



Unwetterforschung im Europäischen Kontext – das ESSL in Österreich

Alois M. Holzer

mit Beiträgen von Pieter Groenemeijer, Georg Pistotnik und anderen ESSL-Kollegen



The European Severe Storms Laboratory

- non-profit research organization
- legally, an association with members
- statutory purposes:

ESSL employees



European Severe Storms Laboratory

1. Perform and support severe weather research at a European level



European Severe Weather Database

2. Management and development of the European Severe Weather Database ESWD



European Conference on Severe Storms

3. Organization or support of the European Conference on Severe Storms



Pieter Groenemeijer
Director



Alois M. Holzer
Treasurer,
Director of Operations



Kathrin Riemann-Campe
Deputy Director



Thilo Kühne
ESWD Quality Control Manager



Magdalena Pichler
Assistant to the Executive Board



Georg Pistotnik
Research Associate



Zhongjian Liang
ESWD Database Programmer



Thomas Schreiner
ESWD Quality Control
and User Support

ESSL members

- Individual members
 - Researchers
- Institutional members
 - 9 National (Hydro-) Meteorological Services
 - EUMETSAT
 - 6 Reinsurance/Risk modelling companies
 - German Aerospace Center DLR
 - Academia Sinica, Taiwan



National Meteorological Administration
(Romania)



CZECH HYDROMETEOROLOGICAL INSTITUTE



Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft



Münchener Rück
Munich Re Group



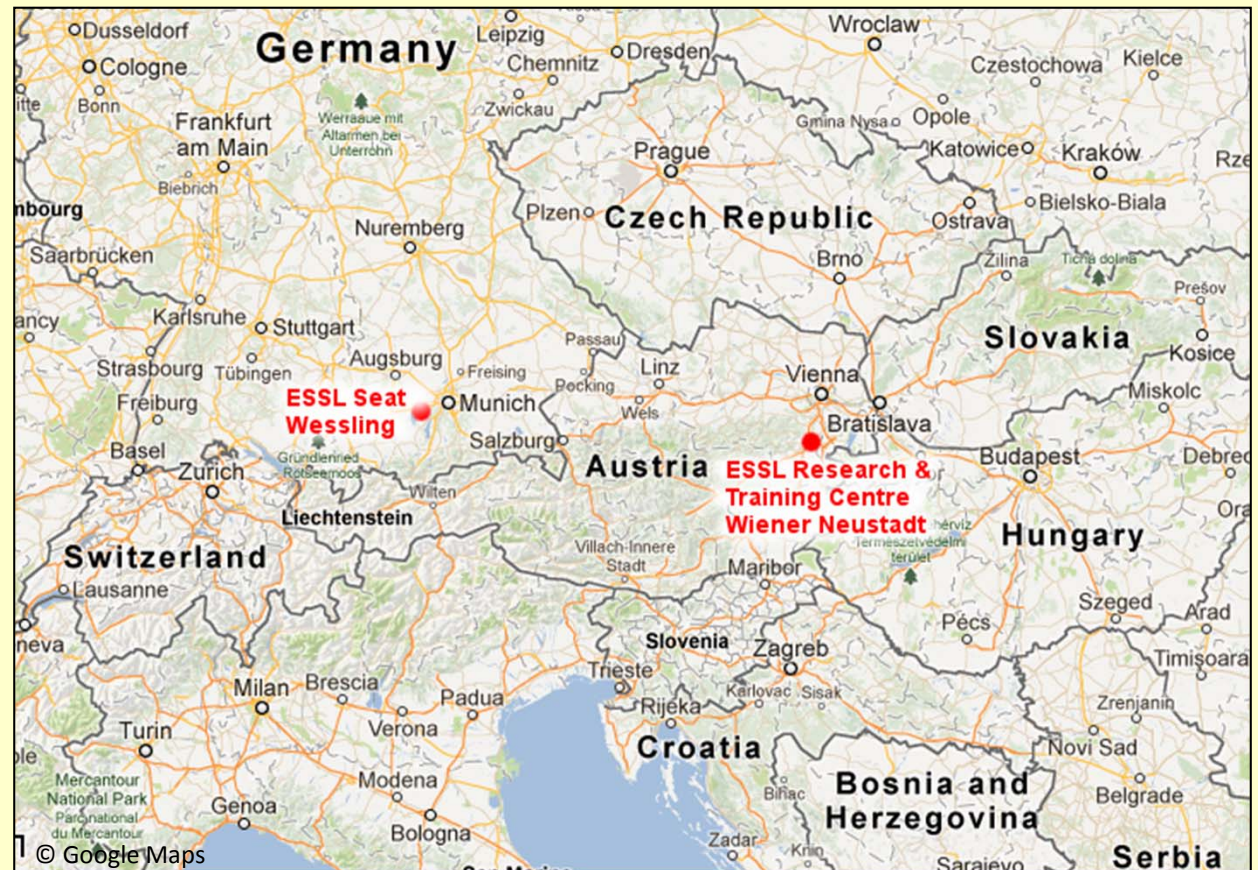
Willis



Two legal entities

- ESSL is seated in Wessling, Germany at the German Aerospace Center
- ESSL has a subsidiary seated in Wiener Neustadt, Austria: ESSL – Science and Training

This is where the **ESSL Testbed** and several training and research activities are carried out.



Financing

ESSL has these primary sources of income:

1. Membership fees

2. Projects funded by third parties, e.g.

- European Commission
- National and regional governments
- Partner research organizations

3. Fees for „own projects“:

- ECSS – European Conference on Severe Storms
- ESSL Testbed
- Trainings, Seminars, Workshops

ESSL's History

- 1997: Formation of TorDACH network
- 2002 - 2004: ESWD-Predecessors
(Fulvio Stel & Dario Giaioti; Pieter Groenemeijer)
- **2006: Formal foundation of ESSL** as spin-off of German Aerospace Centre
- 2008: Modern ESWD with support of German Weather Service (DWD)
- 2009: 5th ECSS conference in Landshut, Germany
- 2010: Passing away of Dr. Dotzek, First ESSL Director
- 2011: 6th ECSS conference in Palma de Mallorca
- **2011: Foundation of ESSL Science and Training in Wiener Neustadt, Austria**
- 2012: First ESSL Testbed and newly opened Research and Training Centre in Wiener Neustadt
- 2012: Number of ESWD Reports exceeds 50 000
- 2013: 7th ECSS in Helsinki



Dr. Nikolai Dotzek
First ESSL Director
† 2010

Motivation

The ESSL focuses on meteorological events that are:

- local and short-lived
- severe (causing damage)

