INDIA

Advanced Forecasting Capability of Hydro-Meteorological Disasters

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Severe weather and climate events are potentially increasing over the Indian sub-continent region in the recent decade. India faces frequent occurrence of High-impact weather events like extreme rainfall events (EREs), cloud burst events (CBEs), Tropical Cyclones, which causes flash floodings, Heat wave and Cold wave etc. Being surrounded by oceans along East, West and South part and great Himalayan mountain system in the northern part of the country it is very challenging task for advanced accurate prediction of these hydro-meteorological disasters. The rise in frequencies in these disaster events also shows the clear cut signature of regional climate change, which may be one of the major factors for the increase in the risk of extreme weather and climate events. As in present time there is intense growth in the computing power, improvement in cloud computing, High Performance Computing (HPC) infrastructures, data migration systems, large network of satellite data, numerical weather and climate models, Big data analytics etc. now it would be possible to study and emphasize on the prevention & mitigation of the disasters due to severe climate events in real time.

In the present study a HPC enabled multi-model forecasting platform is developed and being used for the real time, high resolution and advanced forecasting of the hydro-meteorological events over Indian region. In the CSIR C-MMACS Super computing platform basically three numerical weather prediction model i.e. a variable resolution general circulation model (VR-GCM) and two high resolution Limited area model (LAM) or meso-scale model (JMA-NHM and WRF 3.5) is configured and calibrated for the accurate forecast of the major climate parameters like Temperature, Rainfall, Wind, Humidity etc. The VRGCM allows to simulate at 40Km over the Indian sub-continent where as the LAMs are configured for very high resolution i.e. 2 Km resolution. The modeling and simulation platform is integrated with Geographical Information System (GIS) where all the satellite observation

analysis and the model simulations are analyzed to issue warning for the hydro-meteorological disasters or to evaluate the possible disasters.

In this work first the large scale cyclones in Bay of Bengal are simulated using all the three models discussed above. Then the ensemble average of the meteorological parameters (wind, rainfall, pressure) is computed and the cyclone track and intensity are predicted well in advance (72-96hrs). About 20 Cyclones of different intensity during 2000-2015 over the Bay of Bengal (BoB) are well simulated and results are validated against the satellite and real time observations. The track and intensity error are computed and it is found that the multi-model ensemble (MME) minimizes the errors drastically compared to the individual simulation. All the detail methodology of simulation and ensemble approaches will be discussed elaborately.

Also the recent extreme rainfall due to intense cloud burst in Kedarnath (16-18 June 2014) and Leh (5-6 August 2010), ERE over Bangalore (8 Oct 2013) which resulted urban flash flooding and the recent case of ERE over Chennai (29Nov-2 Dec, 2015) due to the local convective action during active North east Monsoon 2015 are simulated and the capability of MME in capturing the location and intensity of heavy rainfall is well predicted.

In the forecasting platform the GIS and other modules like flash flooding, storm surge, etc. is integrated and a well-connected decision support system for prevention and mitigation of hydro-meteorological disasters is developed. The successful prediction statistics of all the disasters are presented.

Also the use of probability information by ensemble methodologies used for developing decision support tools, which allows providing the probabilistic forecast of disasters due to climate extremes. Assessment of the impact of observational data in the improvement of NWPs with advanced data assimilation (DA) schemes are also important in predicting the severe climate conditions causing disasters, so in future the DA module will also be integrated for improving the disaster forecasting.