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Water in GCAM

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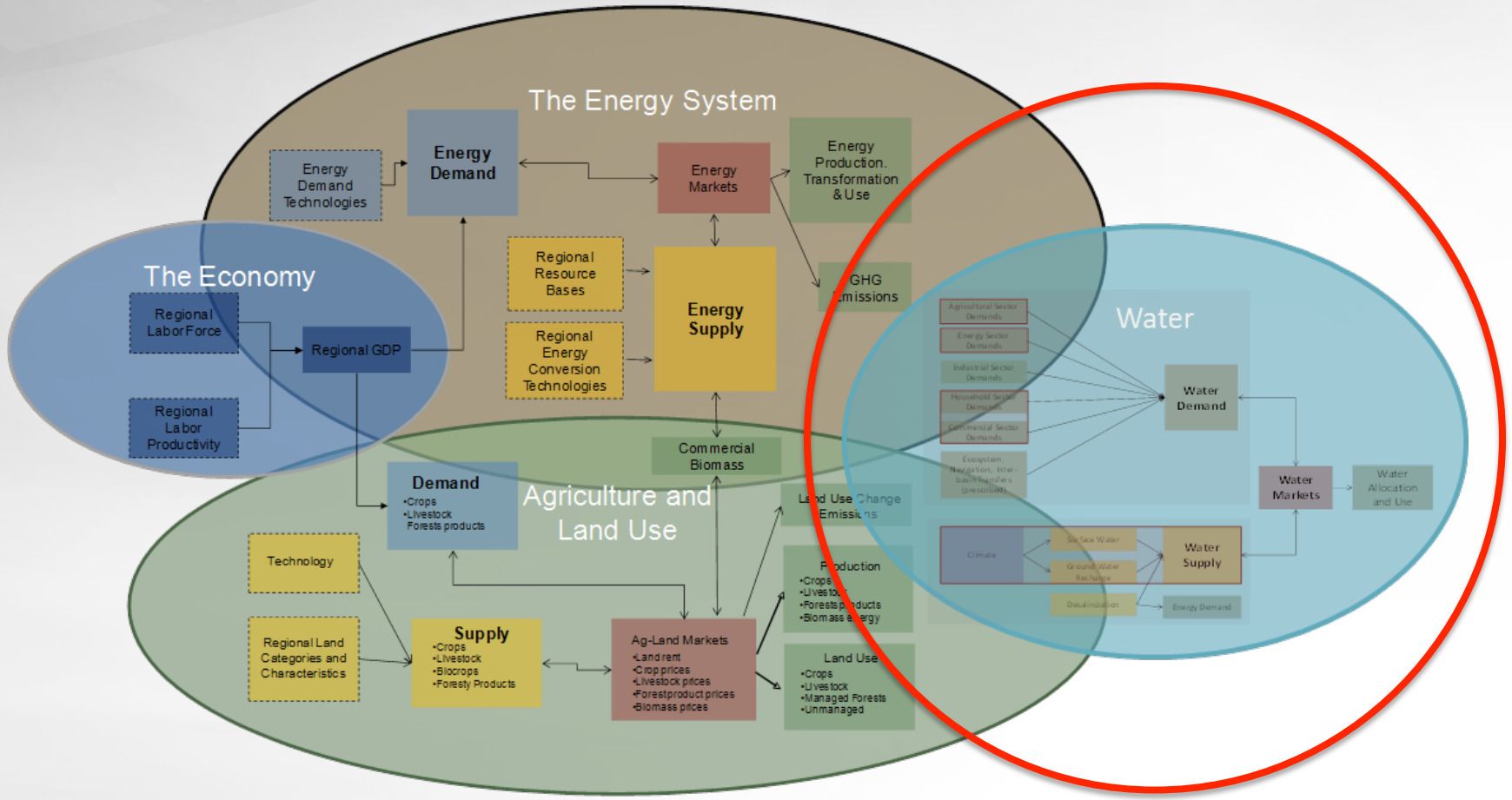
The PNNL Joint Global Change Research Institute
At the University of Maryland in College Park

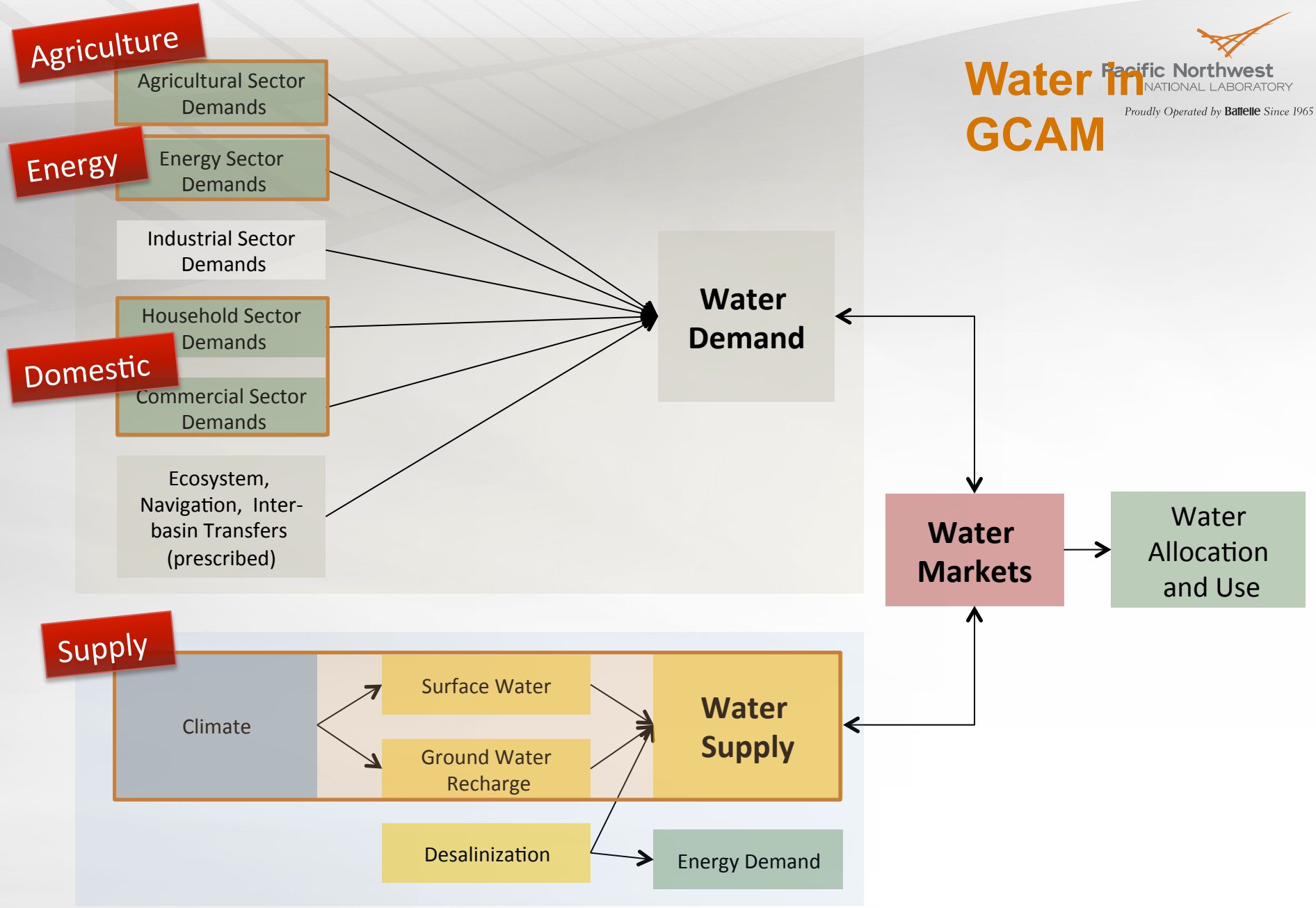
03 August 2012
Workshop on Climate Impacts and Integrated Assessment
Snowmass, Co

