South Asian Precipitation: A Seamless Assessment: SAPRISE

NERC/MoES funded project

Changing Water Cycle Programme

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10: Univ. Reading: Dr Andy Turner, Prof Richard Allan, Prof Ellie Highwood
Partner Institutions and Scientists

Kick Off Meeting Pune in Feb 2012

Exeter Meeting June 2013

Delhi Meeting July 2014
Scientific Objectives

• To investigate driving processes, variability, predictability and forced changes in South Asian precipitation on multiple time scales.

• A key focus will be on interactions with the Indian and remote ocean basins and on the local and remote interactions with the dynamic and radiative effects of aerosol.
Specific Objectives

1. Investigate *processes* responsible for *present day mean, variability and change in South Asia precipitation* and test the *ability of state-of-the-art climate models* to simulate this. **Work Package – 1**

2. Evaluate the *skill of initialized experiments in predicting* South Asia precipitation variability and *investigate mechanisms for predictability*. **Work Package – 2**

3. Investigate *changes in South Asia precipitation* and its *drivers and interactions in a changing climate*. **Work Package – 3**

4. Provide a *seamless assessment and syntheses* of results to advance our *understanding of variability, predictability and change in precipitation in South Asia*. **Work Package - 4**
Observational Challenges

Understanding and evaluating monsoon processes in the MetUM

Gill Martin¹, Richard Levine¹, Stephanie Bush*, Nick Klingaman*

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Monsoon depressions and lows diagnosed in ERA interim re-analysis compared to IMD e-Atlas of MDs and TCs

Method picks up most monsoon depressions and stronger monsoon lows (not included in IMD e-Atlas), however, difficulty diagnosing stationary systems in N Bay of Bengal / NE India
Distinct Teleconnections

Result Summary: Seasonal teleconnections of El Niño Modokis and El Niño are distinctly different and not subject to the inclusion of big El Niño events.

Marathe et al. 2015, Climate Dynamics
Model ensemble of ISM and SST

Clear connection (anti-correlation) between tropical Pacific SST and ISM around central NE India matching observation. [Roy, Tedeschi and Collins, IJC, 2016, under revision]
Local Influence on Regional (Hilly Region) Precipitation

- La Niña in general more precipitation, El Niño less.
- During El Niño, U850 is positive, For La Niña it is negative. Indicate change in direction of Walker circulation.
- CMIP5 models show strong correlation among models in all El Niño and La Niña phases (c.c. = -0.72). [Roy and Tedeschi, Atmosphere, 2016]
Comparison of indirect and direct-only model groups: late C20th minus PI

- Common signal of declining rainfall in E/SE Asia
- Increase of South Asian monsoon in direct-only models suggests GHG dominance

Guo et al. (2013, ACP) showed 2000 aerosol emissions to have decreased EASM since 1950s; both indirect and direct effects implicated.

- Reinforces importance of indirect effects on South Asian monsoon

Guo, Turner, Highwood (2015, ACPD)
Extreme El Niños

SAPRISE Headline Numbers

• Three major project meetings (Pune, Exeter, Delhi) plus numerous other smaller meetings

• 35+ publications associated with the project

• 5 publications in Nature Climate Change, one in Nature Geosciences

• Key messages
  – Observational errors may soon limit progress in improving climate models
  – Models can capture Monsoon-response to canonical El Niños but not Modoki events
  – Aerosol emissions oppose the global warming signal in Monsoon rainfall, which is projected to increase as emissions reduce
SAPRISE Synthesis Paper

- To summarize the current state-of-the-art in S. Asian Monsoon prediction and projection

- Focus on key areas
  - Current status of observations
  - Current status of models
  - Remote teleconnections, their mechanisms and their changes through time
  - Effects of aerosols and their interaction with the greenhouse gas signal

- Recommendations for future research


Thank You