3.4 URBAN SURFACE NETWORK IN MARSEILLE : NETWORK OPTIMIZATION USING NUMERICAL SIMULATIONS AND RESULTS

Grégoire Pigeon*, Aude Lemonsu, Pierre Durand, Valéry Masson
CNRM-Météo-France, URA CNRS 1357, Toulouse, France

1. INTRODUCTION

During the ESCOMPTE field campaign (see Cros et al., P4.2 or http://medias.obs-mip.fr/escompte), an important device has been set up to describe the urban boundary layer over the built-up area of Marseille, France (see Mestayer and Durand, 3.1). In particular, a network of 20 temperature and humidity sensors continuously measured the spatial and temporal variations of these parameters.

2. NETWORK OPTIMIZATION

Before the experiment, the arrangement of the network had been optimized to capture the maximum of the signal variations in temperature and humidity. We worked on output of simulations performed with high-resolution (250mX250m) model involving the TEB (Town Energy Balance) scheme (Masson, 2000) allowing to calculate the urban canopy energy budget according to the mean geometry of the streets in the mesh. Three days corresponding to the IOP of the preparatory field campaign of the ESCOMPTE program (from June 29th to July 1st, 2000) were simulated. These days are representative of the different meteorological situations observed in Marseille during the months of June and July : there are a Mistral wind, a sea-breeze and a south-east wind situations.

First, a qualitative analysis of the fields had enabled the identification of the characteristic phenomena over the town of Marseille. Urban effects and local effects are closely related. The spatial structure of the fields is mostly determined by the direction of the wind interacting with the geography (topography and presence of the sea).

Then, empirical orthogonal functions (EOFs) were used to quantify the spatial and temporal structures of the thermodynamic fields. So, it was possible to determine how to set up the network to capture the maximum of variability.

We chose to instrument four different axes, two of them orientated SW-NE, one W-E from the shoreline and the last one NS, i.e. parallel to the shoreline (see fig 2 in Mestayer and Durand 3.1).

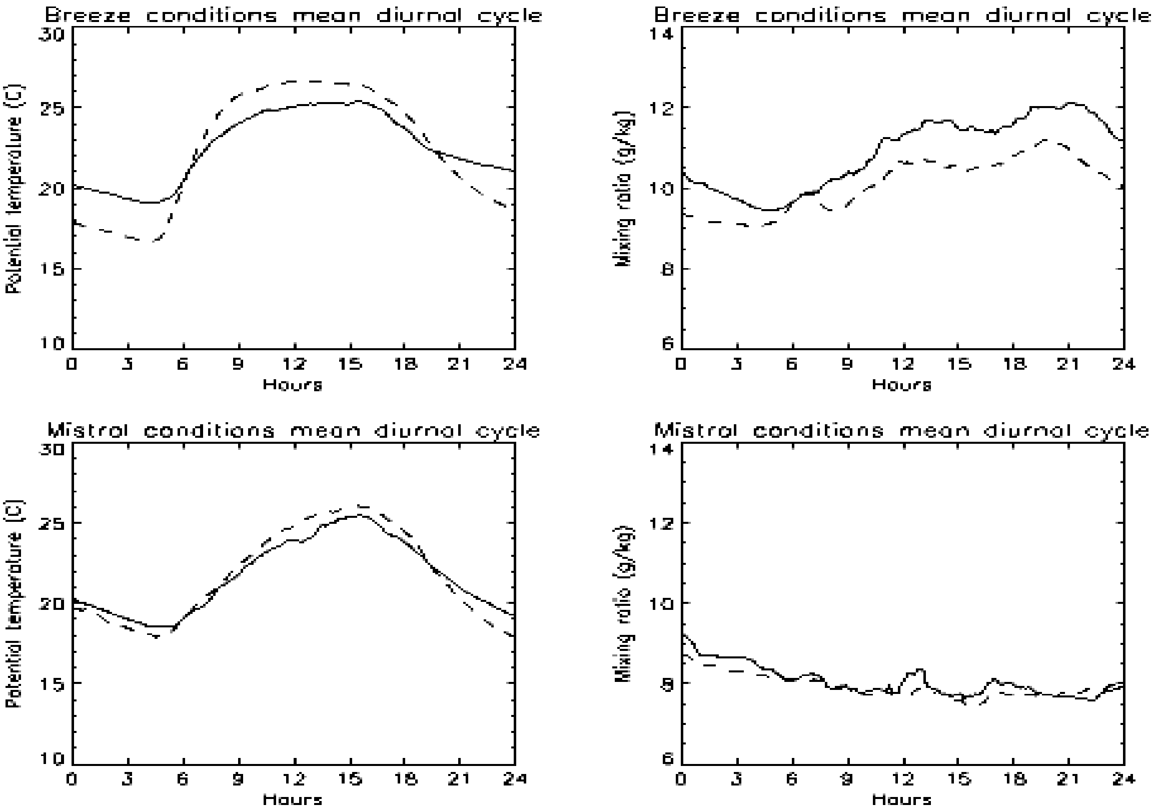
3. ON SITE SET UP

After the determination of the network disposition, the locations of the instruments at the scale of the streets were chosen very carefully to limit the effect of micro-scale variations. So the sensors, placed in a radiation screen, were fixed at about 6 meters height and not to close to the building façades (see Fig. 1).

The data (temperature and moisture) were continuously recorded every ten minutes from the 12th of June to the 16th of July 2001. We did not get any problem with anyone of the sensors during all that period.

Figure 1 : example of sensor disposition.

* Corresponding author address: Grégoire Pigeon, CNRM/GMEI/4M, Météo-France, 42, av G. Coriolis, 31057 Toulouse Cedex, France ; e-mail : gregoire.pigeon@meteo.fr



-------- suburbs places ——— urban center places

Figure 2 : comparison of mean diurnal cycles for suburb and center areas.

4. FIRST RESULTS

The analysis started with the comparison of the mean diurnal cycle for all the different locations. The differences in the diurnal cycle between the town center and the suburbs areas are as we can expect : the center areas are cooler than the suburb areas from the morning to the afternoon, whereas it is the opposite during the evening period and most of the nighttime. These effects are increased by the terrain features surrounding the town : the city center is bordered by the sea in its western part, whereas the terrain elevates quickly towards the eastern direction.

Then a representation of the results on a 3D geographical map enabled us to focus more on the spatial organization of the fields of potential temperature and specific humidity. This allowed us to demonstrate the relationship between the meteorological conditions and the structure of the urban heat and moisture island. We confirm the existence of different spatial organization linked with the meteorological situation. During sea-breeze events, (prevailing in anticyclonic situations) important urban effects are measured on both fields of potential temperature and specific humidity, whereas the urban effects are much weaker for Mistral wind situations (with quite strong winds) (Figure 2).

The next step of the work is to use this data set to improve the surface schemes for urban areas in meso-scale meteorological models.

5. REFERENCES

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