

Major Contributors

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The Challenge: Global Water Security

The Global Risks 2015 Report

The Ten Global Risks in Terms of Likelihood and Impact

Top 10 risks in terms of Likelihood

- 1 Interstate conflict
- 2 Extreme weather events
- 3 Failure of national governance
- 4 State collapse or crisis
- 5 Unemployment or underemployment
- 6 Natural catastrophes
- 7 Failure of climate-change adaptation
- 8 Water crises
- 9 Data fraud or theft
- 10 Cyber attacks

Top 10 risks in terms of Impact

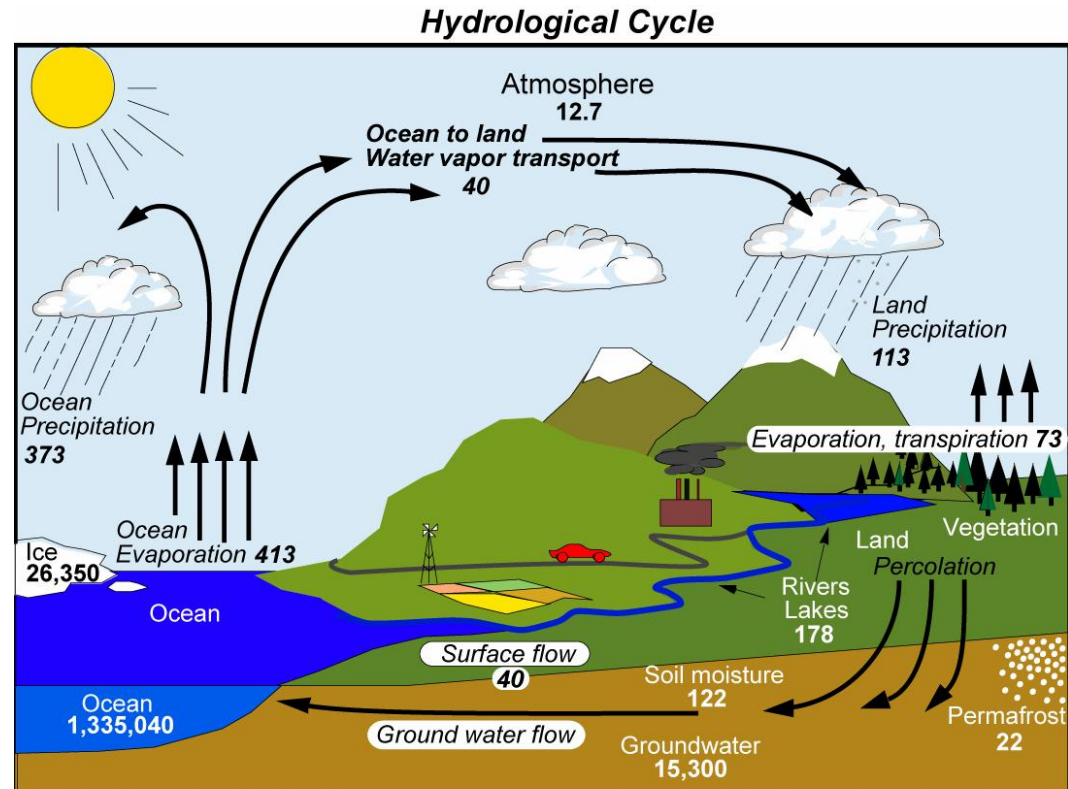
- 1 Water crises
- 2 Spread of infectious diseases
- 3 Weapons of mass destruction
- 4 Interstate conflict
- 5 Failure of climate-change adaptation
- 6 Energy price shock
- 7 Critical information infrastructure breakdown
- 8 Fiscal crises
- 9 Unemployment or underemployment
- 10 Biodiversity loss and ecosystem collapse

