Severe weather

(potential use of PWAT-precipitable water content derived from GNSS data)

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Two aspects of severe weather discussed:

- Excessive rainfall due to cyclogenesis – example of *general severe weather* taking place at a larger area
- Intense convective storms – core type of severe weather (*localized severe weather*)

What do they have in common?

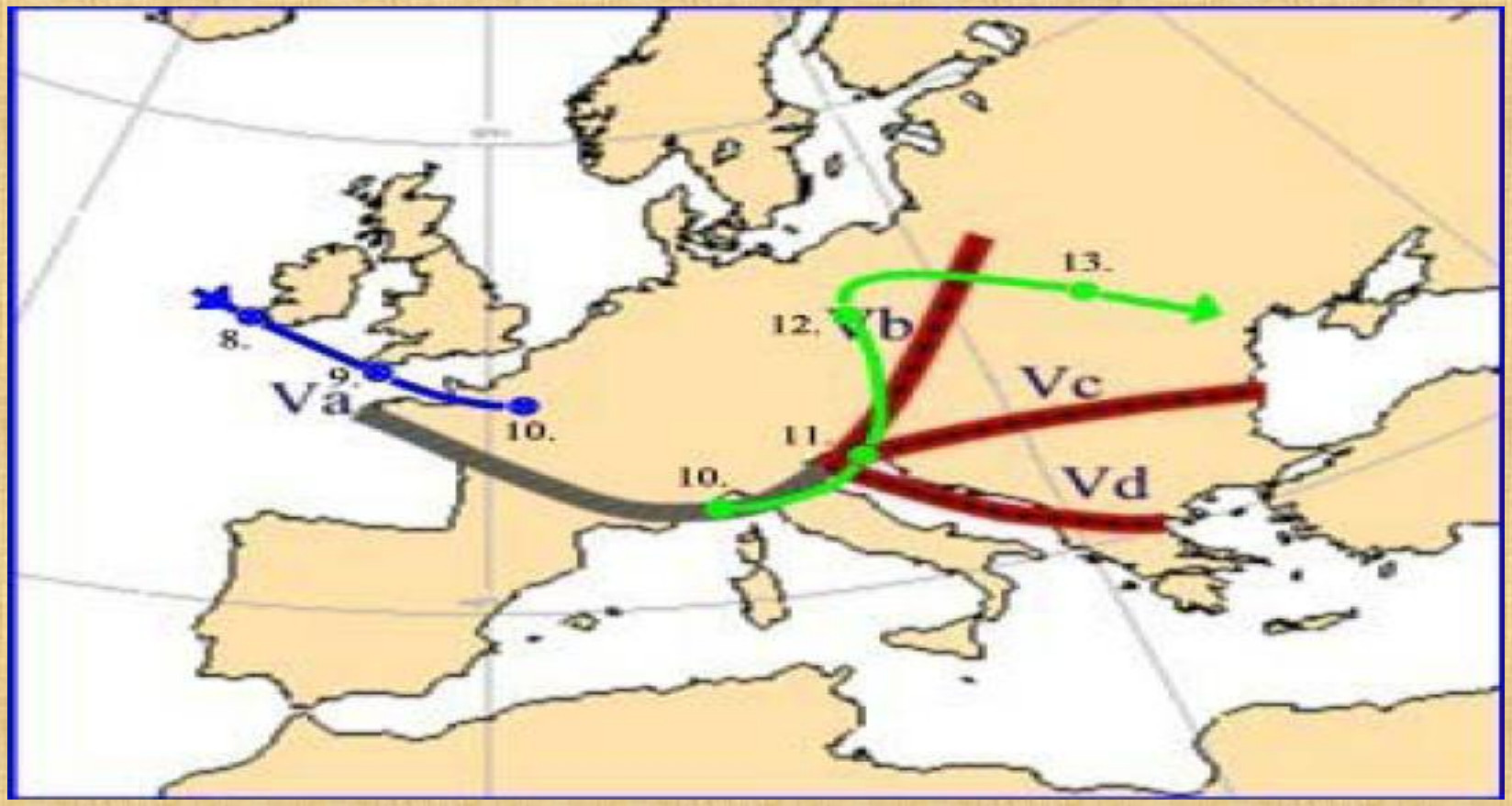
Rainfall totals are often many-fold larger than atmospheric PWAT prior to and during a precipitation event.

Reason for that is the atmospheric convergence: synoptic scale or local respectively

Intense precipitation events (IPE)

- relatively frequent summertime intense precipitation events in the Sudetes with floods as a result
- similarities in synoptic conditions of IPE
  - center of low pressure system to the east from Sudetes
  - northerly jet strem

Low system track, 10-14 August 2002; main wave of rainfall



van Bebber low system track Vb

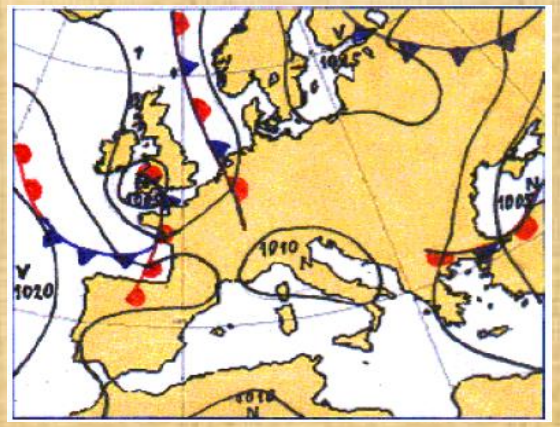
- movement from Bay of Genova or Adriatic Sea towards NE to Central Europe
- thermal asymetry
- substantial wind shear
- long-lasting intense rainfall at wide areas even more than 100 000 km^2 large
- the highest daily totals in mountainous areas

Typical synoptic conditions of IPE

- center of low or axis of meridional trough to the east of the Sudetes
- strong convergence over Sudetes
- strong horizontal pressure gradient to the west of low center over Sudetes
- strong northerly cold air current over Sudetes in lower part of troposphere
- active rainfall-formation processes in mid-troposphere

