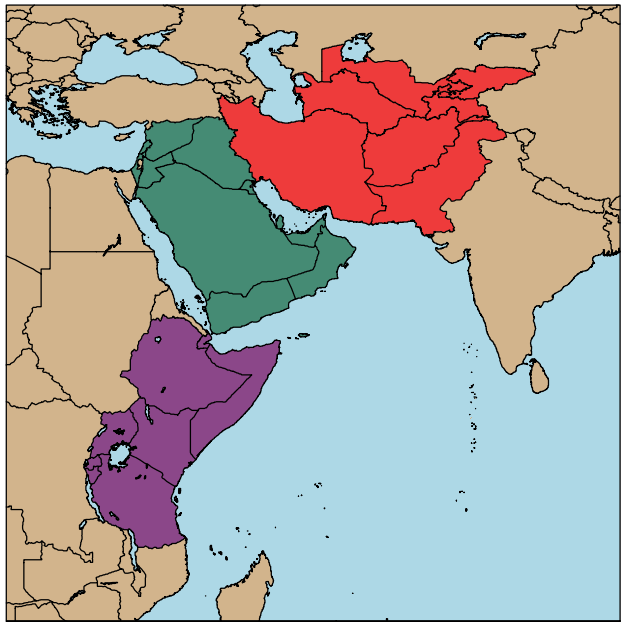
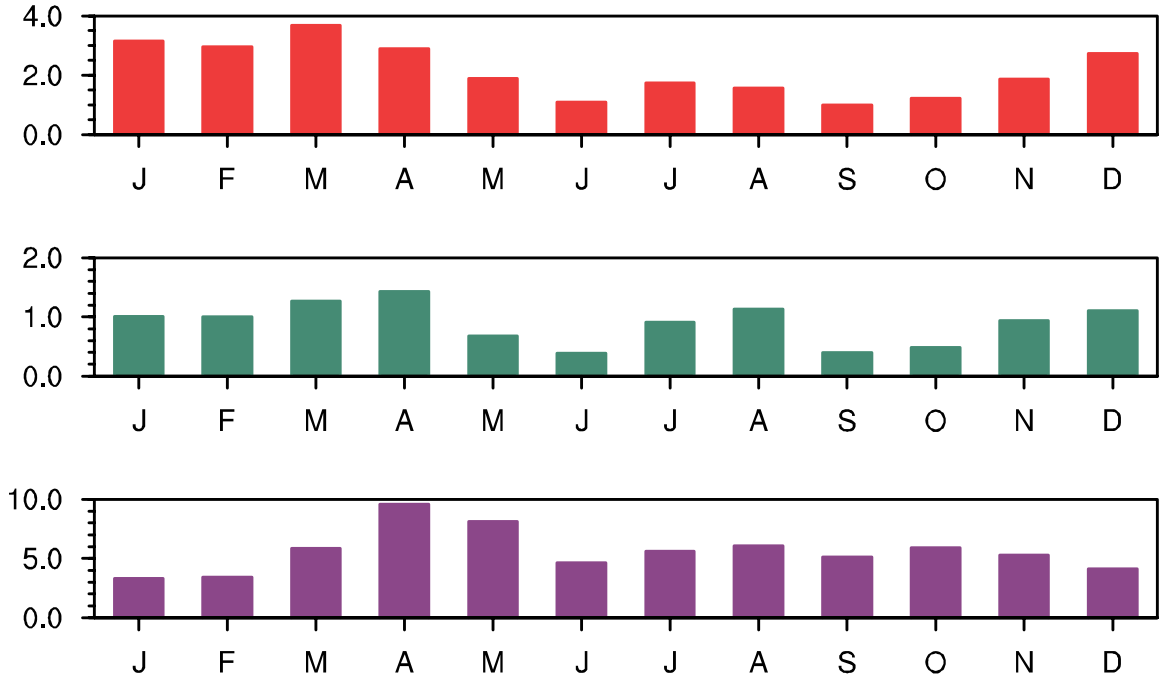
The Northwest Indian Ocean Rim

Countries Considered



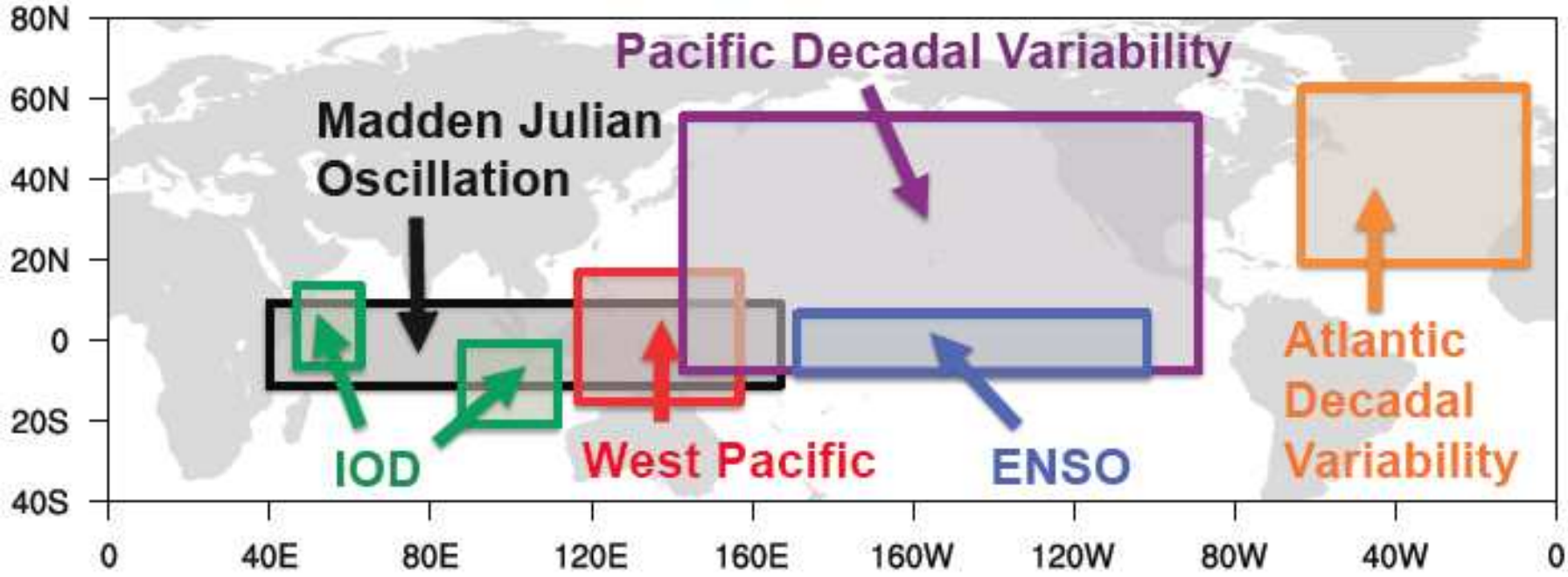
Central Asia Middle East East Africa

Precipitation (cm month^{-1})



