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EWENT

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Estimating the impact of weather on transportation In Europe

(EMS Poster P1-30)

Assessing impact thresholds for different weather parameters

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Impact of adverse weather on transportation

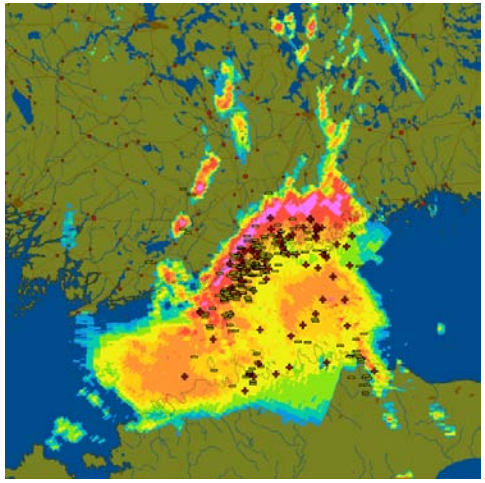
- **Wintry weather conditions (often low pressure related with cold air advection):**
  - Snowfall and poor visibility, wind gusts, low temperature (blizzard)
    - Consequences: traffic accidents, severe pile-ups and traffic jams; delays and cancellations in rail traffic and aviation
- **Summer storms (low pressure related or mesoscale convective systems):**
  - Strong wind gusts, heavy rain, lightning, possibly hail
    - Delayed flights, closed railway lines or roads

On 17 March 2005 in southern Finland a short-term intense snowfall resulted in severe pile-ups on the highways:

- Almost 300 crashed cars, 60 persons injured, 3 persons died; main roads closed for many hours
- High-impact weather does not always have to be extreme, in this case 5 cm of snow was enough (an article of this case by Juga et al. is accepted for publication in Meteorological Applications)

An example of a summer storm case: Impacts of a thunderstorm on 8 August 2010 in Finland

- **An extensive MCS (mesoscale convective system) moved over Estonia north in over Finland.**
- **It caused frequent lightning and violent wind gusts:**
  - 19-26 m/s on land areas
  - 25-29 m/s on coastal sea-areas
- **Fallen trees blocked the main railway lines heading north from Helsinki city, stopping the rail traffic for many hours.**
- **Helsinki-Vantaa airport was closed for a short period.**
- **Some small boats got into trouble on the Gulf of Finland.**



Gulf of Finland

EWENT project deals with the effects of adverse weather on transportation in Europe

- **Identifying the adverse weather elements and related impacts and consequences (WP1)**
- **Assessing threshold values for different weather parameters that show clear impacts on transportation (WP1)**
- **Calculating the frequencies of occurrence (probabilities) of adverse weather conditions with the impact thresholds, in the present and future climate (WP2)**

Assessing the impact thresholds for different weather parameters (EWENT, WP1), ”synthesis” done by FMI

- **The studied weather parameters by each project partner:**
  - **FMI**: (special focus on winter weather)
    - Snowfall, wind gusts, low temperature -> the blizzard
    - High temperature, heavy precipitation
  - **DLR, ESSL** (aviation):
    - Heavy precipitation, hail, tornado, lightning, low visibility, turbulence, in-flight icing/snow, volcanic ash, sand storm, wind – aviation
  - **CYMET** (offshore shipping):
    - Wind mean speed, visibility – fog
  - **Via Donau** (thresholds for inland waterway transport):
    - Heavy precipitation (high water), drought, temperature below 0 ^{o}C, reduced visibility (fog, snow and rainfall)
  - **VTT** (thresholds for roads and railways):
    - Precipitation

Identifying impact threshold values for different weather parameters, method of research (EWENT, WP1; **FMI**)

- **The work based on:**
  - Impact review collected from literature (scientific articles and professional reports)
  - Media reports of hazardous cases; case-studies
  - FMIs recent study concerning the relation between snowfall and traffic accidents in Finland
  - Review of warning criteria used in national meteorological services
- **The aim in the definition work was to find such threshold values for weather parameters that are not necessarily extreme, but show clear impacts on transportation.**
- **Also the values should occur at least sometimes in most parts of Europe, so that their probabilities in the present climate could be calculated.**
- **Three threshold values were assessed for the different parameters based on the severity of identified impacts.**

Impact thresholds for snowfall (SN)

- **SN $\geq$ 1 cm/24 h**
  - Local slipperiness (when T_road < 0 ^{o}C and salting not carried out).
  - Slightly increased accident rate. More consequences in southern Europe.

- **SN $\geq$ 10 cm/24 h**
  - Reduced friction and slipperiness on roads. When the snowfall is combined with low temperature and wind, rail points may get stuck. Substantially reduced visibility.
  - Increased accident rate in road traffic (double accident rate compared to the mean, observed in Finland); traffic jams, delays and cancellations in road and rail traffic as well as in aviation (the London bus traffic stopped totally on 2 February 2009).