Synoptic situation during the main precipitation wave

9 VIII 00 Z



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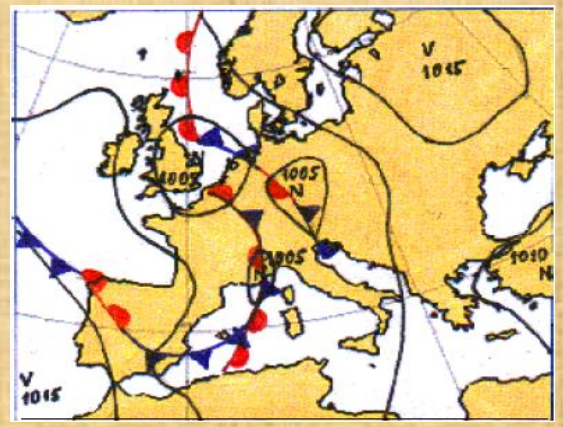

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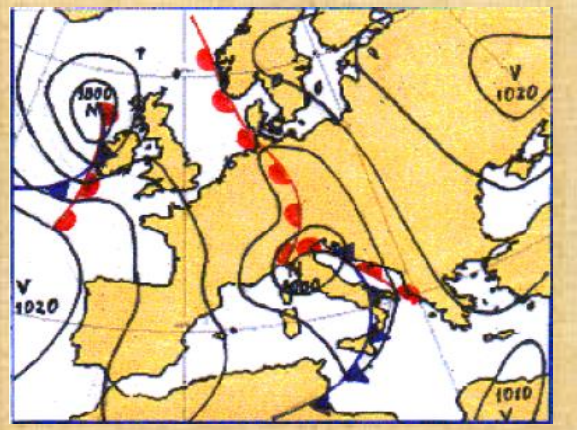

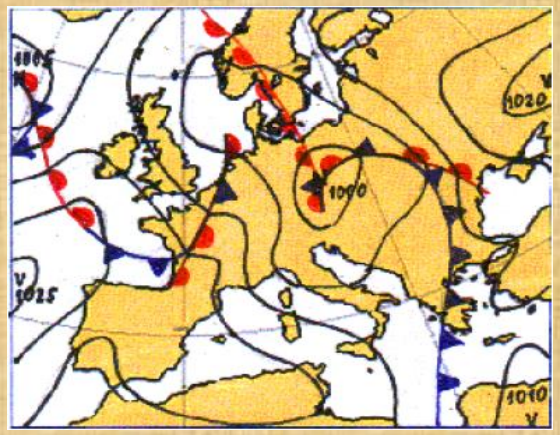

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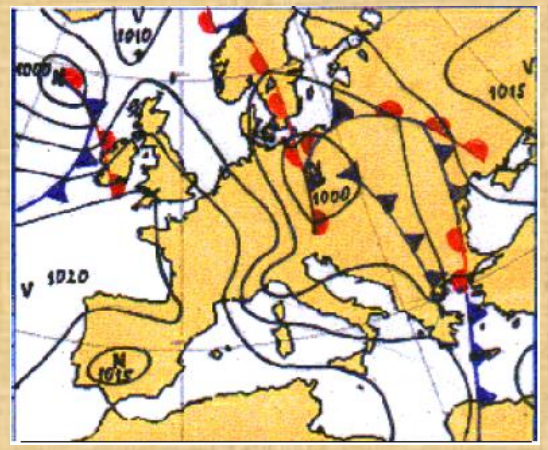

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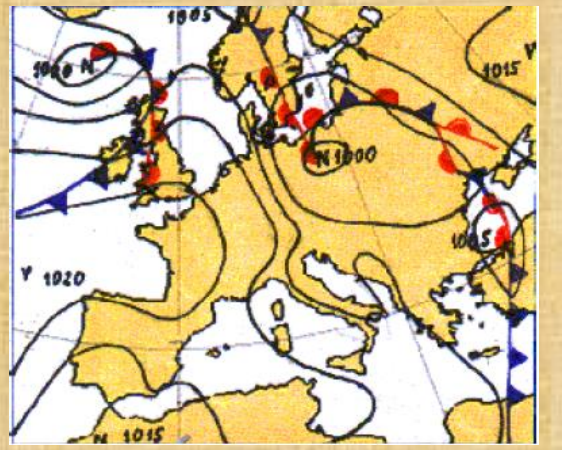

