

Heavy Precipitation in Europe

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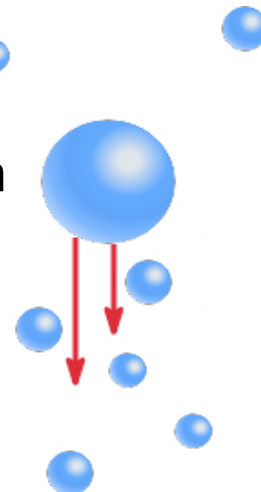
This project is funded by
the European Union

Outline

- What is (heavy) precipitation?
- Predictability
- Warnings
- Climatology
- Climate change
- Ongoing work
- Summary

What is Precipitation?

cold moist air
→ **condensation**



Precipitation = **Rain**
Drizzle
Sleet
Snow
Graupel
Hail

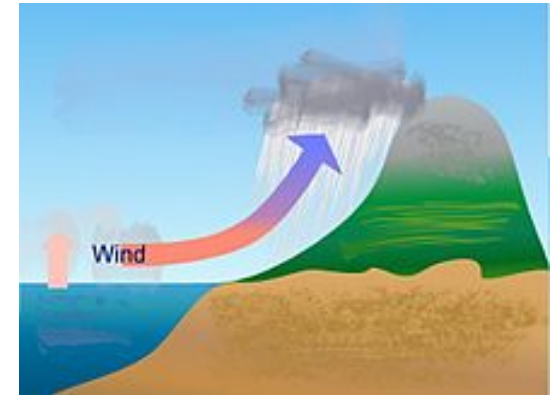


evaporation → **warm** moist air

Types of mid-latitude precipitation

Orography:

- humid air is forced to rise at mountain ridge
- stationary



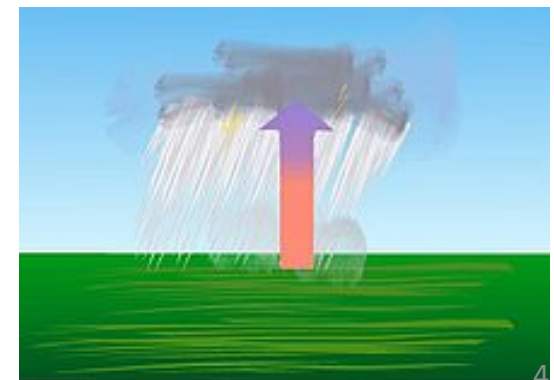
Fronts:

- warm and cold air masses collide (at the warm and cold fronts of cyclones)
- warm air is forced to rise
- large scale



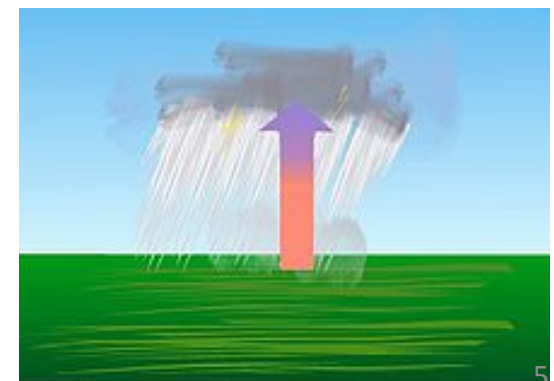
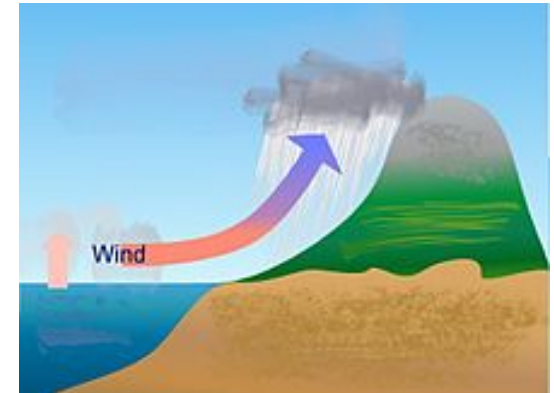
Convection:

- summer
- air warmed by sun
- evaporation and rising motion
- small scale, short duration