Categories

-  Economic
-  Environmental
-  Geopolitical
-  Societal
-  Technological

Addressing the Challenge with Technology

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



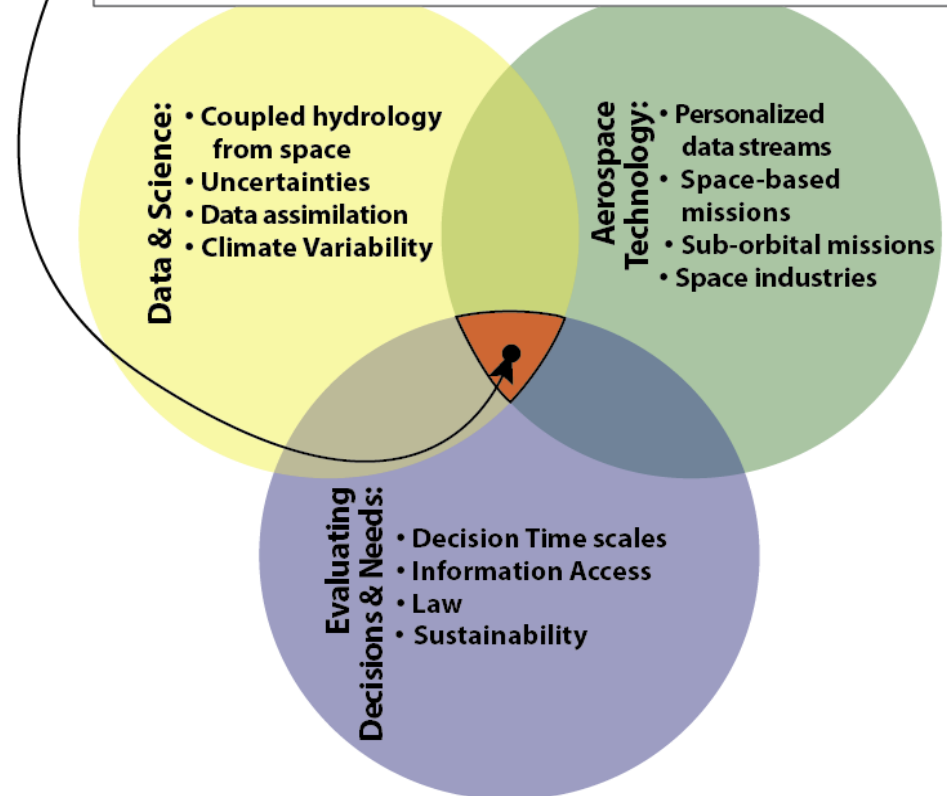
Trenberth et al., 2007

CU & Water: A New Paradigm Emerging

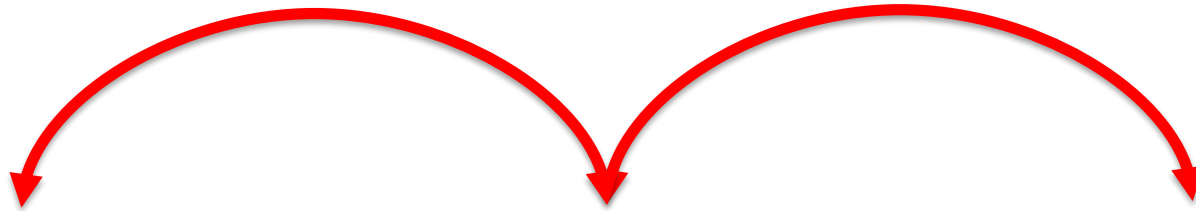
- Catalyze innovation in STEM, arts, and communications.
- Synthesize and translate data, and enhance contextual aspects of emerging technologies (e.g. space, airborne, ground, analytical).
- Transform human relationships with water.

Space-Based Transformation Water Science

- ▼ Economic implications of space-based water information
- ▼ Space-Technology and Decision Support
- ▼ Honoring measurement & model uncertainties
- ▼ Bridging measurement & decision spatio-temporal scales



