Presentation 2.4

FLEET BASED ROAD WEATHER MONITORING

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Accurate wintertime road weather information is essential for road maintenance operations and for more autonomous driving functions of vehicles. Traditional static road weather stations typically provide basis for road weather monitoring. However, on-board sensors of cars have become more popular and recently wireless data transmission allows that commercial vehicles can be used as probes instead of road maintenance vehicles itself. In other words, cars are turning into mobile weather stations producing massive amount of different type of data about continuously alternating surroundings. It is not mandatory to have all the cars equipped with special instrumentation but carefully selected, highly utilised vehicles which will produce data around the clock from the road network of interest.

The data acquisition system of the fleet vehicles consists of optical road probe, 6 degree-of-freedom Inertial Measurement Unit and CAN-bus access. The position is available with GNSS and data is transmitted via cellular network to cloud where it is processed. This enables for example automatic calibration functions for the optical sensors removing the repeated need for maintenance.

The example results were mined from over 1 million kilometres of measurements in Finland and the illustrations are from the Helsinki region. Figure 1 shows how static road weather station can give dangerously misleading information about the road condition. Based on static weather station the road weather is excellent, all main roads are classified as “dry”. However, reality is the opposite, most of the city streets are icy and approximately half of the main roads are icy. The road condition at the static road weather station location was indeed “dry”, but in most of the cases only locally.

Figure 2 shows how moisture transmitted by the traffic from the lower road network can generate a very local icy road section. The image a) shows mostly moist road section (salted) near crossroad with few local icy spots and dry sections further from the crossroad. In the image b), the road is now more dry in general, but some water has been transferred from smaller road to the main road (wet road after crossroad for both driving directions). The situation in image c) shows how this water is freezing during morning rush hours. It also begins to snow which forms slippery ice layer on the road. As shown in image d), there are already some spots covered with snow. When snowing continues, the snow starts to form a layer on top of the icy road making conditions very challenging.

As a conclusion, even a dense network of static road weather stations cannot provide accurate local road condition information, and overall road weather can be estimated incorrectly. Meanwhile, mobile measurements by using highly utilised commercial vehicles is cost effective method to produce current road condition information and is undoubtedly highly valuable for nowcasting and forecasting road weather models. By utilising a fleet of measurement vehicles and cloud-based analysis, both local and large scale road weather phenomena can be observed in real-time. More extensive results are shown in the conference presentation.

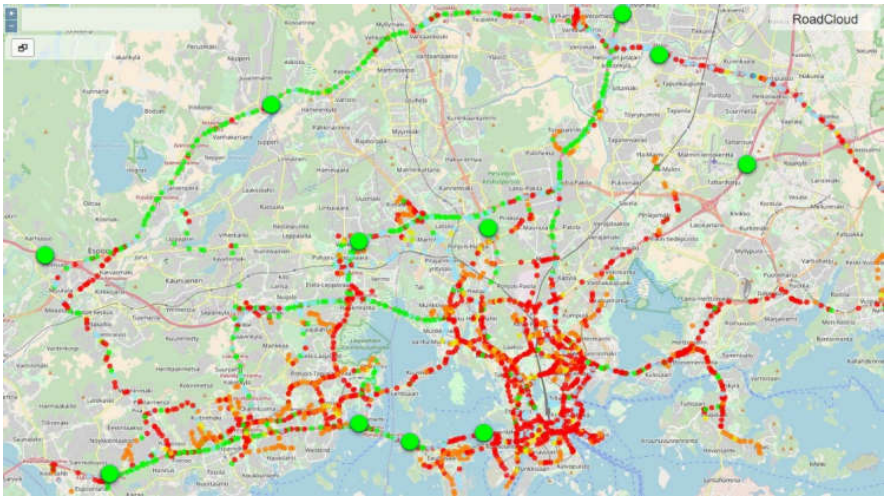

Fig. 1. Road network surface condition from mobile measurements (dry - green, light blue - moist, dark blue – wet, red – ice, snow - orange, yellow - slush) and static weather stations (larger circles) indicating dry conditions.

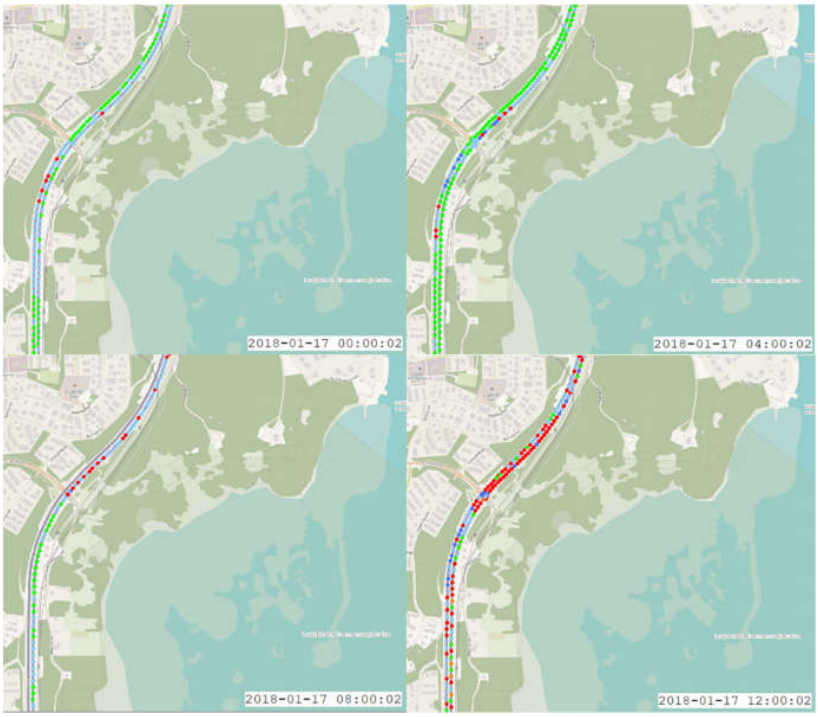

Fig. 2. Road surface condition of Ring Road 1 in Helsinki 17.1.2018 (T = -5 degC). The colours on the map indicates the current road surface condition the same way as in Figure 1.