# Uncertainties in High Resolution Model Verification:
The case of ETA Model Performance in Argentina

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At the National Weather Service in Argentina (SMN) the ETA model with 30km resolution has became operational since 2004. From 2004 until today the ETA SMN has been the primary model for the forecast office. The importance of the verification was inmediate and several issues arose when working on this subject:
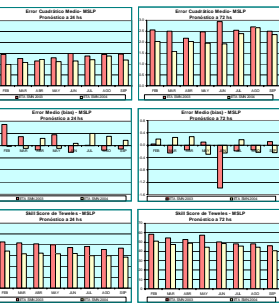
➢ Impact on analysis resolution: higher resolution analysis produced verification fields with much less sistematic errors near the surface.

➢ When compare with another NWP model, in this case the GFS model which at the same time is the parent model of the ETA model, is it possible to outperformed the latter? With the pair anlysis-forecast from the same model, the GFS one performed better than the ETA model. But at the same time, using an independent analysis field to compare with the forecasts of both models, opposite results where obtained (on relative sense). The ETA model showed smaller values of Teweles Skill Score (S1) and Root Mean Square Error (RMSE).

➢ Objective verification of critical variables such as precipitation and extreme temperatures forecasts are done on monthly basis. The method of point verification is used because the lack of a high resolution (similar of the ETA model) observing network. In this sense field verifications are possible but the results would be questionable.

➢ Because evaluation of forecasts issued by the National Weather Service is done since the 80´s it was straight foward to use this results to evaluate the ETA model outputs in its testing period (year 2003) and then operational and official from 2004 until today. A jump in precipitation forecast hits of the forecast office (human forecasts) in 2004 was significant.

➢ The distribution of ETA model extreme temperature errors show the sistematic errors in the forecast. This information is used to correct the raw forecasts of the model by removing the bias by an empirical formulation (not shown).
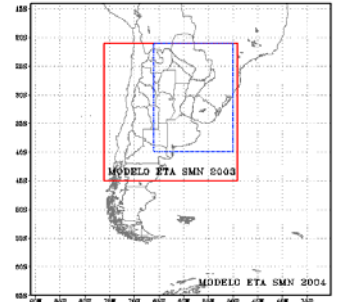
ETA Model domain for the years 2003 (red box), 2004 to date (whole graphic), and verification domain for field verifications (blue box).

ETA model configuration of 2003 and 2004-2007

| ETA MODEL	RESOLUTION	DOMAIN CENTER	INITIAL FIELDS	BOUNDARY DATA
2003	0.25°x0.25° (81x99 grid points) 38 levels	34°S 62°W	GFS model forecasts (NCEP) in its WAFS format	GFS model forecasts (NCEP) in WAFS format every 12 hours
2004	0.25°x0.25° (140x191 grid points) 38 levels	43°S 60°W	GFS model forecasts (NCEP) in regular grid	GFS model forecasts (NCEP) in regular grid every 12 hours

Root Mean Square Error, Bias and Teweles Skill Score for the 24 (left) and 72 hour (right) forecasts of the **Mean Sea Level Pressure** based on the 12UTC cycle of the ETA model. Comparisons between years 2003 & 2004 are shown in each graphic.

Impact on analysis resolution

ETA model forecasts against analysis for years 2003 & 2004
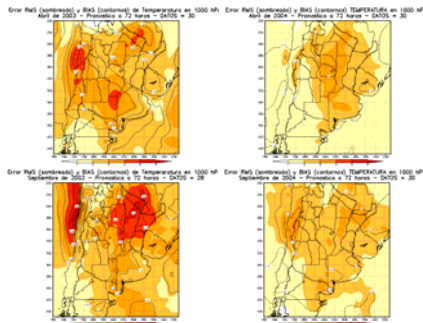
Root Mean Square Error (shaded) and Bias (contour) for the 72 hour 1000 hPa **Temperature** forecasts based on the 12 UTC cycle of the ETA model in April (top) and September (bottom). The left hand side shows the statistics for 2003 while on the right hand side the 2004 fields are display.

