Climate Change and Water Resources Management:
A federal perspective

U.S. Geological Survey Circular 1331

Collaborating for a Sustainable Water Future
February 18, 2009
Orlando, Florida

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USGS Cooperative Water
Program Coordinator

Report purpose

Characterize how a federal water agency can incorporate climate change science into water resources management and planning.

Authors

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- Dr. Robert S. Webb, Chief, Climate Analysis Branch, NOAA, Boulder, CO
- Dr. Kathleen D. White, Research Hydraulic Engineer, USACE-CRREL, Hanover, NH

Chronology of Events

- May 31, 2007: USGS-USACE-NOAA-BOR Climate Change meeting in Washington, DC with action item to form an interagency workgroup that would provide a synopsis on the state of knowledge on climate change;
- November 2007: Organized an ad hoc group to produce a document describing how a responsible federal water agency can utilize climate change science;
- December 3, 2007: First teleconference;
- January 2008: Plans to create an interagency circular are initiated;

Chronology of Events

- February 2008:
  - Draft outline of the report circulated to agencies;
- March - September 2008:
  - First draft of the report created;
  - Draft executive summary created;
  - Internal reviews;
- October – November 2008:
  - External reviews;
  - Face-to-face interagency meeting to resolve comments;

Chronology of Events

- December 2008:

  USGS Circular 1331: Climate change and water resources management: A federal perspective is approved for publication;

- February 2, 2009:

  Official rollout and media release at the MIB in Washington, DC.

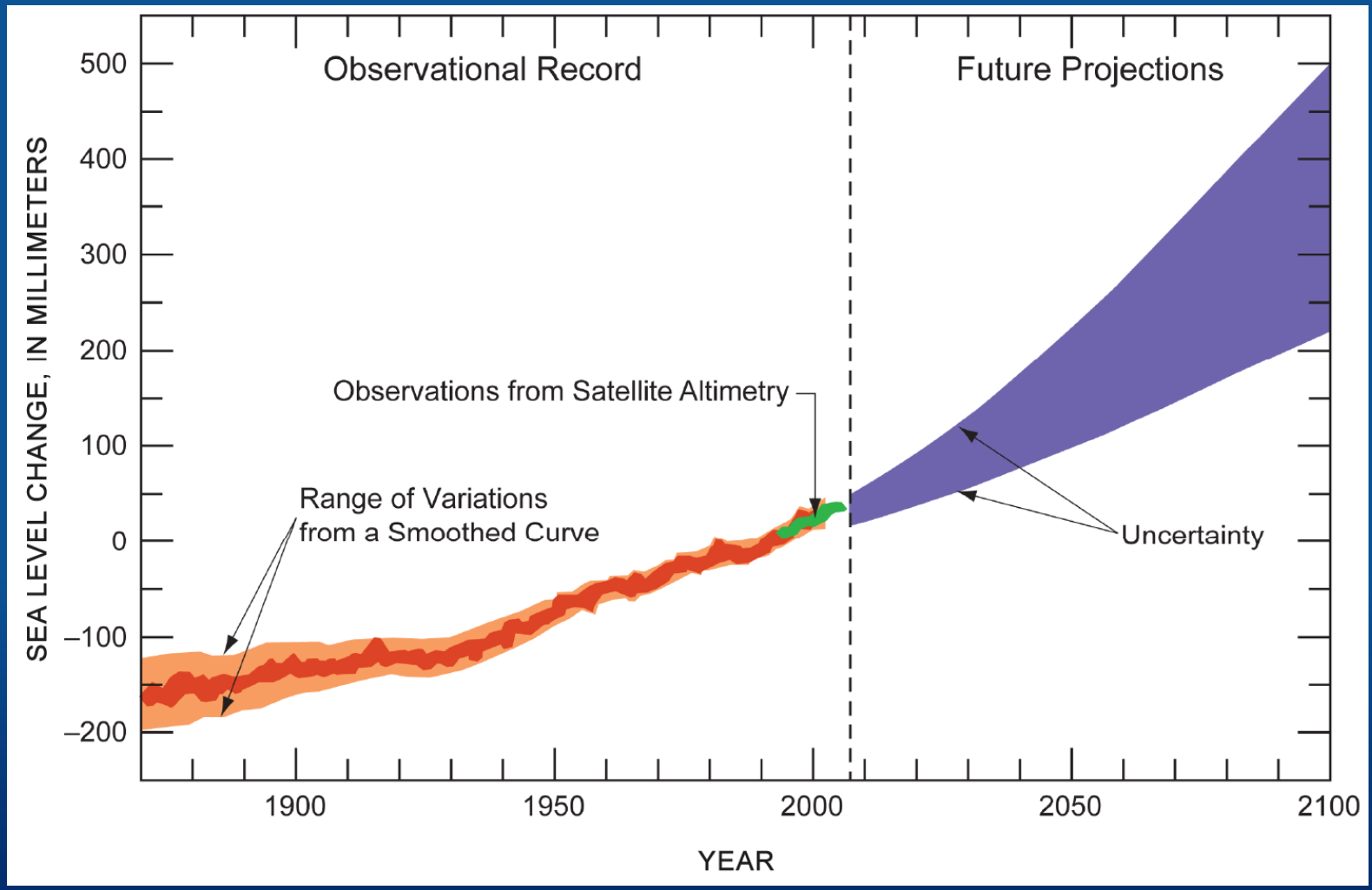
18 Internal Reviews:

