

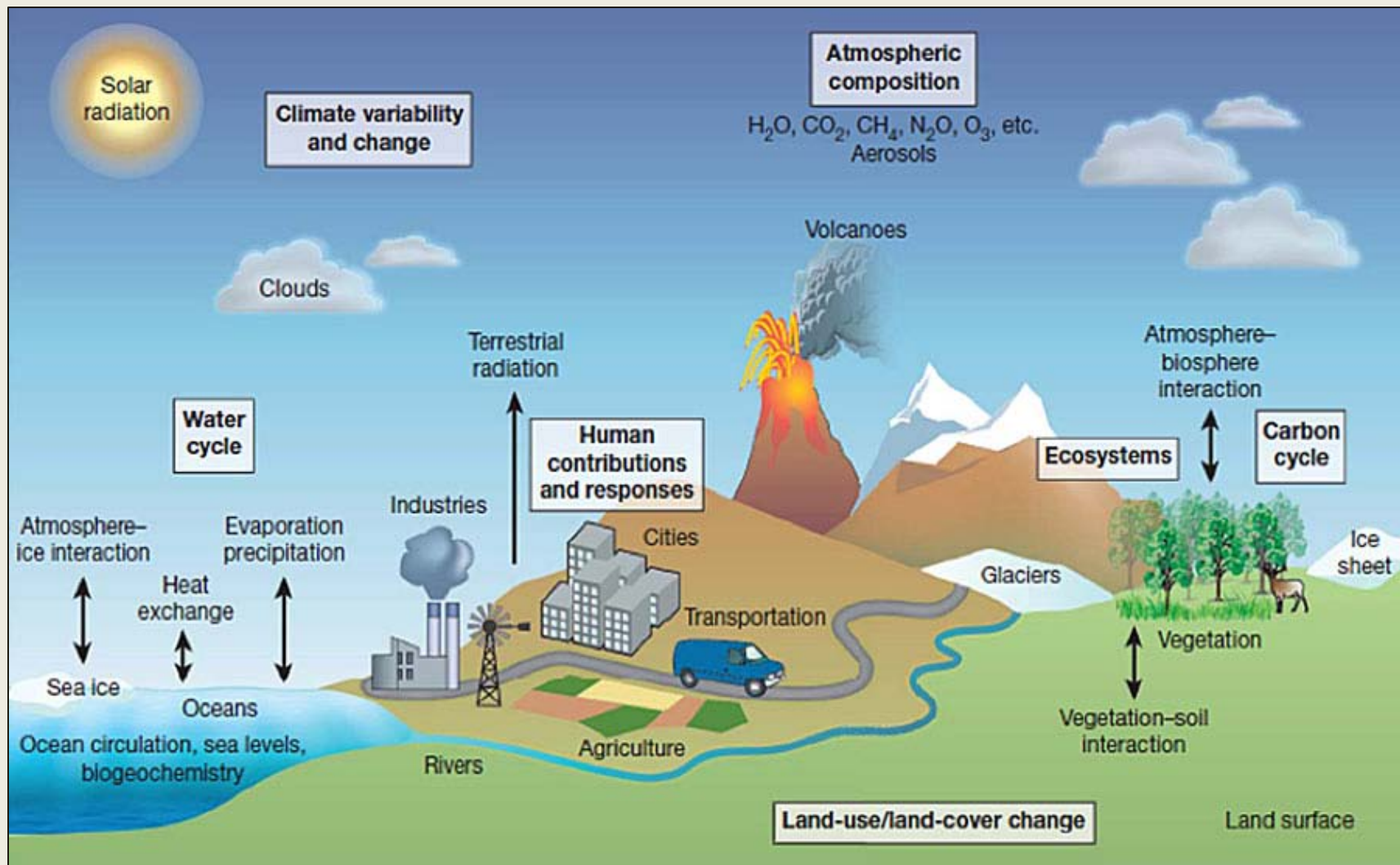
The Impact of Intensified Irrigation on the Indian Monsoon and Moisture Transport



Sonali Shukla McDermid, PhD
November 15th, 2013



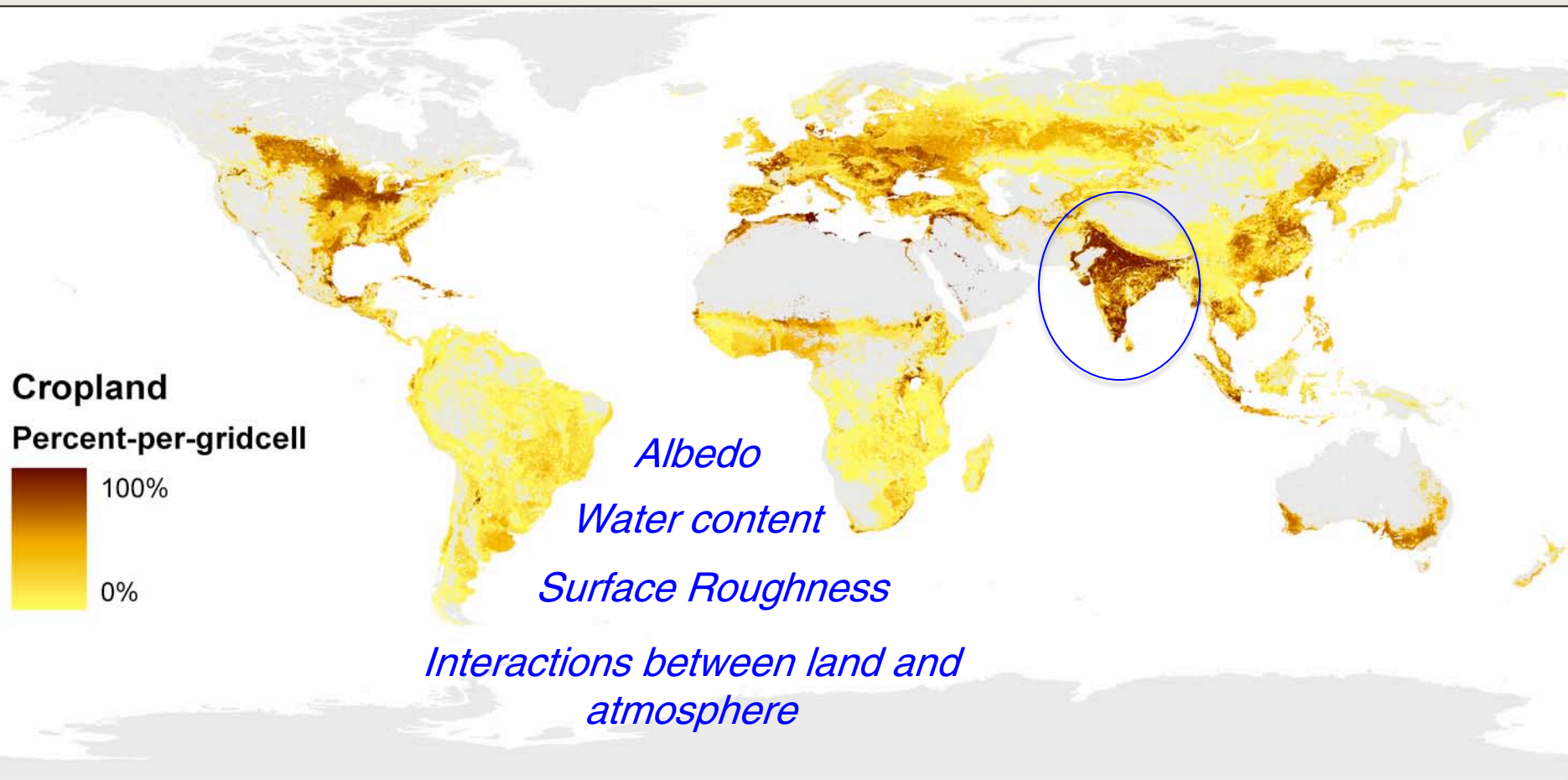
Forcings and Feedbacks in Agriculture and Climate





