The Interagency Integrated Water Cycle Group under the US Global Change Research Program

US Global Change Research Program (USGCRP)
Mike Kuperberg, Executive Director

USGCRP Interagency Integrated Water Cycle Group (IWCG) Co-Chairs
Sandra Connors (EPA), Gary Geernaert (DOE), Wayne Higgins (NOAA)

USGCRP National Coordination Office Support:
Jennifer Saleem Arrigo, Water Cycle Coordination and Advance Science Lead (Contractor)

Presented to:

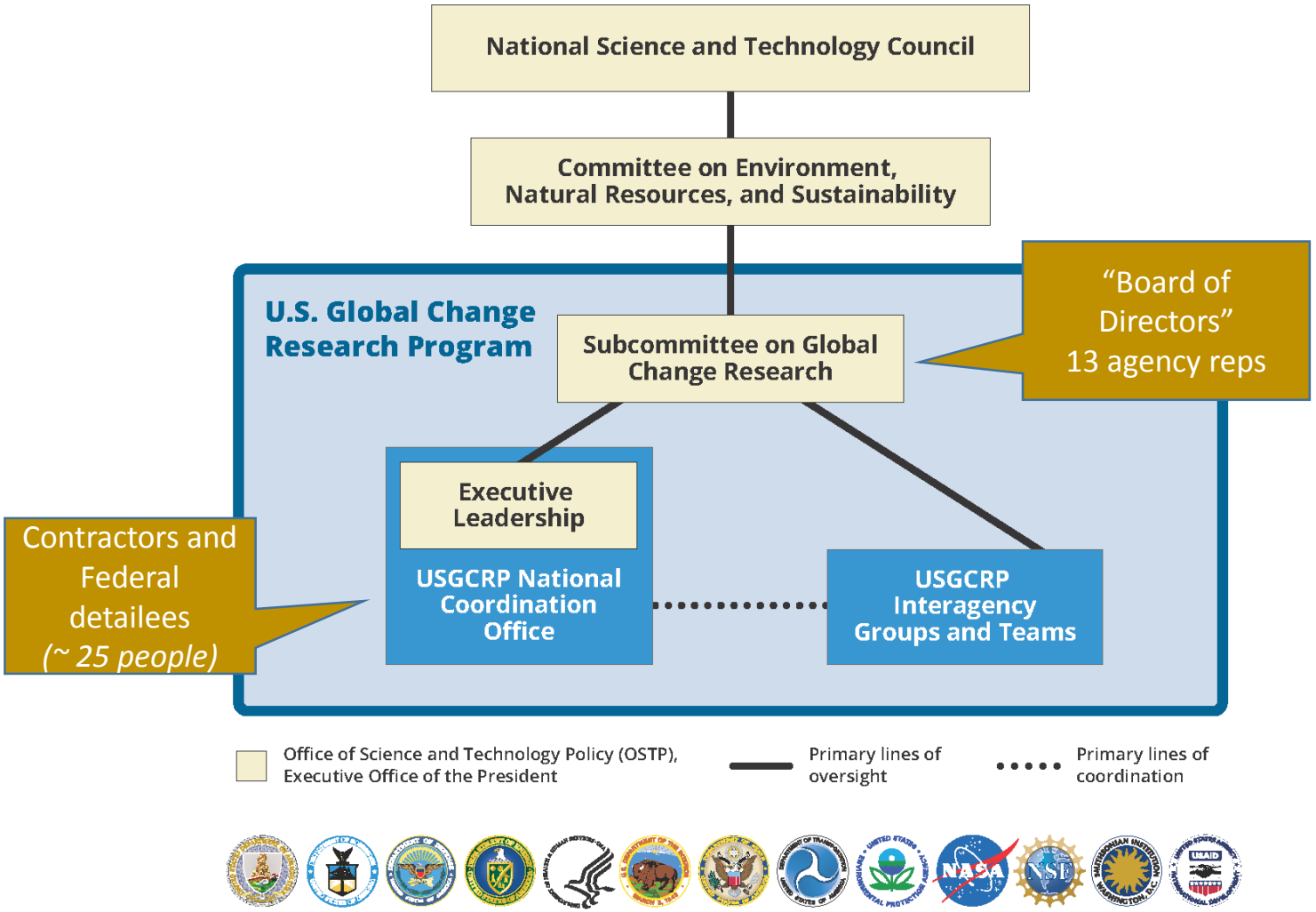
ACWI Water Resources Adaptation to Climate Change workgroup

