Seasonal Forecast of Indian Summer Monsoon (ISM) 2015 using Ensemble Global Atmosphere Model CAM

Atmospheric and Oceanic Sciences Group, Space Applications Centre

The Indian Summer Monsoon (ISM) rainfall for the year 2015 has been predicted in near-real time forecast mode using the Community Atmosphere Model (CAM) developed by National Center for Atmospheric Research (NCAR). CAM version 3 is one of the latest Atmosphere General Circulation Model (AGCM) that has been made available to the scientific community, originating from NCAR Community Climate Model. It is also the atmospheric component of the Community Climate System Model version 3 (CCSM3), which is a fully coupled model. CAM3 incorporates a significant modification from its earlier version to the dynamical formulation and the treatment of cloud and precipitation processes, radiation processes and atmospheric aerosols. The standard version of CAM3 is based upon the Eulerian spectral dynamical core with triangular spectral truncation at 31, 42, and 85 wave-numbers. The zonal resolution at the equator ranges from 3.75° to 1.41° for the T31 and T85 configurations. The vertical dimension is treated using 26 levels with a hybrid terrain-following coordinate. The vertical grid transitions from a pure sigma region in the lowest layer through a hybrid sigma–pressure region to a pure pressure region above approximately 83 mbar.

The land component of CAM, named Community Land Model (CLM), interacts with atmosphere at every 10 model-minutes and exchange required surface fluxes. The land model is coupled with CAM3 and integrated on the same horizontal grid as the atmosphere, although each grid box is further divided into a hierarchy of land units, soil columns, and plant functional types (PFT). There are 10 sub-surface soil layers and up to five snow layers depending on the snow depth in CLM. Land units represent the largest spatial patterns of sub-grid heterogeneity and

include glaciers, lakes, wetlands, urban areas, and vegetated regions. The different surface data for each land grid cell are glacier, lake, wetland, and urban portions of the grid cell; the fractional cover of the four most abundant PFTs in the vegetated portion of the grid cell; monthly leaf and stem area index and canopy top and bottom heights for each PFT; and soil color and soil texture. These fields are taken from the International Geosphere-Biosphere Program (IGBP) land surface datasets and interpolated to model grid from high resolution data sets. To characterize the mean features of the simulated parameters, the model is integrated at T85L26 using observed SST and observed sea ice. In this resolution, the model has a horizontal resolution of ~1.4° and 26 unequal vertical sigma levels.

Initially, the model capability in capturing the variability of ISM rainfall has been examined for several years. Firstly, the model climatology has been generated in T85 resolution over the extended Indian monsoon region through 60-years of long-term model simulation (1951 – 2010) and analyzed with different sets of observed climatology. Consequently, a bias correction technique has been implemented and applied on the model simulated rainfall to correct the model biases on monthly as well as daily scale. Finally, the model has been tested for the seasonal forecast of ISM for several years (2010 to 2014) on experimental mode. The results of the extensive validations carried out for all the forecasts made during 2010-2014 have encouraged us to make the forecast on regular basis but on experimental mode.

The seasonal prediction of ISM rainfall for the year 2015 will be carried out in T85 (~1.41°×1.41°) horizontal model resolution for the duration of June to September (JJAS) and will be issued in May 2015. The seasonal accumulated rainfall, monthly mean rain-rate and time series of pentad rain-rate averaged over Indian landmass will be estimated using ensemble mean approach of large number of CAM simulations, each started from different initial conditions. The

monthly and seasonal forecast will be updated on monthly basis. Further, weekly accumulated rainfall for the upcoming four weeks will also be predicted by the ensemble CAM model that will start from June 1, 2015 onwards and updated on weekly basis. Weekly and monthly validation of the forecast will also be conducted on regular basis using IMD observations.

References:

- Das S K, Deb S K, Kishtawal C M and Pal P K (2015), Validation of seasonal forecast of Indian summer monsoon rainfall, Pure and Applied Geophysics, January 2015, DOI 10.1007/s00024-014-1024-3.

- Das S K, Deb S K, Kishtawal C M and Pal P K (2014), Sensitivity of initial conditions on diurnal variability of Indian Summer Monsoon, Pure and Applied Geophysics, November 2014, DOI 10.1007/s00024-014-0944-2.

- Das S K, Deb S K, Kishtawal C M and Pal P K (2013), Seasonal prediction of Indian summer monsoon: Sensitivity to persistent SST, J. Earth Syst. Sci., 122, No. 5, October 2013, pp. 1183-1193.

- Das S K, Deb S K, Kishtawal C M and Pal P K (2012), Assessment of Indian Summer monsoon simulation by Community Atmospheric Model version 3 (CAM3), Theor Appl Climatol, July 2012, Vol. 109 (1–2): 81–94, DOI 10.1007/s00704-011-0565-y.