Summary: CU Water Research Across Scales

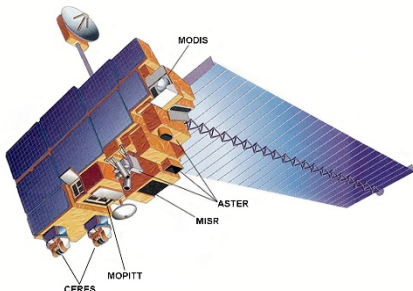


Global / International

Earth-Observing Satellites
GCMs

Sea level, ice sheets,
ENSO, PDO, MJO, Monsoons

Emissions standards, climate
accords, disaster relief, food
security

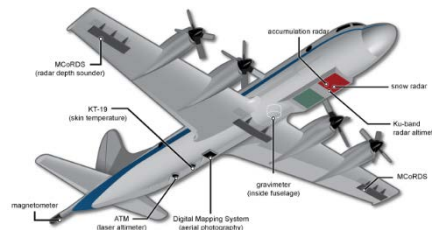


Regional / Inter-State

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

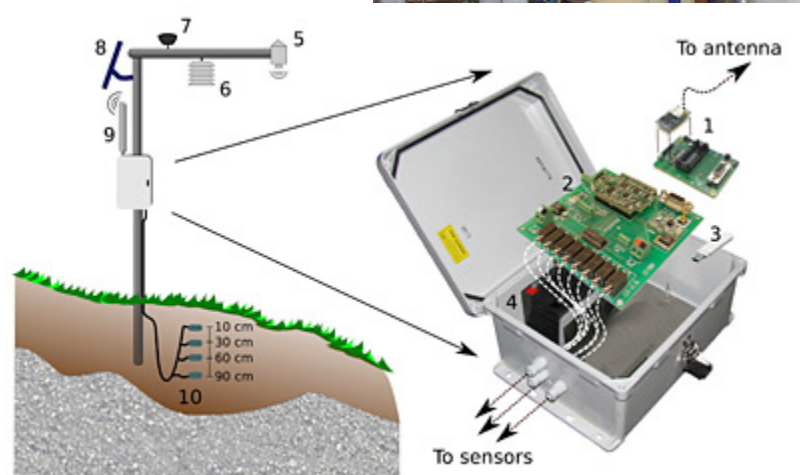
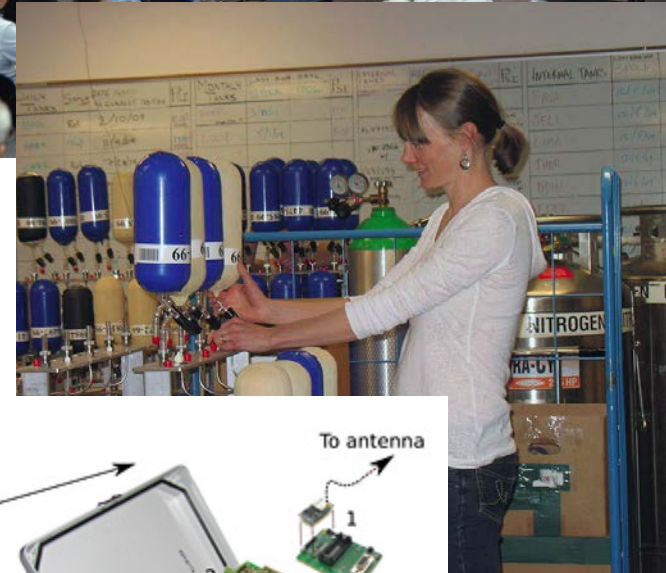
UAV's, ground measurements: snow,
soil moisture, vegetation productivity;
water quality monitoring

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.



★ Contributing to Water Cycle Studies

SLI-TBD
Formulation in 2015

RBI
OMPS-Limb
TSIS-2

JPSS-2 (NOAA)

NI-SAR

PACE

SWOT

TEMPO

GRACE-FO (2)

ICESat-2

CYGNSS

SAGE III (on ISS)

SMAP

OCO-2

TRMM

QuikSCAT

SORCE

ACRIMSAT

Landsat-7
(USGS)

EO-1

Aquarius

Terra

Suomi NPP
(NOAA)

Aqua

Landsat-8
(USGS)

CloudSat

CALIPSO

Aura

GRACE (2)

OSTM/Jason 2
(NOAA)