Long term research support provided by
U.S. DEPARTMENT OF ENERGY | Office of Science

Water is a Major Model Development Focus for GCAM

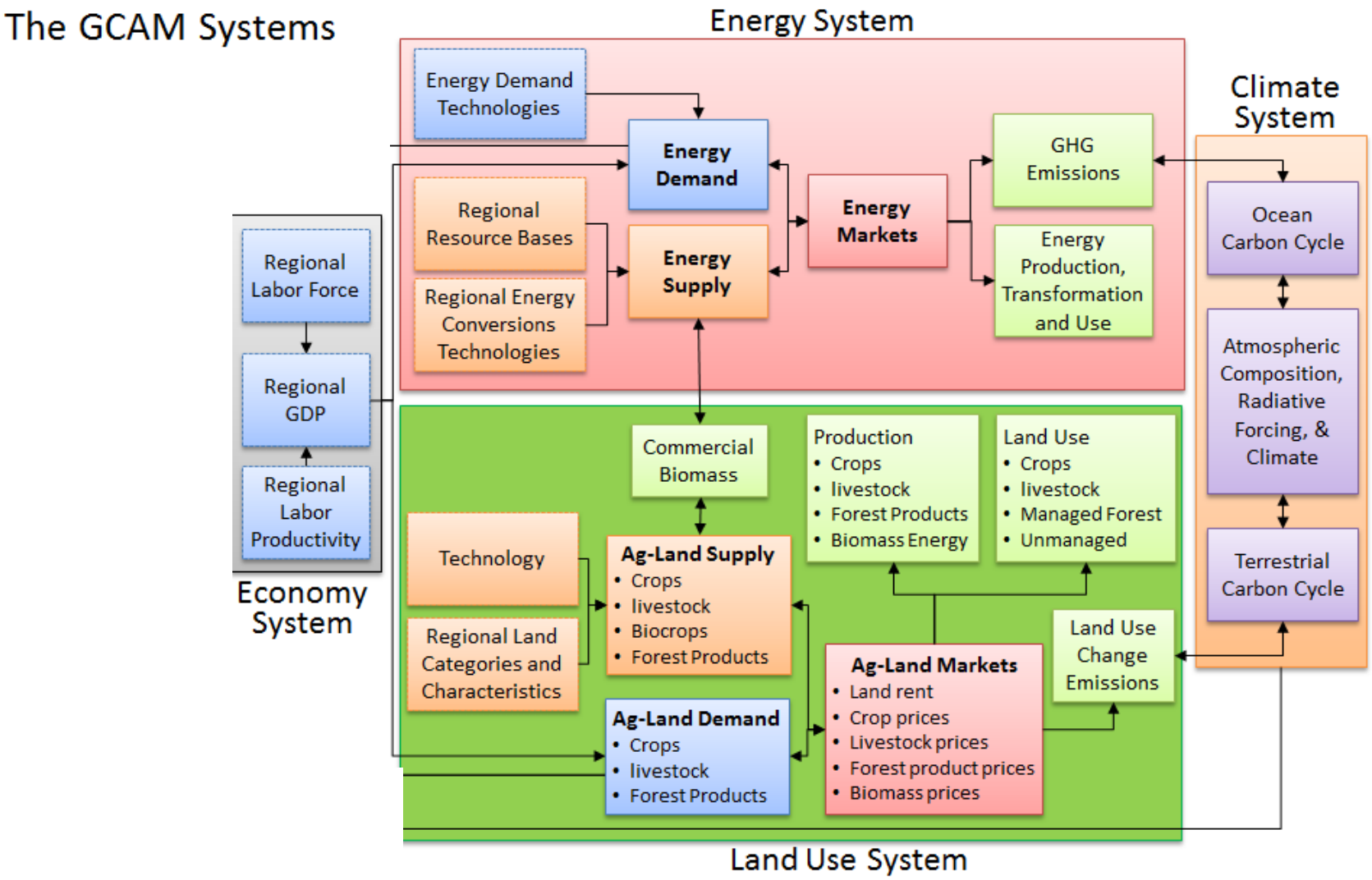


Water in GCAM

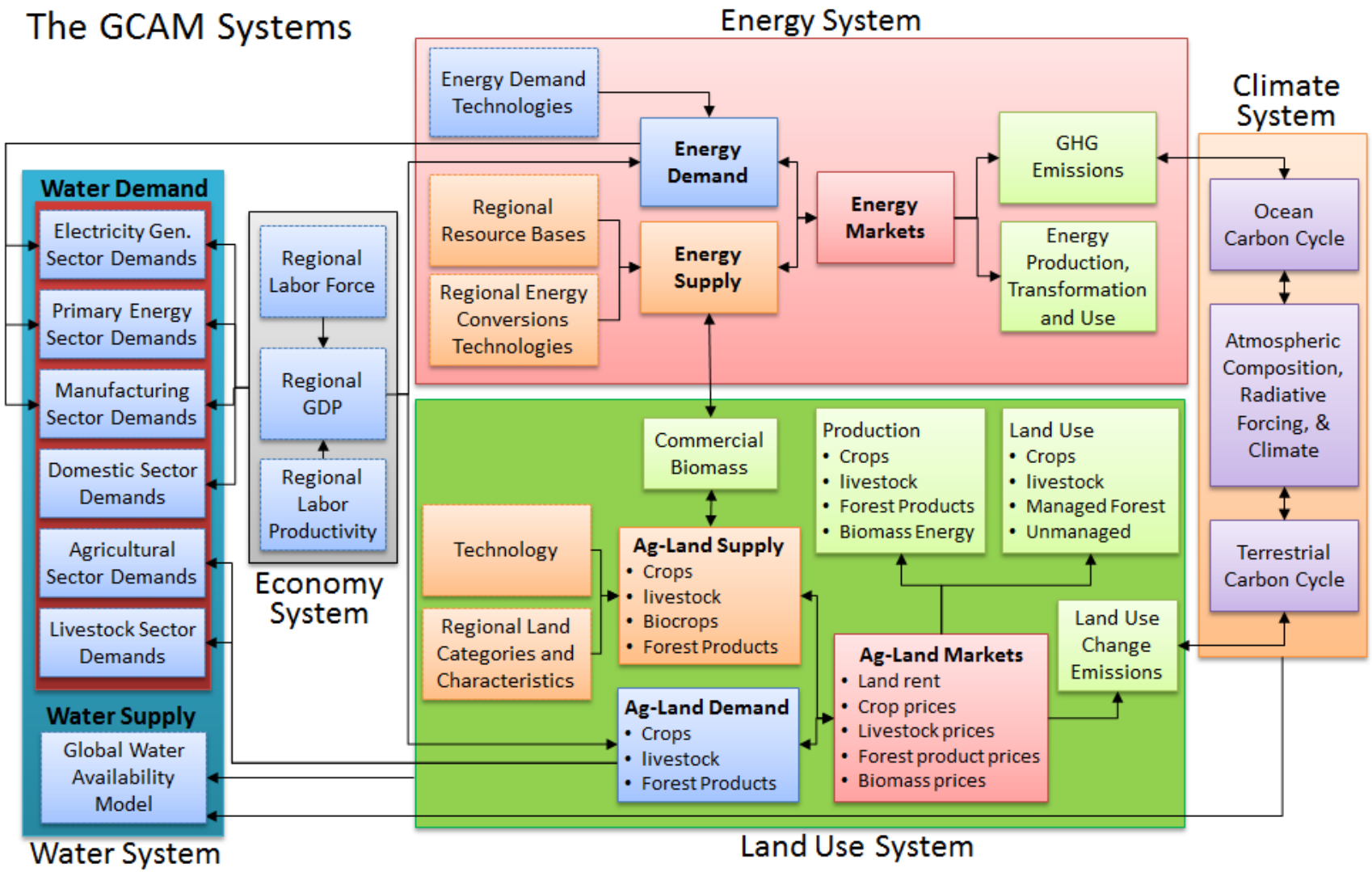


Slide courtesy of M. Hejazi, JGCRI

Incorporating water in GCAM



Incorporating water in GCAM



Water Supply Model

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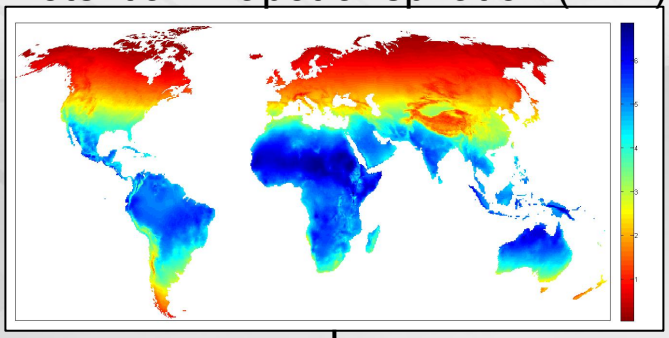
