Challenge

3. Research priorities: *What observations and research are most needed to develop resources for meeting the unmet high-priority information needs shared by water management user groups?*

Conduct research that addresses water management end-user needs, and nurture the transition of these research results into straightforward end-user solutions.

Information about environmental conditions are **critical for real-world applications**.
Users are **inundated with observations and model output** in disparate formats and locations.

Science and technology has the potential to improve water management….
So, why doesn't research and technology advances always improve applications?
→ Inadequate *understanding* of end-user needs produces non-optimal science/technology investment.
→ Inadequate *technology* (lack of useful water resource research results (observations, models, etc.).
→ Inadequate *integration of information* (lack of informative predictions, or bottlenecks in software/hardware engineering).
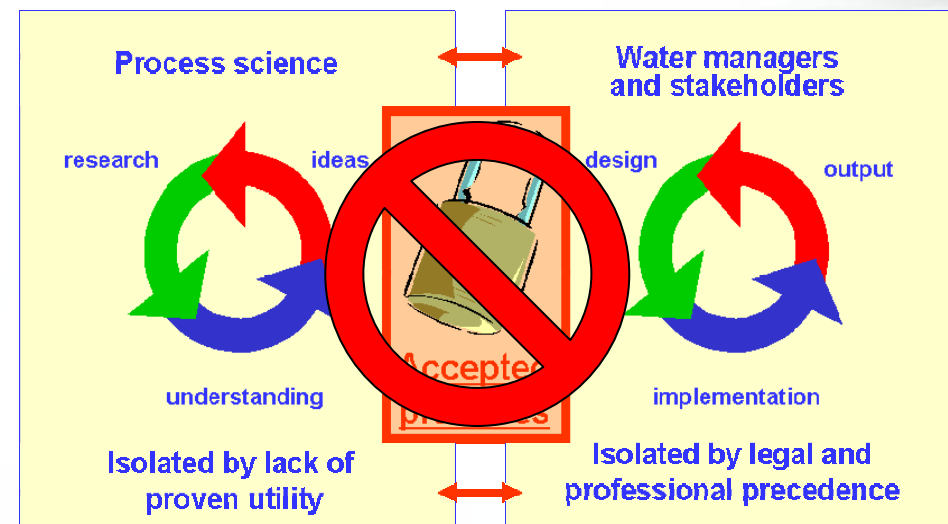
Paradigm lock: (1) science lacks proven utility, (2) users isolated by professional precedence

So, what can we do about this?
Improved prediction of consequences is the key.
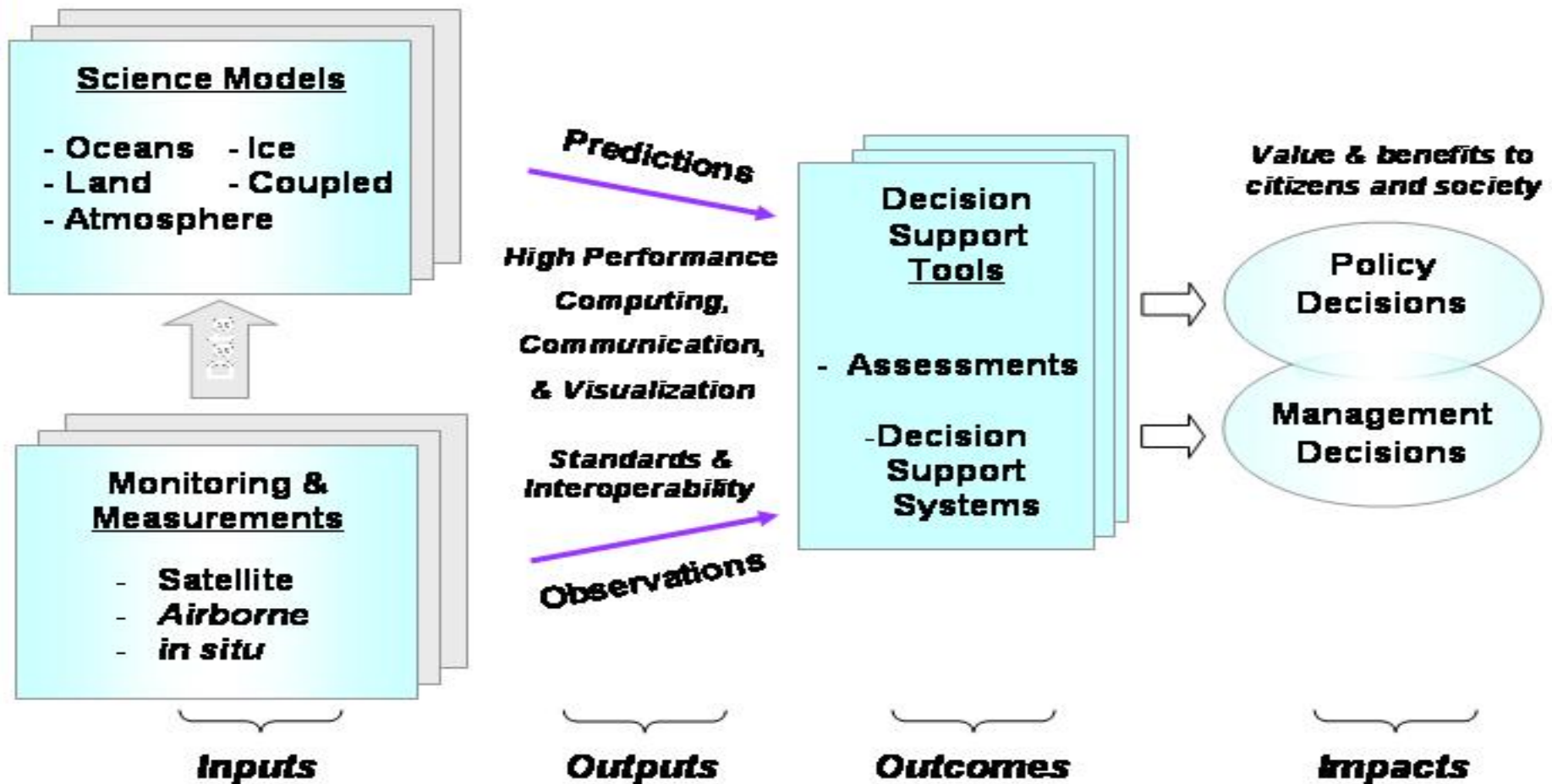
- *Define* research priorities based on needs
- *Observe* key environmental factors
- *Integrate* information from diverse sensors
- **Assess** the current environmental conditions
- *Predict* future environmental possibilities
- *Link* to decision and operation support systems

