Combining fixed and mobile surface observations into a hybrid system
GalileoRoads

History

- After a serious road accident, project ColdSpots (2005-2007) was initiated by the Finnish Government to develop more accurate road forecasts. Partners: Foreca, FMI, Destia. Vaisala developed optical mobile road condition instruments. First mobile field tests started.

- ROADIDEA (2007-2010) with 14 EU partners innovated several new service ideas, including PulpFriction mobile friction measuring service.

- GalileoCast (2009-2010) of Foreca, IMR/Iceland and Cyclonic Systems & Solutions/ France developed innovative weather related GNSS (global navigation satellite system) enabled services utilising coming Galileo positioning system. GalileoRoads developed for road users.
Weather service is a long chain of activities

Global and local observations → Global and local forecasts → Production of products and services → Delivery through various channels (media, mobile)

The start and basis is to get weather observations which you feed into models for forecasting, then create the tailored products for specific users, and finally transmit the products to the users.
GNSS can be utilised in the beginning for mobile observations, in the production phase, and in the final delivery phase.
GNSS has enabled the advent of Mobile Observing Methods

Combine mobile observations to data from fixed stations
to create Hybrid Observing Systems with increased resolution in time and space
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Mobile observing of road conditions

Car with special instruments measures road conditions: air and road temperature, moisture, water, snow, ice, slipperiness

New measurement and car position is saved every 3-5 seconds

This corresponds to spatial resolution of 50-100 meters, whereas fixed station network has spatial resolution of 50-100 kilometers

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Thousand times better resolution!

Fixed network gives just a rough estimate of the road conditions
With GNSS, local variations can be observed with great precision
Cold spots and other risks can be located from the road network

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Effects of road management observed

Global and local observations

Sensor tracking

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Mobile observing with smart phones

Friction can be measured using smart phone’s accelerometer. Car’s position and the measured value are sent to the operator. Users can see warnings on-line on the road network map.

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Next step: forecasting road weather

More accurate observations are fed into road condition models.
GNSS is used to collect large amounts of data from car fleets. This allows generation of very effective warning services. EraNet Road -project MOBI-ROMA develops these in 2011-2012 by Foreca, Klimator & Semcon (Sweden) and Pöyry Traffic (Germany).
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Hybrid system combines the benefits

<table>
<thead>
<tr>
<th>Observing system</th>
<th>Fixed</th>
<th>Mobile</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement units</td>
<td>Equipped masts</td>
<td>Equipped cars with GNSS</td>
<td>Both masts and cars</td>
</tr>
<tr>
<td>Total units</td>
<td>80</td>
<td>10</td>
<td>90</td>
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<tr>
<td>Spatial resolution</td>
<td>60 km</td>
<td>100 m</td>
<td>60 km &amp; 100 m</td>
</tr>
<tr>
<td>Temporal resolution</td>
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<td>3 sec</td>
<td>30 min &amp; 3 sec</td>
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<tr>
<td>Observations / day</td>
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<td>172800</td>
<td>176640</td>
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<tr>
<td>DC synoptic 100 km</td>
<td>100 %</td>
<td>100 %</td>
<td>100%</td>
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<tr>
<td>DC meso-scale 10 km</td>
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<tr>
<td>DC lanes, GPS</td>
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<td>No</td>
</tr>
<tr>
<td>DC lanes, Galileo</td>
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<td>Yes</td>
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</tr>
</tbody>
</table>

DC = Detection Capacity

Road condition observing system should be optimised to maximise the benefits and minimise the costs

Hybrid system must reveal the safety critical phenomena that the fixed system is missing

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GalileoCast
Innovative Forecast and Broadcast Applications
GalileoRoads

Conclusions and next steps

- Intelligent road service systems and infrastructures are developed intensively around the world

- The transport systems of the future will be very much relying on accurate and reliable positioning systems

- In Finland GNSS enabled service development is concentrating on mobile observations, improving of the road condition models with mobile data, and product generation and dissemination which takes into account the user’s position

- It is vital that the transport service community cooperates actively with the Galileo system developers

- Hybrid observing systems and end-user services will be implemented into operational use as fast as possible after Galileo system becomes fully operational

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