The CLEAN-ROADS project: a combined environmental-cost-user gain from the application of a MDSS to winter road maintenance operations

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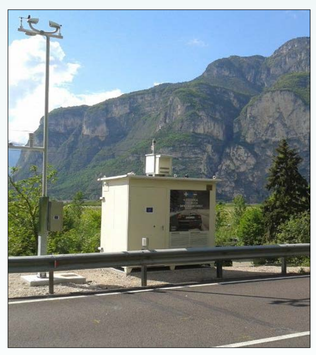
INTRODUCTION

- The CLEAN-ROADS project addresses the problem of the environmental pollution caused by de-icing salts during winter road maintenance activities.
- A demonstrative Maintenance Decision Support System (MDSS) has been developed in order to improve the intervention procedures of the road management service and to influence the local travellers' self-commitment towards more conscious driving styles.

CLEAN-ROADS was tested in Trentino Region, a mountainous area in the Northeast Alps of Italy characterized by severe winter weather.



THE NOVEL CLEAN-ROADS MDSS

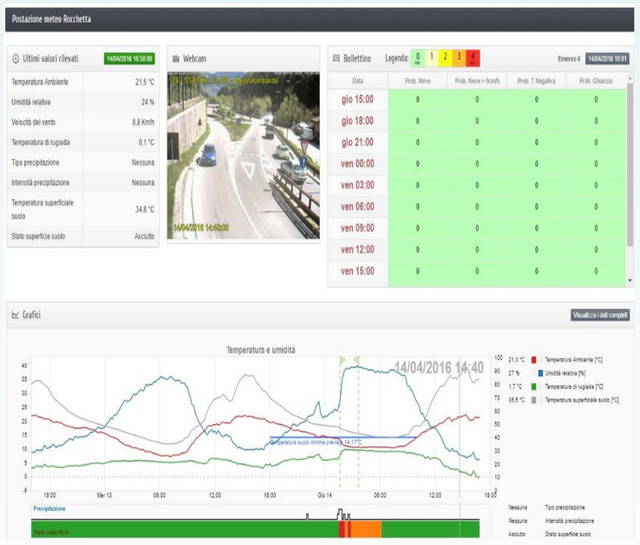
Over three consecutive winter seasons road weather and surface condition data have been collected through a mobile probe vehicle and a state-of-the-art road weather information system (RWIS) of 6 fixed stations. MDSS tool is supported by a four-level hierarchical scheme:

Level 0: RWIS data
- past and present roadway status

Level 1: Probabilistic bulletins
- short-term (36 hours) probabilistic bulletin
- issued according to a four-level scale
- occurrence of a meteorological event: snow, heavy snow (> cm/h), negative air temperatures, road ice formation

Level 2: Road weather models
- nowcast time range (6-9 hours)
- is based on METRo and Reuter's model
- forecast overnight minimum values of road surface temperature (RST)

Level 3: Real-time warning system
- automatically delivers alarms in case a risk of ice on the road
- is based on the RWIS stations data

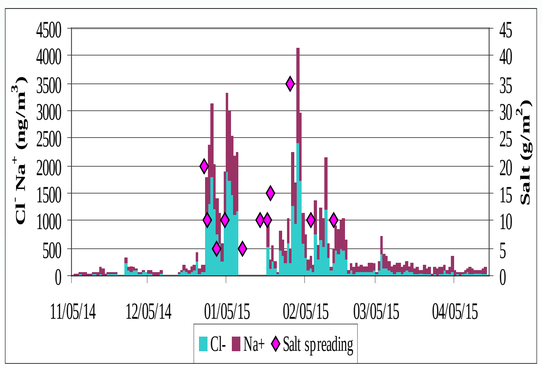


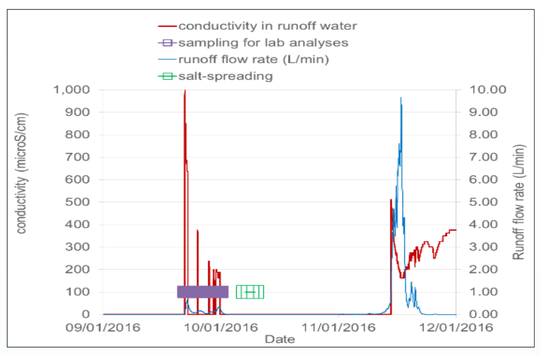
THE ENVIRONMENTAL GAIN

The **environmental monitoring system** quantifies the impact of de-icing salt (sodium chloride) on aquatic systems and air.

