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Influence of different land surfaces on atmospheric conditions measured by a wireless sensor network

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Atmospheric conditions close to the surface, like temperature, wind speed and humidity, vary on small scales because of surface heterogeneities. Therefore, the traditional measuring approach of using a single, highly accurate station is of limited representativeness for a larger domain, because it is not able to determine these small scale variabilities. However, both the variability and the domain averages are important information for the development and validation of atmospheric models and soil-vegetation-atmosphere-transfer (SVAT) schemes. Due to progress in microelectronics it is possible to construct networks of comparably cheap meteorological stations with moderate accuracy. Such a network provides data in high spatial and temporal resolution.

The EPFL Lausanne developed such a network called SensorScope, consisting of low cost autonomous stations. Each station observes air and surface temperature, humidity, wind direction and speed, incoming solar radiation, precipitations, soil moisture and soil temperature and sends the data via radio communication to a base station. This base station forwards the collected data via GSM/GPRS to a central server.

Within the FLUXPAT project in August 2009 we deployed 15 stations as a twin transect near Jülich, Germany. One aim of this first experiment was to test the quality of the low cost sensors by comparing them to more accurate reference measurements. It turned out, that although the network is not highly accurate, the measurements are consistent. Consequently an analysis of the pattern of atmospheric conditions is feasible. For example, we detect a variability of $\pm$ 0.5K in the mean temperature at a distance of only 2.3 km. The transect covers different types of vegetation and a small river. Therefore, we analyzed the influence of different land surfaces and the distance to the river on meteorological conditions. On the one hand, some results meet our expectations, e.g. the relative humidity decreases with increasing distance to the river. But on the other hand we found unexpected anomalies in the air temperature, which will be discussed in detail by selected case studies.