REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING
SLOVENIAN ENVIRONMENT AGENCY

Benefits and Importance of RSS for Slovenia

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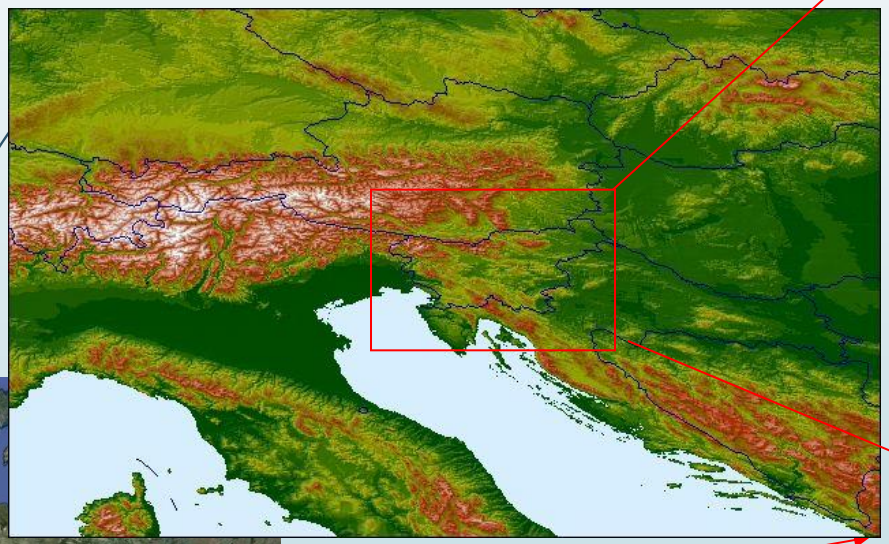
Outline

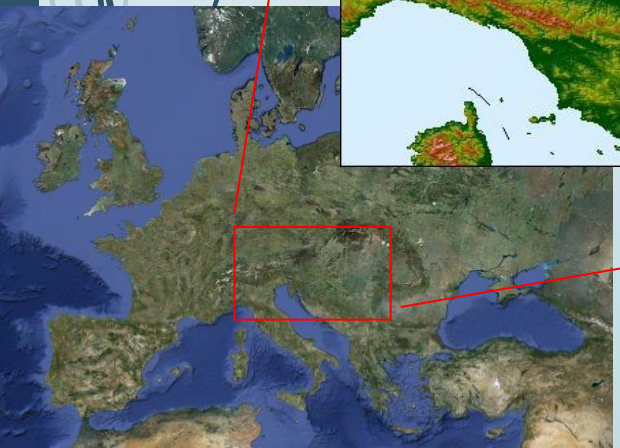
- Severe convection over Slovenia
- Severe convection - illustration of 3 cases (2009, 2011, 2014)
- Multi-sensor approach (lightnings and MTG)
- A strong need for automatic algorithms (with updates)
- Satellite data into INCA NWC model
- Conclusions

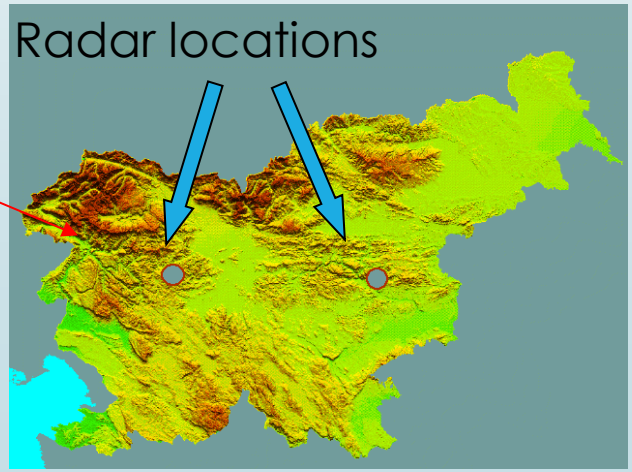
Severe convection in Slovenia

Due to the Alps in the north of Slovenia and a lot of moisture (the Adriatic sea) there are favourable conditions for convection in Slovenia.

