ECSS 2011
Palma de Mallorca
Balearic Islands, Spain

T-re Plots Generated from MSG Data in Severe Storms Forecasting: Testing in Central Europe

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T-re plots

- Profiles of cloud top temperature (T) and particle effective radius (re) relations
- Plots are based on satellite-retrieved data
- Forecasting of severe storms - according the shape and the steepness of this plots

Basic theory

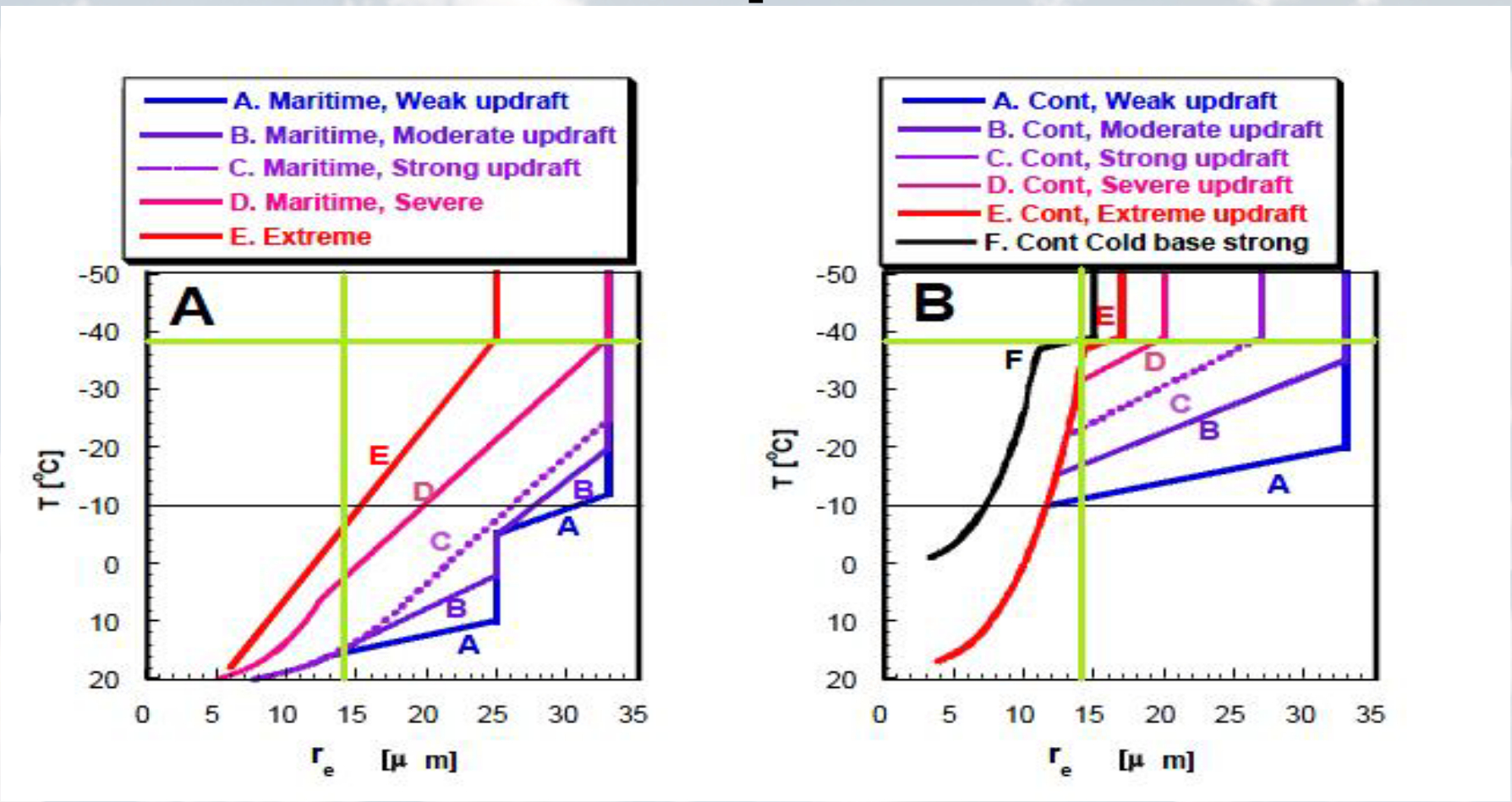
- The driving force of the severe weather phenomena
  is the high updraft speed
- High speed can sustain the growth of large hailstones
  and provide the upward motion necessary
  to evacuate the violently converging air of a tornado
- Stronger updrafts are revealed by the delayed growth
  of re to greater heights in lower T
- There is less time for the cloud particles to grow by
  coalescence, the development of a mixed

- The severe storm microphysical signature,
  (manifested by the vertical profile
  of cloud-particle effective radius) is caused
  by the strong updrafts

