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Impact of the spatial surface heterogeneity on the surface fluxes and on the turbulent structures analyzed with the Meso-NH model applied at fine resolution.

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Numerous studies have shown the importance of the subgrid heterogeneity in climate or hydrologic models estimating the surface fluxes with coarse resolutions (Brunsell and Gillies, 2003). The non linear processes involve significant differences between fluxes computed from various aggregation methods. So it becomes necessary to describe the surface with more accuracy. Remote sensing with the increasing imagery resolution allows the identification of the different types of landuse. The main surface parameters can be obtained from these data and used as input in the models simulating the transfers between soil vegetation an atmosphere (SVAT).

The aim of this work is i) to analyze the effect of the spatial configuration of the surface parameters on the estimation of the main energy fluxes at the scale of a small agricultural region and ii) to study the turbulent structures appearing in the atmospheric boundary layer, for different surface and atmospheric conditions.

We have used the 3D atmospheric model called Meso-NH (http://www.aero.obs.fr/∼mesonh/), applied at a very fine spatial resolution (50m), with LES scheme for the turbulence parameterization, and the ISBA surface scheme well suitable to describe each type of crop.

In a first stage, a validation of surface fluxes simulated over the Alpilles site (5x5 km, http://www.avignon.inra.fr/reseda/) has been performed. The comparison with the measurements gave globally satisfactory results (Courault et al, 2003). In a second

stage, the spatial configuration of landuse has been modified according to different scenarios and wind directions. The results have shown discrepancies of around 7% for the convective fluxes between the different spatial configurations with the same percent of surface occupied, while net radiation remained unchanged. So, the effect of the spatial configuration of crops seemed important to take into account both at local and regional scale. These differences were due to the local advection and turbulence phenomenon occurring at fine scale. Organized large eddies appeared in the atmospheric boundary layer (ABL). A sensitivity analysis has been performed to study the effect of the surface heterogeneity on these structures. Soil moisture and roughness have varied, with different spatial patterns and patches varying from 1 to 16. The effect of the initial atmospheric conditions (ABL height and wind speed) have been also analyzed. The results showed that it was mainly the ABL height which influenced the size of turbulent structures, with a linear relationship between cell size and ABL height. From 4m/s, the organized large eddies moved and parallel rolls appeared. The increase of soil moisture decreased the ABL height and the intensity of the warm air ascents observed at the external boundaries of the turbulent cells. The coherent structures seemed to be located on transition areas over different roughness patches. The results were in agreement with several observations made these last years (Drobinski et al, 1998, Bertrand et al, 2004). They clearly showed that it is necessary to describe with accuracy the surface heterogeneity to reproduce correctly all the exchanges at the scale of a small agricultural region

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