Overview of South Asian Climate and Agriculture: A Prime Example

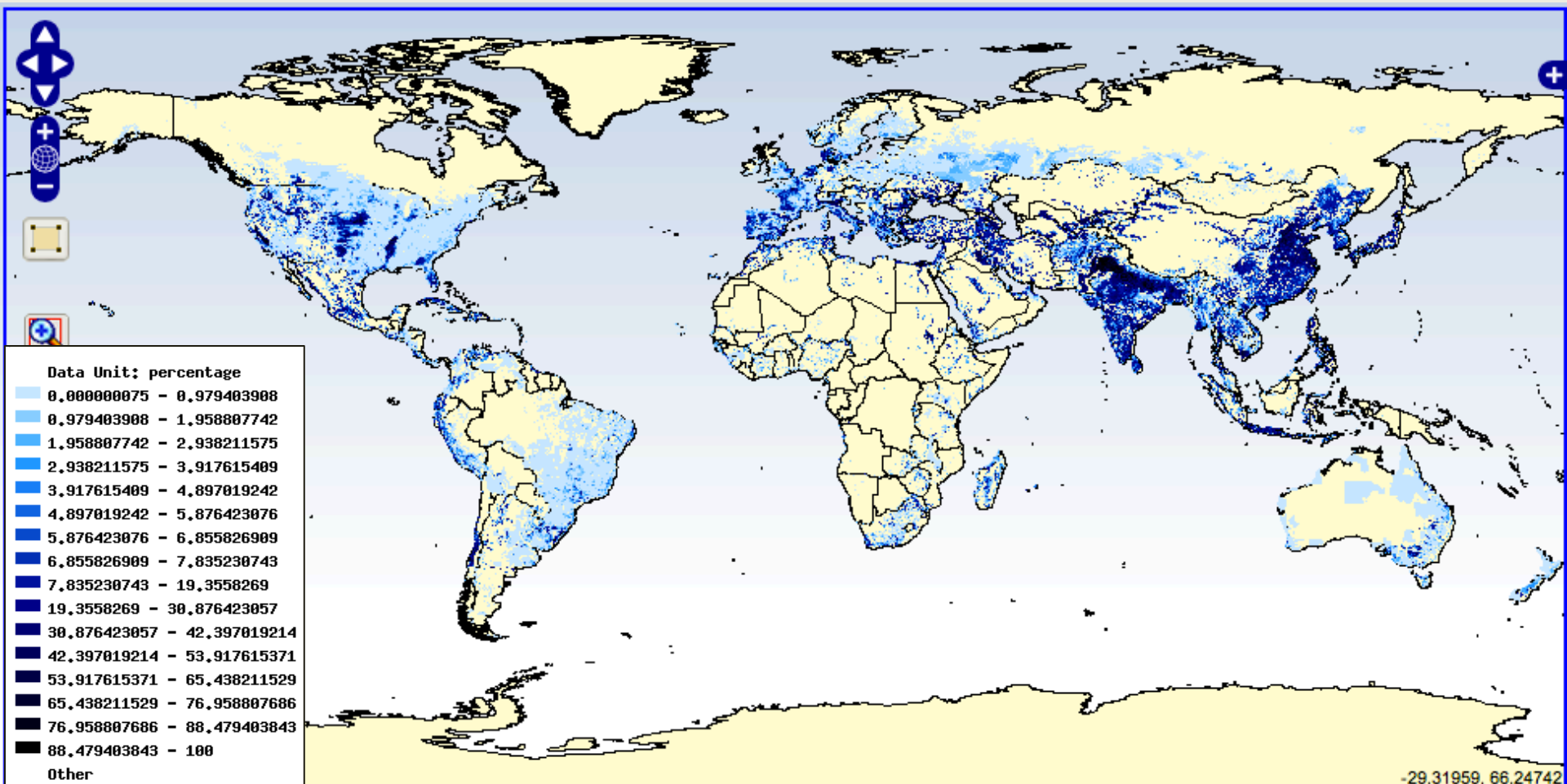
Cropped Areas





Considering Irrigation as a Climate Forcing

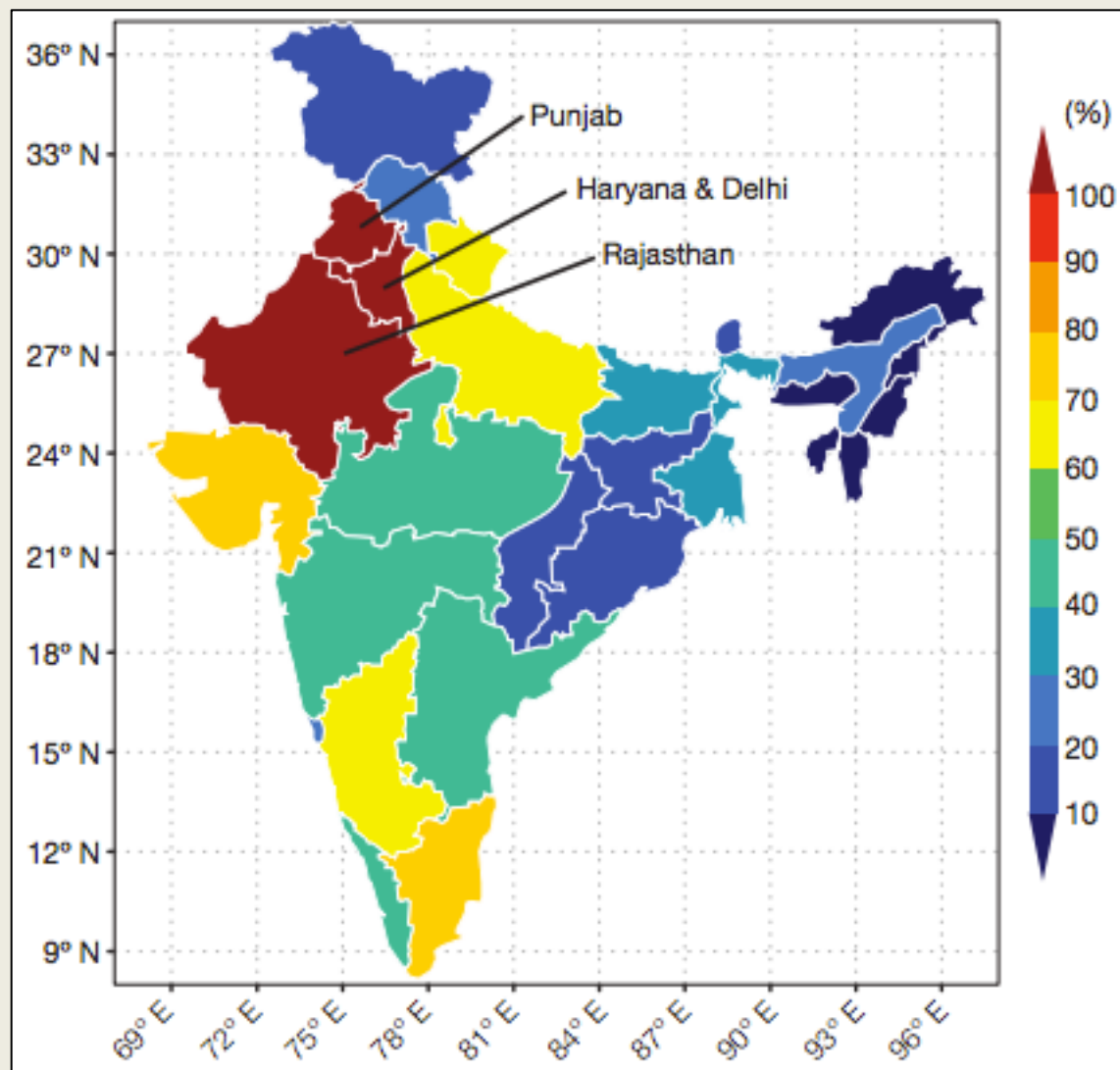
Irrigated Areas (Percent of gridbox)