GPM

- Formulation
- Implementation
- Primary Ops
- Extended Ops



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

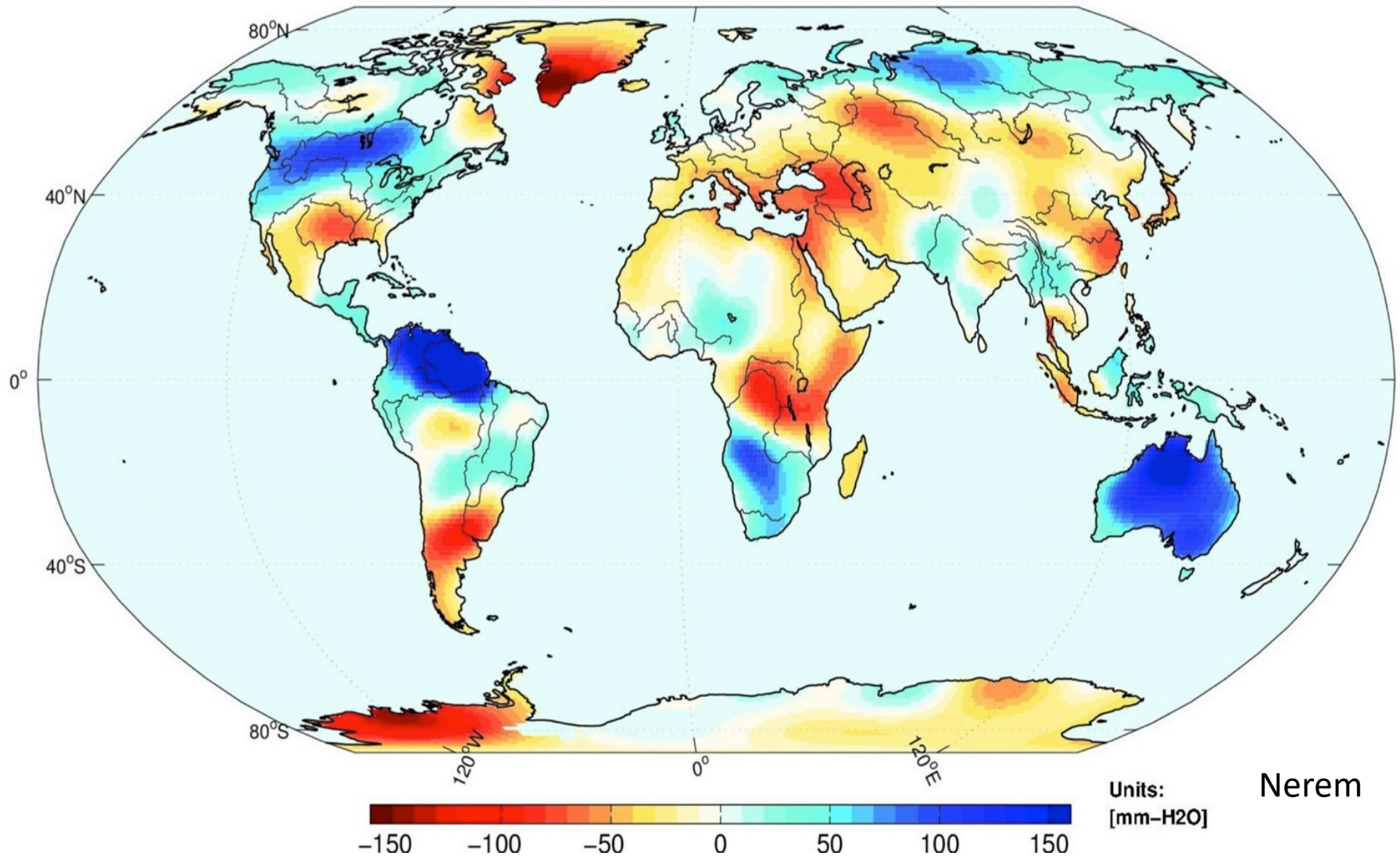
- Usable Science: Must involve potential users from the start.
- Co-Production with End-Users: deep awareness of the context of application.
- Stakeholder-Driven Technology: incorporate institutional, legal, social and economic frameworks into technology development.
- Key Players: IBS, WWA, CADSWES, ENVS, Geography, Economics, Law School / Getches-Wilkinson, Sociology, History, Political Science, Anthropology, Public Health



