Multimodel Superensemble Forecasting of Tropical Cyclones in the Pacific

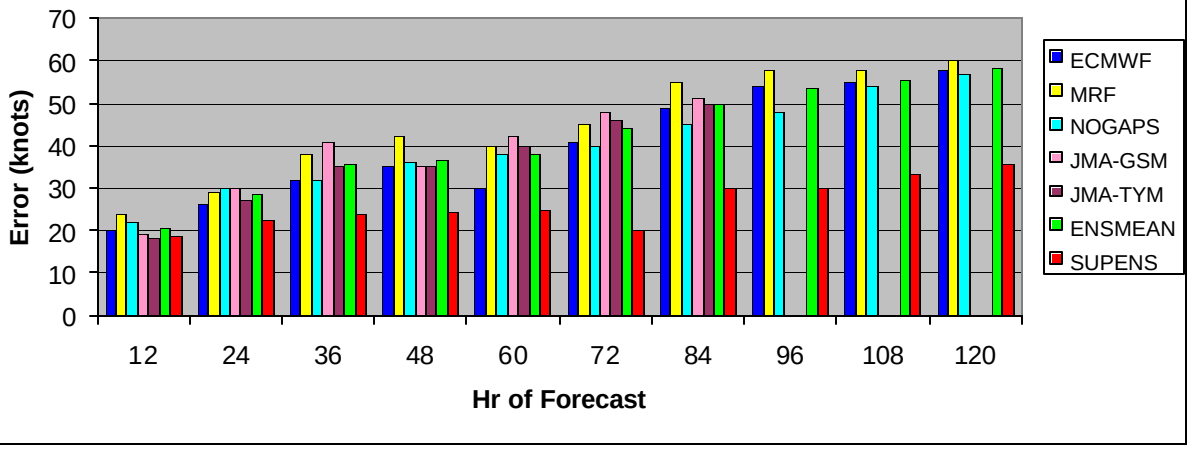
T.S.V. Vijaya Kumar[1], T.N. Krishnamurti[1], Mike Fiorino[2] and Masashi Nagata[3]

[1]Department of Meteorology, Florida State University, Tallahassee, FL 32306-4520
[2]PCMDI, Lawrence Livermore National Laboratory, Livermore, CA 94551-0808
[3]National Typhoon Center, Japan Meteorological Agency, Tokyo 100-8122, Japan.
[1]e-mail: vijay@met.fsu.edu

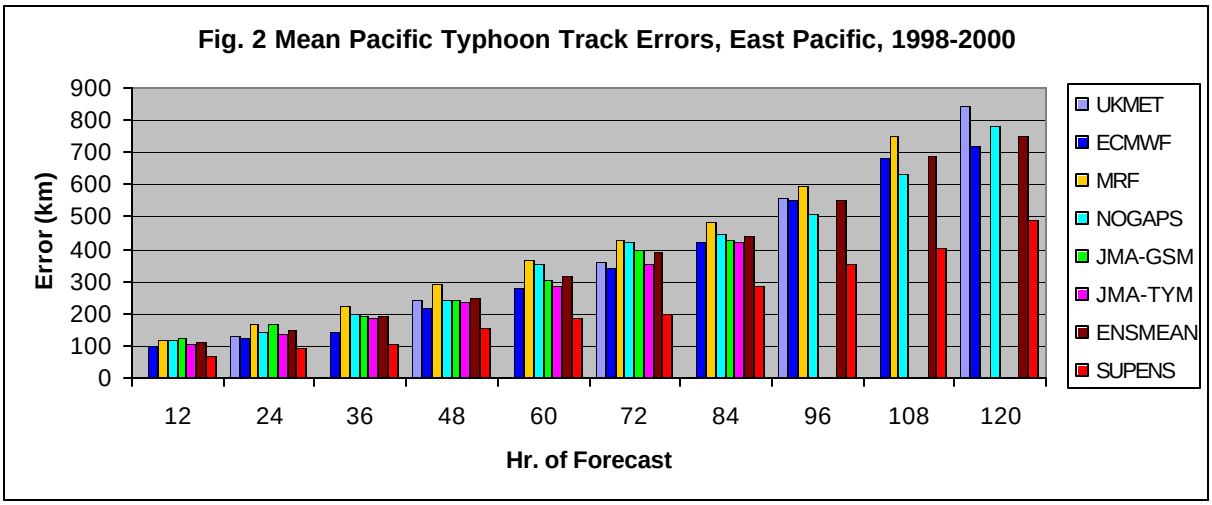
Reduction in position and intensity errors of typhoons (or hurricanes) is a vital forecast issue. It turns out that some measurable improvements are possible from the superensemble methodology (Krishnamurti et al., 1999, 2000, 2001). The current state of the multimodel data sets is far from ideal for performing such studies. Nevertheless, we show in these experimental forecasts that this procedure can be very useful as an operational tool.

