NOAA’s Colorado Basin River Forecast Center

Developing Climate-Informed Ensemble Streamflow Forecasts over the Colorado River Basin

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Overview

• Points to Take Away
• Background
• Data and Methodology
• Provisional Results
• Next Steps
The CBRFC is attempting to utilize climate information to inform long-term streamflow projections

- Utilize projections of precipitation and temperature change from BCSD CMIP3 and CMIP5 data to inform historical inputs driving ESP products
- Provisional results indicate earlier and decreased seasonal (April – July) runoff
Points to Take Away

• Further efforts will attempt to incorporate:
  – Changes to evapotranspiration
  – Use of a stochastic weather generator
  – Couple with a reservoir operations model

• Will eventually separate runs by SRES and RCP scenarios
Stakeholders throughout the Colorado River Basin are developing long-term policy guidelines

- Some decisions are based on CBRFC forecasts
- Agencies need to take climate change information into account

CBRFC would like to provide decision support
CBRFC ensemble forecasts rely on current and initial conditions and future climate (precipitation and temperature) as defined over a historical period spanning 1981 – 2010.

- Can also include 5-day QPF and 10-day QTF
- Limited by sequencing and magnitude of climate events in the historical period
Ensemble Streamflow Prediction

Taylor - Taylor Park Res (TPIC2) Apr-Jul 2014 Runoff Forecast (Includes 5 Day Precip Forecast)
2014-05-01 Official 50% Forecast: 115 kaf (119% of average)

The latest (2014-07-30) 50% ESP forecast (110 kaf) changed 0.2% from previous day and -7.4% from July 1
**These ESP forecasts do not include observed and are not total runoff.
How can we help?

• Providing decision support for policy makers means making projections at a policy scale
  – Information from the latest climate projections
  – Innovate ways to develop climate patterns outside of the historical record
    • Working with the University of Colorado
    • Incorporation of other climatic indicators

• Partner with stakeholders to understand needs
• To “inform” our current historical input of climate data we utilized projected changes from BCSD CMIP3 and CMIP5 data
  
  – BCSD CMIP data is made available by Reclamation, LLNL, and others at:
    http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html
  
  – Gridded projections of climate need to be averaged over spatial zones defined in the CBRFC’s lumped hydrologic model

• Currently averaged over all model runs
Need for Downscaling
Gridded to Lumped Inputs
Data and Methodology

• Average, relative modeled change from 1981-2010 to three future periods is derived
  – 2010-2039, 2040-2069, 2070-2099
  – Gridded values are averaged over each zone
  – Percent change in precipitation is considered
  – Degrees Celsius change in temperature is considered

• Historical information perturbed to develop “climate informed” input
Results - Temperature

BCSD CMIP5 Ensemble Mean Temperature Change from 1981-2010 to 2070-2099

Latitude
Longitude

Degree C Change from Historical Period
-4
-2
0
2
4
Results - Streamflow
Streamflow Impacts

Avg Apr CMIP5 Change from 1981-2010 to 2070-2099

Avg May CMIP5 Change from 1981-2010 to 2070-2099

Avg Jun CMIP5 Change from 1981-2010 to 2070-2099

Avg Jul CMIP5 Change from 1981-2010 to 2070-2099

Avg Aug CMIP5 Change from 1981-2010 to 2070-2099

Avg Sep CMIP5 Change from 1981-2010 to 2070-2099
Limitations

- Process is still dependent on historical sequences of precipitation and temperature.
- Process does not incorporate a dynamic ET component (yet!). ET is derived using a monthly coefficient that is static through time.
- Possible wet bias introduced during the BCSD process?
Next Steps

• Working with colleagues at the University of Colorado to utilize a stochastic weather generator
  – Capable of producing weather sequences not observed in the historical record
  – Can be weighted to incorporate other climate information (e.g., teleconnections, CPC info)
  – Latest results show increased reliability and accuracy using IRI forecast information
Next Steps Continued

• Build on past work done in our office to incorporate dynamic evapotranspiration
• Partner with stakeholders to make this work for them
  – Impacts to reservoir operations?
  – Inform long-term policy development
• Compare with recently released VIC streamflow projections
Questions?

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Extra Slides

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Streamflow Impacts