Comparison of the MM5 performance in ECMWF and NCEP driven simulations _ part A

Summary of the comparison – part A:

0. Simulations overview
1. Synoptic environment
2. Rainfall
3. Bura

0. Simulations overview

In the part A of the comparison, two simulations were run – one driven with ECMWF and the second with NCEP IC and LBC. The other parameters are the following:

1. points in x,y = 190
2. horizontal resolution: 22.5km
3. levels: 30
4. start: 11Nov 12UTC; end: 15Nov 12UTC
5. physics options (same as in UIB operational run):
    a. CPS – KF2
    b. MPS – R2
    c. PBL – MRF
    d. Cloud radiation cooling scheme
    e. Shallow convection
    f. Multi-layer soil temperature model

LITTLE_R was used to assimilate the available data for both simulations.

1. SYNOPTIC ENVIRONMENT

The verification was made with the BUFFR station data available, ECMWF reanalysis and sometimes by comparison with the UK MetOffice analysis (not available, data taken from the Reviewer's remarks of out MZ article)

Station data (from analysis made by Lluis):

Station	**date** $([DD]^{[HH]})$	P_{sfc} (hPa)
60715	13^{15}	995.90
60760	13^{18}	1000.20
62010	13^{12}	1001.10
16429	13^{15}	996.00
16560	13^{15}	998.40
60715	14^{00}	990.70
60760	14^{00}	999.10
62010	14^{00}	
16429	14^{03}	991.10
16560	14^{03}	993.20
60715	14^{12}	1000.00
60760	14^{12}	1006.90
62010	14^{18}	1009.40
16429	14^{12}	994.90
16560	14^{12}	1000.80

Table 1: Central pressure WMO stations (1.1 at different time steps obtained from observational BUFR files from ECMWF

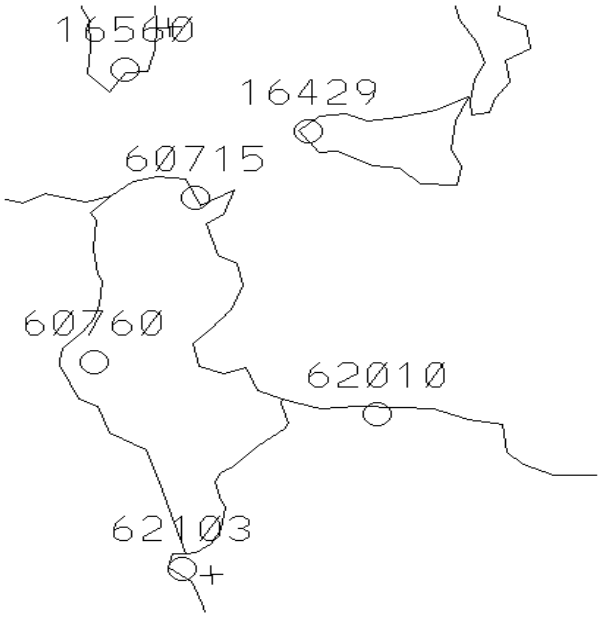


Figure 1.1: Stations WMO

MM5 model data:

Date	Station	ECMWF	NCEP	ECMWF at cyclone centre	NCEP at cyclone centre
13.12h	62010	1002	1004	998	1000
14.00h	60715	**994**	**1004**	992	998
	60760	1001	1002	-||-	-||-
14.12h	60715	1002	998	996	984
	60760	1007	1004	-||-	-||-
	16429	998	992	-||-	-||-
	16560	**1006**	**997**	-||-	-||-

