Extreme Weather Impacts on European Networks of Transport
- first findings

Project for the call TPT.2008.1. Assessing disruptive effects of extreme weather events on operation and performance of EU transport system

Business from technology

WEATHER project workshop 3: adapting transport to weather extremes

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Bio of Pekka

Chief Research Scientist	VTT Technical Research Centre of Finland
Vice-President	Jaakko Pöyry subsidiary (JP-Transplan)
Corporate Analyst	Finnish Railways (VR Group)
Road Policy Engineer R&D Manager	Finnish Road Administration S-E district
Consultant	Finnmap Ltd.

Adjunct professor, University of Oulu, dept. of industrial engineering and management, *business and investment analysis in transportation*

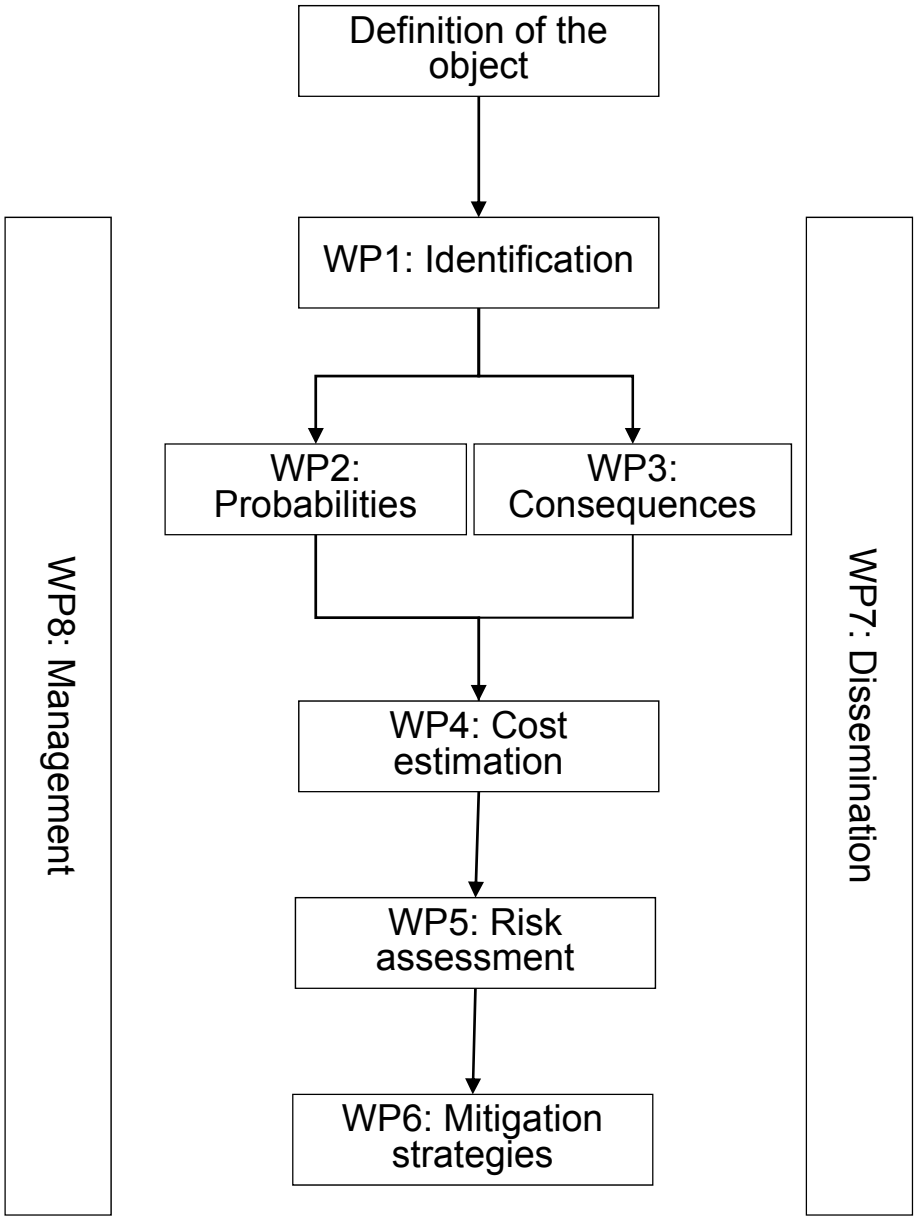
Adjunct professor, Technical University of Tampere, dept. of logistics and business information management, *transport and logistics*

Goal and research strategy

The goal of EWENT project is **to assess the impacts of extreme weather events on EU transport system**. These impacts are monetised. EWENT will also evaluate the efficiency, applicability and finance needs for adaptation and mitigation measures which will dampen and reduce the costs of weather impacts. The methodological approach is based on generic risk management framework that follows a standardised process from identification of hazardous phenomena (extreme weather), followed by impact assessment and closed by mitigation and risk control measures.

EWENT will start this by identifying the hazardous phenomena, their probability and consequences and proceed to assessing the expected economic losses caused by extreme weather when it impacts the European transport system, taking also into account the present and expected future quality of weather forecasting and warning services within Europe.

EWENT will apply **the IEC 60300-3-9 risk management standard framework** all the way through its research process and the project's work breakdown also follows the standard structure (see slide no 4).



OBJECTIVE: Risk management strategy for the EU transport system to prepare for and mitigate the impacts and costs of extreme weather phenomena

WP1: Extreme weather phenomena that have potential internal and external cost impacts on EU transport system; the threshold criteria for weather parameters

WP2: The probability of extreme weather and scenarios for increased probabilities and intensity

WP3: Impact mechanisms for system failures or disturbances (mobility meltdown, reduced safety and security) and operational failures (predictable mobility of passengers and goods); impacts on selected transport system performance indicators

WP4: Estimation of expected costs of extreme weather on time axis, based on identified impacts and scenarios: infrastructure (material damages), operations and traffic (accidents, time delays)

WP5: Evaluation of likely scenarios and most relevant costs; listing of prospective mitigation and adaptive strategies; risk panorama for EU transportation system

WP6: Assessing the effectiveness and preliminary investments required by different mitigation strategies on time axis; e.g. new weather information services, new institutional co-operative models (especially between authority functions and across national boundaries), development needs of standards and engineering guidelines for transportation infrastructures

