



Weather factors triggering the massive car crashes on 3 February 2012 in the Helsinki metropolitan area

Introduction

During snowy and icy conditions, the braking distances can be fourfold compared to bare road conditions, due to differences in road surface friction coefficient C_f . That is why snow and ice removal from the pavements is so important. Efficient road maintenance calls for reliable road weather observations and forecasts. These can be gathered into RWISs (Road Weather Information Systems) or MDSSs (Maintenance Decision Support Systems) when maintenance recommendations are also included.

Road Weather forecast Models (RWMs) are needed in producing guidance for maintenance operations as well as issuing warnings for the drivers. In the Finnish Meteorological Institute (FMI), an RWM has been operational since the year 2000. The present forecast parameters of the model are:

- ◆ Road surface and ground temperatures
- ◆ Thicknesses of water, snow and ice layers on the road surface
- ◆ State of the road (snowy, icy, wet etc.)
- ◆ Road surface friction coefficient C_f

Driving conditions can get really dangerous when there is a simultaneous reduction of road grip and visibility (e.g. due to blowing snow or a dense snow shower). In such conditions, car pile-ups are possible, as happened in the Helsinki region in southern Finland in March 2005 as well as in the Czech Republic and Austria in March 2008. Recently, on 3 February 2012, severe pile-ups occurred again in the Helsinki metropolitan area due to a local dense snowfall. This event is presented here.

The weather situation on 3 February 2012

A strong anticyclone was located over north-western Russia (Fig. 1), causing the spreading of very cold air towards the west in over Finland and Scandinavia. Sea-effect snowfall formed over the Gulf of Finland. The strongest snow band hit the Helsinki metropolitan area (Fig. 2), causing a rapid worsening of driving conditions, which resulted in a large number of car crashes.

Two pile-ups with plenty of vehicles involved occurred 10-15 km northeast from the Helsinki city centre (Fig. 3), along highway 4 and ring road 50. The traffic coming towards the city centre along highway 4 was totally jammed after the crashes (Fig. 4b). Fig. 4a shows that the visibility was occasionally substantially reduced.

Observations from Jakomäki RWS (Fig. 5) by the highway 4 (station location in Fig. 3) show that:

- ◆ Observed friction coefficient C_f was mostly low (ca. 0.2 or below) except for a temporal rise to ca. 0.5 early in the morning, probably due to ploughing or wearing of snow due to traffic.
- ◆ Visibility decreased to a minimum of 360 m around 09 UTC (11 LT), somewhat before the main car crashes. The layer thickness of snow on the road increased (Fig. 5) due to snow showers and the friction coefficient C_f decreased further to ca. 0.15 around the time of the pile-up occurrence.

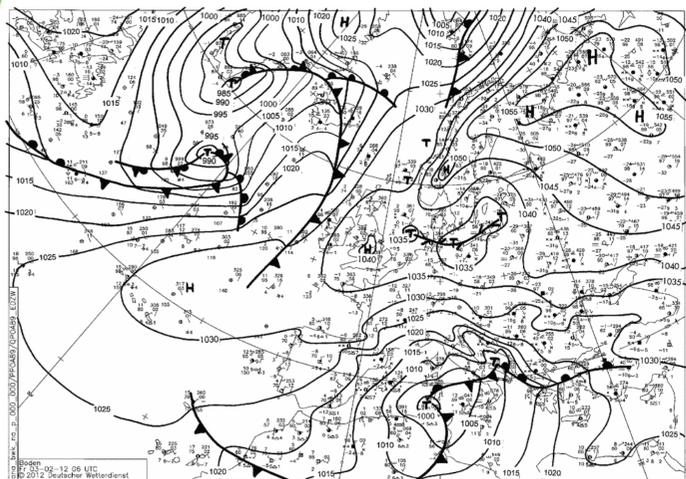


Fig. 1. Weather situation on 3 February 2012 06 UTC (by DWD). The analysis shows pressure isobars and fronts; high pressure and low pressure centres are marked by H and T, respectively.



Fig. 2. Radar image on 3 February 2012 10:00 UTC (12:00 LT). Helsinki city centre is marked by a circle. The precipitation intensities based on the backscattering of the radar signal are visualized with different colours. Air temperatures are also shown.

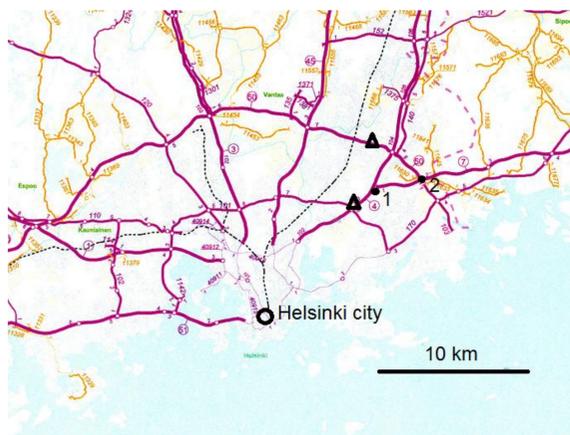


Fig. 3. Road network in the Helsinki metropolitan area. The locations of the main pile-ups are marked with triangles; locations of road weather observations: 1=Jakomäki RWS and road weather camera, 2=Porvoonväylä road weather camera. The highway codes (=numbers) are marked within circles on the map (source: the Finnish transport Agency (FTA)).

