RAIN Workshop on Past Severe Weather Hazards

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166. The contents of this presentation are the author's views. The European Union is not liable for any use that may be made of the information contained therein.

This project is funded by the European Union

Hazard Identification in the RAIN project

RAIN Workshop on Past Severe Weather Hazards

Berlin

27 February 2015

Pieter Groenemeijer

European Severe Storms Laboratory

pieter.groenemeijer@essl.org

... with contributions from several RAIN project partners!

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166. The contents of this presentation are the author's views. The European Union is not liable for any use that may be made of the information contained therein.

This project is funded by the European Union

Hazard Identification Steps

1. Review hazards and their impacts in the past
2. Assess predictably with state-of-the art forecast and warning systems
3. Model the occurrence of hazards in the present and in future climate scenarios

This project is funded by the European Union

RAIN PROJECT

Partners & Hazards

expert partner:

Freie Universität Berlin

TU Delft Delft University of Technology

ESSL
European Severe Storms Laboratory

FMI

Landslides →

GDG GAVIN & DOHERTY GEO SOLUTIONS

Methodological support:

hellenberg Challenging Disasters

PSJ SECURITY & JUDGMENT

This project is funded by the European Union

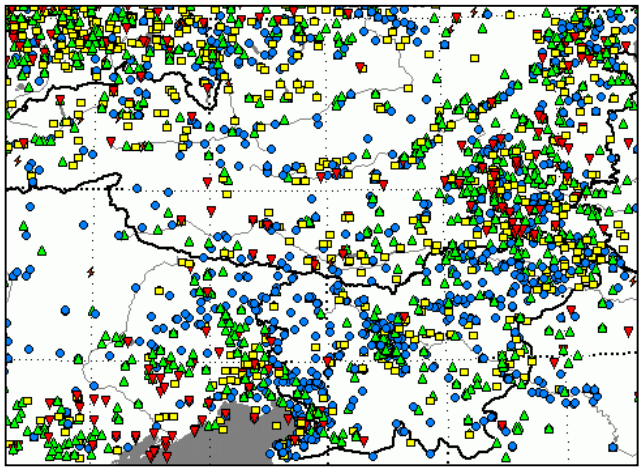
Review hazards and their impacts in the past

- develop methods to identify the events that lead to high impacts

- assesses the impact of past events
  - interact with stakeholders

    ↓

    operators of critical infrastructure & emergency management



Severe weather reports of ESSL's European Severe Weather Database
tornadoes, wind gusts, large hail

Ice in the Baltic Sea 2010/2011

This project is funded by the European Union

Review hazards and their impacts in the past

- RAIN partners have compiled a list of 21 examples of past impacts of severe weather to critical infrastructure

This project is funded by the European Union

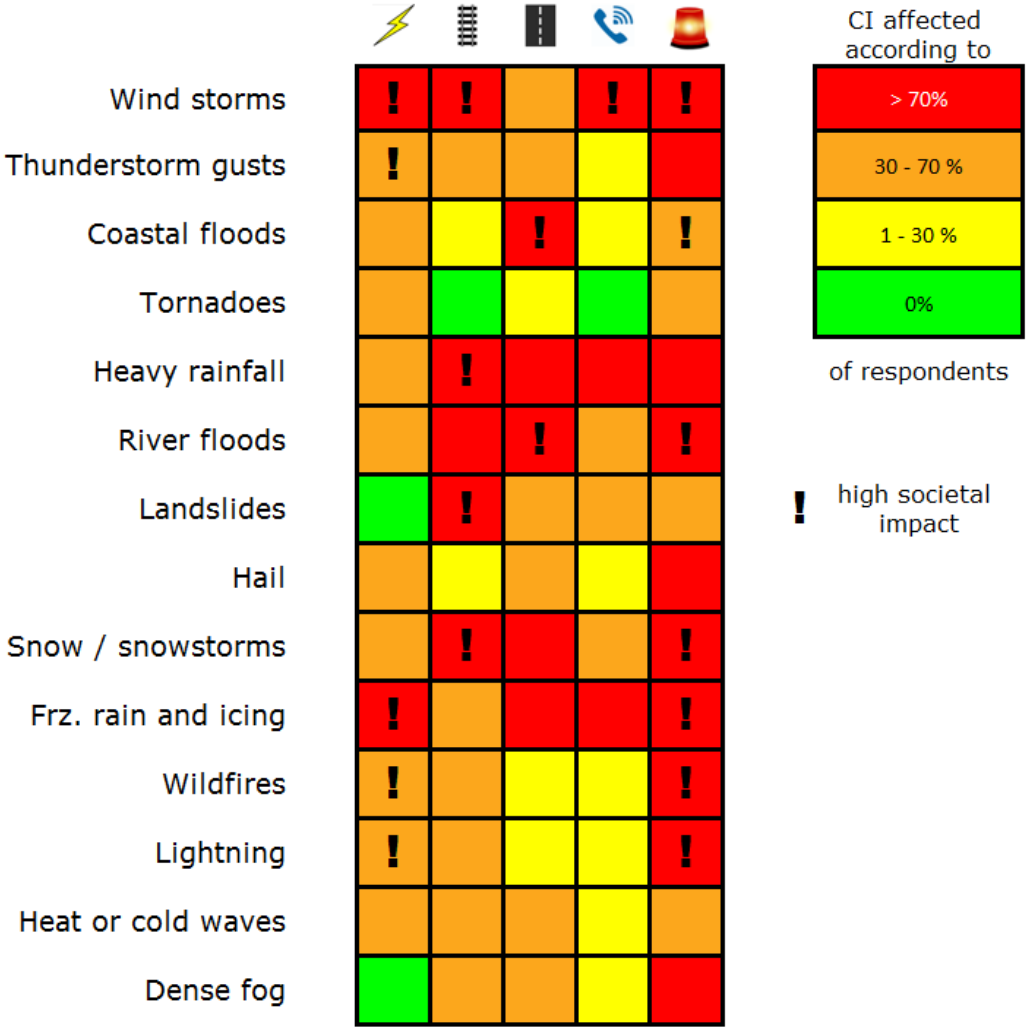
Review hazards and their impacts in the past

- RAIN partners have interviewed **27** critical infrastructure stakeholders from these sectors:
  - railways
  - road management
  - telecommunications
  - power grids
  - emergency management

- Some results...

