Updated road weather forecast system using sky view factor and screening implemented on a motorway in Finland

Virve Karsisto and Matti Horttanainen
Finnish Meteorological Institute, Meteorological research, Helsinki, Finland (virve.karsisto@fmi.fi)

Spatially accurate road condition forecasts are important for road maintenance personnel to keep roads safe in changing weather conditions. Road surface temperature can vary significantly depending on the road surroundings. Buildings, trees, and terrain features can block solar radiation and cause the temperature to be lower than in open surroundings. On the other hand, the long wave radiation from the surrounding objects can make the road warmer on clear nights. Sky view factor and shadowing algorithm were added to the Finnish Meteorological Institute’s road weather model to take the surrounding features into account in road weather forecasts. Sky view factor means the portion of the sky that is visible at a certain point and shadowing algorithm determines whether the road point receives direct solar radiation at a certain time using local horizon angles. The local horizon angles and sky view factors were determined from the digital surface model (DSM) that was generated from National Land Survey of Finland’s laser scanning data. The data’s resolution is at average 0.5 points per square meter. The DSM differ from digital elevation model (DEM) as it includes vegetation and buildings. The DSM was generated in pieces to cover a 150 km long motorway from Helsinki to Turku in southern Finland. The sky view factors and local horizon angles were calculated for road points located every 50 m on both west and east leading carriageways. Some small-scale road structures like light and electricity poles and road signs caused problems as they appeared too bulky in the DSM. An overlay covering the carriageways was taken from a 2m resolution DEM and was added over the DSM to smooth the problematic features. As this was not enough to remove all the small-scale structures at the side of the road, the local horizon angles went through an algorithm that smoothed too large spikes and bulky features. The produced local horizon angles and sky view factors were given to the road weather model. The forecasts are generated once in an hour for all the selected road points on the motorway. Spatial differences in the forecasted surface temperatures can be seen especially in autumn and spring when the sun is low. At many places the northern carriageway leading to the west is warmer in these situations, as the trees or rock cuttings prevent the east leading southern carriageway from getting direct solar radiation. The forecast system is now in testing phase but has potential to improve spatial accuracy of road surface temperature forecasts.