SUMMARY

The SECURE Water Act § 95206(b)(2) authorizes the U.S. Department of Interior’s Bureau of Reclamation to assess climate change risks for water and environmental resources in eight major Reclamation river basins in the Western United States (i.e. Colorado, Columbia, Klamath, Missouri, Rio Grande, Sacramento, San Joaquin, and Truckee basins). The legislation calls for Reclamation to provide periodic reports on implications for water supplies, water delivery, hydropower generation, fish and wildlife, water quality, flood control, ecological resilience, and recreation.

Leveraging the “Bias-Corrected and Downscaled WCRP CMIP3 Climate Projections” archive (Maurer et al., 2007), Reclamation has developed a wide-ensemble of corresponding hydrologic projections. The resulting hydrologic information has the same space and time attributes as the underlying downscaled climate information: 112 projections of monthly downscaled CMIP3 climates from 1950-2099 at 1/8° resolution over the Western United States. These hydrologic projections were derived using applications of the macro-scale variable infiltration capacity (VIC) hydrology model developed by the University of Washington.

An additional goal in developing these hydrologic projections was to make the information available for other climate change and water resources assessments in the Western U.S. To that end, the downscaled hydrologic projections web-service has been modified to serve these hydrologic projections. Web data products include the following monthly grid-portioned projection variables (all time-aggregated from daily VIC inputs and outputs): precipitation, daily minimum temperature, daily maximum temperature, wind speed, potential evapotranspiration, actual evapotranspiration, soil moisture, snow water equivalent, and runoff. The web products also include the daily grid-projected values for five of these nine variables: the four weather input variables and runoff. The web-service also features a data-subsetting interface to access monthly gridputed products for basin tributary to user-specified four-locations.

I. Hydrologic Projections Development

Model
Variable Infiltration Capacity model (VIC, Liang et al., 1994). version 4.0.7 (surface water focus, see VIM).

VIC Model Applications:
Development: originally included in University of Washington "Wesbite Hydrologic Forecast System" (A. Wood); some applications have been refined.
Spatial: 1/8° same grid as BCSD CMIP3 Projections
Temporal: daily, forced by weather specified in Maurer et al., 2002

Use of Applications to develop Hydrologic Projections
Support: Reclamation WaterSMART – West Wide Climate Risk Assessments
Geography: includes the eight VIC applications listed to the right (see map)
Spatial: 112 hydrologic projections consistent with monthly BCSD CMIP3 climate projections (see II)

II. Archive Contents

Climate Projections (monthly BCSD CMIP3)
Bias Correction Spatial Disaggregation (Wood et al., 2002) applied to 112 CMIP3 Projections
Monthly (1950-2099), 1/8° (continental U.S.)
Temperature, precipitation
Climate Projections (daily BCCCA CMIP3)
Bias Correction Construction Analog (Maurer et al., 2010) applied to 52 CMIP3 Projections (doubled of the 112 subjected to BCSD)
Min. temperature, max. temperature, precipitation
Hydrologic Projections (associated with BCSD)
Monthly and daily (1950-2099), 1/8° (continental U.S.)
Monthly (time-aggregated from daily modeling)
VIC weather inputs
precipitation
snow, max. & min. temperature
wind speed
VIC model outputs
soil moisture
snow water equivalent
actual evapotranspiration (ET)
four years of potential ET
runoff
FTP access – gridded
Subsetting access – soil-basin or regular areas, time series or statistics (spatial/temporal)
Data
Stream VIC weather forcings & runoff
FTP access: gridded
To make runoff to desired location, see routing information at Univ. WA website (part 1)

III. Example Data Retrieval

Objectives:
Analyze projected water balance for the Snake River Basin above Brownlee, Idaho
Explore the assessment on monthly, basin-average hydroclimatic conditions
Use website to "Data Subset Request" functionality to retrieve information

Subset Request – Page 1:
Choose variables and associated climate projections

Subset Request – Page 2:
Choose period of request and spatial extent (regular areas or polygon delineated – this example)

IV. Example Data Assessment

Example #1 (using retrieved data from III):
Time-series projected climate & hydrologic variables averaged over the Snake River Basin above Brownlee, Idaho
Look at Monthly, Annual, and Annually Moving 10-year Mean conditions.

Example #2:
30-year Monthly Climatology for six projected variables; same case study basin as Example #1
Three periods: 1970-1999 (red), 2020-2049 (green) and 2070-2099 (blue)

IV. Future Plans

Hydrologic Projections
Apply existing VIC models to develop hydrologic projections forced by daily BCCCA climate projections
Refine VIC hydrologic models, incorporate groundwater
Climate Projections Downscaling
Apply BCSD and BCCCA to CMIP3 climate projections
Explore application of new climate projection downscaling techniques

REFERENCES


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