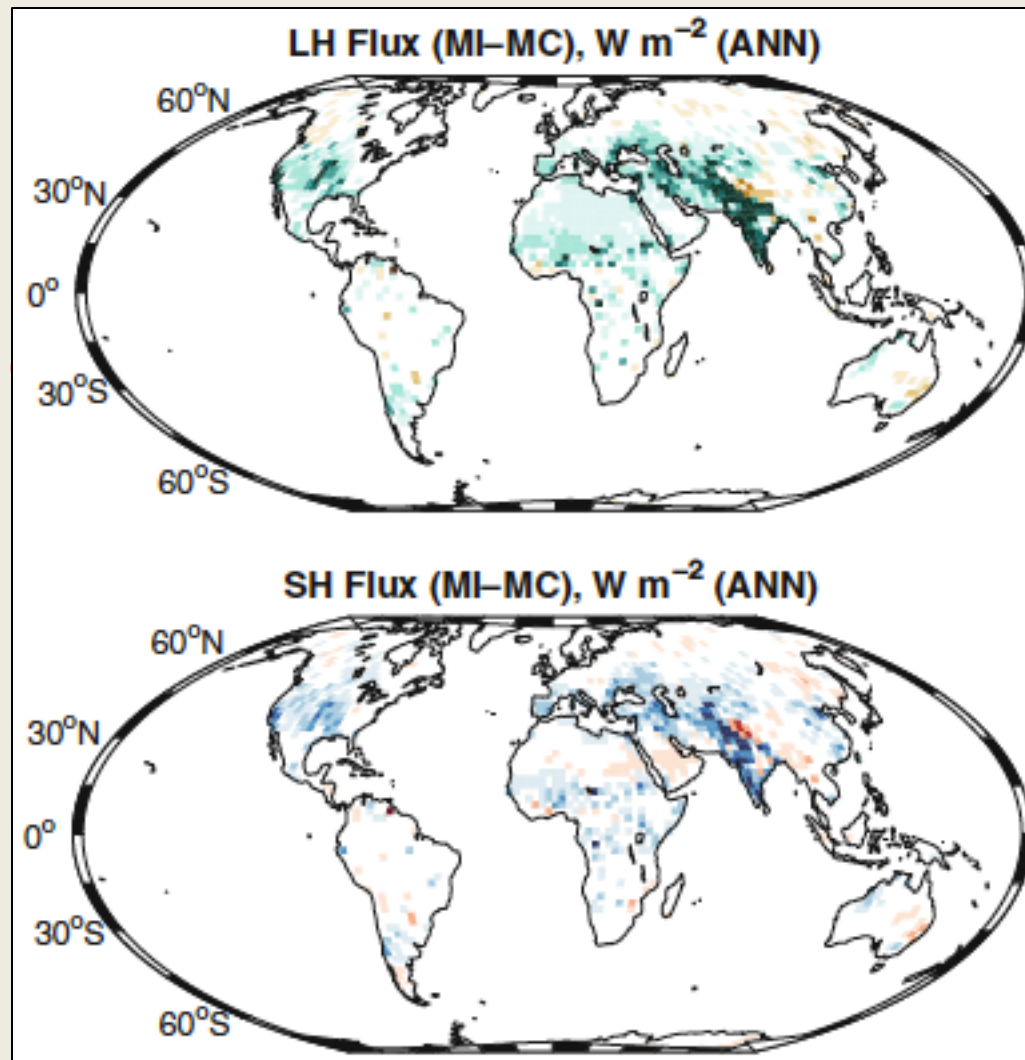
Considering Irrigation as a Climate Forcing

Groundwater
withdrawals as a
percentage of recharge
(based on state-level
estimates
by the Indian Ministry of
Water Resources)



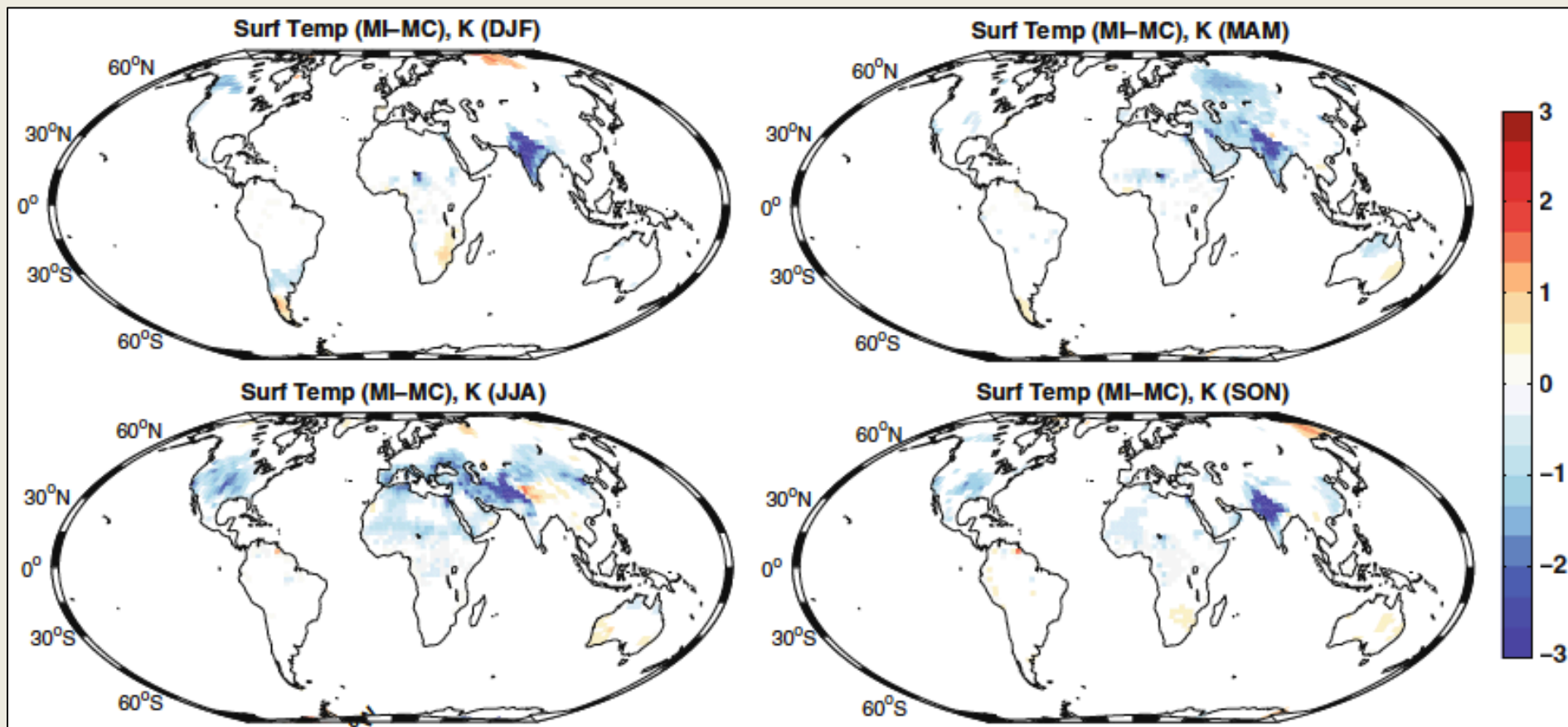
Considering Irrigation as a Climate Forcing

Latent and Sensible Heat Flux (Irrigated – Control Simulations)

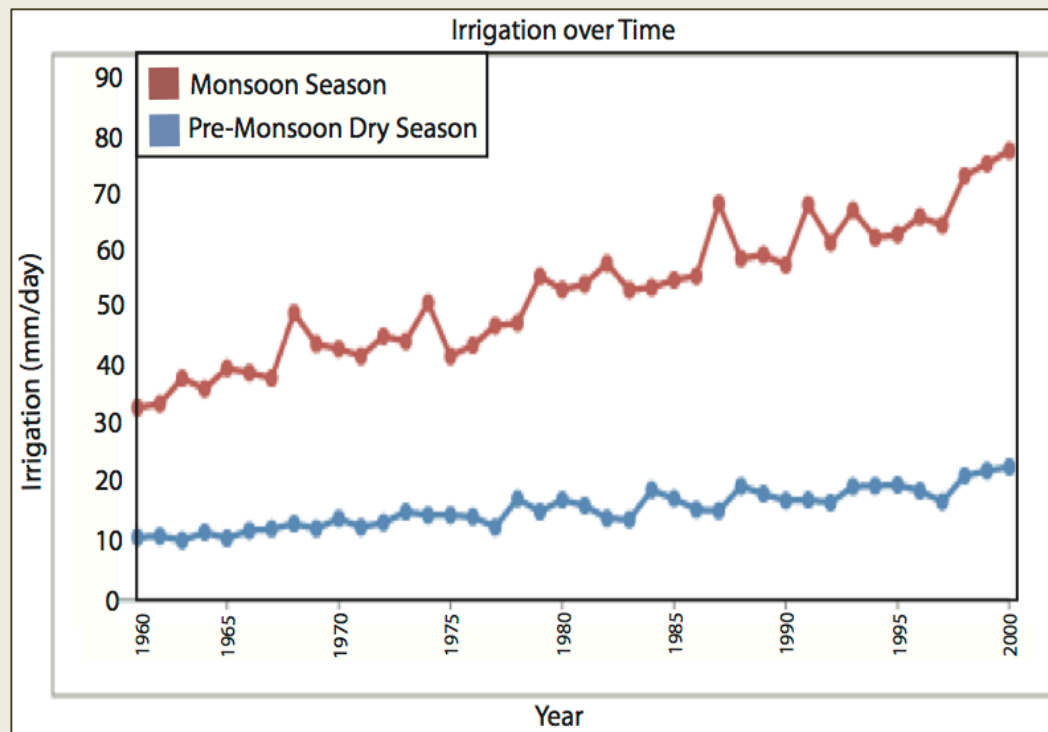
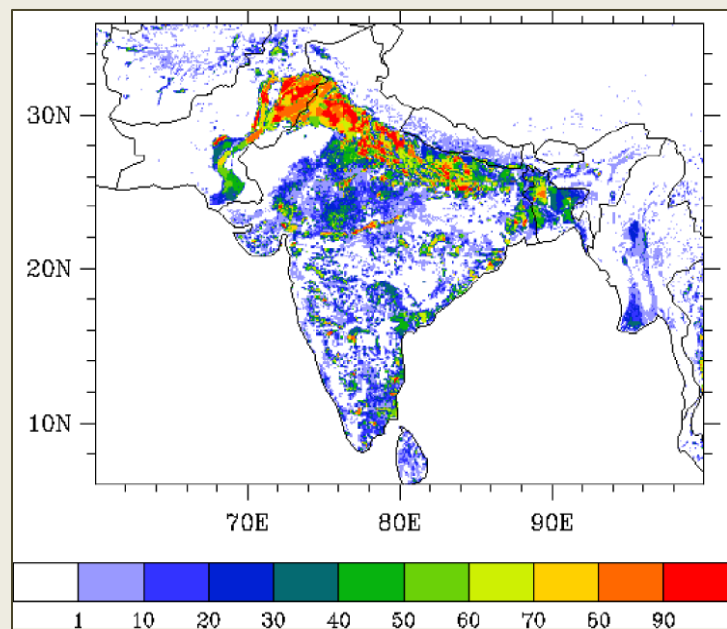


