Sustainable Smart Water Systems (aka Sustainable Water Grid)

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The Big Idea

To develop holistic multi-scale frameworks for sustainable smart water systems that enable climate change resilience, through more efficient resource use. Such frameworks must inform economic growth, ecosystem support, and equity and fair access.

Ultimately, we require new innovations that culminate in a nationwide ***Smart Water Grid***.

Challenges

- Climate change is distorting the spatio-temporal distribution of water (e.g., precipitation, reservoir levels, frequency and intensity of extreme weather events)
- System of systems: complex interactions between water systems and other systems (e.g., agriculture/food, energy, climate, urbanization, economic growth, …)
- Social-behavioral-economic-legal: e.g., rights, lawsuits, subsidies, water-rich lifestyles, equity.
- Multiple spatio-temporal scales (e.g., watershed, basin, town/village water supply, season, year, decade)
- Non-stationarity (e.g., future climate is different than past one), long memory (e.g., reservoirs, aquifers, soil moisture) and teleconnections (e.g, upstream conditions affects downstream) violates key assumptions underlying Machine Learning.
- Uncertainty quantification, predictability, etc.

Goal areas

- Increase climate change resilience
- Anticipate future conditions
- Promote sustainable practices
- Broader impacts and education

Requirements - resources

- Institute level collaboration and long-term (as well as short) large-scale investment
- Timeline: 3-10 years of funding sufficient to support large research teams
- Access to data, testbeds, water infrastructure

Requirements - disciplines/collaborations

- Numerical/mathematical models and advanced math
- Computing and data distributed systems
  - Including cybersecurity
- Sensing and data collection: in-situ and remote
- Water chemistry and hydrology
- Environmental ecosystem sustainability
- Engineering (civil, electrical, mechanical)
- Economics and social Science
- Public policy
- Legal

Value and Impact

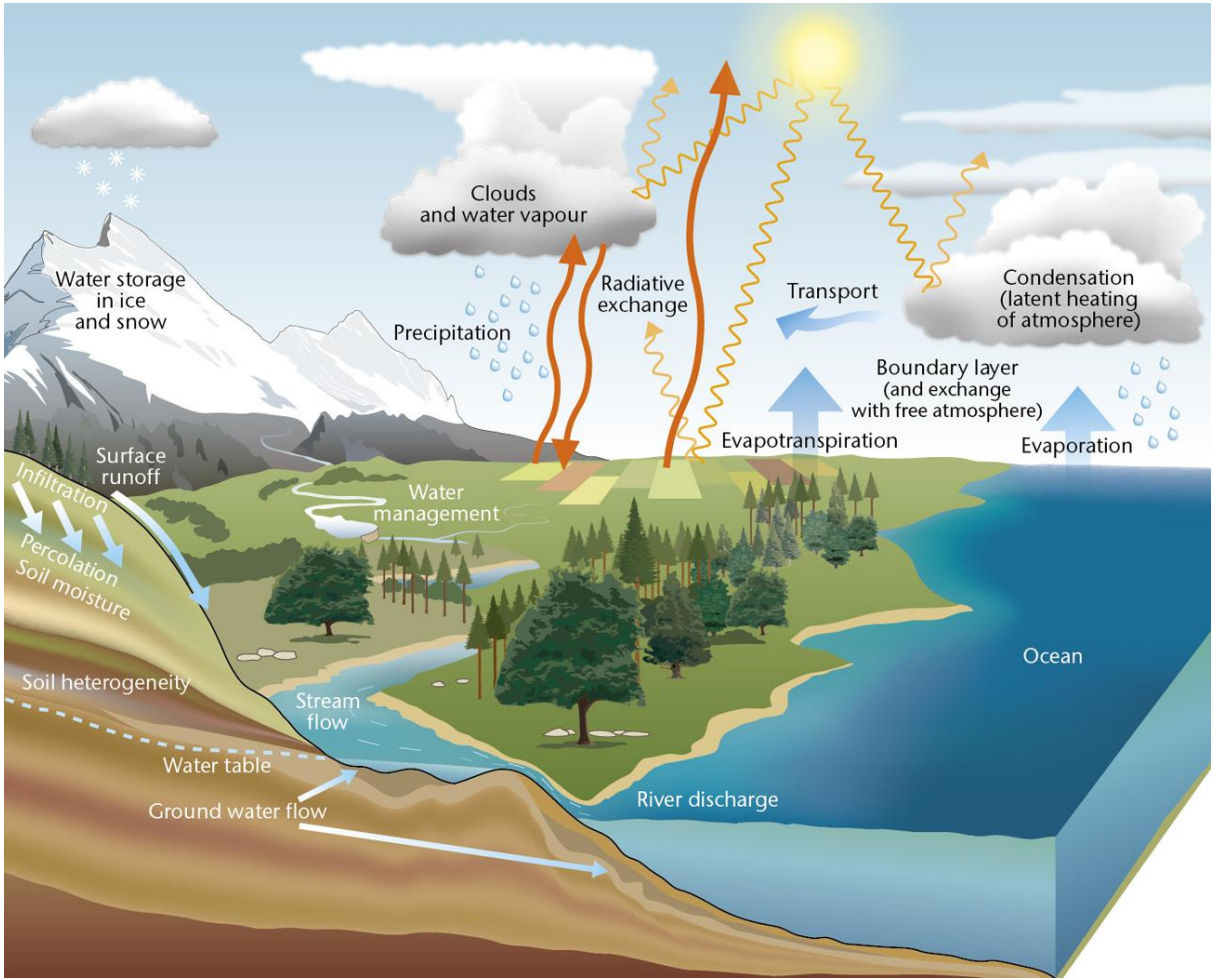
- First-order impacts:
  - More efficient resource use through better water management
  - Climate change resiliency

- Second-order impacts:
  - Economic growth
  - Ecosystems services benefits (wildlife, recreation, flood control, fire protection)
  - Better ability to price water at its marginal costs (most efficient), but need to adapt/account for fairness/equity (efficient markets are not necessarily equitable)
  - Ability to respond to extreme events
  - Ability to predict the future to make more informed management decisions
  - Water network coordination and data sharing at local, regional, US level

Broader impacts

- DEIJ-1: water security for all
- DEIJ-2: reduce disproportionate impact of floods and droughts on disadvantaged community
- Collaboration Nexus - increase sharing of water-efficiency best practices across “water-similar” communities
- Outreach (Public, K-12)
- Education (Graduate, UG)
- Workforce
- Physical/cyber Security
- Policy
- Industry

THANK YOU



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