Water, Climate & Health at CU Boulder

Using and enhancing technology to address water challenges from local to global scales

Center for Water, Earth Science and Technology
UNIVERSITY OF COLORADO BOULDER
Major Contributors

- **Noah Molotch** - GEOG, INSTAAR, CWEST
- **Rajagopalan Balaji** – CEAE, CIRES
- **Bob Brakenridge** - INSTAAR
- **Lisa Dilling** - WWA, CIRES, ENVS
- **Chuck Howe** - IBS, Environment and Societies Program
- **Joseph Kasprzyk** - CEAE
- **Ben Livneh** – CIRES / CEAE
- **Diane McKnight** - CEAE, ENVS, INSTAAR, Hydrologic Science
- **Ralph Milliff** – CIRES
- **Steve Nerem** - CIRES, ASEN
- **Scott Summers** - CEAE
- **John Weiner** - IBS, Environment and Societies Program
### The Global Risks 2015 Report

**The Ten Global Risks in Terms of Likelihood and Impact**

<table>
<thead>
<tr>
<th>Top 10 risks in terms of Likelihood</th>
<th>Top 10 risks in terms of Impact</th>
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<tbody>
<tr>
<td>1. Interstate conflict</td>
<td>1. Water crises</td>
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<tr>
<td>2. Extreme weather events</td>
<td>2. Spread of infectious diseases</td>
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<td>3. Failure of national governance</td>
<td>3. Weapons of mass destruction</td>
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<td>4. State collapse or crisis</td>
<td>4. Interstate conflict</td>
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<tr>
<td>5. Unemployment or underemployment</td>
<td>5. Failure of climate-change adaptation</td>
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<tr>
<td>7. Failure of climate-change adaptation</td>
<td>7. Critical information infrastructure breakdown</td>
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<td>8. Water crises</td>
<td>8. Fiscal crises</td>
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<tr>
<td>9. Data fraud or theft</td>
<td>9. Unemployment or underemployment</td>
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<tr>
<td>10. Cyber attacks</td>
<td>10. Biodiversity loss and ecosystem collapse</td>
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**Categories**

- **Economic**
- **Environmental**
- **Geopolitical**
- **Societal**
- **Technological**

*Source: Global Risks 2015 report, World Economic Forum*
Addressing the Challenge with Technology

- Several NASA missions focused on water resources.
- Data Informatics.
- Computational Modeling.
- Analytical Chemistry.

Trenberth et al., 2007
CU & Water: A New Paradigm Emerging

• Catalyze innovation in STEM, arts, and communications.

• Synthesize and translate data, and enhance contextual aspects of emerging technologies (e.g. space, airborne, ground, analytical).

• Transform human relationships with water.
Summary: CU Water Research Across Scales

Global / International
- Earth-Observing Satellites
- GCMs
- Sea level, ice sheets, ENSO, PDO, MJO, Monsoons
- Emissions standards, climate accords, disaster relief, food security

Regional / Inter-State
- Airborne obs, regional obs networks
- Regional/Basin Models
- Atmospheric river, drought/flood, fire, snowpack, soil moisture
- Inter-state water compacts, land management, air quality management, disaster preparedness

Local / Inter-County
- river /eco/land-use/water quality / hydrologic models
- UAV’s, ground measurements: snow, soil moisture, vegetation productivity; water quality monitoring
- Information systems, decision/management models, trans-basin diversions, food production, environmental remediation
Technology

- Incubate new observing systems in the context of their scientific and water resource management implications.
- CU is a world-leading institution in space technology, airborne platforms, ground measurements, and analytical chemistry.
- Key players are CIRES, INSTAAR, LASP, Aerospace Engineering, industry partners, Federal Labs.
Physical Science

• Understand Process: Global to local physical processes are endowed with uncertainties.

• Integrating Observations & Models: Spaceborne, airborne sensing, in-situ automated systems integrated with modeling (e.g., climate / atmosphere, cryosphere, hydrology).

• Transform Interactions: Connecting existing groups on campus and establish CU as a center for water innovation.

• Key Players: Geosciences and Engineering (geology, geography, hydrology, environmental and civil engineering, and the multitude of federal labs located in Boulder that already collaborate with CU such as NOAA, USGS, NCAR etc). Leveraging NSF-CZO, NSF-LTER, and other large CU Geoscience Programs
Decision Making & Socioeconomics

• Usable Science: Must involve potential users from the start.

• Co-Production with End-Users: deep awareness of the context of application.

• Stakeholder-Driven Technology: incorporate institutional, legal, social and economic frameworks into technology development.

• Key Players: IBS, WWA, CADSWES, ENVS, Geography, Economics, Law School / Getches-Wilkinson, Sociology, History, Political Science, Anthropology, Public Health
Aerospace: Global water & GRACE

GRACE

Gravity Recovery and Climate Experiment

Nerem
Even after epic storms, groundwater still depleted by drought

By Peter Fimrite, San Francisco Chronicle Updated 5:38 pm, Monday, January 30, 2017

It snowed 5.7 trillion gallons of water in California this January

By Jason Samenow January 30

January storms erase part of California's snowpack deficit

Molotch
Globally, Africa has the second highest number of disaster victims year over year. Whereas other continents show a steady decline, disaster victims in Africa are on the rise. These increases can be attributed almost exclusively to floods and droughts. In early 2015, for example, Malawi was hit by severe floods of the Shire River, affecting more than a million people. In Mozambique, flooding the same year affected 160,000 people...
Droughts have a long term impact on drinking water quality

- Reduced streamflow $\rightarrow$ reduced dilution
- Potential for watershed fires $\rightarrow$ mobilization of DOM, metals, turbidity
- Droughts followed by floods $\rightarrow$ exacerbated water quality impacts
CEAE: Watershed Sediment Response to Drought and Wildfire

Objectives: Develop a model ensemble for suspended sediment prediction in large-scale catchments in the Colorado Front Range

- Five sediment modules coupled within a hydrologic model
- Future climate: Increasing risk of drought and wildfire
- Assess risks on water availability and quality

Funded by the U.S. Environmental Protection Agency

Student: Jenna Stewart
Mission of CADSWES...

Provide **Decision Support Tools** to Water Management Agencies that

- Bridge the gap between science and decision-making
- Transform information to knowledge to solve multi-objective problems
- Formulate problems and solutions in terms of risk management

**Transfer technology** to agencies and other users

**Educate** the next generation of water resources engineers and scientists
Theme 1: Vulnerability and Adaptive Capacity
1. Hydroclimate for local use
2. Spatial snow data utility

Theme 2: Extremes & Climate Risk Mgmt.
1. Flood & drought risk characterization
2. Decision modeling tools

Theme 3 – Designing organizations and networks for usable science
1. Role of organizational design in co-production
2. Crossing the Valley of Death

Lisa Dilling, Ursula
Making a water-secure world – the three I’s

INFRASTRUCTURE

to store, transport & treat water

Better & more-accessible INFORMATION

Stronger & more-adaptable INSTITUTIONS