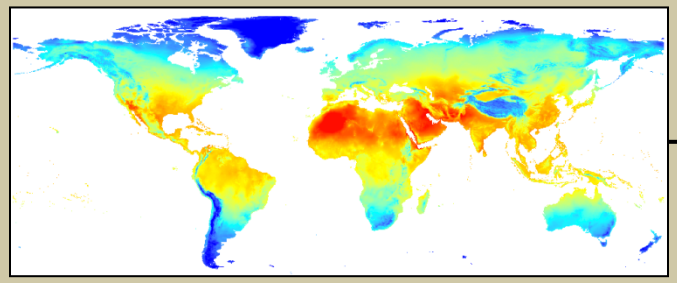
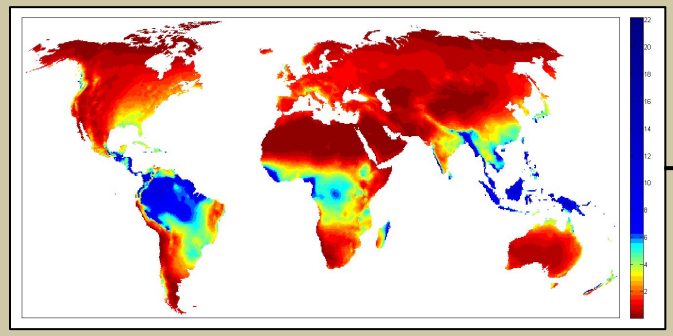
MODEL INPUTS

Potential Evapotranspiration (PET)

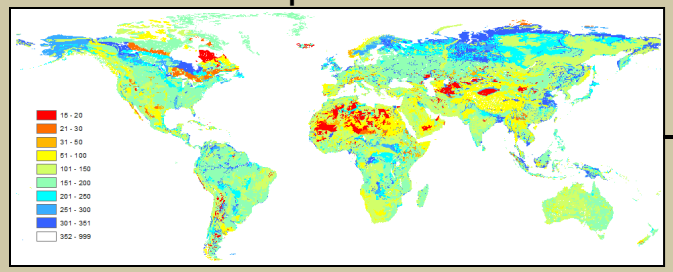




Temperature



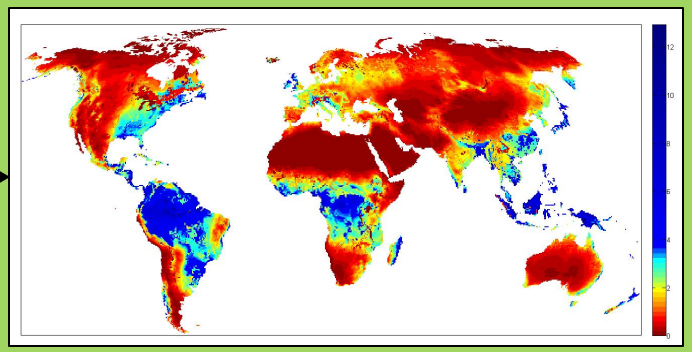
Precipitation



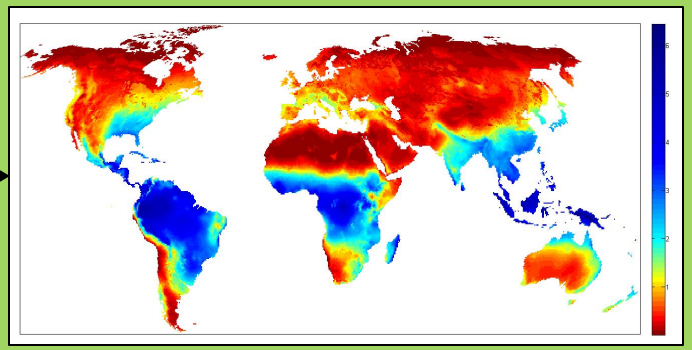
Maximum Soil Moisture Capacity

Monthly Water Balance Model

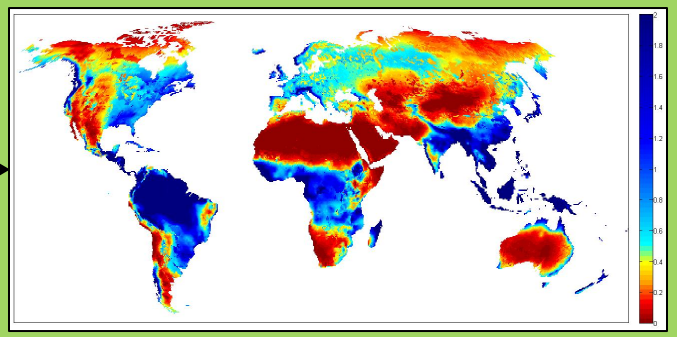
MODEL OUTPUTS



Storage



Actual Evapotranspiration (AET)



