Community Modeling and Long-term Predictions of the Integrated Water Cycle:

Science Grand Challenges

Ruby Leung, Bill Collins, Jay Famiglietti, Tony Janetos

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Science Grand Challenges

1. Modeling the multi-scale processes in the atmospheric and terrestrial systems and their interactions that are integral to predicting water cycle variability and change

2. Understanding and predicting the evolution of the human-earth system and interactions with water supply and use

3. Providing the science basis from modeling to support decision making and mission oriented objectives
Science Grand Challenges

- Complex phenomena and/or systems
- Scientific approaches not immediately clear, but urgency dictates the need for near term and long term solutions
- Multi-disciplinary in nature
- Opportunities and leveraging
- High scientific and user impacts
Science Grand Challenges

Modeling the multi-scale processes in the atmospheric and terrestrial systems and their interactions that are integral to predicting water cycle variability and change

– How do atmospheric and terrestrial processes interact across scales to determine predictability?
  - Develop scaling theories or methods to better understand scale interactions
  - Assess spatial/temporal scales needed to simulate/predict basin scale water budgets

– How to represent the multi-scale processes and the interactions across systems?
  - Explore different approaches for near term and long term solutions
Science Grand Challenges

Modeling the multi-scale processes in the atmospheric and terrestrial systems and their interactions that are integral to predicting water cycle variability and change

- What are the requirements/approaches for modeling testbeds and model evaluation?
  - Develop framework for hierarchical evaluation and experimentation

- What are the data needs for model development and evaluation?
  - Approaches to develop high resolution input data for land surface modeling
  - High resolution in-situ data for critical water cycle components such as ET and soil moisture
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Understanding and predicting the evolution of the human-earth system and interactions with water supply and use

- What are the roles of human systems at different space/time scales in the coupled system?
  - Identify technological/human perturbations that influence the water cycle at different time/space scales

- How to represent the wide range of human-earth system interactions across scales?
  - Develop a phased approach

- How to evaluate coupled human-earth system models?
  - Develop metrics useful for assessing the skill of the models
  - Design controlled uncoupled and coupled experiments
Science Grand Challenges

Understanding and predicting the evolution of the human-earth system and interactions with water supply and use

– What are the data need for modeling the coupled system?
  • Develop database for model development as well as model evaluation (cross disciplinary and institutions)

– How can such models be used to advance understanding of the role of human-earth interactions in water cycle changes?
  • Numerical experiments guided by observations to untangle the role of human vs physical perturbations/processes in documented water cycle changes
Science Grand Challenges

Providing the science basis from modeling to support decision making and mission oriented objectives

– Formation of “climate use teams” to improve use of model data and inform model development
  • Assess the critical information needed from models to inform decisions
  • Improve the utility of model outputs
  • Develop formal processes to facilitate two-way interactions
    – Define use cases
    – Develop demonstrations and testbeds
    – Develop/share data
    – Document lessons learned

Providing the science basis from modeling to support decision making and mission oriented objectives