On the influence of WRF schemes in reconstructing the Planetary Boundary Layer height in the Po Valley

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The reconstruction of Planetary Boundary Layer (PBL) is one of the most important issues in air quality simulations, since its depth affects ground concentrations of primary and secondary pollutants. This is particularly the case in basin valleys where weak circulation conditions often limit PBL heights to the first hundred meters above ground level (Ferrero *et al.*, 2010). A typical example of these conditions is represented by the densely populated area of the Po valley in Northern Italy.

In order to assess the skill of the WRF meteorological model in reproducing PBL structure and evolution in the peculiar area of the Po valley, a sensitivity test has been conducted by comparing experimental data and different model simulations.

Five PBL modelling schemes (ACM2, MRF, MYJ, YSU and UWMT) have been selected for the analysis and compared to particle vertical profiles by balloon soundings as well as to data collected by meteorological balloons and Lidar (Light Detection and Ranging) measurements.

Experimental measures were collected in the urban area of Milan, in the middle of the Po valley, by means of a tethered balloon equipped with an optical particle counter and a meteorological station as well as by a Lidar instrument. PBL height was derived in both cases using a gradient method (Ferrero *et al.*, 2010; Angelini *et al.*, 2009). Additionally, meteorological soundings of Milano Linate airport were considered too. The availability of this set of highly specialized experimental data represented an unprecedented opportunity for model evaluation over Northern Italy.

WRF has been applied for July 2007 and February 2008 over three nested domains, with the last one focused on the Po valley area, having a spatial resolution of 5 km. Initial and boundary conditions were obtained from the ECMWF analysis fields. Only the 5 km domain was compared to observations.

Comparisons have been done in terms of vertical profiles, temporal variation and statistical indexes. As an example, Figure 1 shows the hourly trend of the five schemes and observations for February 11th, 2008.

Results indicate substantial differences among the five schemes, and between these and observations. Table 1 reported model performances for both summer 2007 and winter 2008. The schemes generally overestimate PBL height, but the best performances are clearly related to YSU and UWMT parameterizations.

For each scheme the main parameterizations are discussed as well as their effects on PBL and meteorological fields reconstruction.

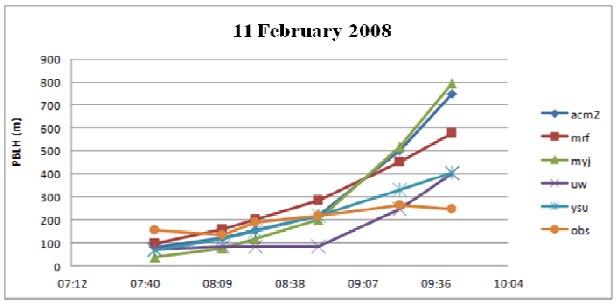

Figure 1. Hourly trend of PBL height in Milan for February 11th, 2008. The figure shows the five parameterizations as well as the observed data by balloon sounding.

Table 1. BIAS index for the five schemes in both July 2007 and February 2008.

	ACM2 (m)	MRF (m)	MYJ (m)	YSU (m)	UWMT (m)
July 2007	198.49	180.33	219.52	113.08	39.26
February 2008	132.67	134.12	118.27	40.98	-19.68

References

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