Many of these events occur with **convective storms**



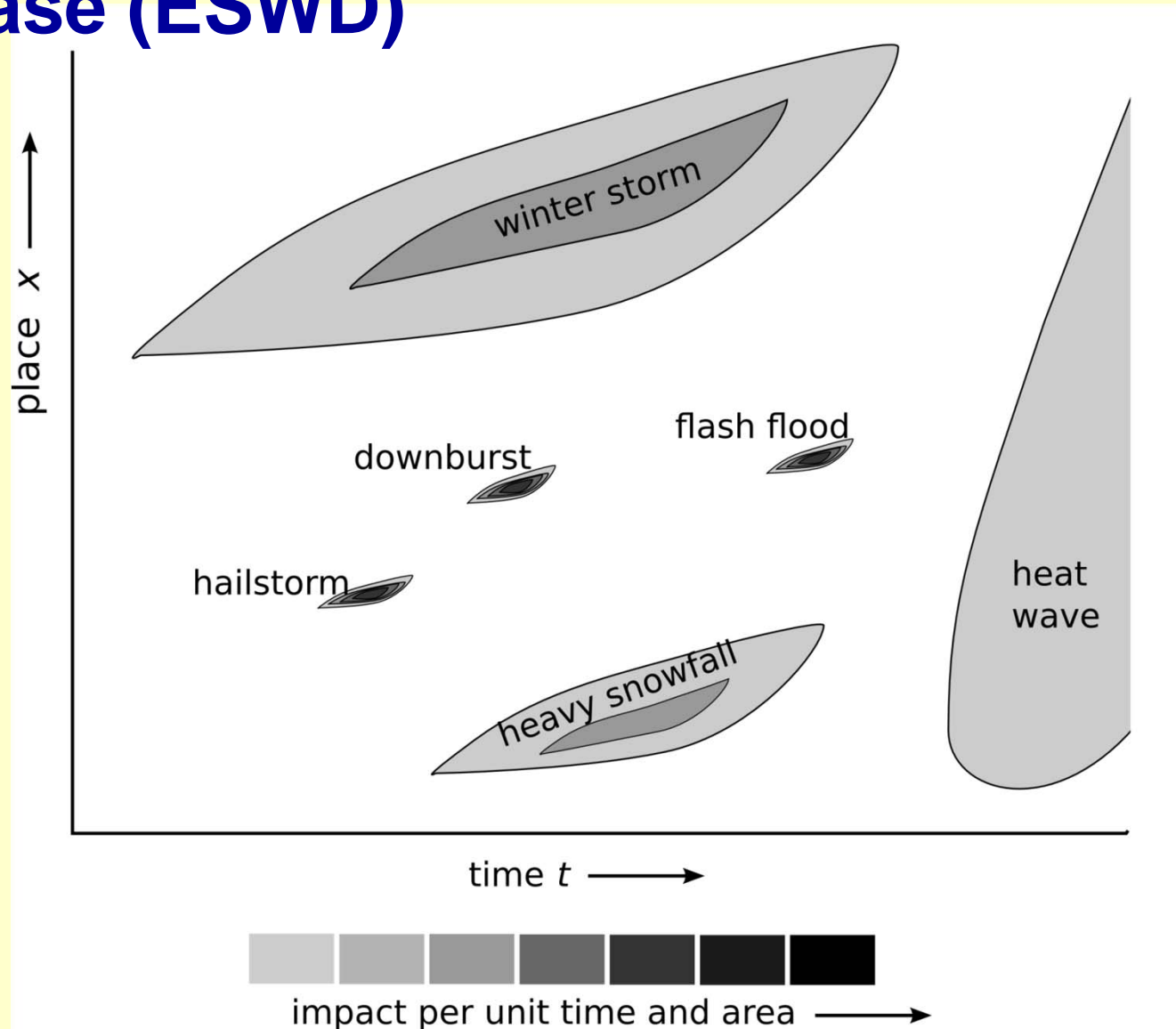
Photo courtesy of Walter Stieglmair

Motivation

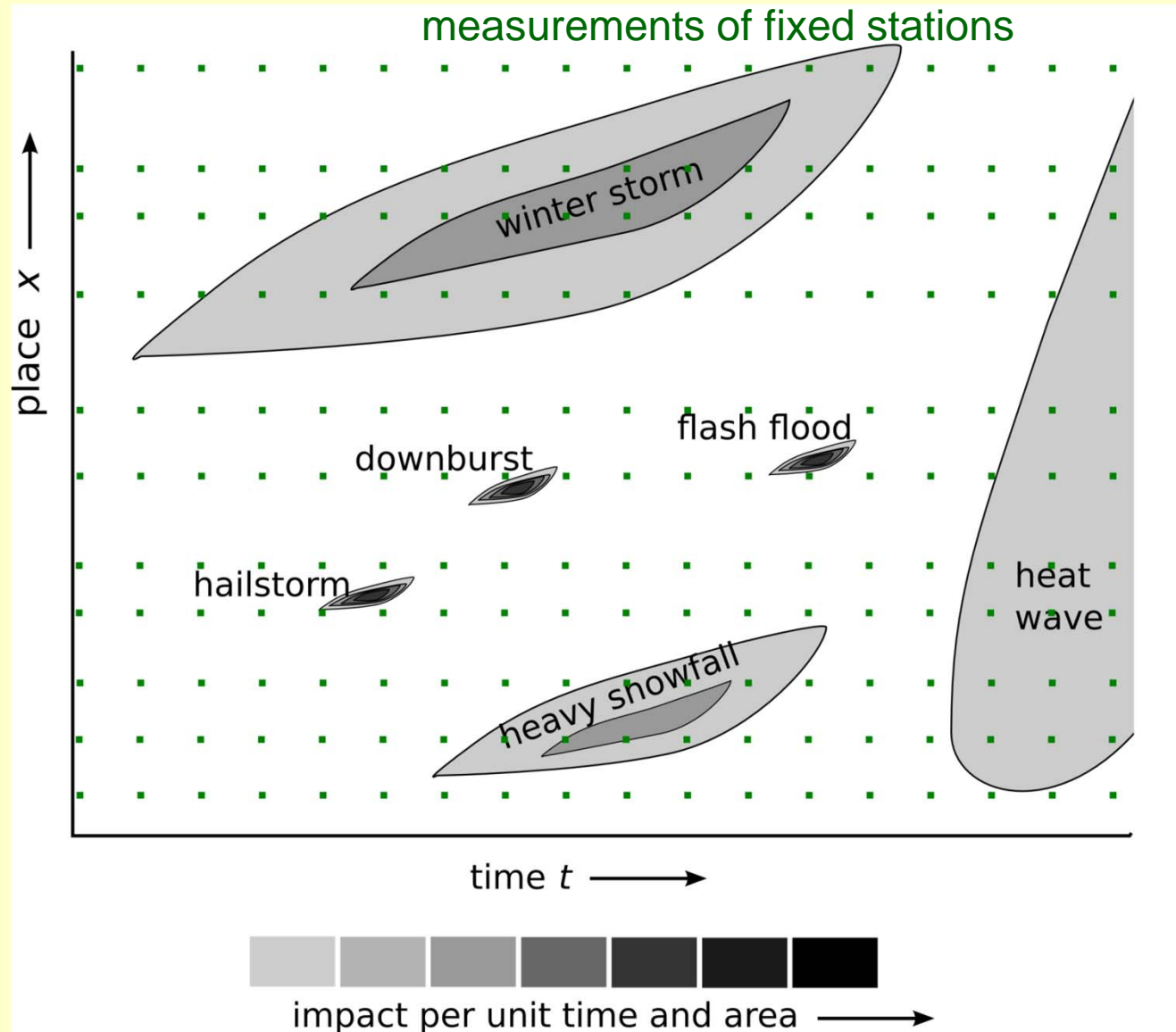
- Keep track of these events (hail, flash floods, gusts, tornadoes, lightning...)



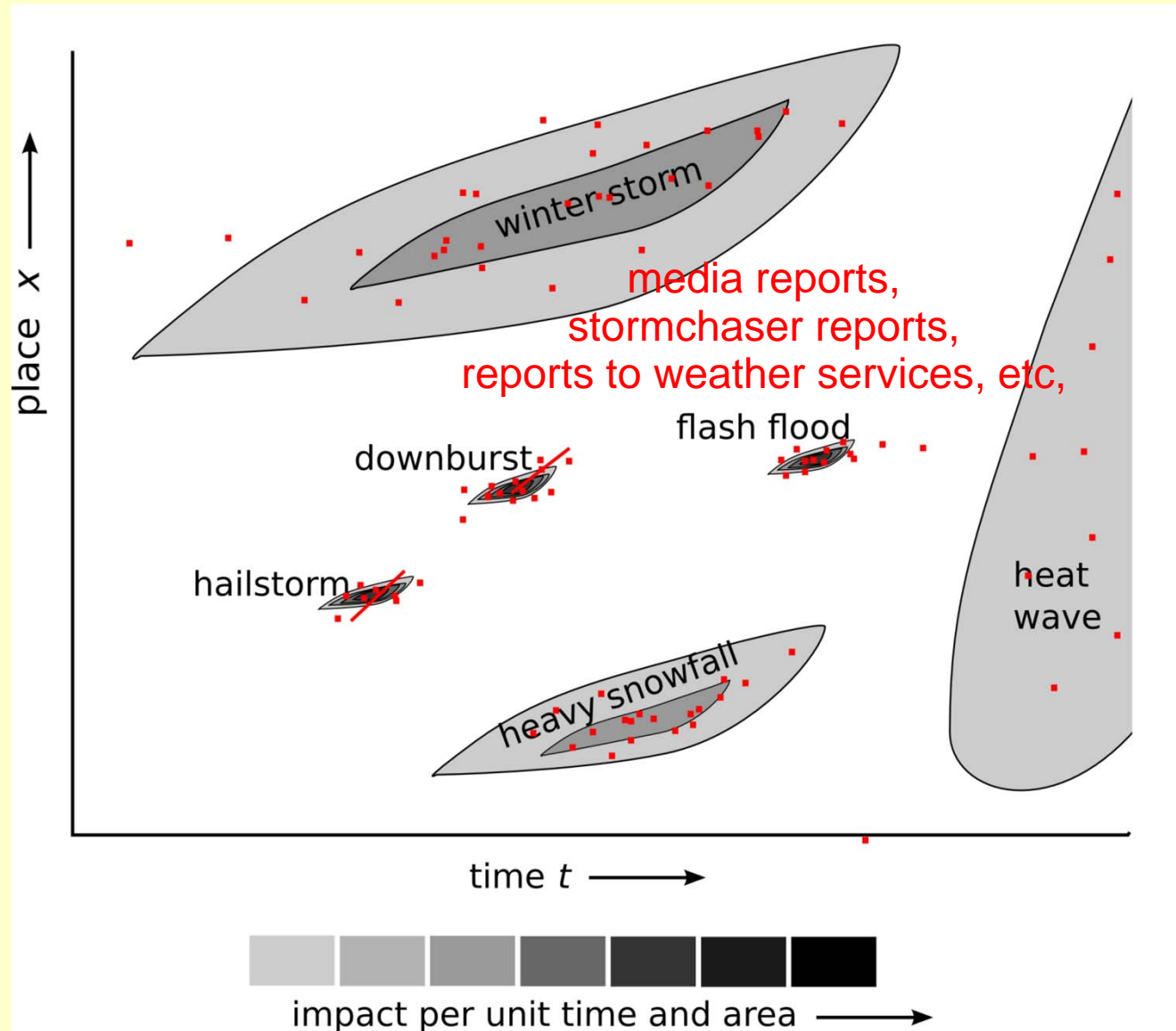
Need for a European Severe Weather Database (ESWD)