Considering Irrigation as a Climate Forcing

Seasonal Surface Temperature (Irrigated – Control)



Indian Irrigation in GISS ModelE





Irrigation and the Monsoon

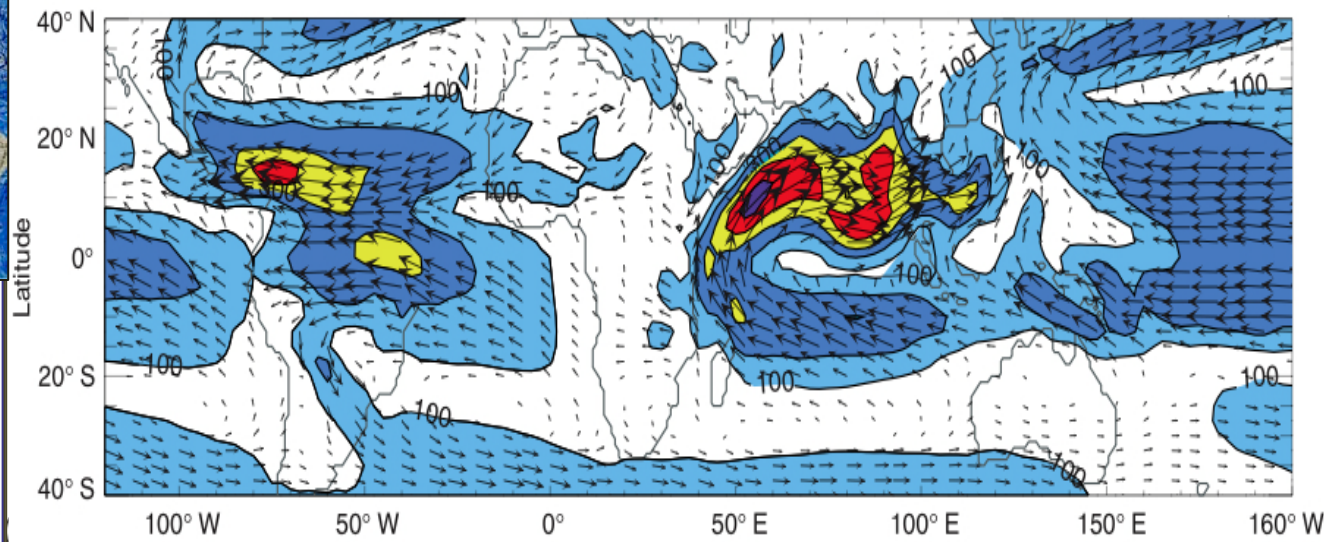
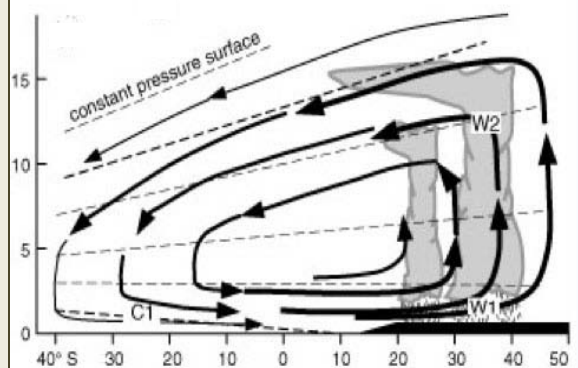
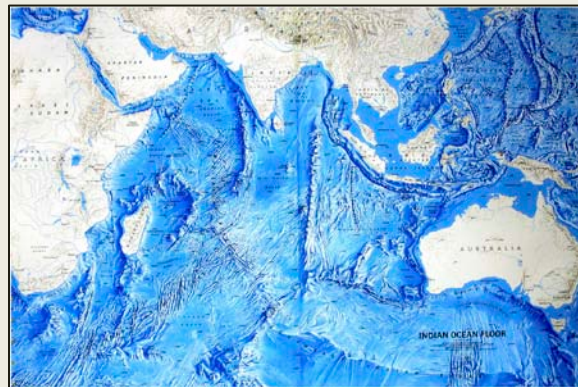




