



Effects of Adverse Weather on Traffic and Safety: *State-of-the-Art and a European Initiative*

Pertti Nurmi

Nour-Eddin El Faouzi

Romain Billot

Bernhard Nowotny



aka:

Real-time Monitoring, Surveillance and Control of Road Networks under *Adverse Weather Conditions*

< COST Action TU0702 >

Pertti Nurmi

Nour-Eddin El Faouzi (Chair)

Romain Billot

Bernhard Nowotny

An Overview...

Keywords:

- *Road networks*
- *Traffic operations*
- *Adverse weather*

European COoperation in Science and Technology

- Is an intergovernmental framework as one of the longest-running instruments supporting science cooperation in Europe, since 1971
- Supports the coordination of nationally-funded research on European level, and aims at reducing the fragmentation in European research investments ⇔ **Collaboration** ⇔ **Partnership** ⇔ Travel funding
- Contributes to opening the European Research Area to worldwide cooperation ⇔ ***This is why we're here...***
- Boasts 35 European member countries; plus reciprocal agreements with Australia, New Zealand and R.S. Africa
- Is organized under 9 key scientific **domains** covering a wide array of research / technology activities ⇔ c. 200 running projects (**Actions**)
 - **Action TU0702** ⇔ **Transport and Urban Development (TUD)**



- a) To gain a better understanding of the impacts of adverse weather (*snow, rain, poor visibility, ...*) on traffic operations...
- b) To develop and promote strategies and tools to mitigate the impacts of adverse weather
⇔ *Eventually, proposing best practices and guidelines...*
- a) To develop weather responsive traffic management plans and tools...
- ❖ **... A strongly multi-disciplinary project !**

Current Practice ⇔ Many Traffic Monitoring Centers (TMC) respond only to traffic, not to weather

Goal ⇔ Integrate weather information into the TMCs



- ✚ 4-year Action: April 2008 - March 2012
- ✚ 17 Signatory / Participating countries (as of early-2010)
 - AT, BE, CH, CZ, DE, DK, ES, GR, FI, FR, IS, NL, PL, PT, SE, TR, UK
 - ~ 50 individual scientists involved
- ✚ 2 additional non-COST countries: Australia & Japan
- ✚ Project coordinator: INRETS, France
- ✚ Work load distributed under 3 (independent) Working Groups (WG)
- ❖ 3 Management Committee (MC) + joint WG meetings
- ❖ 3 Short-Term Scientific Missions (STSM) by young researchers
- ❖ Dissemination activities:
 - 2 workshops / conferences
 - 19 joint publications by Action participants



WG_1. Weather impact on traffic (~ 20 participants)

WP1: State-of-the-art survey of weather and traffic data needs, availability and integration

- *Review of research on weather impacts on traffic*
- *Review of weather information needs to surface transport*
- *Survey of available data sources thru partners*
- *Setting up common databases or at least benchmark available data*

WP2: Traffic modelling, estimation and control under different, adverse, weather conditions

WP3: DSSs for traffic monitoring and users' information



WG_2. Weather impact on road surface and pavement

(~ 10 participants)

WP1: Tools for road surface monitoring

WP2: Analysis of weather impact on different types of pavement

WP3: Tools for reducing the effects of adverse weather

WG_3. Innovative multi-sensor data fusion of traffic and weather data

(~ 10 participants)

WP1: Development of effective methods for reliable and comprehensive information

WP2: Development of optimal sensor configurations for traffic state estimation



+ Two Task Forces

❖ *Considered necessary because of the multi-disciplinary nature of Action*

TF_1. Definition of “Adverse Weather“ (WG_1 / chair: Pertti Nurmi)

“The Action established a task force to define **adverse weather** to clarify the meaning and reach a common understanding of this keyword within different disciplines: traffic engineering, pavement engineering, **meteorology**”...

Multi-dimensionality!!!