This project is funded by the European Union

Review hazards and their impacts in the past



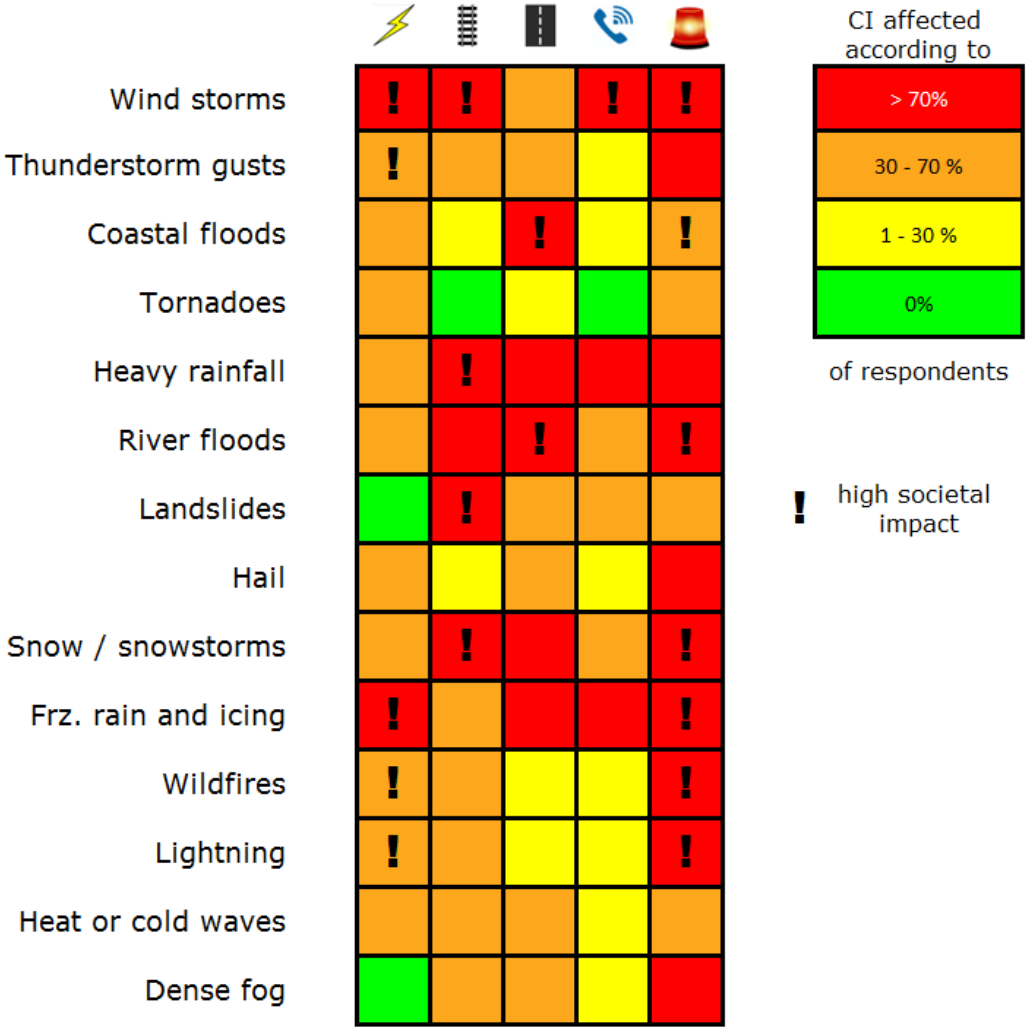
Risk of

- wind storms
- heavy rainfall
- river floods
- snowstorms
- freezing precipitation

most frequently mentioned by CI stakeholders

This project is funded by the European Union

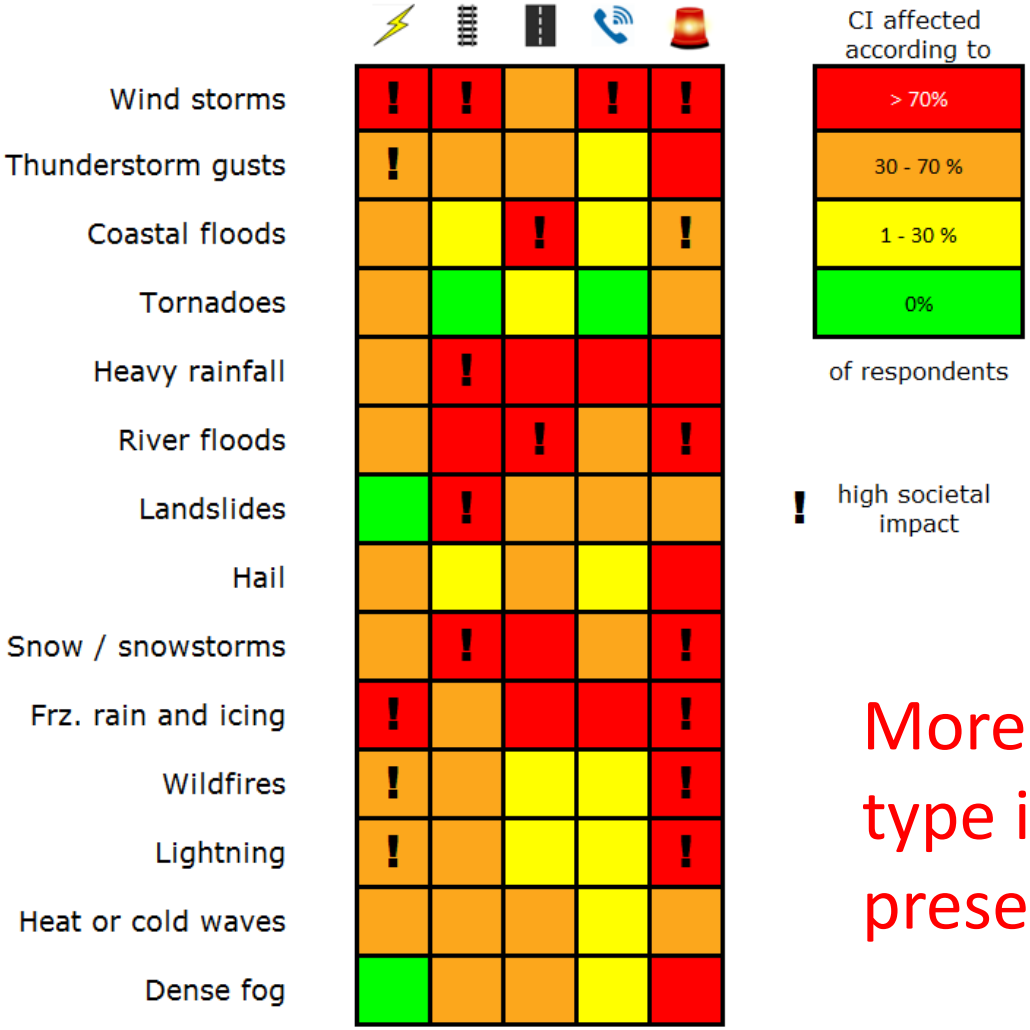
Review hazards and their impacts in the past



Some hazards not mentioned often, but those who mentioned it found that it could cause a great societal impact.