The consortium

Beneficiary Number	Beneficiary name	Beneficiary short name	Country	Date enter project	Date exit project
1 (Coordinator)	VTT Technical Research Centre of Finland	VTT	FI	1	30
2	German Aerospace Center	DLR	DE	1	30
3	Institute of Transport Economics	TÖI	NO	1	30
4	Foreca Consulting Ltd	Foreca	FI	6	30
5	Finnish Meteorological Institute	FMI	FI	1	30
6	Meteorological Service of Cyprus	CYMET	CY	1	30
7	Österreichische Wasserstraßen Gmbh	via donau	AT	1	30
8	European Severe Storms Laboratory	ESSL	DE	1	30
9	World Meteorological Organisation	WMO	UN	6	30


Source: DLR/Frank Rehm


By courtesy of Chirs Baker


Source: Aker Arctic

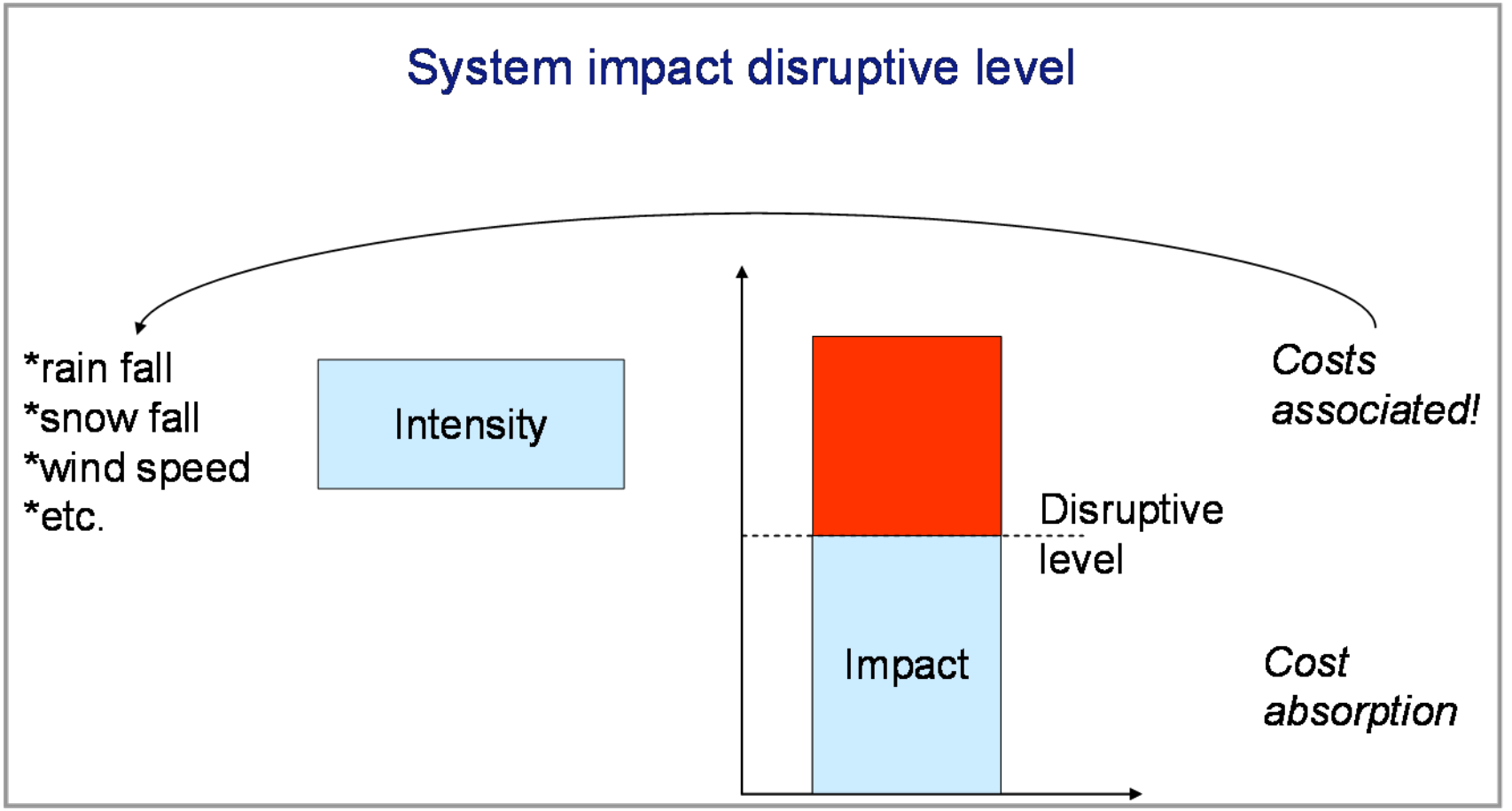
Modal coverage

Depth of analysis	Aviation		Land transport					Marine & waterways		
	Passenger	Freight	Road		Rail		Light	Ocean	Short sea /coastal	Inland ww
			Passenger	Freight	Passenger	Freight				Freight
Detailed	X	X	X	X	X	X				X
Brief							X		X	
Excluded								X		