Progress is being made…

Process science — research — ideas — understanding — Isolated by lack of proven utility

Water managers and stakeholders — design — output — implementation — Isolated by legal and professional precedence

Accepted practices

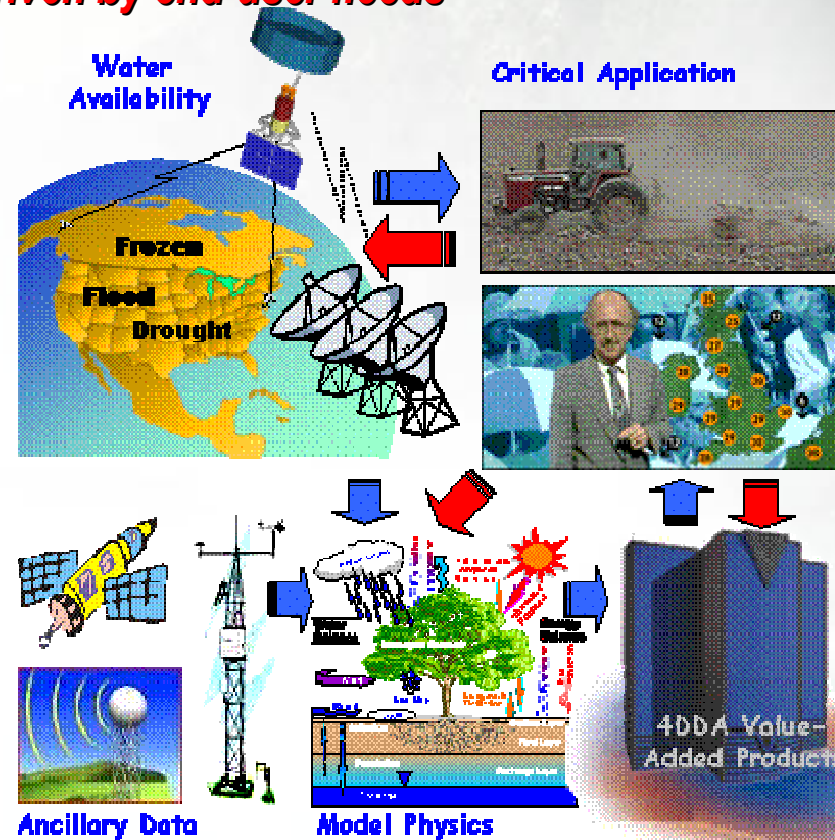Solutions: Science to Decision Support

Linking Science to Consequences

End-to-end coordination enabling understanding and prediction of the Earth system:
Research driven by end-user needs