- Updrafts are direct scale of developing severe
  storms

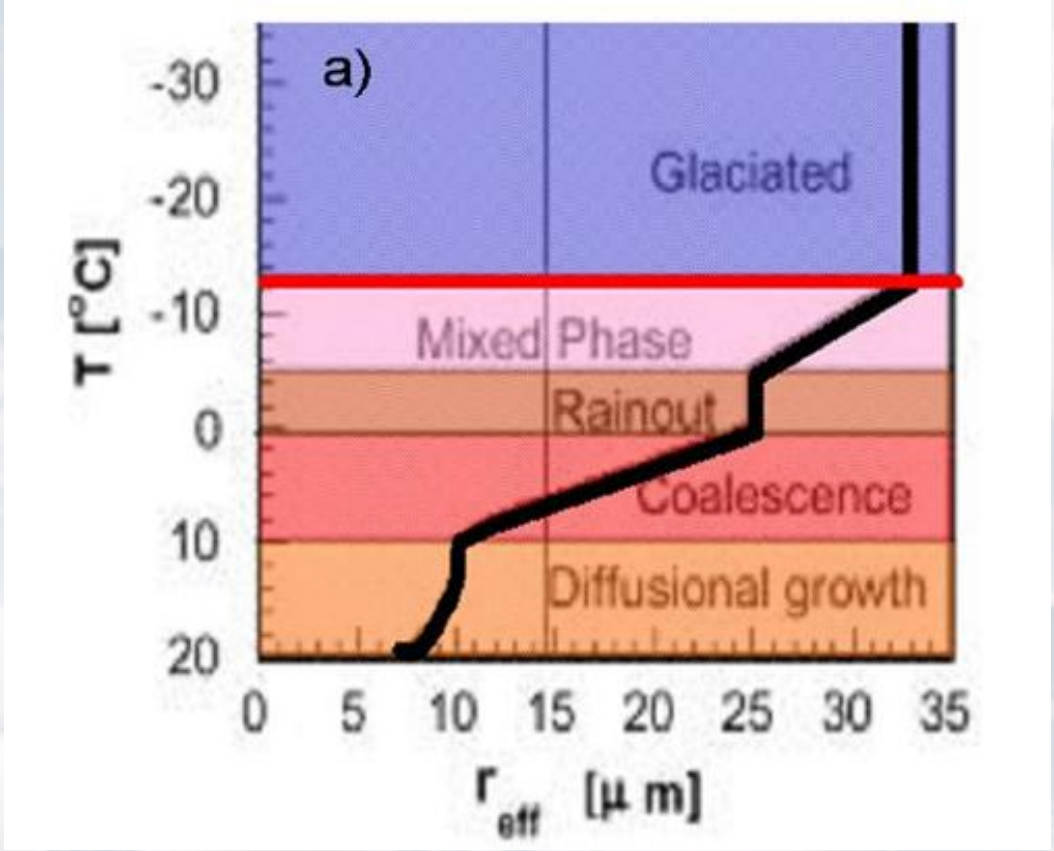
- Received T-re plots reflect updraft

T-re plots



Conceptual models of T-re plots, precipitation threshold, homogenous freezing
threshold. Most cases lies between this two types. [6]

T-Re plots - microphysical zones



Microphysical zones in clouds according to T-re plots

[3

Application of basic theory

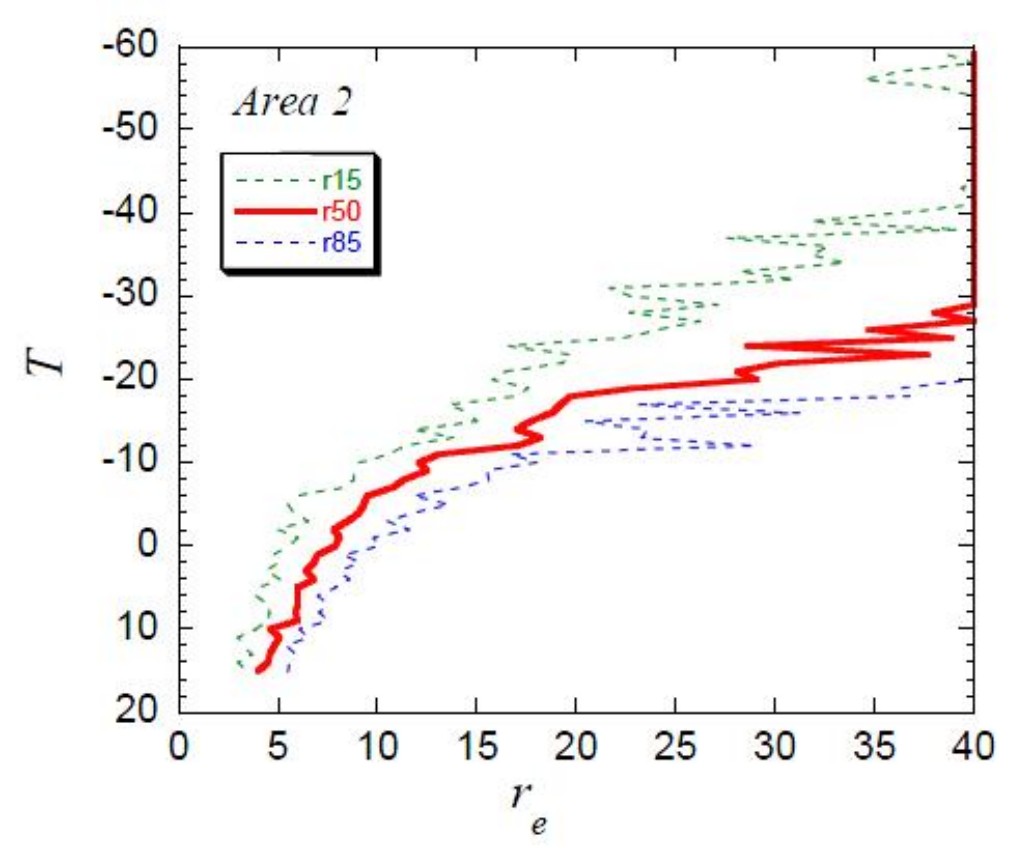
- Use of MSG data to track cloud top temperature
  and convective clouds particle effective radius
- Evolution of T-re shows only weak dependence
  on time, radius depends purely on temperature
- Cloud elements reaching Cb stage have same T-re
  relationship as other cloud elements, that