Irrigation and the Monsoon

General Circulation

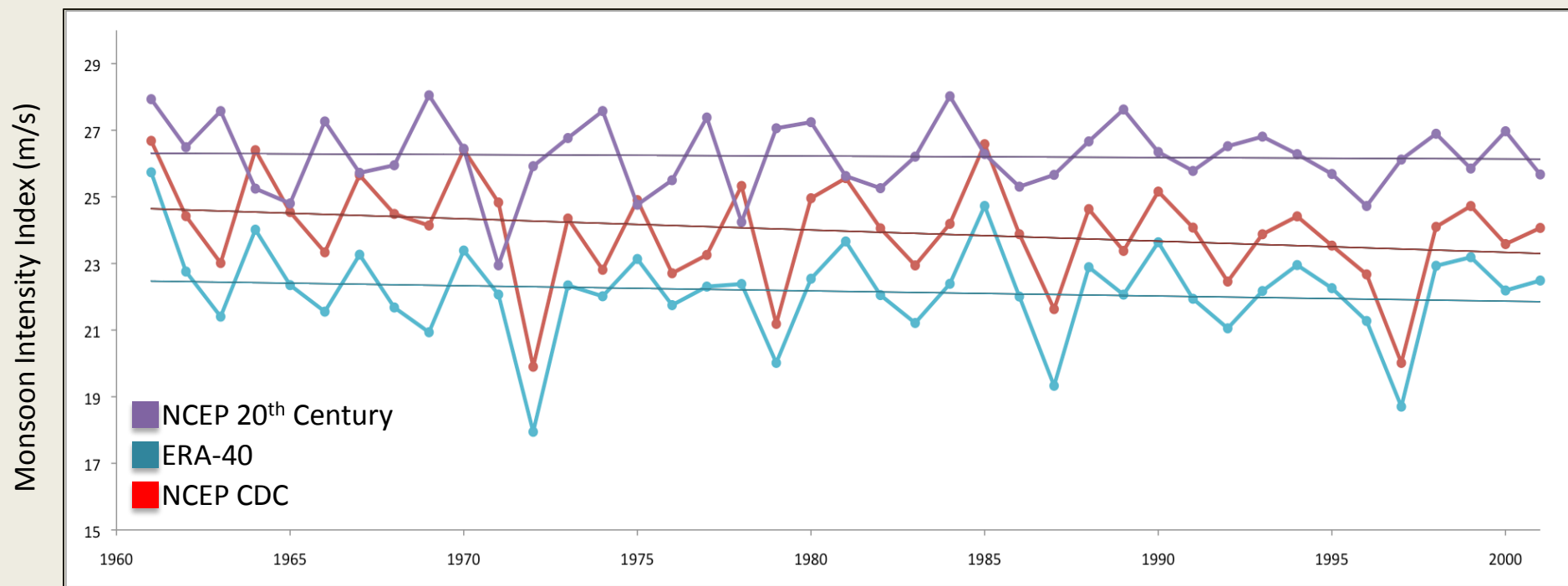
Monsoons



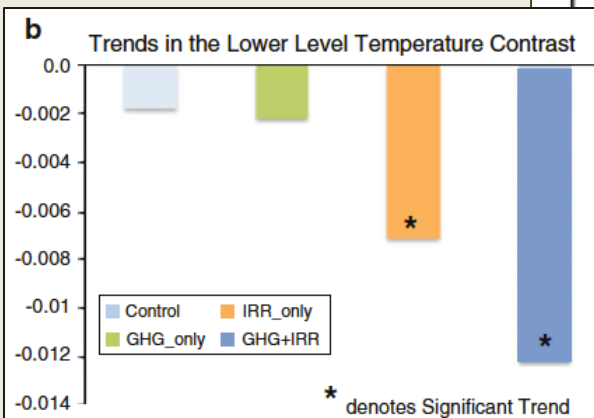
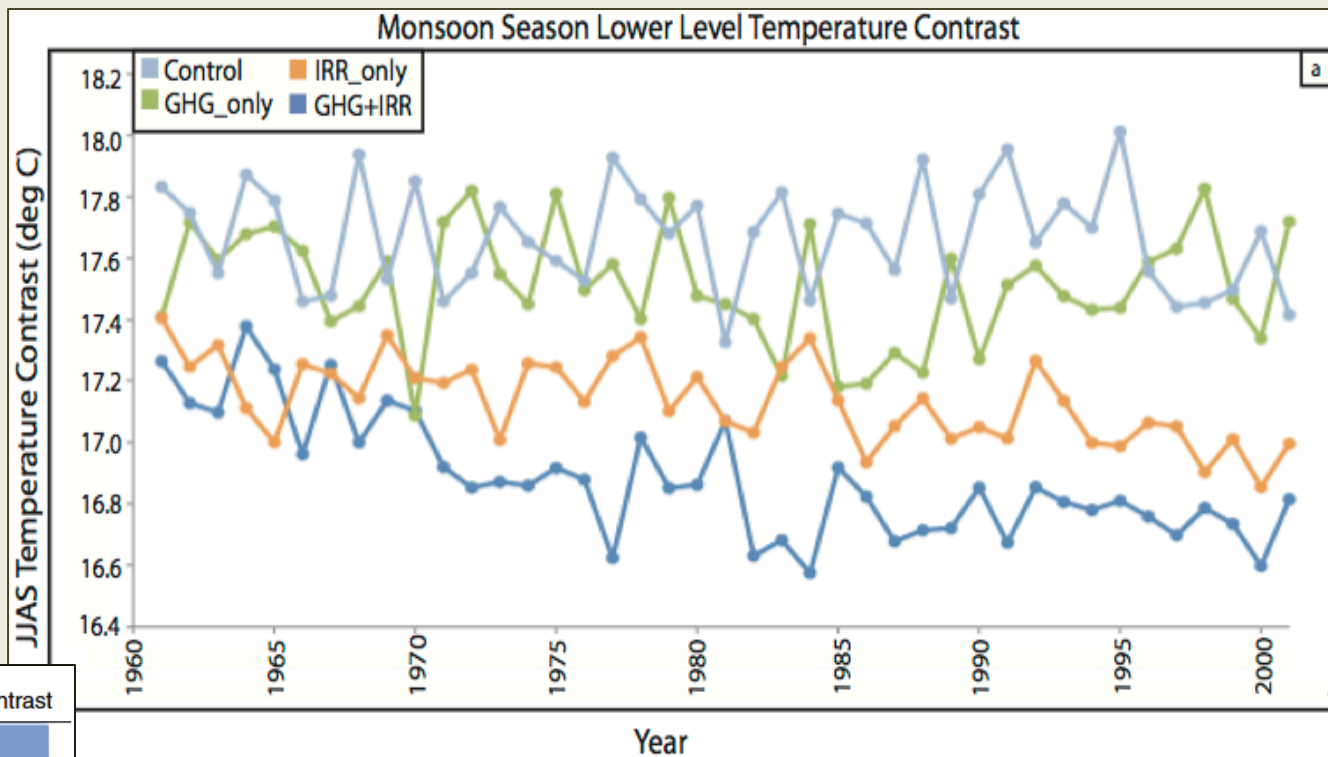
$3 \times 10^2 \text{ kg ms}^{-1}$