Climate Modes & Indian Ocean Rim

The individual and synchronous influences of climate modes make forecasting difficult



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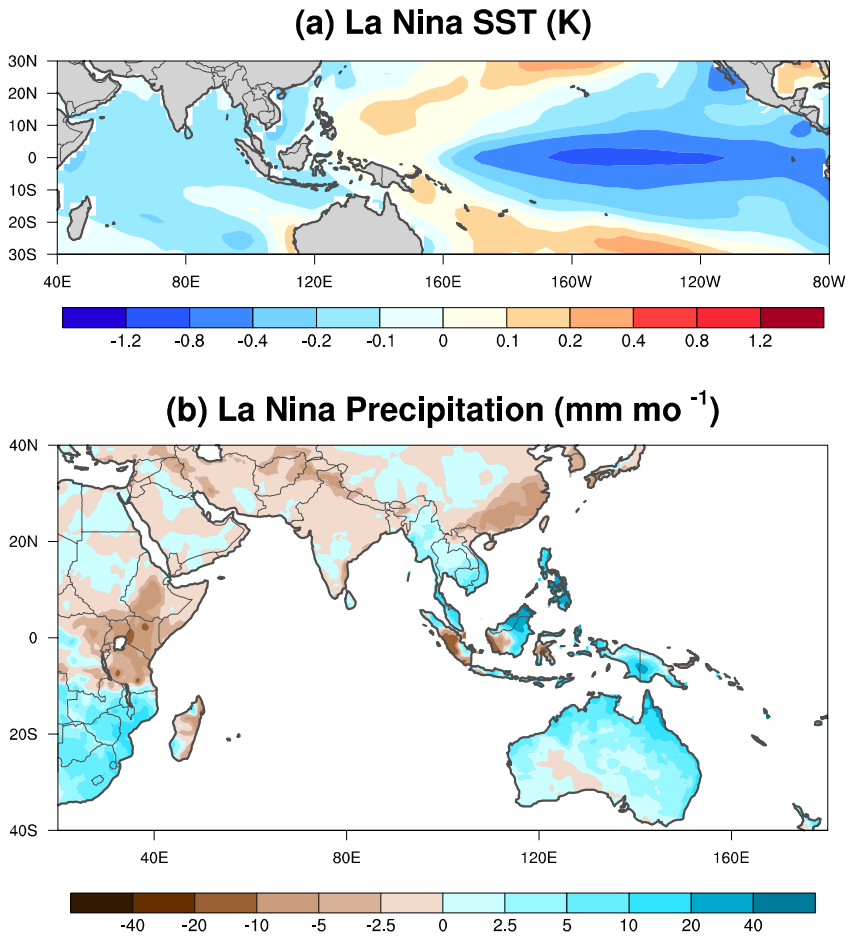
La Niña and Drought in Aggregate

Precipitation mixed during La Niña in aggregate

"Vanilla" La Niña defined as Niño3.4 < -0.5K for December-March

"Vanilla" La Niña typical of canonical ENSO, i.e. east-central tropical Pacific and weak opposing west Pacific