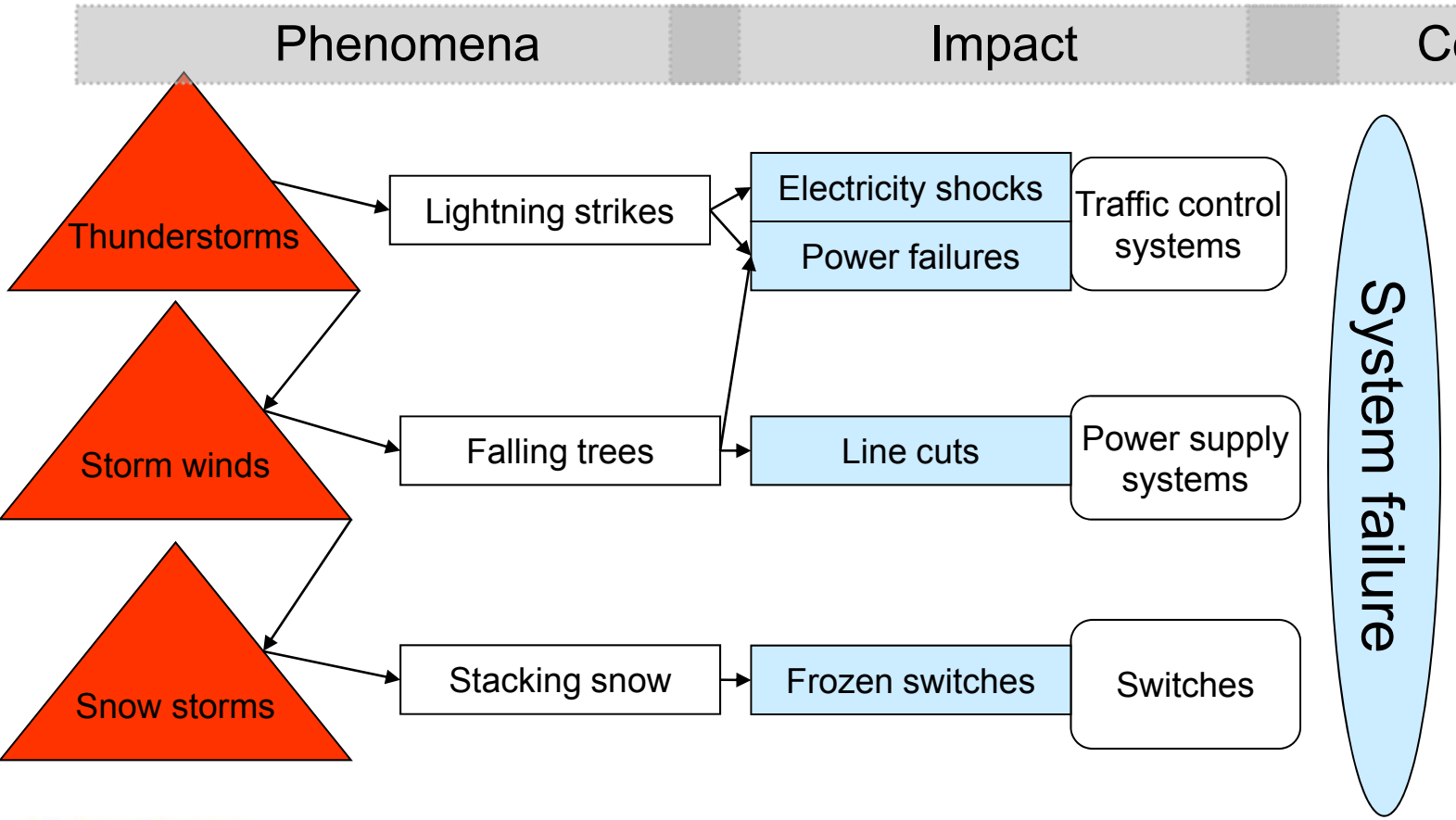
The transport system is viewed from three angles:

- **infrastructure**; these are direct material damages or deterioration of physical infrastructures
- **operations**; these are harmful impacts on traffic safety and transport reliability (both freight and passenger)
- **indirect impacts to third parties**, e.g. supply chain customers and industrial actors.

Cost impact vs. cost absorption



Impact analysis – example railways



- Time delays
- Accidents
- Customer dissatisfaction
- Disturbances is operations
- Increased maintenance / repair costs

Schedule & other info

- The project started in December 2009.
- Duration: 30 months.
- Total budget: ca 2 MEUR

Status in May 2011

- First deliverables issued
  - WP1 completed
  - WP2 95%
  - WP3 50%
  - WP4 started
- Number of interested parties volunteered to join the network, e.g.:
  - OECD
  - CER
  - SNCF
  - EASA
  - Companies
  - Other research projects
- Project web-site: http://ewent.vtt.fi/ running

WP1 - Phenomena

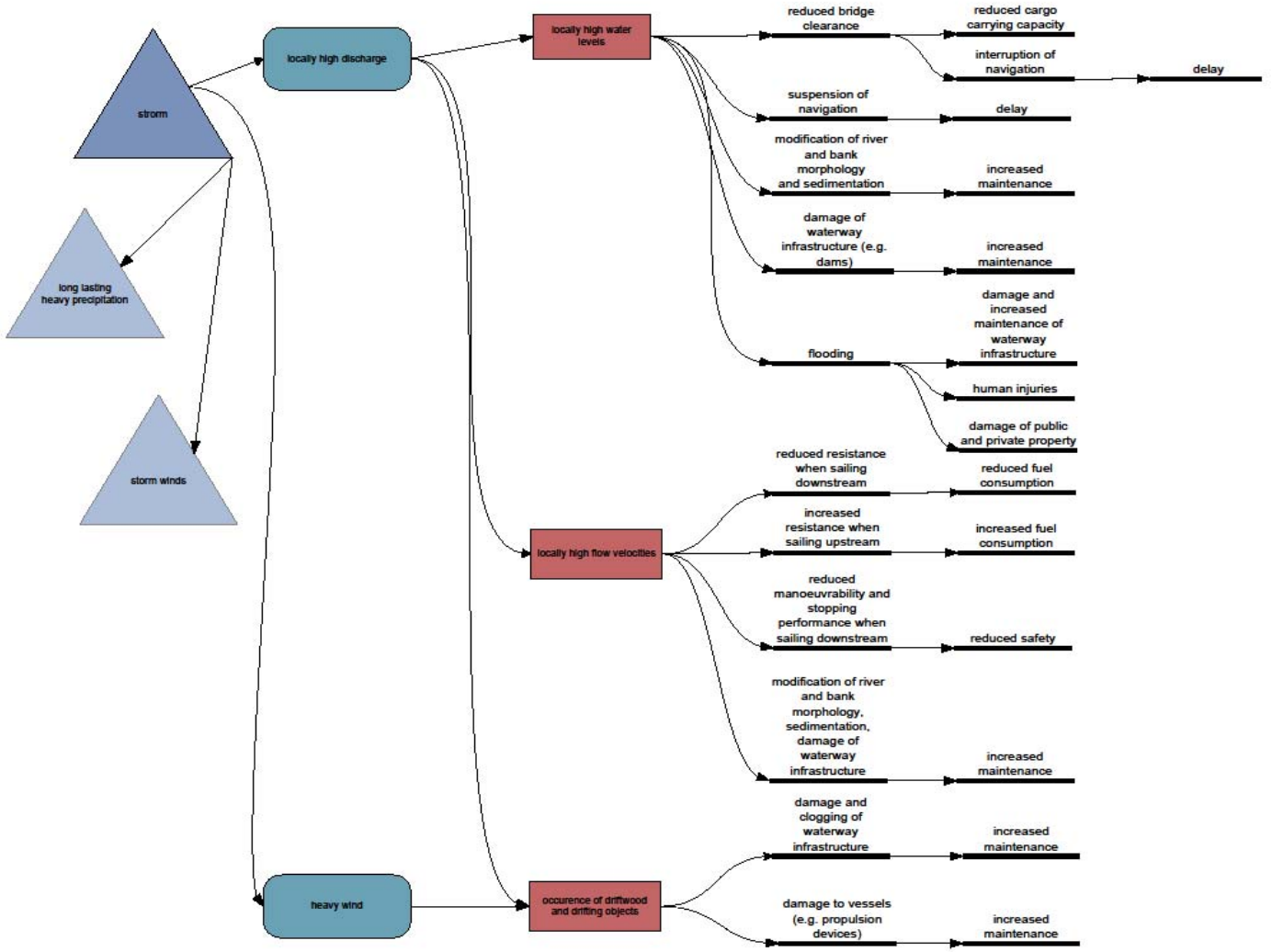
What's in it?