June 26, 2018

Outline

- About the Program and its Interagency Working Groups
- Recent USGCRP work on water cycle extremes
- The Integrated Water Cycle Group*, formed April 2018*
- From Science to Informing Decisions, *the IWCG workstreams*
- Results from recent assessment activities
- Connecting to other efforts

USGCRP Lines of Oversight and Coordination



About USGCRP

- USGCRP began as a Presidential Initiative in 1989
- Mandated by Congress in the Global Change Research Act of 1990 (GCRA) “to assist the Nation and the world to understand, assess, predict and respond to human-induced and natural processes of global change”
- Comprises the science arms of 13 agencies with responsibilities in global change
- Major coordination through Interagency Working Groups
- Supported by the National Coordination Office (NCO)

What USGCRP does

USGCRP agencies work together to:

- Coordinate and **advance global change research** across the government
- Use research results and products to **inform decisions** relating to risk management in a changing climate
- **Deliver products** mandated by the GCRA (i.e., National Climate Assessment (NCA), Our Changing Planet, Strategic Plan)
- Foster **international research cooperation**

Current interagency groups

Interagency groups are currently a key means of achieving USGCRP's strategic goals

- Carbon Cycle
- Observations
- Modeling
- Human Health
- Social Science
- Adaptation Science
- International Activities
- Sustained Assessment
- Indicators
- Integrated Water Cycle
- Data & Information

National Climate Assessment

- The Fourth NCA (NCA4) is being developed in two volumes
  - Vol. I: *Climate Science Special Report* (released Nov 2017)
  - Vol. II: *Impacts, Risks, and Adaptation in the U.S.*
- NCA4 Vol. II scheduled for release in late 2018
- Summarizes current and future impacts of climate change
- Working toward a sustained process that culminates in a quadrennial report

NCA4 Vol. I is available at
science2017.globalchange.gov

Water Cycle Extremes and Impacts

Some Motivating Questions

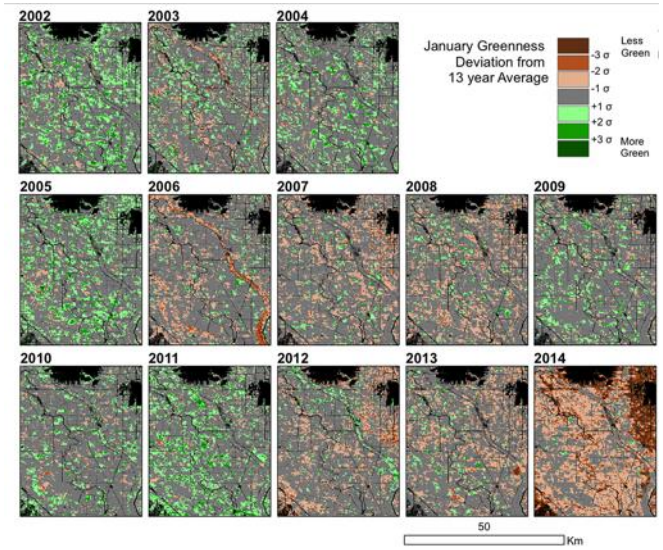
- How do we advance our understanding of the relationships between **global climate change, continental and regional water cycles,** and the interdependent human and natural systems that rely on them?
- How do we better **predict and characterize extreme events and how they are changing,** particularly on decadal and longer timescales?
- How do we better **assess and anticipate the ecological and societal impacts** of water-cycle extremes on key sectors, such as energy, agriculture, infrastructure, and health?

FEMA's Urban Search and Rescue Teams go through neighborhoods with the National Guard to look for residents that may be stranded in a neighborhood that was flooded following Hurricane Matthew. (Source: Jocelyn Augustino, FEMA, as published in Our Changing Planet FY17)

Recent Highlights of USGCRP Work on Water Cycle Extremes and Impacts

- Mapping Fallowed Farmland During Drought (Our Changing Planet FY16[1])
- Building Capacity Among Water Resource Managers (OCPFY16)
- Explaining Extreme Events from a Climate Perspective (OCP FY16)
- Understanding Atmospheric Rivers and West Coast Precipitation (OCP FY17[2])
- Focusing on the California Drought (OCP FY17)