**Use the adequate tool for the job…**

To deliver social, economic and environmental benefit to stakeholders through sustainable and appropriate use of water by directing towards improved integrated water system management
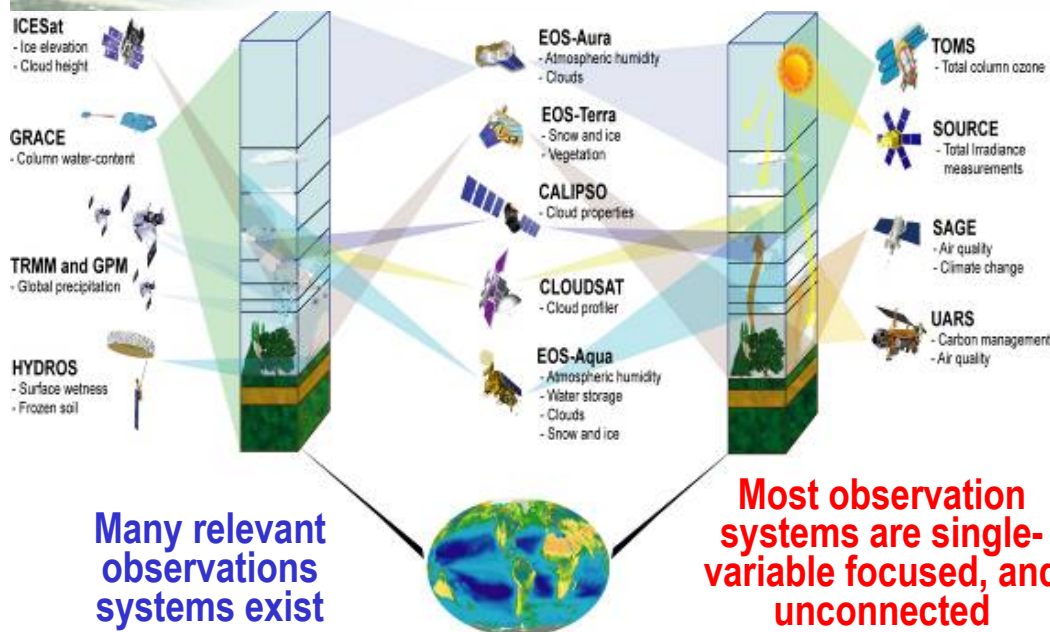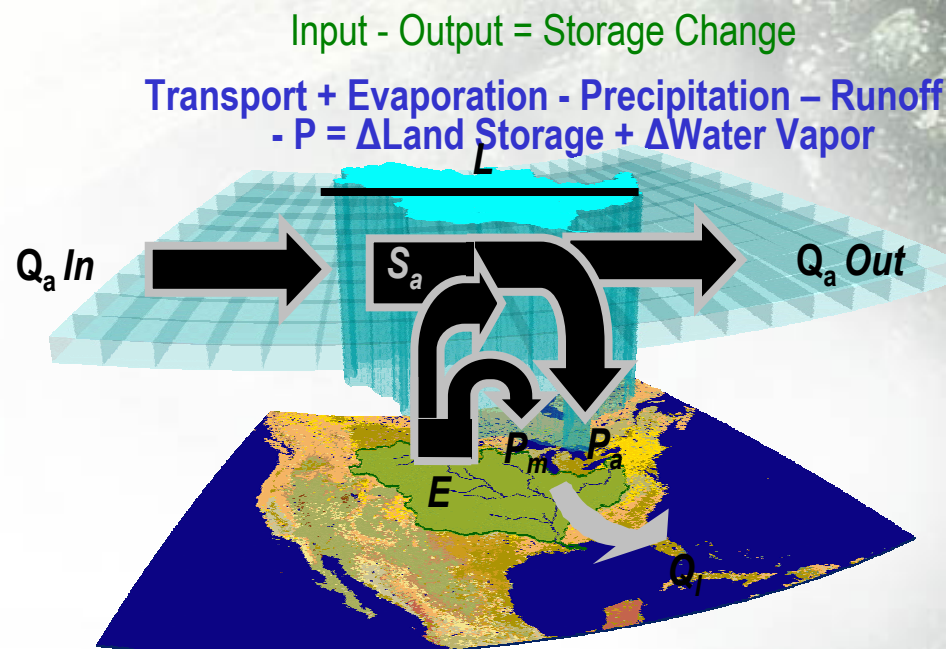
Communication: Solution Networks

The Water Cycle Solutions Network establishes pathways and partnerships between water cycle research investments and decision support needs.