>200 ground stations reporting hail and graupel

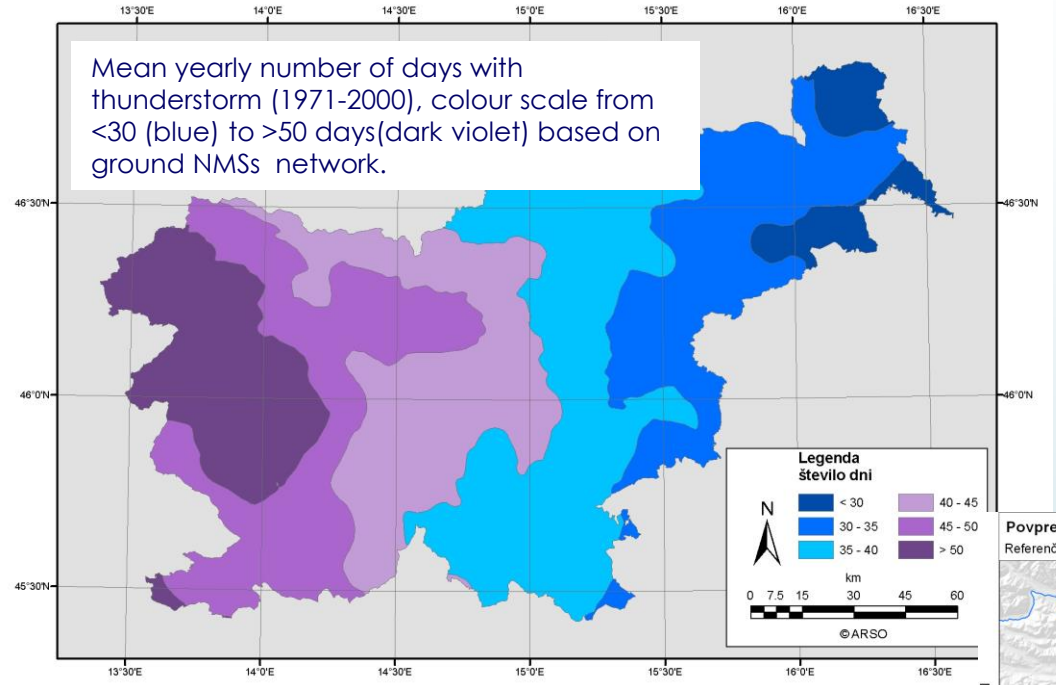






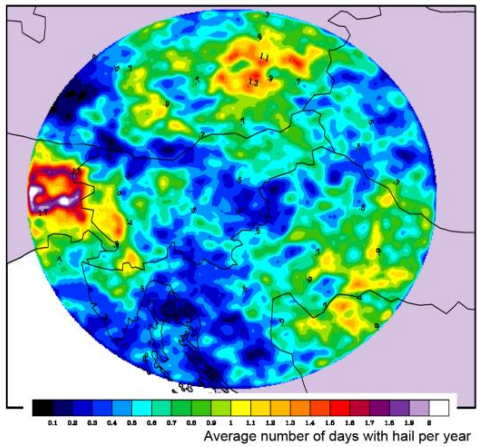
Severe convection over Slovenia

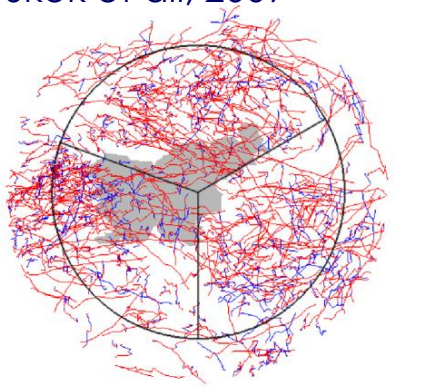
Mean yearly number of days with thunderstorm (1971-2000), colour scale from <30 (blue) to >50 days(dark violet) based on ground NMSs network.



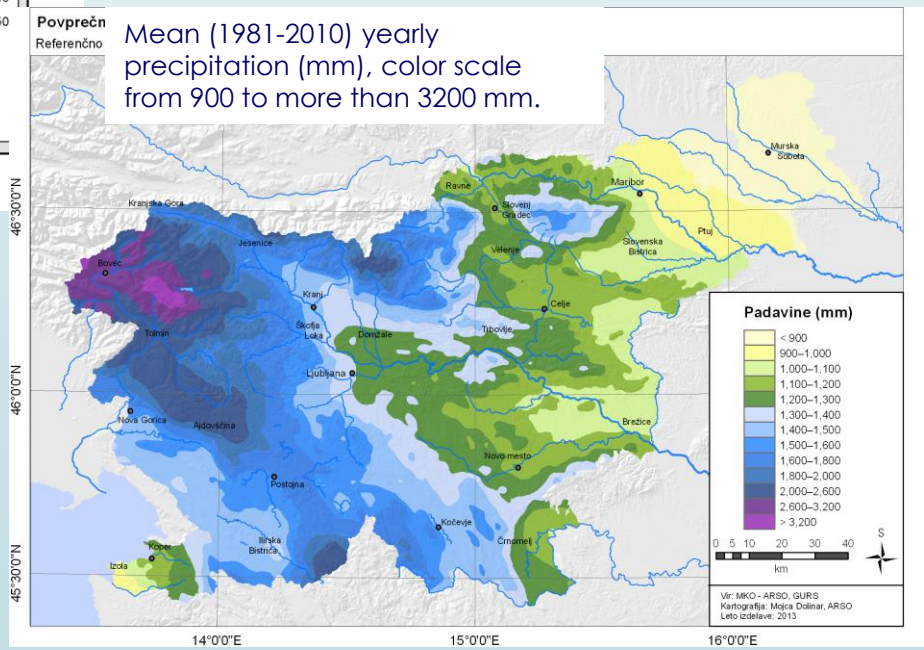
Slovenia has frequent hail in the April-September period, which causes damage of up to 1.5% GDP.
Based on NMS ground station there were up to 69 days in Slovenia with hail or graupel in in the last 40 years in the April-September period.