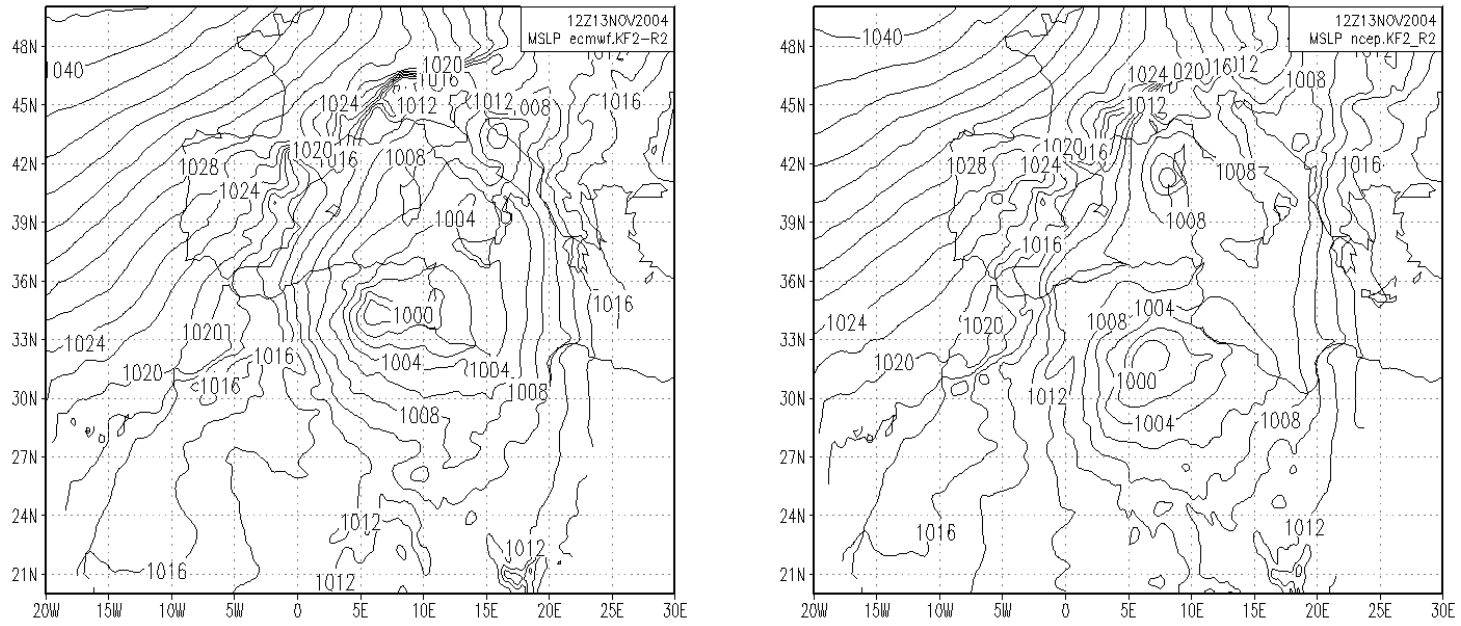


Fig 1. MSLP at 13 Nov 12 UTC. Left ECMWF, right NCEP, interval 2hPa

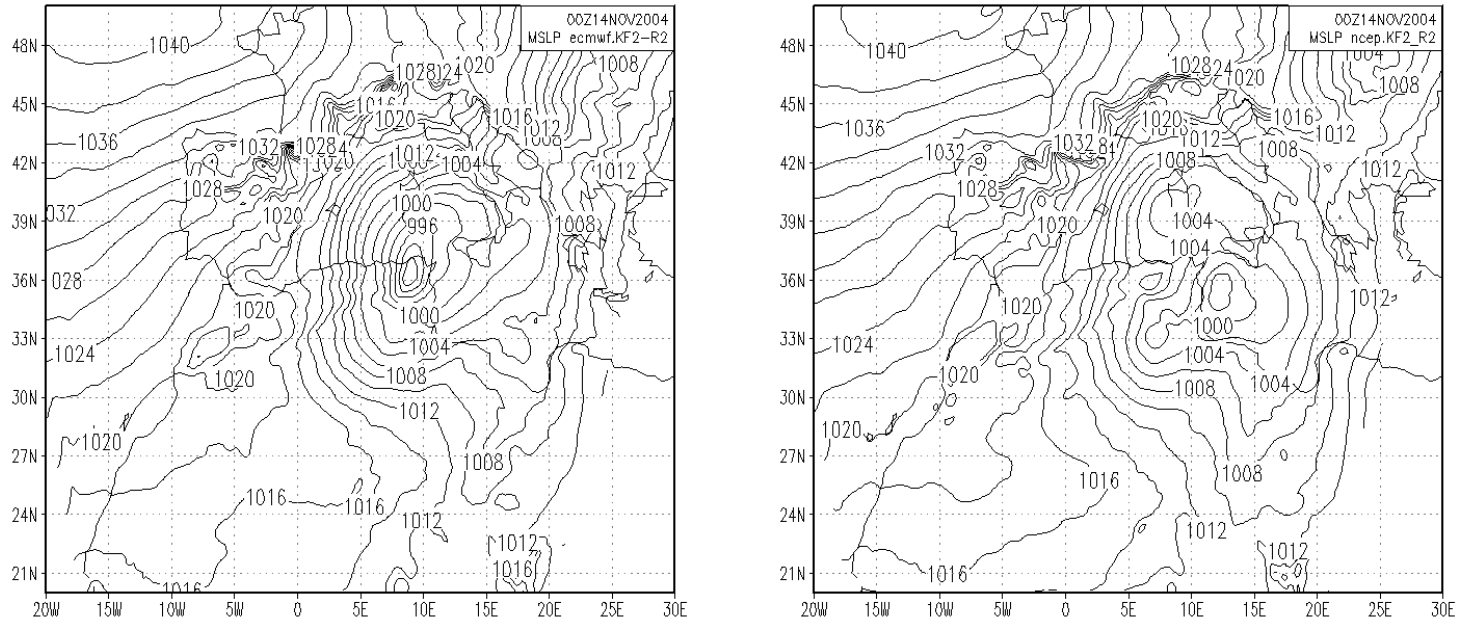


Fig 2. MSLP at 14 Nov 00 UTC. Cyclone centres significantly different – EC 992hPa, NCEP 998hPa (see table above for comparison with station data). At this time UKMet office analysis gives ~990hPa in the cyclone centre