The impact of range-adjusted ground-based radar observations on CRA rainfall verification

C. Accadia[1], N. Tartaglione[2], S. Mariani[3,4], M. Casaioli[3], A. Speranza[2], M. Gabella[5] and S. Michaelides[6]
[1)] EUMETSAT [2)] Univ. Camerino [3)] APAT [4)] Univ. Ferrara [5)] Politecnico di Torino [6)] Meteorological Service of Cyprus

The problem

Sometimes radar data are range-adjusted by means of observations from other instruments or sensors like rain gauges or the Precipitation Radar (PR) on TRMM.

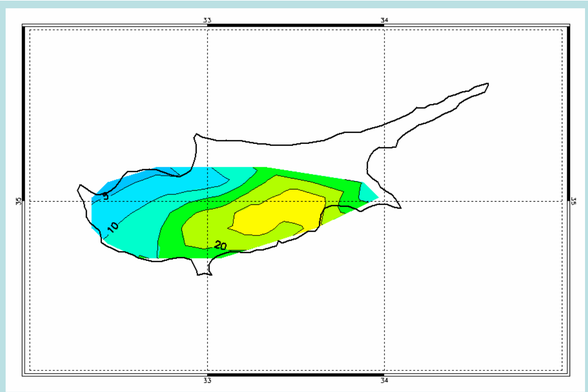
In this case, when performing model verification by means of radar data, how do the verification results change as the range-adjusted data change with respect to the raw observational data?

The work done

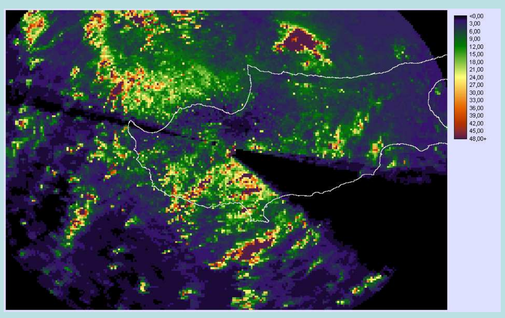
We present a comparison between observation and forecast fields in which the problem of sensitivity of model verification to a linear radar adjustment technique is discussed. The event occurred over Cyprus on 05th March 2003 is shown. This case study was chosen in the frame of the VOLTAIRE project (V FP).

Precipitation accumulated from 06 UTC 5 March to 06 UTC 6 March 2003

Analysis of the *rain gauge* observations obtained by applying the *Barnes scheme*.



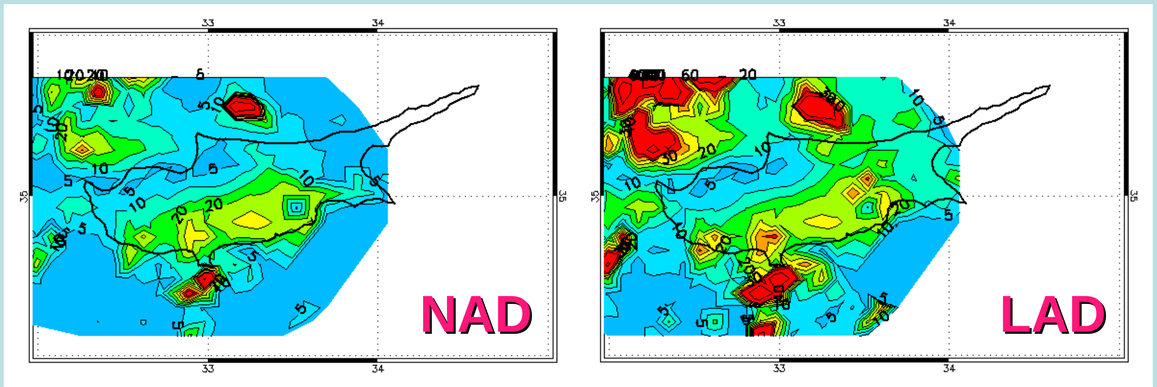
Precipitation as observed by radar accumulated in 24h.



- We have remapped the rain gauge analysis on the same grid of the numerical forecast. Forecast compared to only rain gauge-based analysis gives unstable results.
- Radar data have been then considered. The ground clutter close to the radar was removed by imposing a threshold.
- We have merged together radar data and rain gauge analysis by means of a simple weighted average:

OBSERV. PREC. = [(GD*GD)+(RD*RD)] / (GD+RD)

where GD is the gauge data and RD is the radar data.

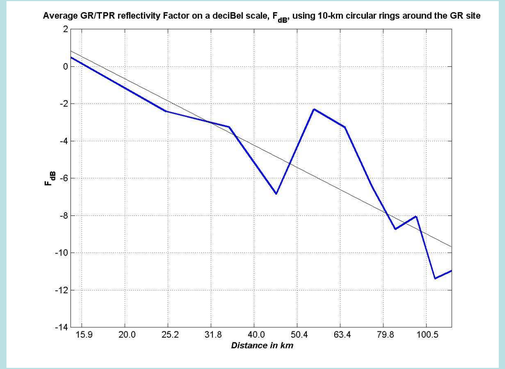


NAD = precipitation field obtained with original radar data (non-range adjusted); LAD = precipitation field obtained using range-adjusted radar data.