Skok et all, 2009

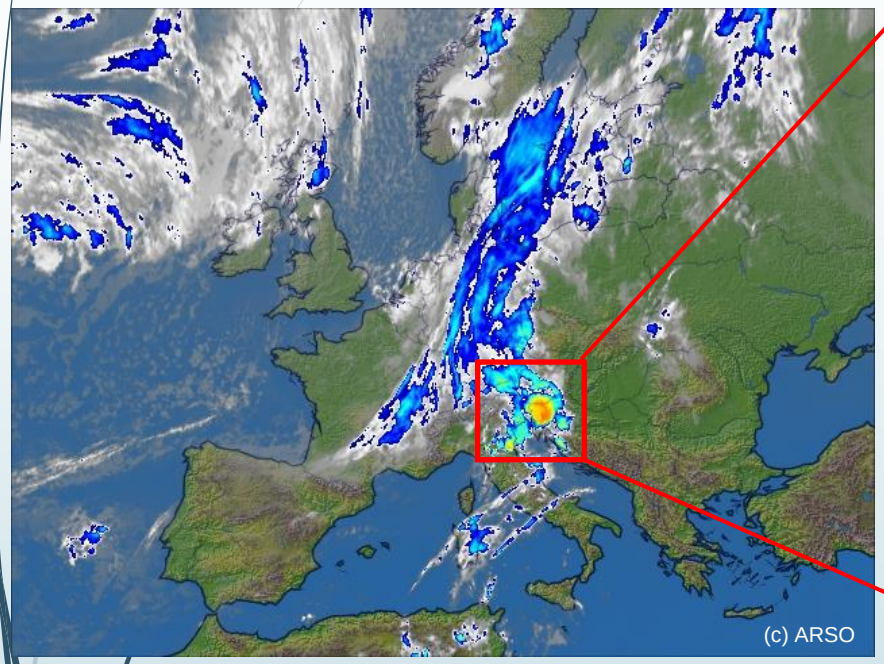


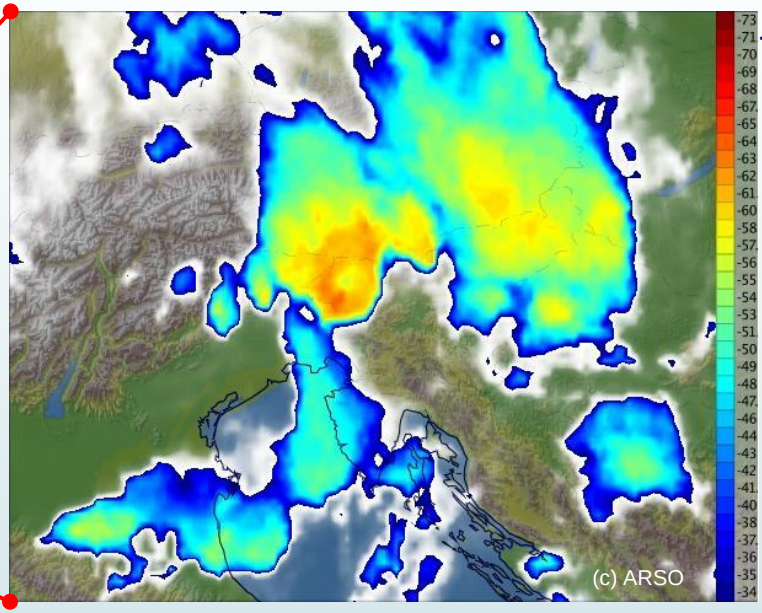


Mean (1981-2010) yearly precipitation (mm), color scale from 900 to more than 3200 mm.



Special patterns atop convective clouds as seen on IR imagery





IR image on 18 Sept. 2007 at 7:30 UTC

„… in the case of severe convection the forecaster on duty needs to issue regional warnings …based on radar and satellite data…cold ring, cold U/V shape in IR image…and lightning data…“
Airtraffic safety - a need for frequent data

Airport use of RSS (5 min) and high interest in 2.5 min (MTG-I)

In case of:

- convection and severe convection;
- fog (dissipation/formation) – airport locations

For issuing:

- TAFs
- AIRMET, SIGMET (updates every 30 min or every 15 min) for the whole country – warnings are more reliable in case of RSS data
- Ensuring airport safety (airplane refueling), at all airports in the country (surroundings: 2 km or 8 km) – every minute if needed

3 cases with large hail

- Hail up to 7 cm (25 May 2009) –

also over the capital - huge car damage

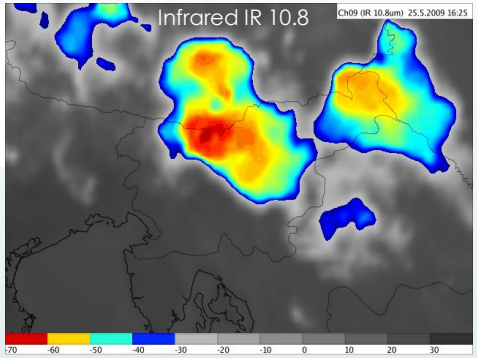
- Up to 20 cm deep layer of hail (11 July 2011),

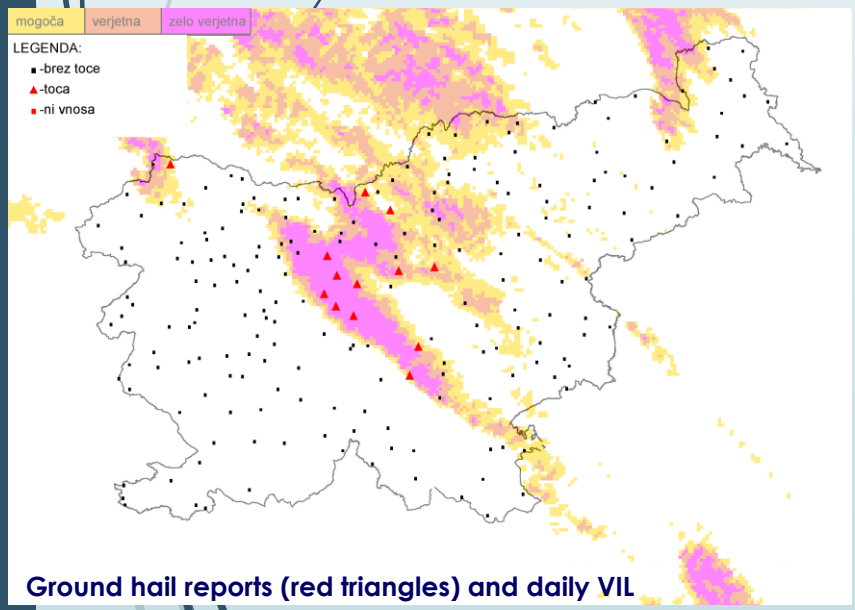
over a large area (5x10 km) – severe damage to crops

- Hail up to 5 cm in Slovenia and hail depth up to 20 cm
  Celovec (AUT) – 23 June 2014– possible lightning signals

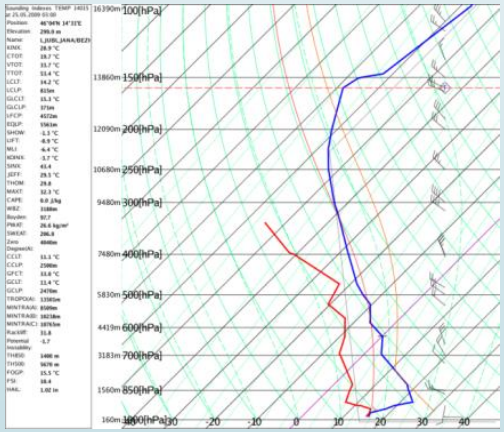
Show case for CR 25 May 2009

Strong wind, strong precip. and large hail caused damage on buildings, cars (>6000).