Motivation for ESWD

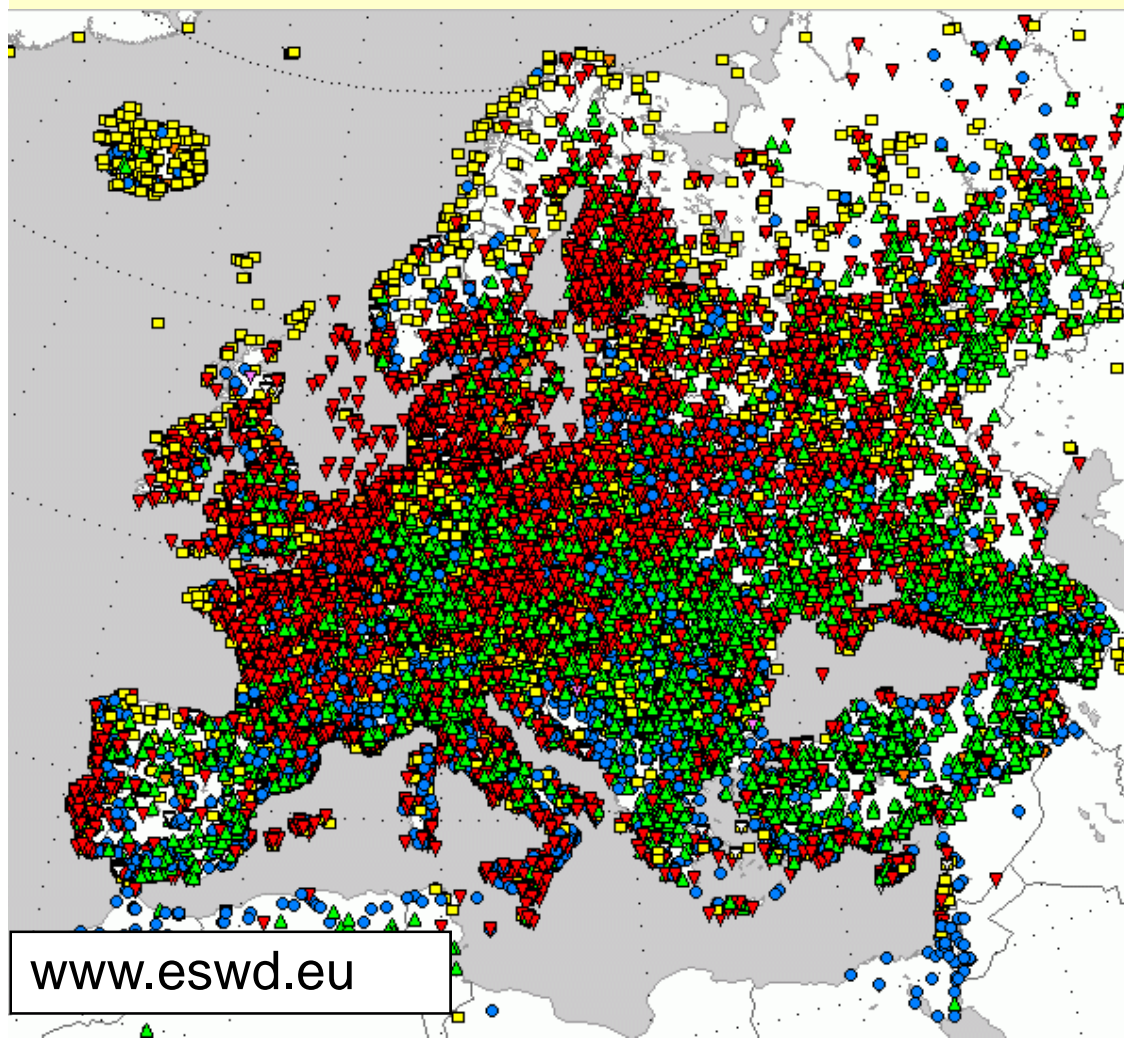


Motivation for ESWD



The European Severe Weather Database

- more than 50 000 individual reports of severe weather



www.eswd.eu



Tornadoes
Severe wind gusts
Large hail
Extreme rainfall

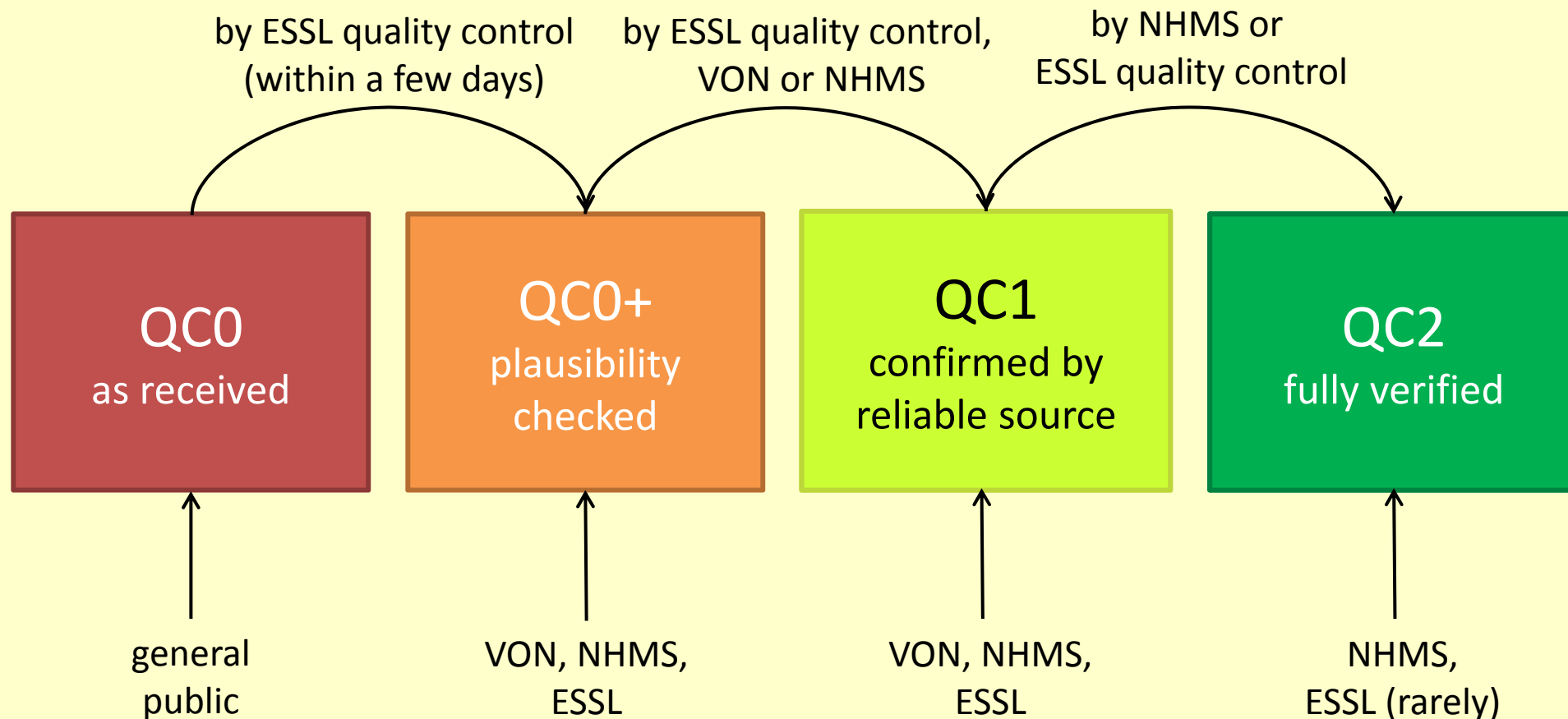
Avalanches
Heavy snowfall
Damaging Lightning
Freezing rain...

Data from the eastern Alpine Region

Tornadoes
Severe wind gusts
Large hail
Extreme rainfall



Quality control



* reliable sources include:

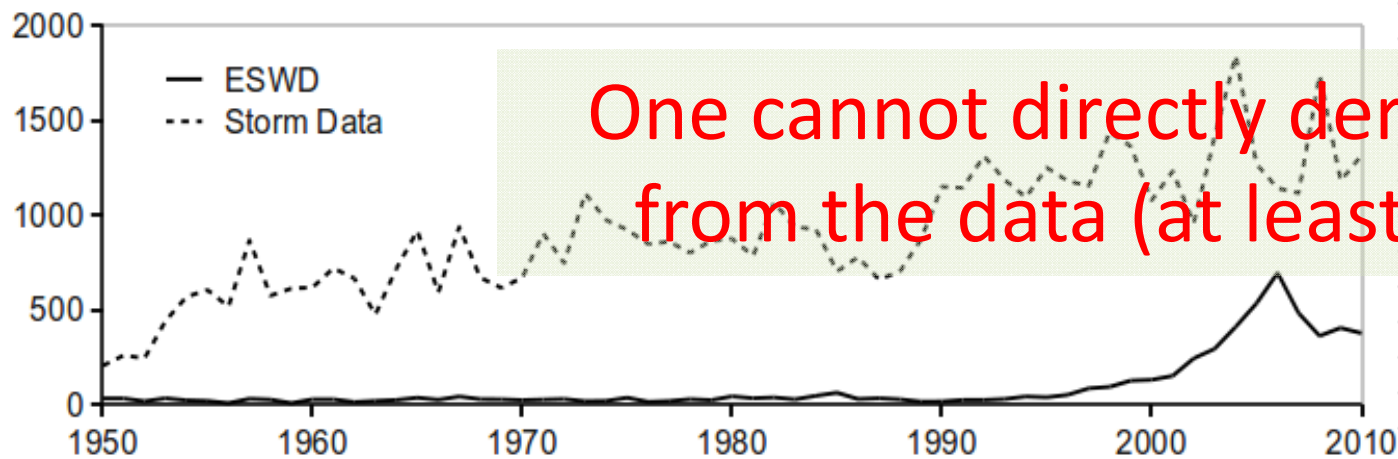
- conclusive photo and/or video material, with accurate time & location
- certified storm spotter reports

VON = Voluntary Observer Network
NHMS = National Hydro-Meteorological Service

ESWD data and climatology

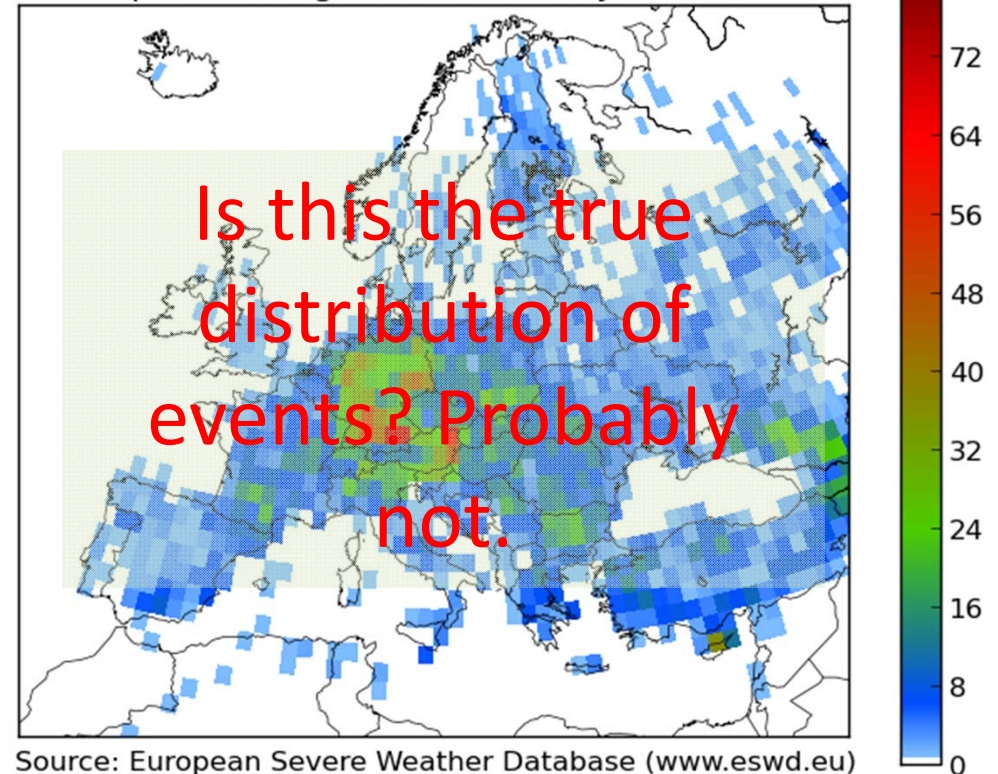
- The data set contains spatial and temporal inhomogenities

Number of tornadoes for Europe (according to ESWD), and for USA according to NOAA Storm Data:



One cannot directly derive trends from the data (at least not yet)

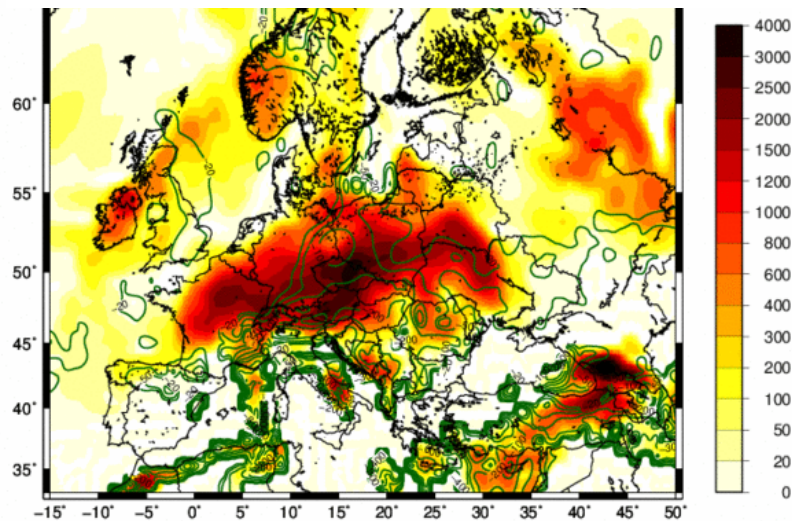
Number of six-hour periods with hail (2+ cm) per 1x1 degree box since 1 Jan 1979