according the anonymous reviewer of MZ article. Notable difference in paths. NCEP cyclone centre located at the similar position as in our MZ study. According to the same reviewer, Ukmet Office has cyclone centre more to the NW, which is more comparable with ECMWF cyclone location.

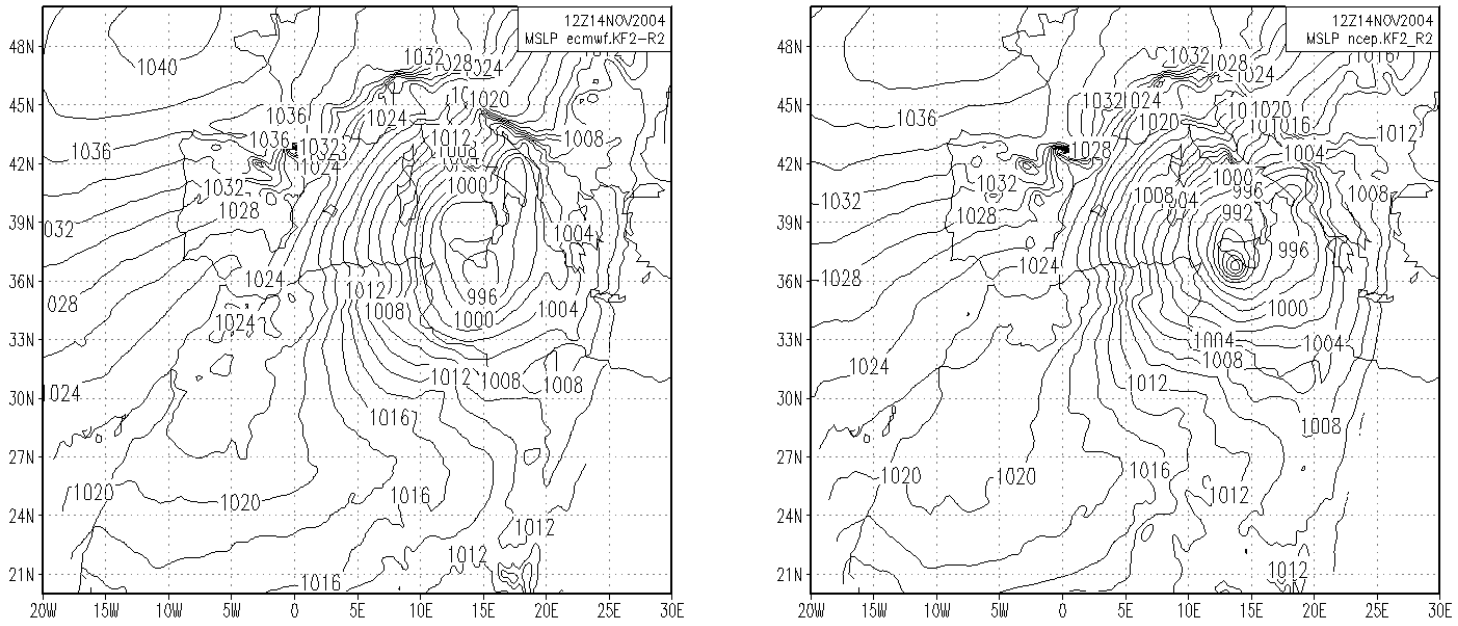
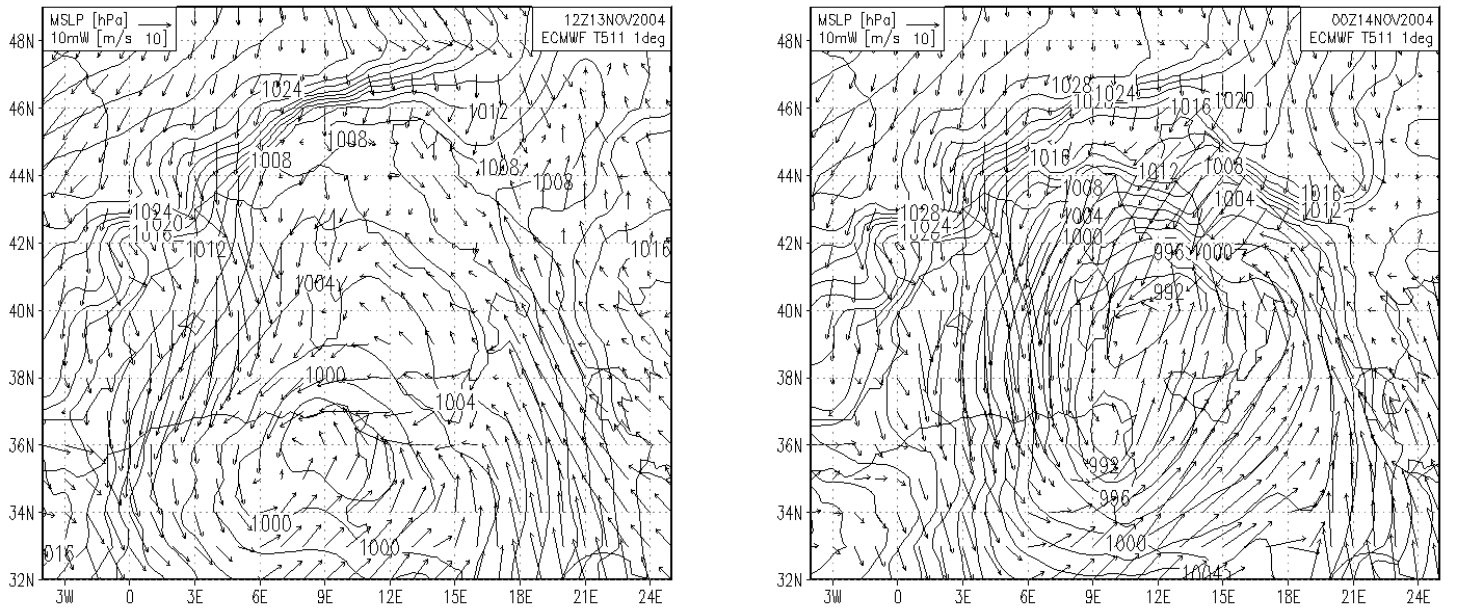