- NaCl presence in air and in runoff water strongly depends on the weather conditions present after gritting
- In dry conditions (e.g. no rainfalls) salting operations immediately increases NaCl concentrations in air
- After a light rain low concentrations of NaCl are detectable in runoff water, while high concentrations are detected in air (some days after spreading)
- Low presence of NaCl in runoff water is detectable if the road treatment is not followed by any rainfall
- When salt spreading is immediately followed by a heavy rainfall, almost all the NaCl is detectable in the runoff water.

The environmental analysis helped to identify some cases of "unnecessary road treatments"





THE USER GAIN

- **Road travellers** were actively engaged in the CLEAN-ROADS project.
- In general they demand ideal road conditions under all meteorological events (heavy snowfalls included).
- Most of road safety issues occurring in winter time are related to inappropriate driving behaviour.

One of the goals of the project has been to put the basis for a **change in the actual local travellers' perspectives**.

- A prototype informative service has been developed in the form of a HTML5 web application (http://map.clean-roads.eu/) and presents a Graphical User Interface (GUI) optimized for visualization from portable devices such as smartphones and tables
- The application is linked to the CLEAN-ROADS MDSS and displays a sub-set of the real-time road weather data collected by the RWIS stations, namely road/air temperature, wind speed and humidity.
- In case of rainy/snowy precipitations, the event is displayed on the map through a specific additional icon, which also indicates the intensity of the precipitation.
- The application informs travellers about where the road temperature is getting "cold" so that they can get familiar with a new concept of "road safety level".
- In "cold" conditions (at present defined when road temperatures are below 2°C) drivers become aware that icy hazards might locally appear, independently from the treatments carried out by the road maintenance service.

THE ECONOMIC GAIN

Weaknesses and strengths in the winter road maintenance management system have been identified. Some of the treatments performed for guaranteeing road safety can be indeed identified as "unnecessary". They can be divided in three main categories:

Road treatment	BEFORE CLEAN-ROADS	WITH CLEAN-ROADS
When road conditions are far from ice-formation conditions	There were some cases of overestimation of ice formation risk	Road operators are informed in advance about the likelihood of ice formation and can therefore plan road treatments
Before heavy rainfalls	Road operators used to grit when they felt uncertain about the likelihood of a precipitation as rain or snow	Affordable, detailed and site-specific probabilistic weather forecast are provided
After heavy rainfalls	Road operators used to make treatments after a heavy rainfall when air temperature is above 0°C so that a minimum quantity of salt could always be present on the pavement	An high percentage of these treatments is avoidable when road conditions are forecasted to be far from ice formation risk

In order to cut the number of unnecessary treatments, the CLEAN-ROADS project revealed the necessity to introduce the experimental use of pre-wetted salt instead of solid salt.

CONCLUSIONS

- The novel CLEAN-ROADS MDSS tool perform a **four-level alarm system** which helps road operators in performing **timely and effective road treatments** and avoiding unnecessary ones.
- Meteorological conditions are key factors in influencing the environmental impact of de-icing products on water and air component. By optimizing the number of anti-icing treatments, the **concentration of NaCl in air and water is reduced**.
- **Local travellers' self-commitment** towards more conscious driving styles **has been influenced**.
- From an **economical point of view**, **significant reduction** of de-icing treatments are expected.
- **Numerical results** and future exploitation plans will be provided by the end of the CLEAN-ROADS project in **September 2016** and make publicly available through the project web **site www.clean-roads.eu.**

References

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