Flooding from heavy rains damaged Boulder, Colorado, in September 2013—one of several extreme events examined in the collaborative report "Explaining Extreme Events of 2013 from a Climate Perspective" l*BAMS, 2014*) (Source: S. Zumwalt, FEMA)

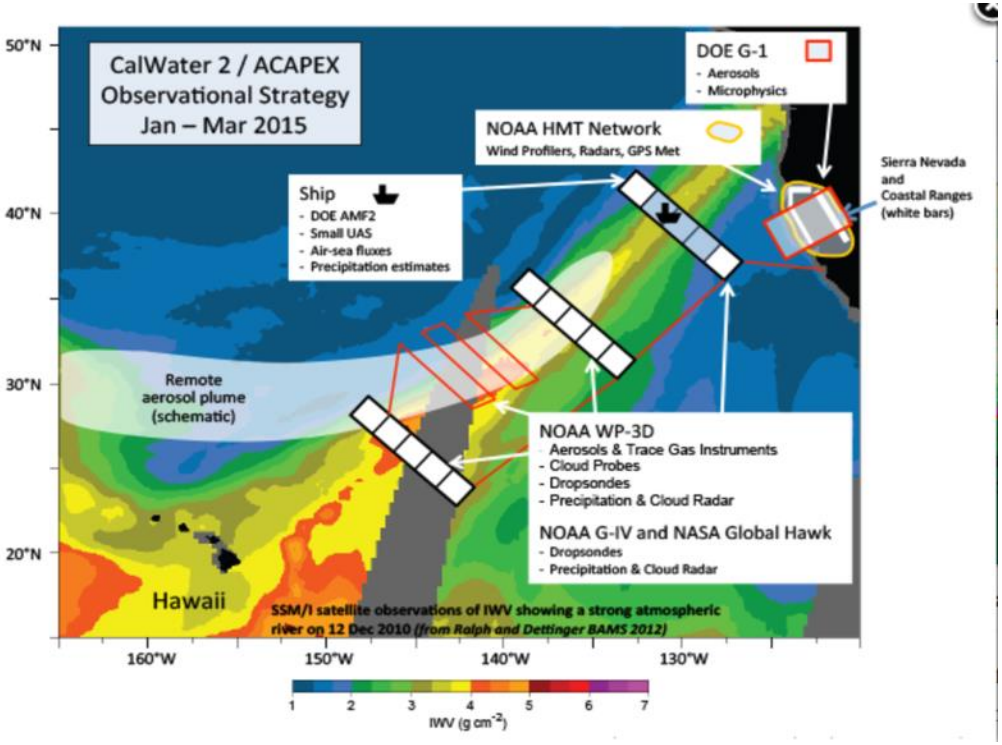


The greenness of croplands in January is shown relative to the 13-year average from NASA MODIS records. Satellite imagery can be a powerful tool for understanding the impacts of drought on agricultural lands. (Source: NIDIS Newsletter, April 2014)

[1]https://www.globalchange.gov/browse/reports/our-changing-planet-FY-2016

[2]https://www.globalchange.gov/browse/reports/our-changing-planet-FY-2017

Atmospheric Rivers



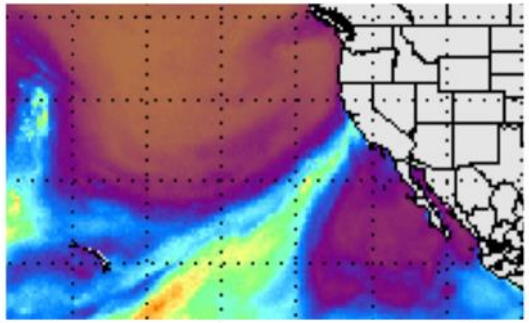
The joint NOAA, NASA, and DOE CalWater-2 2015 campaign collected **a comprehensive dataset for AR development and landfall** (OCPFY17)

Important Phenomena for West Coast Precipitation

Critical part of west coast water supply and snowpack

Severe events can cause catastrophic flooding

Uncertainty about processes and features that determine storm development within events