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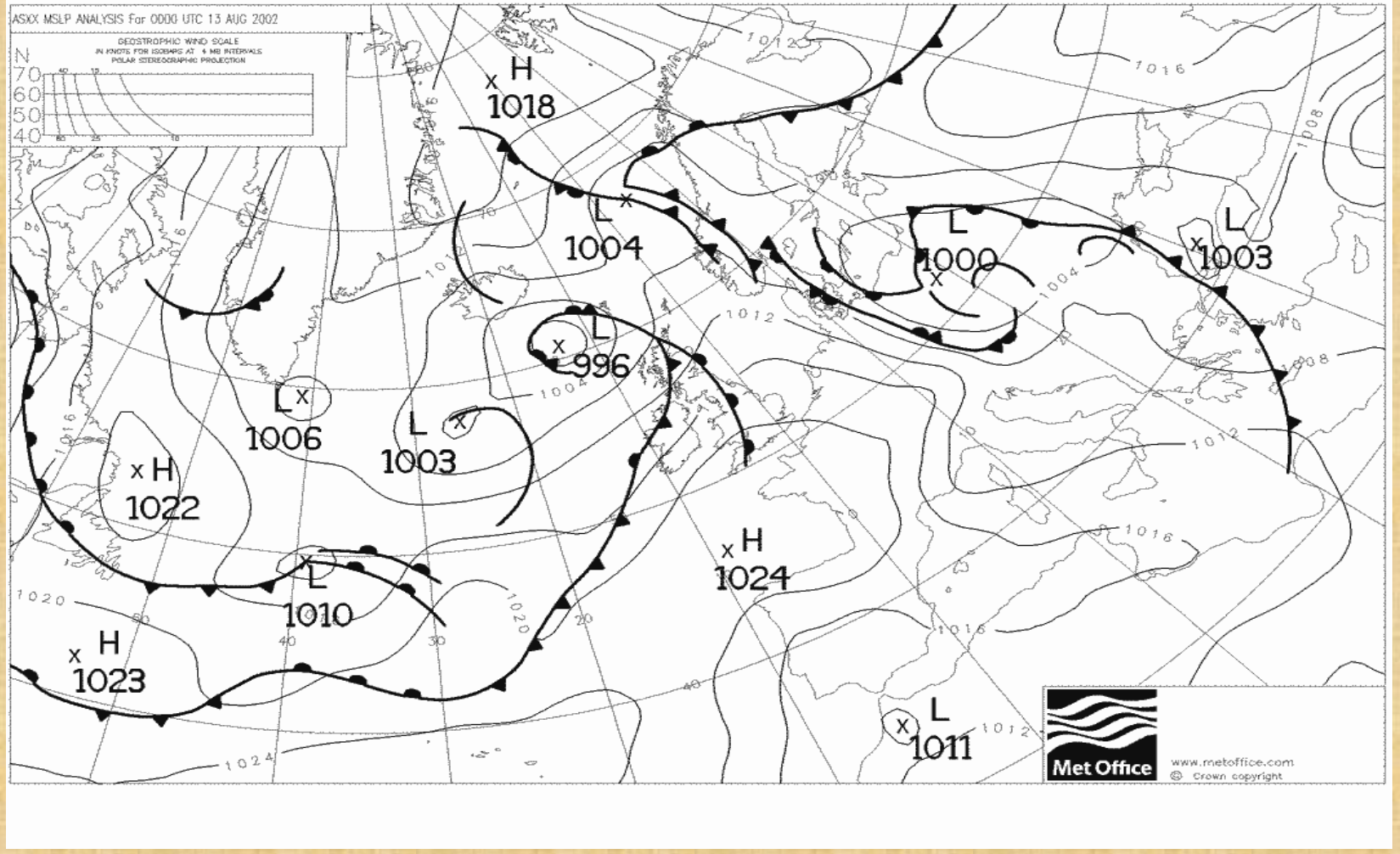
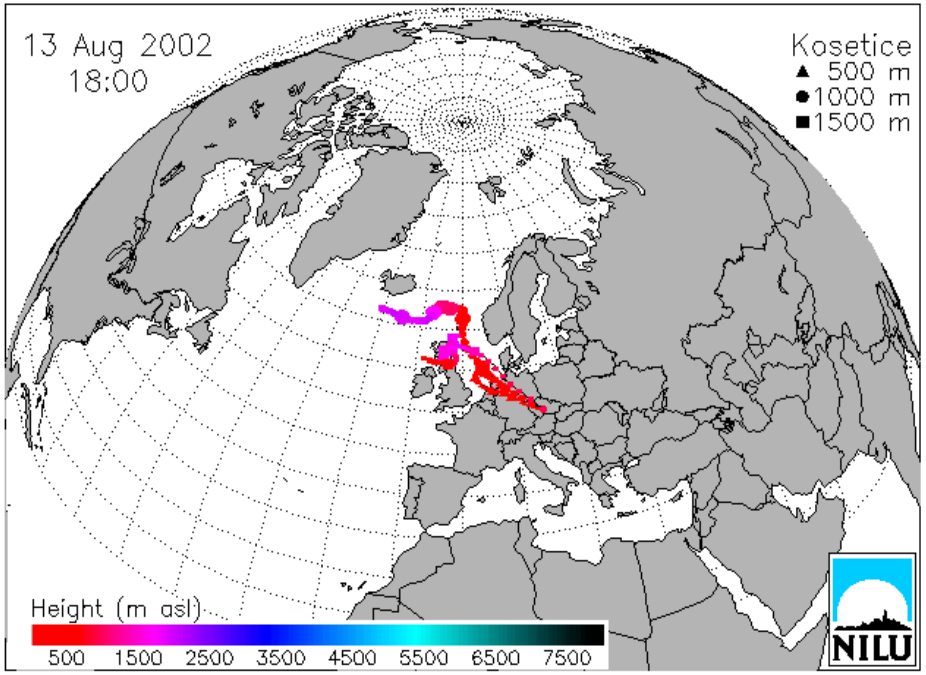
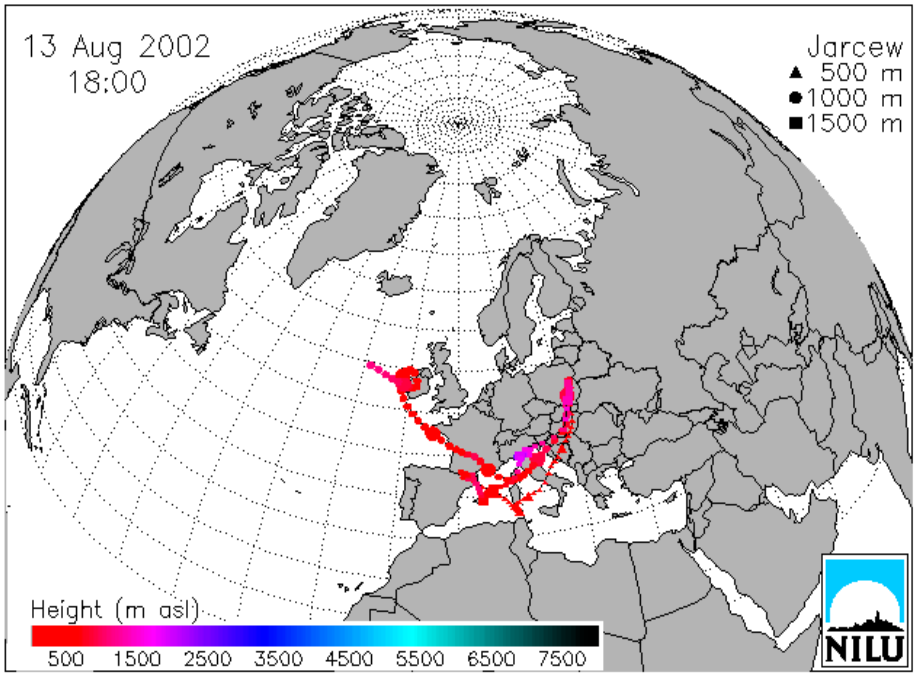