Precipitation impacts not strong or clearly defined

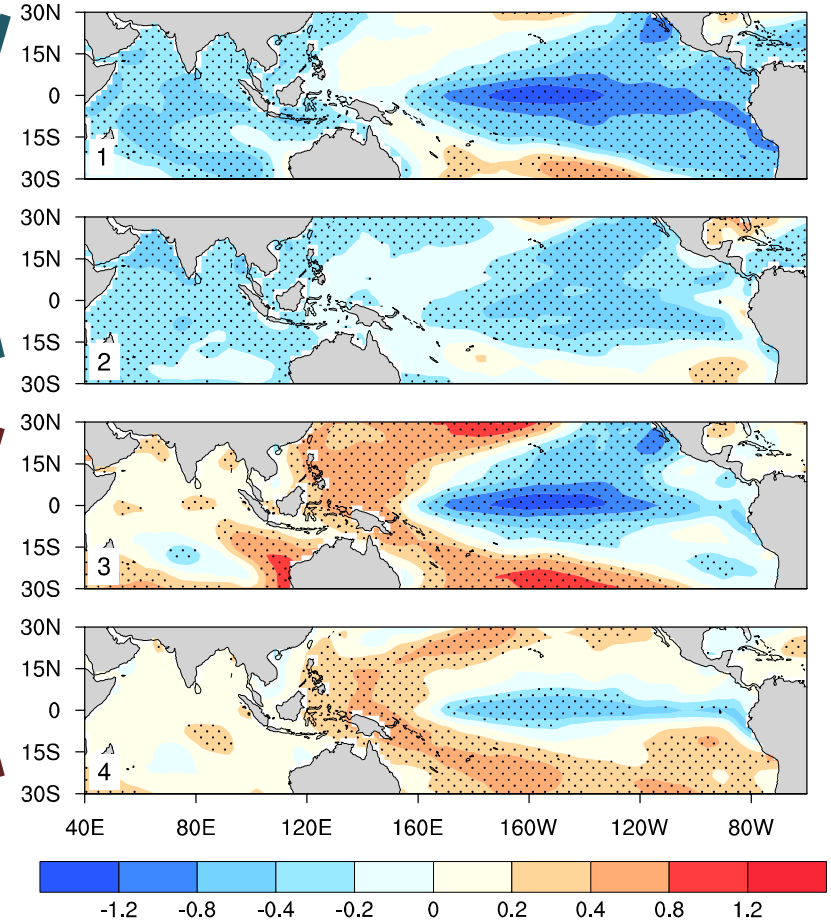


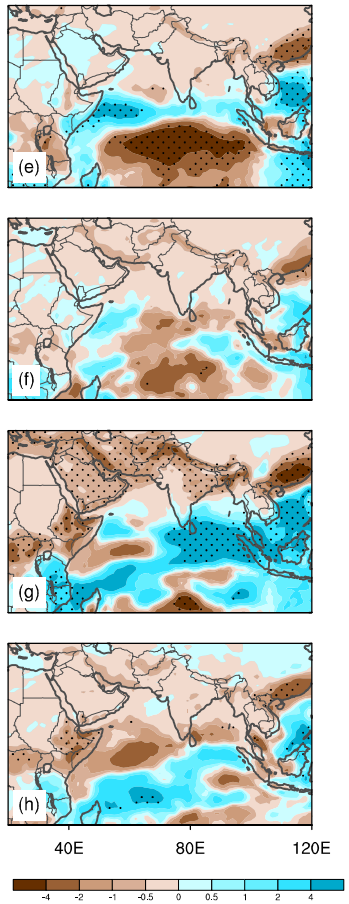
La Niña Variations and Drought

Precipitation impacts vary as a function of SST pattern

Eastern Pacific La Niña have weak influences

Central Pacific La Niña combined with warm west Pacific have strong influences