- Rosenfeld and Lensky introduced this method
  in 1998
- Consequently used in various projects
- Technics based on 2 presumptions:

  1) re development with height (T) for group
  of clouds is same as T-re of one cloud in this
  area

  2) re at the cloud top is same as inside another
  cloud in the same height (until

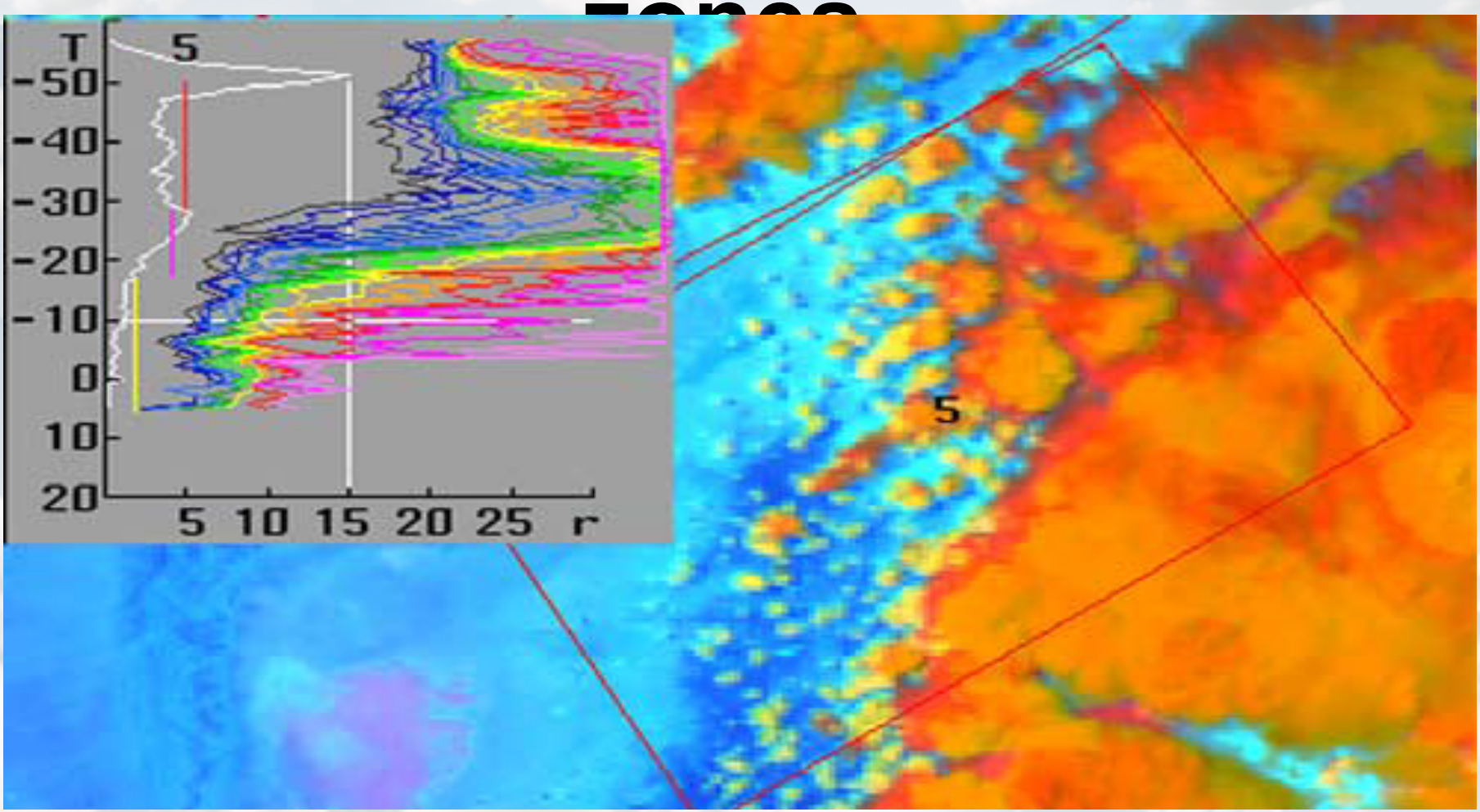
T-re plot



15th, 50th and 85th percentile in 1 °C step. Lower percentiles represent vigorously growing (younger) clouds at given height.