Sea-level synoptic map, 13 AUG 2002 12 Z



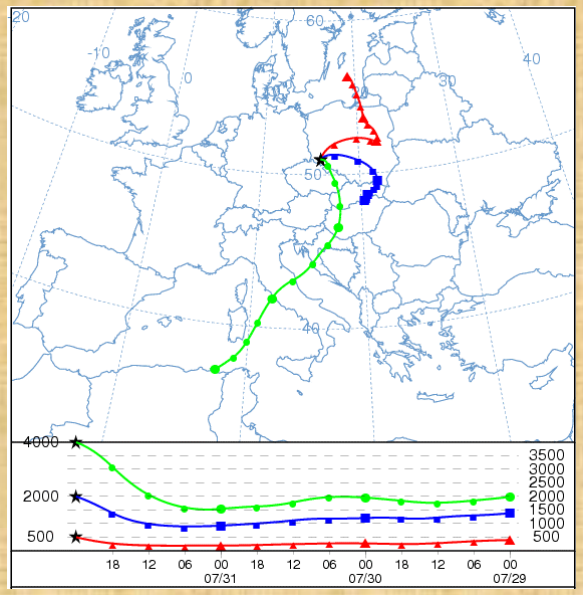


Air masses back-trajectories Kosetice and Jarczew; 13 VIII 05 18Z

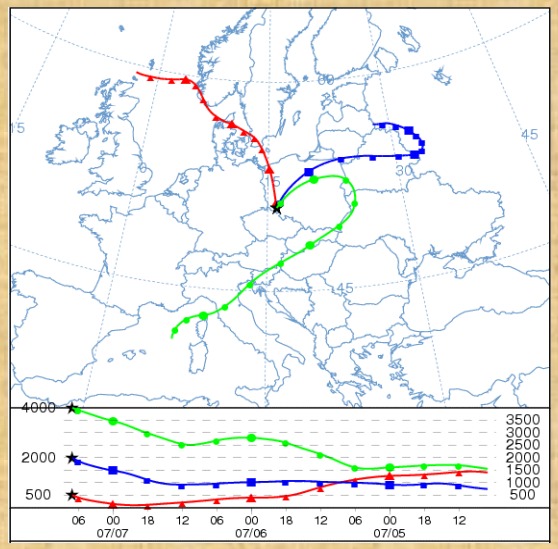
- significant contrast of the air masses origin visible
- the warm mass gliding effect over the cold one is responsible for synoptic-scale atmospheric precipitation generated from mid-troposphere