- **SN $\geq$ 20 cm/24 h**
  - Slippery roads and airfield pavements, accumulated snow banks. Poor visibility. (Snow accumulation of 20 cm/24h or more doesn't occur very often in lowland districts)
  - Disturbed traffic, high accident rate, closed roads (for example: trucks stuck in snow banks, Sweden, highway E4, on 17 Dec. 2009), airfields temporarily closed, plenty of delays and cancelations in rail traffic.

Impact thresholds for low temperature

- **Daily T_mean $\leq$ 0 °C**
  - An important threshold related to slipperiness (ice formation, form of precipitation: rain, sleet, snowfall, freezing drizzle). The temperature itself is rather a modifier of hazardous conditions than a main cause.
  - Low temperature combined with precipitation and wind can have a disruptive effect on traffic.
- **Daily T_mean $\leq$ -7 °C**
  - The effect of salting for ice removal decreases in low temperatures. So, even relatively small amounts of snowfall can cause slippery conditions on highways when packed on the road surface by traffic. Rail points may get stuck by drifting snow in low temperatures.
  - Increased accident risk, delays and cancellations in road and rail traffic (for example the Eurostar trains during winter 2009/10).
  - Inland waterway transport might be disrupted when ice formation starts.
- **Daily T_mean $\leq$ -20 °C**
  - Some vehicles might have fuel problems (breaks in public transport in Oslo, winter 2009/10). Rivers get ice-covered, stopping the riverboat traffic. Dangerous wind chill conditions occur when moderate winds prevail (limited outdoor working hours).

Impact thresholds for wind gust (WG)

- **WG $\geq$ 17 m/s**
  - Trees can fall down over roads and cars as well as over railway electricity lines.
  - Suspension of small boat operation, local/occasional problems may occur in road and rail traffic.
- **WG $\geq$ 25 m/s**
  - Plenty of fallen trees. Reduced visibility due to the blowing snow or dust.
  - Electricity cuts, delays and cancellations in air, rail and road traffic. Ferry traffic is disturbed, only the biggest ships might cruise.
- **WG $\geq$ 32 m/s**
  - Huge amount of fallen trees, wide and long-lasting power failures are possible. Reduced visibility, high waves on the sea, especially if the event lasts for a longer period.
  - Ferries stay at the harbor, airfields are closed. Large material damages. Some railway lines might be closed for several days.

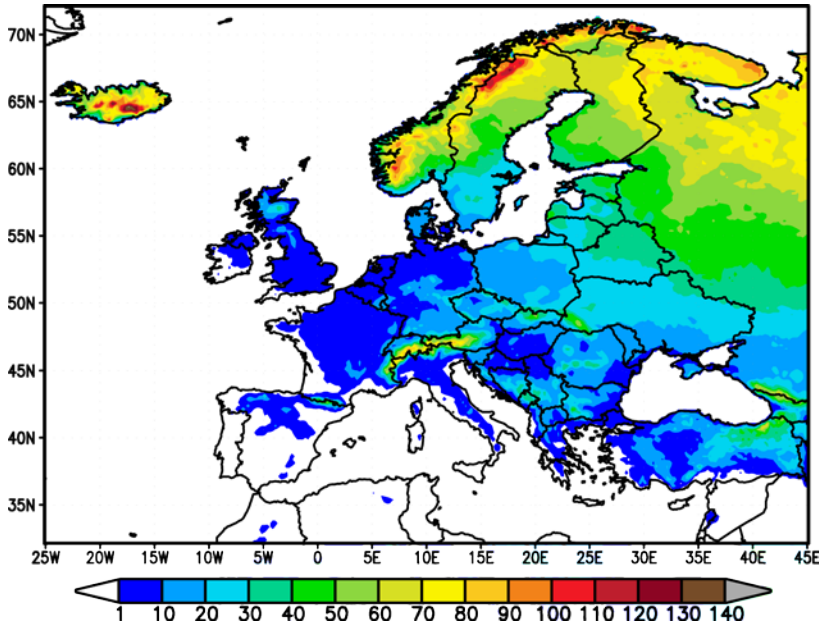
Impact thresholds for blizzard

- Snowfall $\geq$ **10 cm/24 h**
- Wind gust $\geq$ **17 m/s**
- Daily mean temperature $\leq$ **0 °C**

  - Fallen trees, snow banks, slippery roads and runways, poor visibility, rail points may get stuck.
  - Increased rate of injuries and accidents in road traffic (2-4 times more accidents compared to the mean, observed in Finland), delays, and cancellations/stops in all the transportation modes.

Conclusions

- **The impact thresholds for different parameters should more or less be regarded as indicative (not exact limits for certain impacts or consequences to occur).**
- **The actual consequences are also dependent on the transport mode, the day of the week and time of day (traffic density) and the preparedness for the hazard (area/ country).**
- **Anyway, with the impact threshold values, the frequencies of occurrence (probabilities) of the adverse weather phenomena can be calculated for the whole Europe, in the present and future climate.**
- **Thereafter, the differences between the present and future situation (due to climate change) can be identified.**



Average number of days per year with snowfall exceeding 1 cm/24 h (based on E-OBS data from years 1971-2000)