Runoff

Climate change effect on runoff

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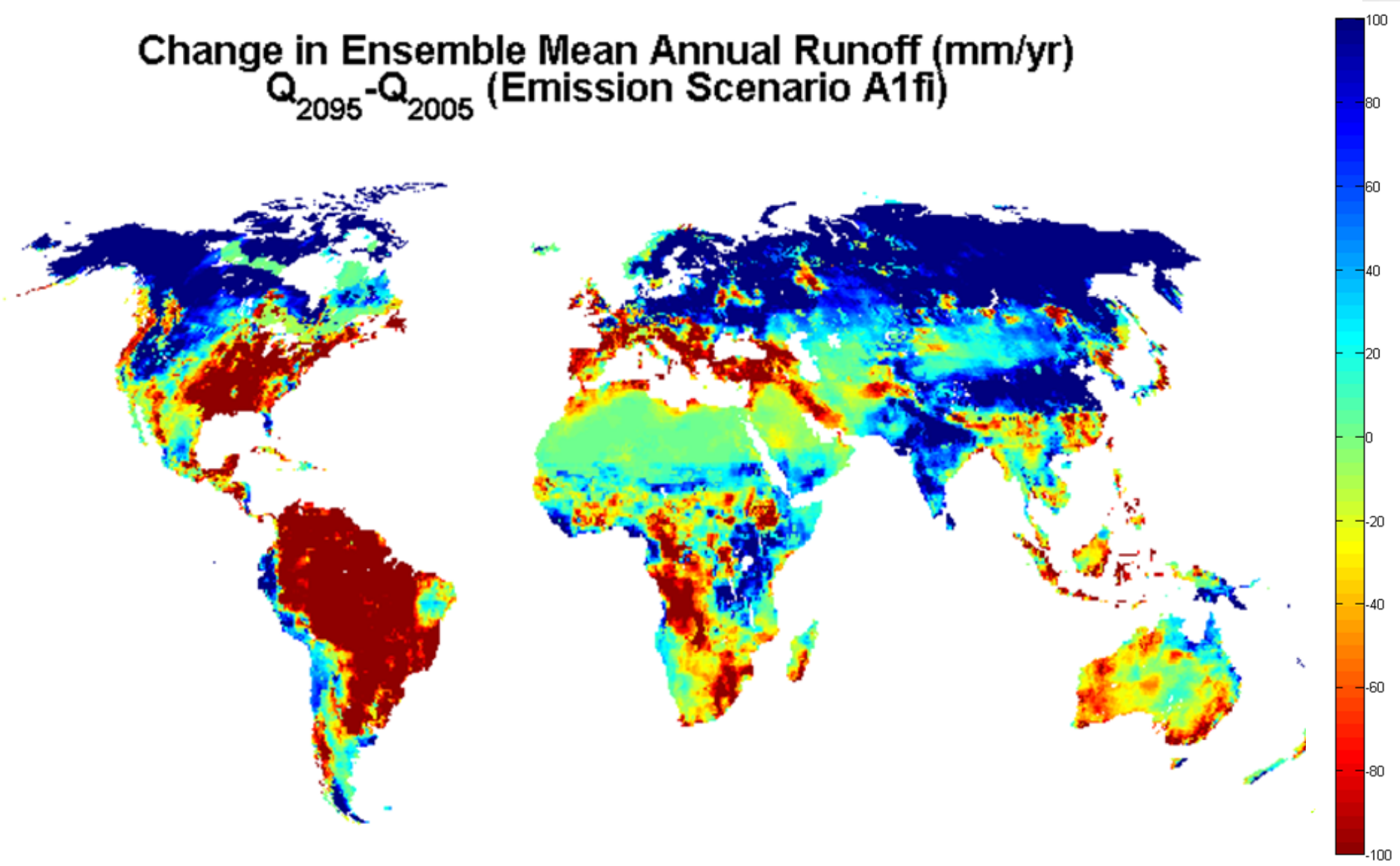
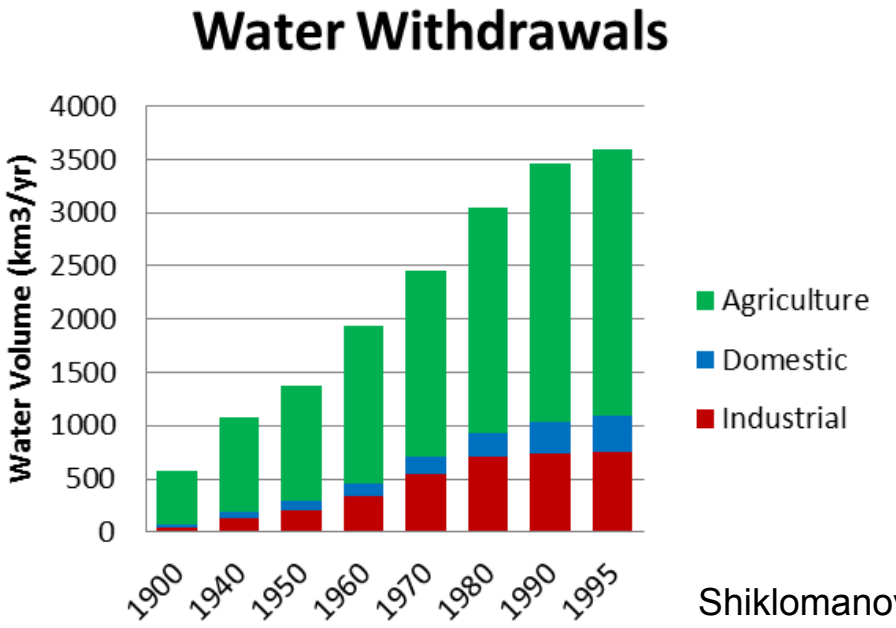
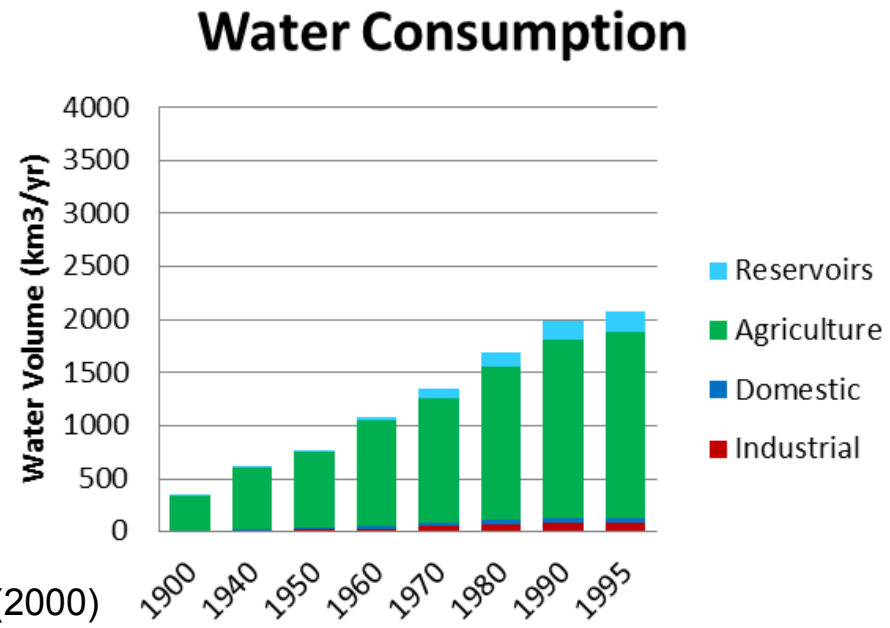