- Long list of extreme weather phenomena with critical threshold values
- A set of causal maps
- Analysis of >200 media reported cases
- Review of 150 scientific and professional publications

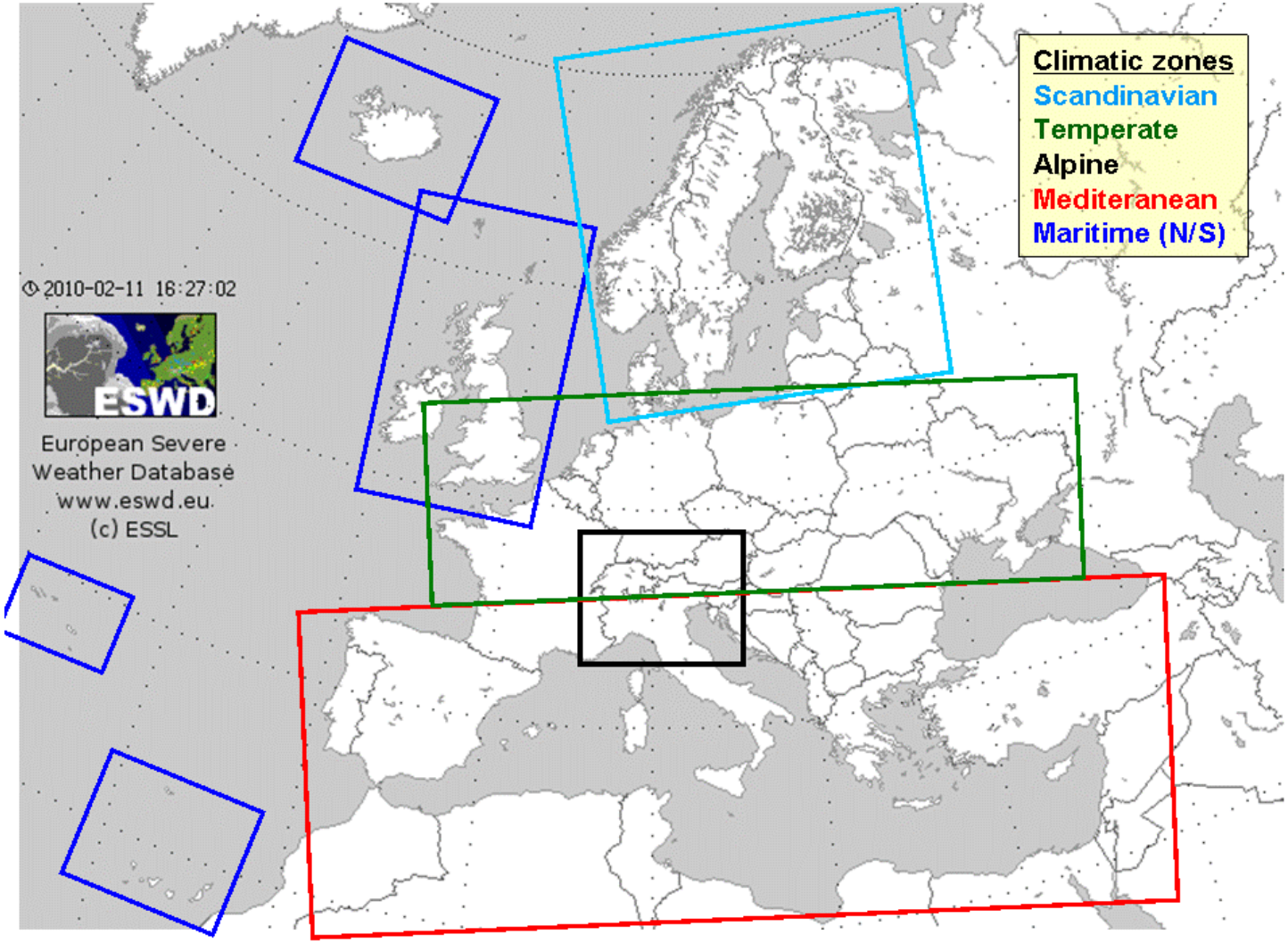
- Go to www.vtt.fi => publications => search EWENT

Table 8. Threshold values for winter conditions.

