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Water-Resources Challenges for the Next 25 years:

Future Water Priorities for the Nation: Directions for the U.S. Geological Survey Water Mission Area

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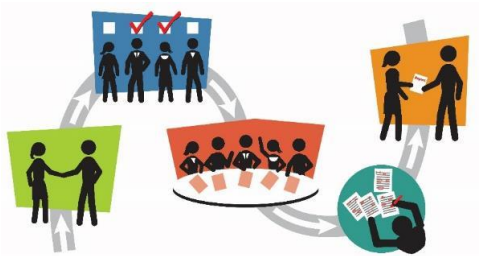

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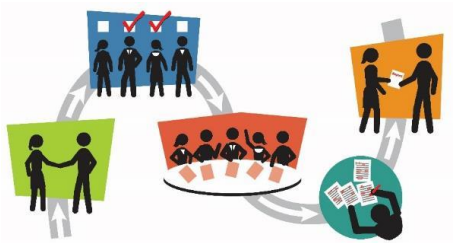

Statement of Task

Address the most compelling national water resource and science needs during the next several decades.

1. Identify the nation's highest-priority water science and resources challenges over the next 25 years,

2. Provide recommendations on the strategic water science and research opportunities for the USGS Water Mission Area that would address the highest-priority national water challenges.

Committee Membership

GEORGE M. HORNBERGER, *Chair*, Vanderbilt University

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JENNIFER L. TANK, University of Notre Dame

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Study Approach (2017-2018)

- 4 in-person meetings (3 information-gathering)
- Presentations and webinars from and discussions with federal/state/local agencies, academia, NGOs
- Additional information gathered from questionnaires sent to Water Science Center directors and State Geologists
- Comprehensive literature review of relevant studies
- Identified important challenges, questions that could address those challenges, then a subset that benefits USGS strategic directions

Priority Water Science and Resource Challenges

- Understanding the role of water in the Earth system
- Quantifying the water cycle
- Developing integrated models
- Quantifying change in the socio-hydrological system
- Securing reliable and sustainable water supplies
- Understanding and predicting water-related hazards

Questions to Address High-Priority Challenges

- Committee defined 10 questions to address high-priority challenges
- Developed a rubric to score and rank these questions

Source: USGS

Questions Most Relevant to USGS

1. What is the quality and quantity of atmospheric, surface, and subsurface water, and how do these vary spatially and temporally?

2. How do human activities affect water quantity and quality?

3. How can water accounting be done more effectively and comprehensively to provide data for water availability and use?

4. How does changing climate affect water quality, quantity, and reliability, as well as water-related hazards and extreme events?

5. How can long-term water-related risk management be improved?

Additional Questions

6. How does the hydrologic cycle respond to changes in the atmosphere, the lithosphere, and the biosphere through Earth's history and in the near future?

7. How can short-term forecasting for climate, hydrology, water quality, and associated social systems be improved?

8. How do institutions and governance and institutional resilience impact the quantity and quality of water?

9. How can understanding of the connections between water-related hazards and human health be improved?

10. How can competing uses for water resources be managed and maintained to sustain healthy communities and ecosystems in a changing world?

Emerging Technologies

- Future observations will:
  - come from a wider array of sources
  - be more affordable
  - offer data from previously inaccessible locations
  - provide “fit-for-purpose” temporal and spatial resolution
  - deliver measurements of new parameters
  - require systems that can rapidly collect, assess, store, process, and share data in near real-time

- Technical challenges still exist for measuring and monitoring water quality, but approaches such as microsensors and eDNA are advancing rapidly

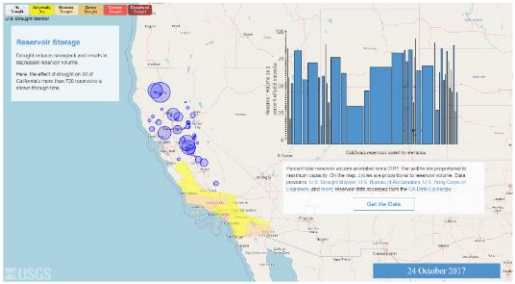
- Developments in “big data” and data integration support:
  - improved scientific understanding
  - improved models
  - interdisciplinary model integration
  - decision-making under uncertainty

Recommendations

1. What is the quality and quantity of atmospheric, surface, and subsurface water, and how do these vary spatially and temporally?

