Quantitative Precipitation Forecast Verification over Southeastern South America using CMORPH and CPC Data.

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1. Introduction:

The WRF (Weather Research and Forecasting) model has been implemented at CIMA (Centro de Investigaciones del Mar y la Atmósfera) since November 2005, to provide operative short range, mesoscale weather forecasts over South America (http://wrf.cima.fcen.uba.ar). One of the most important aspects related to the utility of a forecast is the skill of the Quantitative Precipitation Forecast (QPF). QPF verification over South America is particularly difficult because of the lack of raingauge observations and the in-homogeneity of their location (Saulo and Ferreira, 2003). As stated by these authors, precipitation gridded data sets obtained through any kind of interpolation over this region, are crude representations of actual rain, since they generally tend to smooth the field and enlarge the area with precipitation. For these reasons, we decided to use two different gridded data sets to assess the skill of WRF QPF using two alternative convective schemes.

2. Methodology:

Two different configurations of the WRF model have been tested for the period October 22nd - November 27th 2005: the first one uses Grell cumulus parameterization (Grell 1993) (WRF-G) and the second one uses the Kain Fritsch scheme (Kain and Fritsch, 1990) (WRF-KF), while all other settings were kept identical. The model was run in non-hydrostatic mode with an horizontal resolution of 50 Km and 31 vertical levels. Both configurations have been verified over the South American region using two different precipitation gridded data sets: the CPC Daily precipitation analysis, which is based on raingauge data and is available with a 1º horizontal resolution (http://www.cpc.ncep.noaa.gov/products/precip/realtime/) and the CMORPH precipitation estimates (Joyce et. al. 2004). This particular data set provides precipitation estimates based on passive microwave sensing at a maximum resolution of near 0.1 degree and a temporal resolution of 30 minutes. In this study 24 hourly accumulated precipitation at 1º degree spatial resolution has been used. QPF has been evaluated through the calculation of the Equitable Threat Score (ETS) and the Bias Score (BIAS) as in Saulo and Ferreira (2003). The QPF has been verified over two distinct areas, one encompassing the northern portion of South America (25º to 0º S and 80º to 50º W) and the other, the southern one (45º to 25º S and 80º to 50º W). This partition of model domain roughly accounts for the large differences found in precipitation regimes between tropical and midlatitude areas.

3. Results:

Figure 1 shows the ETS as a function of precipitation thresholds for both regions calculated using the CMORPH precipitation estimates. ETS are higher over the southern region than over the northen region, as expected. Over the northern region the model scores are nearer to persistence, indicating that the model forecast provides less useful information about QPF. This result is similar to that reported by Ebert et. al. (2003) in an intercomparison of global forecasts over northern Australia. Over the Southern region (Figure 1 b) WRF skill is far above persistence and scores are higher than over the tropical region. Differences between both parameterizations seem to be small but indicate a better performance of the WRF-G for higher thresholds and 24-hour forecast (Figure 1 b). For 48-hours forecast WRF-KF has better scores, what may be due to an underestimation of precipitation in the WRF-G (Figure 3 b).

Figure 2 shows the ETS scores computed using the CPC dataset. These scores are better than when comparing against CMORPH data for both configurations at higher thresholds and WRF-KF performs slightly better than WRF-G at 24 hours. The difference in the scores computed from different precipitation estimates may be due to the lack of a dense and homogeneous raingauge network. CMORPH data provides precipitation estimates with higher spatial and temporal resolution allowing the verification of QPF at higher resolutions and with a more homogeneous spatial coverage. The accumulated precipitation for the whole period (not shown) and a day by day subjective inspection of precipitation fields, reveals that accumulated precipitation is less in CPC than in CMORPH. WRF-G shows BIAS near 1 when compared to CMORPH data, but has large positive BIAS when compared against CPC data (not shown).