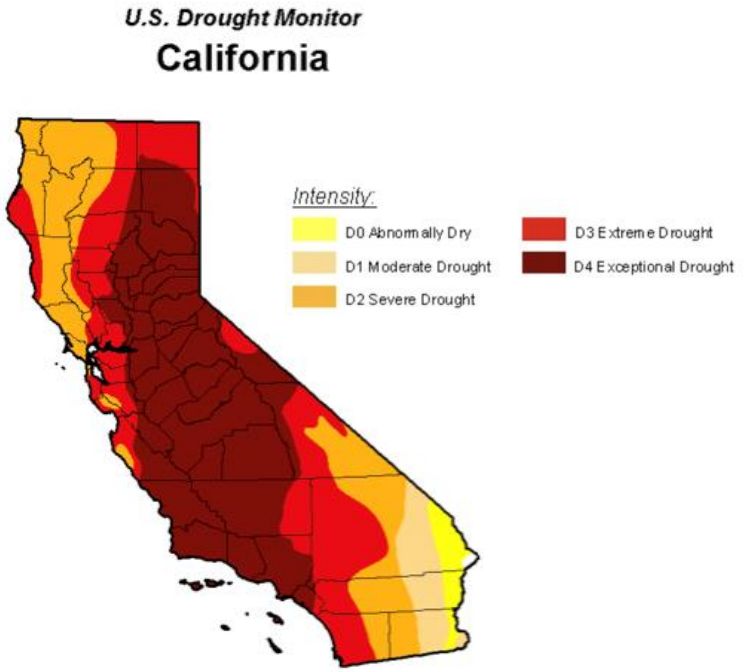


Atmospheric River event February 10 00 GMT. The Oroville Dam Crisis, in northern California, occurred during this event in 2017.

Satellite imagery source http://tropic.ssec.wisc.edu/real-time/mimic-tpw/global/main.html

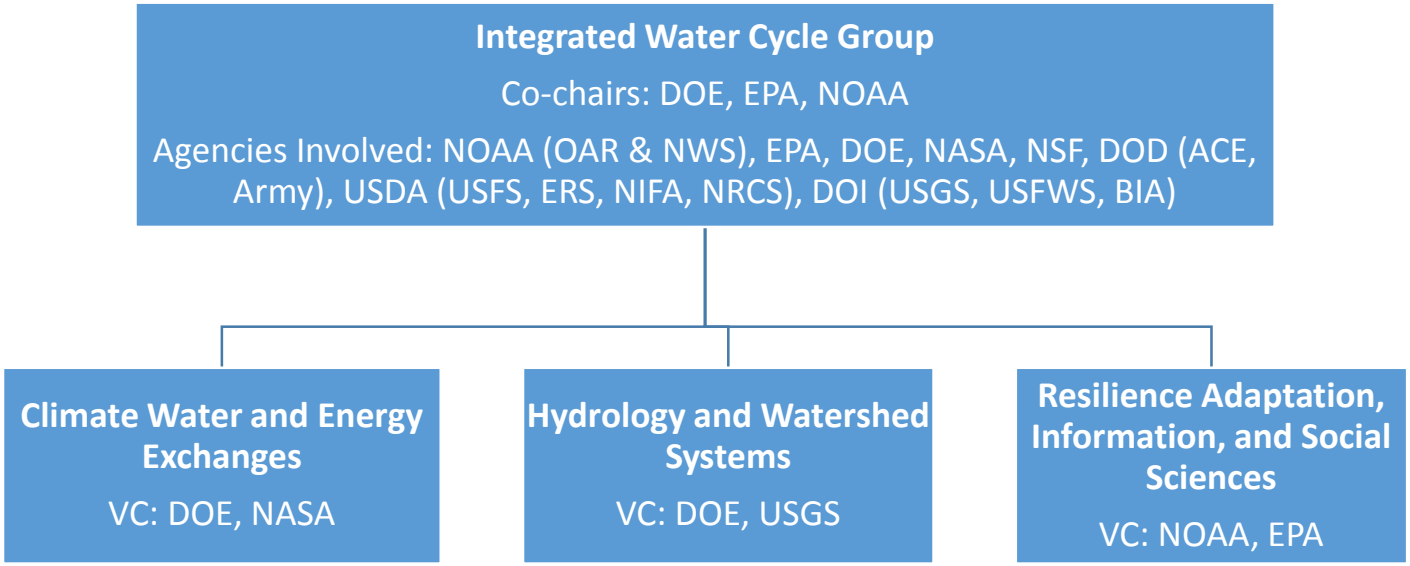
Focusing on the California Drought

- Severe drought of 2011- 2016
- Interagency efforts and coordination contribute to comprehensive efforts
- USGCRP **research** contributes to better understanding of drought science
  - the National Integrated Drought Information System (NIDIS)
  - California Drought Early Warning System (DEWS)
- USGCRP agencies **bring science to decision makers**
  - NOAA Drought Task Force assessment



U.S. Drought Monitor map of California from November 3, 2015, when 71% of the state was experiencing extreme or exceptional drought.