Affiliation	Position	Reviewer
NOAA	Program Manager, Sector Applications Research Program, Climate Program Office	Nancy Beller-Simms
Reclamation	Environmental Specialist, Program and Policy Services	Art Coykendall
Reclamation	Director of Research and Development	Curt Brown
Reclamation	Regional Planning Coordinator, Great Plains Region	James Gjerde
Reclamation	Hydraulic Engineer, Lower Colorado Region	Carly Jerla
Reclamation	Hydraulic Engineer, Lower Colorado Region	Jim Prairie
Reclamation	Hydrologist, Division of Planning, Mid-Pacific Region	Michael Tansey
USACE	National Research Council Research Associate, Institute for Water Resources	Stacy Langsdale
USACE	Res. Reg. Team Leader - Missouri River Basin	Larry Murphy
USACE	Research Civil Engineer, Engineer Research and Development Center	Jacqueline Richter-Menge
USACE	Environmental Engineer, Engineer Research and Development Center	Martin Schultz
USACE	Water Resources Engineer, Tulsa District	David Williams
USGS	National Research Program Hydrologist	Bob Hirsch
USGS	National Research Program Hydrologist	Bob Jarrett
USGS	Hydrologist, Idaho Water Science Center	DeWayne Cecil
USGS	Office of Surface Water Hydrologist	Harry Lins
USGS	Hydrologist, Climate Change Program	Pete Murdoch
USGS	Office of Surface Water Hydrologist	Tim Cohn

16 External Reviews:

Affiliation	Position	Reviewer
CA Department of Water Resources	Interstate Resources Manager	Jeanine Jones
Cornell University	Professor, Dept. of Civil and Environmental Engineering	Jery Stedinger
EPA	Assistant Administrator for Water	Ben Grumbles
EPA	Office of Groundwater and Drinking Water	Mike Muse
NOAA	Chief Scientist, Office of Hydrologic Development	Pedro Restrepo
Texas Water Development Board	Director, Surface Water Division, Texas Water Development Board	Barney Austin
The Nature Conservancy	Director, Eastern U.S. Freshwater Program	Mark P. Smith
Tufts University	Research Professor, Dept. of Civil and Environmental Engineering	Paul Kirshen
US Forest Service	Director Office for Watershed, Fish, Wildlife, Air and Rare Plants	Anne Zimmerman
USACE	Senior Environmental Policy Advisor, Headquarters	Ellen Cummings
USACE	Deputy Commanding General of the Army Corps	Major General Don Riley
USACE	Flood Risk Program Manager, South Pacific Division	Stu Townsley
USACE	Hydraulic Engineer, Hydraulic Engineering Branch, Portland District	Randal Wortman
USGS	National Research Program Hydrologist	Mike Dettinger
World Bank / Harvard University	Gordon McKay Professor of the Practice of Environmental Health in the School of Public Health (SPH) / Professor of the Practice of Environmental Engineering in the School of Engineering and Applied Sciences (SEAS) Harvard University	John Briscoe
University of Southampton, UK	Professor of Coastal Engineering, School of Civil Engineering and the Environment	Robert J. Nicholls