Fig 3. MSLP at 14 Nov 12 UTC. Note rather explosive cyclogenesis in MM5-NCEP reaching 984hPa (14hPa in 12hr).

At this point cyclone centre is over the sea and station data is not sufficient for analysis. Consulting the ECMWF re-analysis (for all 3 periods):



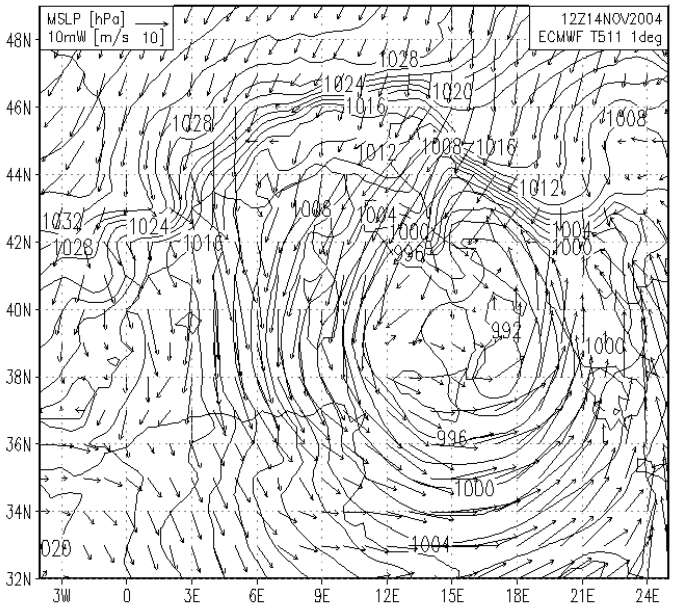


Fig4. ECMWF T511 (0.5deg) analysis data: MSLP (hPa) and 10m wind (m/s) at 13 Nov 12 UTC, 14 Nov 00 UTC and 14 Nov 12 UTC.

At 13Nov 12UTC and 14Nov 00 UTC MM5-ECMWF performed better forecast compared to ECMWF analysis, both in cyclone centre intensity and location. At 14 Nov 12 UTC, both forecasts miss the cyclone location with a considerable difference in MSLP centre as mentioned above. MM5-ECMWF run overestimates the pressure at the cyclone centre for 4 hPa, and MM5-NCEP underestimates the pressure for 8hPa.

2. RAINFALL

Data available by Capt. Fuccello for the whole South Italy (only charts total precip 00UTC-00UTC; by help of Mr. Augusti) and Daniele Mastrangelo, an Italian collegue of mine who did a diploma work on the rainfall analysis and simulation in Salentine region of the Puglia region of Italy (the heel of the shoe). For some strange reason I was not able to insert Fuccello charts in this document, so I enclose them separately as attachments.