This project is funded by the European Union

Review hazards and their impacts in the past



Rail and road have more “reds”

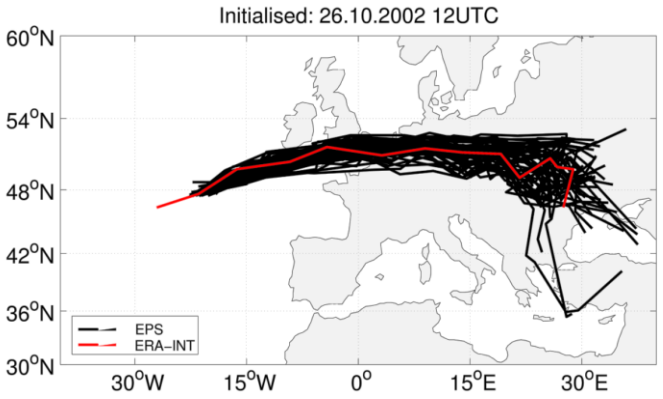
→ more vulnerable, because their functioning can be impaired even before damage sets in.

More results per hazard type in following presentations...

This project is funded by the European Union

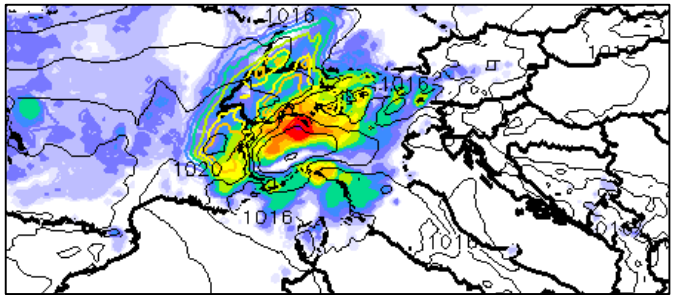
2. Assess state-of-the art prediction and warning systems

- study the predictability of hydro-meteorological hazards in Europe
  - short-range (“nowcasting”, <48 h)
  - medium-range (days)
  - seasonal



Ensemble forecasts (black) and real path of winter storm Jeannett

- assess state-of the art early warning systems, and formulate improvements
  - important: **needs of users** of these warnings
  - interact with **providers** of these warnings



Forecast of potential floods across the Alps

This project is funded by the European Union

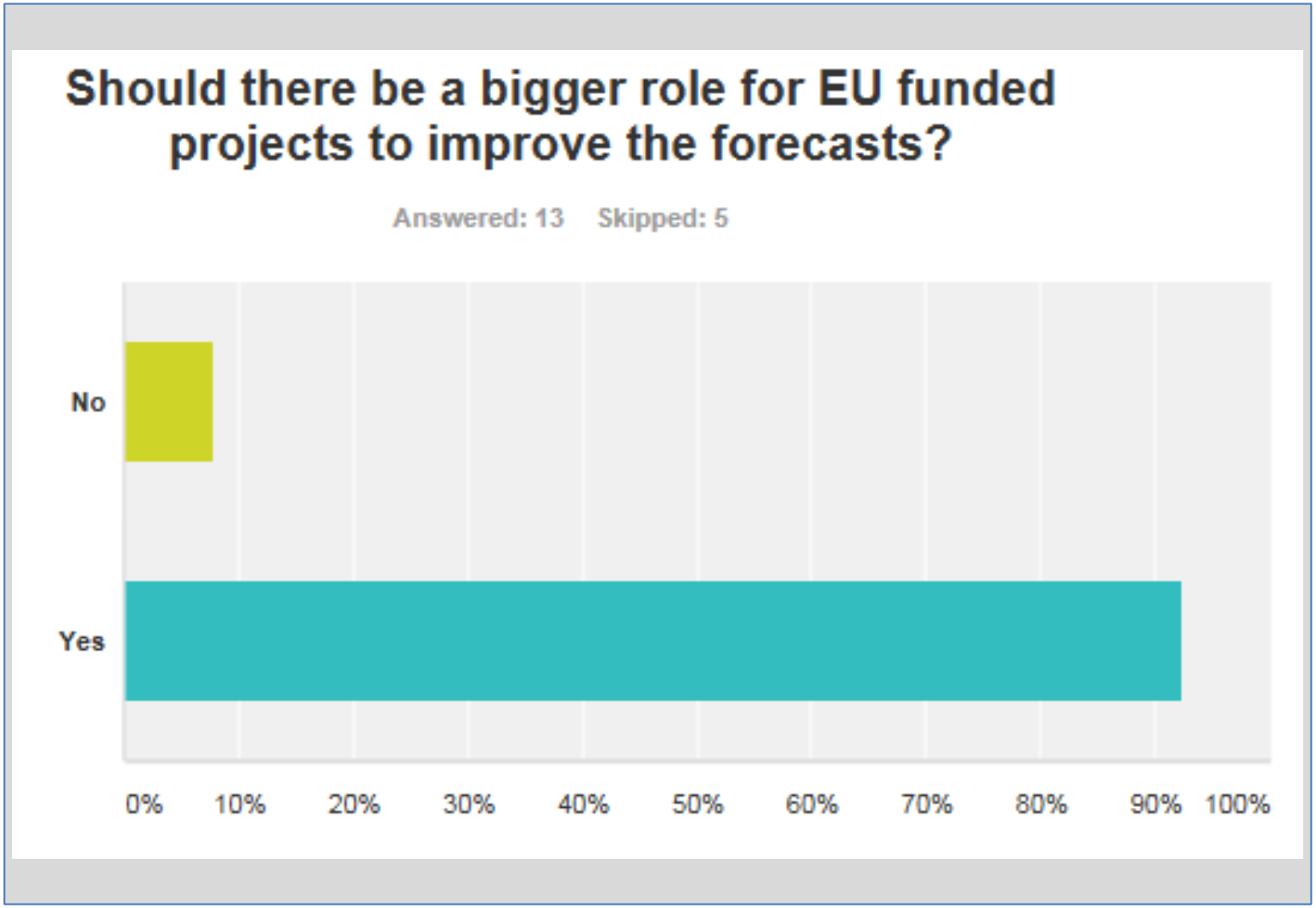
2. Assess state-of-the art prediction and warning systems