Using currently available operational forecast data sets on the tracks and intensity of tropical cyclones over the Pacific Ocean for the years 1998, 1999 and 2000 we have constructed a multimodel superensemble, following our earlier work on the Atlantic hurricanes, Williford et al. (2002). The models included here comprise forecasts from the ECMWF, EMC/NCEP (AVN and MRF), NOGAPS, UKMET and JMA. The superensemble methodology includes a collective bias estimation from a training phase where a multiple regression based least square minimization principle for the model forecasts with respect to the observed measures is employed. This is quite different from a simple bias correction where a mean value is simply shifted. These bias estimates are described by separate weights at every 12-hour of forecasts for each of the member models. Superensemble forecasts for track and intensity are then constructed up to 144-hr into the future using these weights. Some 100 past forecasts of tropical cyclone days are used to define training phase for each basin.

Fig. 1 Mean Pacific Typhoon Intensity Errors for East Pacific, 1998-2000



A summary of the mean track and intensity errors for the years 1998-2000 for the forecast phase of superensemble are shown in Figure 1 and Figure 2. The position (Figure 1) and intensity (Figure 2) errors at 12-hour intervals are shown for the member models, ensemble mean and the superensemble for the entire Pacific Ocean region.



We note that the skill from the superensemble is consistently high compared to the member models and the ensemble mean. It is found that we can obtain skill improvements of the order of 61, 138, 159 and 198 km for the tropical cyclone position errors over the best models for forecasts at the end of days 1, 2, 3 and 4 respectively. The intensity forecast skills (rms errors) at days 1, 2, 3 and 4 of forecasts by the superensemble exceed those of the best models by 5, 10, 13 and 20 knots.

This study appears to hold promise for possible use in real time typhoon forecasts. The real time implementation of this methodology does require that we reduce or eliminate altogether the need for long training period from the early storms of the same year. These are issues that need to be addressed by the real time forecast application group who wish to pursue this approach.

References:

Krishnamurti, T.N., C.M. Kishtawal, T. LaRow, D. Bachiochi, Z. Zhang, C.E. Williford, S. Gadgil and S. Surendran, 1999: Improved skills for weather and seasonal climate forecasts from multimodel superensemble. *Science*, 285 (5433), 1548-1550.

Krishnamurti, T.N., C.M. Kishtawal, T. LaRow, D. Bachiochi, Z. Zhang, C.E. Williford, S. Gadgil and S. Surendran, 2000. Multi-model superensemble forecasts for weather and seasonal climate. *J. Climate*, 13, 4196-4216.

Krishnamurti, T.N., S. Surendran, D.W. Shin, R. Correa-Torres, T.S.V. Vijaya Kumar, C.E. Williford, C. Kummerow, R.F. Adler, J. Simpson, R. Kakar, W. Olson and F.J. Turk, 2001. Real Time Multianalysis/Multimodel Superensemble Forecasts of Precipitation using TRMM and SSM/I Products. *Mon.Wea.Rev.*, 129, 2861-2883.

Williford, C.E., T.N. Krishnamurti, Ricardo Correa Torres, Steven Cocke, Zaphiris Christidis and T.S.V. Vijaya Kumar, 2002: Real-Time Multimodel Superensemble Forecasts of Atlantic Tropical Systems of 1999. *Accepted for publication in Monthly Weather Review.*