Checking first the "Fuccello" rainfall data we see the following:

1. most of the precipitation happened on 12 Nov and 13 Nov, implying that we should give more weight to the good MM5 forecast until 14Nov 00 UTC, at least for verification of the model rainfall in Italian region
2. there are 3 main centres of precipitation:
    a) Calabria with ~100mm/24hr on 12 Nov
    b) The northernmost coastal part of Golfo di Taranto with ~250mm/24hr on 12 Nov
    c) Salento region (south Puglia) with ~200mm/24h on 13 Nov

Here is the more data from the region of Salento (courtesy of Daniele):

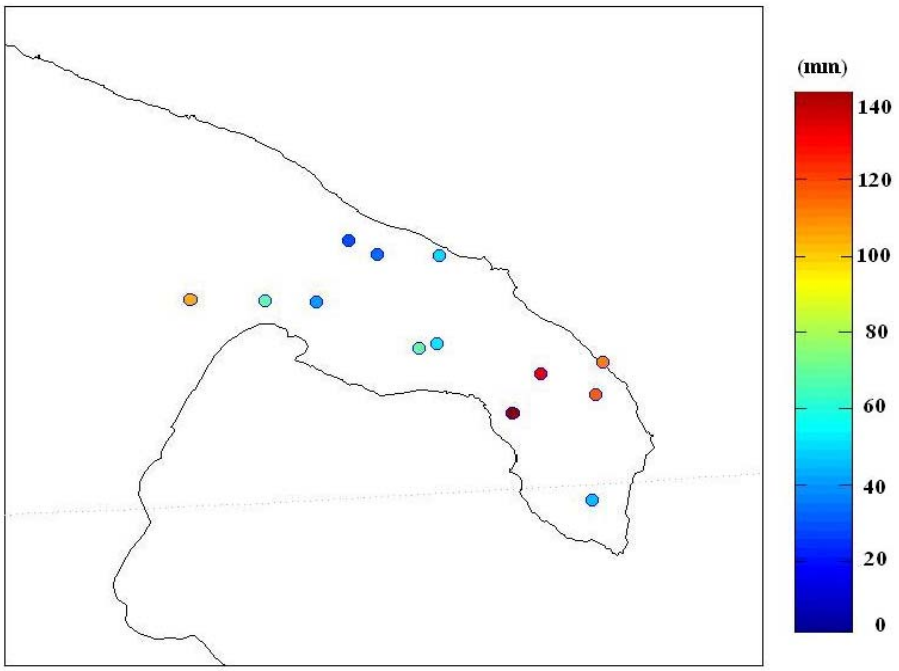
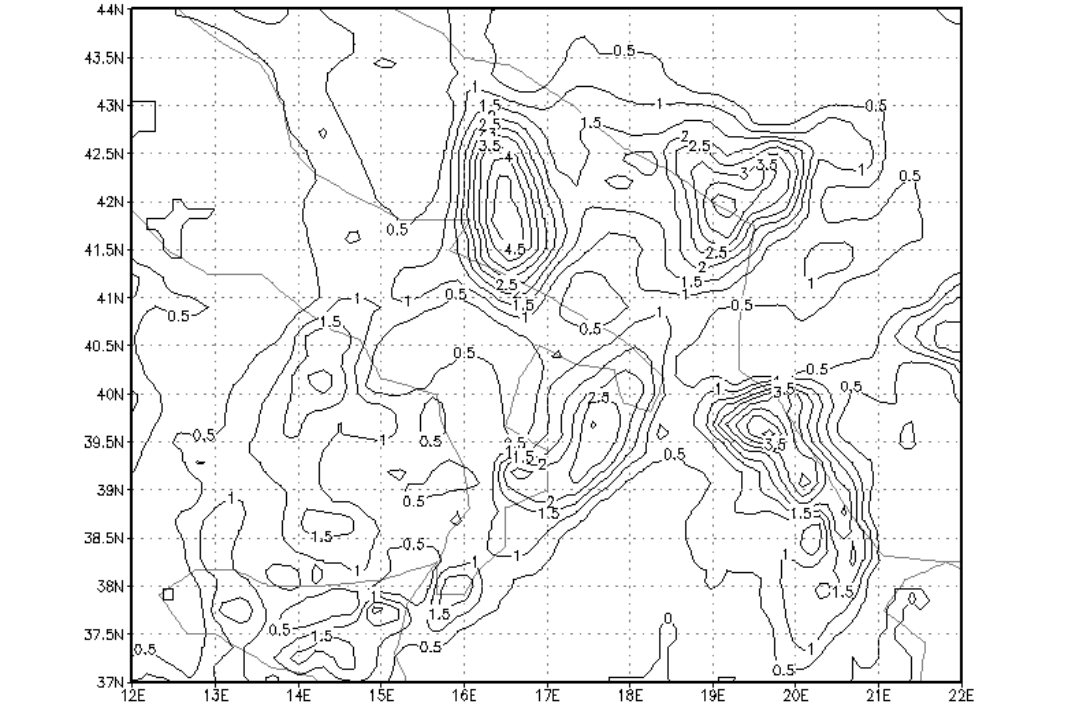


Figura 3.8: distribuzione delle centraline di rilevamento sull'area d'interesse; i colori indicano l'accumulo pluviometrico registrato nel periodo di 36 ore dalle 1200 UTC del 12 novembre alle 0000 UTC del 14 novembre 2004.