- 18 interviews with weather services in total
  - 13 National Weather Services
  - 5 Commercial / private entities

- Questions about:
  - Services provided
  - Specialized products for different user groups
  - Covered types of weather events
  - Types and magnitudes of thresholds
  - Essential framework arrangements
  - Means of information exchange
  - Constraints
  - Improvements in METEOALARM project

This project is funded by the European Union

2. Assess state-of-the art prediction and warning systems



This project is funded by the European Union

Workshop Goals

To better learn...

1. how CI operators are impacted by extreme weather
2. how CI operators prepare for and deal with extreme weathe, and what their needs are regarding weather warnings
3. where opportunities lie to mitigate damage by improved early warning systems, according to all involved stakeholders (e.g. CI operators, weather services, risk analysists, ...)

This project is funded by the European Union

Workshop Programme

09:00	Welcome addresses	**Alan O'Connor** (Project Coordinator) **Uwe Ulbrich** (host)	TCD FU Berlin
	Part 1: Impacts on critical infrastructure – contributions by RAIN project partners		
09:10	Hazard Identification in RAIN	**Pieter Groenemeijer** (WP Leader Hazard Identification)	ESSL
09:20	Impact of ***thunderstorm***-related hazards on critical infrastructure	**Pieter Groenemeijer**	ESSL
09:35	Impacts of ***windstorms*** and ***heavy precipitation*** on critical infrastructure	**Nico Becker**	FUB
10:00	Assessment of ***flood*** hazard on European scale: concepts and methods	**Dominik Paprotny and Oswaldo Morales Napoles**	TU Delft
10:30	*Coffee break*		
11:00	Risk assessment of interconnected infrastructures	**Bas Jonkman**	TU Delft
11:25	Impacts of ***severe winter weather*** events on critical infrastructure	**Andrea Vajda**	FMI
11:50	High impact weather warning procedures and assessment	**Ilkka Juga and Pertti Nurmi**	FMI
12:15	*Lunch break*		
	Part 2: Experiences and prominent cases – contributions by stakeholders		
13:15	Management of extreme weather events in the Austrian Federal Railways	**Günther Kundela**	ÖBB
13:40	Meteorological risk models & alarm systems for critical infrastructure	**Stefan Eisenbach**	UBIMET
14:05	The effect of extreme rain on critical infrastructures, the case of Tous Dam	**Eloy Picazo**	DRAGADOS (ACS GROUP)
14:30	***Panel discussion*** Timo Hellenberg (Hellenberg International), Pertti Nurmi (FMI), Günther Kundela (ÖBB), Eloy Picazo (ACS Group), Pieter Groenemeijer (ESSL)	**Alois M. Holzer**	Panel host
15:30	*End of workshop*		

Impact of thunderstorm-related hazards on critical infrastructure

RAIN Project
General Assembly

Berlin, 25 February 2014

Pieter Groenemeijer

ESSL

pieter.groenemeijer@essl.org

www.rain-project.eu

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 608166. The contents of this presentation are the author's views. The European Union is not liable for any use that may be made of the information contained therein.

This project is funded by the European Union

Thunderstorms

Accompanying phenomena:

- Lightning

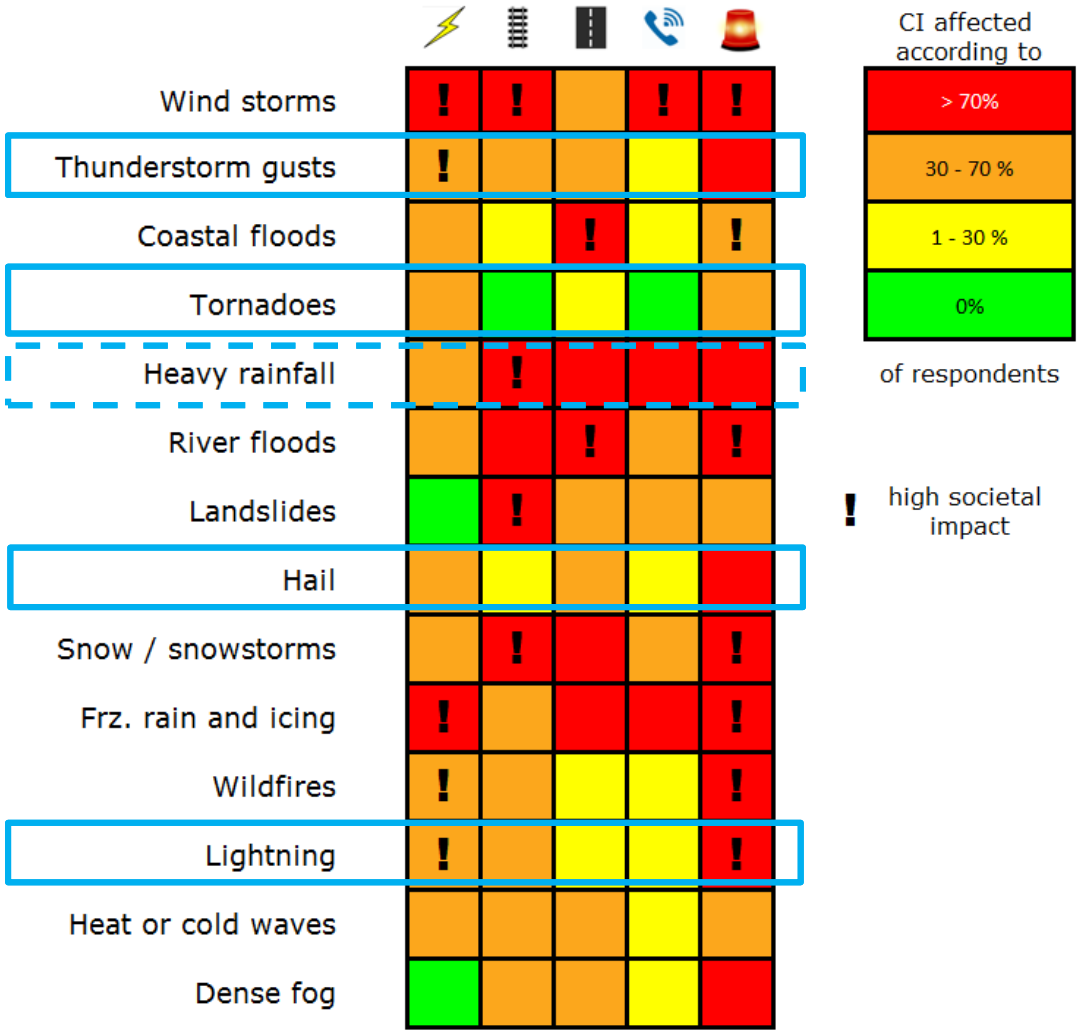
Severe thunderstorms:

- Large hail
- Tornadoes
- Flash floods
- Severe wind gusts

Are treated separately from wind storms or large-scale floods, because of the different meteorology and predictability

This project is funded by the European Union

Thunderstorms



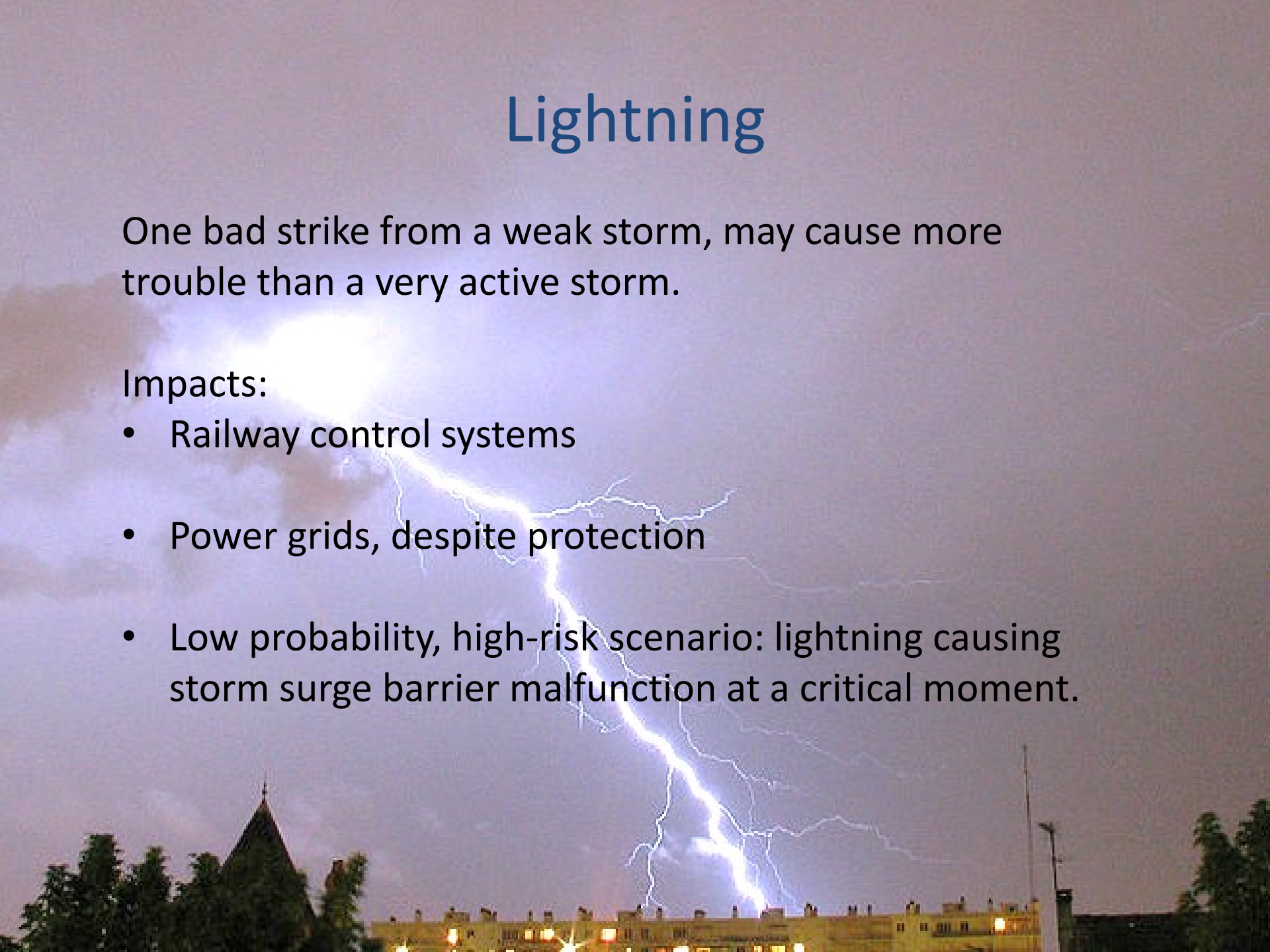
This project is funded by the European Union

Lightning

One bad strike from a weak storm, may cause more trouble than a very active storm.

Impacts:

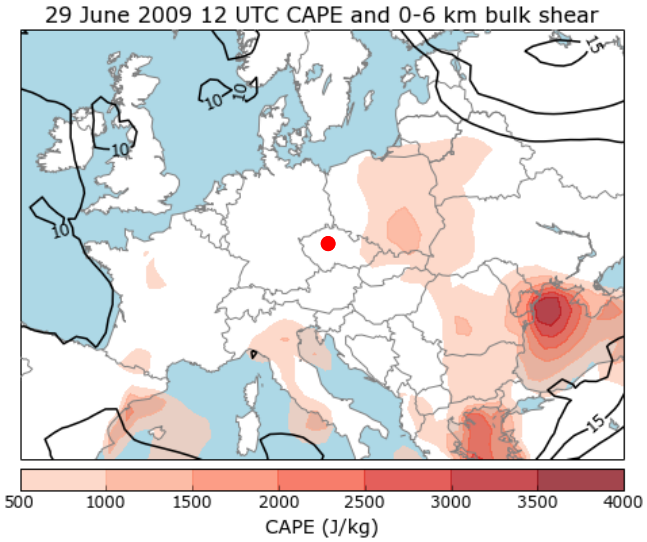
- Railway control systems
- Power grids, despite protection
- Low probability, high-risk scenario: lightning causing storm surge barrier malfunction at a critical moment.



