Progress Report on Numerical Weather Prediction - 2002

ARGENTINA

Departamento de Procesos Automatizados
Servicio Meteorológico Nacional
(www.meteonet.com.ar)

I. Summary of research development and main operational changes.

The Specialized Regional Meteorological Center Buenos Aires (CMRE BUENOS AIRES) is running an operational regional ten levels primitive equations model, with an horizontal resolution of 150km, since April 1998 in replace of the five levels filtered one which was run since 1990. Model runs at an Impact 10000 Silicon Graphics workstation, and some fields obtained are sent to the Servicio Meteorológico Nacional (www.meteonet.com.ar) twice a day.
An ETA model (80km resolution) is running daily in an operational way, since October 1999 on an ORIGIN 2000 (SGI) with a R10000 processor.
An upgrade of the limited area ETA model (MPI version), called ETA2000 at SMN, is running almost operationally since September 2002 using its MPI capabilities on the ORIGIN 2000 with seven R10000 processors using AVN / WAFS data as initial and boundaries conditions. The resolution achieved is 30km.

II. Research and development in Data Assimilation and Numerical Forecasting

The ARPE model was implemented operationally the first time by the Bureau of Meteorology of Australia and adapted later for routine forecasting at New Zeeland Meteorological Service. It was adapted to our region by the C.I.M.A. Group directed by Dr. M. Nuñez.
Main features of the model are: primitive equation model with vertical mode initialization scheme and a semi-implicit time difference. Physical processes such as surface fluxes of momentum, heat and moisture, large scale and convective precipitation, surface temperature and diurnal cycle have been included
The objective analysis scheme was adapted from the five levels one in our center. The analysis scheme used is a successive corrections one (Cressman) adapted to our region. The analyzed variables are geopotential heights, temperature, humidity and wind components for ten pressure levels (1000, 850, 700, 500, 400, 300, 250, 200, 150 and 100 hPa); temperature, pressure and humidity at surface and tropopause pressure level. The area coverage is regional, using a grid horizontal resolution of 150 Km. Data assimilation is performed every twelve hours. The first guess field is generally the twelve hours one predicted by the model in the previous run and in case of model divergence, the climatological field for that month.

The development of the ETA2000 model begun en 1972 by Fedor Mesinger and Zaviša Janjic at the University of Belgrade and the Federal Hydrometeorological Institute of Yugoslavia. During the last decades, the major developments and improvements were done at the National Centre of Environmental Prediction (NCEP) in Washington, where this model runs operational since 1993. This model was adapted at the SMN to a regional domain which covers Argentina, Uruguay an Chile. Several runs are made for the same cycle for experimentation purposes and results are being stored for verifications. No assimilation is done yet for this model. Major features and improvements are:

- ?? the nonhydrostatic option

?? the ability to run in sigma or eta coordinates

?? the option of using the traditional Betts-Miller-Janjic convection scheme or an alternative Kain-Fritsch parameterization.

?? higher-resolution SST analysis

?? the ability to generate hourly station output in BUFR format

?? a crude nesting capability, where a higher-resolution ETA run gets initial and lateral boundary conditions from a "parent" run.

?? inclusion of significantly better land-sea mask data (30" resolution)

III. Variables obtained from the ARPE model integration

?? Geopotential height in ten levels.

?? Surface pressure.

?? Temperature in eleven levels.

?? Humidity in eleven levels.

?? Horizontal and vertical wind components in ten levels.

?? Convective and large scale precipitation.

Information concerning these variables is obtained for 6, 12 18, 24, 30 and 36 hours' periods.

The ETA2000 model has 40 levels and produces 50 variables. It generates a 96 hour forecast which are available every 3 hours on a GRIB format.

IV. Research and development results for applications of NWP products.

_ Five different fields (surface pressure and 1000/500 hPa thickness, 850 hPa geopotential and dew point, 500 hPa geopotential and temperature, 500 hPa vertical wind component, 250 hPa geopotential and wind speed) are actualized in the Servicio Meteorológico Nacional Intranet network twice a day . Horizontal and vertical interpolations are made to obtain analyzed horizontal wind components and temperature fields every two degrees of latitude and longitude and forecasted fields every six hours at the seven flight levels used in our country and this information is also sent to the Servicio Meteorológico Nacional web page (www.meteonet.com.ar) as well as to the Intranet network and actualized twice a day.

_ The ETA model, which uses the boundary conditions provided by the ten levels regional one, has shown good results especially concerning the precipitation fields. The outputs from the ETA model are used to generate the meteograms for several cities in Argentina.

_ Statistic methods have been applied to vorticity fields of global models in order to obtain precipitation amount in some particular points of the field, with acceptable accuracy of probability of precipitation. The method is also applied to our regional model output.

_ Another statistic technique is applied to the 500 hPa field of global and regional models to obtain probability of cyclogenesis leeward Los Andes mountain range.