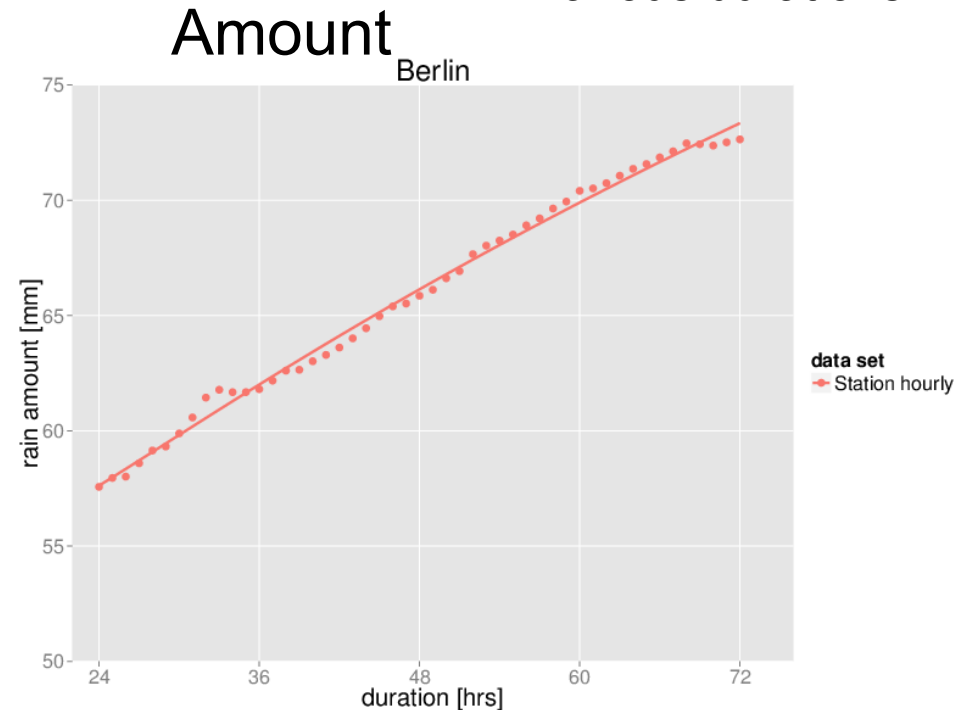
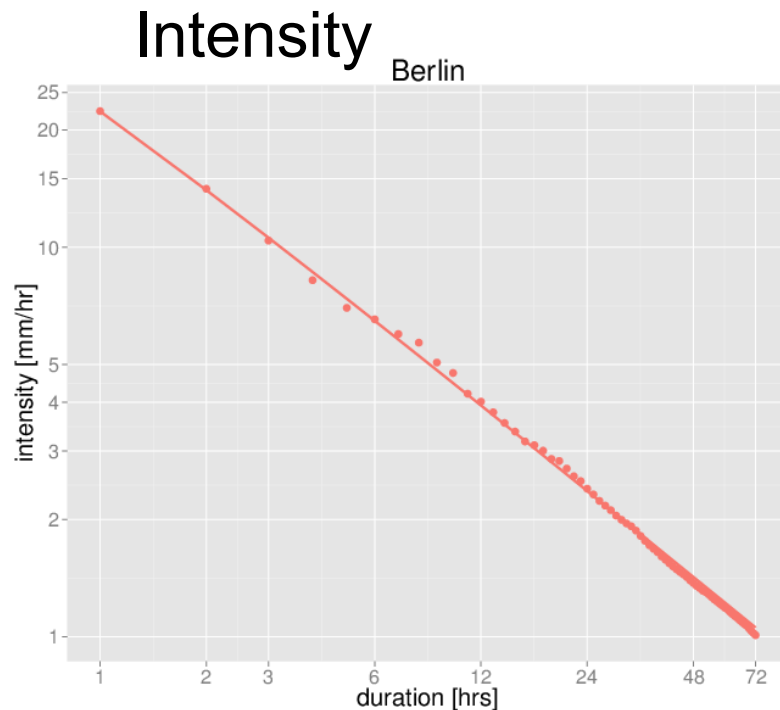
Heavy precipitation

- 1: High atmospheric moisture content
- 2a: Rapid lifting → high intensity
- 2b: Stationarity and moisture convergence → high amount



Heavy Precipitation

10-year return values for various durations



Infrastructure providers concerned about:

20-30 mm/hour

50-100 mm/day

Legislation:

Drainage design based on return levels (e.g. for railroad 10-year return values)

Effects on Infrastructure



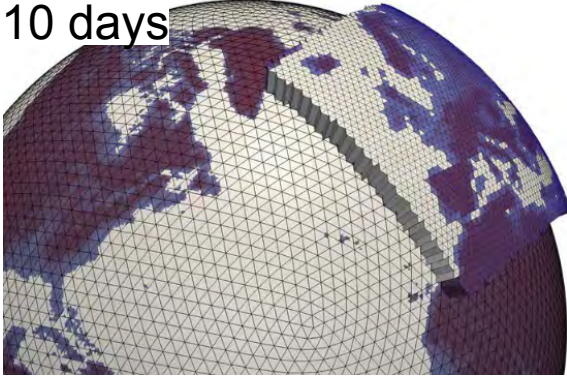
Berliner Morgenpost



Spiegel online

Forecasts (at the German Weather Service DWD)