Ground hail reports (red triangles) and daily VIL



Radiosonde, Ljubljana 3 UTC

Hail size up to 7 cm

Location	max hail size
Domžale	2 cm
Dvor pri Ljubljani	6.5 cm
Dvor pri Polhovem Gradcu	1 cm
Grm	1 cm
Kranj	1 cm
Lipoglav	6 cm
Ljubljana Bežigrad	4 cm
Ljubljana Šiška	4 cm
Pirniče	6 cm
Preddvor	1 cm
Trboje	7 cm
Vodice	5 cm
Zgornje Loke pri Blagovici	1 cm

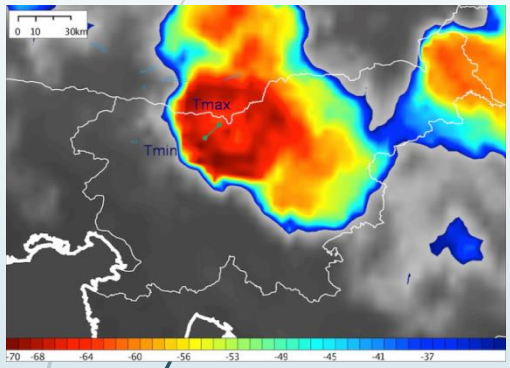
5 minute RSS, 25 May 2009

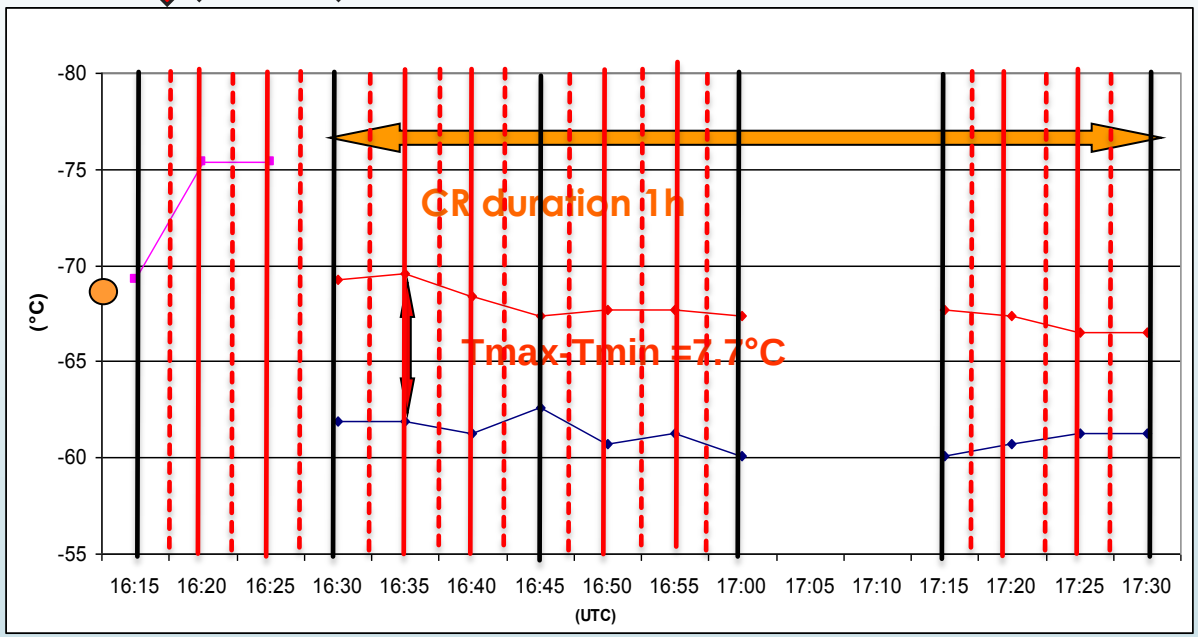
Nominal scan: 15 min,
Rapid Scan (RSS): 5 min,
Super Rapid Scan: 2.5 min

2.5 min: additional information

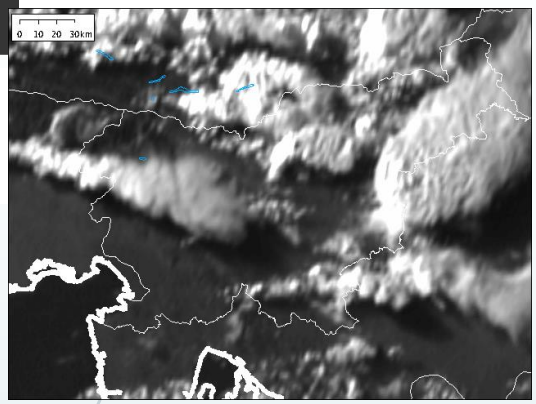
5 min: strong signal 10 minutes before CR

15 min: no special signal before CR

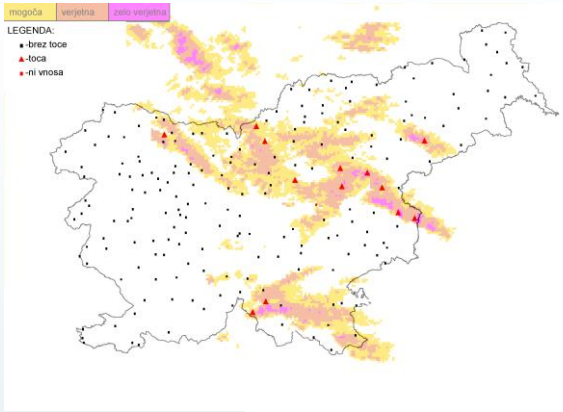




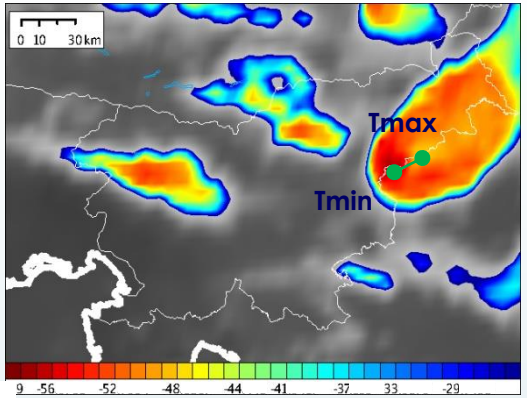
Damage to vegetation due to severe hail, 11 July 2011