December - March

As in Johnson 2013, J. Climate

Hoell et al. Submitted to *Climate Dynamics*

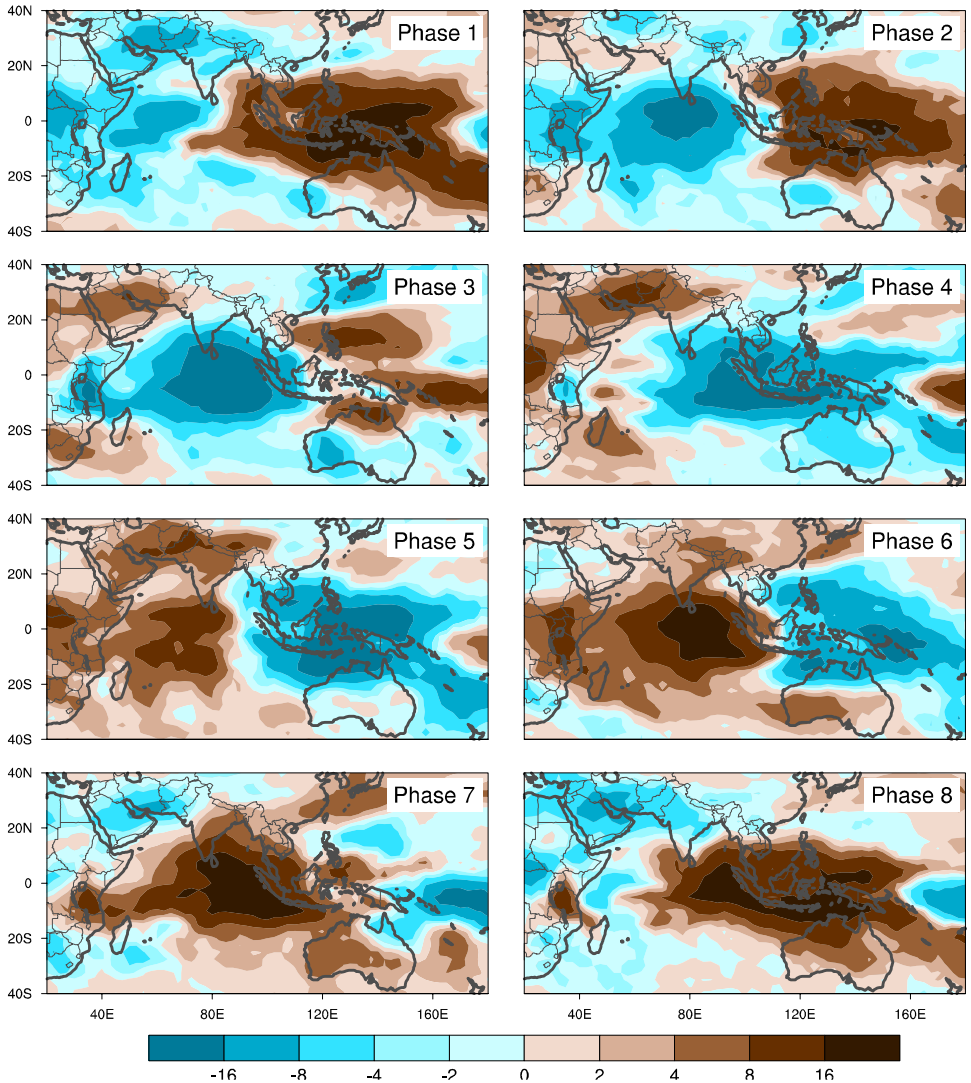
Madden Julian Oscillation Influences

Convection centers associated with MJO propagate at near 5 m s^{-1}

Phase 3-5 result in reduced precipitation

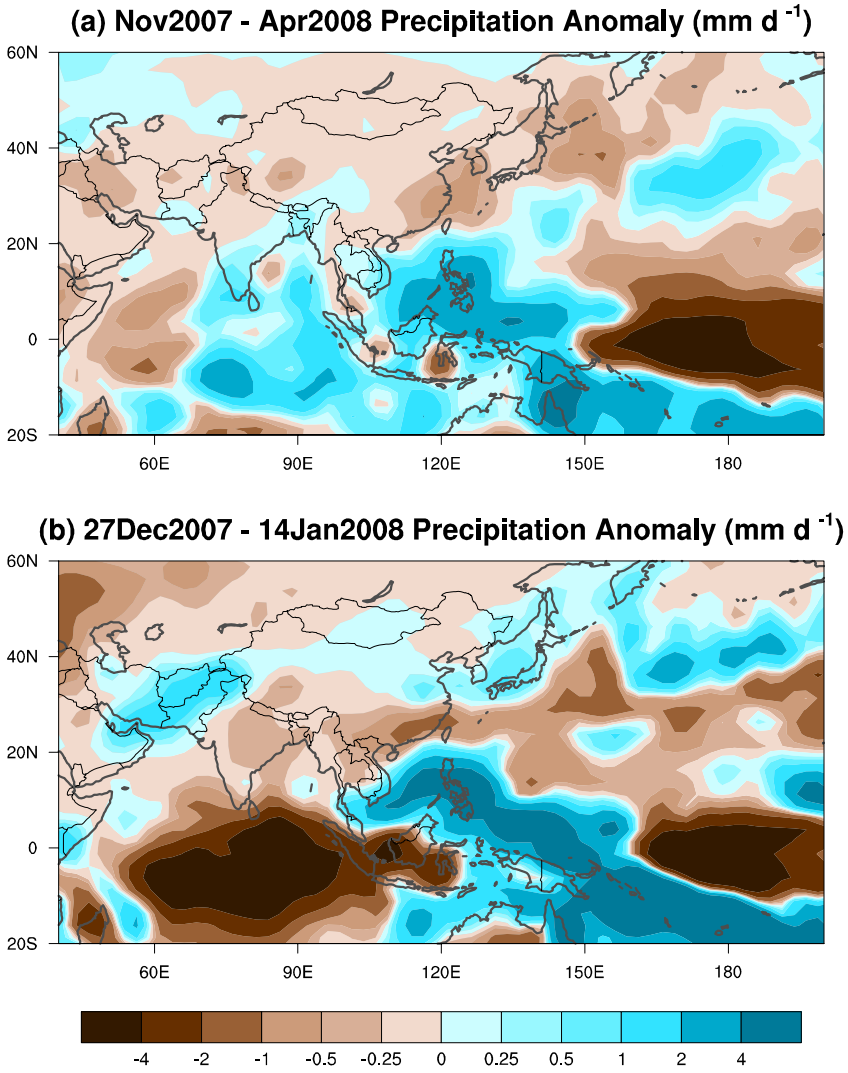
Phase 7,8,1 result in enhanced precipitation