Monsoon Metrics: Monsoon Circulation Intensity

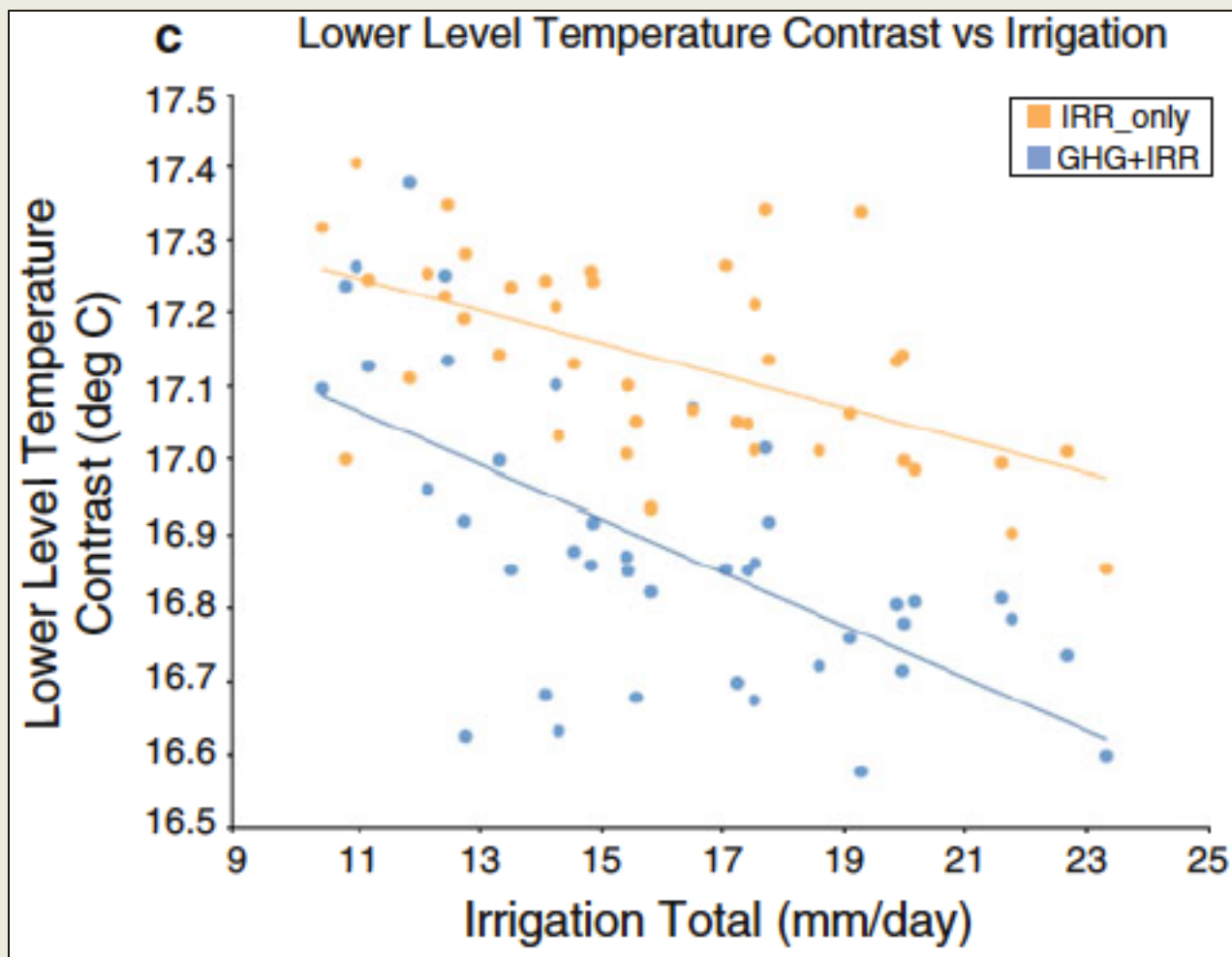


Monsoon Metrics: Monsoon Circulation Intensity

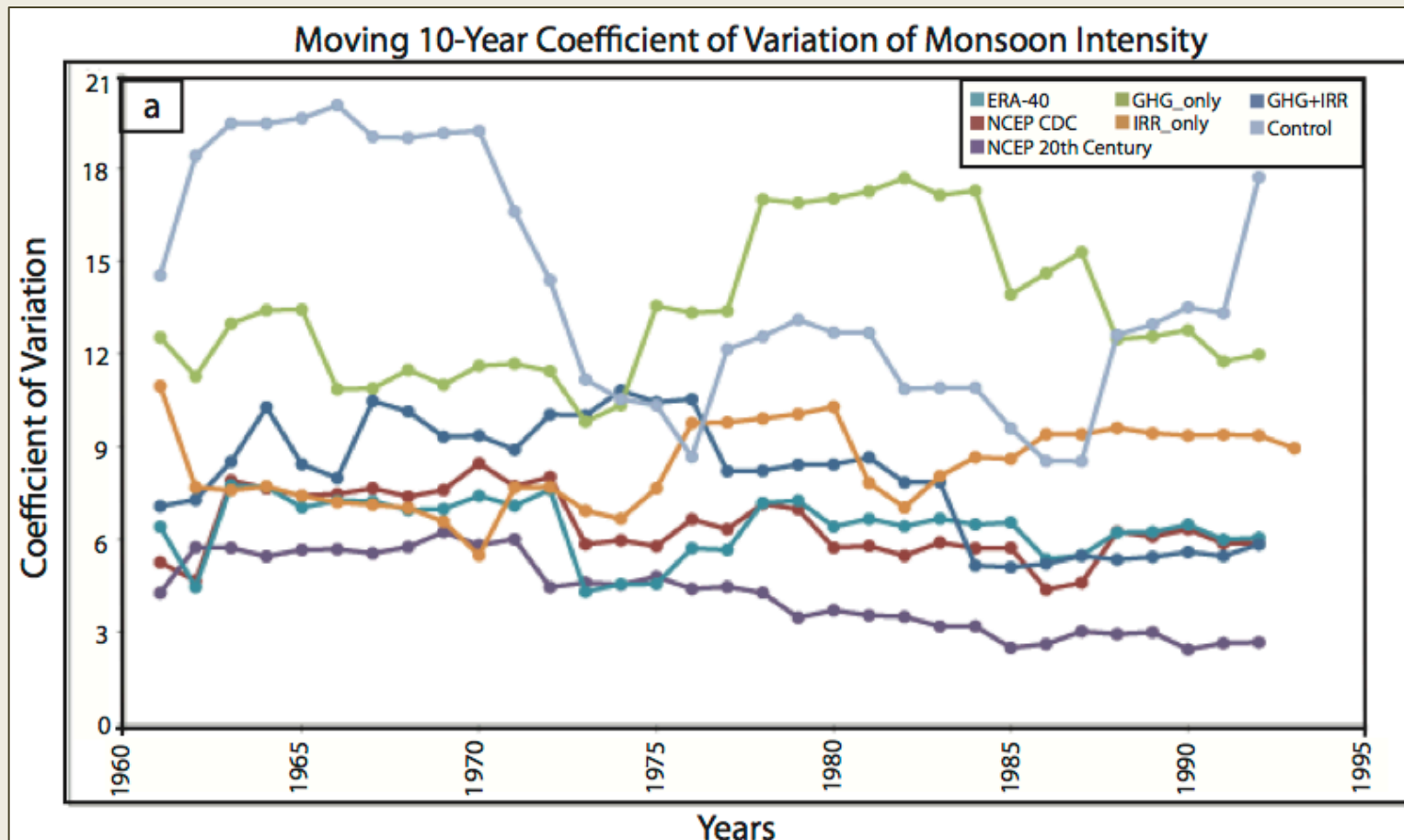


Indicates the temperature contrast between the northern Indian land surface and the equatorial Indian Ocean

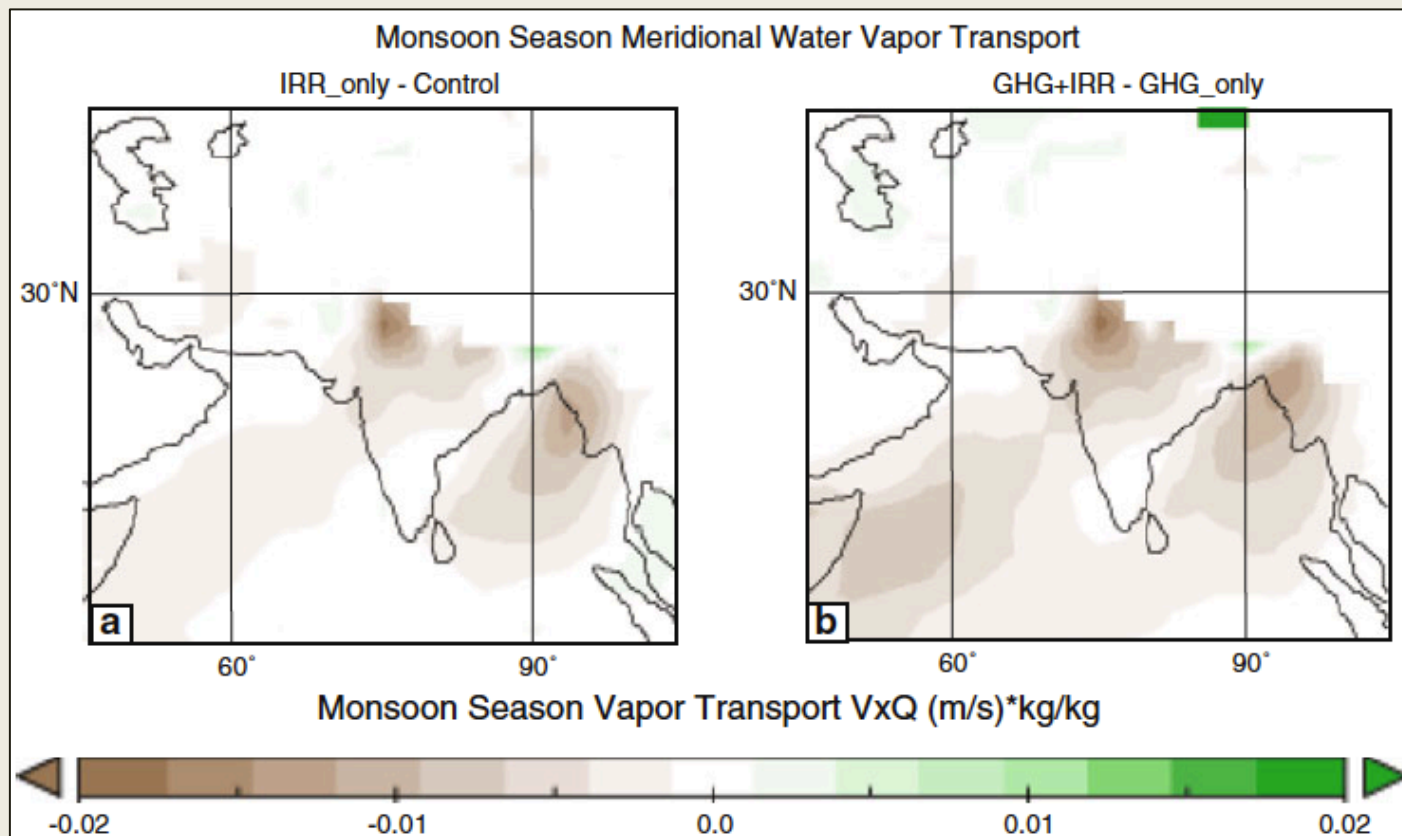
Monsoon Metrics: Monsoon Circulation Intensity



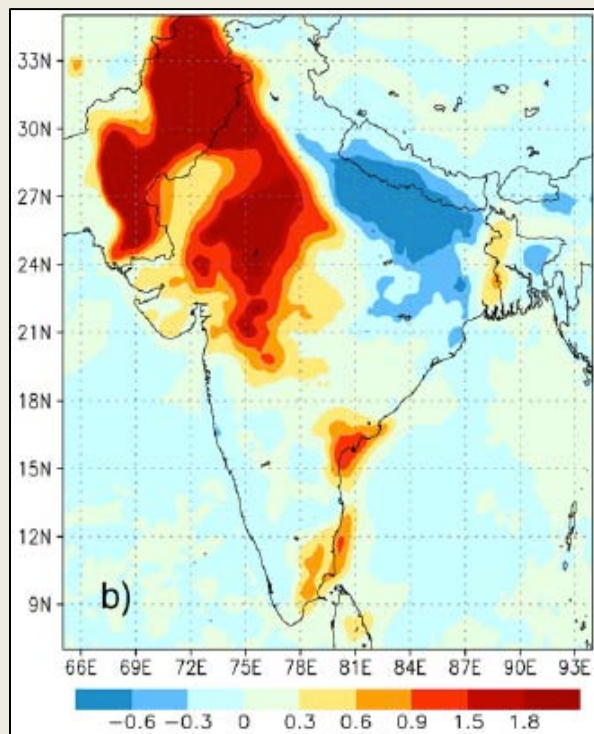
Monsoon Metrics: Variation in Monsoon Intensity