Integrated Water Cycle Group (IWCG)

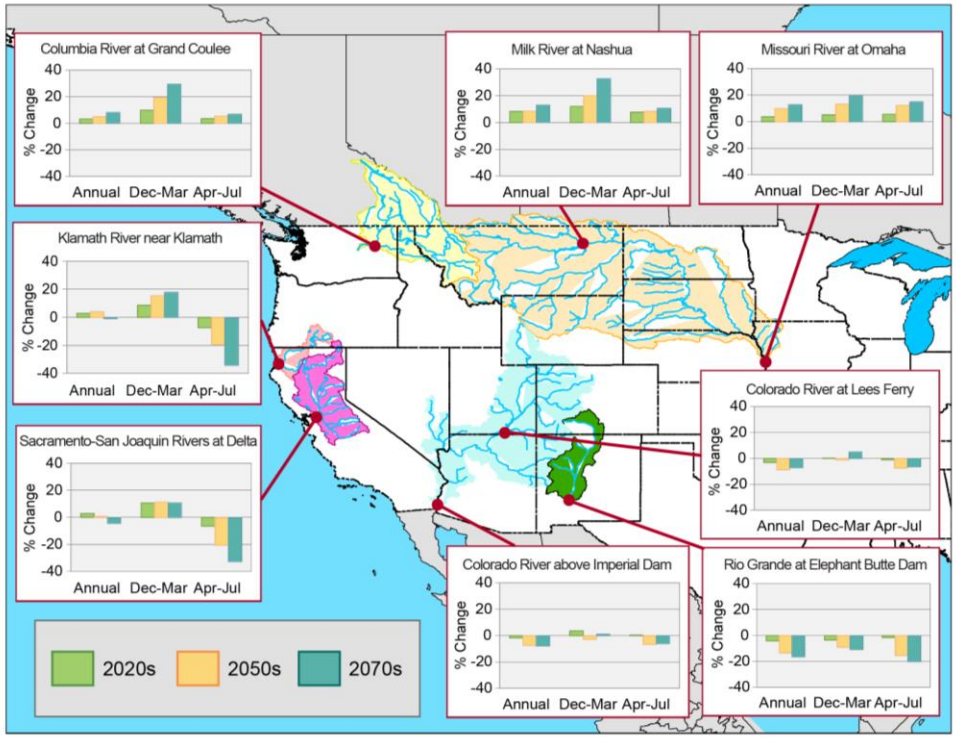


- **Coordinates and integrates global-change relevant water cycle research;**
- Pursues **interagency and end-to-end approaches** to water cycle science and in support of decision making;
- **Advances capabilities and infrastructure** that support water cycle observation, modeling and predictability at a range of scales;
- **Develops approaches to apply and translate** our understanding and inform decisions surrounding preparedness and resilience.

Advancing Science, Informing Decisions

HWS: Hydrology and Watershed Systems

- local watershed perspectives to higher spatial and temporal scales
- hydrologic model structure and modularity
- observation and analyses methods for hydrologic systems undergoing change



From NCA3 (2014): Annual and seasonal streamflow projections based on CMIP3 scenarios for eight river basins in the western United States. Source: U.S. Department of the Interior – Bureau of Reclamation 2011; Data provided by L. Brekke, S. Gangopadhyay, and T. Pruitt

Advancing Science, Informing Decisions

From OCP16: Federally coordinated regional science centers work individually and together on projects that support tangible outcomes in their regions. (Source: B. Neely, The Nature Conservancy)

Resilience, Adaptation, INformation, and Social Sciences

- translation of water cycle science information in ways that are responsive to user needs and the complex decision-making challenges they face
- advance our understanding of user needs to better support decision making
- communication and activities that help identify science needs from water resource decision makers.

Advancing Science, Informing Decisions

CWEX: Climate, Energy and Water eXchanges

- multiscale atmospheric processes
- surface-atmosphere interactions
- teleconnections
- impacts of large scale human-Earth system interactions (e.g. land management and irrigation) on regional and global water cycles

From OCP FY17: A Plains Elevated Convection at Night (PECAN) mobile observing station. (Source: James Kurdzo).