Aerospace: Global water & GRACE

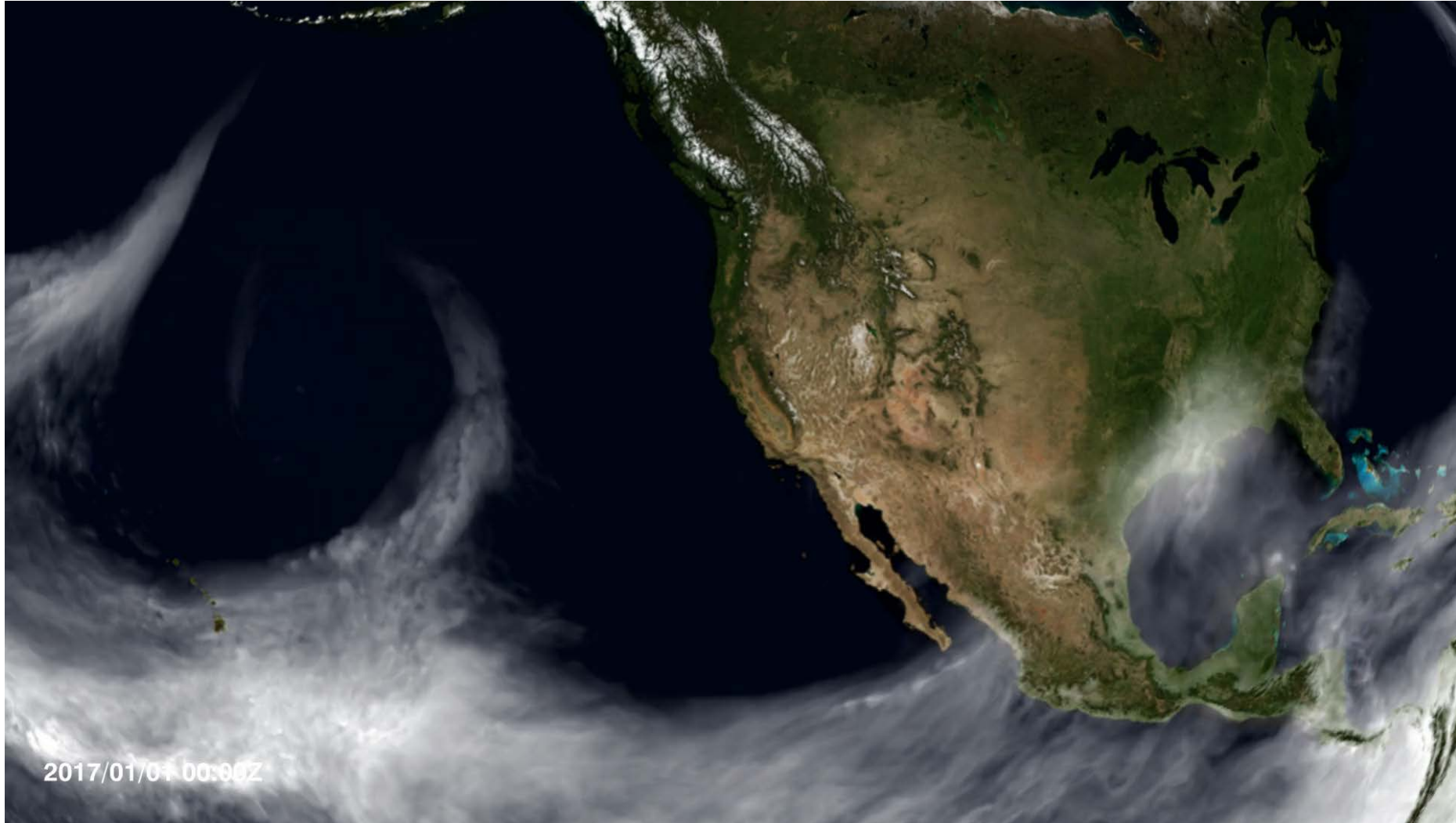


GRACE Terrestrial Water Changes



Boening, C., J. K. Willis, F. W. Landerer, R. S. Nerem, and J. Fasullo, The 2011 La Nina: So Strong, The Oceans Fell, *Geophys. Res. Lett.*, 2012.