Monsoon Metrics: Variation in Monsoon Intensity

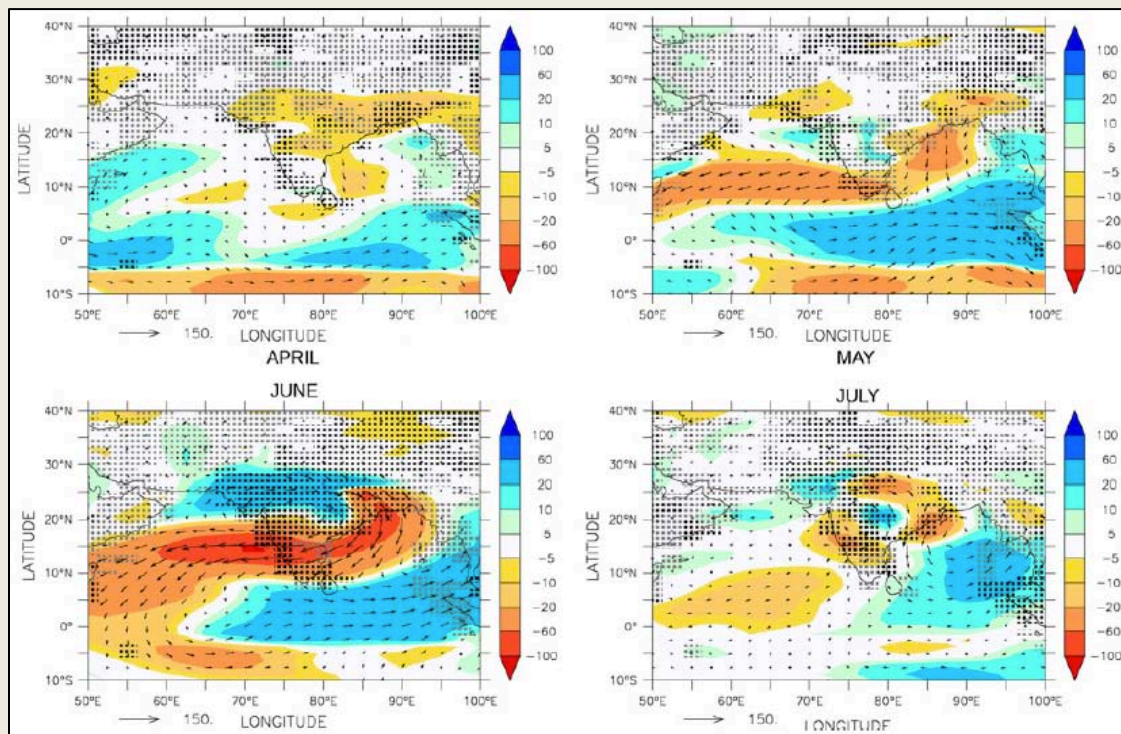


Change in Water Vapor (g/kg)



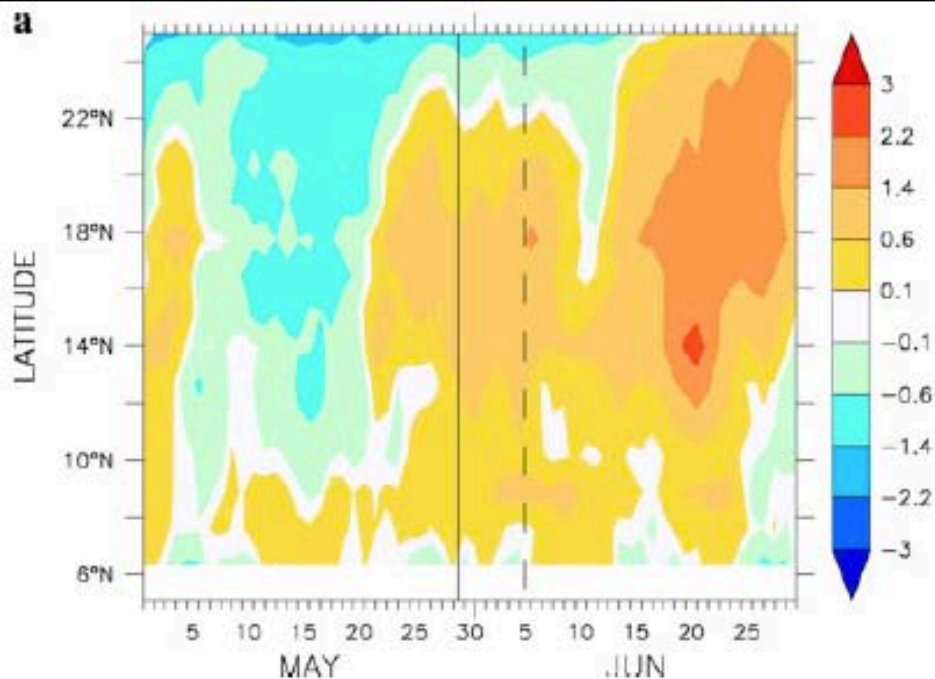
Douglas et al. 2009

Change in Moisture Transport (kg/m/s)