>10 days

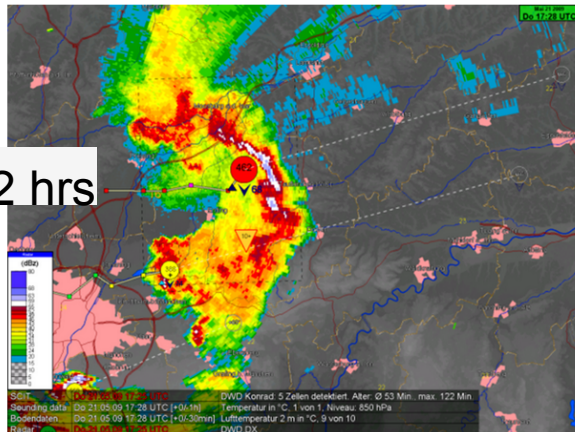


24 hrs

Numerical Weather Prediction (NWP) Model:

- Measurements -> Physical equations -> Forecast
- Calculations on grid:
Global (13km) -> European (7km) -> German (2.8 km)
- Measurements (starting conditions) are uncertain.
Estimate of the effect on the forecast using ensemble of model simulations. Ensemble spread = uncertainty

2 hrs



0 hrs

Nowcasting:

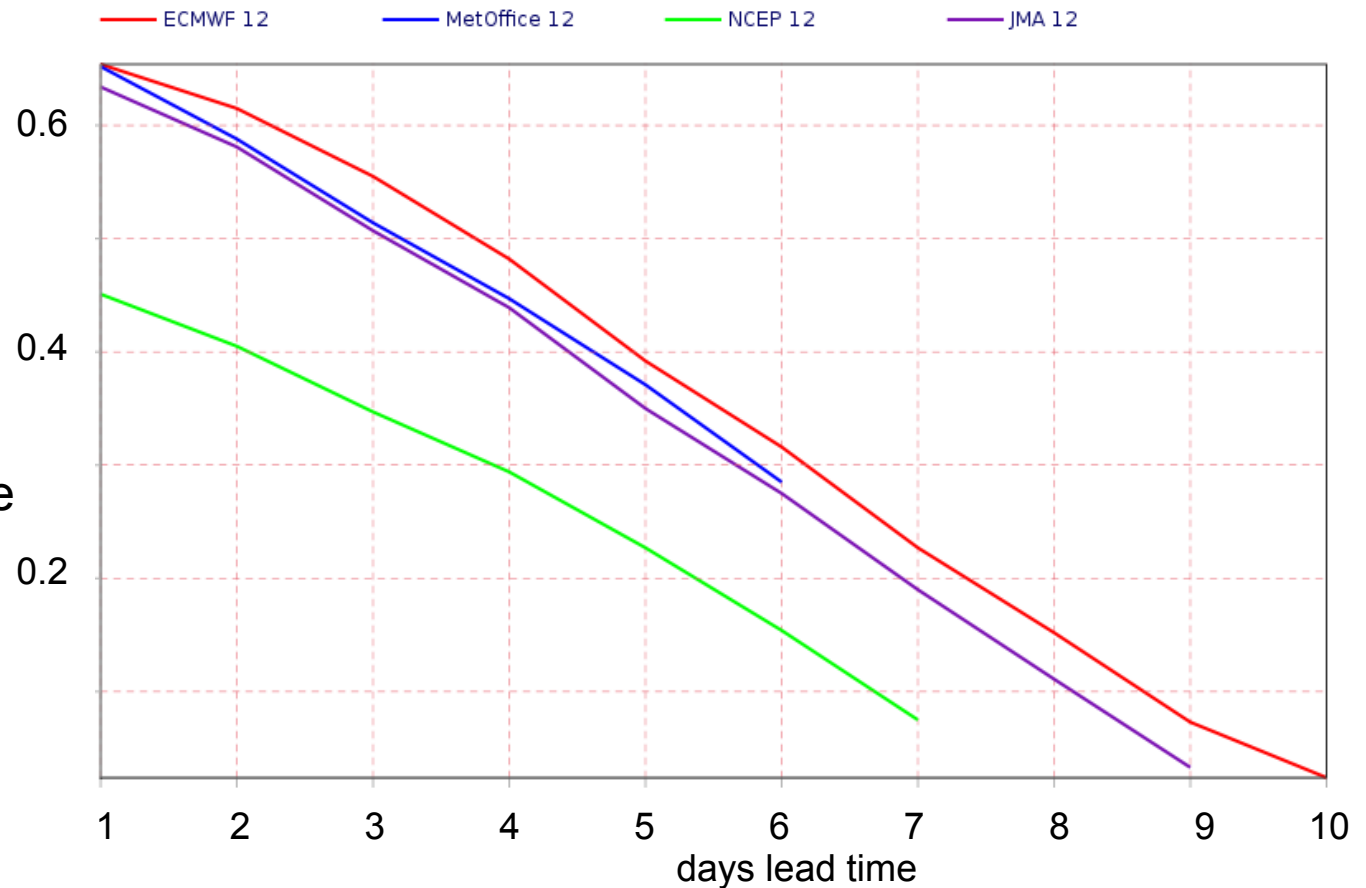
- especially useful to forecast convective precipitation
- Based on radar observations
- Cell detection and movement
- Lightning
- Water content
- ...