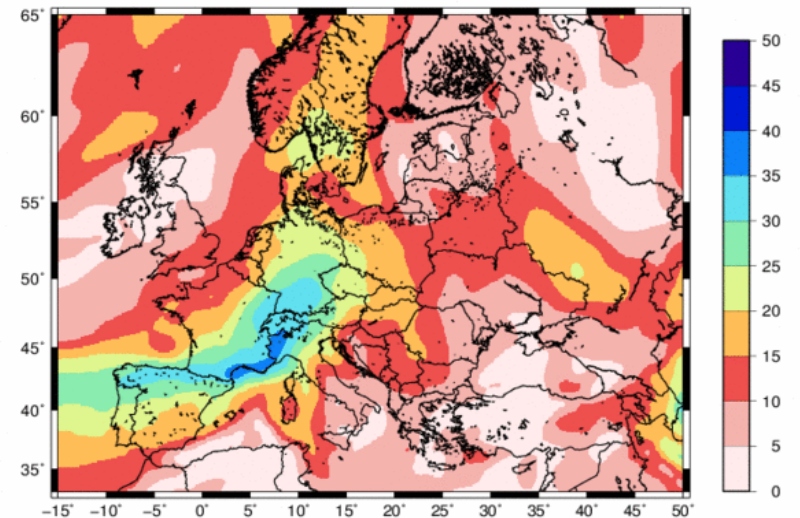
ESWD data and climatology

- ESWD data can tell one under which atmospheric conditions severe weather occurs

High latent instability (CAPE, J/kg)



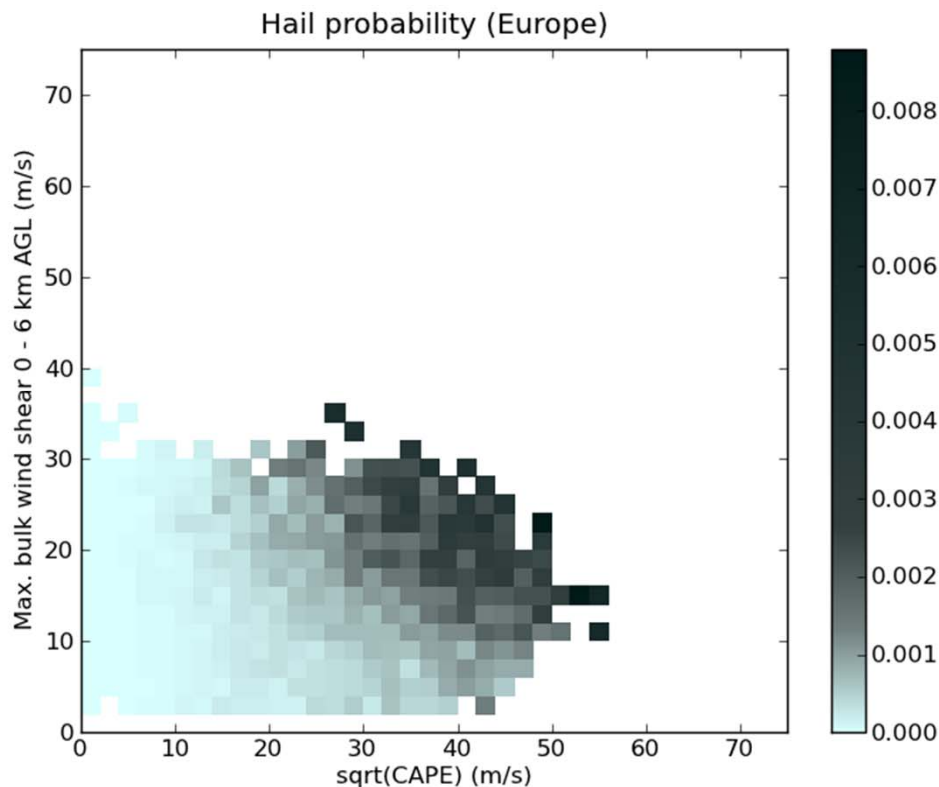
Strong 0 – 6 km wind shear



European Severe
Weather Database
www.eswd.eu
(c) ESSL

ESWD Reports at this (23 July 2009 1200 UTC)
Yellow: wind, Green: large hail, Red: tornado

ESWD data and climatology



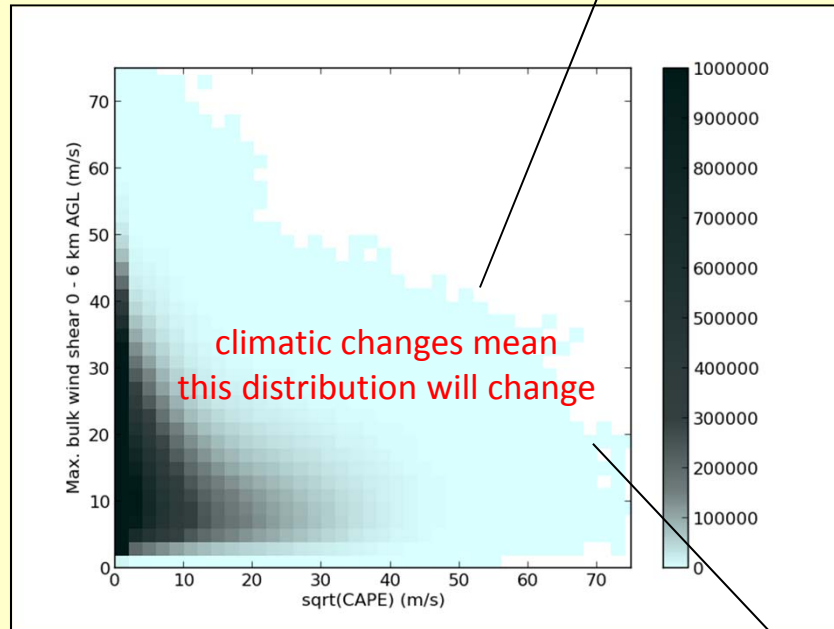
Probability of **large hail (2+ cm)** as a function of two parameters, $\sqrt{\text{CAPE}}$ and 0 – 6 km AGL wind shear.

Data sources: ECMWF (*ERA-Interim 1979-2011*) and ESWD

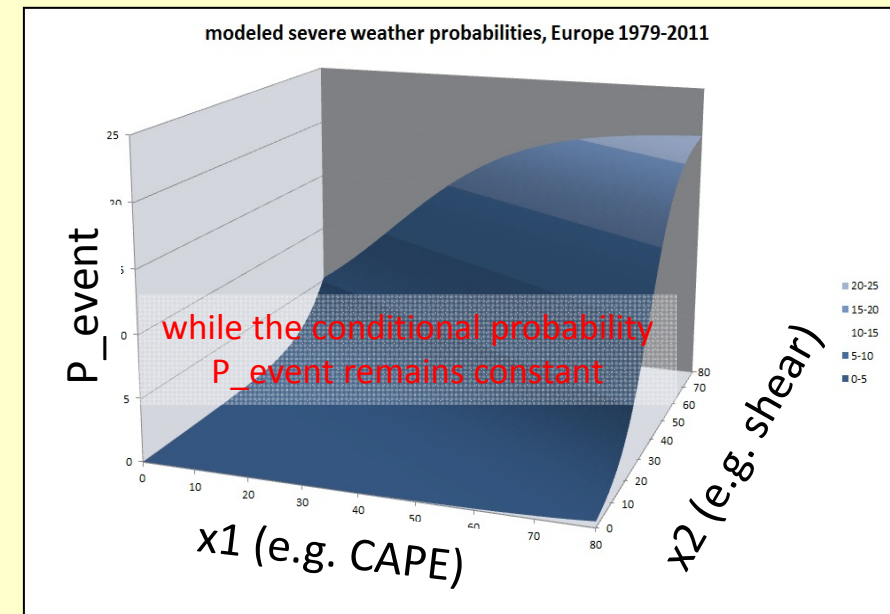
preliminary data from project STEPCLIM
funded by German Ministry of Education and Research

Modelling severe weather occurrence (STEPCLIM, RAIN)

f : how frequently does the atmosphere visit a particular area of parameter space?



P_{event} : the probability that severe weather occurs given that the atmosphere is in a given region of parameter space?

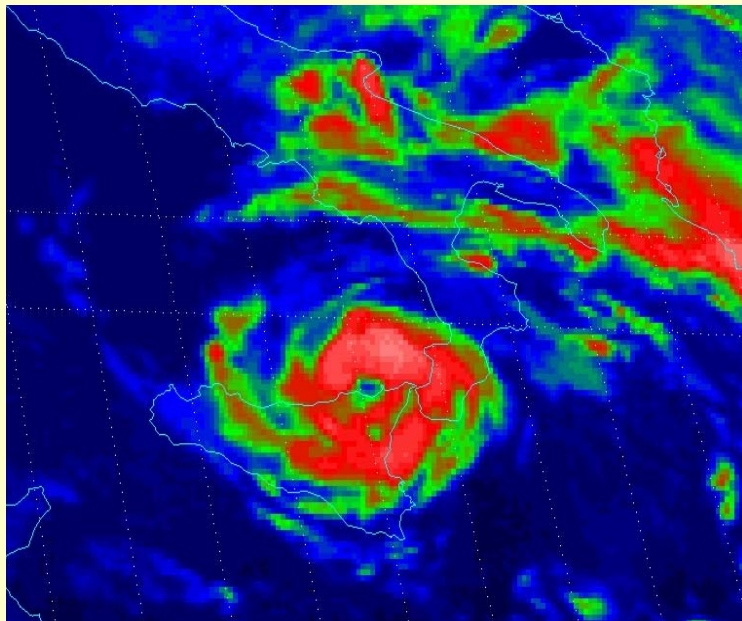


$$N = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \dots \int_{-\infty}^{\infty} f P_{event} dx_n \dots dx_2 dx_1$$