MJO influences precipitation for weeks at a time



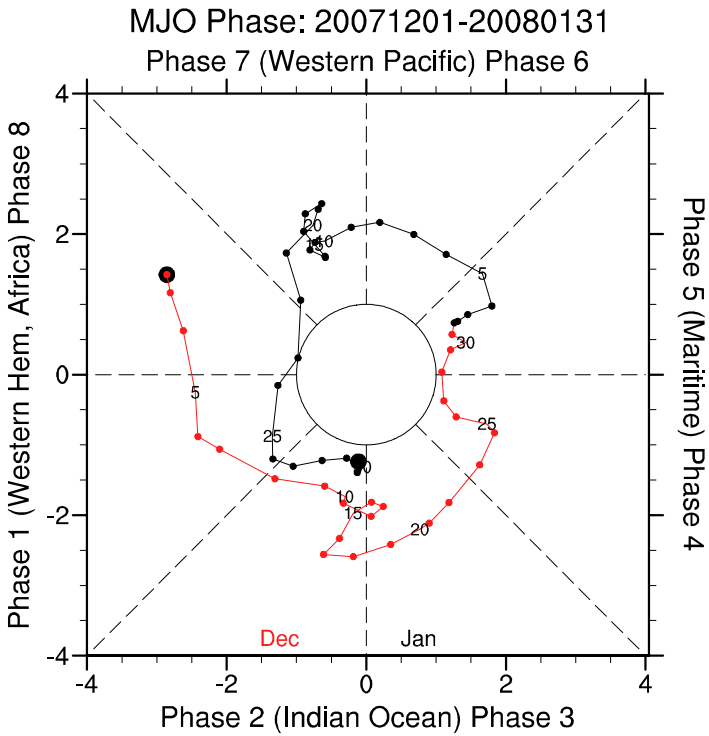
As in Wheeler et al. 2009, *J. Climate*

MJO Causes Predictable Breaks of ENSO



As in Hoell et al. 2012, *J. Climate*

Active MJO can destroy the atmospheric branch of ENSO, thus leading to predictable breaks for weeks at a time



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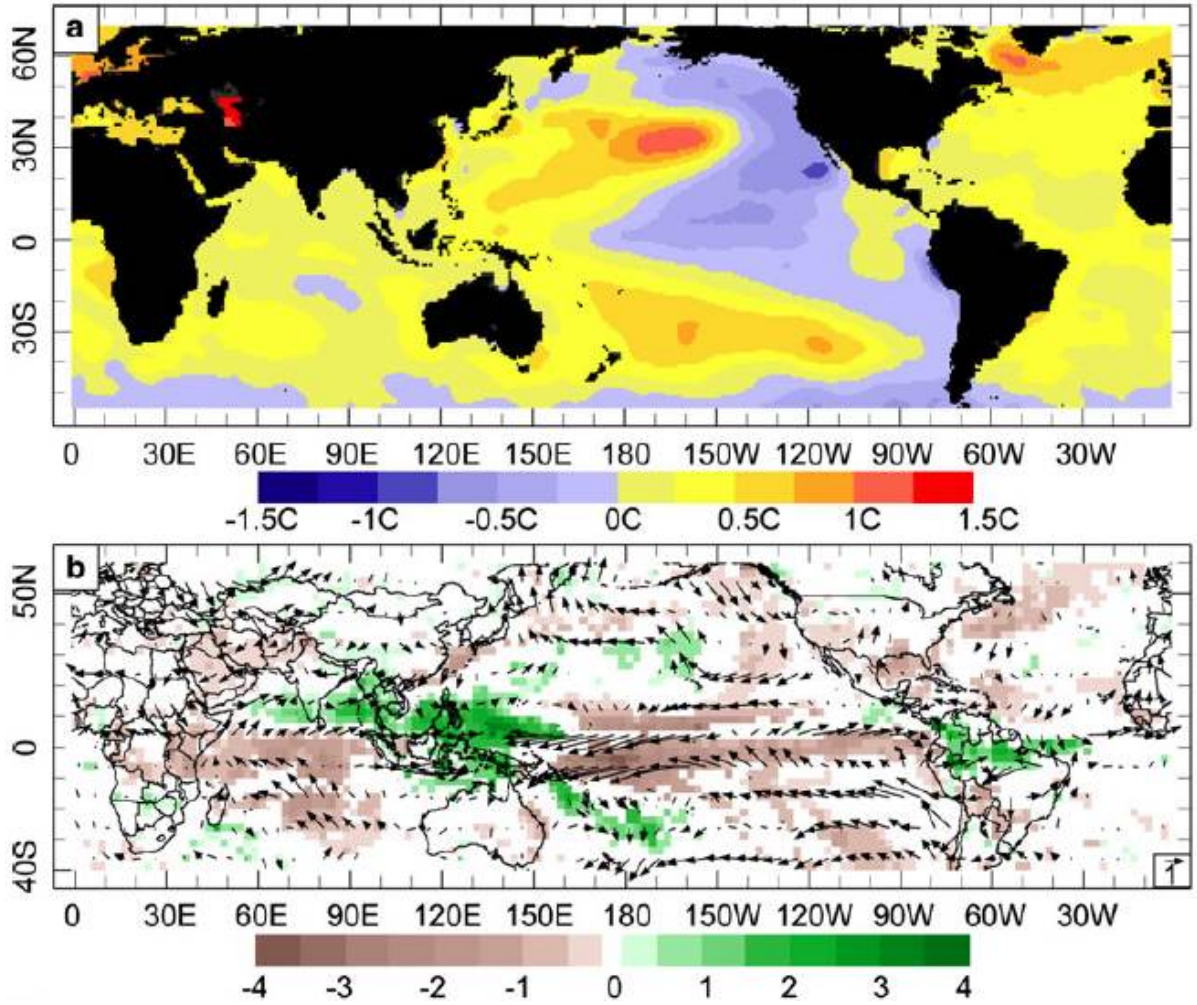
SST Influences on Post-1999 Drought

SST expression contains signals from decadal variability and a long-term trend

SST have forced drought over the last 13 years

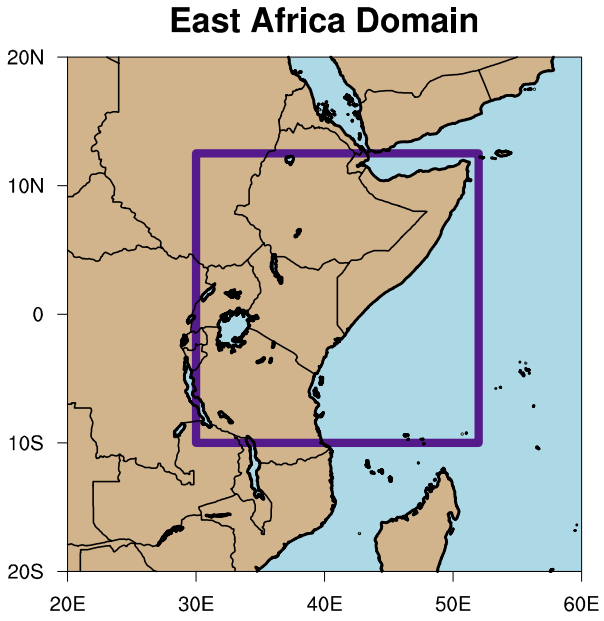
How have these modes influenced the past and how will they influence the future climate?

