Experimental high-resolution forecast in a region of Argentina

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Introduction

Heavy rainfall and other severe phenomena related to deep convection and their forecast is a major problem in different geographical regions. Subtropical South America (including the La Plata basin) is particularly affected by large and intense mesoscale convective systems (MCSs) within which severe events develop specially during the warm season. One of the main objectives is to progress in the forecast of these intense events in order to reduce related damages.

For that purpose, there is a joint effort of National Weather Service, University of Buenos Aires and Research Center of the Sea and the Atmosphere (CIMA) to design and implement an operational high-resolution forecast at the National Weather Service to contribute to improve mesoscale phenomena forecast, as convective storms. Since november 2010, an experimental operation of a high-resolution forecast in a region of Buenos Aires Province in Argentina is being carried out. Available computational resources are not enought to performed a forecast for the whole day. Forecasts are made every day and cover only the night time because several authors have shown that it is the period of greatest convective activity in the region.

Numerical model setup

Version 4.2 of Brazilian Regional Atmospheric Modeling System (BRAMS) is used to perform the forecasts; a general description of this model can be found in Freitas et al (2009) as well as online at http://www.brams.cptec.inpe.br. BRAMS model has been applied in the region to forecast and simulate different mesoscale phenomena and results show that it represents the observed conditions satisfactorily (Garcia Skabar and Nicolini, 2009; Nicolini and García Skabar, 2010 and references therein). The model setup was defined with two grids with increasing horizontal resolution of 8 and 2 km. Domains are shown in figure 1. The model uses a two way nesting technique. Vertical coordinate is terrain-following and contains 50 levels, with variable grid intervals of 20 m near surface to 1000 m at the top. The lowest level is located at 10 m from ground surface, whereas the highest level is at 26 km. The initial and boundary data are provided every 3 hours by ETA model forecast operative at the National Weather Service with 25km horizontal resolution (Suaya and Valdivieso, 2009). Model forecast are performed for 18hours, from 18 UTC to 12 UTC of the next day and are initialized with a 6 hours forecast of ETA model.

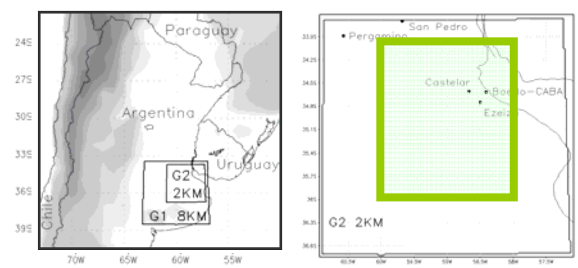

Fig.1.Left:Nested domains. Right:Detail high res. grid.

Shallow and deep convection parametrization were turned off in both grids. Microphysics parameterizations with 8 water species and bulk water scheme was applied, where mean diameter is diagnosed from forecasted mixing ratio and number concentration(Meyers et al, 1997).

Case study

During early morning of January 12, 2010 an extended convective line developed associate with a cold front that propagated over the central and northern part of Buenos Aires Province, Argentina. Related storms produced severe winds (reported gusts exceeding 30 m s^{-1}) in different locations around the city of Buenos Aires, causing material damage and even lost of lives.

For this case study model forecast performance was evaluated against measurements from radar, disdrometer, CMORPH estimations (8km-30min) and surface observations available in the region.
Forecast represents a squall line reflectivity and precipitation patterns similar to observations, but the forecast is approximately two hours later (figure 2). The same delay was observed in ETA SMN forecast that was used as initial and boundary conditions.

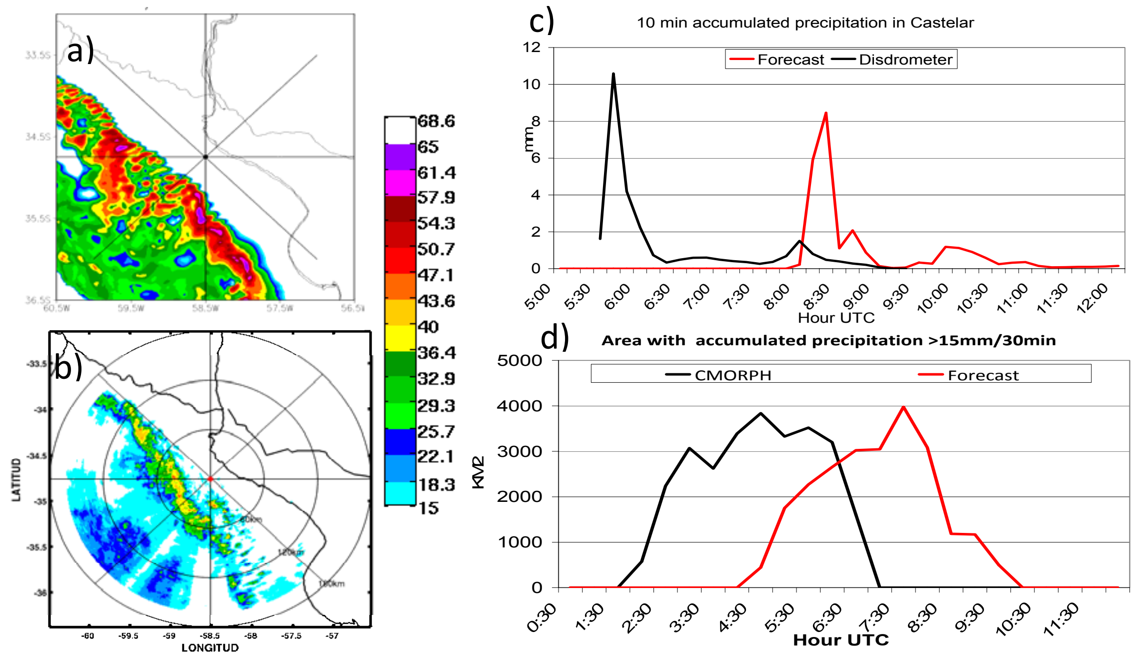

Figure 2. Reflectivity at 3km (CAPPI) a) forecast at 7 UTC and b) observed by Ezeiza ground-based radar at 5 UTC. C) 10minutes accumulated precipitation in Castelar forecast (red) and observed by disdrometer (black), d) Area where precipitation intensity is greater than 15mm/30min forecast (red) and estimated by CMORPH (black)

Future plans

Progress is needed on the development of an objective verification methodology and apply it over an extended period in an operational way.
It is also important to extend the high-resolution forecast to the whole day and to other regions of the country that are also affected by severe weather.

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