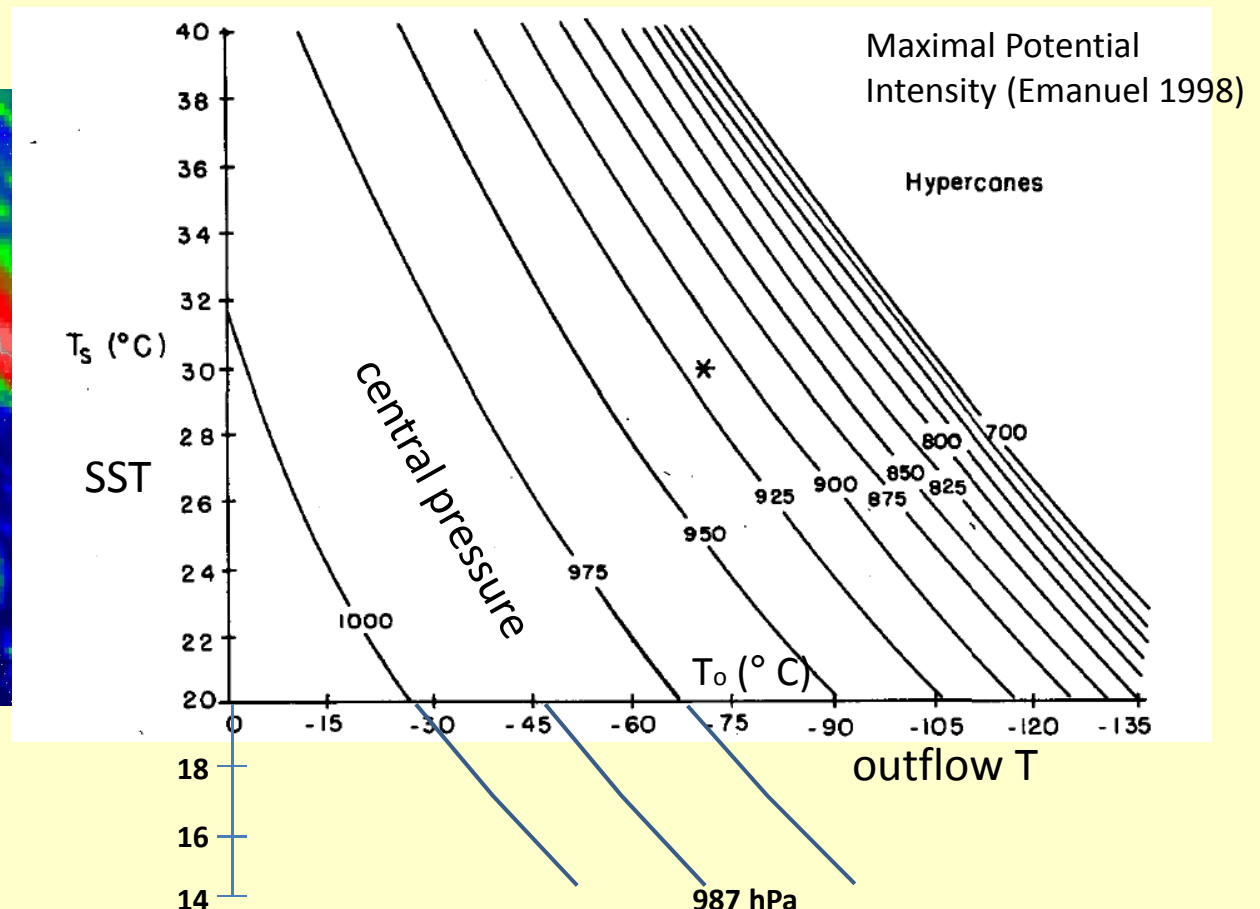
(number of severe weather events)

(Sub-)tropical cyclones near Europe

Hurricane-like systems occur occasionally over the Mediterranean and Black Sea, and the eastern Atlantic.



“Enhanced” IR image
10 Oct 1996 00 UTC (EUMETSAT)



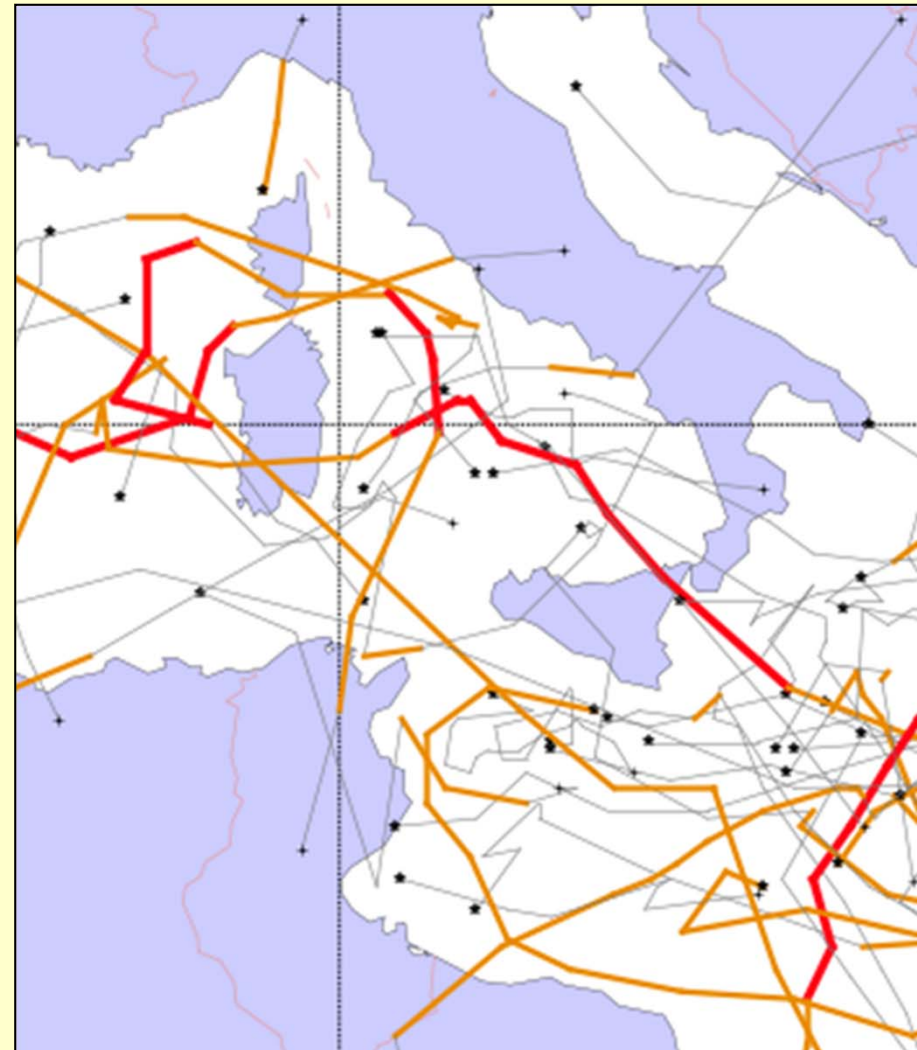
(Sub-)tropical cyclones near Europe

ESSL has established the first systematic study to derive a climatology using METEOSAT-Data from 1982 – 2006.

Intensity was assessed with Dvorak and Hebert-Poteat methods (used e.g. at U.S. National Hurricane Center)

Results also available for

- western Mediterranean
- eastern Mediterranean
- eastern Atlantic Ocean
- Black Sea



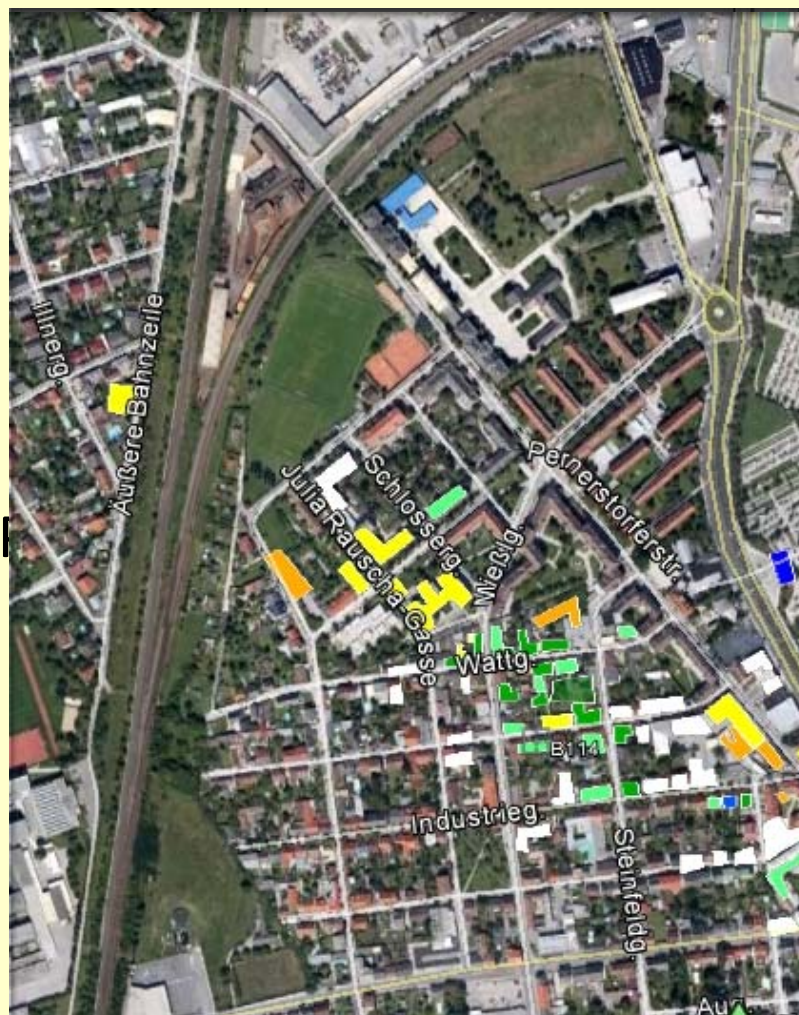
All tropical and subtropical cyclones 1982 – 2006 across the Mediterranean Sea:

16 (Sub-)tropical depressions

27 (Sub-) tropical storms

4 Hurricanes

Assessment of an historical tornado

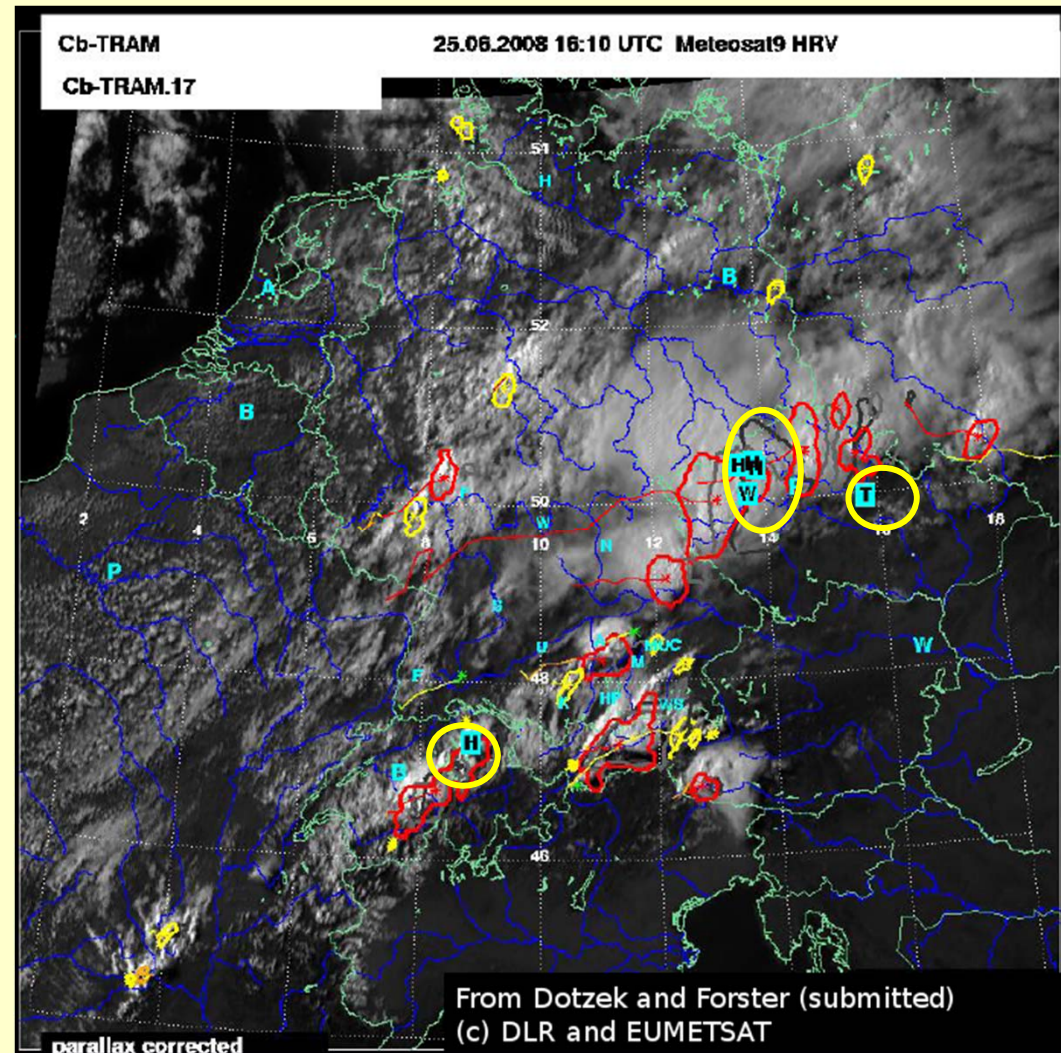


F-Skala	Klassenmitte		Unsicherheit +/- 30 %		Farbcode
	[m/s]	[km/h]	[m/s]	[km/h]	
F0-	22	79	7	24	
F0+	29	104	9	31	
F1-	37	133	11	40	
F1+	46	166	14	50	
F2-	56	202	17	60	
F2+	66	238	20	71	
F3-	76	274	23	82	
F3+	87	313	26	94	
F4	105	378	32	113	
F5	130	468	39	140	hier nicht vorhanden

Wiener Neustadt (A), 10 July 1916, F4, 35 fatalities, fourth-deadliest in EU

Verification of satellite-based storm-detection products

- Comparison of ESWD data with CbTRAM algorithm
- Results:
 - 47% of severe weather events within Cb-TRAM polygons
 - Wintertime severe events not as well detected as summertime events



The ESSL Testbed: motivation

researchers
and developers

interaction

forecasters



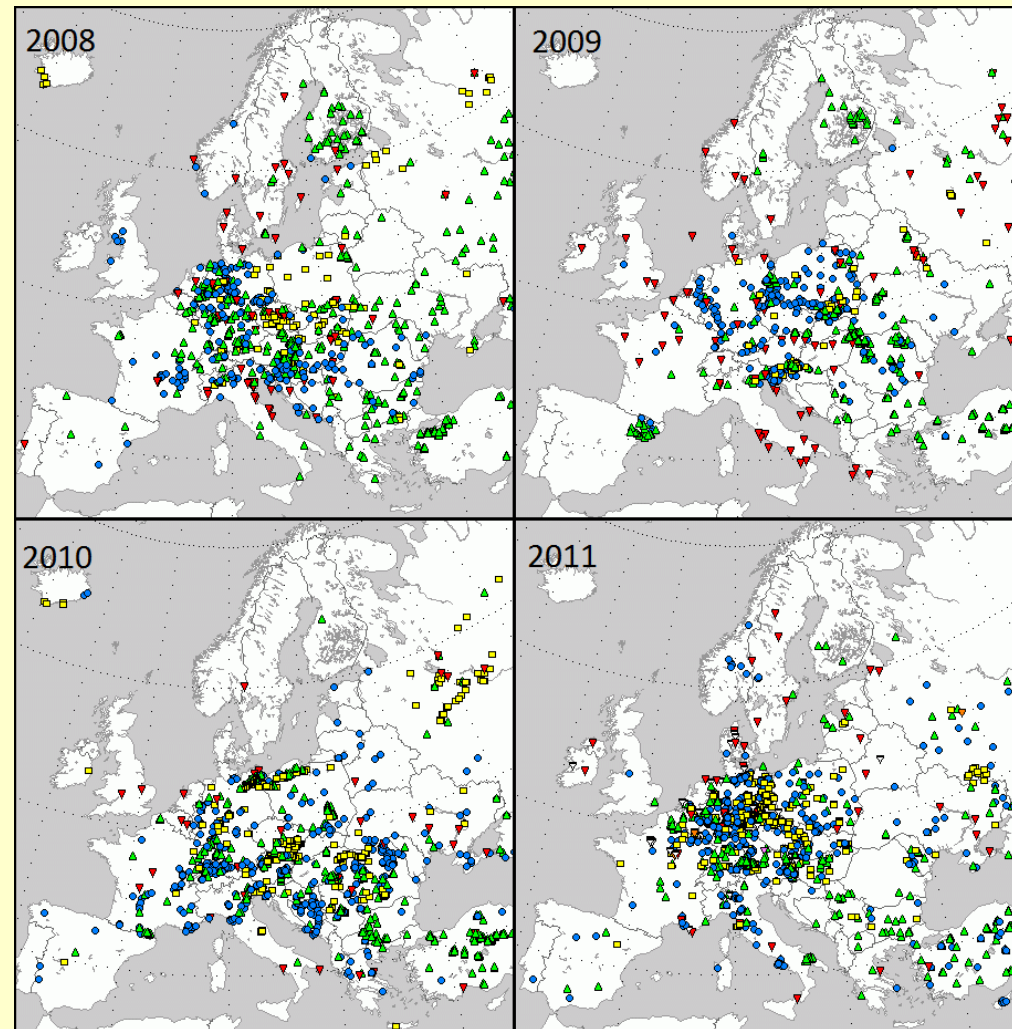
The ESSL Testbed

- brings **forecasters** and **researchers** together to evaluate new forecast-supporting products.
- requires participants to take part for one week **on-site** and offers additionally to join **online** sessions.



The concept

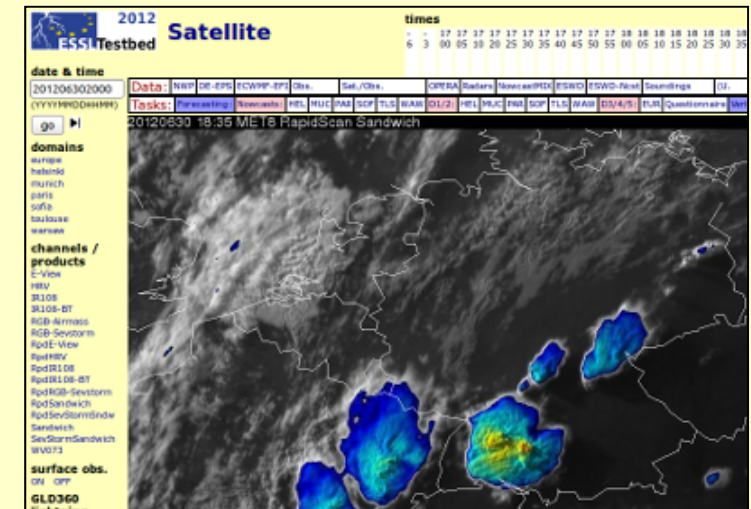
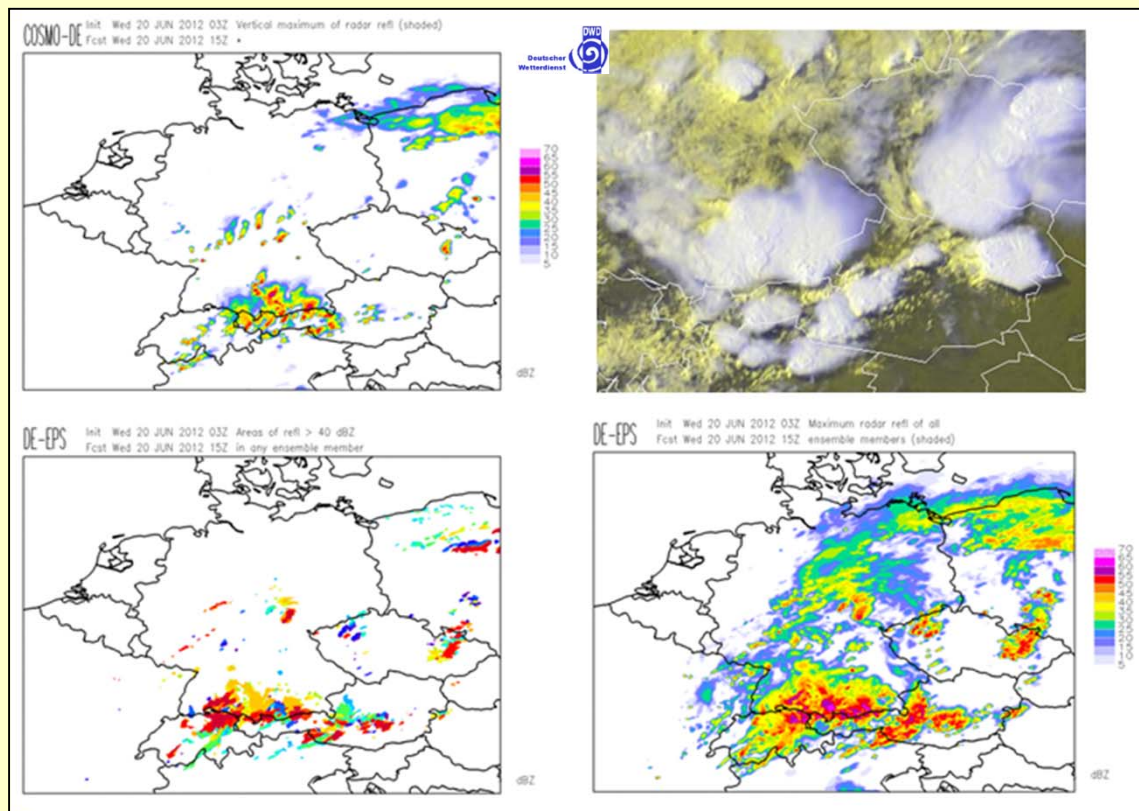
- central location
- in the European severe weather season
- participation for both forecasters and developers
- 4 - 5 groups



Severe weather reports in the month of June
from European Severe Weather Database (www.eswd.eu)

The products

include NWP-, radar-, satellite- and remote sensing products



Examples:

- COSMO-DE Ensemble Prediction System (DWD) visualizations
- Satellite-sounder based NearCasts (Univ. Wisconsin)
- GLD-360 lightning detection system (VAISALA)
- Mesocyclone Detection Algorithm (DWD)
- OPERA European Radar Composite (EUMETNET)

A day at the Testbed...

- Forecasting
- Forecast verification
- Product evaluation
- Online Weather Briefings
- Product Lectures



2013

ESSL Testbed

Nowcast Display

Time

(c) ESSL, EUMETSAT, Z...