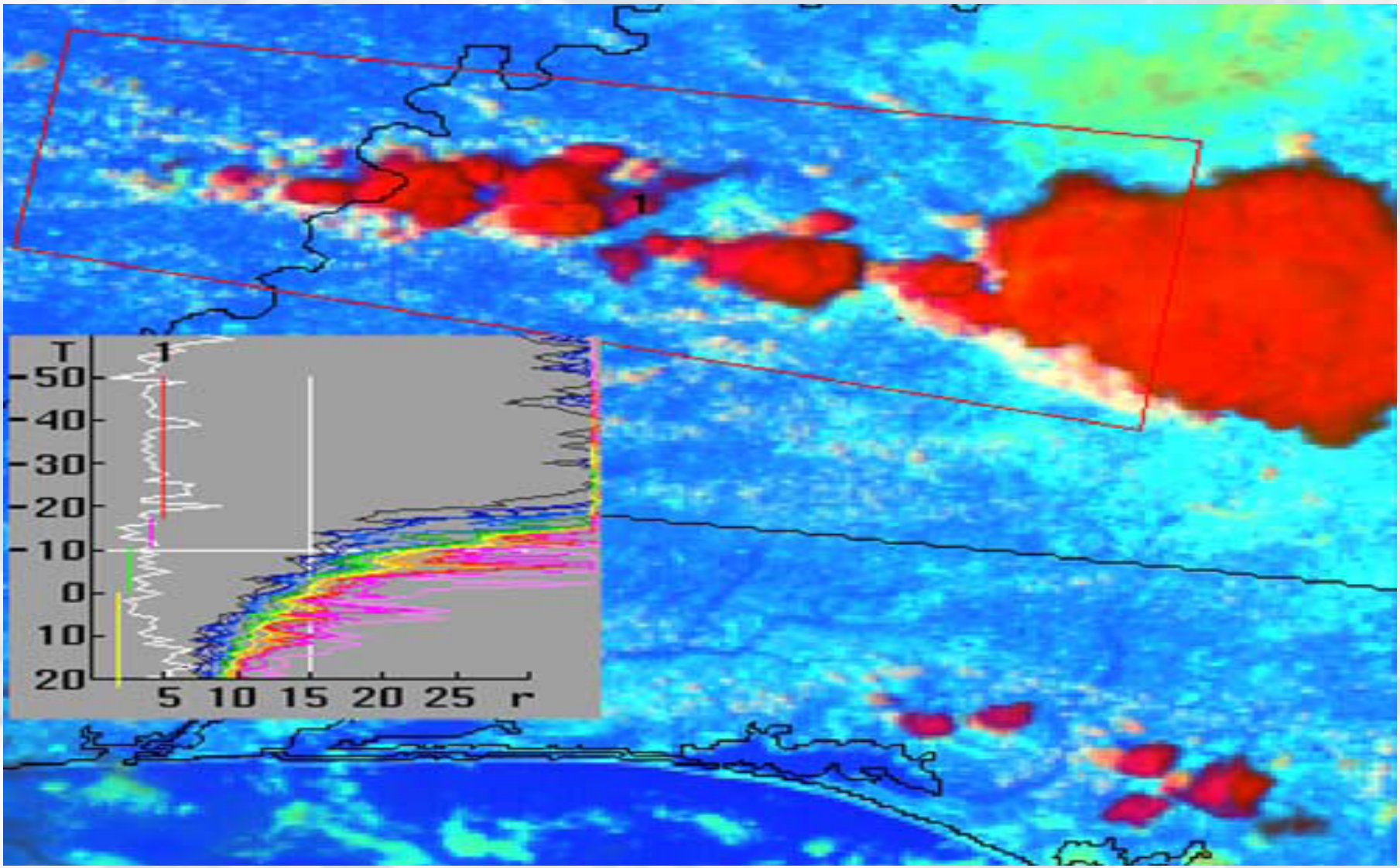
[1]

