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The impact of the urban surface forcing on temperature and humidity near the ground in the city of Paris during summer 2006: model evaluation and results.

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Temperature tends to be higher in cities than in the surrounding rural areas, which is known as the urban heat island effect. The change in meteorological parameters in and around cities, especially the increase in temperature, has an impact on human and envirmonmental health, like an increase in death rate during heat waves. It also results in a decrease in air quality by the increase of pollutants such as ozone, and the increase in water temperature which stresses water ecosystems. At last, it has an impact on energy consumption from cooling systems like refrigerators and air conditioning.

We are modeling the influence of a big city on the local temperature, humidity and wind speed, by performing a numerical simulation with the ARPS meteorological model at 1 km horizontal resolution, which is cascade nested into ECMWF-reanalysis. It contains a simple parameterization for urban effects. The simulation domain is centered over Paris and covers its wider agglomeration. We take a simulation period of 12 days in june of 2006, which is characterized by a steady increase in air temperature. We perform "Base case" simuation to validate the model with ground measurements and profiles. For the "scenario run", the city surface is replaced by a natural surface and we will compare its output with that from the base case.

Firstly, we do a model evaluation for temperature, humidity and wind speed for 2 fixed ground measurement stations, for which the first is in Paris-Montsouris near the city core, and for which the other is at Melun which lies in a rural area. We also evaluate the modeled difference between these two stations. Secondly, we investigate the meteorological impact range of the urban surface, so we have to know whether meteorological fields up to 2500 m height are correctly modeled. This is why we compare model results for temperature, humidity and wind speed with radiosonde data measurements from Trappes, 20 km away from the Paris city core.

A good result is found when comparing the 2m temperature of the model with observations from the stations. We approximately get a correlation of 0.97 and a mean error of 1.3K for both the urban and rural station. The diurnal evolution of the temperature seems to be modeled well ranging between 276K and 305K. If we look at the difference between the two stations, we get a correlation of 0.61 and a mean error of 1.15K. The mean temperature difference between the urban and rural station is 2.5K and has peaks of up to 6.4K and minima of -2K . The timing of the events of maxima, which is allways during the night, matches the observations. This difference disappears in the scenario run with only an average of 0.5K, which reveals the impact of the urban surface.

The wind speed varies between 0 and 5.6 m/s for both station. Allthough the observations of wind speed has a low resolution of only 2 knots, the modeled wind speed corresponds to the observed with a correlation of 0.46 (0.67 when taking the moving average of two hours) and mean error of 1.0 m/s. The modeled wind speed averaged over the whole period seems to be 0.93m/s lower in the city station compared to the rural rural which isn't observed in the scenario run. This difference seems to be an overestimation, since it is observed that the wind speed is only 0.3 m/s lower at the city station than at the rural station. The specific humidity varies between 4.6 and 10.6 g/kg with a correlation of 0.57 and a mean error of 0.8 g/kg, so the evolution of the specific humidity is simulated reasonable for both stations. The average of the modeled specific humidity is 0.64 g/kg lower in the city station than in the rural station while the observed of the latter is only 0.15 g/kg. The mean error of the differences of wind speed and specific humidity are resp. 1.23 m/s f and 0.77 g/kg, which explains the uncertainty on those differences.

During periods where the model agrees with the temperature, humidity and wind speed from radiosonde measurements, the model shows a temperature gradient of 3K/15km at night when going from the city center to

outside the city. This gradient is visible up to 150m above the surface. This isn't observed in the scenario run. At the same time the urban surface seems to have an impact on the wind speed with a decrease of 2m/s at the