1. *Evolve a network of partners:* identify and analyze partner organizations to define collaboration pathways.
2. *Routinely identify, prioritize, mine and communicate relevant research products and results.*
3. *Optimize water cycle partner access* to research results and products to create a self-sustaining network.
4. *Analyze and document* the network effectiveness through metrics, resource estimates and documentation.
5. *Education and outreach* is important to help society understand and use the research in every-day application.
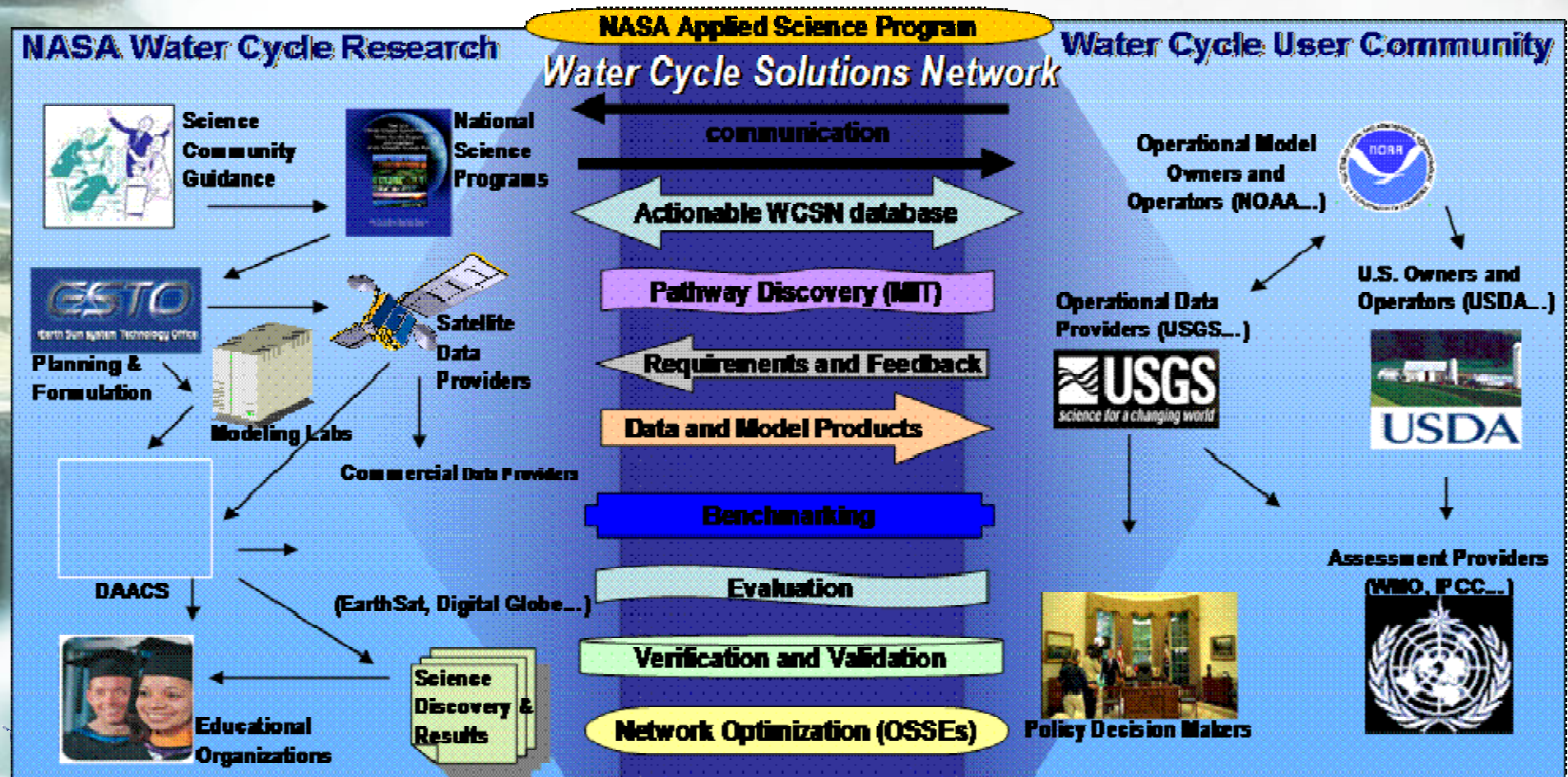
Observation

The availability of new _observations_ _strongly motivates advances_ in understanding, prediction, and application.