In practice – microphysical zones

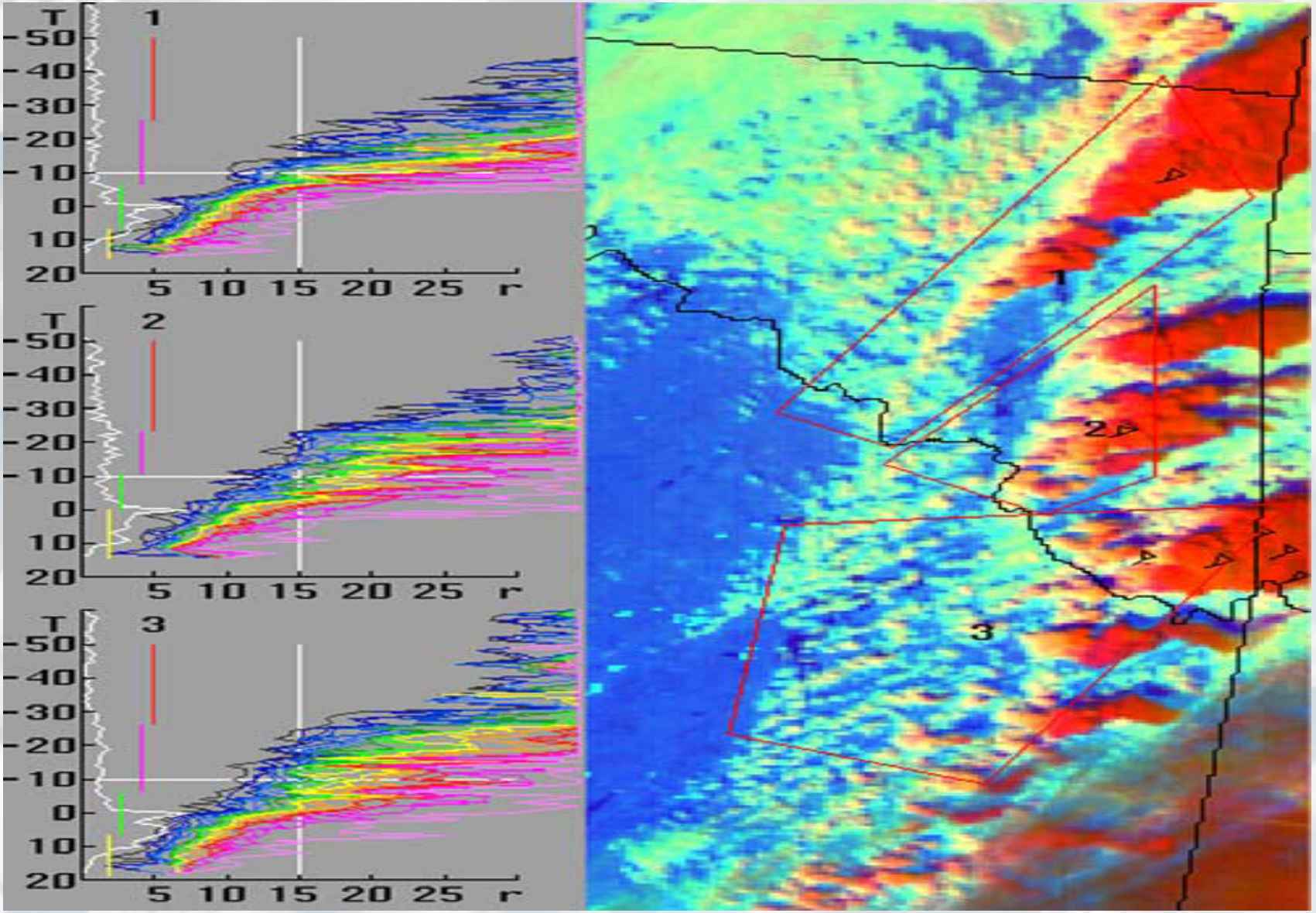


- Cloud tops T-re analysis, anvil partially formed by homogenous freezing
- Percentiles 5th to 100th in step by 5, vertical lines: yellow - diffusional growth, pink - mixed phase, red - glaciated zone.

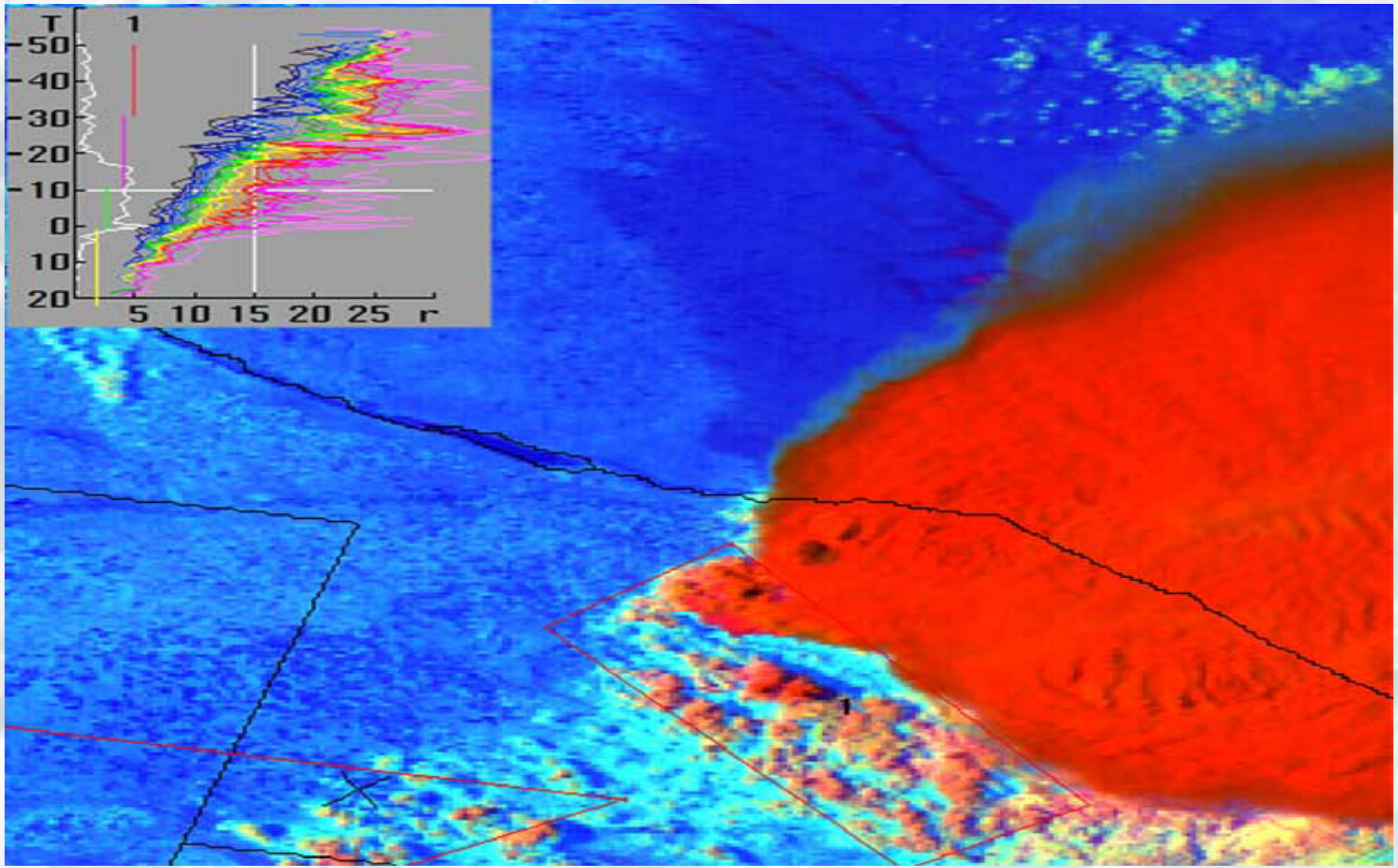
[6]