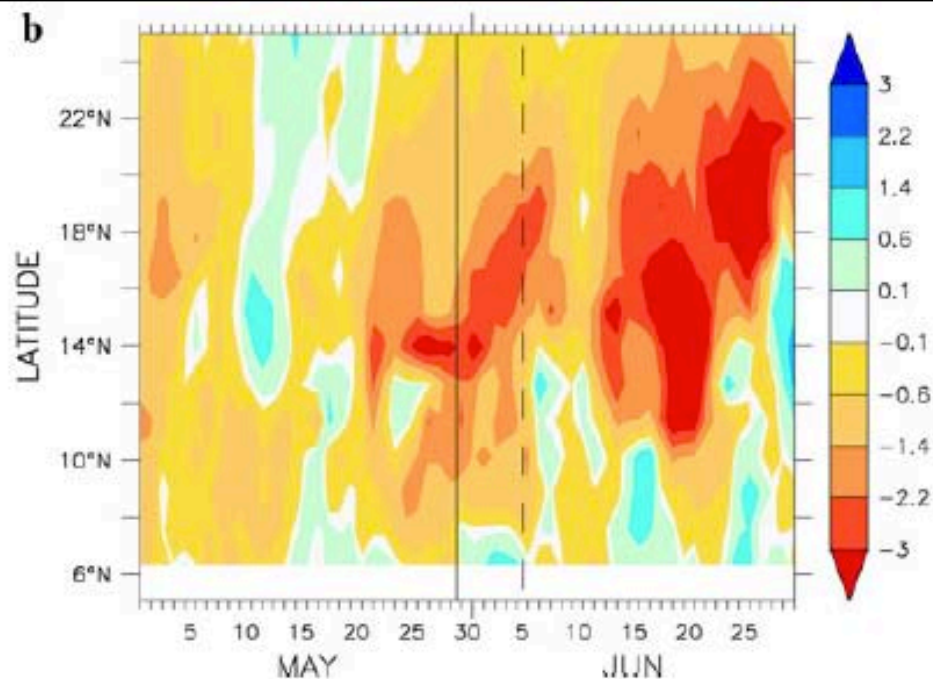


Guimberteau et al. 2011

Difference in Surface Temp



Difference in Rainfall





Agricultural Land use and the Monsoon

Significant Irrigation Amounts Regulates the Surface Temperature

Attenuates the Monsoon Circulation

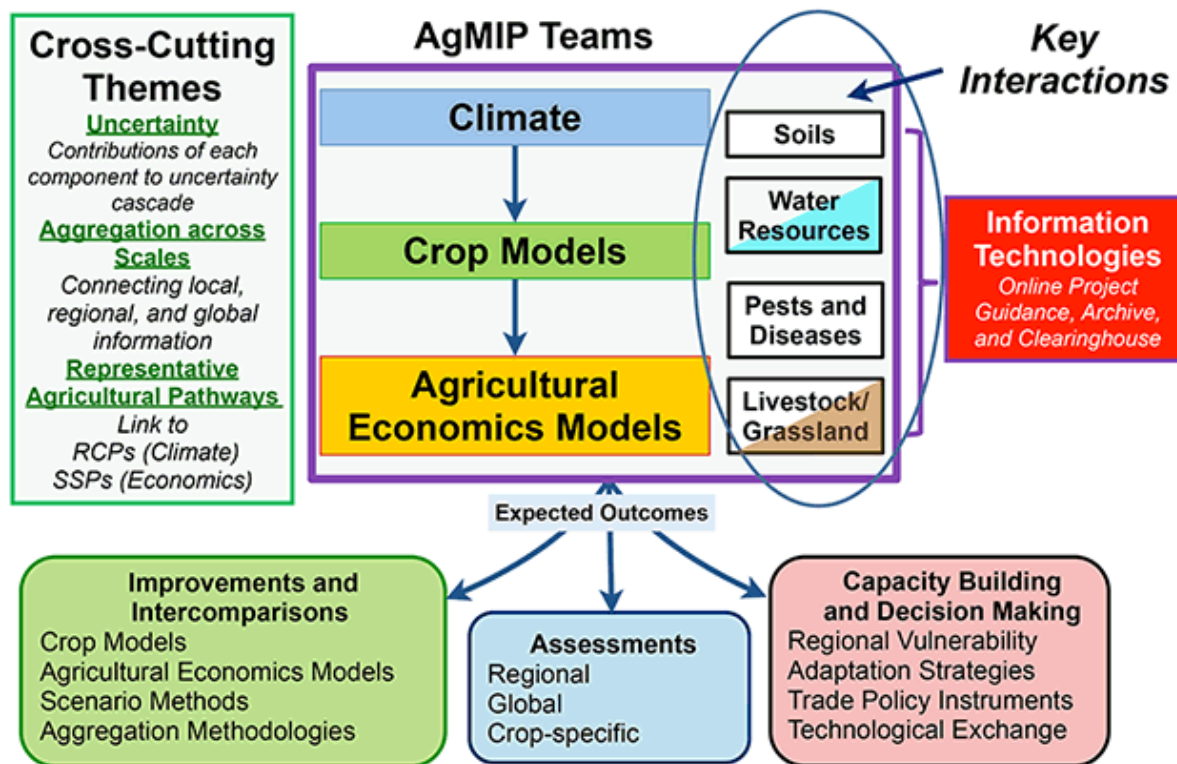
Significant Regional Forcing

Better Representation when Combined with GHG Forcing



AgMIP and South Asian Assessments of Food Security

AgMIP Teams, Linkages, and Outcomes



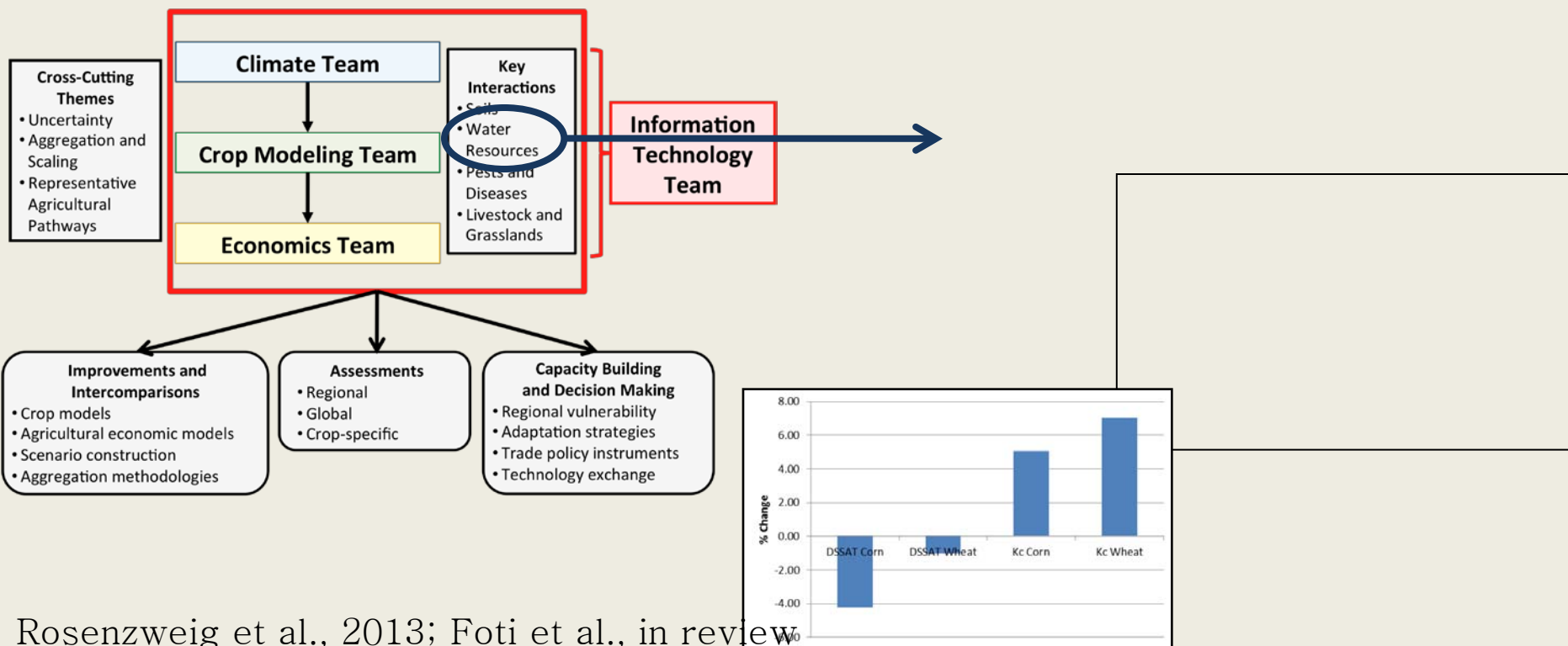
Rosenzweig et al., 2012 (in press)

The Agricultural Model Intercomparison and Improvement Project
www.agmip.org



AgMIP and South Asian Assessments of Food Security

Develop projects that assess the effects of climate change and variability on irrigated crops in the United States and throughout the world, as well as build collaborative opportunities to create a portfolio of research at the interface of water and agriculture within the AgMIP framework.

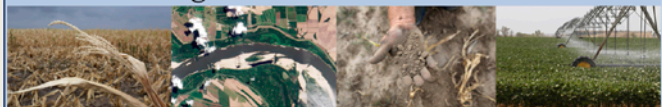




AgMIP and South Asian Assessments of Food Security

NASA-funded AgMIP Water pilot project that uses a cascade of hydrologic and crop models to assess irrigated agriculture in California under future climate

AgMIP-ERS Workshop: Integrating Water Scarcity into Future Agricultural Assessments



NASA Goddard Institute for Space Studies
New York, NY
April 30 - May 1, 2013

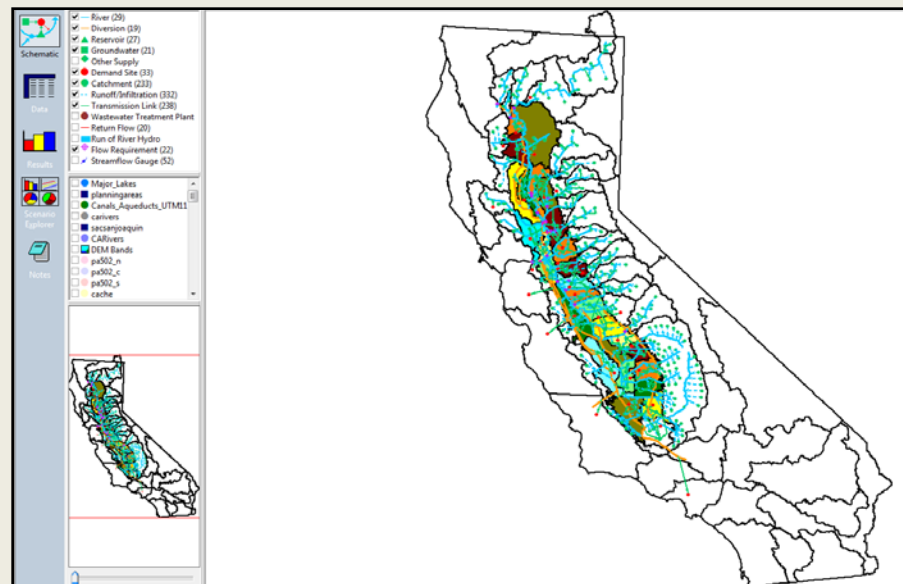
This workshop will bring together leading scientists in climate, hydrology, water resources management, agronomy, and economics to create strategies for integrating water supply and demand into AgMIP assessments of the agricultural sector. Specific objectives include:

1. Survey key existing climate, hydrologic, water resources management, agricultural, and economic modeling efforts
2. Identify and prioritize critical areas of uncertainty within and cascading across climate, hydrologic, water resources management, crop, and agricultural economic models
3. Leverage expertise in the fields of climate, hydrology, water resources management, agronomy, and economics to improve integrated assessment studies
4. Establish a research community to develop an AgMIP project exploring the impacts of water supply and demand on future agriculture

Contact: Jonathan Winter (jw2893@columbia.edu)



Center for Climate Systems Research
Earth Institute, Columbia University



AgMIP – USDA Economic Research Service Water Workshop, which brought together over 35 scientists in climate, hydrology, water resources management, agronomy, and economics to create strategies for improving the representation of water supply and demand in agricultural assessments



AgMIP and South Asian Assessments of Food Security

- AgMIP Global Workshop Breakouts – Come find out more about and shape the future research of AgMIP Water!
- Publications – Distill AgMIP-ERS Workshop notes into a report
- Global Collaborations – Link to ongoing national and international efforts at the water-agriculture nexus.
- Next AgMIP Water Workshop – Currently organizing and searching for funding
- More proposals – Continue to pursue funding to build individual projects that explore facets of climate impacts on water resources and agriculture

Questions, comments,
suggestions?

Jonathan Winter

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