The USGCRP Climate Science Special Report: Overview

- A required component of the 4th National Climate Assessment
  - CSSR is an assessment of the science: About 600 pages of text, figures, references, and traceable accounts
  - Report written by Lead Author team
    - 32 Lead Authors (Federal, academic, and industry scientists), 3 review editors
  - Oversight by Federal Science Steering Committee
  - Additional Contributing Authors for special needs
  - Extensively reviewed (including public, National Academy of Sciences, and U.S. agency reviews)
- Basis for the chapter on climate science that appears in NCA4
- Policy relevant, but not policy prescriptive

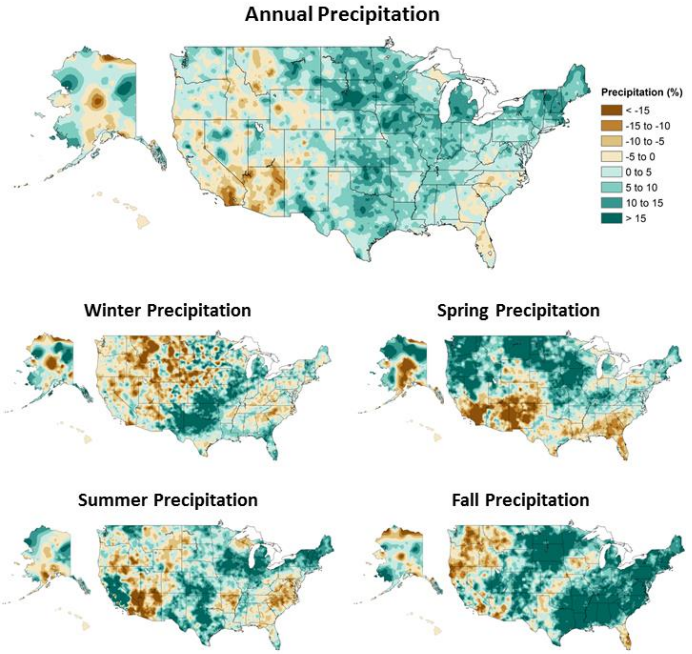
CSSR Major Findings

- New observations and new research have increased our understanding of past, current, and future climate change
- Since NCA3, stronger evidence has emerged for continuing, rapid, human-caused warming of the global atmosphere and ocean. It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century. For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence
- Significant advances have also been made in understanding of extreme weather events and how they relate to increasing global temperatures and associated climate changes. Trends are expected to continue in the future over climate (multi-decadal) timescales

Precipitation Changes

Key Finding:

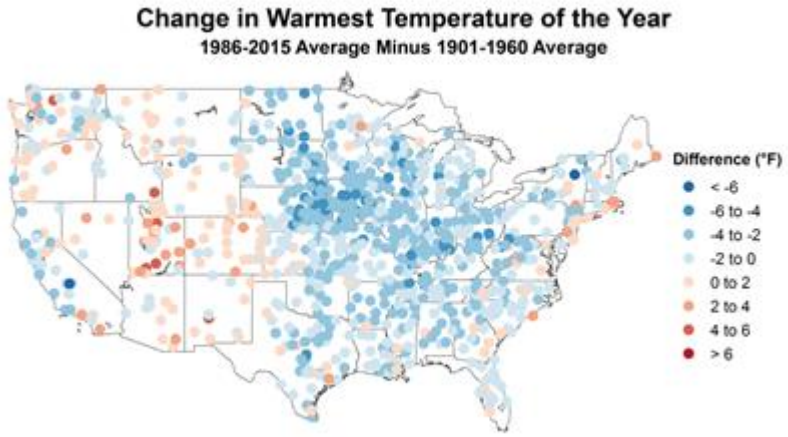
Annual precipitation has decreased in much of the West, Southwest, and Southeast and increased in most of the Northern and Southern Plains, Midwest, and Northeast. A national average increase of 4% in annual precipitation since 1901 mostly a result of large increases in the fall season.



Annual and seasonal changes in precipitation over the United States. (Figure source: [top panel] adapted from Peterson et al. 2013, © American Meteorological Society. Used with permission; [bottom four panels] NOAA NCEI, data source: nCLIMDiv].