Predictability

Date: 201501-201503 SEEPS/tp/europe/observations

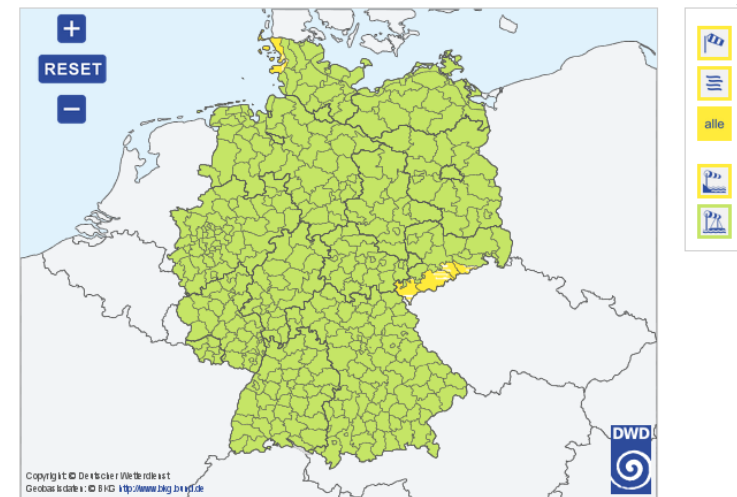
verification score for
precipitation in Europe
for 4 NWP models

1 = perfect
0 = no skill



Warnings (at the German Weather Service DWD)

- Heavy precipitation (intensity and amount), thunderstorms
- Fixed thresholds
- Weather watch (timing and location still uncertain)
- Warnings on county level, 0-3 hrs in advance (convective events)
- (Pre-) warnings issued by a meteorologist
- Graphical and text versions
- Tests with computer-based suggestions edited by meteorologist



Anzeige Warntext nach Auswahl der Warnregion

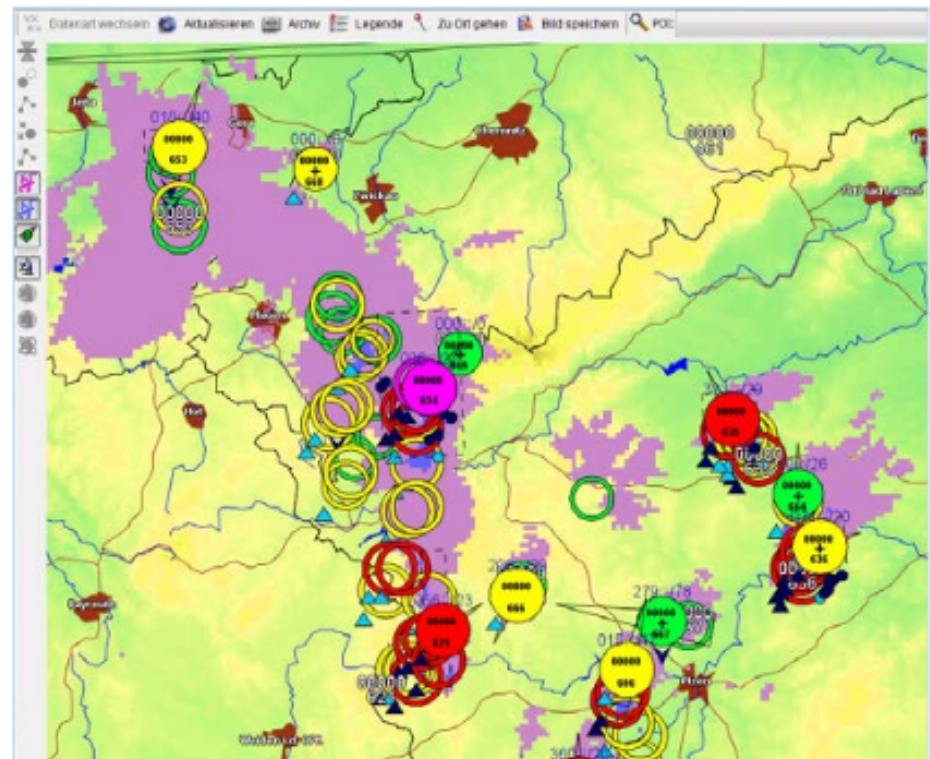
Public information

	Vorabinformation Unwetter		Hitzewarning
	Warnungen vor extremem Unwetter		UV-Warning
	Unwetterwarnungen		Keine Warnungen
	Warnungen vor markantem Wetter		
	Wetterwarnungen		

Warnings (at the German Weather Service DWD)