Report highlights



Global mean sea level, USACE illustration based on IPCC figure

Highlights

- Consensus among the research community:
  - The planet is warming
  - The sea level is rising
  - Snow is melting sooner in some regions
  - Atmospheric CO_2 is increasing rapidly
- Huge uncertainty remains about potential climate change impacts on water resources

Key Point 1: The best available scientific evidence based on observations from long-term monitoring networks indicates that climate change is occurring, although the effects differ regionally.

Key Point 2: Climate change could affect all sectors of water resources management, since it may require changed design and operational assumptions about resource supplies, system demands or performance requirements, and operational constraints. The assumption of temporal stationarity in hydroclimate variables should be evaluated along with all other assumptions.

Highlights

Water Resources Management Challenges

- GW depletion
- Legal requirements for environmental flows;
- Aging infrastructure
- Demographic shifts (e.g., increased population near the Nation's coast)
- Land use change
- Climate change

Key Point 3: Climate change is but one of many challenges facing water resource managers. A holistic approach to water resources management includes all significant drivers of change.

Highlights

Monitoring networks are essential to

- tracking changes to hydrology

- advancing climate change science

- water resources management and planning

Key Point 4: Long-term monitoring networks are critical for detecting and quantifying climate change and its impacts. Continued improvement in the understanding of climate change, its impacts, and the effectiveness of adaptation or mitigation actions requires continued operation of existing long-term monitoring networks and improved sensors deployed in space, in the atmosphere, in the oceans, and on the Earth's surface.

Key Point 5: Monitoring needs to focus on locations that describe the climate signal (for example, upstream and downstream of major water-management infrastructure or in vulnerable ecological reaches).

Highlights

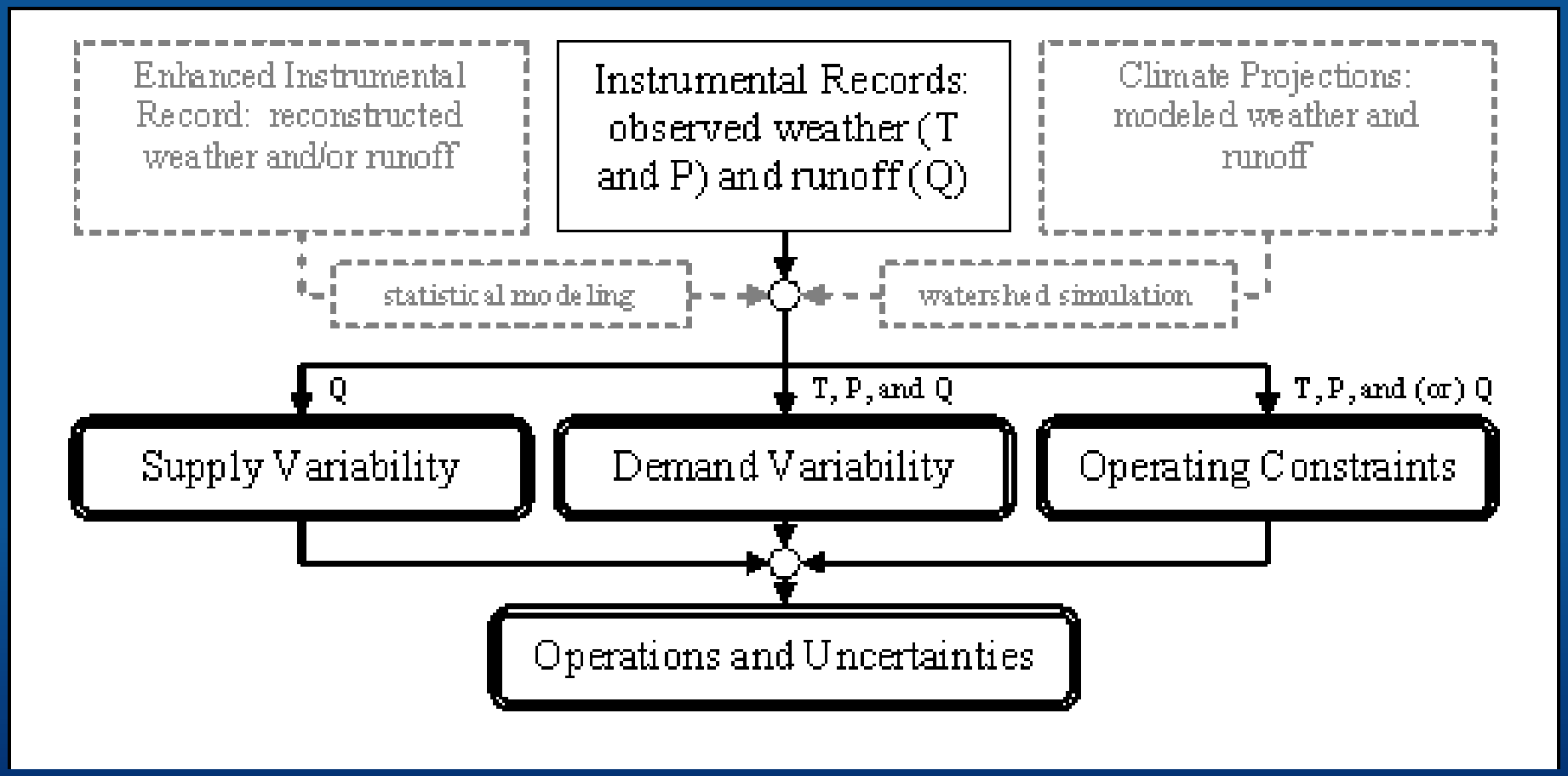
Expanded planning scenarios can be developed from:

- **stochastic modeling**
- **paleoclimate information**
- **climate projections (downscaled)**

Key Point 6: Paleoclimate information and stochastic modeling can be useful for developing climate scenarios that include a wide range of potential hydroclimatic conditions. The expanded variability may allow a more robust evaluation of planning alternatives, particularly when there is concern that study outcomes and decisions be sensitive to climate assumptions.

Key Point 7: Evidence of past climate change and current expectations about future climate might lead to less reliance on historical climate information. Rather, planning assumptions might instead be related to projections of future temperature and precipitation. This can be accomplished using a multitude of approaches; a best approach has yet to be determined.

Key Point 8: A System Projection paradigm for adaptation planning, as opposed to a Stationary System paradigm, may offer a more appropriate context for characterizing planning assumptions, albeit at the potential cost of adding planning complexity.



Framework for relating climate to water supplies, demands, and constraints.

Highlights

System flexibility and robustness may be more valuable when future climate is uncertain.

Key Point 9: Adopting alternatives that perform well over a wide range of future scenarios could improve system flexibility. Water resources planning and management requires an appreciation of existing and potential future uses of water resources, particularly when public health and safety are involved.

Key Point 10: Adaptive management is an approach where decisions are made sequentially over time and allows adjustments to be made as more information is known. This approach may be useful in dealing with the additional uncertainty introduced by potential climate change.

Highlights

Where climate change is expected to significantly affect water resources, adaptation options to consider include:

- operational changes
- demand management
- infrastructure changes

Key Point 11: Adaptation options include operational, demand management, and infrastructure changes.

Highlights

Additional research and monitoring is needed, but we also have enough information and tools to begin our response now.

Key Point 12: Research and monitoring are both needed to fill knowledge gaps and set up advances in planning capabilities. Although neither will eliminate all uncertainties, they will provide significant improvements in understanding the effects of climate change on water resources, including quantity and quality, and in evaluating associated uncertainties and risks required for better informed decision making.

Next steps

- Enhance collaboration on research and monitoring networks
- USACE and Reclamation to provide more specific guidance to their field operations

Thanks!

http://pubs.usgs.gov/circ/1331/

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