Ekstremalne opady atmosferyczne

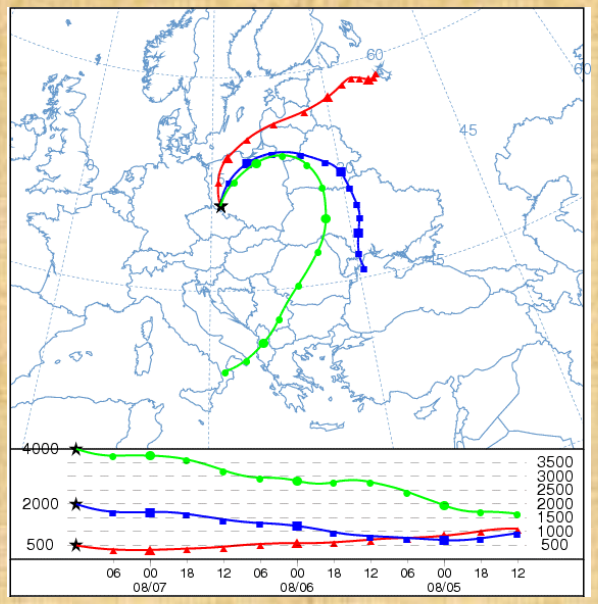
1 VIII 1977

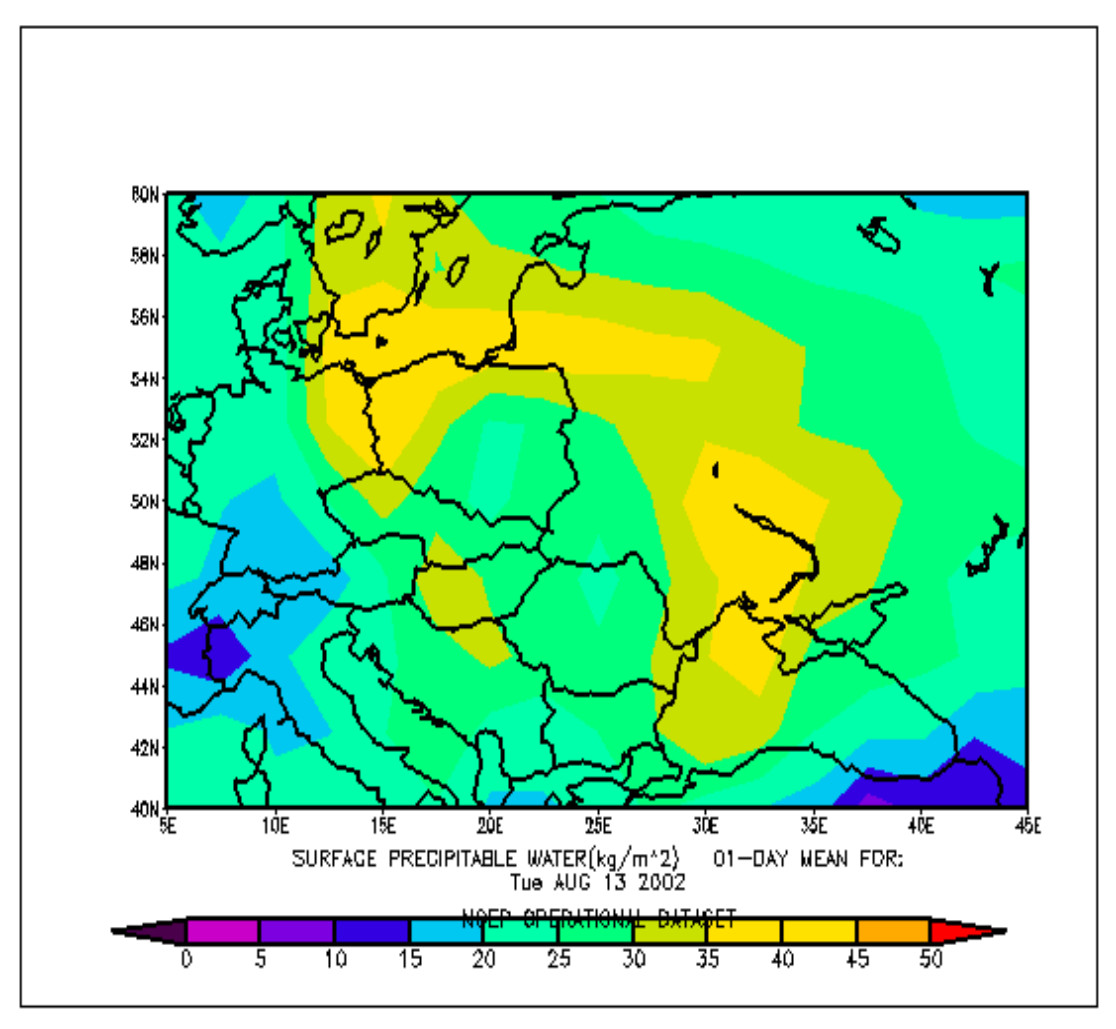


7 VII 1997



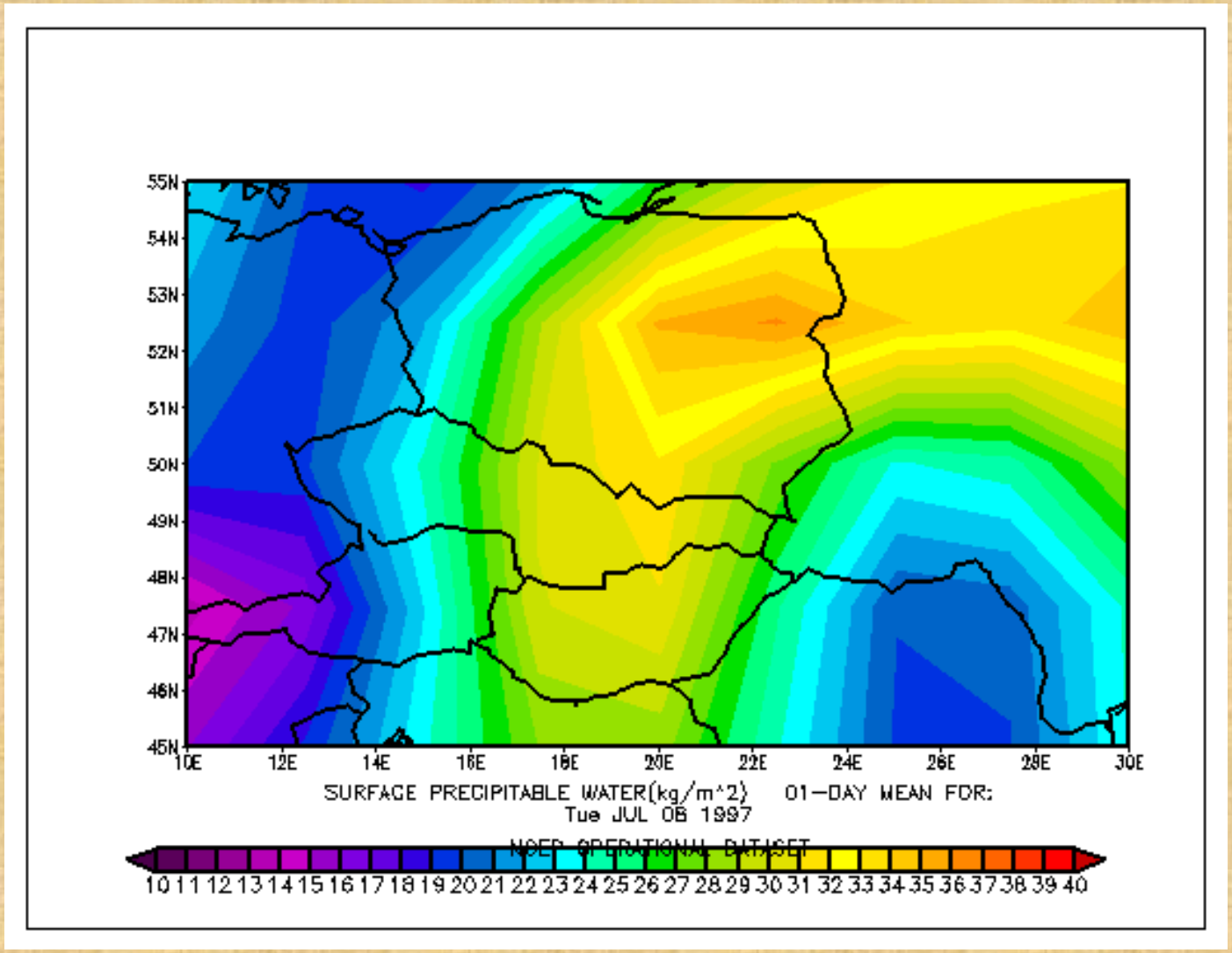