Nonsevere storm [6]



Hailstorm [6]

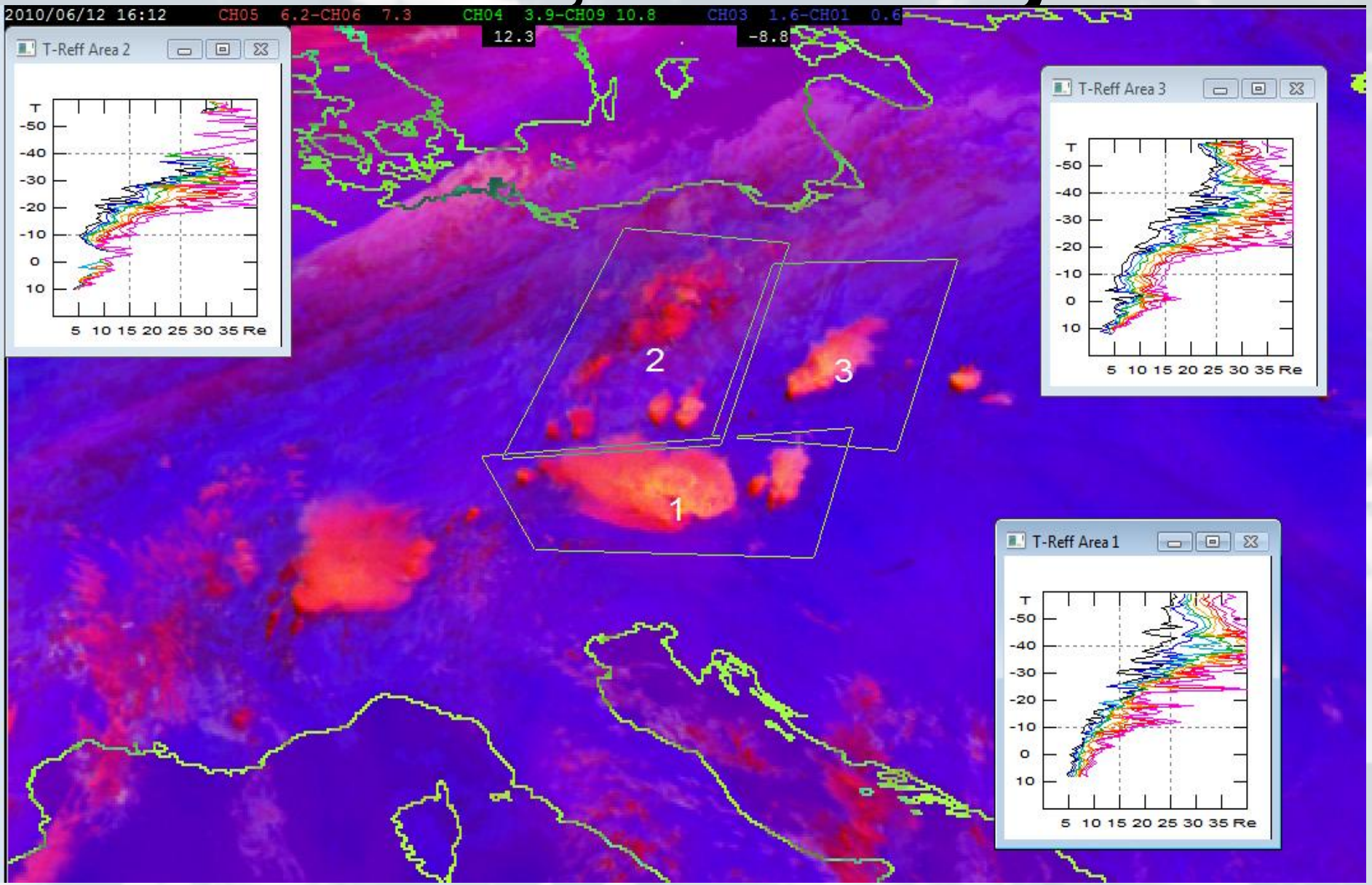


Tornadic storm, hail 4.5 inches [6]