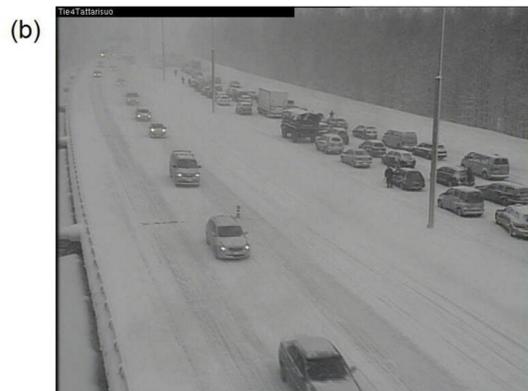


Fig. 4. Scenes from (a) Porvoonväylä road weather camera at 12:28 LT and (b) Jakomäki road weather camera at 12:51 LT, the locations are shown in Fig. 3 (source: FTA).

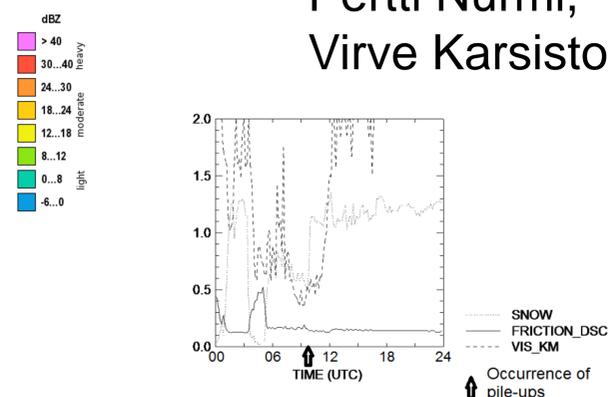


Fig. 5. Jakomäki RWS observations on 3 Feb 2012: The layer thickness of snow (in equivalent mm), the coefficient of friction C_f on the road surface measured by Vaisala's optical DSC111 device (scale of C_f : 0.1-0.82), and horizontal visibility (in km).

The consequences of the car accidents

- ◆ During the day, 690 vehicles were involved in the accidents.
- ◆ 43 injured persons were taken to hospital.
- ◆ After the main pile-ups, the traffic on highway 4 and ring road 50 was badly jammed, disturbing transport to/from Helsinki main harbor and Helsinki-Vantaa airport.
- ◆ The cleaning of road sides took several days.
- ◆ Costs for insurance companies were estimated at 1 m €.

Road weather forecasts during the event

The sea-effect snow was quite well predicted by the FMI high resolution model HARMONIE (grid point interval 2.5 km). Also the operational HIRLAM model (7.5 km) predicted some snowfall, thus giving the FMI RWM adequate background information to predict reduced grip on the roads. FMI issued a warning for poor driving conditions already on the previous evening.

Fig 6 shows the FMI RWM friction forecast for Jakomäki RWS, compared to the measured friction by optical DSC111 instrument. A relatively good consistency can be seen, the main difference being that the temporal improvement of the observed friction early in the morning is not visible in the forecast, probably because the model doesn't include road maintenance actions yet.

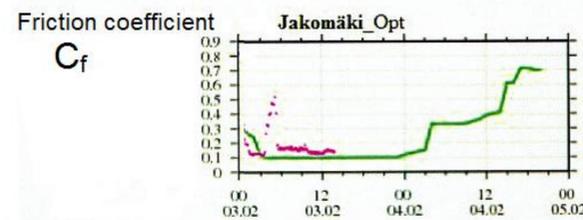


Fig. 6. Predicted friction coefficient (C_f) by the FMI road weather model (green curve) and observed C_f measured by DSC111 (pink curve), in Jakomäki RWS (location in Fig. 3), from 3 February 2012 00 UTC (02 LT) on.

Conclusions

Rapid worsening of driving conditions can trigger severe car accidents and cause disruptions in traffic. Some useful tools for supporting transport safety and fluency under adverse weather events might be for example:

- ◆ Real-time road weather products for the drivers, e.g. road condition analysis and forecast for different road stretches (routes)
- ◆ Variable message signs and speed limits
- ◆ Wireless data transfer of road surface conditions, obstacles, traffic flow etc., from vehicle to vehicle and between vehicles and infrastructure (methods are currently under development)
- ◆ Communication strategies involving TV, radio, websites and other modern communication systems

ACKNOWLEDGEMENTS

This study was partly supported by EU FP7 project MOWE-IT.