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Validation of high-resolution WRF-ARW model runs against airborne measurements over complex terrain in central Italy

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An intensive aerial campaign was flown in the context of the CARBIUS project (Maselli et al., 2010) between July 2004 and December 2005. The flights covered, over more than 240 Km, a target area in central Italy (between the regions of Lazio and Tuscany) characterized by various land uses and topography, ranging from coastal zones to mountainous landscapes (Colline Metallifere, Tuscany). The aerial vector (Sky Arrow 650 ERA) was equipped for high frequency (50 Hz) measurements of the three components of mean wind and turbulence, as well as air temperature, CO_2 and H_2O concentrations. While the aim of the CARBIUS campaign was focused on GHG fluxes, the dataset is used in the present work as a benchmark to assess the capability of mesoscale models to correctly simulate transport fields. A first assessment has been done by comparing the dataset to a coupled WRF-NMM-CALMET system (Gioli et al., 2014), but the aim of the present work is to expand on those foundations by comparing the data to higher resolution WRF-ARW simulations. WRF-ARW outputs are, in fact, frequently used as inputs to multiple dispersion models and any misrepresentation of the "real" situation is therefore propagated through the modelling chain. Our aim is to assess these potential errors keeping into account different topographic situations and seasons thanks to the existent aerial dataset. Moreover the sensitivity of the WRF-ARW model to different initial and boundary conditions (ECMWF vs. CFSR) is explored, since also the initial forcing may influence the representation of the transport field. Results show that the model is generally capable of reproducing the main features of the mean wind field independently from the choice of the initial forcing. Terrain features still show an impact on the model outputs (especially on wind directions), moreover the performance of the model is also influenced by seasonal effects.

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Maselli F., Gioli B., Chiesi M., Vaccari F., Zaldei A., Fibbi L., Bindi M., Miglietta F. (2010): "Validating an integrated strategy to model net land carbon exchange against aircraft flux measurements". Remote Sensing of Environment, 114(5), 1108-1116 pp.