June 12th, 2010

- After 15 UTC near Olomouc and Tábor mighty Cbs
- After 16 UTC near Šumperk thunderstorms registered, locally with rainstorm
- Near Tábor probably supercell appeared, probably with spout
- After 17 UTC in south Bohemia - hail diameter more than 3 cm and very heavy rain
- Southern Moravia – wind gusts about 16.30 UTC
- About 19.30 UTC in the vicinity of Přerov heavy rain and strong wind reported
- About 20 UTC near Zlín strong wind reported. Roofs and trees damage noted
- About 18.30 UTC in Austria squall line with wind speed 25 m/s

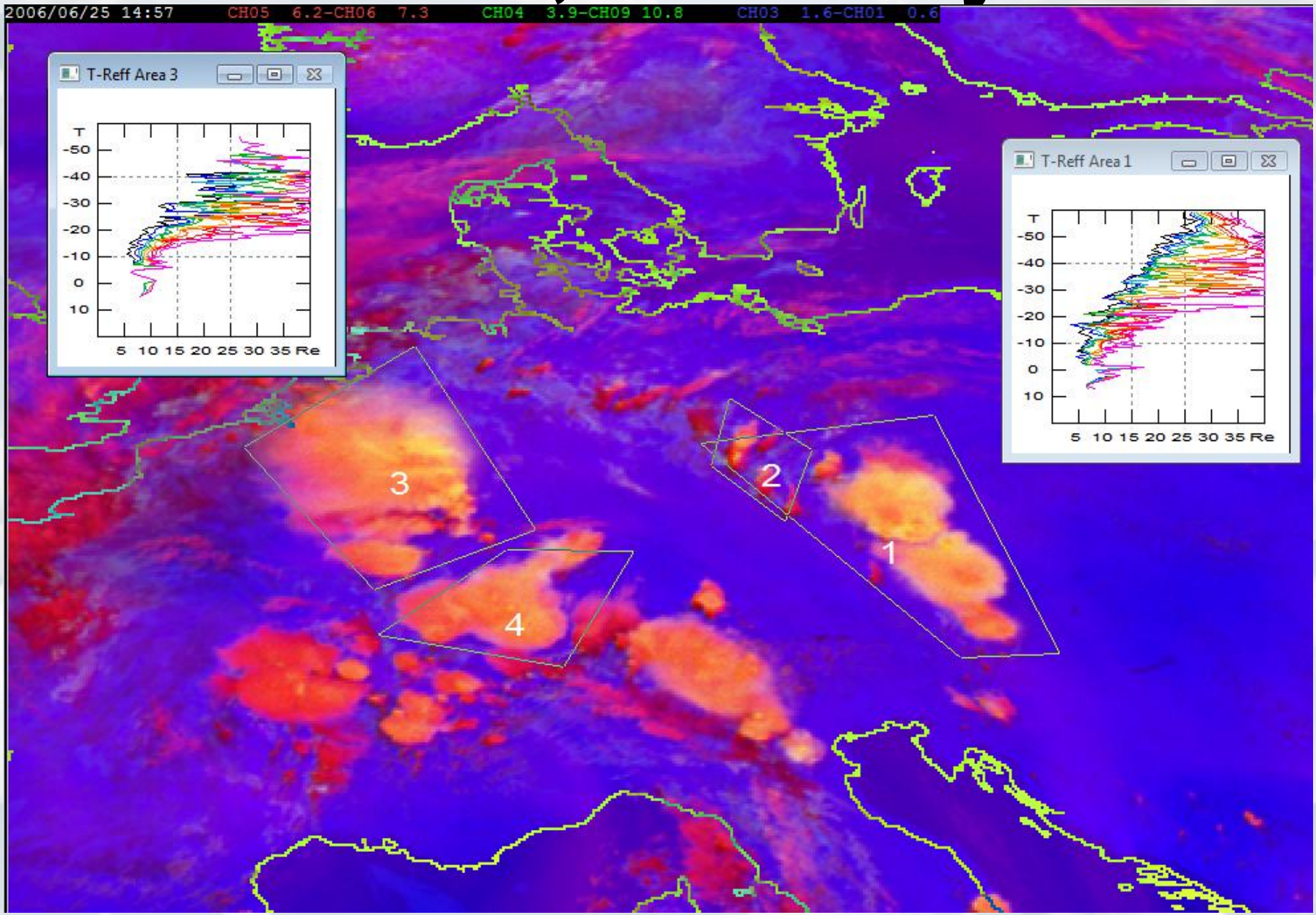
June 12th, 2010 analysis



June 25th, 2006

- In Germany - tornado at 16.30 UTC
- Intensity – category F1 T3
- The funnel cloud was observed, suction vortices
  were observed, path length - 3 km, maximum
  path width - 300 m
- Later in Germany hail, diameter 1.5 - 3 cm,
  heavy rain 50 mm/h, wind gusts 35 m/s
- Visibility in rain about 100 m
- Forests and crops damage
- In CZE hail near Soběslav about 16 UTC, hail size

