# Implementation and preliminary results of high resolution Ensemble Prediction System at NCMRWF

## Abhijit Sarkar, Ashu Mamgain and E. N. Rajagopal

*National Centre for Medium Range Weather Forecasting, NOIDA, India*

*abhijit@ncmrwf.gov.in*

National Centre for Medium range Weather Forecasting (NCMRWF), India has been running global ensemble prediction system (NEPS) based on Met Office Global and Regional Ensemble Prediction System (MOGREPS-G) since October, 2015. This ensemble system has been updated recently and the updated version was made operational on 1 June, 2018. Previous version of NEPS had horizontal resolution of 33 km and ensemble size of 45 (44 perturbed + 1 control) members. The horizontal resolution of the current operational NEPS has been increased to 12 km. The initial condition perturbations of this ensemble prediction system are generated by Ensemble Transform Kalman Filter (ETKF) method (Bowler et al., 2009) and model uncertainties are taken care by the Stochastic Kinetic Energy Backscatter and Random Parameters schemes (Tennant et al., 2011). The forecast perturbations obtained from 6 hour short forecast run of 22 ensemble members are updated by ETKF four times a day (00, 06, 12 and 18 UTC). Perturbations of surface parameters such as sea-surface temperature, soil moisture content and soil temperature (Tennant and Beare, 2014) are included in the 12-km NEPS in order to address the problem of lack of ensemble spread near the surface. The NEPS aims to provide 10-day probabilistic forecasts using 23 members (22 perturbed + 1 control) ensemble system. Out of 22 perturbed ensemble members, one set of eleven members run from 00 UTC of current day and the other set of 11 members run from 12 UTC of previous day to provide ensemble forecast of 10 days. The operational deterministic forecast running at 12 km resolution from 00 UTC is used as the control forecast.

As 12 km NEPS is implemented first time in NCMRWF, initial condition perturbations were not available at this resolution. Therefore, ensemble members with perturbed model physics were cold-started from the same initial condition (analysis of deterministic model). The results of experiments indicate that the spread of the cold started ensemble members becomes nearly equal to the operational NEPS ensemble spread after 15-16 short forecast cycles. Figure 1 shows that spread in specific humidity at 5600 m height of 17km NEPS takes about 16 short forecast cycles to become nearly equal to that of the operational 33 km NEPS. A technical report by Mamgain et al., 2018 describes in detail the operational implementation of this high resolution EPS at NCMRWF.

Both the 33 km and 12 km NEPS were operational during 1st June 2018 to 16th July 2018. A comparative study has been carried out to investigate the improvement in model performance due to the change in NEPS configuration based on the forecasts by both the systems during this period. The study has been conducted for both the hemispheres of the globe as well as for the tropical region separately. The relationship between root mean square error and ensemble spread with forecast lead time has been compared for both the systems. The verification of probabilistic forecasts from both the systems is carried out by testing the reliability, consistency and accuracy of the prediction system. The ability of the NEPS to discriminate the situations leading to occurrence and non occurrence of events has also been investigated.

The performance of 12 km NEPS has also been analyzed for heavy rainfall cases over Indian region.

Fig 1: Ensemble spread in Specific Humidity at 5600m height

# References

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