-	-	08	08	08	09	09	09	09	10	10	10	10	11	11	11	11	12	12	1
12	6	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	00	15	3
hr	hr																		

Date & Time

Current: 201308290955

201307271400

(YYYYMMDDHHMM)

go ▶

Satellite products

E-View

HRV

IR108

RGB-Airmass

RGB-NatCol

RpdE-View

RpdHRV

RpdSandwich

Sandwich

WV073

Overlays

surface observations ☐lightning (GLD360) ☐meso. detection ☐

Overlays 2

conv. initiation

RADAR (EuRadCom)

OPERA max. column refl.

OPERA rain rate

turn all off

Nearcast Model

Delta theta-e

Theta-e 778 497

NWP Models

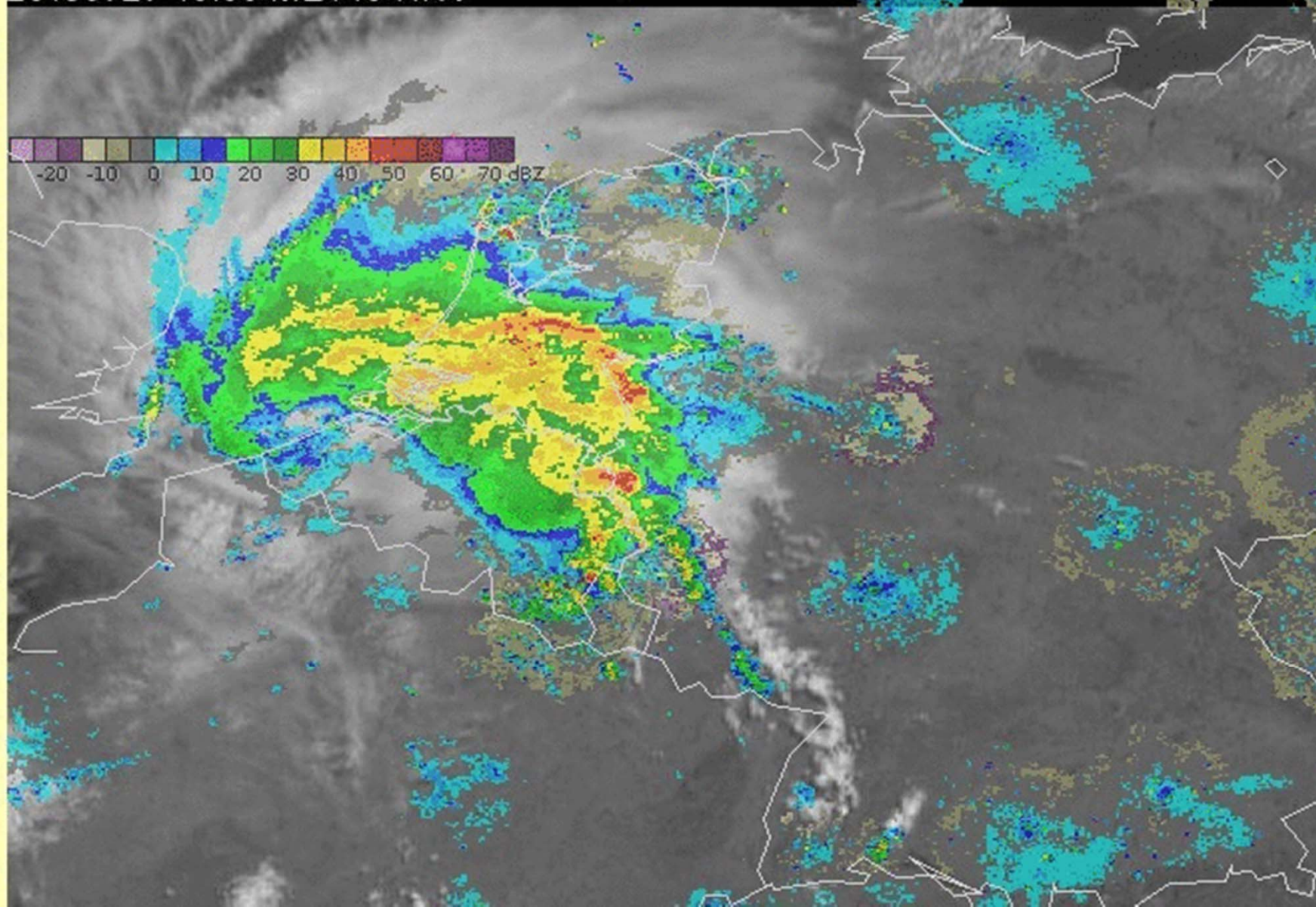
turn off
NWP layerGFS
ECMWF
COSMO-EU
COSMO-DENOWCAST
DISPLAYNWP
MODELSCOSMO
DE - EPSSURFACE
MAPSW
W
WBLOG
INFOESWD
DATA

VERIFICATION

Nowcasts Day 1&2

Day 3-5

20130727 10:00 MET10 HRV



Testbed briefing

Activity:

- A representative of each team presents the forecast that was made during the morning.
- Verification of the performance of yesterday's forecasts



Testbed Briefing for a local audience
and for online participants
(in cooperation with EUMETCAL)

Expert lecture

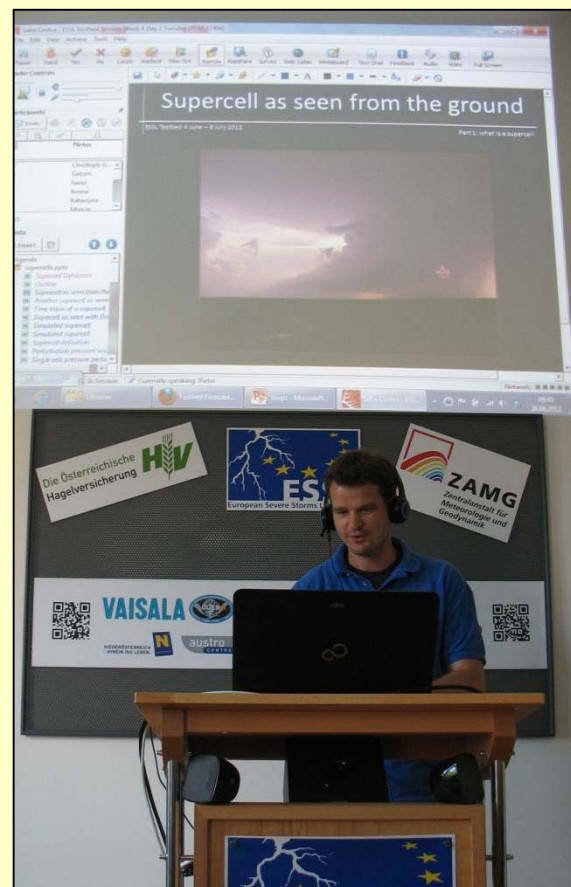
Activity:

A researcher / developer or forecasting expert presents a tool or discusses a forecasting topic.

On-site lectures by researchers on lightning detection systems...



on supercells...



overshooting top detection.



Forecast Verification

Activity:

Compare forecast to the real observed severe weather.

Day 2 Forecast valid Sat 30 Jun 2012 06:00 – Sun 01 Jul 2012 06:00 UTC

Issued: Fri 29 Jun 2012 08:56 UTC. Forecaster: ESSL TESTBED

Reported severe weather is plotted on the map, source: www.eswd.eu

Legend: tornadoes (red); heavy rain (cyan); large hail (green); severe winds (yellow)

EUCLID data available at: 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05