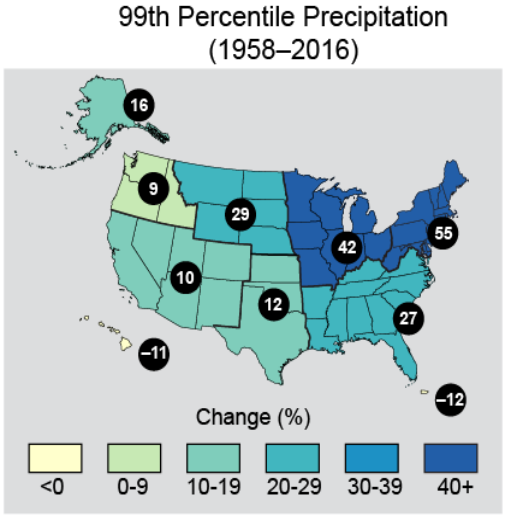
Many Temperature and Precipitation Extremes are Becoming More Common

The frequency and intensity of extreme heat events and heavy precipitation are increasing in most regions of the world and will *very likely* continue to rise in future. Trends for floods, droughts, and severe storms vary by region



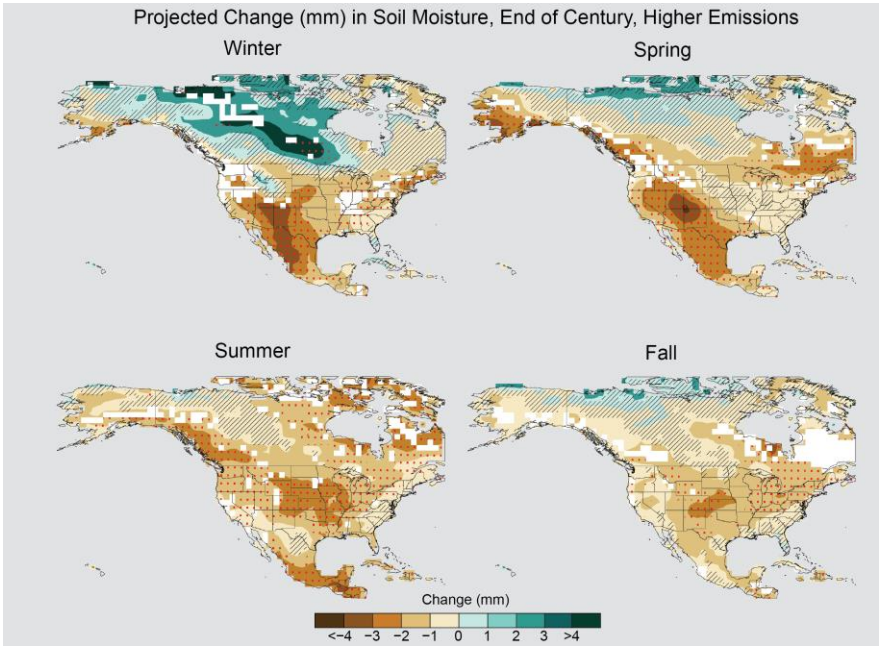
Both extremely cold days and extremely warm days have become warmer. Extreme cold waves have become less common while extreme heat waves have become more common

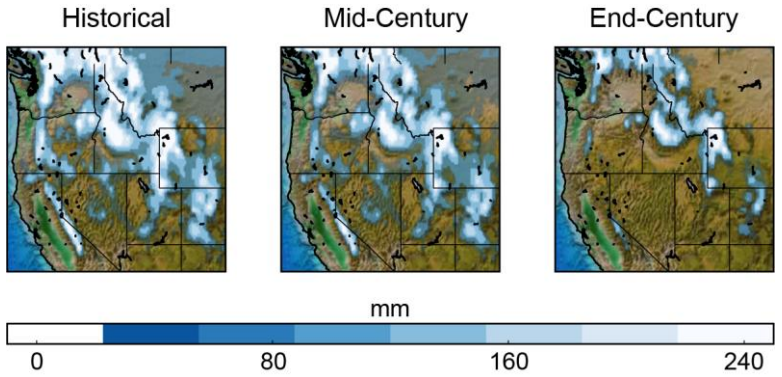
Heavy precipitation events in the United States have increased in intensity and frequency since 1901, with important regional differences in trends



Droughts

Future decreases in surface (top 10 cm) soil moisture from anthropogenic forcing over most of the United States are *likely* as the climate warms under higher scenarios.