Obviously these stations don't include the ones in Fuccello dataset, because here the highest precipitation is ~135mm/36hr.

Now we can see how did both models simulate these 3 precipitation centres:



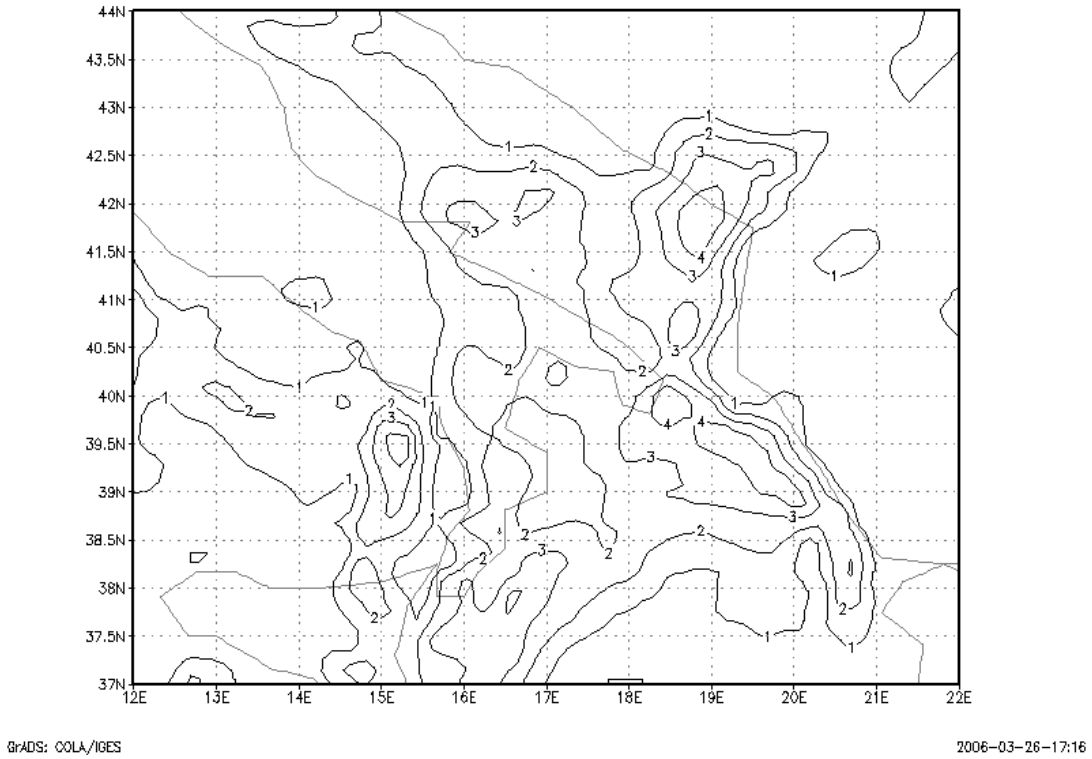
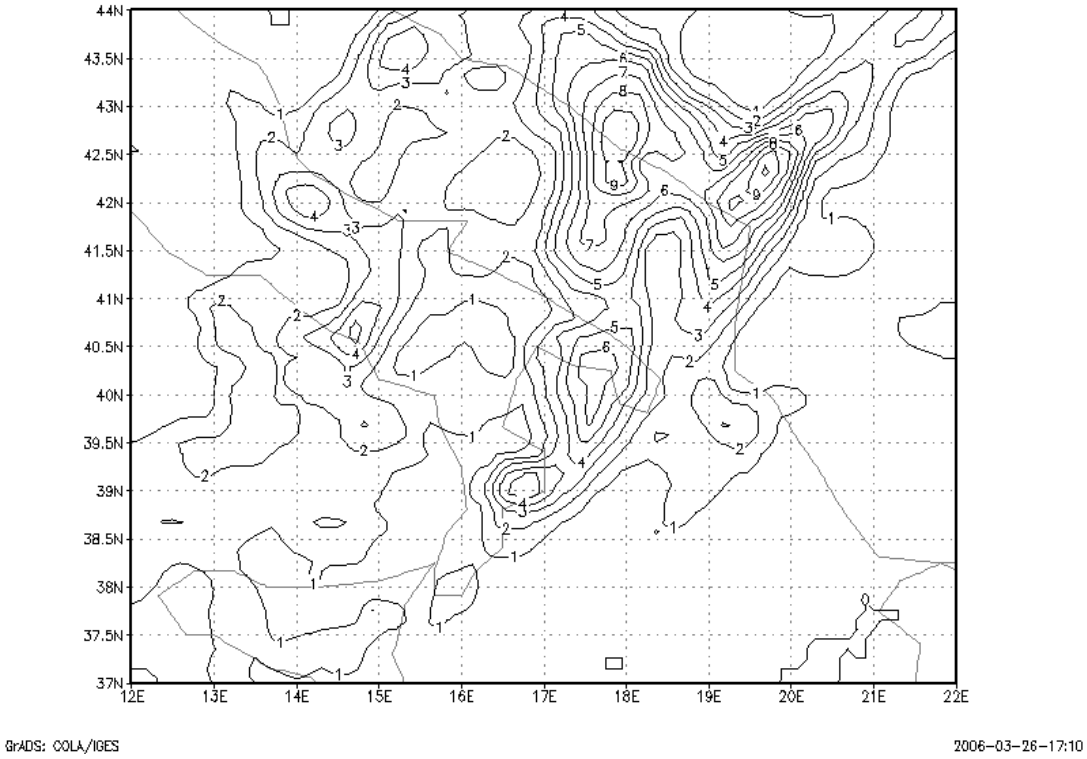