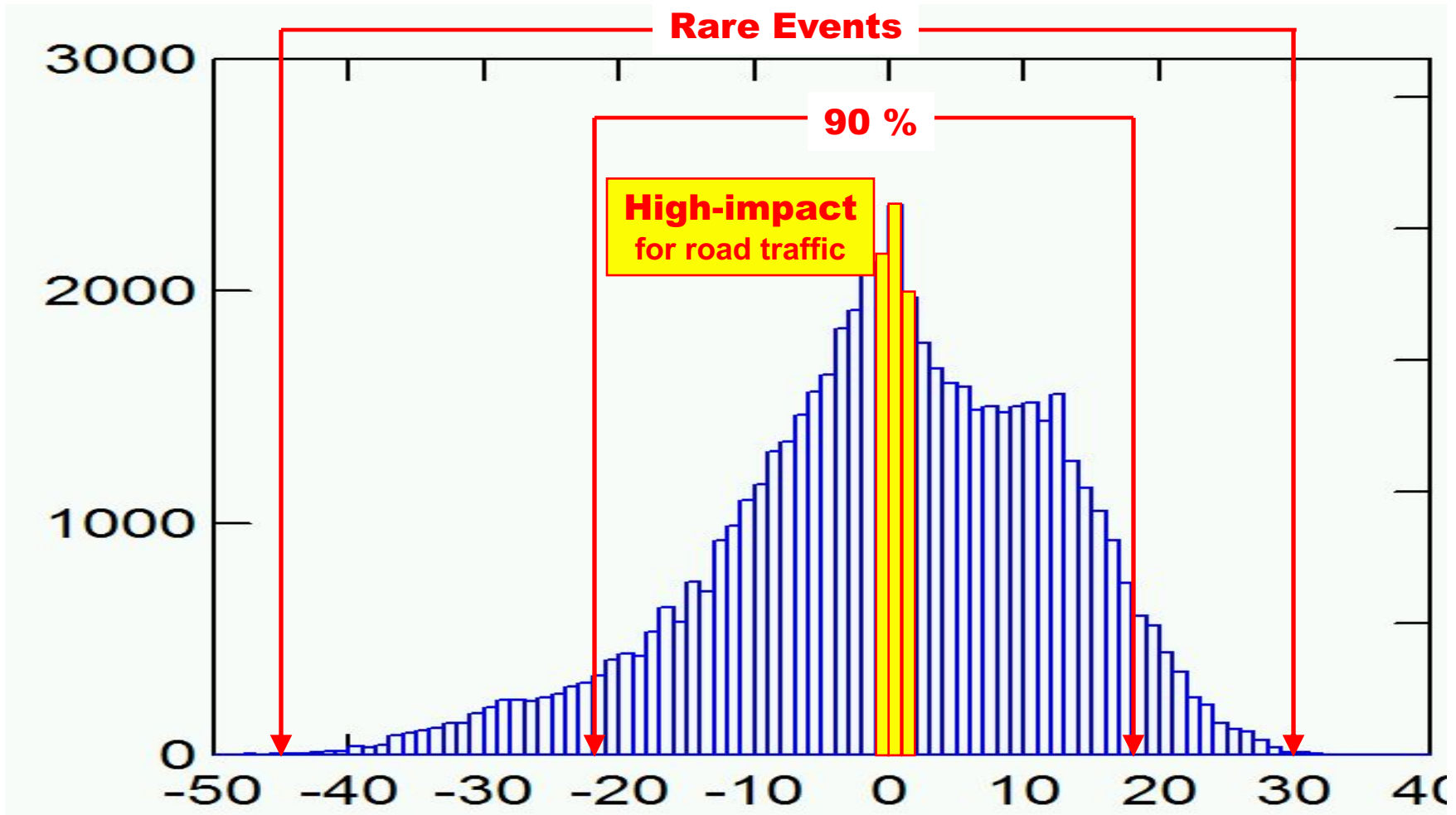
SEVERE
EXTREME
HIGH-IMPACT
RARE
ADVERSE

TF_2. Terminology related to modelling, data fusion, etc... (WG_3)






