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Atmospheric Measurement Techniques Discussions

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

Based on the Editor response of June 3rd, 2013, reviewers indications have been considered to improve the manuscript. I attach also the pdf of the last uploaded manuscript.

Editor response: *Dear Author, I was not aware of the model evaluation session of the ISTP session, which is the basis of this special issue. Under these circumstances the argument that "the manuscript is too poor in terms of Measurement Techniques" does not hold any more for a special issue covering all aspects of the symposium. Please account for the review items of both reviewers.*

Authors report

Section 3 has been reorganized to simplify the measurement discussion.

Major

1. The paper has been submitted for the special issue of the International Symposium on Tropospheric Profiles (ISTP), where the work has been presented; one full session at the ISTP was dedicated to the "'Evaluation of Models and Data Assimilation"' and this is the reason of the submission to AMT.

2. The novelty of the paper is in the combination of different measurements and WRF model results for understanding different PBL parameterizations skills in representing the local circulation of the urban area of Rome in typical scenarios. This was never done before for this area. Some hypothesis is discussed in the paper to justify model discrepancies respect to measurements and this should be the starting point for an eventual future improvement of the schemes or for a tuning of their parameters for the area.

3. Some more reference has been added. Most of findings are in agreement with the cited literature.

4. The comment was considered and the accuracy of meteorological measurements was included. However the standard deviations for the meteorological variables were used.

5. The choice of the schemes combination is not absolutely random. The first step has been to compare local and non local schemes for that area. Based on our experience

(operational run) WRF is responding correctly in case of strong forcing (that's why we chose cases with no too strong large scale forcing) but in summer time it may miss some local events. YSU has been chosen as the new generation of the MRF used in MM5 and MYJ for its TKE closure characteristics. Currently, each surface layer option is tied to particular boundary-layer options; so the MYJ has been coupled with the Eta surface layer based on similarity theory, often referred as MYJ surface, whereas the YSU with the MM5 surface model (Skamarock et al., 2008). On the other hand the land-surface models (LSM) have various degrees of sophistication in dealing with thermal and moisture fluxes in multiple layers of the soil; some of them may handle vegetation or canopy effects. Both the PBL schemes considered can run with the LSM based on the MM5 5-layer soil temperature model (TD-MM5 in the paper) and with the 4-layer soil temperature and moisture Noah LSM; thus experiments with both LSM have been considered. In the Noah LSM cases further experiments with urban canopy models (more sophisticated than the default bulk-approach one associated to urban areas) have been presented to investigate the eventual improvement induced by these models on the local circulation forecast.
6. Because of the lack of precise information about most of parameters relative to the Rome area, the URBPARM.TBL has been used with default settings. Only one urban category is used in the model. Parameters relative to urban morphology (street width, building heights, etc) associated to urban category are on average also representative of the modern environment of the city; the ones relative to physical properties are probably different, but no data was available to do changes of sense. These could be a weak point for the discussion, but if any deficiency of the results is due to the table parameters, this should arise for both PBL, thus saving final conclusion in the comparison.

Minor:
- Paper is hard to follow since the authors refer to the figures in a non logical order, starting with Fig2, then 6 and 7 and then 1...
Measurement figures have been repeated in section 3 to avoid the apparently illogical

sequence.
- Ln 63: a sonic is not passive: it obstructs the flow which should be accounted for.
The comment was considered and "'passive"' was deleted.
- Table 1: These standard deviations are taken over the whole time series or represent standard deviations within the instrumental averaging time. Unclear.
They are mean SD taken over the time series to give an idea of their order of magnitude. The SD within the instrumental averaging time are plotted on relative figures. The comment was considered to point out the text in section 3.
-Ln 191: Which version of WRF is used here. In all version older than 3.4.1. a bug in the stable boundary layer code was discovered in YSU (see WRF website). As such older versions than 3.4.1. should be ignored concerning YSU.
The WRF version we used for this work (3.1.1) had some minor bugs for the Prandtl number calculation. These are not invalidating for the conclusions inferred in the comparison between the two PBL schemes used in this work. The sum of all adjustment in model version later than the one we used resulted in an improvement of the YSU performance but do not compromise the results presented. Moreover all the WRF PBL schemes present similar performances in representing stable PBL. Shin and Hong (2011)concluded that the representation of surface variables is still uncertain under stable conditions regardless the PBL scheme used. One more bug related to YSU was found in model version previous than 3.4.1 if using a nesting domain starting later, which is not our case.
-Ln 258: The statement has been clarified. The contradiction (MYJ warmer than YSU for most of the perfomed simulations) can not be generalized and can be addressed to the peculiaties of the circulation in the urbanized area of the italian central-west coast (Ferretti, 2003).
-Ln 309: RH is not a good quantity to evaluate WRF for humidity since it is not a conserved variable. RH depends on temperature and vapour pressure. If the model has the correct vapor pressure but the wrong temperature, you will give WRF a penalty for the wrong reasons. Use specific humidity instead.

We agree with this comment, but no additional quantity was available to retrieve specific humidity from sonic anemometer or related sensor in the measurement site. The comparison through relative humidity for sure penalizes the model; the parallel comparison of temperature in part helps to understand when a deficiency is related to vapor forecast or to some other factor. This could be not sufficient to unequivocally evaluate WRF for humidity, but partially recovers the measurement unavailability.

-Ln 345 and Ln 448: WRF cannot resolve downdrafts since these are parameterized in WRF...

WRF is a fully compressible at the primitive equations model. It resolves the three-dimensional structure of the wind, obviously depending on the scale. Since the model is here used at 780 m of horizontal resolution and at a variable vertical resolution ranging between 50 and 200 m within the first km of atmosphere, we expect the motion at this scale to be completely resolved and to reproduce up and downdrafts at these scales.

-Ln 381:, Generally ....: on which objective measure do you base your statement here?

The adverb was here improperly used; the statement refers only to the two meteorological scenarios occurred during the discussed case study.