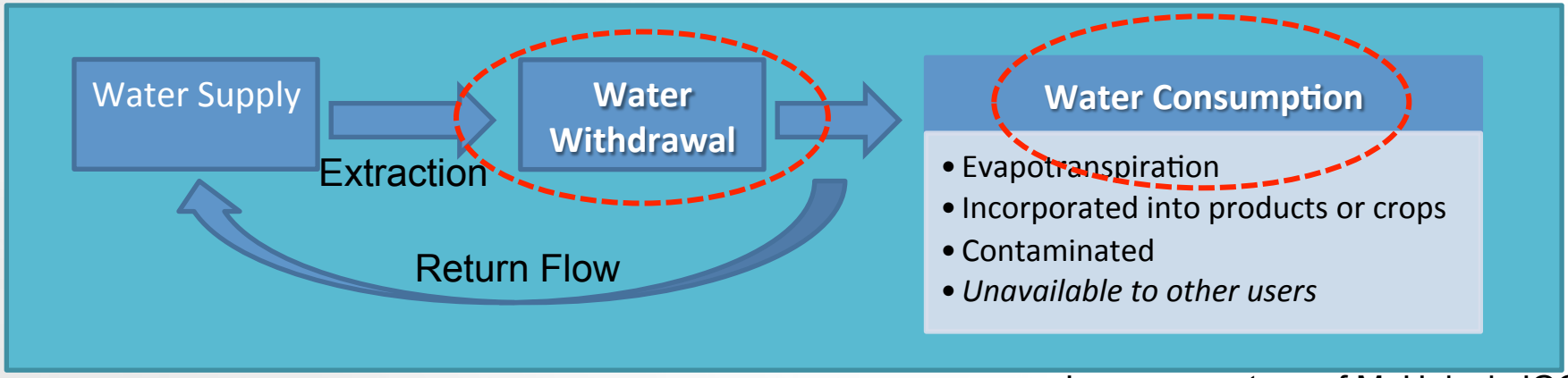
Water use now – global





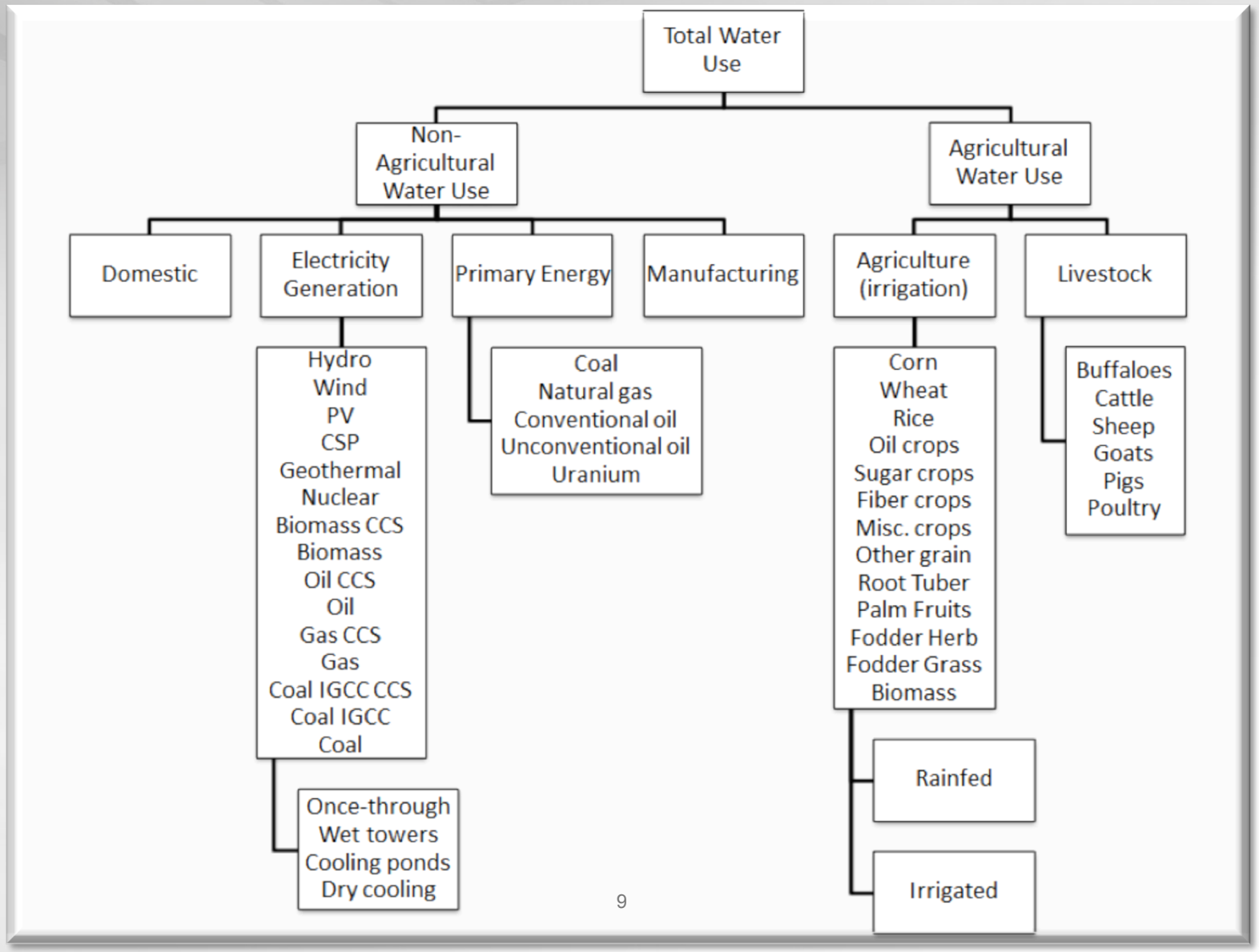
Shiklomanov (2000)