Independent analysis fields for NWP models verification.
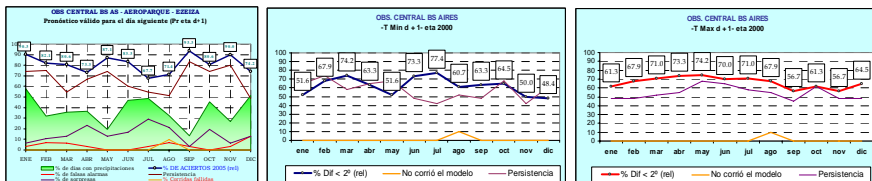
Comparison between ETA & GFS models.
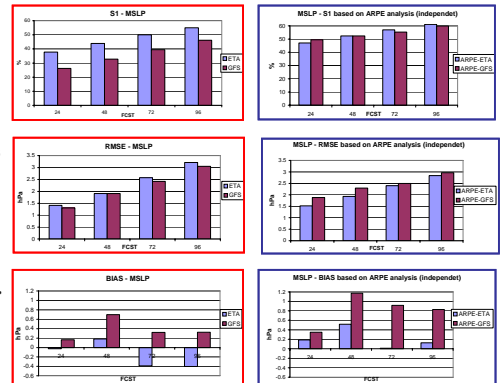
Area average of the Teweles Skill score (S1), Root Mean Square Error (RMSE) and Bias for the **Mean Sea Level Pressure** (MSLP) in the period Feb-Mar 2003. On the left hand side the ETA (GFS) model forecasts where compared to the analysis from the ETA (GFS) model. On the right hand side the ETA and GFS forecasts where compared to the analysis field from the ARPE model (independent analysis).

Monitoring ETA model forecasts of critical variables on selected locations
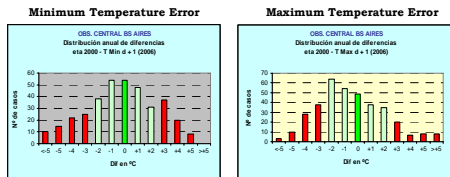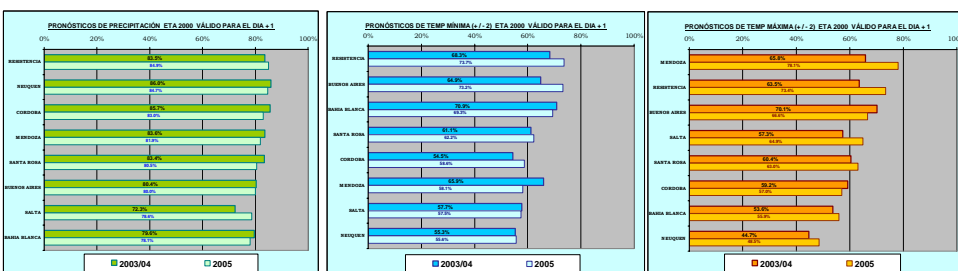

Distribution of **Extreme Temperature** errors forecasted by the ETA model for the following day based on the 12 UTC cycle
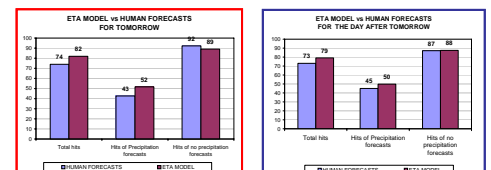
Monitoring Human & ETA model forecast of precipitation
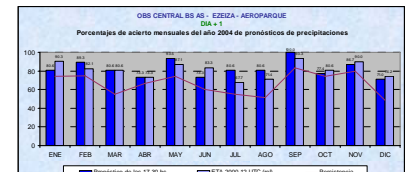
Precipitation hits on monthly basis. ETA model vs. Human forecasts (light blue and blue respectevily) are shown. For reference the forecast by persistence is displayed (thin line). Valid forecast time is tomorrow (12-36 hs)
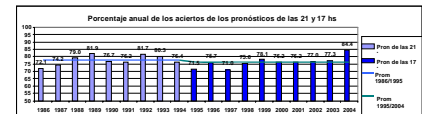
Performance of **Precipitation** forecasts issued by the National Weather Service during the last 20 years. The decline in 1995 correspond to a change of forecast issue time (from 21hs to 17hs) while the sudden rise in 2004 is explained by the high resolution ETA model introduced in 2003 but operational in 2004.

Monthly values of **Precipitation** forecasts hits (rain/no rain) for the following day (blue line). Persistance is shown by the thin line and shaded area represents the number of days (in %) with rain for each month.

Monthly values of **Minimu temperature** hits for the following day (blue line) and forecasted by persistance (thin line). Hits are considered when the absolut error is less then 2°C.

Monthly values of **Maximum temperature** hits for the following day (red line) and forecasted by persistance (thin line). Hits are considered when the absolut error is less then 2°C.

Total hits of **Precipitation** forecasts (rain/no rain) from the **ETA Model vs. Human Forecasts** when the model was in the testing period. Also shown are the relative hits of precipitation when rain occurred and relative hits of no precipitation as well. The periods of forecasts are 12-36 hours (tomorrow) and 39-54 hours (day after tomorrow).

ETA model performance from year 2003 to 2005 on different locations

Precipitation

Minimum Temperature

Maximum Temperature

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