7 VIII 2006

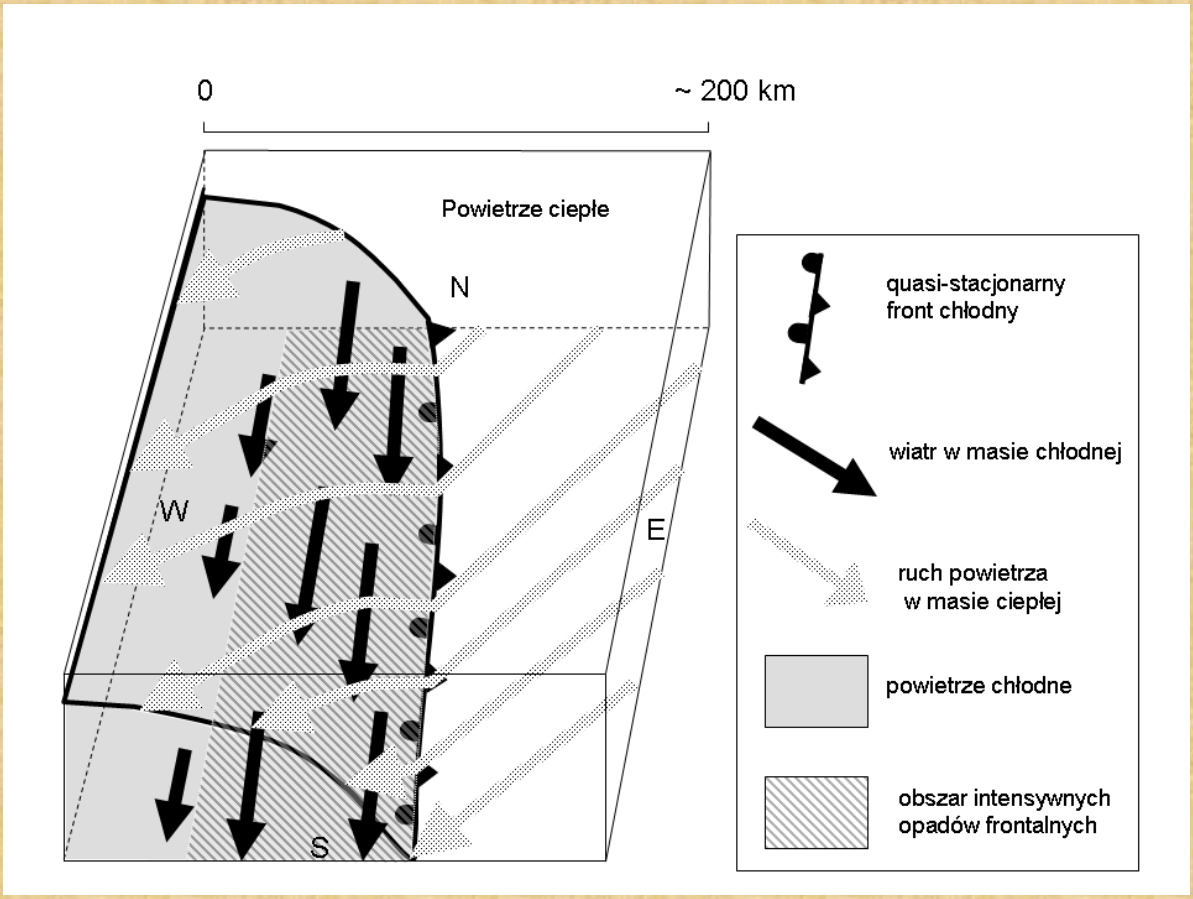




Precipitable water content in the troposphere – 13 AUG 2002 (daily mean)

Precipitable water content in the troposphere (06 VII 1997)