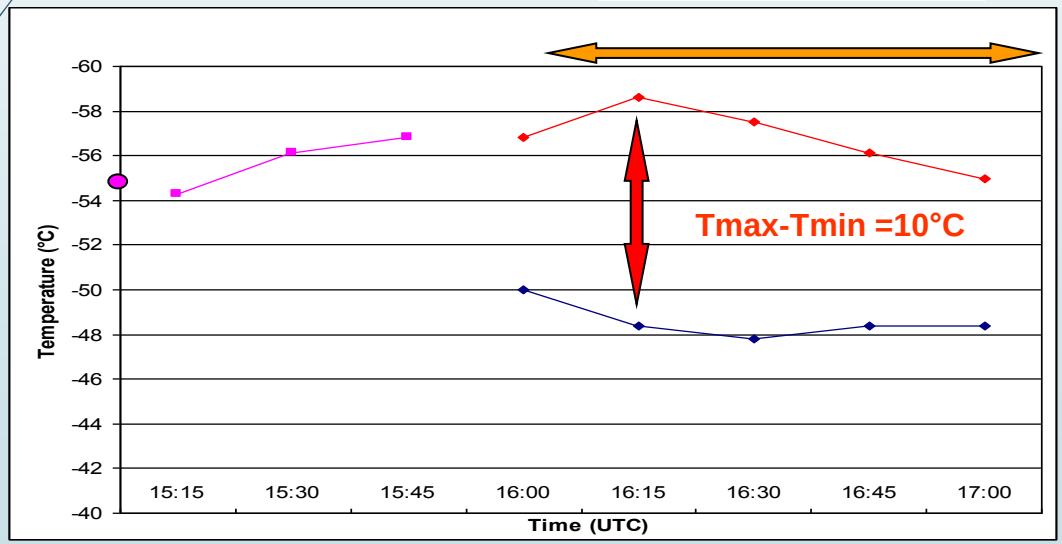
High Resolution Visible



Infrared IR 10.8



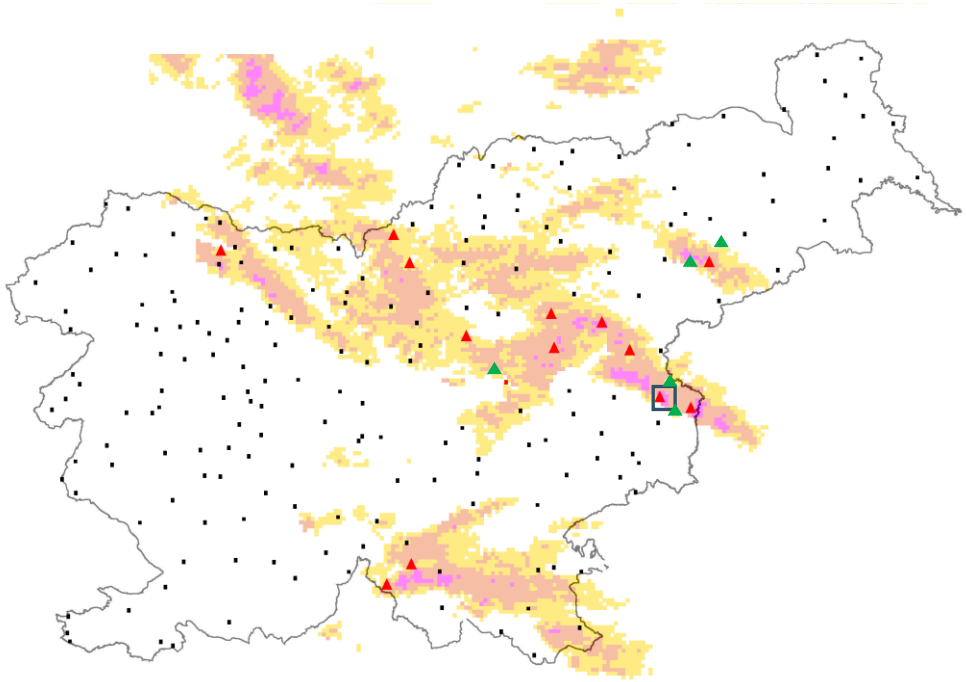
CR duration 1h



(>20 cm hail layer)

Strong wind, strong precip. and large hail caused damage on buildings, infrastructure and crops.

Case 11 July 2011



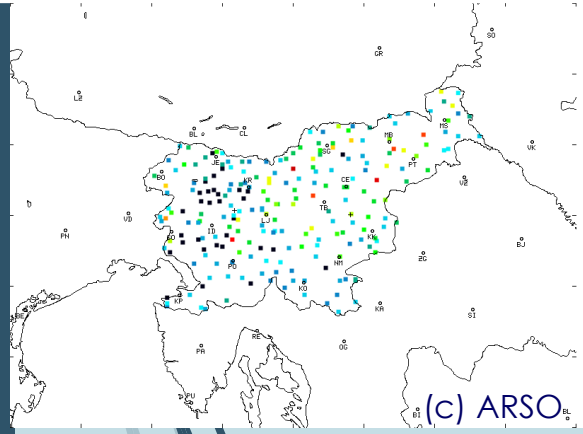
Ground hail reports from different sources:

- NMS ground network
- Emergency calls:
  – damage due to large hail
- ESWD

Ground hail reports 2007-2013

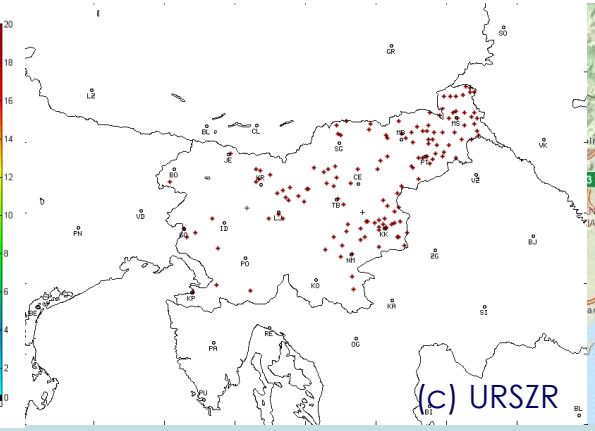
NMS ground network

1106



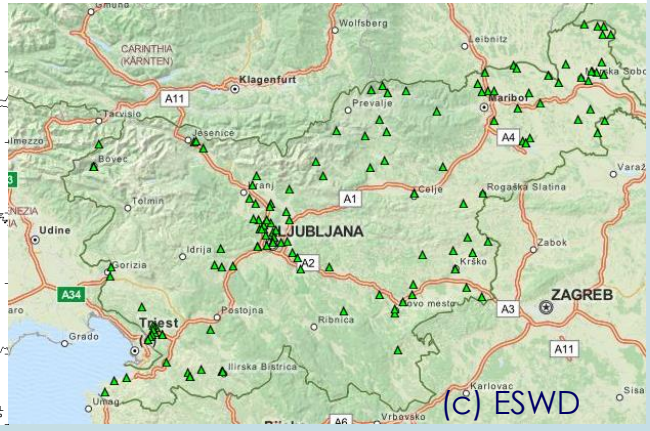
Intervention needed due to hail damage (SPIN database 112)