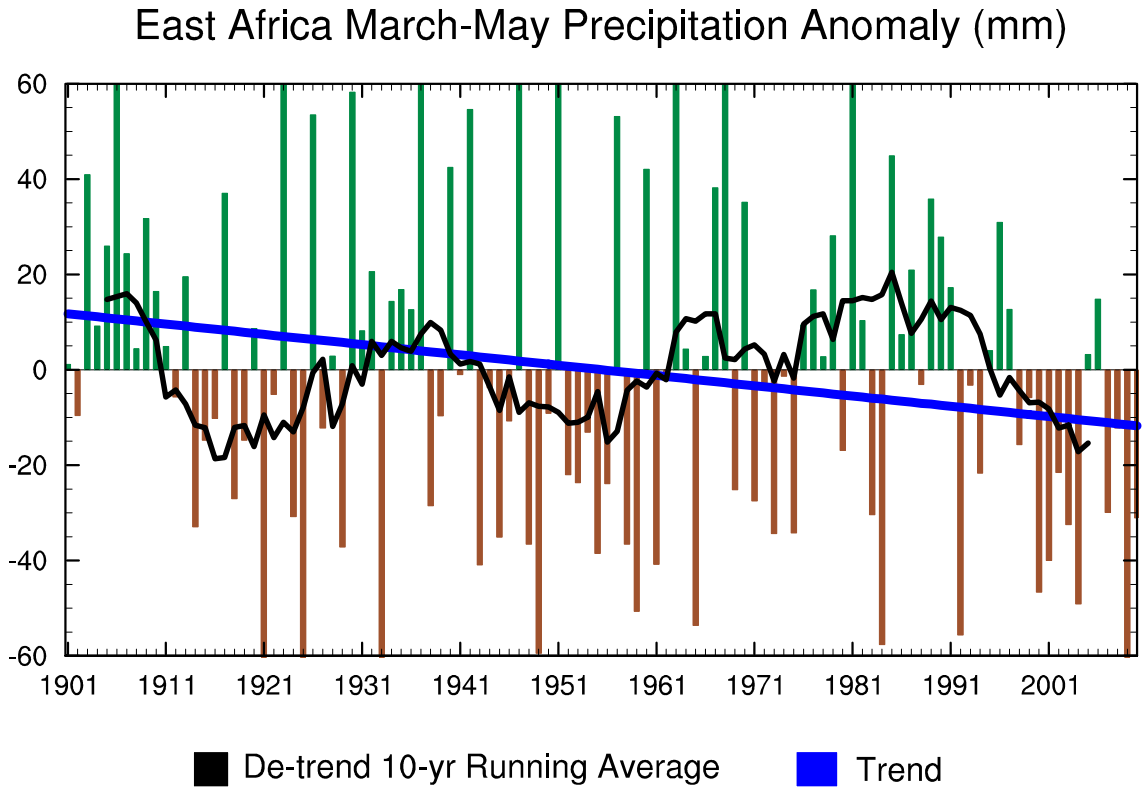


Lyon et al. 2013, *Climate Dynamics*

Long-Term Variability of East Africa Rainfall

East Africa demonstrates decadal-scale and trend-scale precipitation variability during March-May

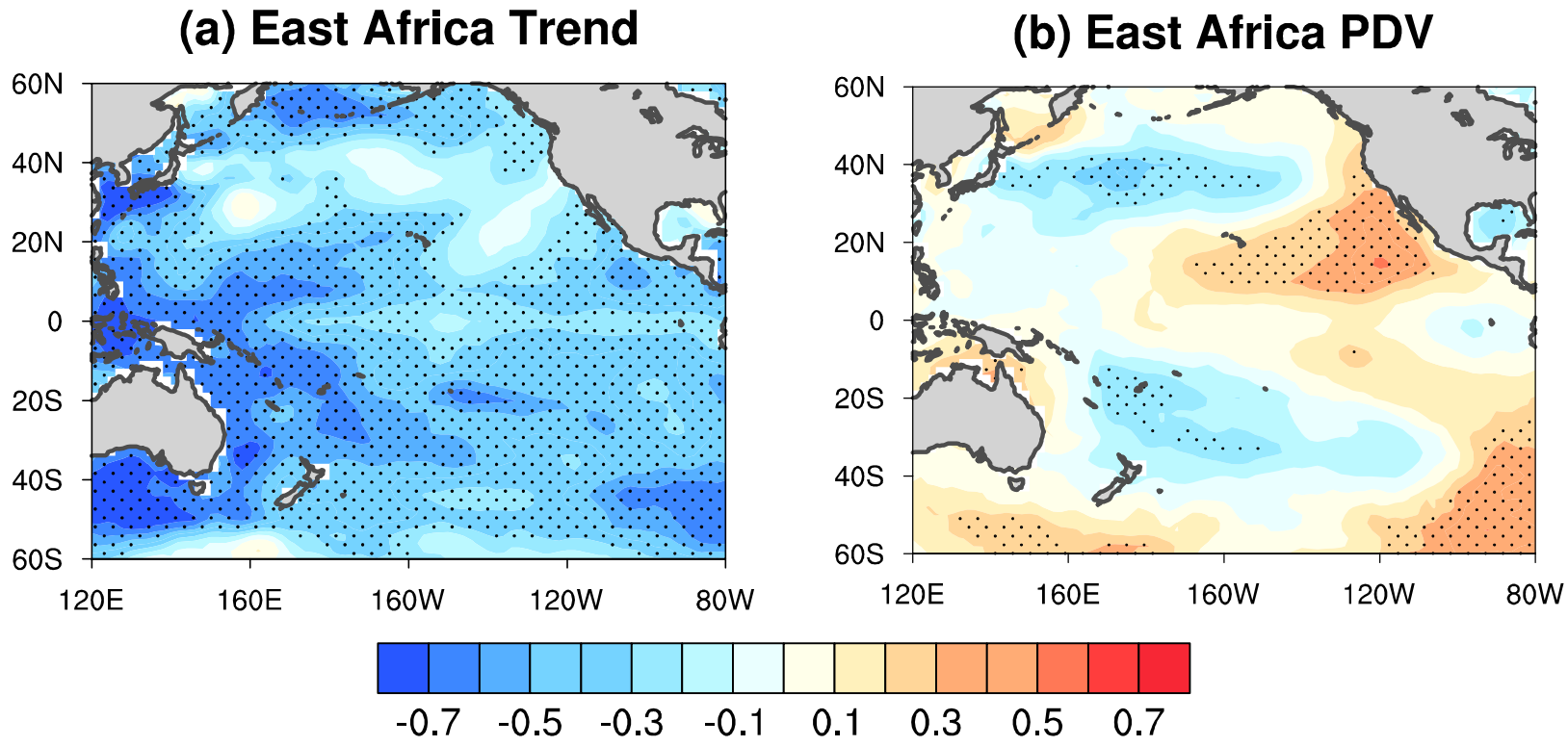




Hoell et al., Submitted to *Climate Dynamics*

SST Influences on East Africa Rains

East Africa decadal-scale and trend-scale precipitation variability during March-May is associated with SST