- Non-public special products for infrastructure operators and emergency rescue services

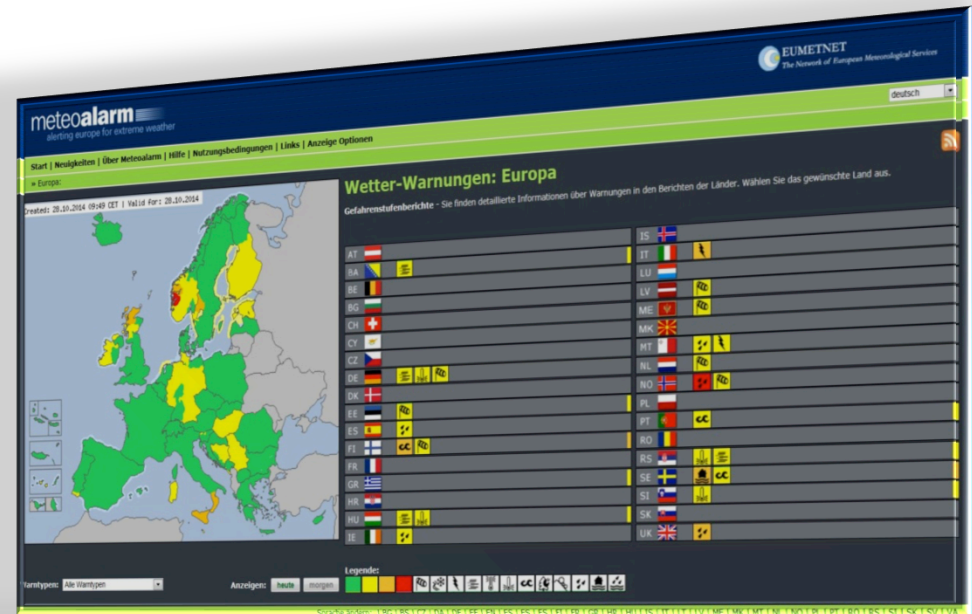
Non-public information



Screenshot of KONRAD
part of the Firefighter Information
System (FeWIS)

