Geophysical Research Abstracts
Vol. 16, EGU2014-6988, 2014
EGU General Assembly 2014

PLS Road surface temperature forecast for susceptibility of ice occurrence

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Winter maintenance relies on many operational tools consisting in monitoring atmospheric and pavement physical parameters. Among them, road weather information systems (RWIS) and thermal mapping are mostly used by service in charge of managing infrastructure networks. The Data from RWIS and thermal mapping are considered as inputs for forecasting physical numerical models, commonly in place since the 80s. These numerical models do need an accurate description of the infrastructure, such as pavement layers and sub-layers, along with many meteorological parameters, such as air temperature and global and infrared radiation. The description is sometimes partially known, and meteorological data is only monitored on specific spot. On the other hand, thermal mapping is now an easy, reliable and cost effective way to monitor road surface temperature (RST), and many meteorological parameters all along routes of infrastructure networks, including with a whole fleet of vehicles in the specific cases of roads, or airports.

The technique uses infrared thermometry to measure RST and an atmospheric probes for air temperature, relative humidity, wind speed and global radiation, both at a high resolution interval, to identify sections of the road network prone to ice occurrence. However, measurements are time-consuming, and the data from thermal mapping is one input among others to establish the forecast. The idea was to build a reliable forecast on the sole data from thermal mapping. Previous work has established the interest to use principal component analysis (PCA) on the basis of a reduced number of thermal fingerprints. The work presented here is a focus on the use of partial least-square regression (PLS) to build a RST forecast with air temperature measurements. Roads with various environments, weather conditions (clear, cloudy mainly) and seasons were monitored over several months to generate an appropriate number of samples. The study was conducted to determine the minimum number of samples to get a reliable forecast, considering inputs for numerical models do not exceed five thermal fingerprints. Results of PLS have shown that the PLS model could have a R^2 of 0.9562, a RMSEP of 1.34 and a bias of -0.66. The same model applied to establish a forecast on past event indicates an average difference between measurements and forecasts of 0.20 °C. The advantage of such approach is its potential application not only to winter events, but also the extreme summer ones for urban heat island.