- **Enhance data collection, include citizen science, and develop Web-based analytical tools.**
- **Coordinate with agencies and organizations on data delivery.**

Source: USGS; Mad Fish Digital. www.madfishdigital.com/ccimages



2. How do human activities affect water quantity and quality?

- **Increase focus on the relationships between human activities and water**

Recommendations (cont'd)

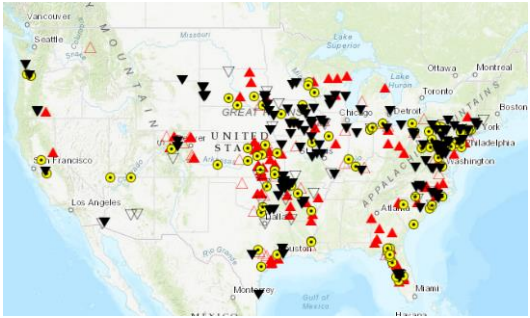
3. How can water accounting be done more effectively and comprehensively to provide data for water availability and use?

- **Develop a robust water accounting system.**
- **Collaborate with agencies and organizations on water-data standards and categories of use.**

Source: USGS

4. How does changing climate affect water quality, quantity, and reliability, as well as water-related hazards and extreme events?

- **Ensure that monitoring networks provide adequate information to assess changing conditions.**



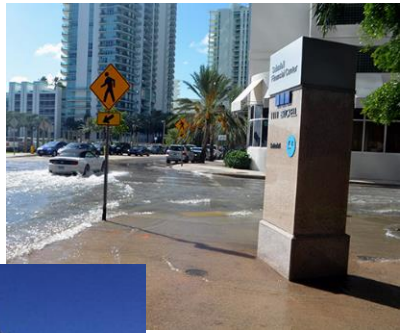
Recommendations (cont'd)

5. How can long-term water-related risk management be improved?

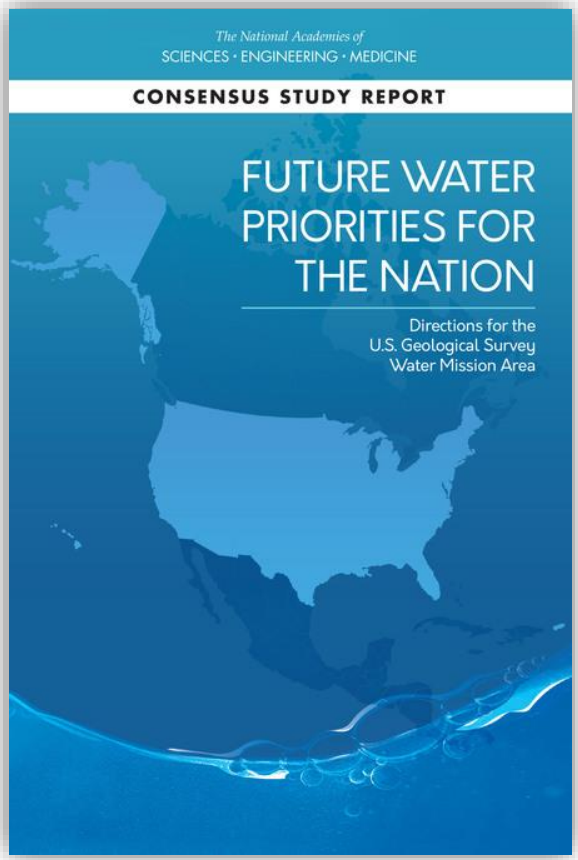
- **Focus on long-term prediction and risk assessment of extreme water conditions.**

Additional Recommendations

- **Develop multiscale, integrated, dynamic models that encompass the full water cycle.**
- **Collaborate as appropriate both within and outside of USGS, including agencies and the private sector.**
- **Build a workforce who are ready to take on new water challenges.**



Source: Wikipedia



Thank you for your time.

Questions?

The report can be downloaded at:
https://www.nap.edu/catalog/25134