

**Missouri Basin Climate Collaboration
Bureau of Reclamation**

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The Bureau of Reclamation's climate activities can be viewed at <http://www.usbr.gov/climate/>. Research & Development Program climate activities are summarized at: <http://www.usbr.gov/research/climate/>. Notable Reclamation climate-related activities in the Missouri River Basin include:

Assessing climate change implications for watershed hydrology, sediment yield, reservoir sedimentation, and reservoir operations A collaborative effort between Reclamation's Technical Service Center, Great Plains and Upper Colorado regions, and Corps of Engineers' Omaha and Albuquerque district offices. Contact: Paula Makar (pmakar@usbr.gov).

West-Wide Climate Risk Assessments – Hydrologic Projections One of several activities being implemented under Reclamation's WaterSMART program and in support of SECURE Water legislation (contact: David Raff, draff@usbr.gov). Modeling effort spans the Missouri Basin and involves developing 112 hydrologic projections for the 21st century corresponding to the ensemble of downscaled climate projections at http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/dcpInterface.html. Technical memorandum expected March 2011 (contact: Subhrendu Gangopadhyay, sgangopadhyay@usbr.gov). Public access to gridded hydrologic projections available Spring 2011. Monthly variables (aggregated from daily simulation values) include 1/8 degree spatial resolution and nine surface water balance variables (precipitation, daily maximum temperature, daily minimum temperature, wind speed, actual evapotranspiration, potential ET, snow water equivalent, soil moisture, and runoff). Daily variables include precipitation, maximum temperature, minimum temperature, wind speed, and runoff.

WaterSMART – St. Mary/Milk River Basin Study This 2010-2011 study is a cost-shared effort focusing on future supply and demand imbalances and how such imbalances may be affected under climate change. Implementation is co-led by Montana Department of Natural Resources and Reclamation's Montana Area Office with technical assistance from the TSC.

Daily Downscaled Climate Projections St. Mary/Milk River effort uses monthly downscaled climate projections time-disaggregated to daily weather conditions for hydrologic modeling. This time-disaggregation blends daily weather sequences from observations with downscaled monthly climate sequences from global climate models. Reclamation has also collaborated with Scripps Institution of Oceanography, Climate Central, Santa Clara University, Lawrence Livermore National Laboratory, and Institute for Water Resources to implement an alternative downscaling technique that preserves daily weather sequences simulated by GCMs. These data products will be useful for assessments focusing on flood hydrology or ecosystem impacts under climate change where the former depends on reoccurrence of relevant sub-monthly weather patterns and where the latter depends on projected diurnal temperature range. The methodology has been applied to a subset of 53 of 112 CMIP3 projections currently represented at the archive for three periods (1961-2000, 2045-2064, and 2080-2099) and for three variables (precipitation, maximum temperature, and minimum temperature). Spatial attributes are the contiguous U.S. at 1/8 degree). Data from this new technique expected to be available Spring 2011.

With respect to processing and communicating climate change and variability implications in the basin, it is apparent awareness of the subject matter is growing, and the capacity to evaluate it in Reclamation planning practices is likewise growing. Reclamation's TSC has been called upon to provide technical support within and outside of the agency ranging from implementation to scoping assistance. Reclamation's R&D program and Programs Management Office have supported climate-related activities in the basin that has served capacity building.

It would be a good idea to invite basin agencies with offices investing in climate research to meet periodically. It would be helpful to know funding calendars for these offices (e.g., when they set research priorities and when they issue calls for proposals) and perhaps schedule two meetings a year - one when priorities are annually adjusted and another to review funded projects. Meetings might be web-based.

Reclamation makes available reservoir operations and water management information and heavily leverages monitoring investments by other federal agencies (USGS, NRCS, NOAA NWS, FWS, etc).

A user needs document was recently issued by the Corps of Engineers and Reclamation (<http://www.usbr.gov/climate/userneeds/>) that identifies priority areas of need with the goal of motivating related research activity. The document lists several areas of need including making decisions about how to use climate projection information in planning, guidance on best methods for assessing natural systems responses, and guidance on methods for communicating results/uncertainties for effective decision-support.

Leveraging capacities might include sharing agency reports and research products, communicating annually when research priorities are decided and after project grants have been awarded, and communicating periodically to review non-research assessments and program activities where climate change is being addressed or considered as part of the study context.

We suggest the federal science corners of the climate community (NOAA Climate Services, DOI Climate Science Centers, National Oceanic and Atmospheric Administration Labs, NOAA RISAs, National Center for Atmospheric Research, NASA GISS) make the first attempt to align to "one voice" and then engage with a stakeholder community. It may prove problematic to align to a single language given that resource concerns and timeframes vary greatly among agencies. However, it would be productive if the science community aligns on a terminology and guidance for the user community e.g., what is/isn't credible information in climate outlook information

Reclamation uses historical weather observations and short-term weather and hydrology forecasts, weather forecasts from National Weather Service offices, and hydrologic forecasts from Natural Resources Conservation Service and NWS River Forecast Centers for short-term planning.

For long-term planning, Reclamation uses historical streamflow information to provide a proxy for possible variability, recent studies with multi-decade look-aheads that have involved defining future climate scenarios, conducting associated watershed hydrology modeling under these future climate conditions, and using such modeling results to adjust historical streamflow data to be "future" streamflow data.