NOAA Water Cycle Science Challenge Workshop

30 August – 1 September, 2011
NOAA/Earth System Research Laboratory
Boulder, Colorado

Co-Chairs: Dr. F. Martin Ralph (NOAA) and Dr. Robert Davis (USACE)

Attendees: Interagency Program Committee plus roughly 50 invitees from the broad community of experts related to water cycle science

Background

This Workshop is a follow-up to a 2010 NOAA report "Strengthening NOAA Science" sponsored by Dr. Jane Lubchenko that identified the following NOAA Science Grand Challenge: "***Improve understanding of the water cycle*** *at global to local scales to improve our ability to forecast weather, climate, water resources and ecosystem health."* This has been included in NOAA's Next Generation Strategic Plan.

Workshop purpose

To discuss and develop recommendations to NOAA Leadership, including the NOAA Research Council, that will inform a subsequent "NOAA Science Conference" and the next NOAA 5-Year Research Plan on the topic of**: "Understanding and predicting conditions associated with either too much or too little water"**

To fulfill this purpose the Water Cycle Science Challenge Workshop will:

- encompass the current state of understanding;
- identify gaps that can be addressed over the next 5-years;
- identify NOAA's role in filling those gaps in concert with external partners and other institutions over the next 5-years;
- outline the expected benefits of filling the gaps.

The Workshop will also

- consider implications for relevant observing systems
- characterize uncertainties associated with water cycle science information
- discuss how best to communicate water cycle science information and associated uncertainties accurately and effectively to policy makers, the media, and the public at large.

Workshop Program Committee

Name	Affiliation
Marty Ralph (Co-Chair)	NOAA Earth System Research Laboratory/Physical Sciences Division
Bert Davis (Co-Chair)	US Army Corps of Engineers Cold Regions Research Laboratory
Gary Bardini	California-Department of Water Resources (with Mike Anderson)
Kurt Brown	Bureau of Reclamation (with Levi Brekke)
Mike Dettinger	USGS
Ralph Ferraro	NOAA NESDIS/STAR
Dave Jorgensen	NOAA National Severe Storms Laboratory
Jim McNamara	Boise State University
Christa Peters-Lidard	NASA
Pedro Restrepo	NOAA National Weather Service
Robin Webb	NOAA Earth System Research Laboratory/Physical Sciences Division

Primary Technical Topics

1. What are the “forcings” needed for NOAA hydrologic prediction services of the future, and for external partners? “Forcings” here refers to those inputs needed to drive explicit stream flow prediction models typically forecasting out hours to days or weeks, e.g., precipitation, soil moisture, snow pack, evapotranspiration, base flow.
2. What methods and basis are best for estimating extreme meteorological and hydrological event possibilities, deterministically or probabilistically, in a changing climate?
3. How to jointly utilize the longer-term climate variability from observed records, paleoclimate, and projected climate information when portraying drought and surplus possibilities in planning?
4. What will NOAA’s future hydrologic models consist of and how to develop them under the Integrated Water Resources Science and Services (IWRSS) interagency framework?
5. What scientific inputs are needed on water cycle extremes, normals, predictability, climate trends and uncertainty information for policy makers dealing with major infrastructure planning, typically for decades into the future (e.g., water supply and flood control) and/or endangered species (e.g., salmon)?
6. How to make better use of existing and future weather & seasonal/annual climate predictions related to the water cycle?

Breakout Session topics:
Next generation hydrologic modeling
Hydrometeorological forcings for hydrologic models
Physical processes underlying the water cycle
Climate dimensions

Highlighted Crosscutting topics:
User needs
Extreme events (drought, flood)
Observations
Communication
Ecosystem health

Questions

- What are the major deficiencies in our understanding of the physics of heavy rain systems and what does it imply about uncertainties in prediction? Are these gaps primarily in our understanding of cloud microphysics?

- What are the major gaps in our understanding of the meteorological and climatic underpinnings of droughts? What do we need to know in order to predict the onset, persistence, depth, and cessations of droughts? How well do we forecast these aspects of meteorological drought?

- What are the implications for needs for observing systems? What are the gaps? What could be the path to closing the gaps (both near and long term)? What interagency opportunities exist?

- What are needs for process understanding and model development, including NOAA's models for weather, climate and hydrology, especially factors affecting precipitation and steam flow?

- What field or modeling experiments might be useful for addressing key questions, and what are their requirements?

- What computing and information systems are required for high-resolution hydrologic and water resources monitoring, predictions and understanding nationwide and for their associated meteorological inputs, e.g., surface, profiles, radar, satellite, numerical weather predictions?

- What are the primary mechanisms by which water-cycle variations on meteorological time scales establish climatic variations and changes? What are the influences of climate-scale variations and changes on the water cycle at meteorological time scales? That is, what do we need to know to better understand (and ultimately predict) the weather-climate interface?

- Water yields and the demand side of the water cycle question: Do we have the instrumentation to adequately measure and have the observing networks to monitor evapotranspiration and evaluate predictions of water demand? Looking beyond just temperature and precipitation, how well do model forecasts and projections represent the full complement of surface water/energy budget variables (e.g, the variables used in Penman Montheith or Priestly Taylor calculations) for use in hydrologic modeling? Can these weather/climate/atmospheric model calculated variables be effectively downscaled and/or bias correct.

Agenda strategy

Day 1: Overview of emerging user needs and science directions (Plenary)
Introductions, overview of requirements, plus for each of 4 major breakout topics there is a 1 h 15 min session to provide background and stimulating ideas

- a 15 minute summary of emerging needs
- three 15 minute presentations of emerging science
- a 15 minute period for discussion

Day 2: Feedback and brainstorming in breakout groups (Breakout sessions)
There are 4 topics with 4 participant groups rotating through each topic. Breakout group co-leads (drawn from the Program Committee) stimulate discussion using the relevant "questions" identified by the Program Committee plus any new questions that may have arisen on Day 1, and rapporteurs record the results. Each workshop participant, excluding two co-leads and two rapporteurs for each breakout topic, is randomly assigned a number 1, 2, 3 or 4, which defines which participant group they are in. Each participant group spends 1 h 20 min on each breakout topic. The day ends a bit early for "participants," allowing 1-2 h for the breakout session co-leads and rapporteurs to prepare reports to be presented in plenary the next morning.

Day 3: Discussion and Synthesis into Future Science Directions (Plenary)

- report outs by breakout session leads (1.5 h), one breakout co-lead handles the background session on Day 1 (maybe making a presentation) while the other co-lead presents the breakout report on Day 3
- two panel discussions on key questions regarding future science directions (3 h)
    - Science directions for hydrologic predictions
    - Science directions for climate applications
- wrap up (0.5 h)

~60 attendees, Day 1: 20 speakers, Day 2: breakouts, Day 3: 4 speakers plus ~10 panelists

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