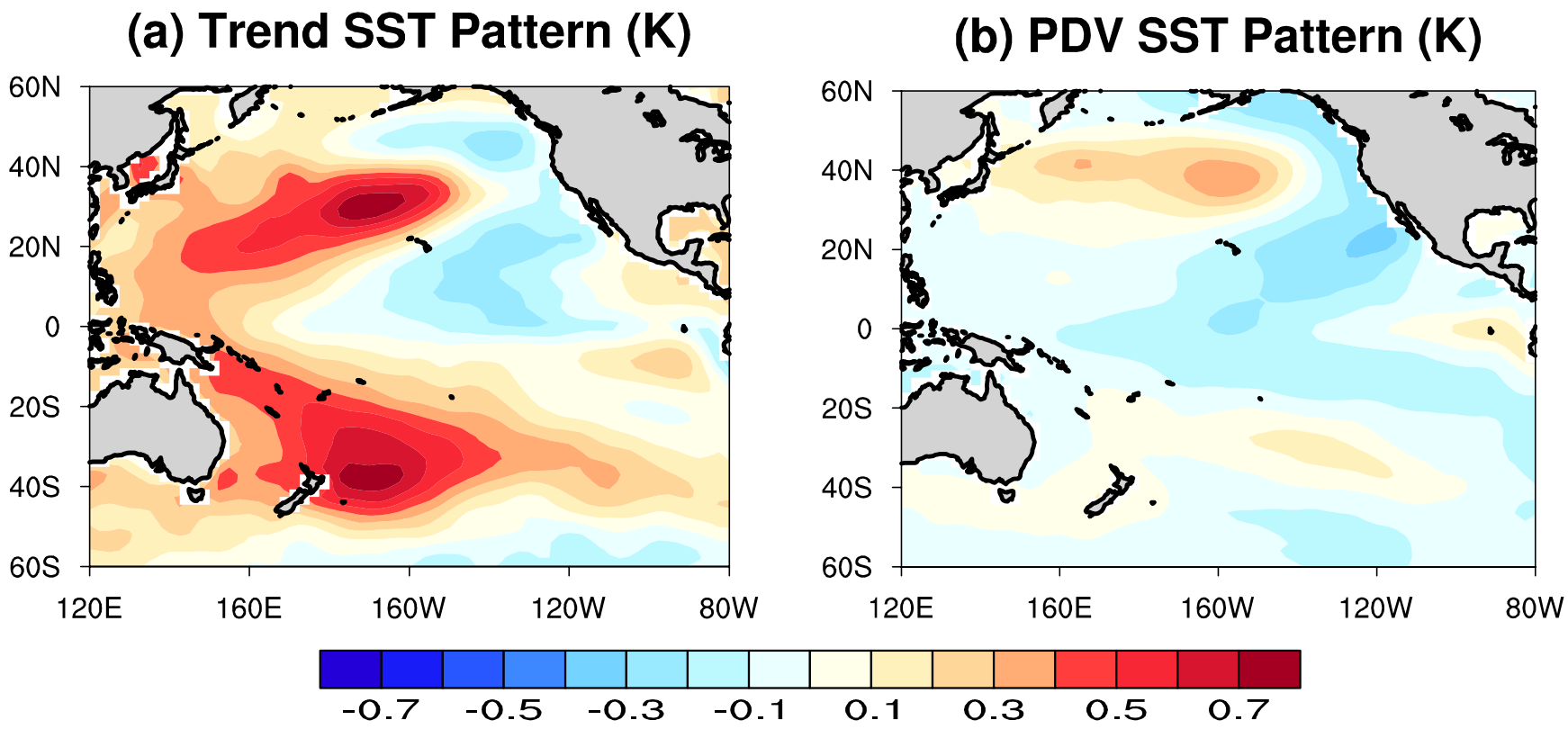


Hoell and Funk, Submitted to *Climate Dynamics*

Separating Recent Decadal SST Signals

Trend: Accounts for variability over west Pacific

PDV: Accounts for variability over east Pacific

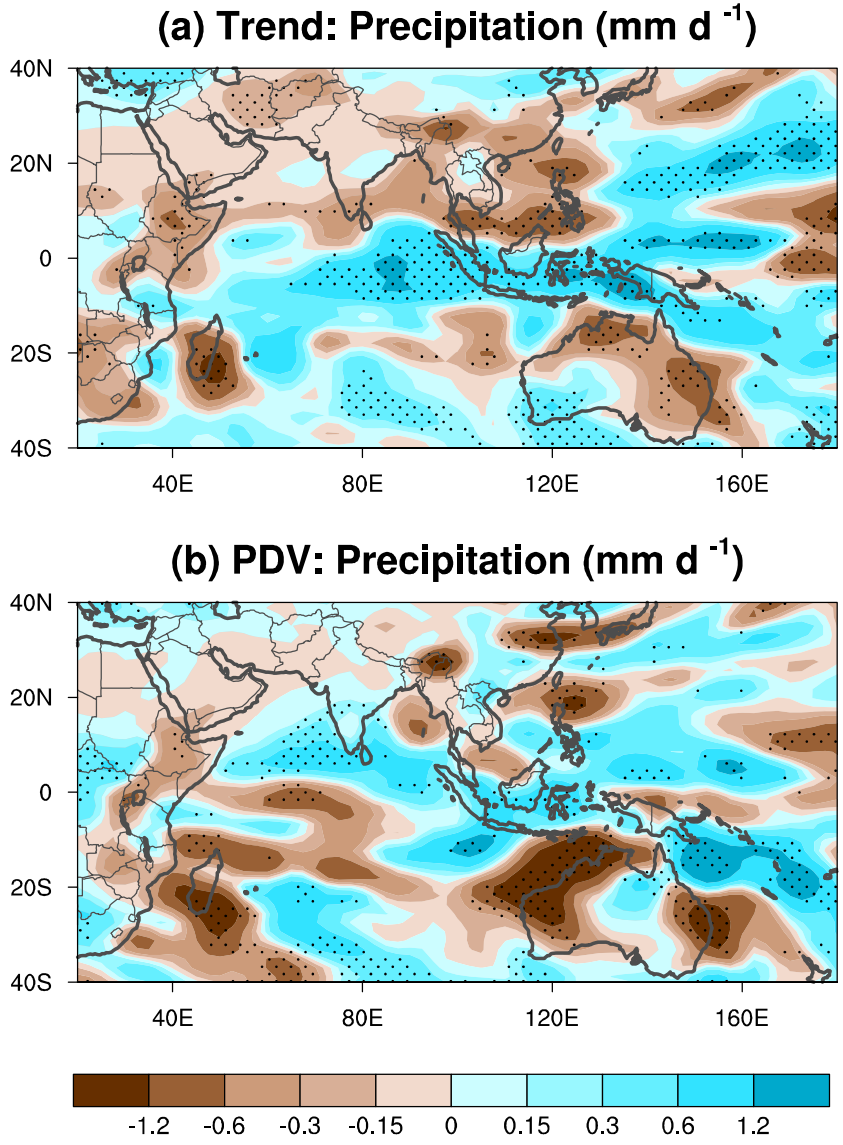


Hoell and Funk, Submitted to *Climate Dynamics*

Precipitation: PDV vs. Trend

Trend: Strong and statistically significant drying everywhere

PDV: East Africa drying, but otherwise mixed precipitation elsewhere



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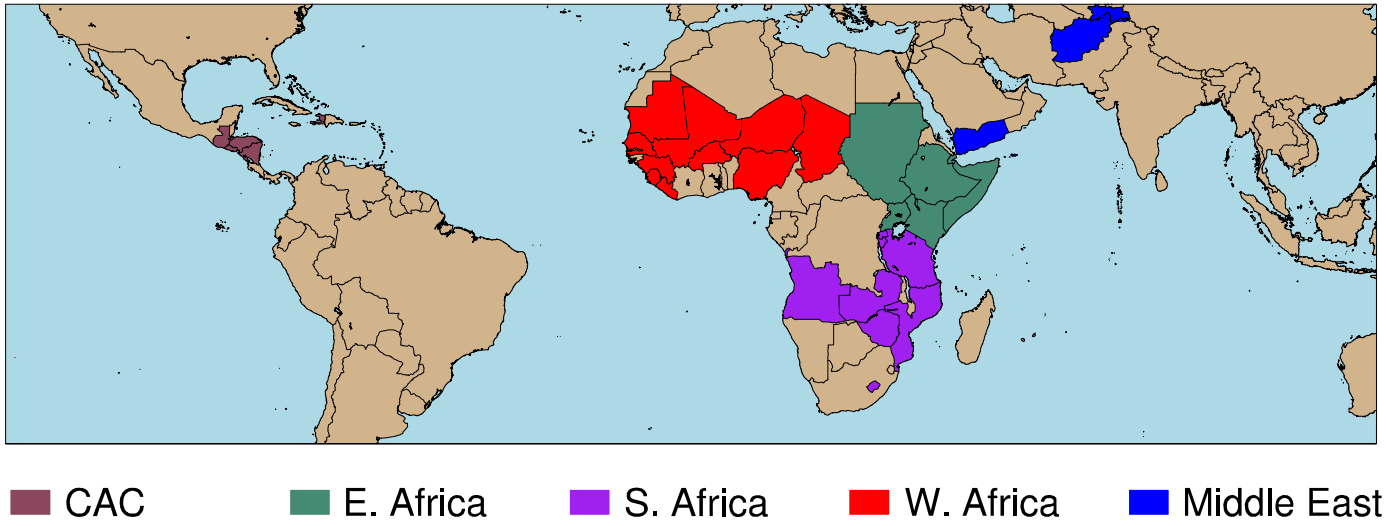
FEWS NET
FAMINE EARLY WARNING SYSTEMS NETWORK

- **Scientific Partners**
  - U.S. Geological Survey / U.C. Santa Barbara
  - U.S. National Oceanographic and Atmospheric Administration (NOAA)
  - U.S. National Aeronautics and Space Administration (NASA)
- **Scientific Goals**
  - Monitor land surface and atmospheric conditions
  - **Increase understanding of climate drivers over regions of concern**
  - **Provide monthly forecasts to decision makers**

