May 2010

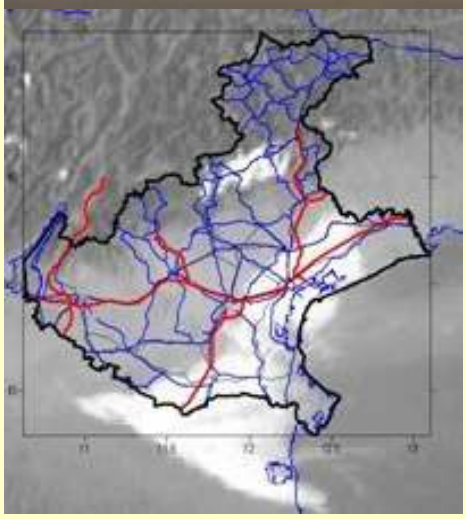
ROADIDEA

FOG PILOT

The combined Fog Monitoring System over the region Veneto – Italy

ROADIDEA studies the innovation potential of the European ITS sector by analysing available data sources, revealing existing problems for data utilisation and service build-up. The **Fog Pilot**, one of ROADIDEA's pilot projects, constitutes a proof of concept, as well as a practical application of how road safety can be improved by accounting for adverse meteorological conditions, in this case reduced visibility.

European Commission
Information Society and Media



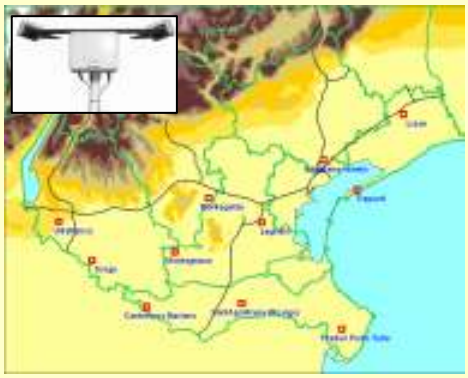
Fog in the Po Valley
The presence of fog is a frequent phenomenon in the Po Valley (up to 80-120 days per year), with consequent strong impact on road, air, ship and railway traffic, by dangerous reduction of visibility.

Social Economical Impact of Fog
The total social costs produced by fog in the region Veneto is of the order of 35M€ (total costs for accidents in Italy in 2003 is about 35G€, of which 1% attributed to fog, of which 10% attributed to Veneto).
[Italian Central Institute of Statistics, Automobile Club Italia]

Present warning systems
Deployment of fog monitoring warning systems is generally limited to selected stretches of the main motorway networks, yielding only information on the local fog conditions, not however on its areal extension. Most of the regional to national road networks are not covered by such a service.

Monitoring of fog
Fog monitoring is well known to be a significant challenge, not least due to the high spatial and temporal variability of the phenomenon. The development and refinement of fog forecast methods requires first a good monitoring system.

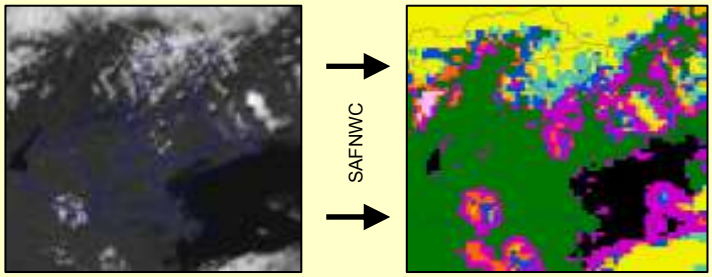
Objectives of the ROADIDEA Fog Pilot
The main objectives of the ARPAV Fog Pilot in ROADIDEA are:
• to set up a cost effective, areal fog monitoring system for diagnosing reduced visibility conditions over an extended geographical region as alternative to the expensive in situ monitoring;
• set up a relatively low resolution network of direct visibility measurements (visibilimeter);
• set up of an information model to merge direct and indirect visibility information derived from satellite and meteorological surface stations;
• maintain open architecture to allow integration of complementary and innovative data sources for visibility (reports, intelligent cars, webcams, etc.).



The visibility sensors network of ARPAV: ten instruments are now installed in the Veneto Plain.

The network of visibility sensors
For the ROADIDEA Fog Pilot a network of 10 visibilimeters was installed. The siting is limited to the Veneto plain most prone to intense and persistent fog. Visibilimeters provide direct visibility measures which then are converted in a probability of fog (reduced visibility conditions) for merging with other data sources.

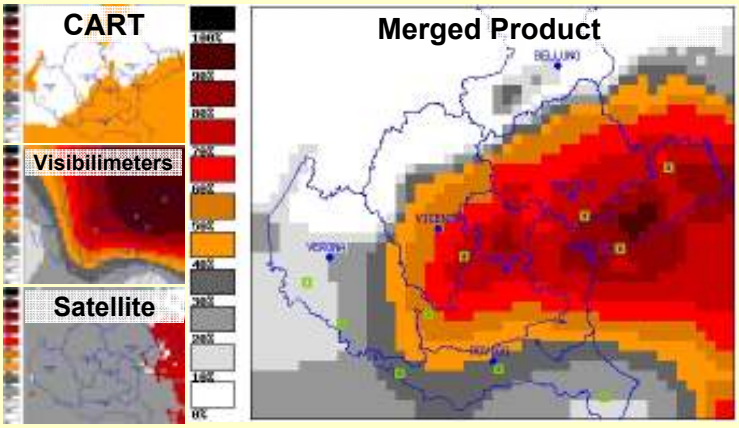
Ground data statistical elaboration
The data obtained from the automatic surface meteorological stations network yields another, indirect probability estimate for fog occurrence based on current meteorological conditions by applying a statistical decision tree methodology (CART).



METEOSAT Satellite images

Cloud Type product

Satellite information: elaboration by SAFNWC
The METEOSAT satellite images have the potential to provide areal fog information and were used to aid the spatial interpolation of the direct visibility measurements. The satellite information was processed by cloud classification algorithm of the Satellite Application Facility Nowcasting (SAFNWC), a software system developed over the last 13 years by a consortium of European national weather services.



The Fog Pilot data merging
The merging methodology for the different data sources was chosen to be probabilistic and can be divided into the following steps:
• estimate a fog probability map for each data source;
• attribute to each data source a relative quality, or weight, which accounts for the reliability for the current conditions;
• statistically combine the individual probability fields, accounting for the relative data quality.

The final product consists in a probability map of reduced visibility, which can yield fog alerts based on selected thresholds (e.g. 40%).

Conclusions
The main results of the ROADIDEA Fog Pilot can be summarized as follows:

• a probabilistic areal fog monitoring system has been built using a limited number of visibility sensors, a satellite cloud classification system and a meteorological surface station network;
• probabilistic verification of the Fog Pilot shows good performance with a probability of detection of 80%, probability of false detection of 10%;
• most value to the final product is brought by the direct visibility measurements, whereas the satellite information brings added value for the spatial interpolation; the impact of the meteorological surface observations has yet to be established;
• to the knowledge of the authors, the Fog Pilot constitutes the first attempt of an areal combined fog monitoring system for road transport purposes, and has the potential to give a significant support for accident prevention and traffic management.

ARPAV (Regional Agency for Environmental Prevention and Protection of Veneto) is the regional meteorological service of the north-eastern Italian region Veneto and, as such, is responsible for meteorological support to institutional and private users. In the framework of ROADIDEA ARPAV developed pilot system for the fog monitoring.

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