Fig. 24hr model simulated total precipitation in cm (12 Nov 00 UTC – 13 Nov 00 UTC) for MM5-ECMWF and MM5-NCEP runs. Sorry for the different isoline interval. This figures should be compared to Fuccello data on 12 Nov (attached).



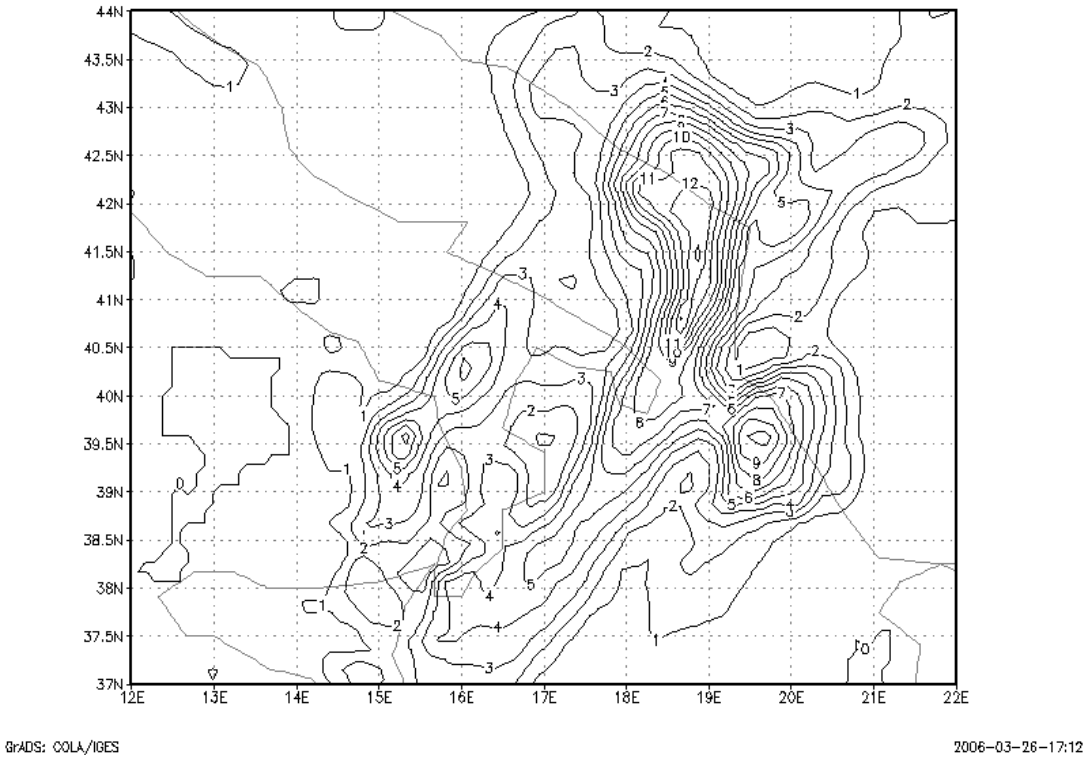


Fig. 36hr model simulated total precipitation in cm (12 Nov 12 UTC – 14 Nov 00 UTC) for MM5-ECMWF and MM5-NCEP runs. This figures should be compared with the Salentine 36hr rainfall data above.

