NATIONAL OBSERVATORY OF ATHENS

Use of satellite data for the improvement of high resolution precipitation forecasts in the Mediterranean

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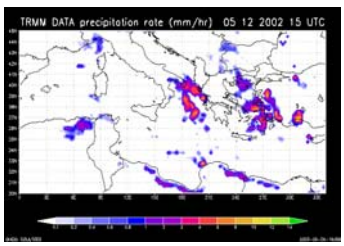
Objective

In this work the potential of various methods of assimilation and nudging of observational data (mainly satellite products) on the improvement of precipitation forecast skill are investigated.

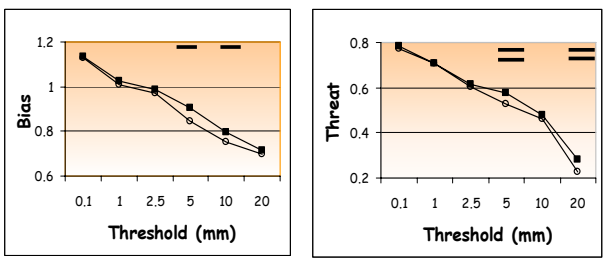
Methodology

1. Sixteen cases of heavy precipitation in the Eastern Mediterranean have been selected.
2. Control runs with no data assimilation or nudging have been performed for the 16 cases with BOLAM and MM5 models.
3. A simple **humidity adjustment** technique that modifies the initial fields used by BOLAM limited area model using the near real-time precipitation estimates distributed by the National Aeronautic and Space Administration Goddard Space Flight Center has been applied.
4. The **3DVAR assimilation** scheme of MM5 that introduces both conventional measurements (i.e. surface observations and soundings) and satellite data from sensors on board SSM/I and QuikSCAT has been applied.
5. The results are compared using common statistical scores.
6. Insight on a flood producing case study.

A Humidity adjustment technique



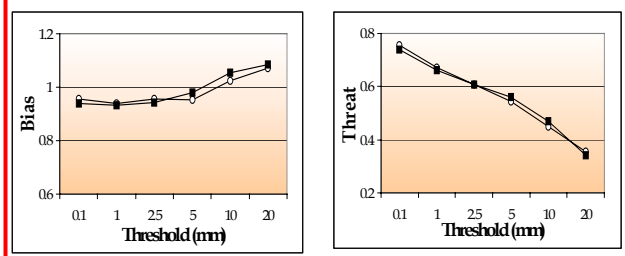
Example of the 3B42RT product distributed near-real time by NASA/GSFC



Bias and threat

Scores for various precipitation thresholds (in mm) for the verification period (t+18)-(t+42) of BOLAM coarse grid, averaged over the sixteen analysed cases. The line with circles denote results of the CNTR simulations, the line with solid rectangles results of the HA simulations. Single bar on the top of the graph denotes a statistically significant improvement at 90% and double bar at 95% confidence level for the HA experiment.

B 3DVAR

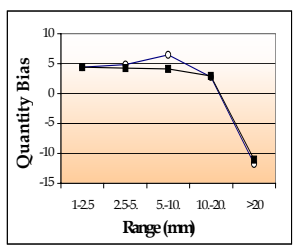


Bias and threat

Scores for various precipitation thresholds (in mm) for the verification period (t+18)-(t+42) of MM5 fine grid (8 km resolution), averaged over the sixteen analysed cases. The line with circles denote results of the CNTR simulations, the line with solid rectangles results of the 3DVAR simulations.

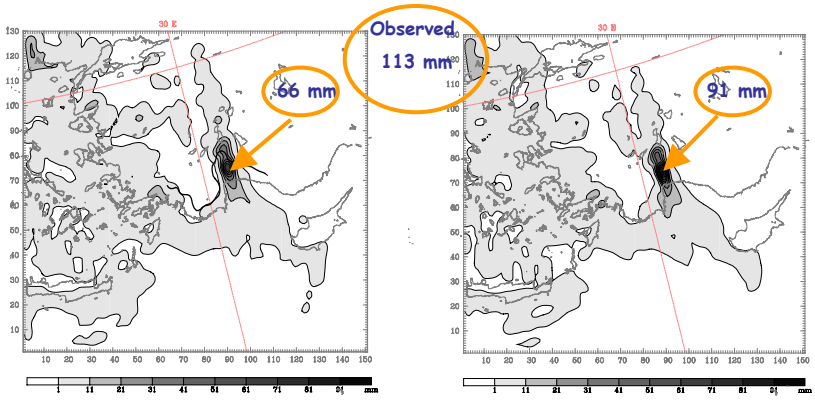
Quantity Bias

For various precipitation ranges (in mm) for the same verification period (t+18)-(t+42) of MM5 fine grid (8 km resolution) averaged over the sixteen analysed cases. The line with circles denote results of the CNTR simulations, the line with solid rectangles results of the 3DVAR simulations.



C A case study – THE ANTALYA 5 DECEMBER 2002 STORM

- the humidity field in the model initial conditions has been adjusted based on the satellite-estimated rainfall (from METEOSAT-7 infrared sequence, calibrated using passive microwave algorithm applied on SSMI and TRMM data).



6-hour accumulated precipitation (at 10 mm interval) valid at 1800 UTC 5 December 2002 as predicted by MM5 Grid 2 CNTRL run (left panel) and ASSIM run (right panel). The mountain barrier around Antalya area is denoted by a bold line.

D Remarks

- Humidity adgustment technique: The statistical analysis revealed an overall improvement of precipitation forecasts, mainly on the model coarse grid forecasts and this improvement was for the medium and high precipitation amounts statistically significant, at least at the 90% confidence level. The method is easy to implement and it is not model dependent, since the technique is applied only during the initialisation phase.
- 3DVAR: the assimilation of conventional data and satellite derived winds has little effect in the improvement of the quantitative precipitation forecasts. Small improvement in the areal bias for the 10mm threshold and in the quantity bias for the 5-10 mm range is obtained through the application of the 3DVAR method.
- Case-study: the results of the adjustment of the humidity field in the model initial conditions based on the satellite-estimated rainfall showed that the model reproduced more correctly the maxima of precipitation in the area of interest and timely, without increasing in general the precipitation field in the whole model domain.
- IMPORTANCE OF THE IMPROVEMENT OF HUMIDITY FIELD IN THE MODEL INITIAL CONDITIONS