The Range Adjustment

Relationship between TRMM and ground-radar reflectivity. It is an average obtained on several cases:

$$y = -4.1 - 10.1 * \log_{10}(x/40)$$

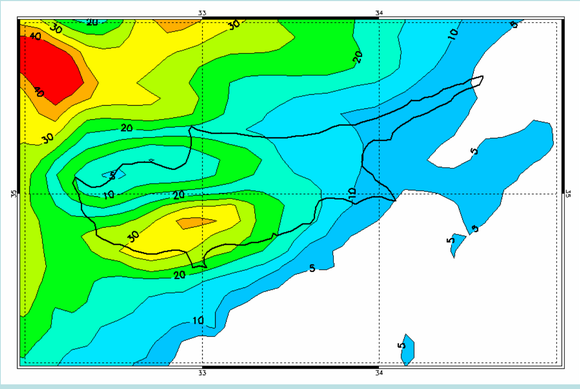


The Forecasting procedure

Model used: BOLAM (BOlogna Limited Area Model). ECMWF data nested in a coarse grid spacing (0.3°) domain (FATHER) encompassing all Mediterranean area (from Gibraltar to Israel).

Output of FATHER nested in a domain with a finer grid (0.09° or 10 km) covering the Eastern Mediterranean (from Greece to Israel).

Forecast precipitation accumulated in 24h from 06 UTC 5 March to 06 UTC 6 March 2003. *The same period of the observations, of course!*



Which comparison technique?

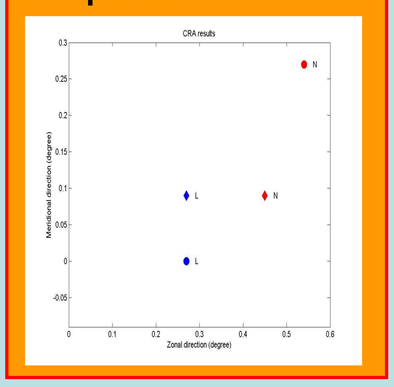
We have used the Contiguous Rain Area (CRA) analysis. This objective-oriented technique allows to quantify a possible shifting error other than measuring differences between the two compared fields.

Two criteria have been used for comparing the forecast and observed fields: Mean Square Error (MSE) and the Pearson Correlation (CORR).

Forecast fields shifted w.r.t. observations to maximize CORR or minimize MSE

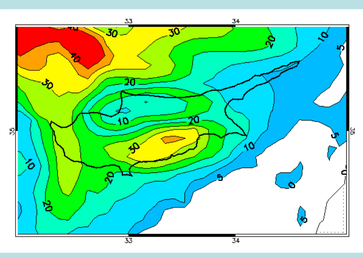
We can summarize results in the figure shown below:
L = (Linear) range-adjustment by means of TRMM/PR;
N = Non-adjusted data.
Diamond = CORR
Circle = MSE

Are these results reliable? To check using a visual (subj.) comparison!

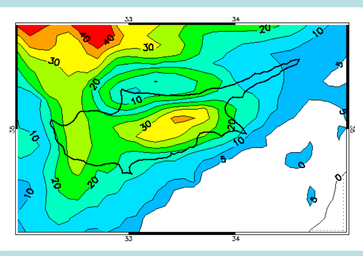


Results obtained comparing forecast precipitation fields with:

NAD

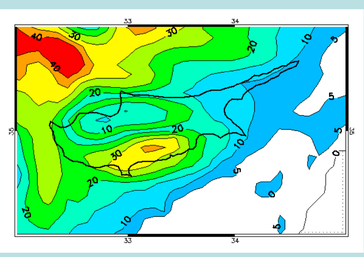


CORR (0.45°, 0.09°)

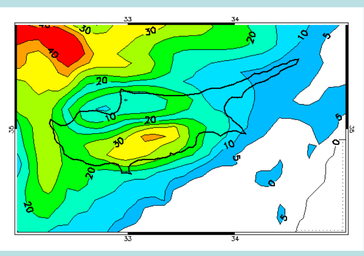


MSE (0.54°, 0.27°)

LAD



CORR (0.27°, 0.09°)



MSE (0.27°, 0.00°)

CONCLUSIONS

Taking also into account a subjective verification of the shifted forecast fields (w.r.t. to the precipitation analysis), we have obtained a better agreement between data adjusted by TRMM/PR with forecasts than non-adjusted data with forecasts. Besides, linear adjusted data results give comparison results stable enough changing the comparison criteria.

Results obtained using CORR (also with only rain gauges) seems to be better than the MSE ones (at least in this case!).

Corresponding author: Christophe Accadia
E-mail: christophe.accadia@eumetsat.int