CWEST & CEAE: Regional Climate & Hydrologic Extremes



CWEST: Snowpack, Water Supply, & Flood Risk

SFGATE LOCAL NEWS SPORTS BUSINESS A&E FOOD LIVING TRAVEL REAL ESTATE

Even after epic storms, groundwater still depleted by drought

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

✉ f t p g 35



By Jason Samenow January 30



Los Angeles Times
MONDAY FEB. 20, 2017
MOST POPULAR LOCAL SPORTS ENTERTAINMENT POLITICS OPINION PLACE AN AD

January storms erase part of California's snowpack deficit



Molotch

INSTAAR / Dartmouth Flood Observatory: Remote Sensing of Floods



Dartmouth Flood Observatory

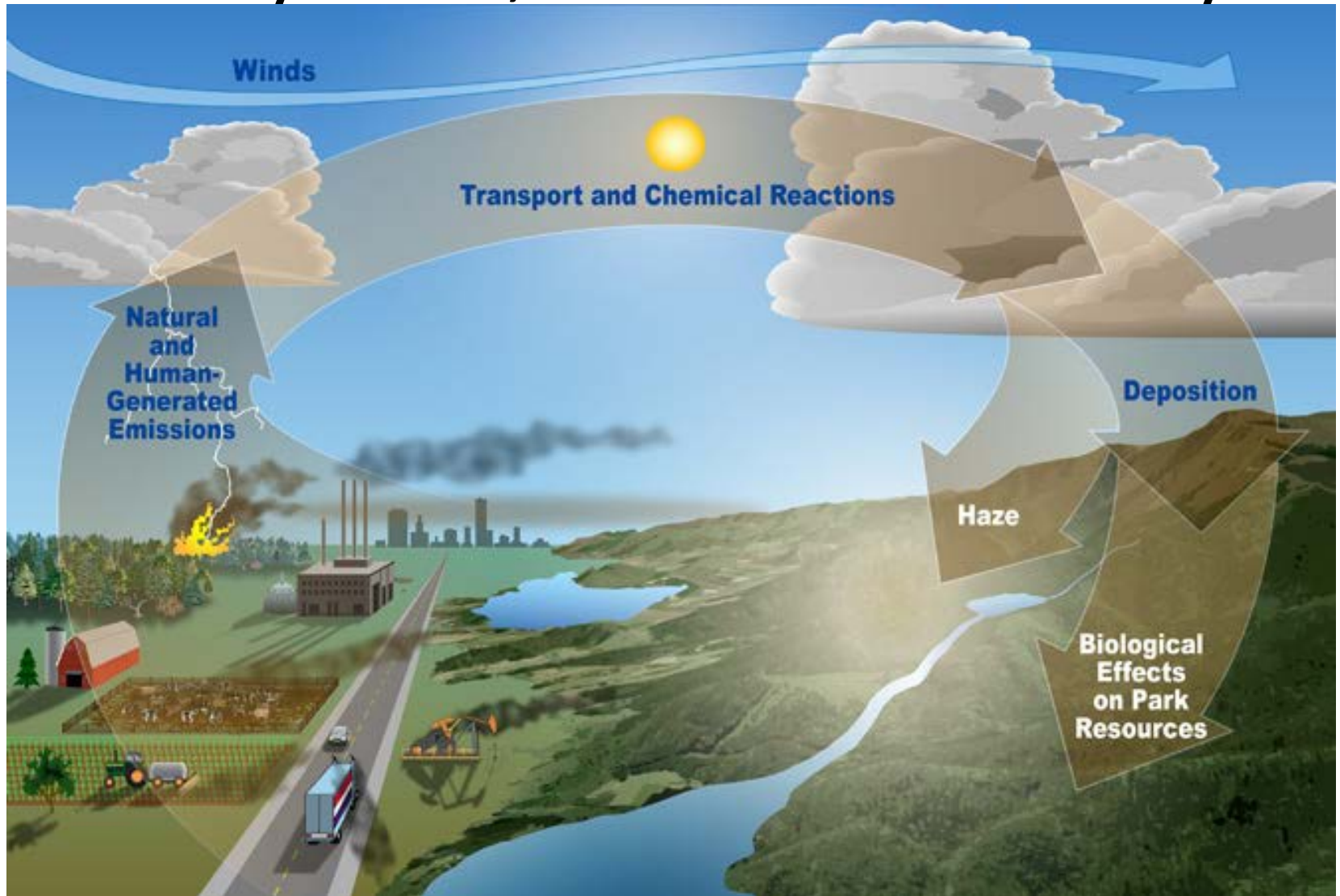
Web map services to improve
real-time flood data in Africa