_ Monthly anomaly fields at all levels are obtained and analyzed.

_ The ETA2000 model generates temperature extremes forecasts for 30 cities of the integration domain

V. Plans for future research and development activities.

_ Use of a model for trajectory and dispersion of volcanic ashes in support of the Volcanic Ashes Advisory Center Buenos Aires.

_ The analyzed and forecasted fields every 6 hours obtained from the ARPE model were used in an operational sea wave's model, and results are being tested. Plans for using the higher resolution forecasts produced by the ETA2000 model replacing the ARPE model are being evaluated.

_ This same fields are also used in a precipitation model which involves the pixel information from satellite data.

_ New satellite data, such as vertical soundings, might be available in the year 2003.

_ Our goal is to run the ETA2000, in operational basis in order to eventually replace the ARPE model, keeping the same domain and significantly improve the resolution. The optimal resolution achieved will depend, in our case, on the execution time of the model which has to comply with the operational requirements from the forecast office. Nowadays the ETA2000, with a 61x99 grid and 39 levels, takes 1 hour to run and do the postprocessing for a 96 hour forecast.

_ Different assimilation techniques will be evaluated in the next year. More sophisticated schemes has shown to be necessary in order to make use of all the information available and the generation of more accurate initial fields for the new model.

Before the final switch from the ARPE to the ETA2000 model is accomplished, verifications and comparisons of the performance from both models have to be studied and evaluated. Preliminary results will be obtained on 2003.

VI. Development in objective interpretation and verification procedures including performance statistics.

_ Objective verification of forecast products continued during 2002 but no major changes were made on the ARPE model so results don't differ from the previous year. Statistical scores such as correlation between real and predicted changes, Teweles Skill Score for 12, 24 and 36 hs forecasted fields and persistence have been calculated for geopotential height and temperature fields and are being analyzed for the mode for the year 2001 (Figure 1).

The graphic shows the difference between 1000 hPa geopotential levels and upper levels, which are represented by 500 hPa fields, but almost the same results are obtained for 400, 300, 250 and 200 hPa geopotential fields. The influence of SATEM data (absent from August 2000 to December 2001) is clearly shown, in very low values of upper levels' scores (less than 35 since

August 2000) and difference with persistence (dashed lines). On the other hand, the positive influence of the SATOB data (available for the model since July 2001) can be seen in the increment of the Skill Score by the end of the year 2001 and for the two levels.

_ A correlation between real and forecasted temperatures is being calculated at argentine airports which have radiosonde data. An example is shown in Figure 2 for Ezeiza airport (87576), using the measured temperatures in six selected levels and those forecasted by the ARPE model the day before. The temperature field doesn't show any improvements with the addition of the SATOB data to the model but it continues to show its sensitivity to the absent of the SATEM data.

Ten years of analyzed fields using the five levels model and four years (1998-2002) of analyzed fields using the ten levels model (including the operational visualization of meteorological fields using the GRADS software) are available in this Center.

VII. Other items

Objective Analysis and Forecast Area director: Dr. H.H. Ciappesoni.
SMN Scientific Group: Lic. L. Rosso, M. Suaya and M. Gatto.