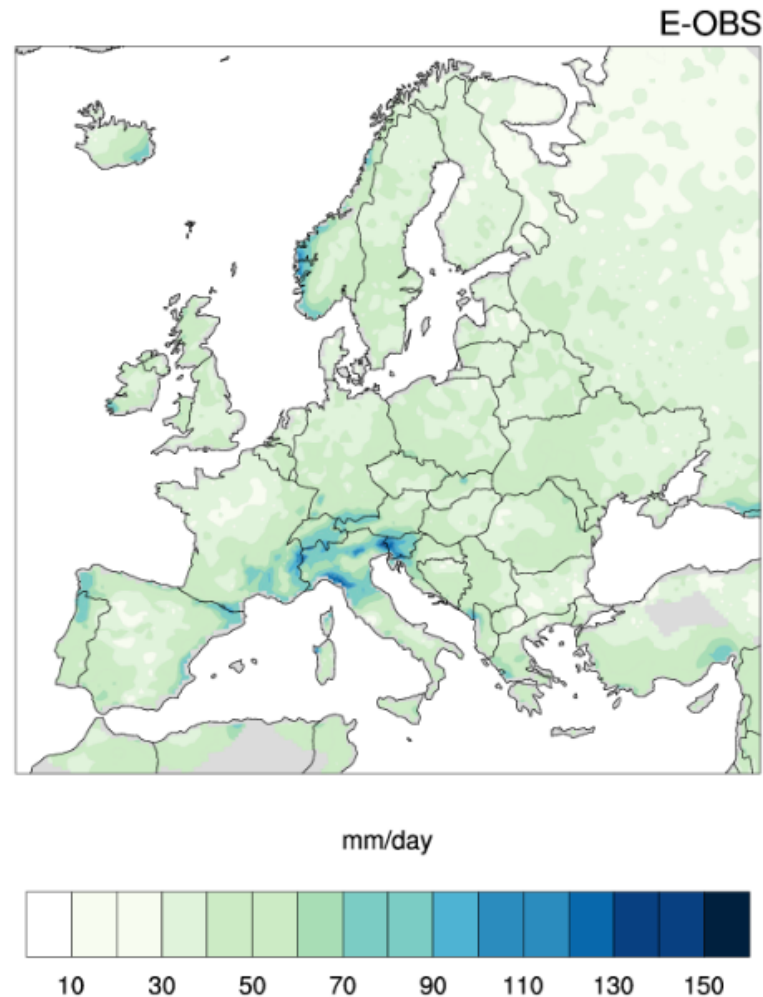
Warnings at European scale

www.meteoalarm.eu



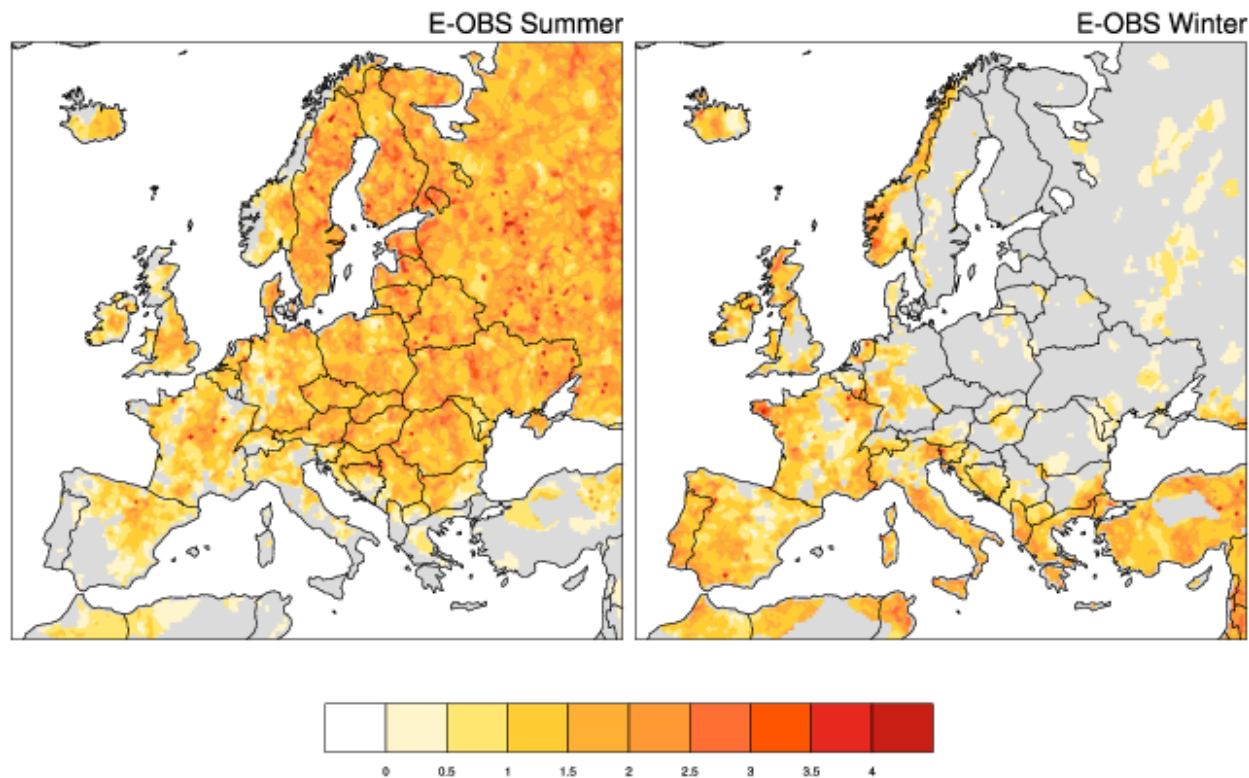
- Collects warnings of the national weather services
- Individual thresholds for each country

Climatology of heavy precipitation



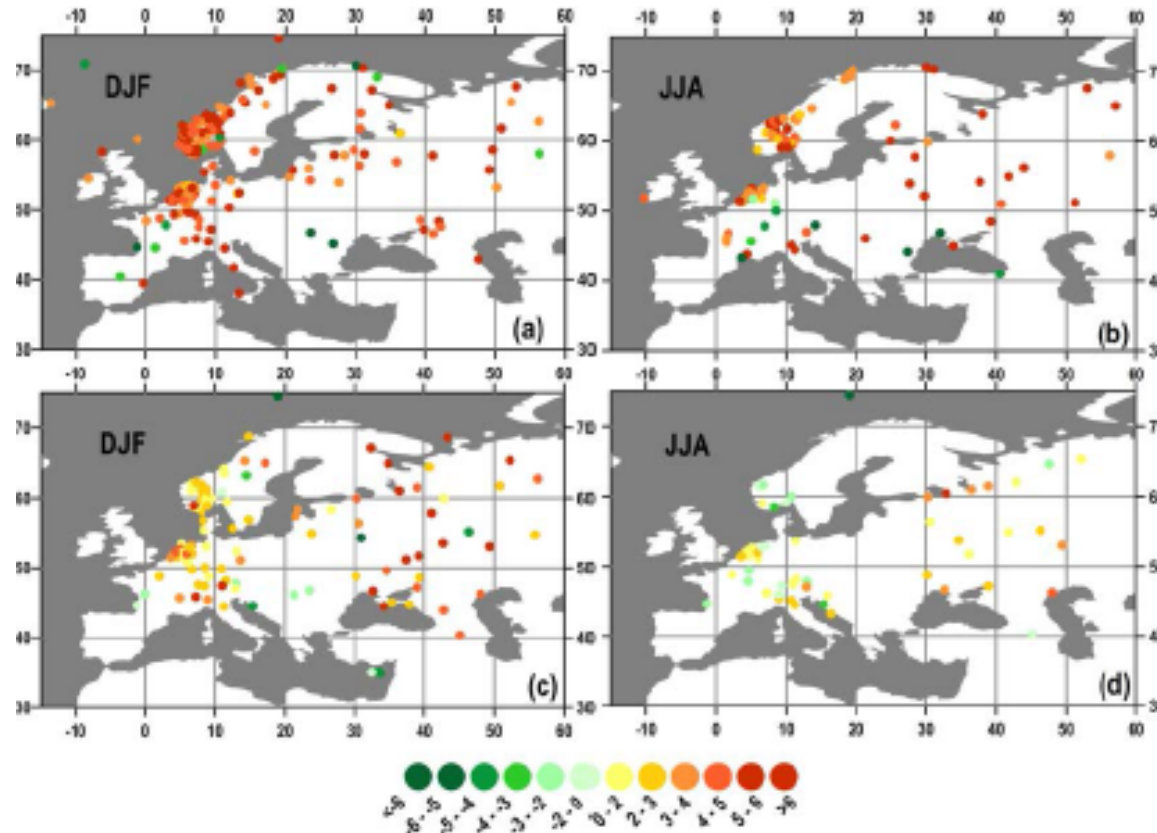
10-year return value
1971-2000
from gridded E-OBS
observational data set