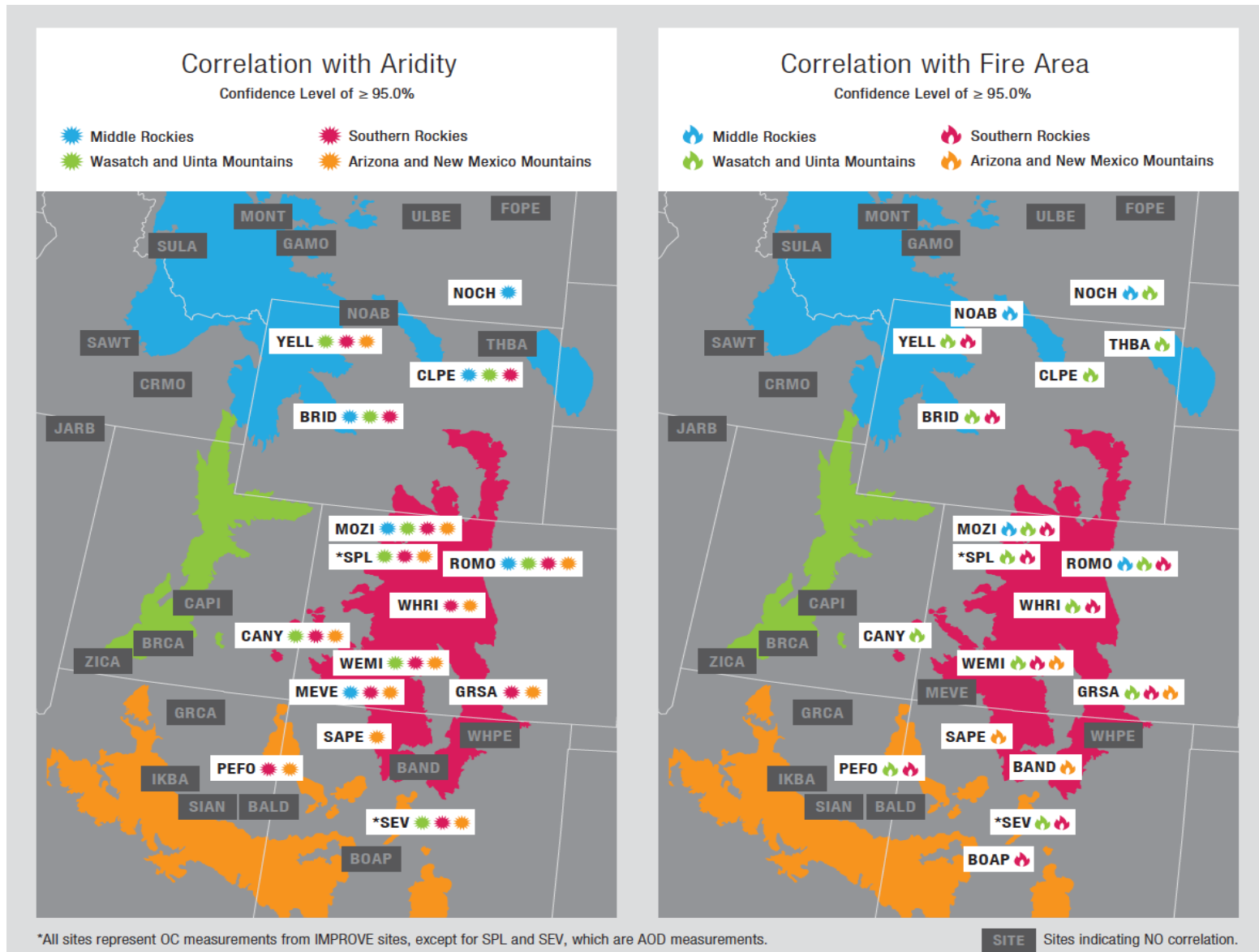
Brakenridge

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.

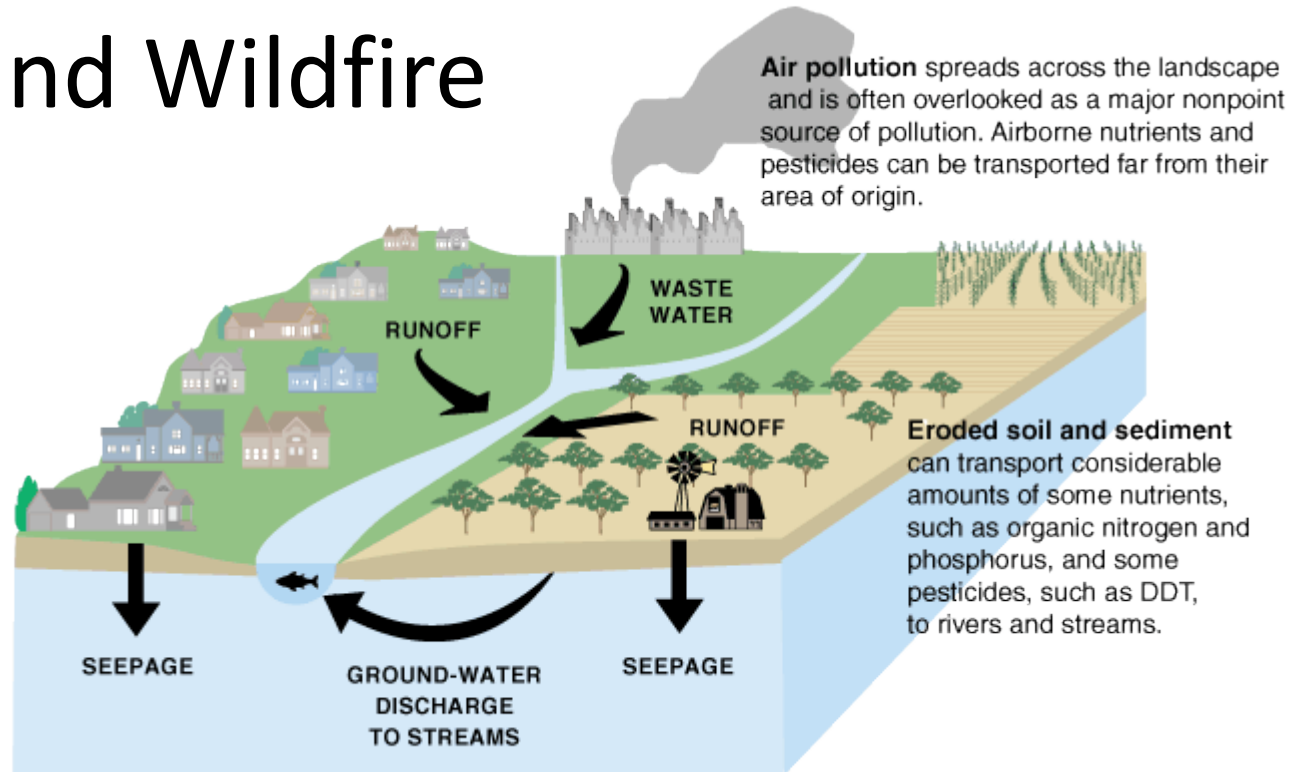
CWEST & CEAE: Drought, Wildfire, Ecosystems, Air & Water Quality



