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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Combining fixed and mobile surface observations into a hybrid system

P. Saarikivi
Foreca Consulting Ltd, Helsinki, Finland (pirkko.saarikivi@foreca.com, +358 9 6689 6411)

The emergence of Global Navigation Satellite Systems (GNSS) has allowed mobile observing of atmospheric conditions with unprecedented spatial accuracy. Fixed weather stations are typically 100 km apart, whereas observations from moving vehicles can be performed with 100 m resolution. This paper presents results from project GalileoCast (2009-2010) co-financed by the European Commission, which had the key objective to innovate new GNSS enabled services for general public and for specific professional users. Feasibility and use of the present EGNOS and coming Galileo satellite systems for these services was also analysed. One specific topic was to develop hybrid (i.e. fixed and mobile combined) observing systems to study local variability of road surface conditions. The field tests were performed during winter months in Southern Finland with a specially equipped vehicle with optical devices measuring air and surface temperature, air moisture, and amount of water, snow and ice on the surface. From these, friction was calculated and local risk for slipperiness evaluated. Mobile observations were compared to the output from the fixed network of operational Road Weather Information System making automatic measurements every 30 minutes.

The field tests revealed the small-scale variability that cannot be resolved at all with fixed network data. This variability consists of different scales starting from few centimeters (e.g. in and outside the wheel paths), few meters (e.g. road structure, bus stops) to hundreds of meters (local topographic effects). Very large variance of surface conditions was observed in some of the measurements, typically in cases of strong inversions after clear and calm nights. On the other hand, there were cases when the variability inside the total study area of 100 km2 was negligible and could be resolved just as well with fixed observing methods. Results indicate that the optimal hybrid observing network where resolvability is maximized and costs minimized could be achieved by complementing the fixed network with a reasonable number of routine mobile observing drives that are targeted to risky weather situations and cover the road stretches that are known for their large local variability or unusually high risk for slipperiness and accidents.

Mobile observations provide also good reference data to test and verify road condition models in very fine scale and to develop better filtering methods to downscale atmospheric model output into – from end user perspective - the most critical local road surface scale.