Climatology of heavy precipitation



Number of events per decade exceeding 10-year return values.
Events with durations between 1-3 days. 1971-2000

Climate Change (trends in extremes in recent past)

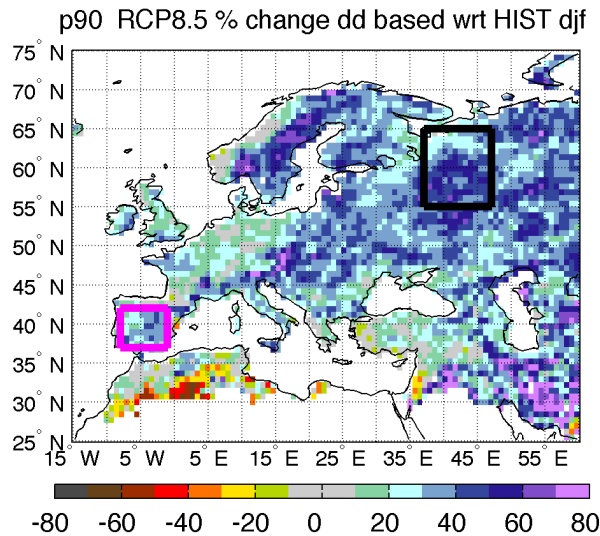


1901–2010

1951–2010

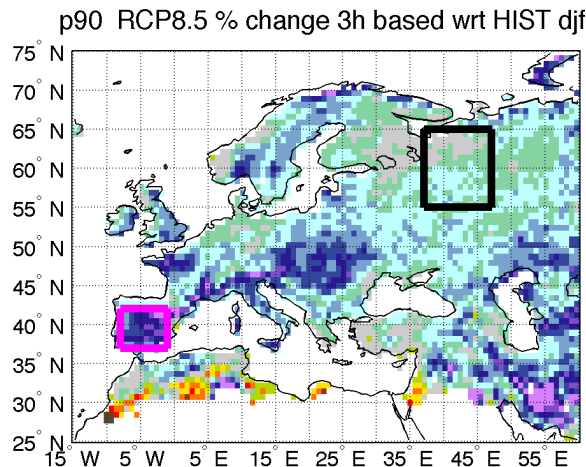
Linear trends (1901–2010) and (1951–2010) in 95th percentile of daily precipitation over Europe for winter and summer. Only significant trends (95% level) are shown. (Zolina, 2012)

Climate Change (climate projections of extreme events)



daily

Predicted change of intense precipitation (95th percentile) in % between present day and 2081-2100 in winter. Scenario RCP8.5.