Past case: Jistebik (CZ), 29 June 2009

Cause:

- Weak thunderstorm: no severe weather
    - Low potential energy for thunderstorms:



Convective Available Potential Energy

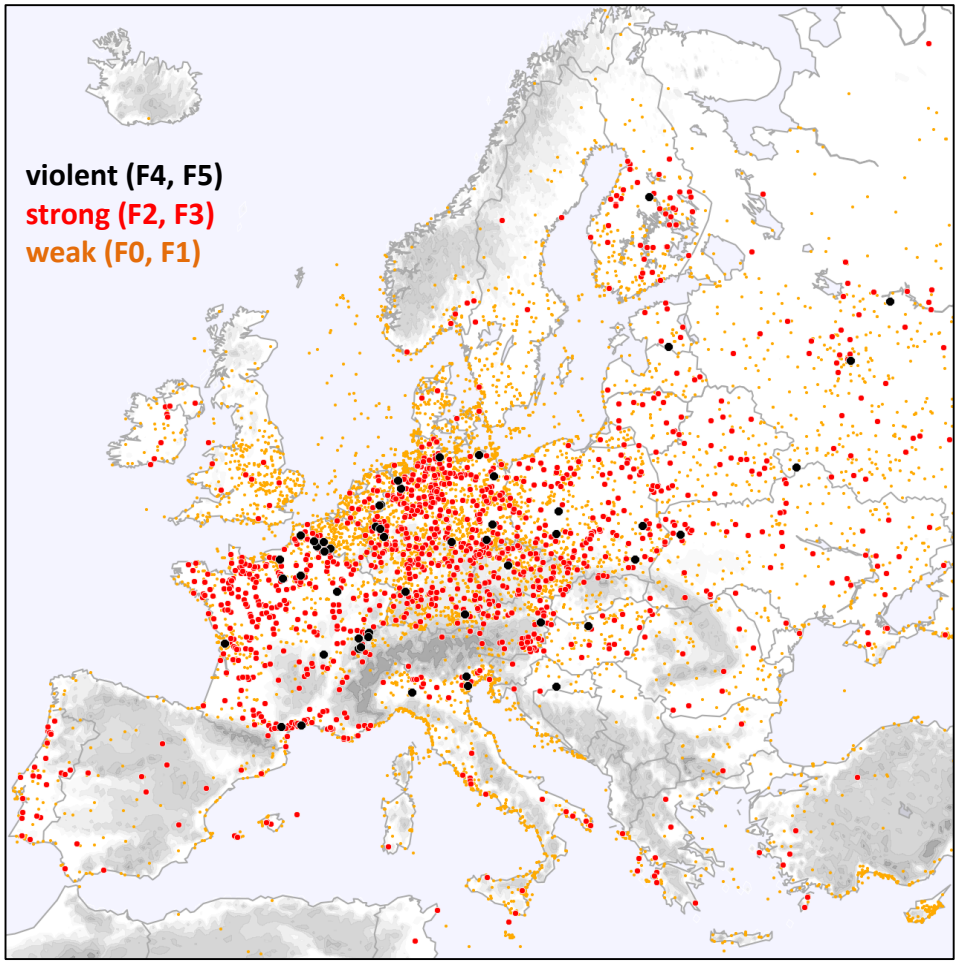
Impacts:

- Railway signaling system in station struck by lightning
- Severe disruptions to rail traffic for several hours.

This project is funded by the European Union

Tornadoes

- Tornadoes capable of doing large damage are rare
- Estimated number of victims per year in Europe: 10-15 (cf. USA: 80)
- Past examples of CI impact on critical infrastructure are rare.
- Very low probability / high risk scenario: strong tornado damaging nuclear plant



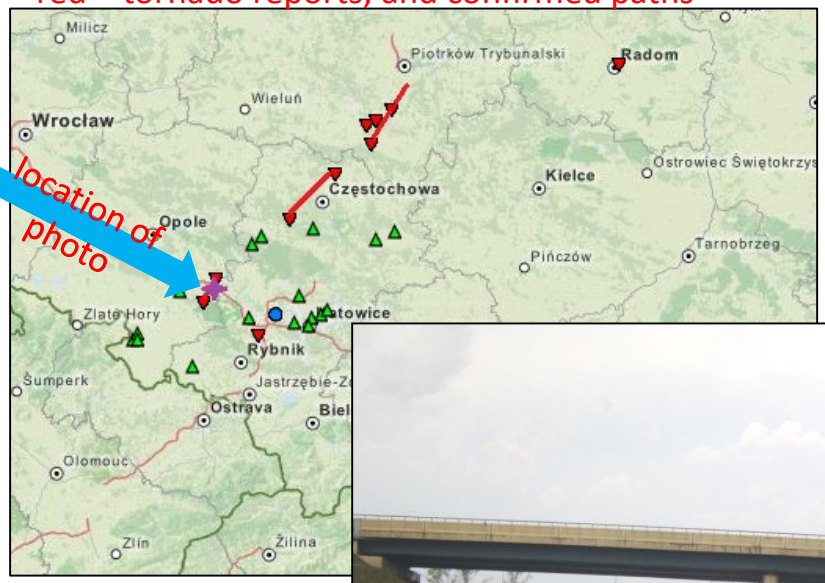
Tornadoes in Europe up to 2013.
(source: European Severe Weather Database, www.eswd.eu) From: Groenemeijer & Kühne (2014)

This project is funded by the European Union

Past case: Poland, 15 August 2013

- Tornado affecting motorway
- Overturning bus, injuring 30
- Damaging lamp posts and signs, lofting van and bus blocking road