“Adverse weather”

Temperature distr. at a cold station in Finland (50 years, c. 55000 observations)



and Research Directions

Real-time Monitoring and Control of Road Networks under Adverse Weather Conditions

-  WG_1
-  WG_2
-  WG_3

I. Traffic modelling, estimation and control under different weather conditions

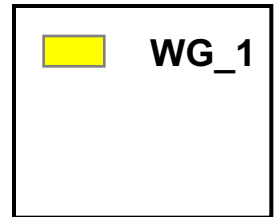
III. Modelling weather impact on surface and pavement

II. Multi sensor, multisource fusion of traffic and weather data

IV. DSS for traffic management and users' information



and Research Directions



Real-time Monitoring and Control of Road Networks under Adverse Weather Conditions

I. Traffic modelling, estimation and control under different weather conditions

I. Traffic modelling, estimation and control

- Compiling of state-of-practice of Road Weather Information Systems (RWIS)
- Performing empirical studies on weather and traffic
- Modelling driver behaviour under different weather conditions
- Development of a weather responsive traffic simulation model prototype
- Development of Weather Responsive Traffic Management strategies (WRTM)



and Research Directions

Real-time Monitoring and Control of Road Networks under Adverse Weather Conditions

WG_3

II. Multi-sensor, multi-source fusion of traffic and weather data

II. Multi-sensor, multi-source data fusion

- Better assessment of road traffic and weather conditions using data fusion
 - Comprehensive information
 - Robustness and addressing missing data problems
- Development of optimal sensor configurations for traffic state estimation
 - Minimum detector configurations, from which no detector could be removed without any negative impact on the traffic state estimation



and Research Directions

Real-time Monitoring and Control of Road Networks under Adverse Weather Conditions

 WG_2

III. Modelling weather impact on surface and pavement

III. Modelling weather impact on surface and pavement

- Provision of tools for surface monitoring in relation to the weather
- Analysis of weather impact on different types of pavement, with two main aspects:
 - Changes of the pavement parameters (skid resistance) under weather conditions
 - Relationships between the pavement type (material, light absorbing) and intensity of the weather phenomena (e.g., glazed frost, freezing water)



and Research Directions

Real-time Monitoring and Control of Road Networks under Adverse Weather Conditions

 WG_1

IV. DSS for traffic management and users' information

IV. DSS for Traffic management and users' information

- Development of DSSs aiming to help monitoring and managing traffic flows
 - Weather responsive traffic management
- Procurement of weather responsive information to the users
 - Performance indicators incorporating weather effects (e.g. travel time)



- ☑ Formation of an enthusiastic pan-European network around general aspects of road and weather, with broad European participation (17 countries)
- ☑ Increase in membership and interest within non-COST countries can be seen as indication of the importance of the Action
- ☑ Literature review on the state-of-the-art of weather effects on traffic operations and RWISs (Road Weather Information System) soon available
- ☑ Compilation of a comprehensive inventory of existing practices, resources, frameworks and initiatives (of traffic and weather data) at national level in Europe, covering shared resources, which otherwise were not easily obtainable
 - ⇔ To be shared amongst Action participants
- ☑ Skid resistance analysis with respect to road surface type
- ☑ Definition of adverse weather terminology
- ☑ Intermediate report (early 2010) covering much of the above...



☑ **Established international co-operation with :**

- American Transportation Research Board (TRB) through the AH010 TRB Committee
- US Federal Highway Administration (FHWA) within the Clarus initiative,
- University of Tokyo and two leading Australian universities: Monash and Queensland

☑ **Strong collaboration with :**

- NEARCTIS (Network of Excellence for Advanced Road Cooperative Traffic management in the Information Society) dedicated to innovative traffic management tools
- ECTRI (European Conference of Transport Research Institutes) through its thematic working groups





For further information :

- ✓ <http://www.cost.esf.org>
- ✓ <http://tu0702.inrets.fr/>

Thank You for
Your Attention !