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Interactive comment on "The role of urban boundary layer investigated by high resolution models and ground based observations in Rome area: a step for understanding parameterizations potentialities" *by* E. Pichelli et al.

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The role of urban boundary layer investigated by high resolution models and ground based observations in Rome area: a step for understanding parameterizations potentialities.

by E. Pichelli, R. Ferretti, M. Cacciani, A.M. Siani, V. Ciardini, T. Di Iorio

Major

a) The approach of this study is based on an extensively already published literature investigating among the PBL schemes, available for models MM5 (at first) and then WRF, their response for different meteorological events on urban or rural areas (Dandou et al., 2005, Grossman-Clarke et al., 2008, Thomsen and Smith, 2008, Trusilova et al., 2008 etc.). The previous studies allowed for both highlight biases of the model and for understanding the errors mechanisms generation (Dandou et al., 2005). The finding of model errors is important as well as a good model response. The present study is the first one, in our knowledge, comparing high resolution model results to a set of different instruments on the urban area of Rome. Again several studies investigated the urban PBL; among them Collier (2006) clearly stated the need for better understanding the PBL of the urban areas because of their impact on the weather. The most gross distinction among existing PBL schemes is done dividing them into first-order and TKE (one and a half order) closure schemes. Previous studies have demostrated that the representation of characteristics of the boundary layer is more or less sensitive to PBL parameterizations if one consider mean or turbulent structure of the layer (Holt and Raman,1988). Based on our experience (operational run) WRF is responding correctly in case of strong forcing but in summer time it may miss some local events. WRF model offers numerous options for PBL schemes; recent studies (Shin and Hong, 2011) have compared some of them concluding that non local schemes are more favorable under unstable conditions, whereas TKE closure schemes perform better under stable conditions, even with large bias for most variables. They show that main differences rise belonging to local or non local nature of the parameterization, except for near-surface variables, which are strongly influenced by surface schemes more than by PBL ones. This is why we tested WRF over Rome area using local and non local schemes. Among the ones available for WRF, we have chosen the YSU as non local scheme, being the new generation of the MRF PBL used in MM5 model, largely used

both in operational simulations for the area of interest and for specific studies (Ferretti et al., 2013) with good results. On the other hand, Shin and Hong (2011) shows that local schemes tend to converge to similar results for turbolent structure of the PBL and that surface schemes are responsible for differences near the surface more than PBL scheme. Among TKE closure schemes available for WRF, the MYJ has been chosen also because it can be coupled with the multi layer canopy model available with WRF (Martilli, 2002). It has been shown (Lee et al., 2010) how an appropiate explicit parametrization of urban physical processes produces more accurate results for other urban areas. Using MYJ has given the possibility of exploring WRF performances over Rome in terms of both local scheme potentialities and more complex urban canopy modeling for that area. For sure some more configuration could be added, but this first comparison was useful for giving an idea of an appropriate operational configuration that will be statistically evaluated over a large range of weather conditions as a future work. Biases between model and observations found in the present paper are coherent with averaged biases in other studies over urban areas for most variables (Kim et al., 2013); only the wind speed bias results higher than other findings, but it is supposed to lower considering averaged values on more than one point, as also the comparison on suburban areas would suggest.

The comment has been integrated in the final manuscript for clarifying the choice of the configurations presented in this work.

b) The reviewer is right in writing that an exented evaluation (both in time and over a large number of domain points) of the model performances over the area of interest would be necessary to choose the best operational configuration, but the present study helped to understand some of the observed deficiencies of the operational configuration in case of weak winds regime on high resolution domains. That configuration used the YSU PBL. The comparison point inside the urban area is the only available with both low and upper levels measurements. The comparison with the

SODAR observation, even at only that point, has been very useful for assessing an excess of large scale momentum trasmission at lower levels in weak winds regime, that has been verified also in other point of the domain, as the comparison with suburban stations revealed. Cases study allowed for considering a change in the operational configuration with the MYJ as PBL scheme; the study highlights that it allows for lowering errors for most of variables, even if further adjustments are evidently necessary with surfaces schemes to improve results. The new configuration performances will be statistically evaluated with surface stations data as a future work. A more precise reference about this indication for the PBL choice has been added to conclusions paragraph.

c) As in synoptic meteorology, authors refers in general to *advection* to indicate the horizontal components of motion, that is, the wind field. As suggested by the reviewer synoptic maps have been added to the manuscript to help to understand meteorological conditions of the more discussed event and some more precise description is given for other cases.

Minor:

Minor comments have been considered to improve the manuscript:

a) Pag 5298 line 25: motions has been replaced with processes

b) References added to the sentence included in pag 5299 lines 15-17. (Grossman-Clarke et al. (2007),Salamanca et al. (2011), Salamanca et al. (2012), Kim et al. (2013))

c) Pag 5300 line 5: sentence has been corrected.

d) Pag 5302 line 7: reference added (Thomas, 1995).

e) Pag 5306 line 13: error has been corrected.

f) Pag 5307 line 4: resolution of the 3rd domain has been added (2.4 km).

g) Pag 5318 line 18: sentence has been corrected.

Fig. 1. Synoptic maps from ECMWF analyses at 0.25deg of resolution for **(a)** 6 February 2008 at 12:00 UTC and **(b)** 7 Februry 2008 at 18:00 UTC. Colors represents the mean sea level pressure (hPa), white lines the geopotential height at 500 hPa (m) and black vectors the horizontal speed at 10 m (m/s).

Together with this report other two pdf files will be uploaded:
1) pdf of the manuscript available for the open discussion, with integrated comments swhere changes have been done. Most important changes are in the introduction and in the conclusions paragraphs.
2) to semplify eventual reading of modified introduction and conclusions, a pdf of the manuscript recompiled with a different format respect to the one in point 1). The authors apologize for that, but at the moment they have problems in recompiling the manuscript exactly with open discussion format (THIS WILL BE UPLOADED IN A FOLLOWING COMMENT).

A list of new references and the added maps for synoptic conditions follow:

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