

APPLICATION OF REGIONAL MODELS: HIGH-RESOLUTION CLIMATE CHANGE SCENARIOS FOR INDIA USING PRECIS

Rupa Kumar Kolli

Indian Institute of Tropical Meteorology, Pune 411 008, India
(kolli@tropmet.res.in)

The Third Assessment Report (TAR) of the Inter Governmental Panel on Climate Change (IPCC) notes that the current versions of atmosphere ocean general circulation models (AOGCMs) have generally well simulated the features of the present day climate at the large and continental scale. TAR also notes that the AOGCM resolution limitations, especially for impact application, are likely to remain for many years, so that regionalization work will be an important step to better understand regional climate change processes and to provide regional information for impact assessments. The effects of climate change are expected to be greatest in the developing world, especially in countries reliant on primary production as a major source of income. One of the high priorities for narrowing gaps between current knowledge and policymaking needs is the quantitative assessment of the sensitivity, adaptive capacity and vulnerability to climate change, particularly in terms of the major agro economic indicators which largely depend upon regional/local manifestations of climate change. Keeping in view the widely felt need for high-resolution regional scenarios of climate change for impact assessment studies, state-of-art techniques have been used to dynamically downscale the global model projections for the Indian region. The regional model has enabled quantitative estimates of future changes at a resolution of ~50 x 50 km, which have been extensively used in impact assessments by several groups (e.g., Indo-UK, NATCOM, APN, START, etc.).

The latest version of Hadley Centre Regional Climate Model, PRECIS developed by Hadley Centre has been used to generate the climate for the present (1961-1990) and a future period (2071-2100) under two different socio-economic scenarios both characterized by regionally focused development but with priority to economic issues in one (A2/SRES) and to environmental issues in the other (B2/SRES). The model simulations are performed with and without including the sulfur cycle, to understand the role of regional patterns of sulfate aerosols in climate change. Three ensembles have been simulated for the baseline, to estimate the uncertainties associated with the internal variability of the model. The lateral boundary conditions for PRECIS have been generated through a two-tier strategy using global atmosphere-ocean (HadCM3) coupled and global atmospheric (HadAM3) general circulation models.

The high-resolution regional simulations generated using PRECIS have been studied in detail to evaluate the model's skills in realistically representing the regional climatological features, especially the summer monsoon characteristics. Mean climatologies as well as the extreme climatic events have been considered for this purpose. Extensive observational data over the past century and also the reanalysis data have been used for model evaluation. PRECIS, by a better representation of the high-resolution features of the regional climatic processes, has been able to provide a vastly more realistic description of the local variations. The results indicate an all-round warming over the Indian subcontinent associated with increasing greenhouse gas concentrations, and also a slight increase in summer monsoon precipitation.

High-resolution regional climate change scenarios have been developed for various surface and upper-air parameters of critical importance to the impact assessments, both on monthly and daily time scales. The scenarios for the time slice 2071-2100 have been directly derived from the model simulations, but those for the time slices 2020s and 2050s have been derived from a pattern scaling approach. Considerable effort is being put in to archive the huge amount of scenario data products, and also to package the data products for direct use in impact assessment projects. Data are being provided to the impact assessment groups in the formats required by them. The scenario data generated under this project constitute one of the best sources of scientifically derived regional climate change estimates for the Indian subcontinent, and are expected to benefit a variety of climate change studies in the years to come, not only for India but also for the neighbouring countries.