Low temperature – daily mean temperature		
Threshold	**Impacts**	**Consequences**
≤ 0°C	This is an important threshold related to slipperiness (ice formation, form of precipitation: rain/sleet/snowfall). The temperature itself is rather a modifier of hazardous conditions for transportation than a main cause. Low temperature combined with precipitation and wind can have a disruptive effect on traffic. Occurrence of freezing drizzle, increased frequencies of freeze-thaw cycles.	Increased accident risk in road traffic. The occurrence of freezing drizzle might be hazardous for aviation and road traffic. Premature deterioration of road and runway pavements.
≤ -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 (observed in Finland and Canada). Ice formation on rivers may start if there are many cold days in a row. Some vehicles might have fuel problems ("summer diesel sort").	Increased accident risk, delays and cancellations in road and rail traffic (e.g. Eurostar trains during winter 2009/10). Inland waterway transport might be disrupted.
≤ -20°C	Some vehicles might have fuel problems (Oslo, winter 2009/10). Rivers get ice-covered if there is a long-lasting cold period. Dangerous wind chill conditions occur when moderate winds prevail.	Public transport may encounter breaks due to fuel problems. (Oslo, winter 2009/10), riverboat traffic may stop. Limitations to transport personnel working outdoors.


storm
long lasting heavy precipitation
storm winds
locally high discharge
heavy wind
locally high water levels
locally high flow velocities
occurence of driftwood and drifting objects
reduced bridge clearance
reduced cargo carrying capacity
interruption of navigation
delay
suspension of navigation
delay
modification of river and bank morphology and sedimentation
increased maintenance
damage of waterway infrastructure (e.g. dams)
increased maintenance
flooding
damage and increased maintenance of waterway infrastructure
human injuries
damage of public and private property
reduced resistance when sailing downstream
reduced fuel consumption
increased resistance when sailing upstream
increased fuel consumption
reduced manoeuvrability and stopping performance when sailing downstream
reduced safety
modification of river and bank morphology, sedimentation, damage of waterway infrastructure
increased maintenance
damage and clogging of waterway infrastructure
increased maintenance
damage to vessels (e.g. propulsion devices)
increased maintenance

P(X) P(Y) P(Z) P(W)


Climatic zones
Scandinavian
Temperate
Alpine
Mediteranean
Maritime (N/S)
2010-02-11 16:27:02
ESWD
European Severe
Weather Database
www.eswd.eu
(c) ESSL

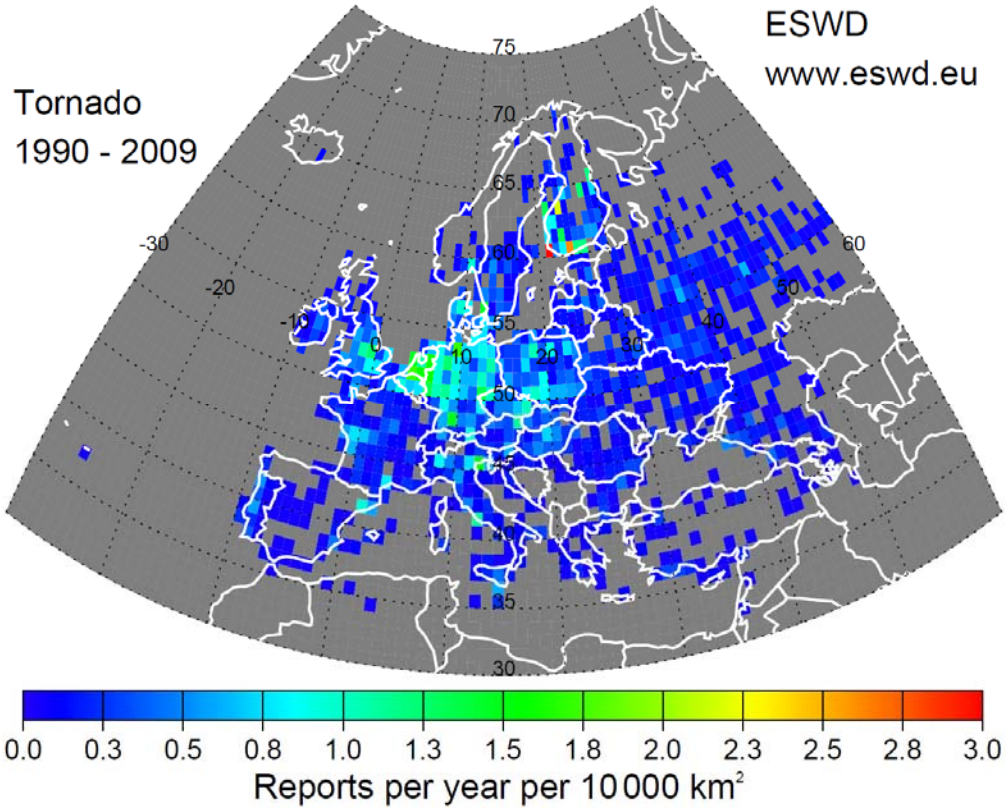
Media data file including > 200 cases

13.11.2007	Heavy snow	Strong wind		More than ten centimetres of snow	Sweden	Roads				Large numbers of motorists trapped in their cars on snow-blocked road , snowploughs and gritting trucks have been unable to get through, military all-terrain vehicles were able to help get control of the situation		http://www.thelocal.se/9091/20071113/ http://www.thelocal.se/9092/20071114/
24.12.2007	Hail	First flush - "mud flush" (mudslide)		40cm of water on the streets	Spain	Roads	Public	Hail/slush storm in Vélez-Málaga y Torre del Mar. The big amount of hail came down in 15minutes.		Roads A-7 needed to be cut between Velez-Malaga and Torrox in 7 kilometres.Lot of flooding and stream came with the power in Torre del Mar, Caleta, Algarrobo Costa and Mezquitilla.	27.7.2010 PAK	http://www.alertatierra.com/Torm1207.htm
26.12.2007	Heavy rain			45 litres of water per square metre	Spain	Roads				Heavy rain brings flooding to the Western Costa del Sol. The main A-7 road was closed to traffic.Christmas Eve saw a spectacular hail storm in parts of the Axarquia, causing traffic problems and damage to crops in the area.		http://www.typicallyspanish.com/news/publish/article_14305.shtml#ixzz0htj7rH7r
1.1.2008	Heavy snow	Strong wind		wind speed 70km/h	Romania	Aviation		1.-3.1.		Snow storm in the whole country. Many national roads and a highway were closed , , maritime ports from the Black-sea were also closed , the traffic on the Danube-Black sea canal was restricted, delays in road and rail traffic. The Henri Coanda airport and Baneasa airport from Bucharest were closed for several hours, many flights delayed		http://www.hotnews.ro/stiri-esential-2146336-ninsori-puternice-tara-trenuri-intarzieri-mari-curse-aeriene-amanate-porturi-blocate.htm , http://www.romanialibera.ro/actualitate/eveniment/autoritatile-troienite-de-primul-viscol-114724.html , http://stiri.rol.ro/Cel-putin-9-drumuri-nationale-sunt-inchise-trenurile-au-intarzieri-Otopeni-s-a-redeschis-100449.html