Understanding

Analysis

Observation

Consequences Monitoring Validation Models

Assimilations & Initialization

Predictions

Input - Output = Storage Change

Transport + Evaporation - Precipitation – Runoff - P = ΔLand Storage + ΔWater Vapor

Q_a *In* S_a Q_a *Out*

L

P_m P_a

E

Q_r

ICESat
- Ice elevation
- Cloud height

GRACE
- Column water-content

TRMM and GPM
- Global precipitation

HYDROS
- Surface wetness
- Frozen soil

EOS-Aura
- Atmospheric humidity
- Clouds

EOS-Terra
- Snow and ice
- Vegetation

CALIPSO
- Cloud properties

CLOUDSAT
- Cloud profiler

EOS-Aqua
- Atmospheric humidity
- Water storage
- Clouds
- Snow and ice

TOMS
- Total column ozone

SOURCE
- Total Irradiance measurements

SAGE
- Air quality
- Climate change

UARS
- Carbon management
- Air quality

Many relevant observations systems exist

**Most observation systems are single-variable focused, and unconnected**

We must define and develop an _integrated_ user-focused water observation system that can not only detect climate trends but also local variation of extremes

We must _preserve_ critical _in-situ_ benchmark observations that enable us to detect trends & extremes.

Paul R. Houser, 6 December 2005, Page 5

Research: Advanced Process-Resolving Models

Climate models' grid-box representation of Earth's processes...
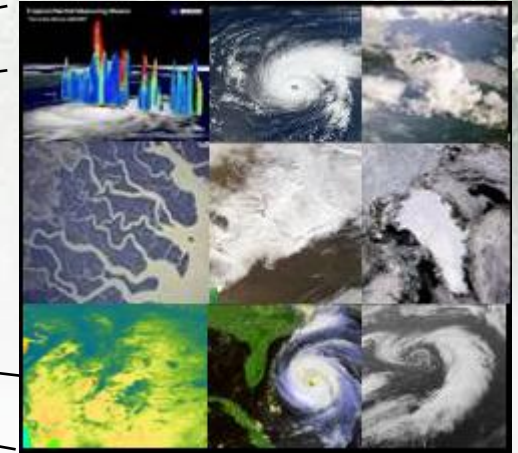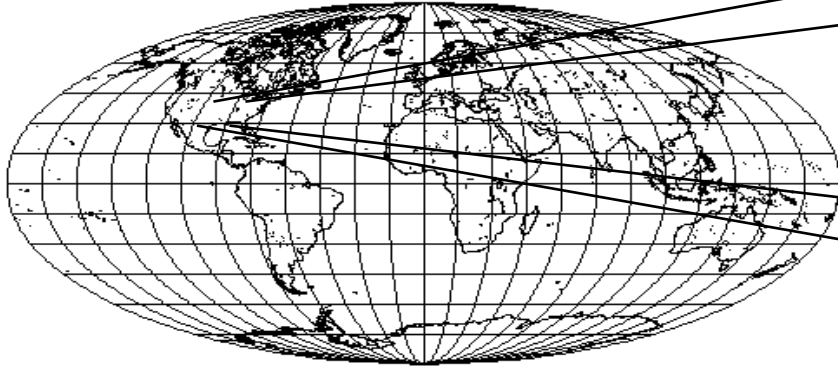
Each grid-box can only represent the "average" conditions of its area.

However, controlling processes of the water cycle (e.g. precipitation) vary over much smaller areas.

Developing Advanced Process-Resolving Models

▪Useful prediction is critical – it is the link to stakeholders.

▪We must move towards a new paradigm of climate models that produce useful weather-scale, process-scale, and application-scale prediction of local extremes (not just mean states).

▪We must more fully constrain climate models with observations, to improve their realism and believability.

CREW
Center for Research on
Environment and Water

Conclusion

3. Research priorities: *What observations and research are most needed to develop resources for meeting the unmet high-priority information needs shared by water management user groups?*

*Researchers must work in close **partnership** with end-users, and define their research priorities based on user needs.*
→*Develop improved communication and resource networking strategies*

•*Observations:*
→We must define a integrated water & energy observation system that can detect global mean trends and local variation of extremes
→We must preserve critical *in-situ* benchmark observations that enable us to detect trends & extremes.

•*Research:*

→*Develop climate models that produce useful weather-scale, process-scale, and application-scale prediction of local extremes.*

→*More fully constrain climate models with observations, to improve their realism and believability.*

*Improved **prediction** of water management consequences is a key to meet unmet user needs.*

CREW
Center for Research on
Environment and Water