177

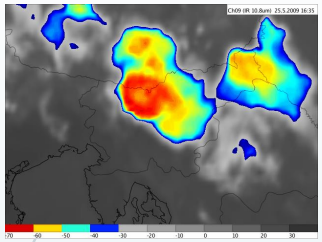


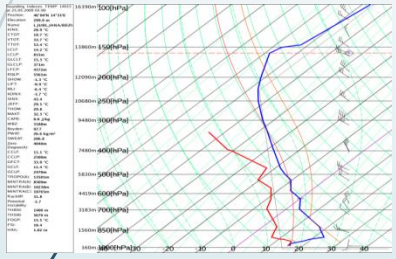
ESWD database

140



Algorithm for Automatic Recognition of CR, cold U/V shapes SATSEVERE – for day- and night-time convection





INPUT: Meteosat data (IR10.8)

T tropopause

Masking

T trop + offset

candidates for T min in cold-ring (CR)

Criteria on:

- distance between T min and T max
- temperature difference
- T max in relation to T tropo

for large areas K- means clustering is applied to speed up the algorithm

candidates for T max in Central Warm Spot (CWS)

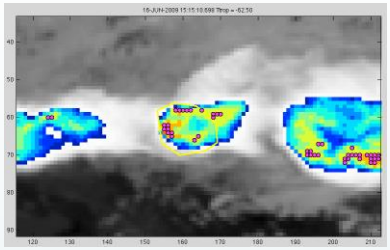
Searching for ring - two step approach:

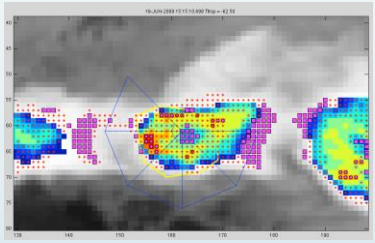
- arc of at least 3/4
- arc of at least 6/8