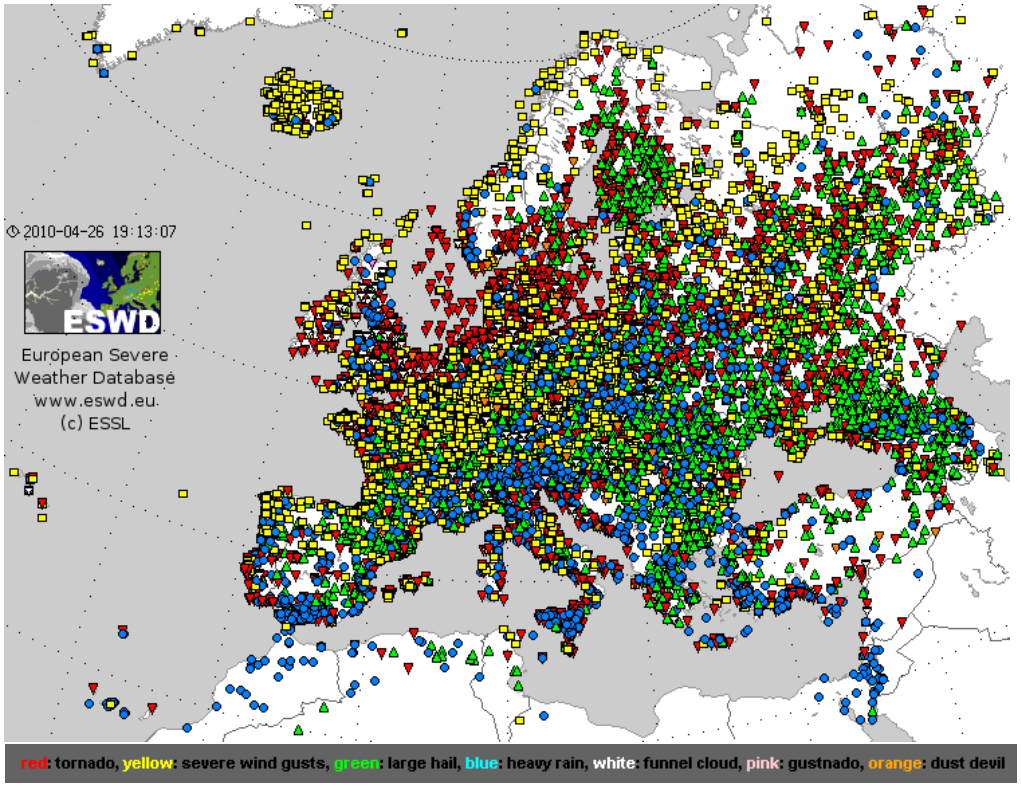
WP2 first results

Status of the European Severe Weather Database

Application, e.g., tornado incidence



Reporting



Output formats at **essl.org/ESWD/**:

- Public: Map, HTML text table
- Users: also ASCII + CSV raw data

26/04/2010 *n* = 24688 reports since 1950

NMHS Partner

Source: Dotzek / ESSL

Six regional climate models

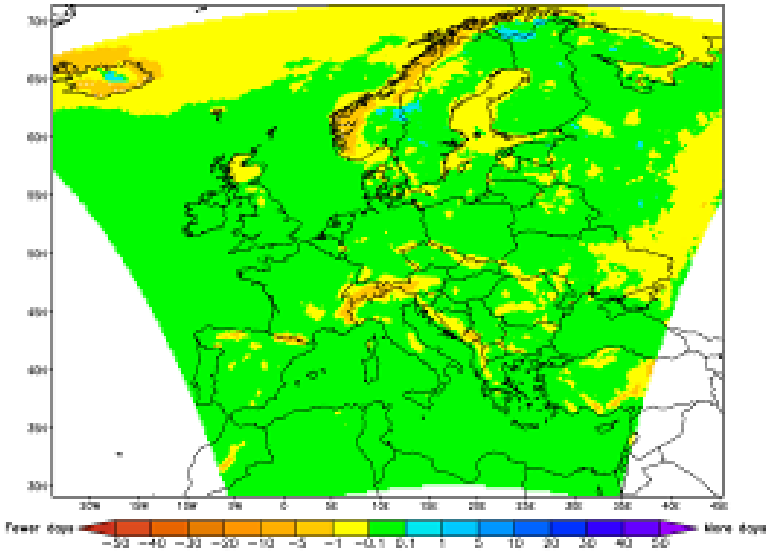
The chosen regional climate change projections are:

- SMHIRCA-ECHAM5-r3
- SMHIRCA-BCM
- SMHIRCA-HadCM3Q3
- KNMI-RACMO2-ECHAM5-r3
- MPI-M-REMO-ECHAM5-r3
- C4IRCA3-HadCM3Q16

Projections for 2020 and 2050

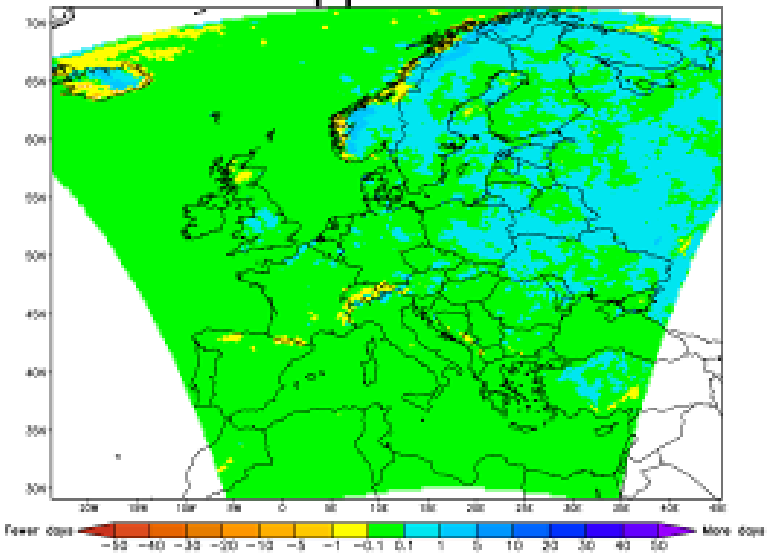
- 2011-2040
- 2041-2070

Multi-model mean

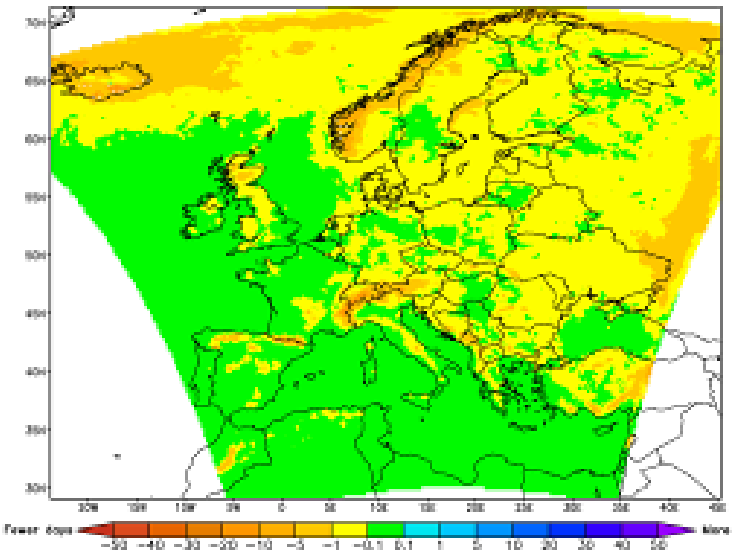


Source: FMI

Upper limit



Lower limit



WP3

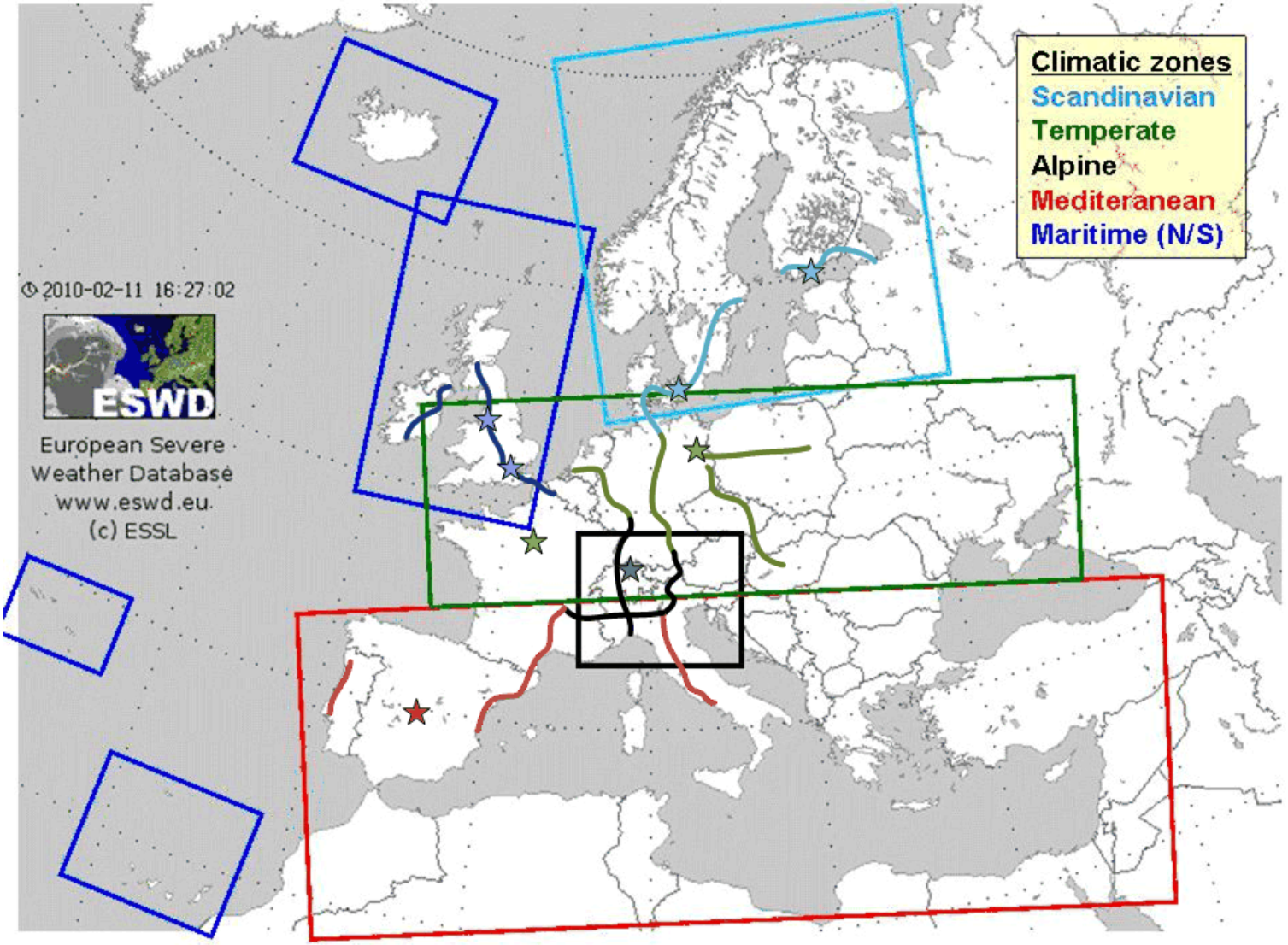


Figure 4: Rail corridors (freight), marked with lines, and urban/regional/commuter rail networks (passenger transport), marked with stars, for the five climatic zones.

