Climate change projection database and climate impact on water in South Asia

An understanding of likely future climate is critical to river basin planning and management in South Asia. CSIRO has developed a consistent set of climate change projections to inform integrated climate-water modelling to assess climate change impacts and to guide adaptation and planning in water and related sectors.

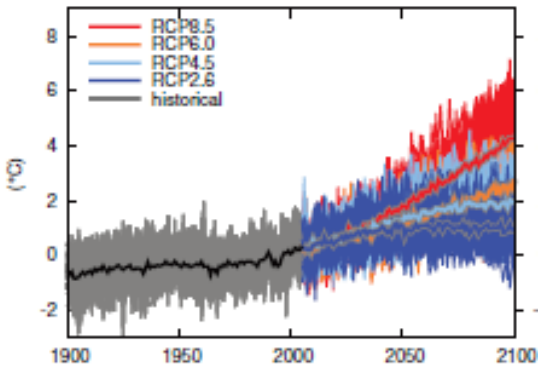
Climate change and water security

Climate change will impact water and related sectors. Temperature and potential evapotranspiration will be higher. Changes in future precipitation are uncertain and will be amplified in river flows. Security of water supply will be compromised due to longer and more severe droughts, more precipitation falling as rain rather than snow, increased seasonality of river flow and retreat of glaciers. Flood risk will increase due to more intense extreme precipitation events.

Climate change projection database

CSIRO has developed a climate change projection database[1] for the South Asia region by analysing simulations from all available global climate models (GCMs)[2] using a consistent approach. The database presents empirical scaling factors for 0.5° grids that reflect changes in six climate variables (precipitation, heavy precipitation, potential evapotranspiration, daily average temperature, daily minimum temperature and daily maximum temperature) for a future period (2046–2075) relative to the current. The projected changes in the climate variables are derived for each of the 12 months, the four seasons and annual values for a low-medium RCP4.5 and a medium-high RCP8.5 (Representative future greenhouse gas Concentration Pathways). These are presented for each of the 42 GCMs, as well as the median and range (uncertainty) of the projections.

1 The climate change projection data can be downloaded from <https://research.csiro.au/sdip>.
2 The SDIP project analysed projections from 42 GCMs from the CMIP5 data portal used in the IPCC AR5 (Intergovernmental Panel on Climate Change Fifth Assessment Report).



Trend in historical temperature (Jun-Aug temperature averaged across South Asia) and projections into the future under various global greenhouse gas emission scenarios – from IPCC AR5 "Atlas of global and regional climate projections", http://www.climatechange2013.org/report/full-report/

Climate and water futures

The median and range of hydroclimate projections across South Asia are shown on the next page. Averaged across South Asia, temperature is projected to increase by 2.9°C by 2046–2075 (median projection for medium-high future greenhouse gas emission pathway). The projected temperature increase is slightly higher in winter than in summer, and is greater in high altitude areas in the north. There is large uncertainty in the projections of future precipitation, with significant variations within and between GCMs, and in the different seasons and regions. Nevertheless, a higher proportion of GCMs simulate an increase in precipitation, particularly in the north-east and much more so in the summer monsoon than winter. The changes in future precipitation with be amplified in the runoff.

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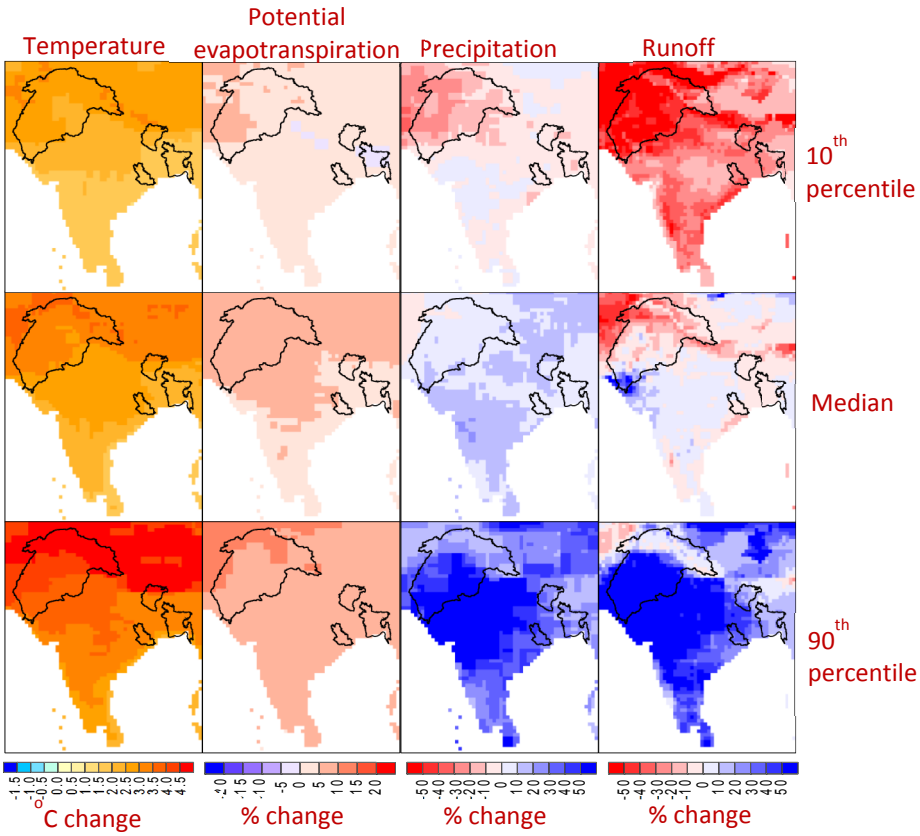

Median and range in climate change projections and modelled impact on runoff for 2046–2075 relative to current for a medium-high RCP 8.5 future greenhouse gas emission pathway (10th percentile, median and 90th percentile values informed by 42 CMIP5 GCMs). River basin boundaries are shown for the Indus, Koshi, Brahmani-Baitarni and Bangladesh

Integrated modelling informing policy, adaptation and planning

These consistent set of projections are informing integrated climate-hydrological modelling across South Asia and river basins to assess potential climate change impacts and to guide water resources adaptation and planning.

Climate change impact assessment can be carried out in two ways (or a combination of the two):

- a top-down approach where the projected changes to the climate variables (empirical scaling factors) in the database are used to scale the historical climate series to reflect a future climate series that is then used as inputs into models to predict future water availability and hydrological characteristics, or
- a bottom-up approach or sensitivity analysis of how changes in the input climate data can affect the modelled responses and risks to systems, to inform the need for and to guide climate impact-adaptation-vulnerability assessments.

Publications

Charles SP, Chiew FHS, Zheng H (2016) South Asia climate change literature review. CSIRO SDIP Report.

Chen Y, Singh R, Liu R (2015) Historical climate data for regional hydrological modelling across South Asia. CSIRO SDIP Report.

Zheng H, Chiew FHS (2016) Database of CMIP5 climate change projections across South Asia. CSIRO SDIP Report.

Zheng H, Chiew FHS, Charles SP (2015) CMIP5 climate change projections for hydrological modelling in South Asia. In Proc. 21st International Congress on Modelling and Simulation, MODSIM2015, Gold Coast, December 2015, pp. 2409–2415.

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