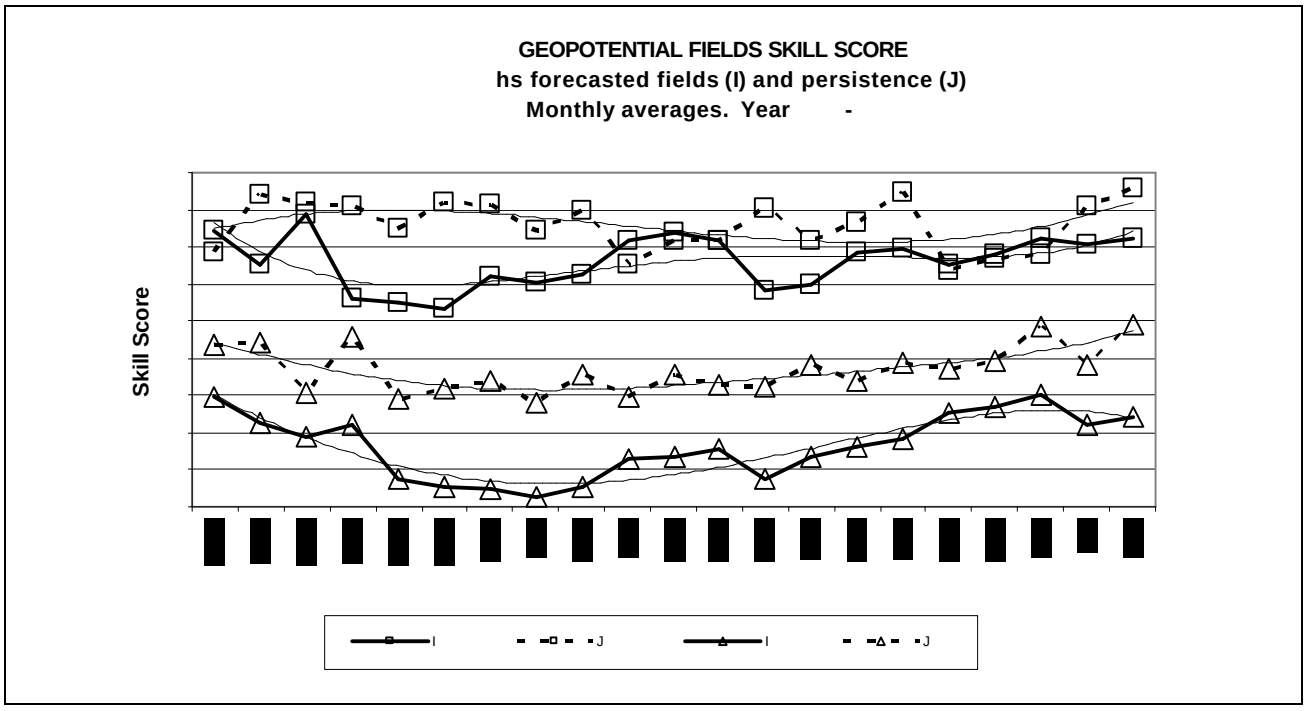

Figure 1: This figure shows the two Skill Score for the geopotential field in 500 hPa and 1000 hPa. A high degree polynomial tendency (thin lines) is superimposed to each curve in the figure.

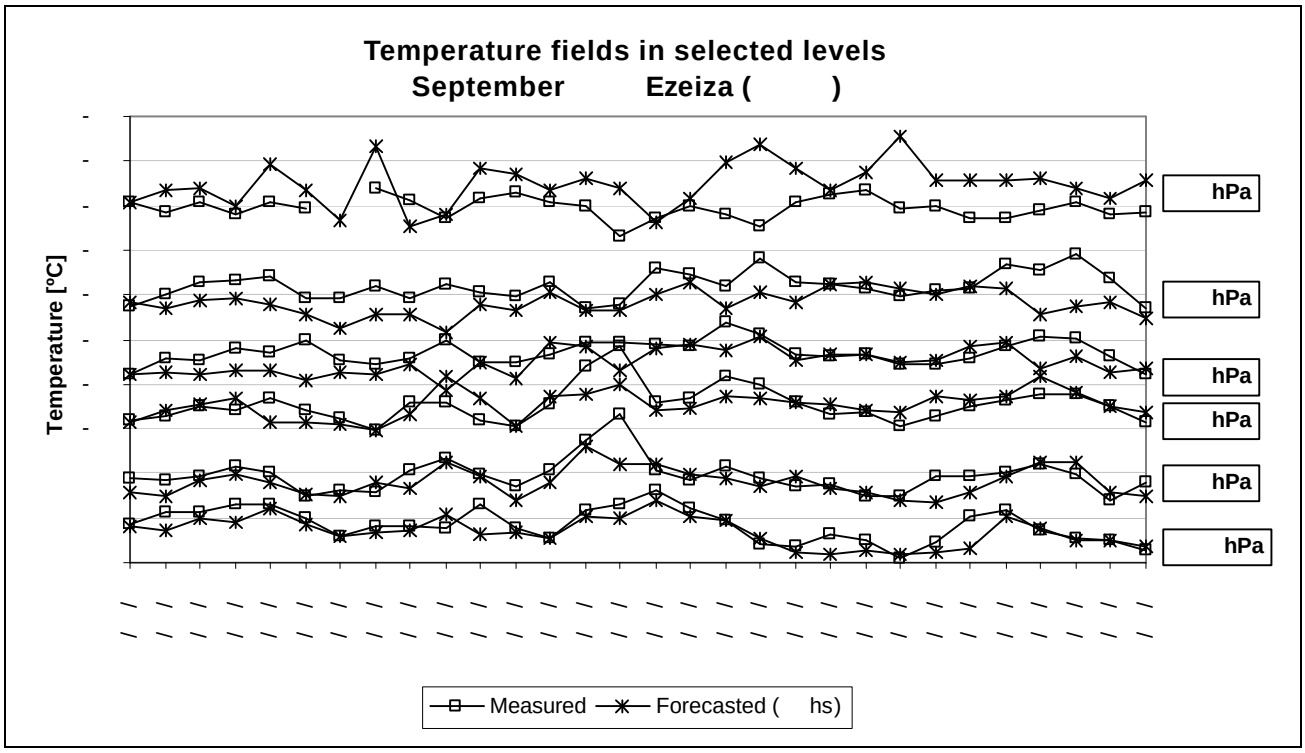

Figure 2: Daily observed temperature and 24 hr forecasted temperature by the ARPE model for several levels.