- Differentiate between withdrawal and consumption

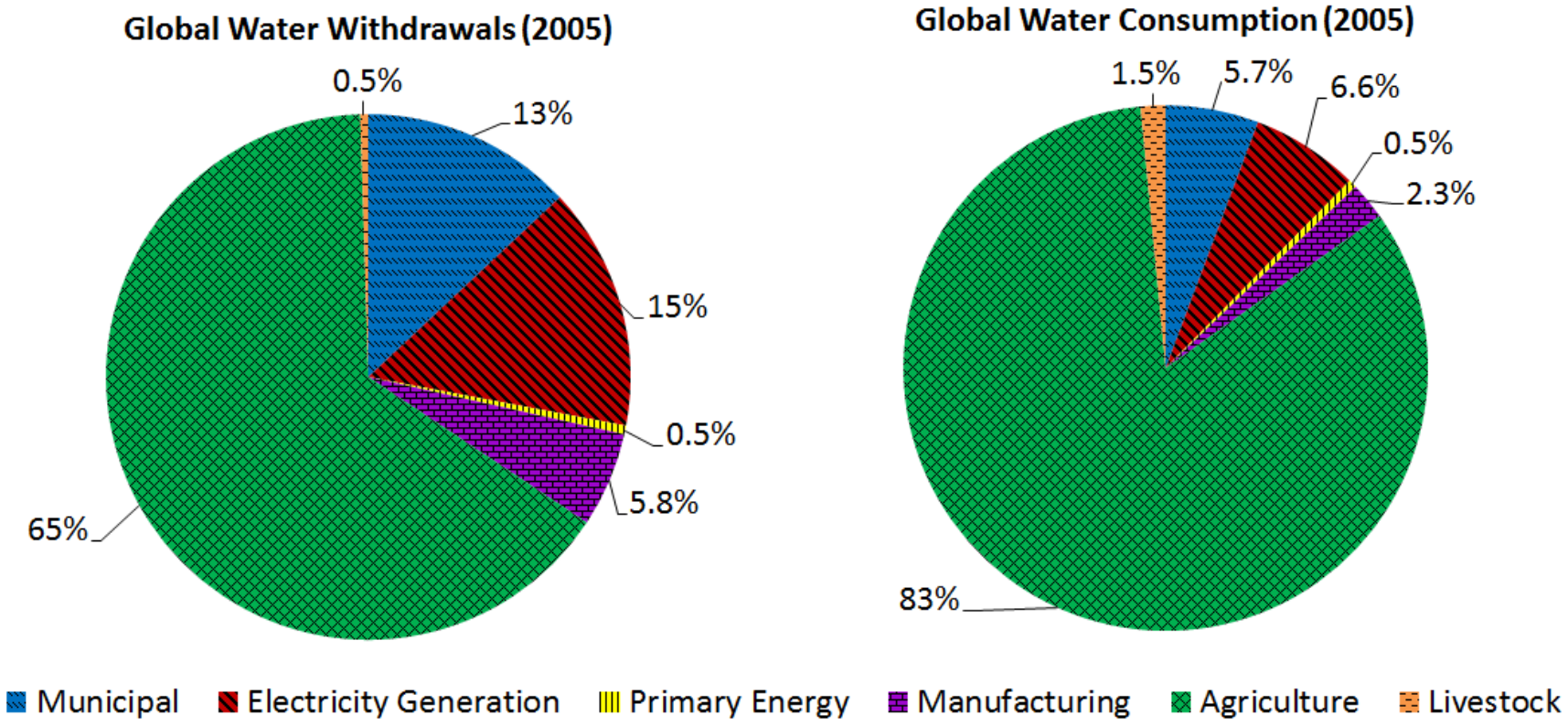


Images courtesy of M. Hejazi, JGCRI

Representation of all components of the water demand sectors in GCAM



Distribution of global water consumption and withdrawals by sector in year 2005



Global water withdrawals vs. literature estimates of water use

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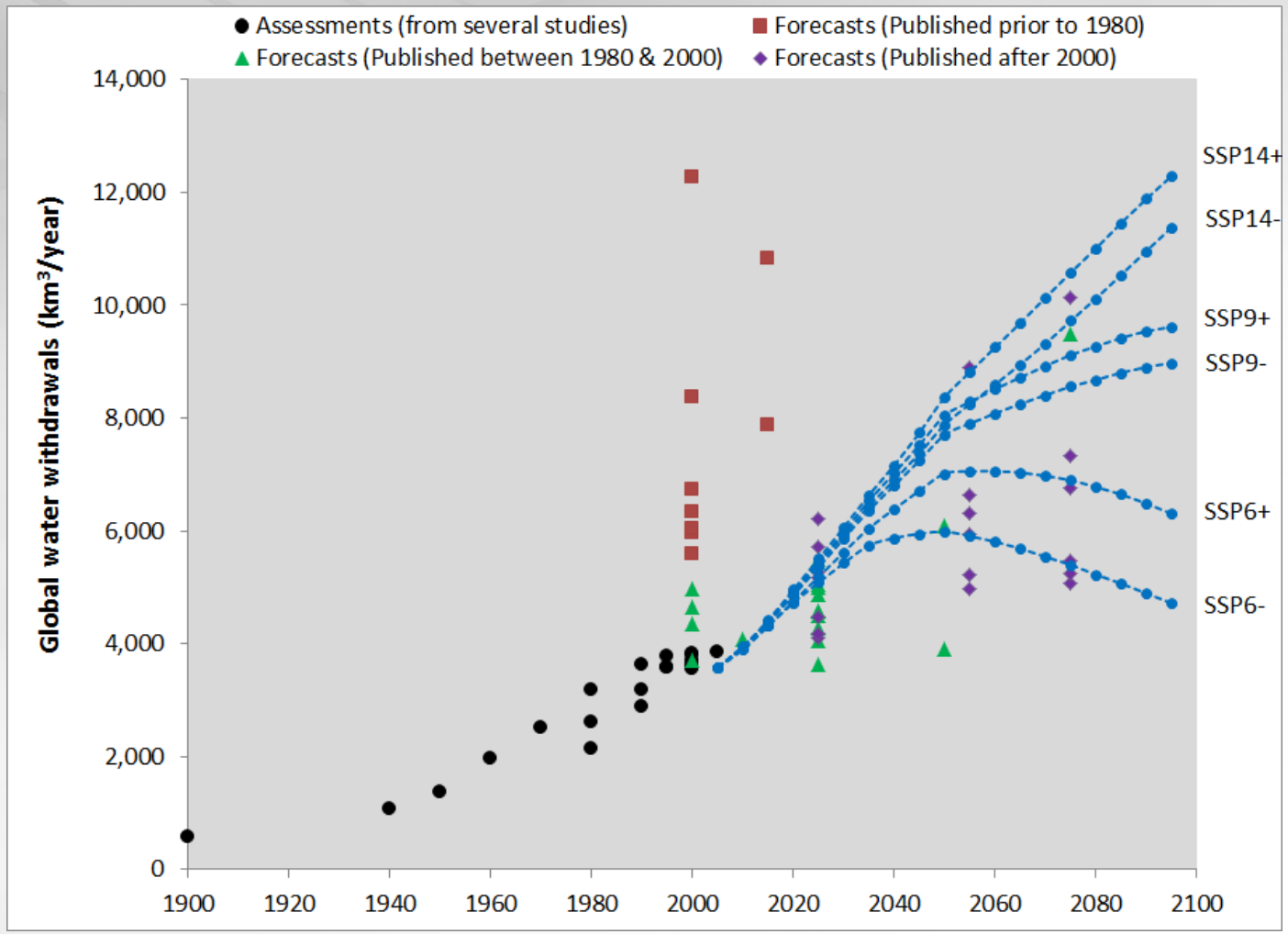
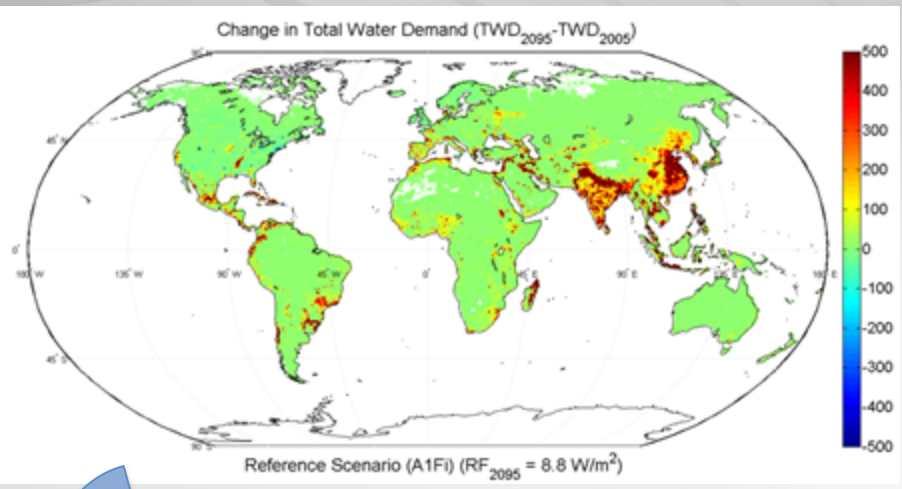
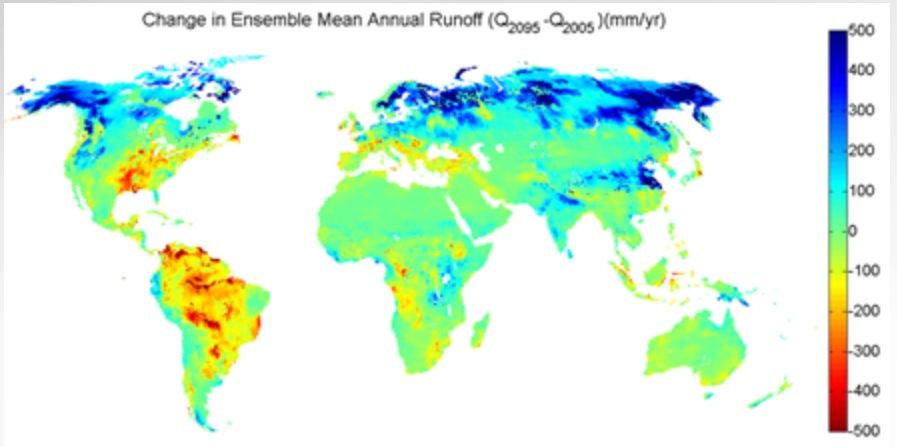
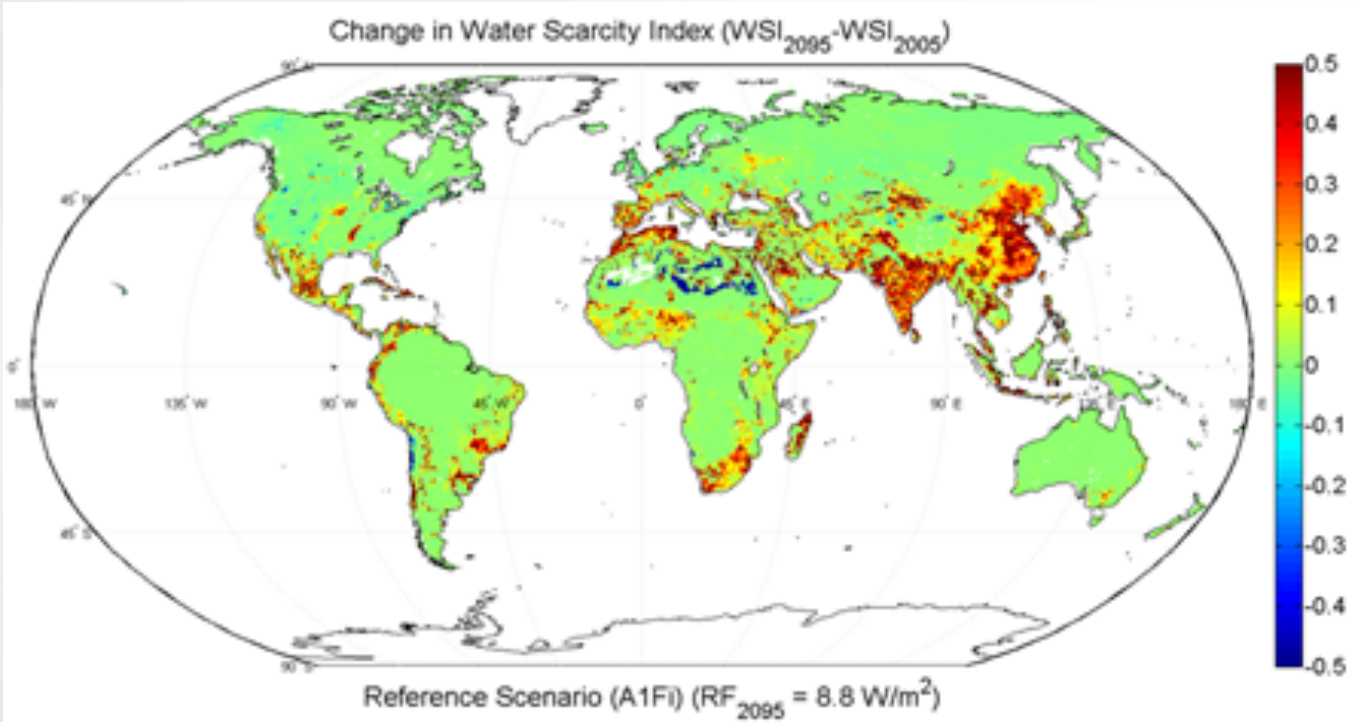


Sources: Gleick 2003 (and references therein), Falkenmark & Rockström, 2000, Alcamo et al. 2003a, Alcamo et al. 2003b, Shiklomanov & Rodda, 2003, Alcamo et al., 2007, Shen et al. 2008, Wada et al., 2011, and AQUASTAT 2011

Change in water scarcity







Summing up

- Constructed a global water supply model
- Constructed a global demand model for each of the sectors (agric., energy, dom., …)
- Integrated water supply & demand in GCAM
- Downscaled water demands to grid scale
- Estimated water scarcity under climate change and socioeconomic changes