Although differences between verifying dataset don't allow to conclude which configuration attains better scores, there are significant BIAS differences for the WRF-G between the 24 and 48 hours forecast which produces faster forecast degradation with increasing forecast length (Figure 3).

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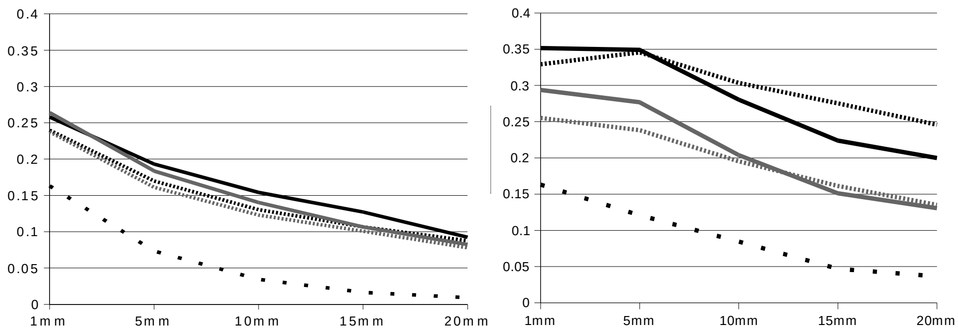
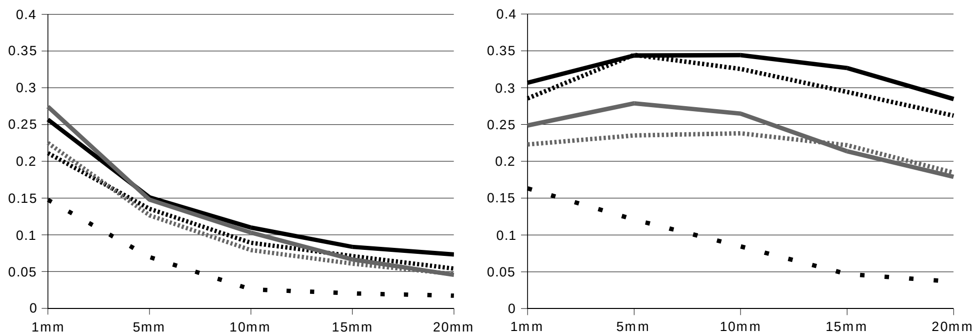


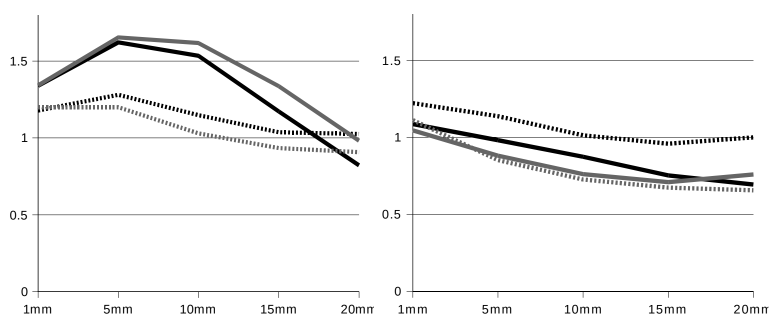
(a) **(b)**

Figure 1: ETS (against CMORPH data) for 12-hour accumulated precipitation as a function of precipitation thresholds. (a) North and (b) South. WRF-Grell (fine dotted line), WRF-KF (continuous line) and persistence (dotted line). 24-hr forecast in black and 48-hr forecast in grey.



(a) **(b)**

Figure 2: As in Figure 1, but compared against CPC raingauge interpolated data.



(a) **(b)**

Figure 3: BIAS for 24-hour accumulated precipitation as a function of precipitation thresholds for the northern region. (a) Northern region and (b) Southern region. WRF-G (fine dotted line), WRF-KF (continuous line). 24-hour forecast (black), 48-hour forecast (grey). In both cases, BIAS are calculated with respect to CMORPH data.