CWEST & CEAE: Drought and Air Quality



CEAE: Watershed Sediment Response to Drought and Wildfire



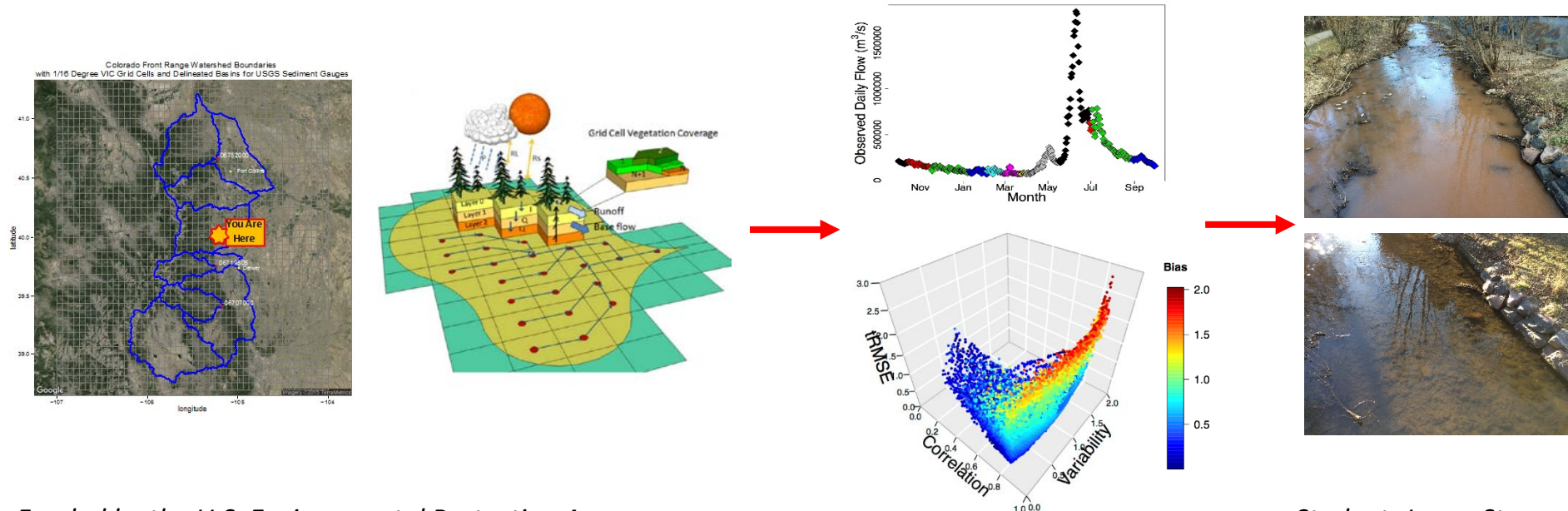
Droughts have a long term impact on drinking water quality

- Reduced streamflow → reduced dilution
- Potential for watershed fires → mobilization of DOM, metals, turbidity
- Droughts followed by floods → 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

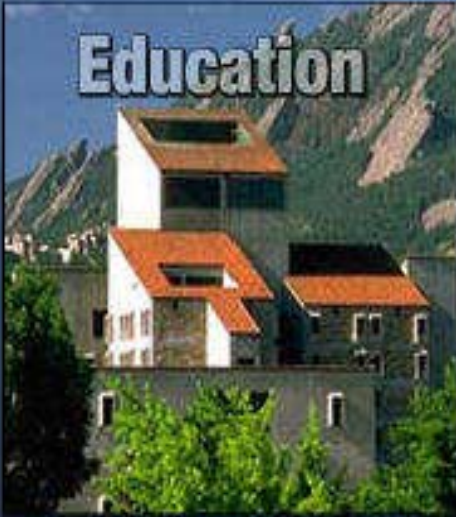




CADSWES

The Center for Advanced Decision Support for Water and Environmental Systems

Education



Research & Development



Technology Transfer



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



WWA: Western Water Assessment



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

Exchange
and
Engagement

Theme 3 – Designing organizations and networks for usable science

1. Role of organizational design in co-production
2. Crossing the Valley of Death

Making a water-secure world – the three I's

INFRASTRUCTURE
to store, transport
& treat water



Stronger & more-
adaptable
INSTITUTIONS



Better & more-accessible
INFORMATION