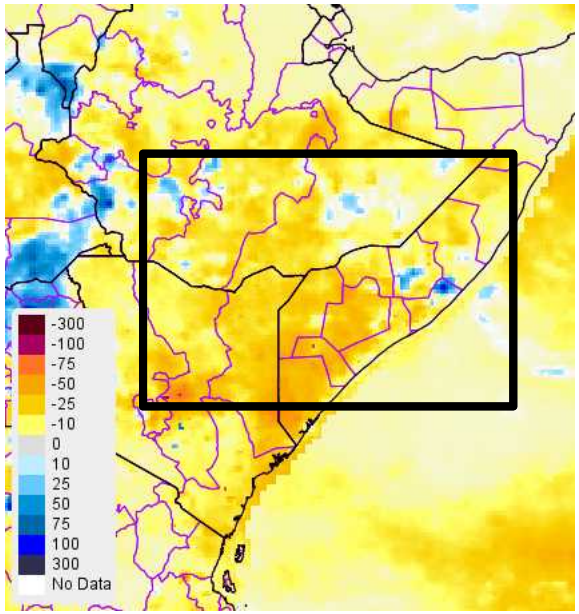
FEWS NET Countries

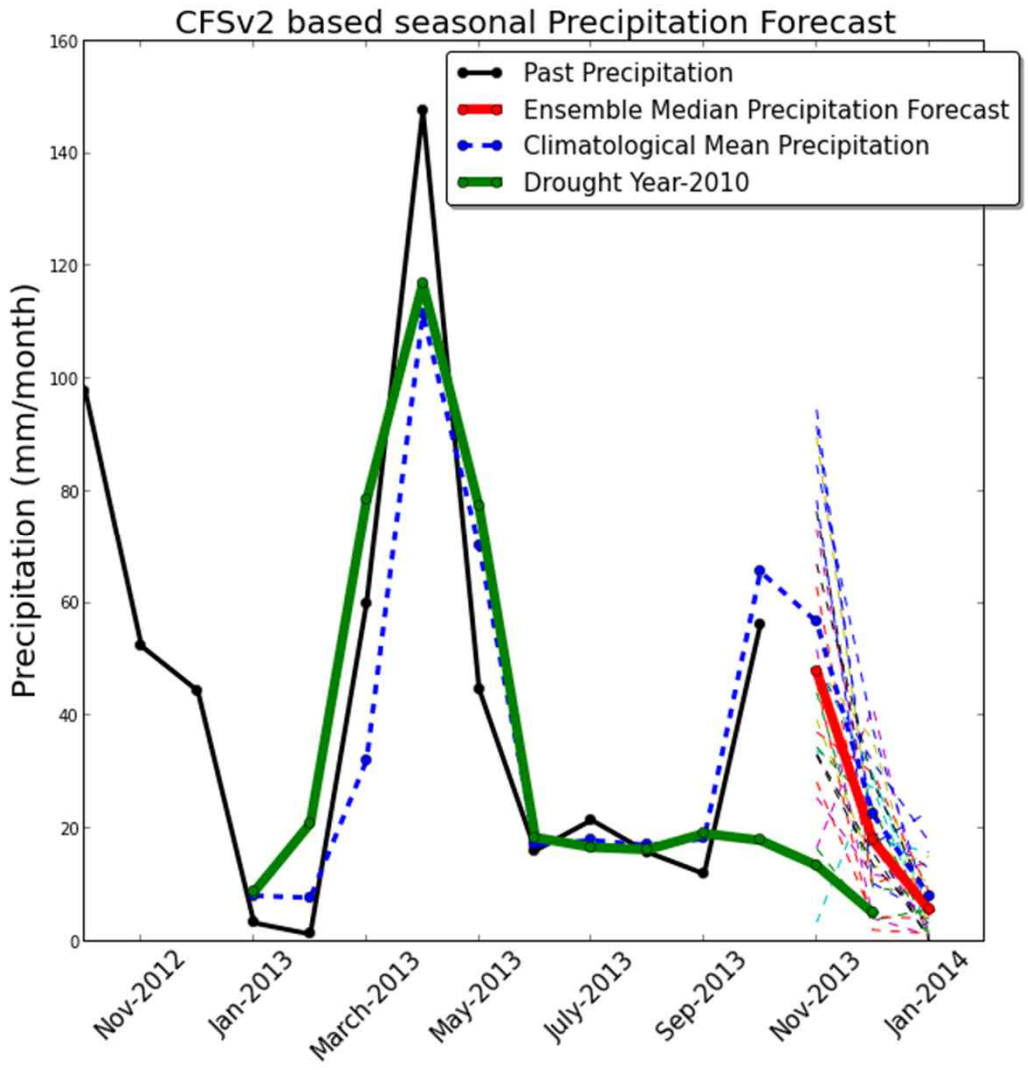


Real-time Precipitation Monitoring and Precipitation Forecasts

Precipitation forecasts for upcoming seasons created from correlation between hindcasts of CFSv2 rainfall over the Indo-Pacific and correlation of East Africa rainfall

Precipitation Anomaly (October 2013)

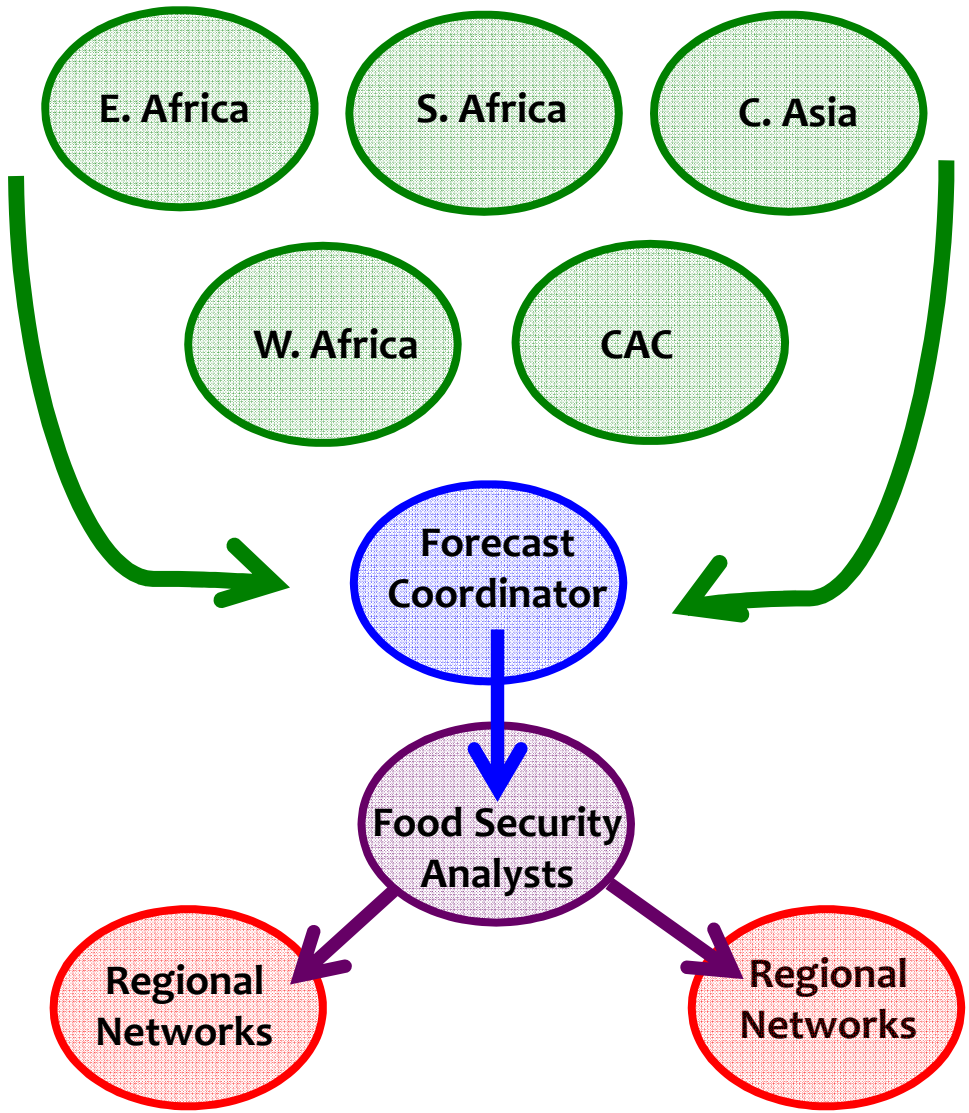




Shukla et al. 2013, in prep.

Collaborative Forecasting Activities

1. NOAA CPC presents an overview of the global climate
2. FEWS NET scientists and affiliated climate dynamicists discuss the current conditions over each region and the the role of large-scale climate variability on seasonal outlooks
3. The forecast coordinator synthesizes the analyses and presents to the food security analysts
4. The food security analysts communicate with the regional authorities
5. The regional authorities prepare for anticipated agro-climatic conditions



Summary

- The climates of Western Asia, the Middle East and East Africa are strongly influenced by Indo-Pacific climate variability operating on weekly to multi-decadal time scales
- Improved climate forecasts rely on our ability to understand how Indo-Pacific climate modes individually and synchronously force climate variability
- Improved climate forecasts are critical to food security over Western Asia, the Middle East and East Africa