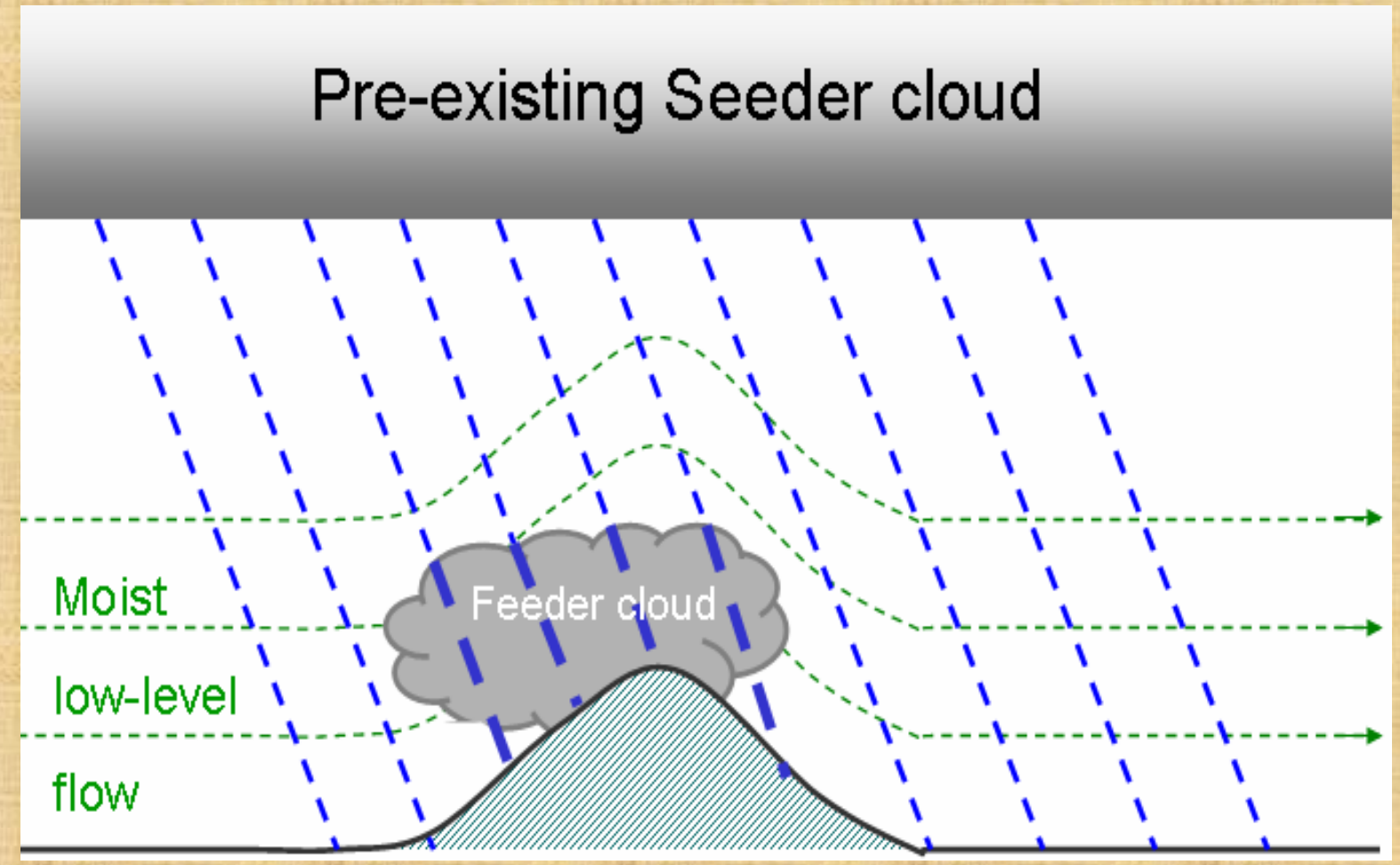


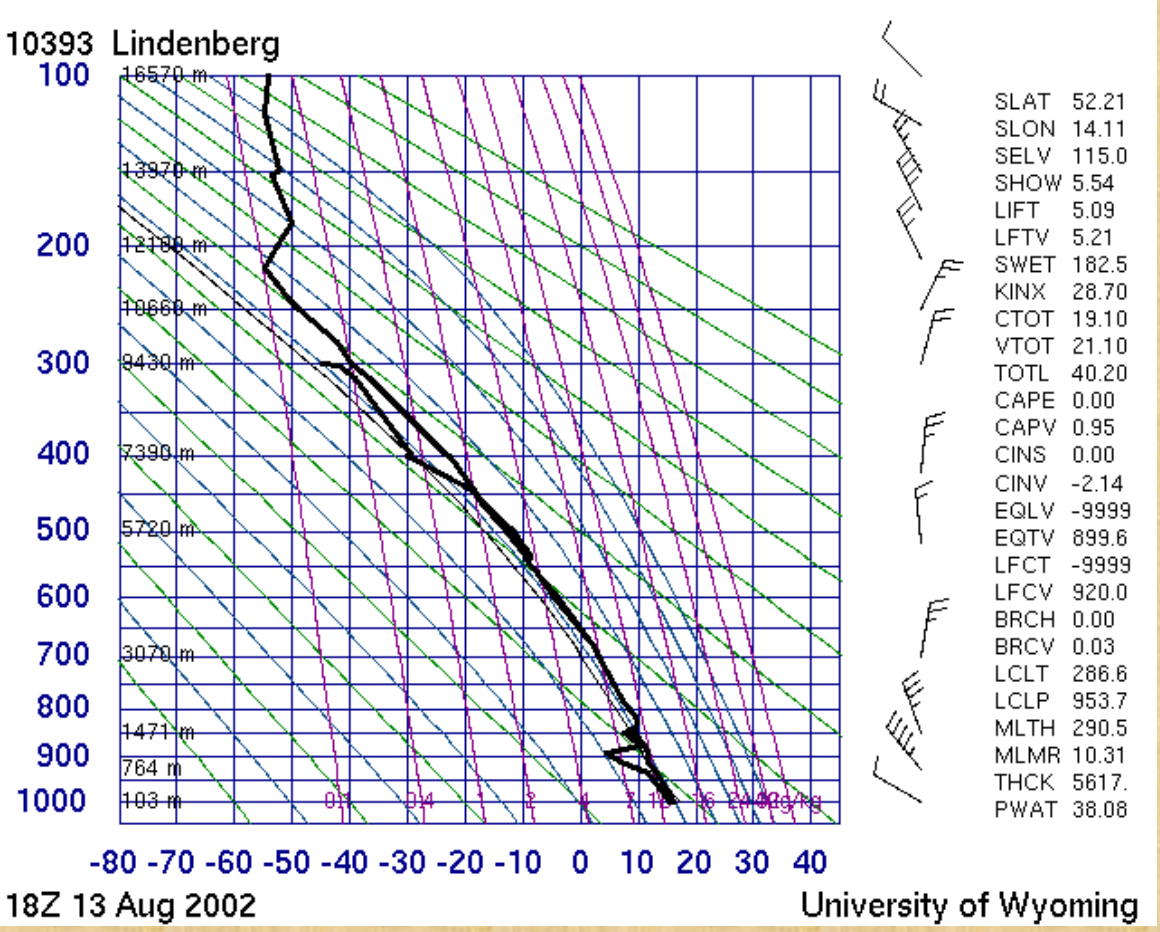
- streamlines convergence – ascending motion of warm and humid air;

- slow motion or stagnation of the steering low pressure system;

