Ohio River Basin Climate Change Project

The Army Corps of Engineers (USACE) wanted to know what possible adaptations would be required based on climate change projections. The project took climate change model data of temperatures and precipitation down-scaled using the Intergovernmental Panel on Climate Change (IPCC4) Coupled Model Inter-comparison Project (CMIP3) datasets as input into the NOAA/NWS Ohio River Forecast Center (OHRFC) hydrologic river model.

The link is provided here for the CMIP 3 data used.
http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

The USACE Institute of Water Resources (IWR) used Global Circulation Models (GCMs) for temperatures and rainfall. The approach clustered over 75 ensembles into nine ensemble scenarios. The output (Fig. 1) includes oe past period of 1952-2001 and three future time periods of 2011-2040, 2041-2070 and 2071-2099.

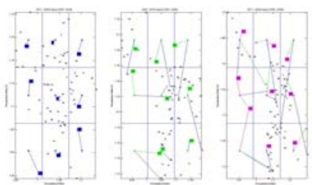

Fig. 1. Nine clustered ensembles for 2011-2040, 2041-2070, 2071-2099

OHRFC used the Community Hydrologic Prediction System (CHPS) along with the Sacramento Soil Moisture Accounting Hydrologic Model (SAC-SMA) to generate the river response in an unnatural state using a reservoir (RES-J and RES-SNGL) modeling system. The output includes streamflow, temperatures, precipitation and snow water content (in CSV format for easy use). The river model output is at the bottom for each tributary along with the Ohio River.

Results show the simulated past from 1951-2001 compared to what actually occurred were within 2% on the Ohio River and 5% on tributaries. This builds confidence in the ability to look at the future.

The hydrologic model output is retained at the same time-scale as the input climate grids, monthly. The following graphics show the percent changes in annual flow for mean, minimum and maximum flows for the three future periods of 2011-2040 (Fig. 2), 2041-2070 (Fig. 3) and 2071-2099 (Fig. 4) compared to the retrospective period of 1952-2011.

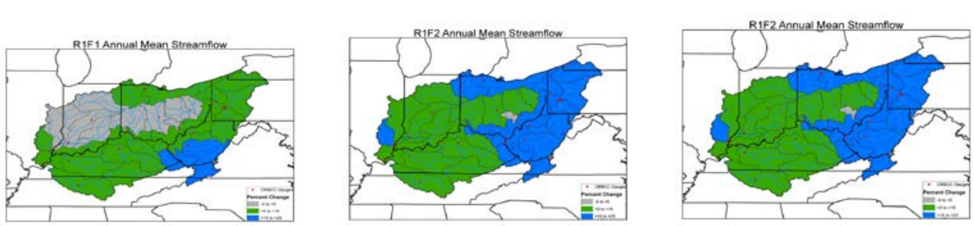

Fig. 2. Annual changes in mean flows (percent) for 2011-2040, 2041-2070, 2071-2099 compared to 1952-2011. Gray(+/-5%), Green (+5 to +15%), Blue (+15 to +25%)

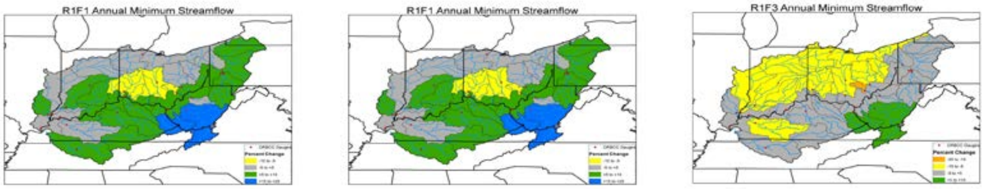

Fig. 3. Annual changes in min flows (percent) for 2011-2040, 2041-2070, 2071-2099 compared to 1952-2011. Yellow (-5 to -15%), Gray(+/-5%), Green (+5 to +15%), Blue (+15 to +25%)

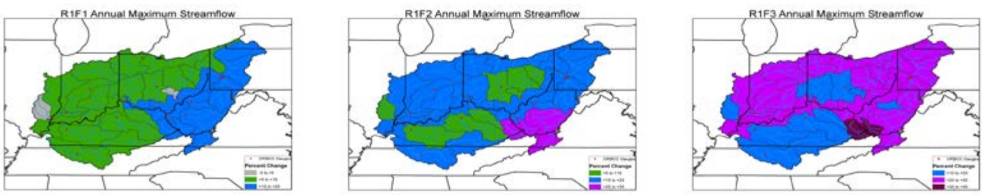

Fig. 4. Annual changes in max flows (percent) for 2011-2040, 2041-2070, 2071-2099 compared to 1952-2011. Gray(+/-5%), Green (5 to 15%), Blue (15 to 25%). Purple (25 to 35%)

Output can also be viewed in terms of actual flow for each basin in the Ohio Valley.

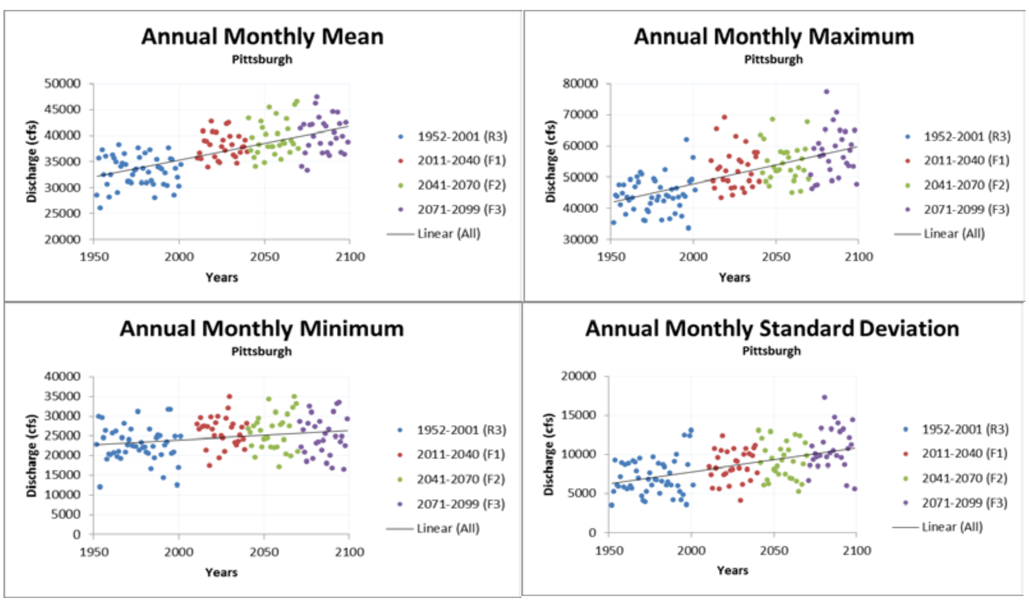

Fig. 5. Annual stream flows for mean, minimum, maximum and variability at Pittsburgh

Results show mean, minimum and maximum flows within the historical range through 2040 except autumn. Beyond 2040 increases occur in the mean and maximum flows of between 10 to 40%. Minimum flows decrease beyond 2070. Minimum and maximum flows exceed the historical range especially beyond 2050-2070. Autumn season experiences the greatest changes.

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