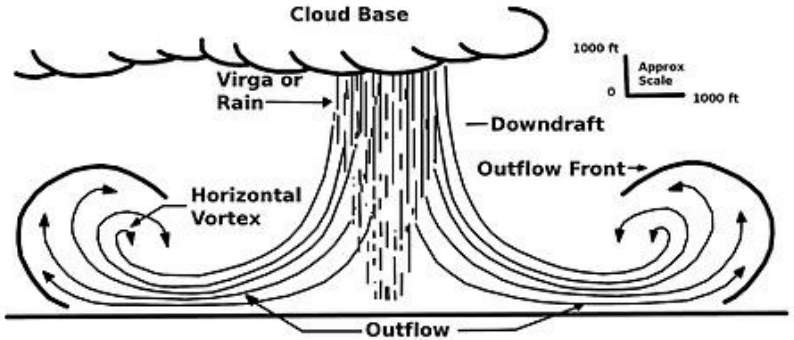
red = tornado reports, and confirmed paths



This project is funded by the European Union

Thunderstorm winds

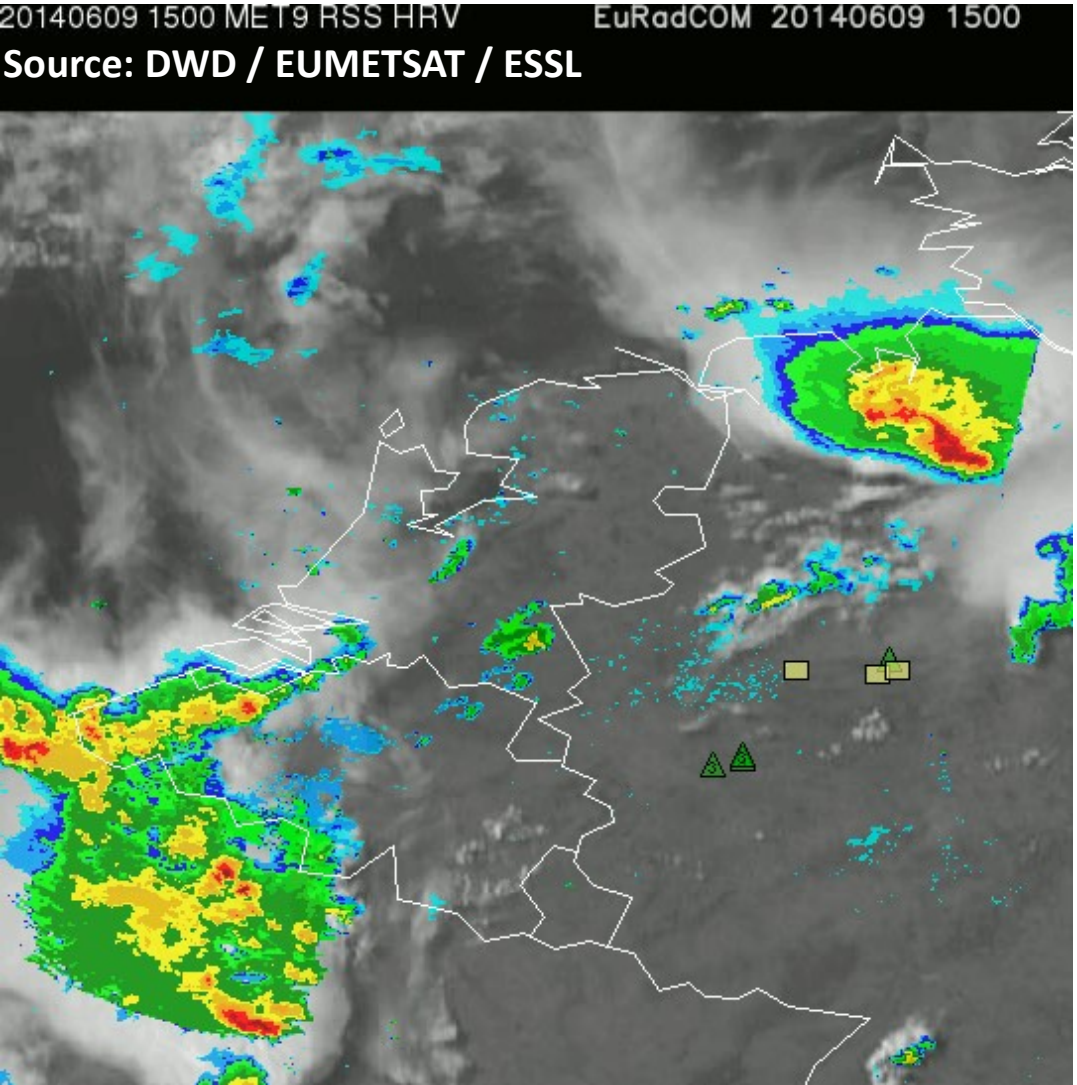
- Largest impact of thunderstorms besides flash floods
- May be very local, or arise as rapidly-moving bow-shaped storm systems



- Are frequent in summer, when trees are green and more susceptible to high winds

This project is funded by the European Union

Past Case:
Bow-echo in western Germany 9 June 2014



- Radar image and ESWD reports of "bow echo" on 9 June 2014.

Legend:

- wind damage report
- large hail report
- flood report

This project is funded by the European Union

Thunderstorm winds

- Most expensive natural hazard impact in history of Deutsche Bahn
- 2200 km of overhead lines destroyed due to fallen trees and branches. Some tracks unusuable for up to a week.
- Many roads blocked in Düsseldorf
- 880 million euro damage (Munich Re, 2014)

Damage to suburban railways in Brechten.
Photo: Rainer Klute.

This project is funded by the European Union

Thunderstorm winds

Predictability:

- Overall very high potential in atmospheric energy can be recognized in advance
- The question whether the energy will be released, and if so, where and when... is difficult