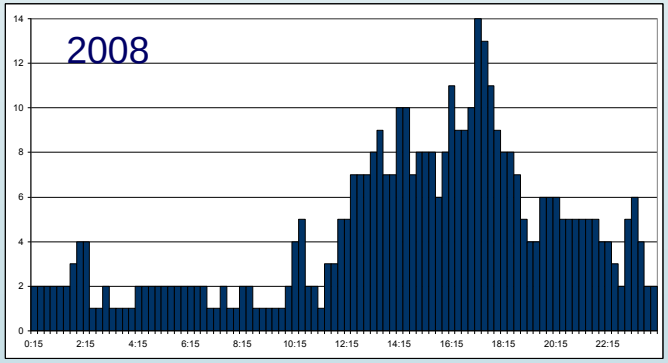
T max in CWS

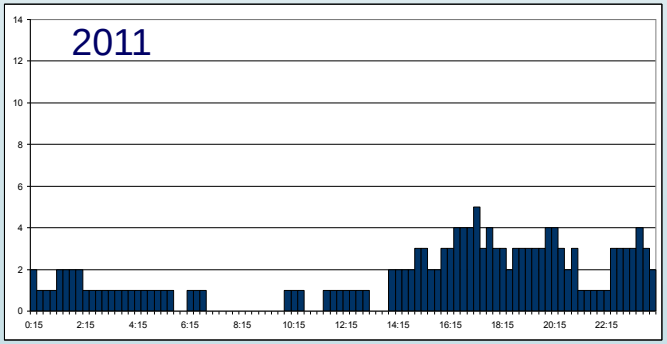
Coldest T min

T min in CR



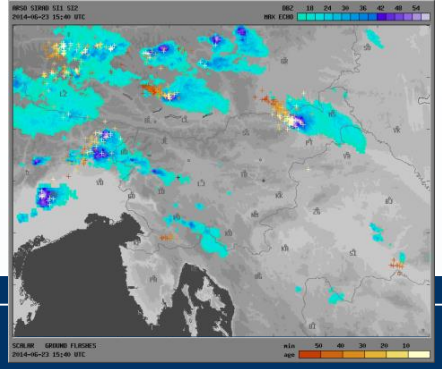


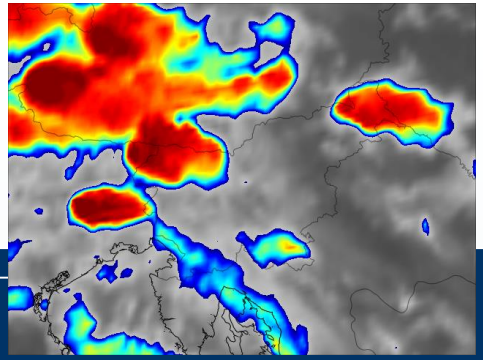


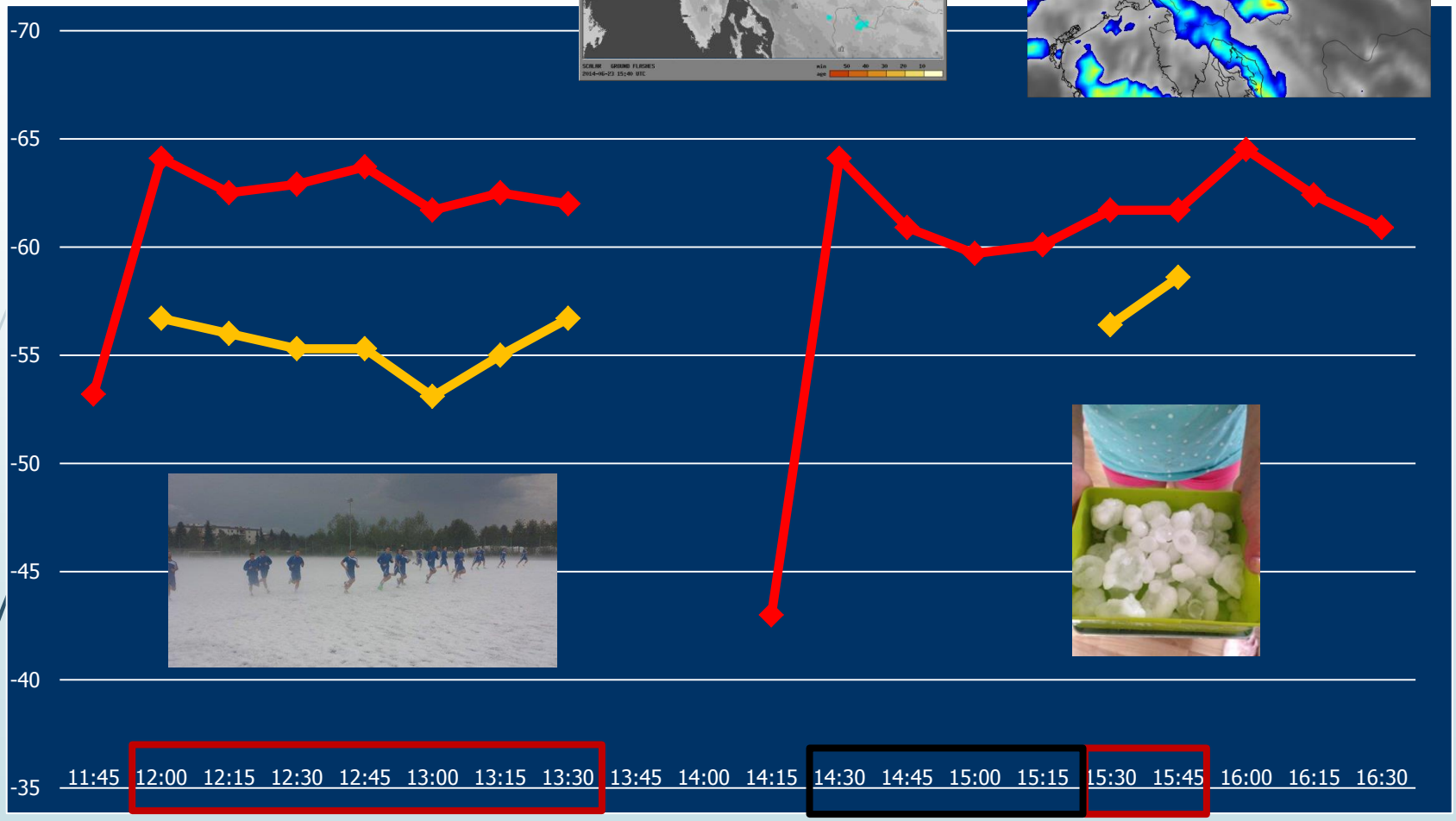


Iršič Žibert et al., 2013. Monitoring and automatic detection of the cold-ring patterns atop deep convective clouds using Meteosat data, *Atmosph. Res.*