DISCUSSION

Fraction of global population living under different levels of scarcity

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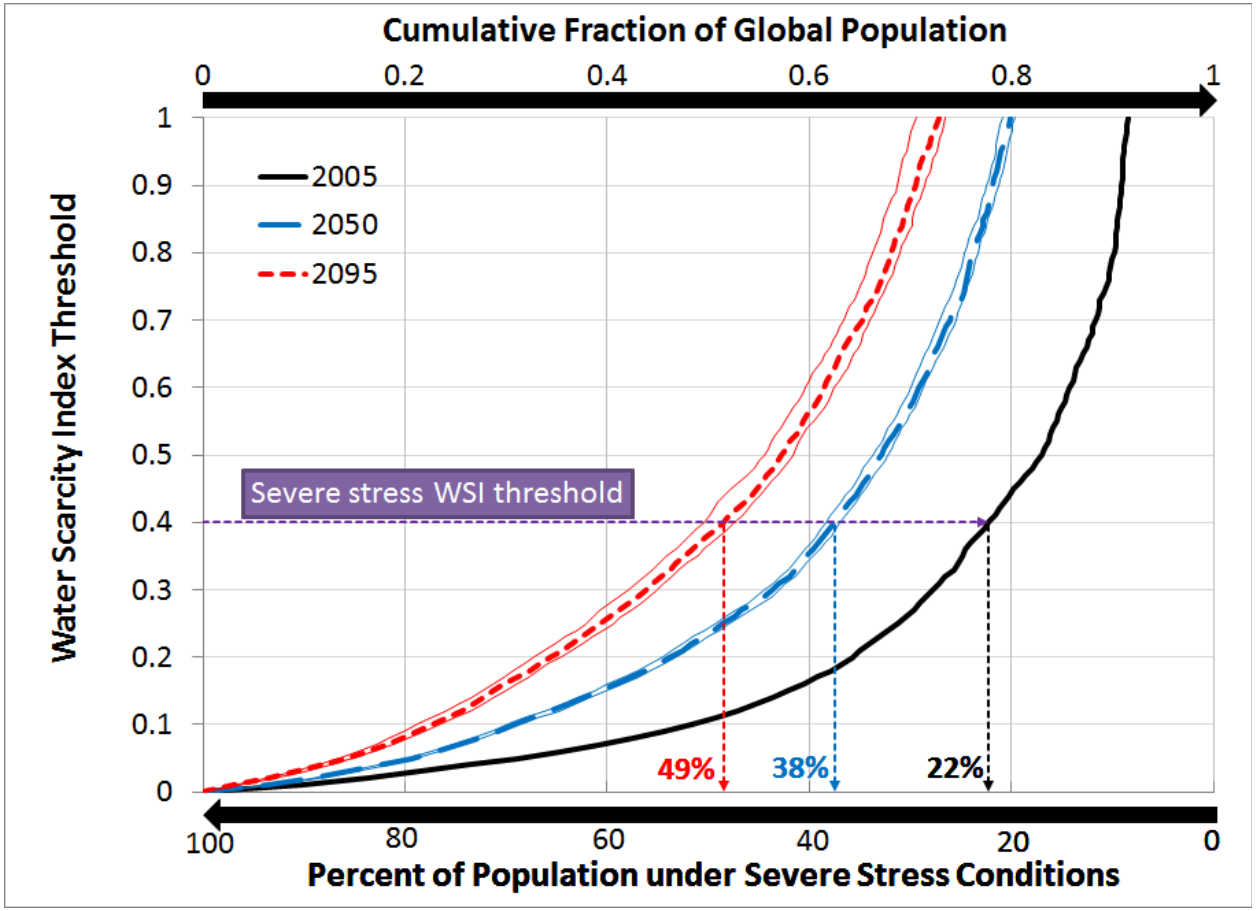

Shifts to the cumulative probability density function of the fraction of global population living under different levels of scarcity (WSI); water scarcity is estimated at the grid scale; the thin lines reflect the uncertainty corresponding to the any one of the four GCMs instead of the ensemble mean; global populations living under severe water stress conditions increase from 22% in year 2005 to 38% and 49% in years 2050, and 2095, respectively

Methodology & Results

IMPACT OF CLIMATE POLICY

The effect of climate change mitigation policies on water scarcity

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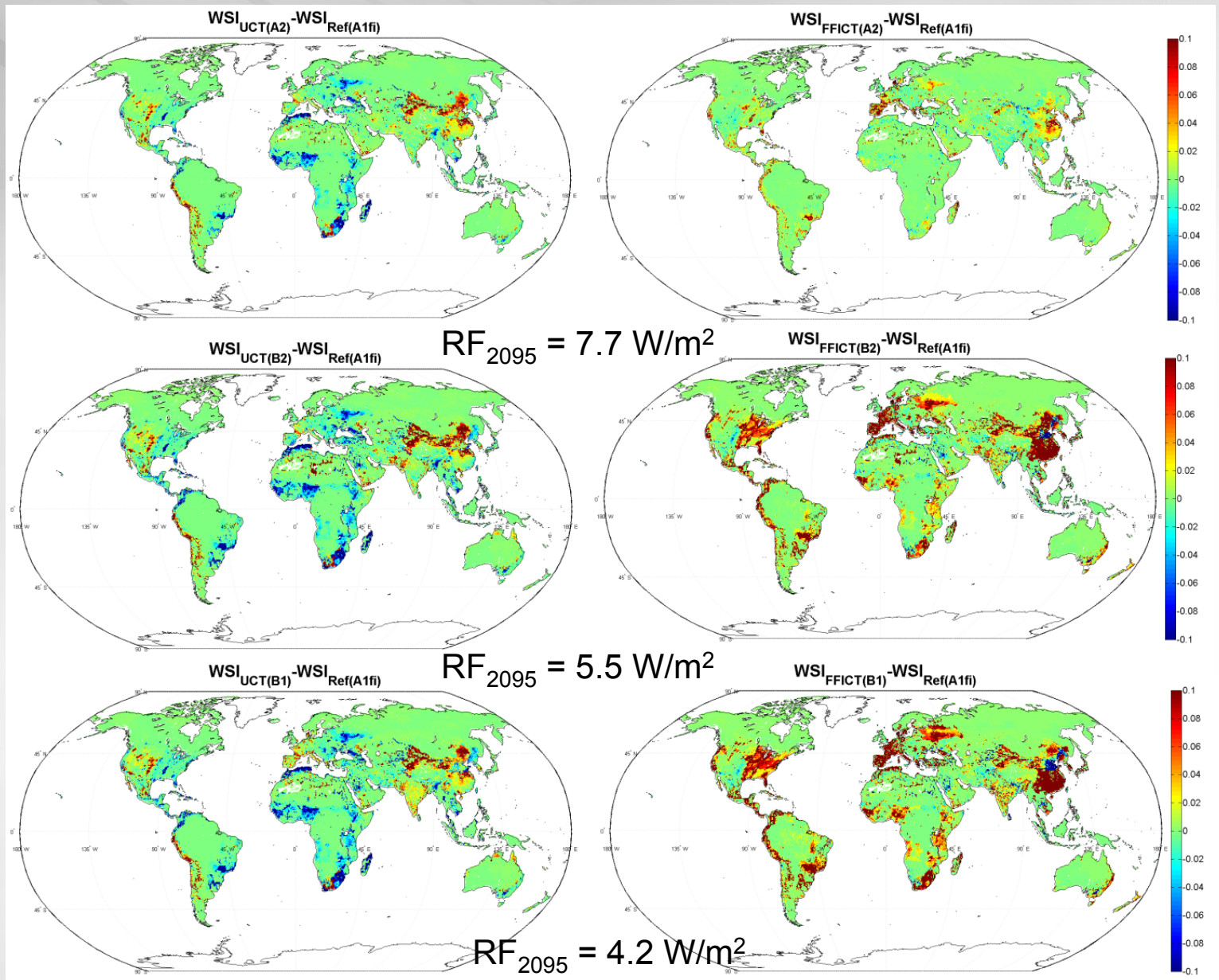

More stringent climate mitigation policies

Percent of population living under severe water scarcity conditions in year 2095 under different climate policies