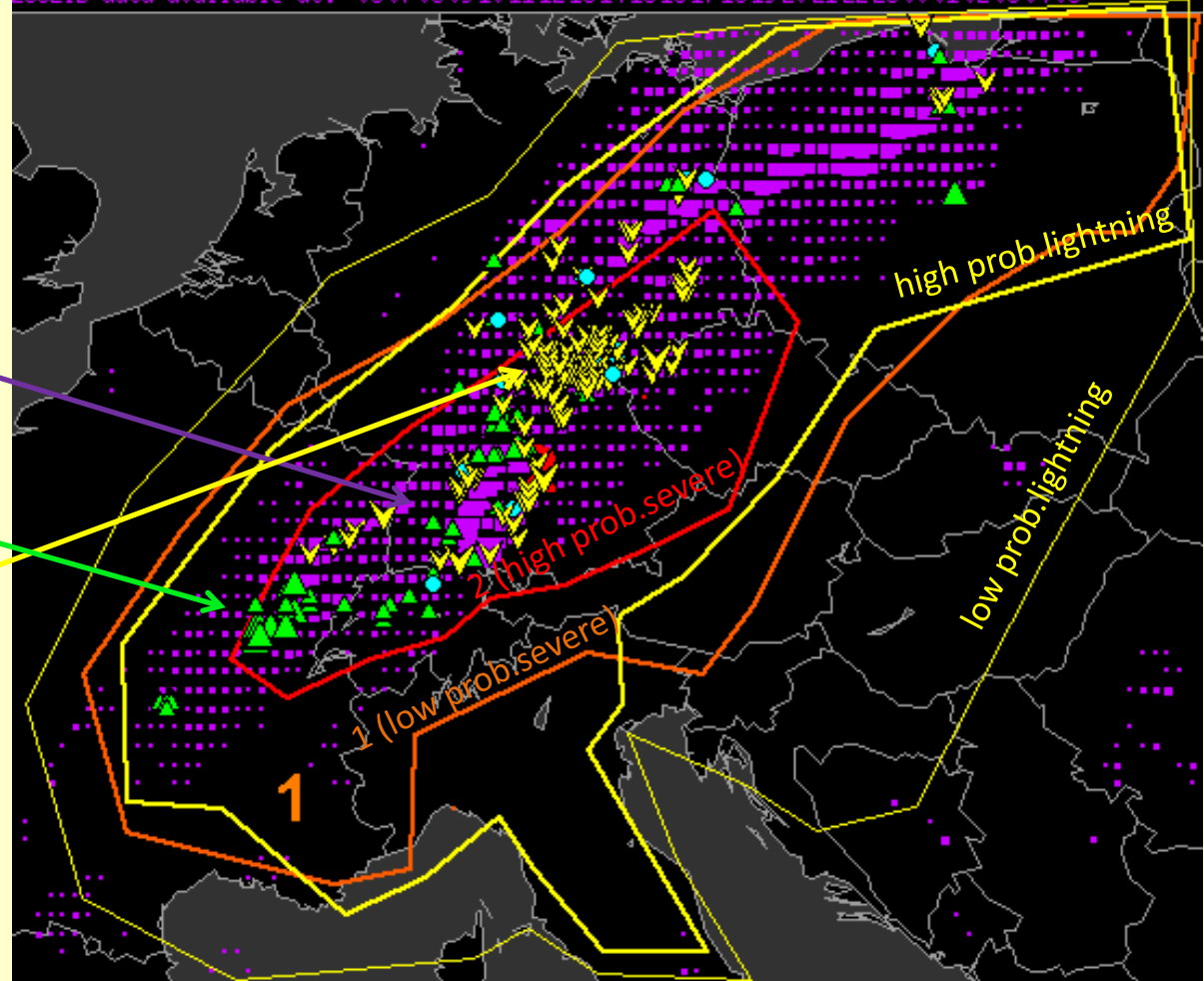
Lightning detections

Hail reports

source: ESWD

Severe wind reports

source: ESWD



Forecast Verification

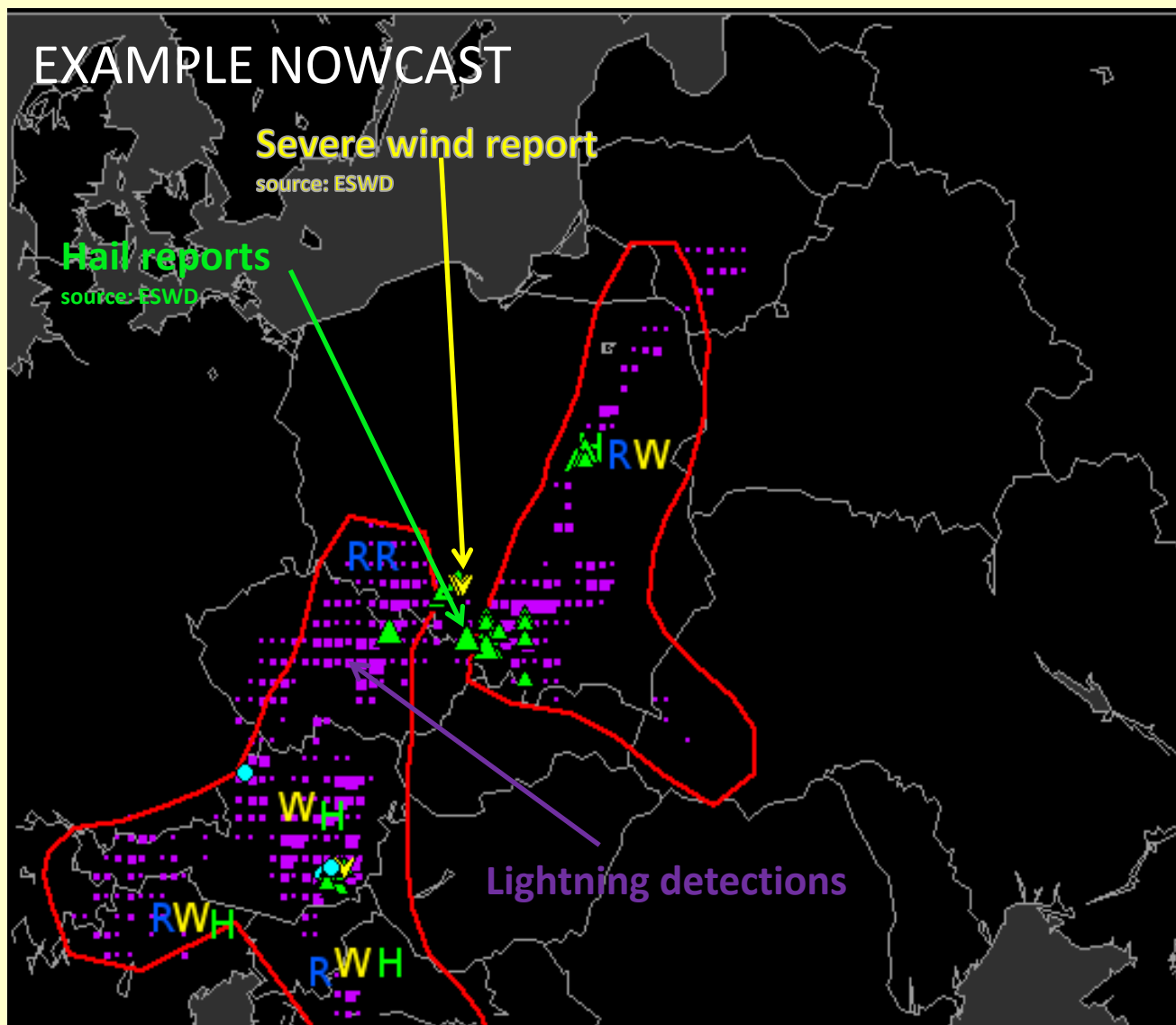
Activity:

Compare forecast to the real observed severe weather.

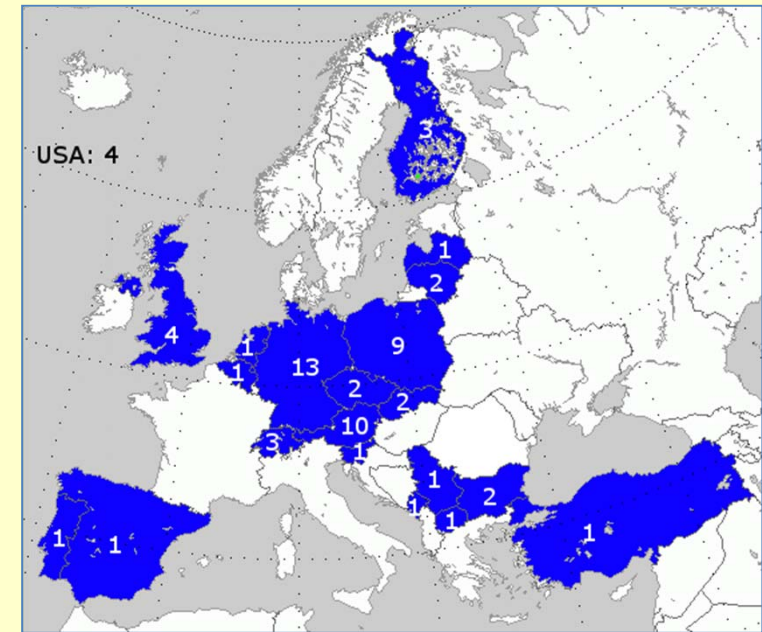
Red lines indicate where severe weather is forecast in the next 2 hours

Characters indicate the expected type of severe weather: **R**ain **H**ail, **W**ind, or **T**ornadoes.

Verification data are small coloured symbols and lightning detections in **magenta**.



International Cooperation



Number of participants per country.
Total: 67 participants from 21 countries.

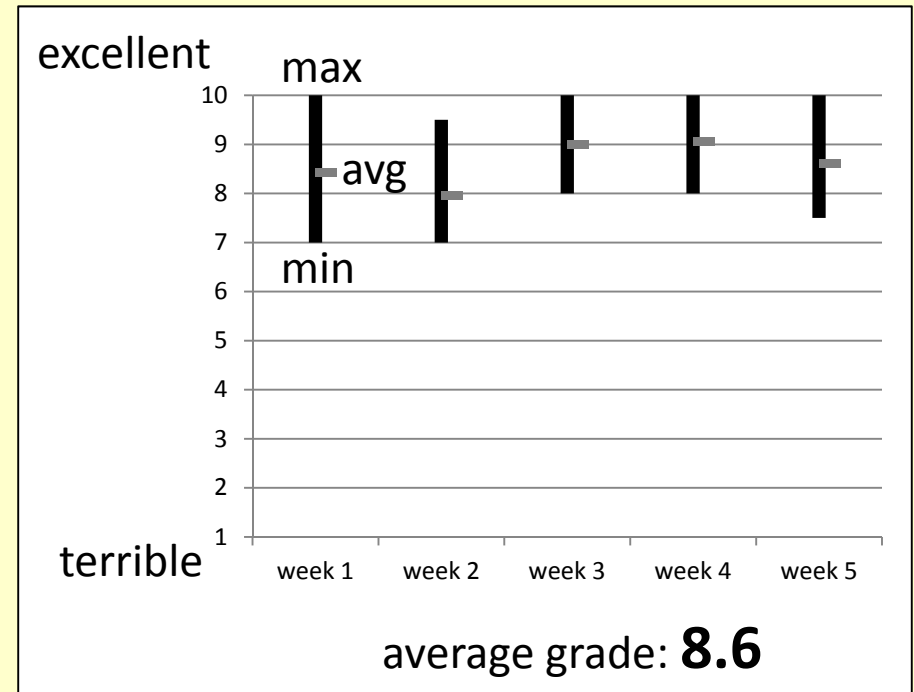


Participant Feedback

"It is a great balance between theoretical and practical training."

"I'm working on the developer's side so there was a lot of new information on how forecasting is generally done and how different data sets can be used."

"It was the most productive week in my career as a meteorologist."



"The Testbed offers a chance for forecasters to learn from developers and scientists and for them to learn from forecasters. We need more of this in our field!"



Participation:

Registration is possible until fully booked

www.essl.org/testbed

Product evaluation:

Ask me or contact Pieter Groenemeijer

pieter.groenemeijer@essl.org

The 2013 Testbed data can be viewed at:

www.essl.org/testbed/data

The Testbed Blog can be viewed at:

www.essl.org/testbed/data



2 - 27 June,

13-24 October 2014

ESSL Research and Training Centre
Wiener Neustadt, Austria



European Conferences on Severe Storms



European Conferences on Severe Storms

- 7th ECSS Conference took place 3 – 7 June in Scandic Marina Congress Center, Helsinki

- Organized in cooperation with FMI (Local Organizer)

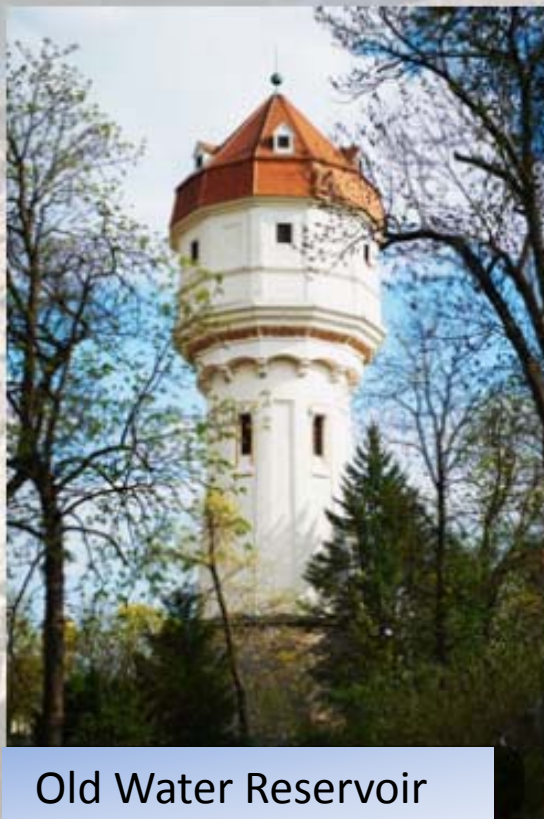


- About 220 participants



- Topics range from remote sensing to dynamics of storm systems and storm climatology





Old Water Reservoir



Romanesque Cathedral



Historical City Walls



Castle: Oldest Military Academy of the World





A baroque style conference room

... located in the central pedestrian zone,
many small restaurants and cafes
within walking distance





**See you at the next ECSS
in Wiener Neustadt, Austria!**

14 – 18 September 2015





The European Severe Storms Laboratory

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www.essl.org