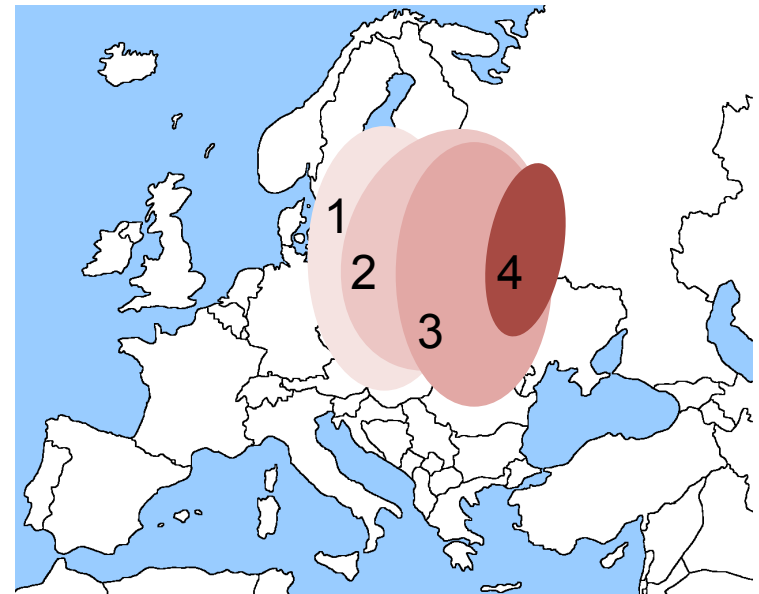


3 hourly

RAIN-Project Approach

Detection of events:

Areas affected by heavy precipitation (amount and intensity) are tracked in time and space

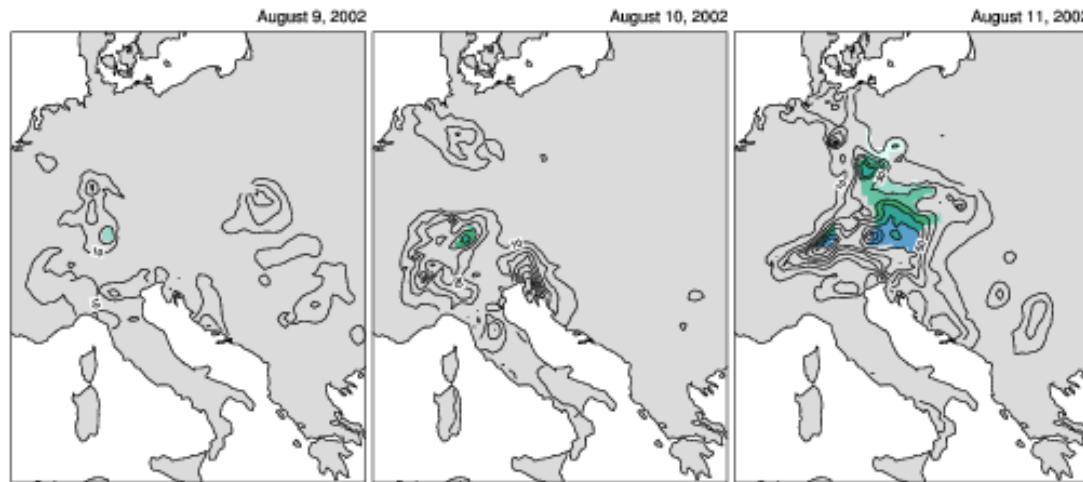


Information about

- duration
- size
- severity (duration, size and amount)

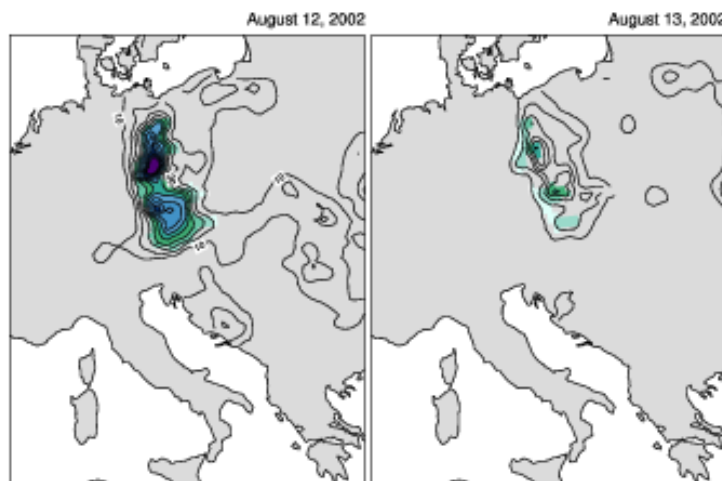
RAIN-Project Approach

Example August 2002:



Duration: 5 days
Area: 185 000 km²
Severity: 50
 (99th percentile of all events)

Precipitation
 exceeding
 10-year return
 level (mm)



www.pirna.de



Outlook

- Apply event detection to ensemble of climate change simulations (different models and different scenarios) -> robust results
- Very high horizontal resolution
- Thresholds appropriate for infrastructure

Summary

Forecasts

Deterministic precipitation forecasts for Europe loose skill after 10-days

Warnings

For convective events only some hours in advance

Present day climate:

Regional differences in spatial and temporal distribution of extreme precipitation

Climate change:

Warmer Climate -> More moisture in the atmosphere-> More extreme precipitation events

RAIN- project:

- Event-based approach to determine the climate change signal
- Robust results due to high number of model simulations
- Amount and intensity taken into account