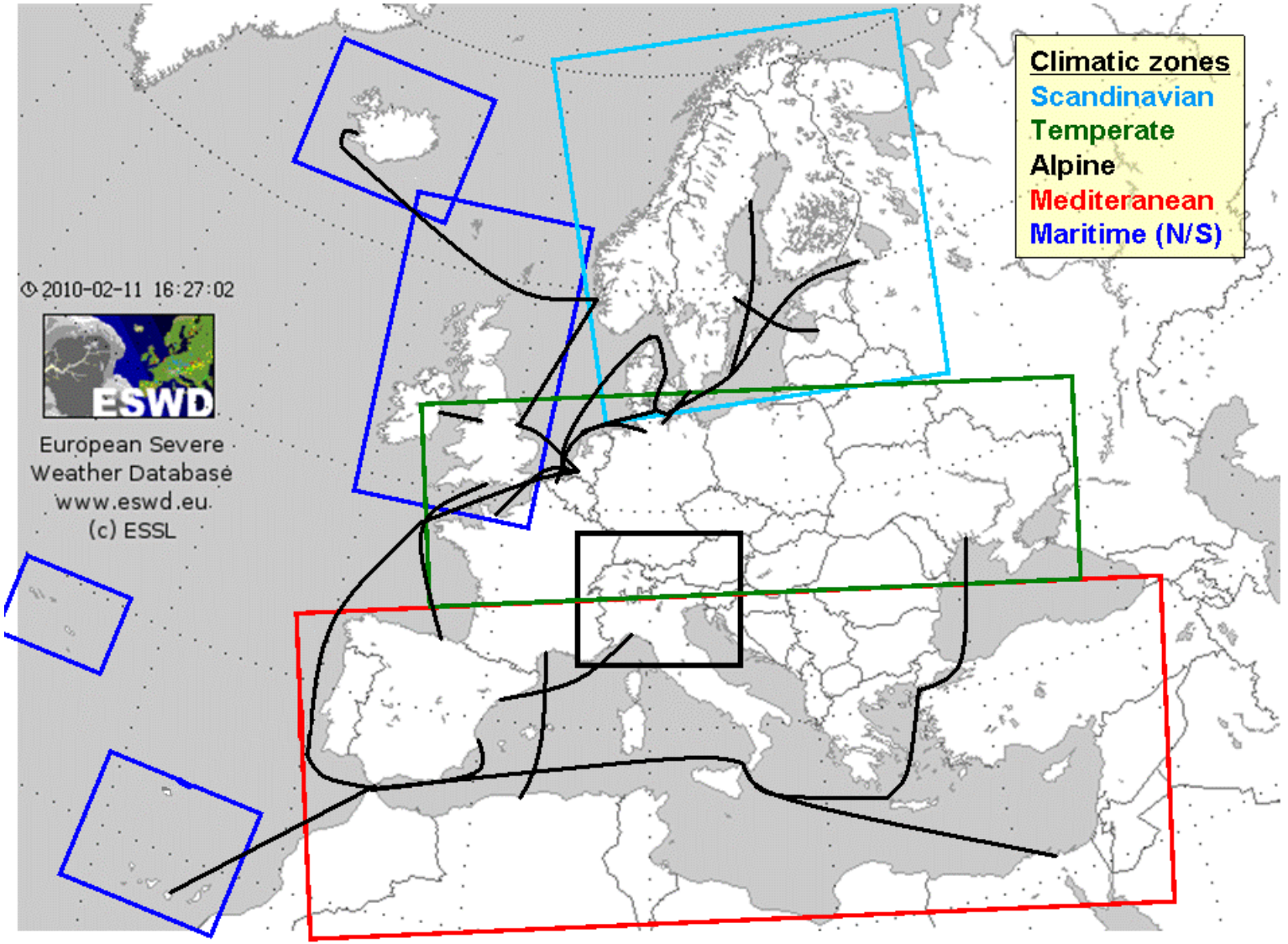


Figure 6: Typical sea transport routes (black lines).

Changes / Weather phenomena skenario maps (2011-2040) / European ports

Port	Wind			Snow			Blizzard	Heavy precipitation			Heat waves			Cold waves		
	17m/s	25m/s	32m/s	1cm/d	10 cm/d	20 cm/d		30mm/d	100mm/d	150mm/d	≥25°C	≥32°C	≥43°C	≤0°C	≤-7°C	≤-20°C
Primorsk mean	g	h	h	g	g	h	i	g	h	h	i	h	h	l	k	i
Primorsk upper	j	i	h	j	i	h	g	g	h	h	j	i	h	k	j	f
Primorsk lower	f	g	g	f	g	g	i	i	h	h	g	g	h	k	l	l
Bergen mean	f	g	h	f	g	h	i	g	h	h	h	h	h	k	k	h
Bergen upper	j	j	i	j	j	i	h	f	h	h	h	h	h	g	g	h
Bergen lower	e	f	g	e	f	g	i	i	h	h	h	h	h	l	k	i
Gothenburg mean	i	h	h	i	h	h	h	g	h	h	i	h	h	k	k	i
Gothenburg upper	j	j	i	k	j	i	g	g	h	h	i	h	h	i	g	h
Gothenburg lower	f	f	g	f	f	g	i	h	h	h	g	h	h	k	k	j
Tallin mean	h	h	i	i	i	i	i	h	h	h	h	h	h	l	l	j
Tallin upper	j	j	j	j	j	j	g	g	h	h	j	i	h	l	j	g
Tallin lower	f	f	h	f	f	h	i	i	h	h	h	h	h	l	l	j
Riga mean	g	i	i	g	i	i	h	g	h	h	j	h	h	l	l	j
Riga upper	j	j	h	j	k	i	g	g	h	h	j	i	h	k	g	g
Riga lower	f	f	h	f	f	h	i	h	h	h	h	h	h	l	l	j
Rotterdam mm	j	i	h													
Rotterdam upper	j	j	h													
	f	g	h													

Weather induced cancellations or delays in aviation:

Airport	Declared Capacity [mv/hr]
- KASTRUP	83 [6]
- GARDEMOEN	60 [7]
- ARLANDA	90 [3]
-	80 [8]
PULKOWO	39 [2]
CHARLES DE GAULLE	114 [6]
FRANKFURT	83 [6]
SCHIPHOL	106 [8]
NATIONAL	74 [6]
	40 [8]

How does it look so far?

- Climatological models project different future states of the climate
- Causality can be described conceptually
- Empirical material for time delays and accidents can be found

- ”Everything” is uncertain: the impacts, consequences, climate scenarios, technological responses, etc., etc.

- But is seems that we are able to say something relevant, where the gravest risks in terms of safety and efficiency seem to lie
  - Safety = accidents
  - Efficiency = time & maintenence costs

- Long-term impacts and consequences are even more tricky to forecast