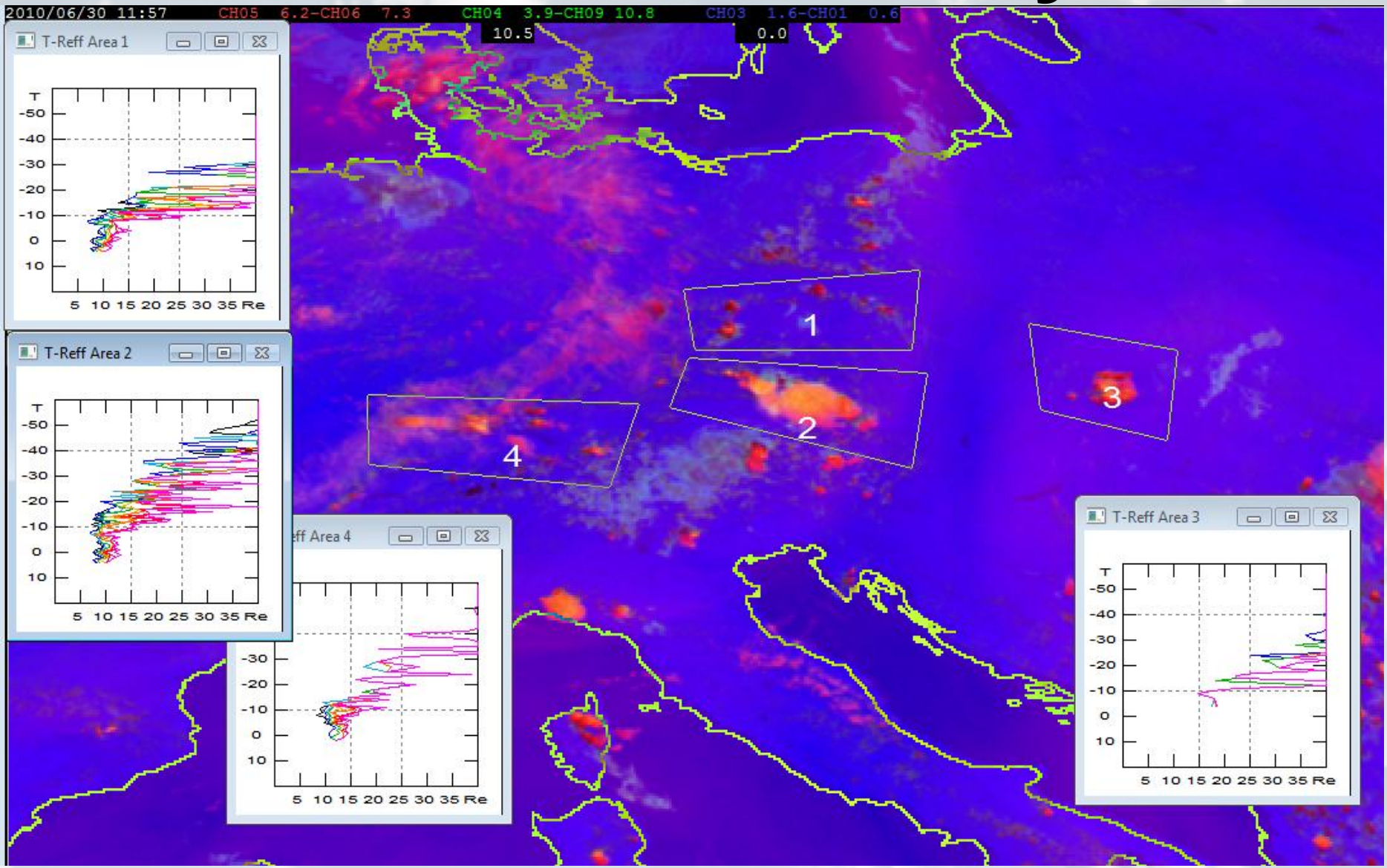
June 25th, 2006 analysis



June 30th, 2010

- Vigorous convection since the morning, afternoon thunderstorms in eastern Bohemia
- Near Náchod thunderstorms about 12 UTC
- Near Liberec thunderstorm after 11:30 UTC,
  graupels 0,2-0,5 cm
- In western Bohemia hail 1 cm, time was not reported
- In Slovakia hail 2 cm
- After 15 UTC in Germany hail 3 cm and wind
  gusts

June 30th, 2010 analysis



Future Plan

- Analysing nonsevere situations
  - excepting dangerous events (databases, radars…)
- Comparing results to severe situations
- Setting up criterion
- Application in convective season(s)
  - manually / automatically
- Using in practice

Conclusions

- Described theories based T-re plots generated from satellite data.
- Tested in USA, Brazil, Israel,...
- In case of confirmation in central Europe we could gain useful tool for severe weather nowcasting
- Improving severe event nowcasting would lead to protecting of property, health and lives.

References

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[2] LINDSEY, D. T. - HILLGER, D. W. - GRASSO, L. - KNAFF, J. A. - DOSTALEK, J. F., 2006. GOES Climatology and Analysis of Thunderstorms with Enhanced 3.9 μm Reflectivity, Monthly Weather Review, č. 134..

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[4] ROSENFELD, D. - LENSKY, I., 1998. Satellite-Based Insights into Precipitation Formation Prosesses in Continental and Maritime Convective Clouds, The Bulletin of American Meteorological Society 79, s. 2457-2476.

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[6] ROSENFELD, D. - WOODLEY, W. L. - LERNER, A. - KELMAN, G. - LINDSEY, D. T., 2008. Satellite Detection of Severe Convective Storms by Their Retrieved Vertical Profiles of Cloud Particle Effective Radius and Thermodynamic Phase, J. Geophys. Res., č. 113, D04208, doi: 10.1029/2007JD008600.

Thank you for your attention!