23 June 2014

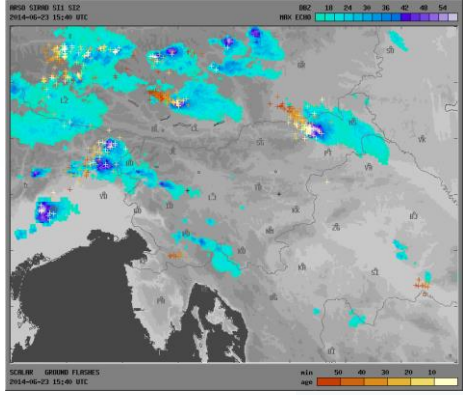


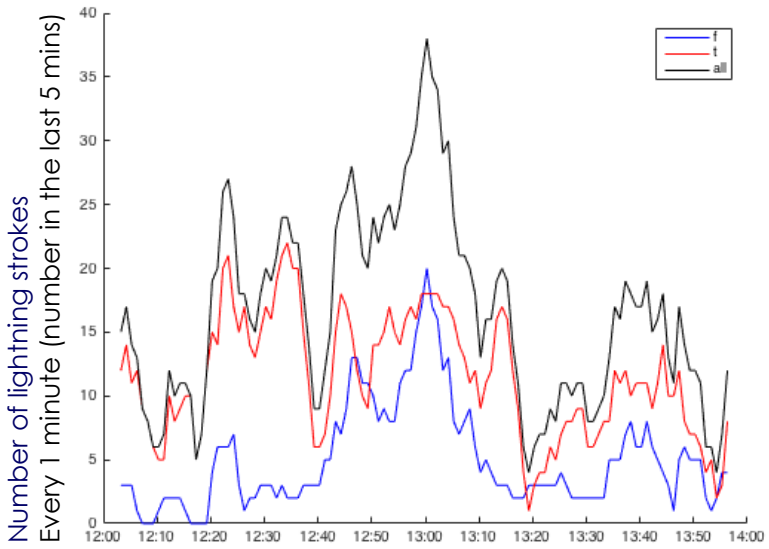


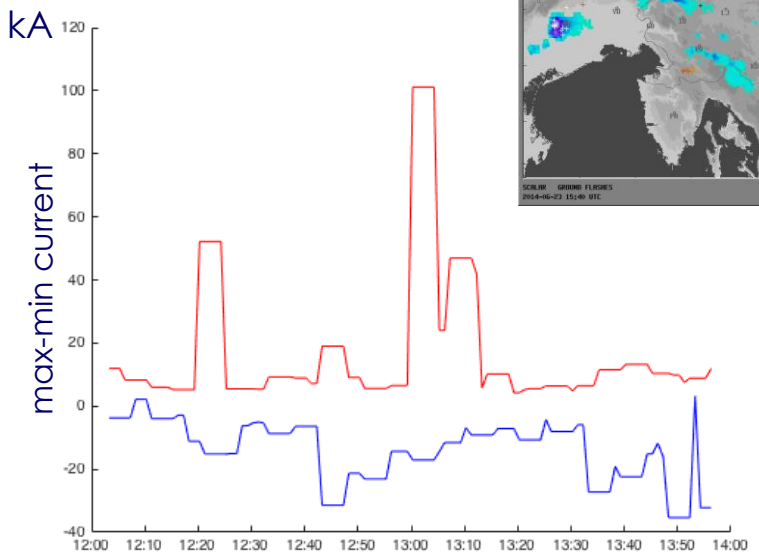

Cloud Top Temperature (°C)
-70
-65
-60
-55
-50
-45
-40
-35
11:45
12:00
12:15
12:30
12:45
13:00
13:15
13:30
13:45
14:00
14:15
14:30
14:45
15:00
15:15
15:30
15:45
16:00
16:15
16:30
Time (UTC)

23 June 2014
12-14 UTC

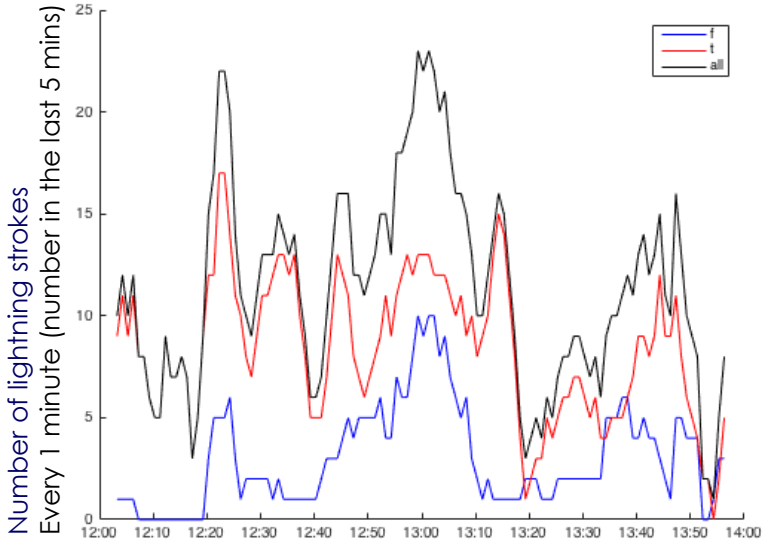
Lightning network SCALAR-EIMV (part of EUCLID)

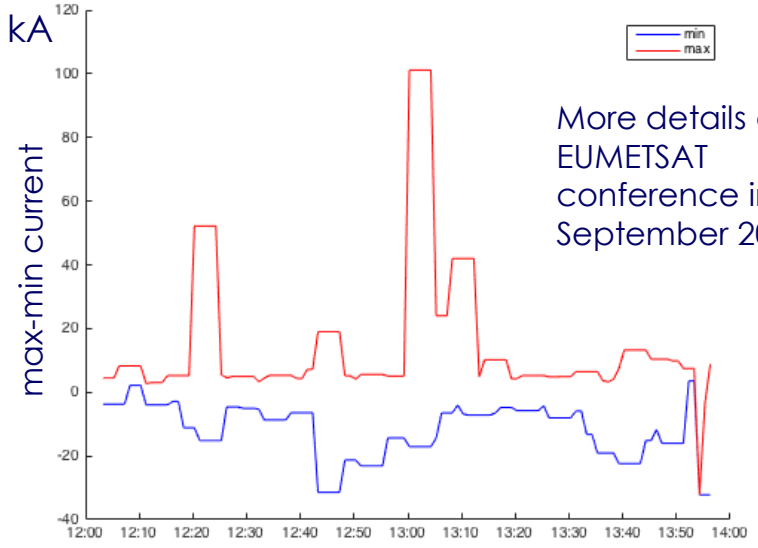






Number of lightning strokes(all, CC, CG) for a selected convective cell during its life-cycle (left) and max-min current (right) in 5 minutes sliding interval. Top no quality control, bottom chi2<2, (c)EIMV- SCALAR.





More details at the EUMETSAT conference in September 2016

Constant upgrades

MSG 15 min, MSG 5 min RSS
MTG 10 min, MTG 2.5 min

- training
- feedback

forecaster

RSS

Integration into NMS's environment

Features selection

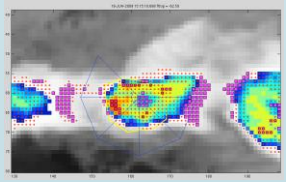
New features:
New sensors

operatialisation

Automatic recognition

NWCSAF
or similar

Prototype model



Prototype model
Scores on database Upgrade of the model

Multi- sensor approach

satellite

- Special features atop convective clouds
- Automatisation needed- constant improvements

MSG 15 min, MSG 5 min RSS
MTG 10 min, MTG 2.5 min

feedback/training

lightnings

- Ground network
- MTG LI

Radar data

- HDF5 EU composite
- Filtering of errors- other sources

NWCSAF

- PC
- CRR
- CT
- CTTH

NWCSAF

MTG IRS every 30 minutes

INCA

NWP

Conclusions

- For convection in operations all possible sources of information are used (NWP, NWC, satellite, radar, lightnings, radiosondings, aircraft measurements, …)
- A strong need for automatic methods with constant improvements (new features, new sensors…):
  - MTG more frequent data – new/upgraded methods
  - MTG LI – possibility for multi-sensor approach
- RSS gives most important information just before CR in IR and allows better recognition scores for automatic recognition methods, higher reliability when issuing official warning (also at the airports)
- Night-time convection is poorly forecasted in NWP in N Italy (propagating to Slovenia) – methods only based on IR needed (in spite the fact that incl. HRV gives better scores during daytime).
- Integration of different products
- Training of forecasters and forecaters feedbacks
- RSS needed:
  - for study of severe convection
  - new feature for automatic algorithms – improving the performance
  - early detection allows early and/or more reliable warnings