Both simulations showed the most intensive precipitation centres mostly in Albania and Montenegro - however, I had no data to verify that.

As far as the precip in South Italy is concerned, both simulations were quite bad on 12 Nov in simulating 2 existing centres of maximum total rainfall (Calabria and north of Taranto bay, see “Fuccello” 12 Nov). Later, it seems that MM5-ECMWF simulation managed to predict the 2 centres (Calabria and Salento), although the rainfall amount is underestimated. Third, most intensive centre (see Fuccello, 12Nov) was not visible in any of the simulations.

In summary, I believe MM5-ECMWF simulation did a better job on the South Italian precipitation, although I am a bit indecisive whether this simulation would be of good enough quality to pursue our study.

3. Bura event

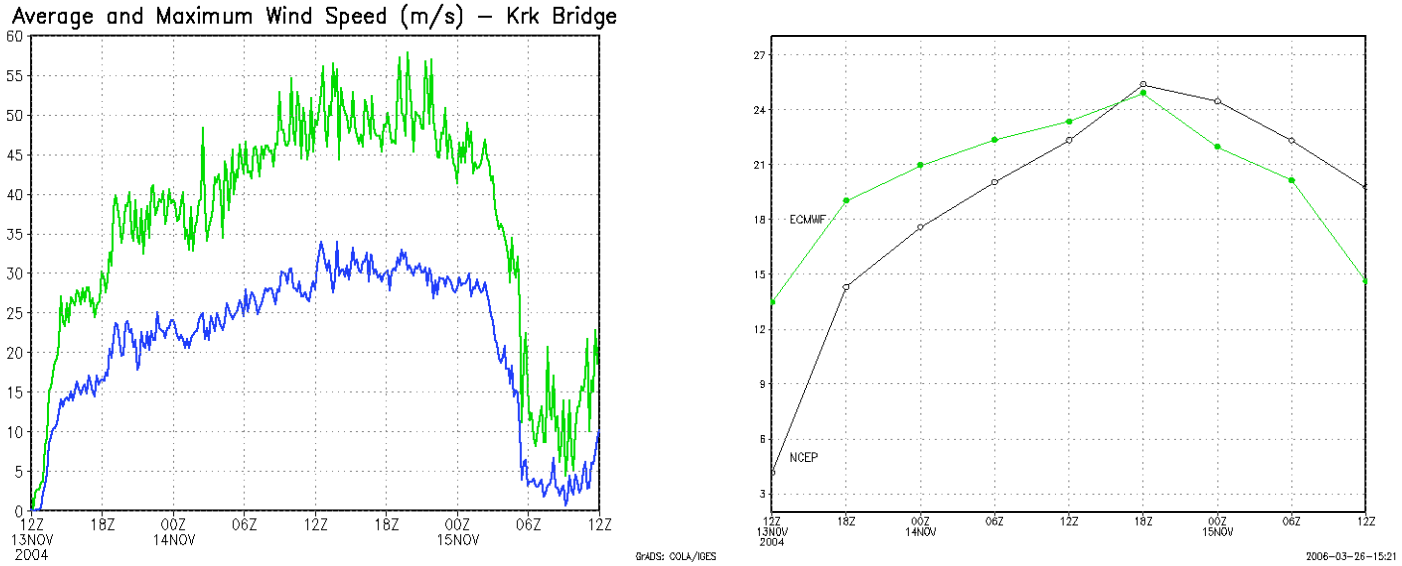


Fig. Measured bura wind speed (blue) and wind gusts (green) on the location of bridge Krk, showing the highest measured values on the Eastern Adriatic Coast during the event (left). MM5-ECMWF (green) and MM5-NCEP (dark) simulated wind speeds at the same location for the same period – 13Nov12UTC-15Nov12UTC (right)

In my opinion, ECMWF is somewhat better here too. Both simulations underestimate the maximum wind speed, but that is normal concerning the resolution. MM5-ECMWF, although the episode starts too early and finished too late (what could have relationship to weaker blocking by the lower mountain in the simulation then in reality), seems to have overall better timed Bura event, then MM5-NCEP that starts at a good time, but is very bad in producing the end of the this strong wind process.

4. CONCLUSIONS

It seems MM5-ECMWF model performed a better simulation then NCEP. This impression is expressed the most by looking at the MSLP patterns on 14Nov 00 UTC, where NCEP simulation is very wrong. Also, it seems that in South Italian precipitation forecast as well as prediction of Bura, MM5-ECMWF was better to an extent, although not completely satisfying, specially for precipitation pattern and underestimation of the total rainfall.

At this point, I decited to several simulations driven by ECMWF data using different CPS and MPS. This is the topic of the part B.