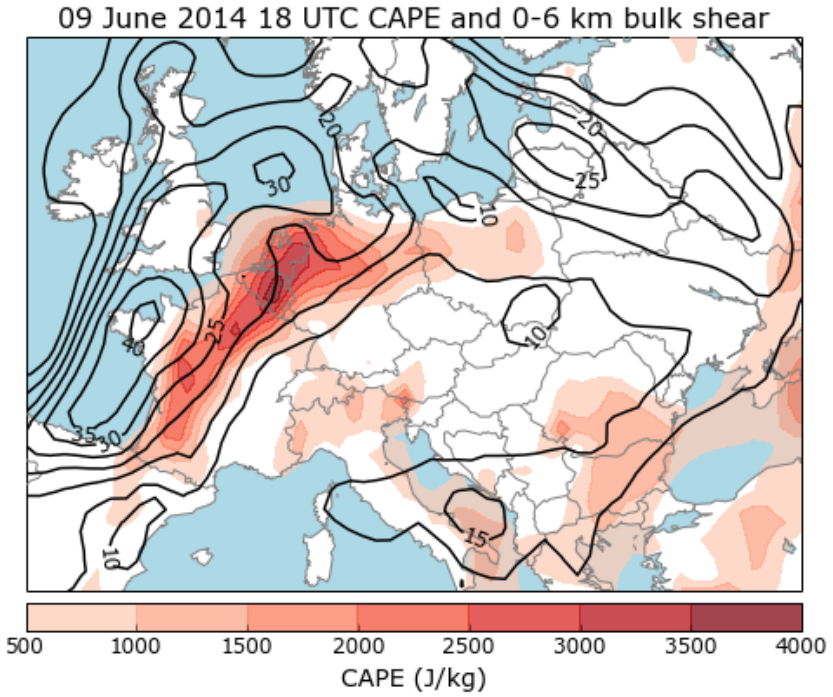
This project is funded by the European Union

Thunderstorm winds

Predictability:

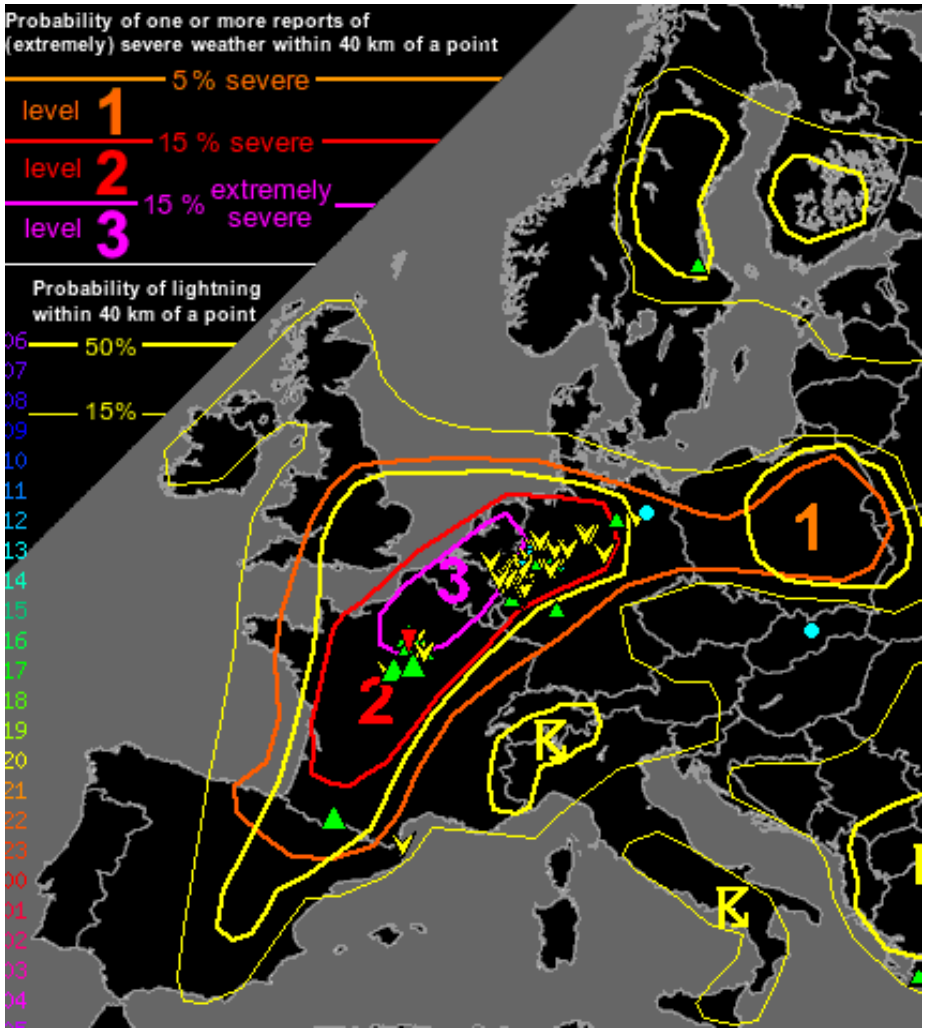
- Overall very high potential in atmospheric energy can be recognized in advance
- The question whether the energy will be released, and if so, where and when... is difficult

CAPE = Convective Available Potential Energy



This project is funded by the European Union

Thunderstorm winds

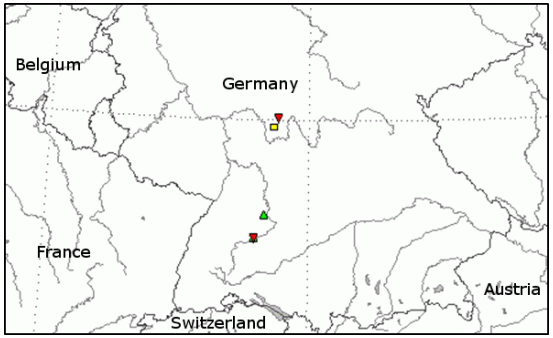


Forecast of thunderstorm risk.
Source: European Severe Storm Forecast Experiment
estofex.org

- Numerical models are still not able to consistently predict these extreme events well
- Fairly good warnings can be given once the system has developed and detected by radar (lead time: ~ hour, sometimes more)

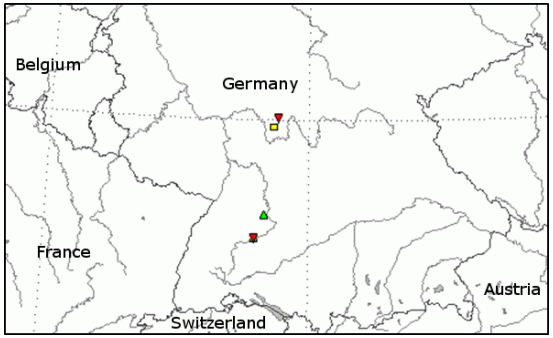
This project is funded by the European Union

Past case: Hail in Stuttgart 15 August 1972



This project is funded by the European Union

Past case: Hail in Stuttgart 15 August 1972



This project is funded by the European Union

Hail

Has has relatively modest effects.

However, it can...

- Create slipperiness, reducing road capacity
- Damage railway control equipment if hail is very large
- Cause or aggravate flash floods

This project is funded by the European Union