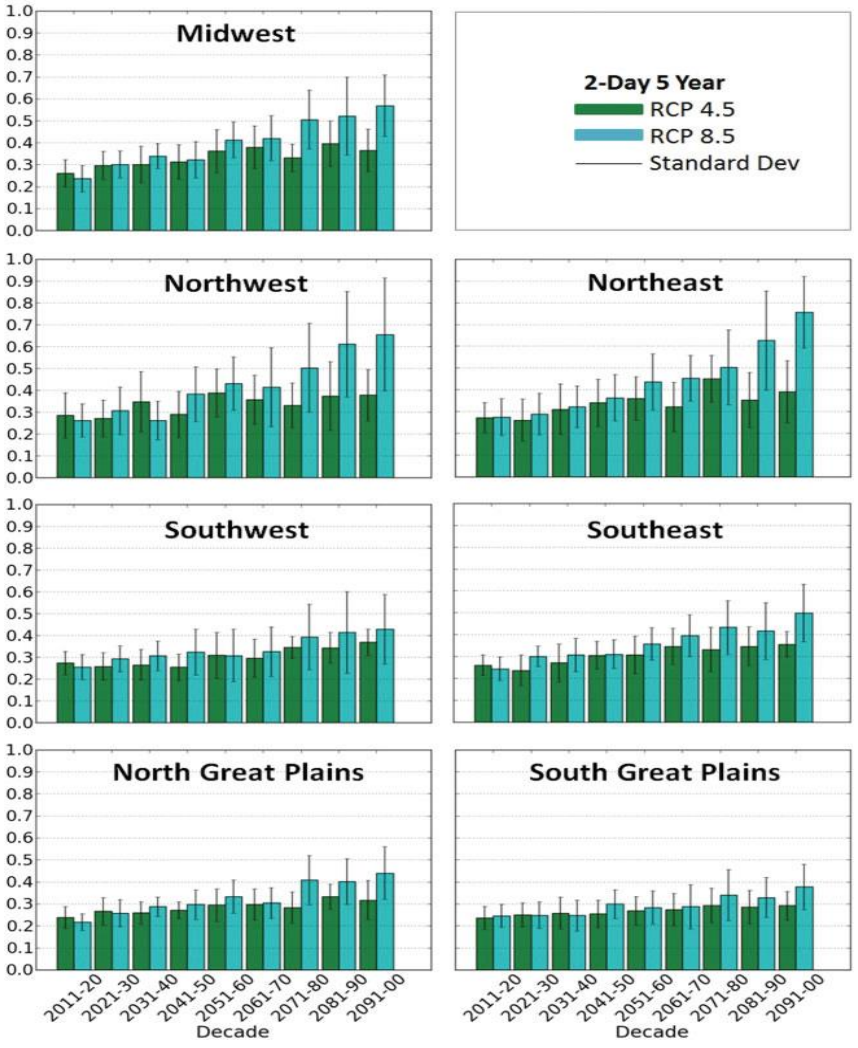
"*Projected Change in SWE*" provided **by Michael F. Wehner.**

Substantial reductions in western U.S. winter and spring snowpack are projected as the climate warms. Earlier spring melt and reduced snow water equivalent have been formally attributed to human-induced warming (*high confidence*) and will *very likely* be exacerbated as the climate continues to warm (*very high confidence*).

Floods

Extreme precipitation, one of the controlling factors in flood statistics, is observed to have generally increased and is projected to continue to do so across the United States in a warming atmosphere.

However, formal attribution approaches have not established a significant connection of increased riverine flooding to human-induced climate change, and the timing of any emergence of a future detectable anthropogenic change in flooding is unclear. *(Medium confidence)*



Extreme Precipitation Event Frequency
for events of 2-day duration and 5-year return (for high and intermediate scenarios

Other Themes and Interagency Efforts

- NOAA National Water Model (http://water.noaa.gov/about/nwm)
- Thriving on our Changing Planet: NASA Decadal Survey (http://sites.nationalacademies.org/cs/groups/depssite/documents/webpage/deps_183919.pdf)
- Many agencies were involved in the process of Looking Forward: Priorities for Managing Freshwater Resources in a Changing Climate National Action Plan Update (November 2016)
- USGCRP IWCG Membership connections with:
  - Subcommittee on Water Availability and Quality (SWAQ)
  - Advisory Committee on Water Information (ACWI)
  - Community Advisory Committee for Water Prediction (CAC-WP) (advises NOAA on NWM)
  - Interagency Collaborative on Environmental Modeling and Monitoring (ICEMM)

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