- intensification of precipitation where low level airflow meets mountains

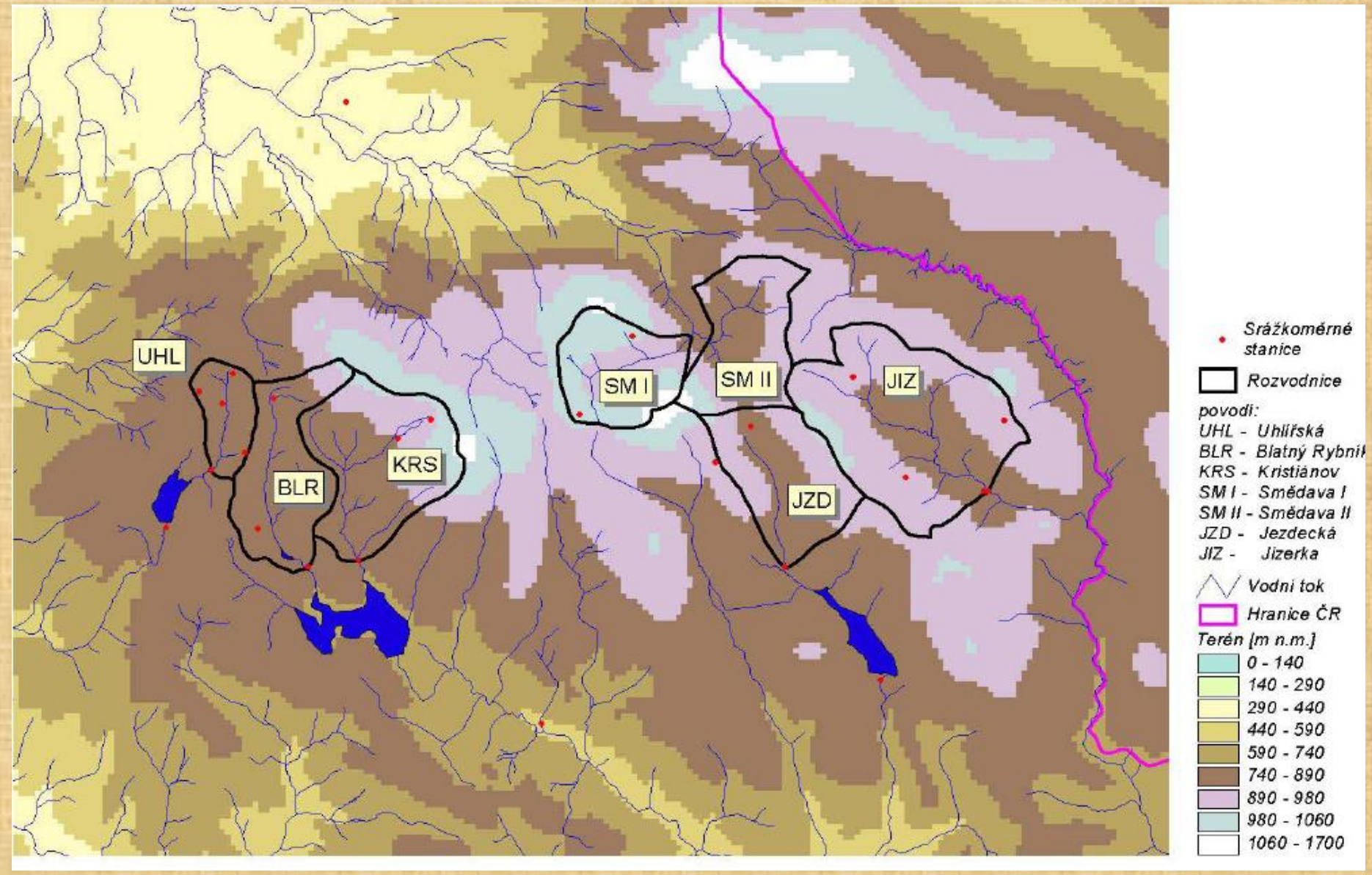
Seeder-feeder effect



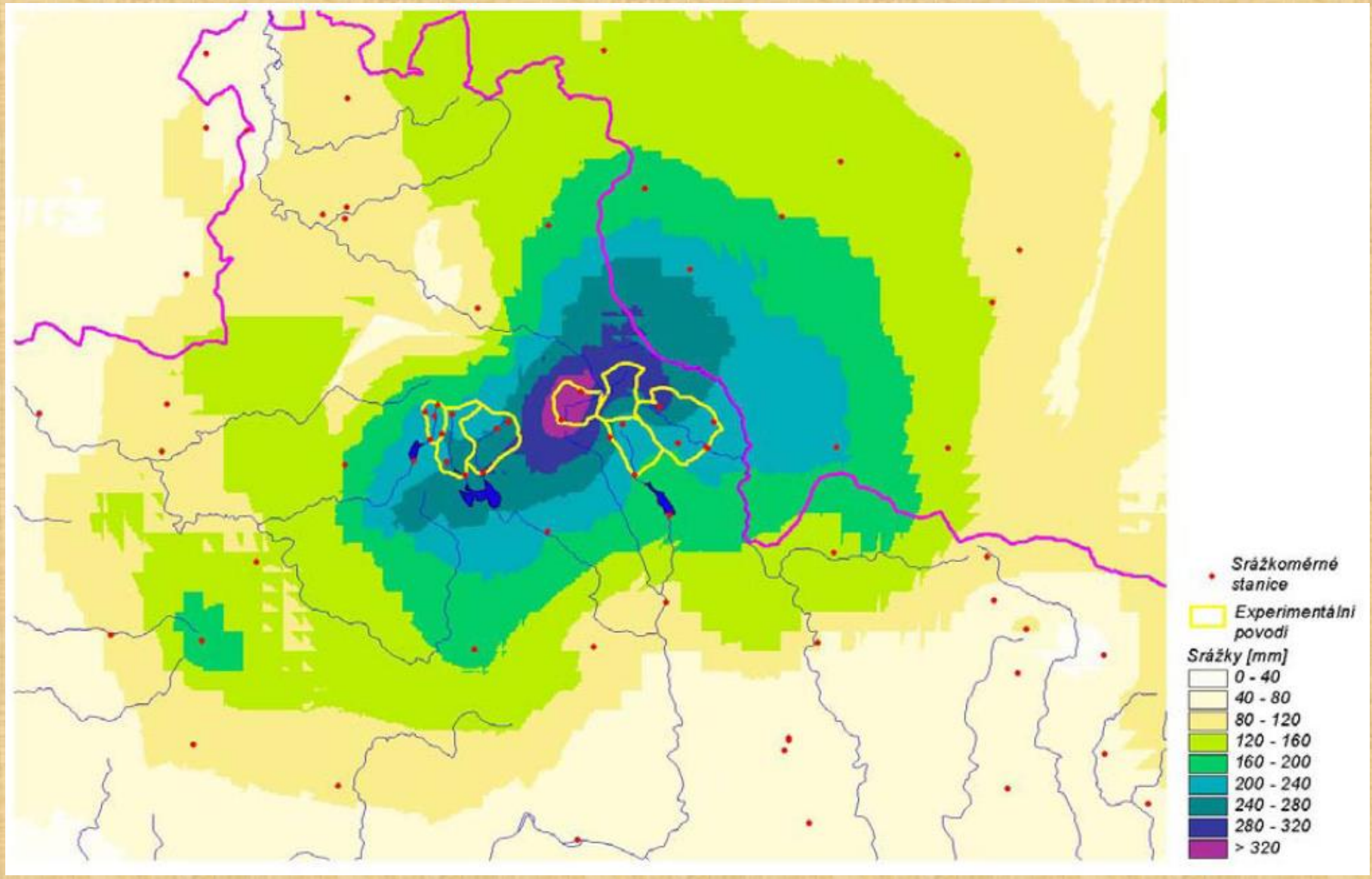


- wind at station level WNW 5 m/s
- wind at 764 m: NW 22,5 m/s
- wind at 1471 m NNW 17,5 m/s
- wind at 700 hPa N 12,5 m/s
- wind at 500 hPa N 7,5 m/s
- frontal inversion at around 1,5 km

Vertical structure of atmosphere; Dresden 13 VIII 2002, 18 Z

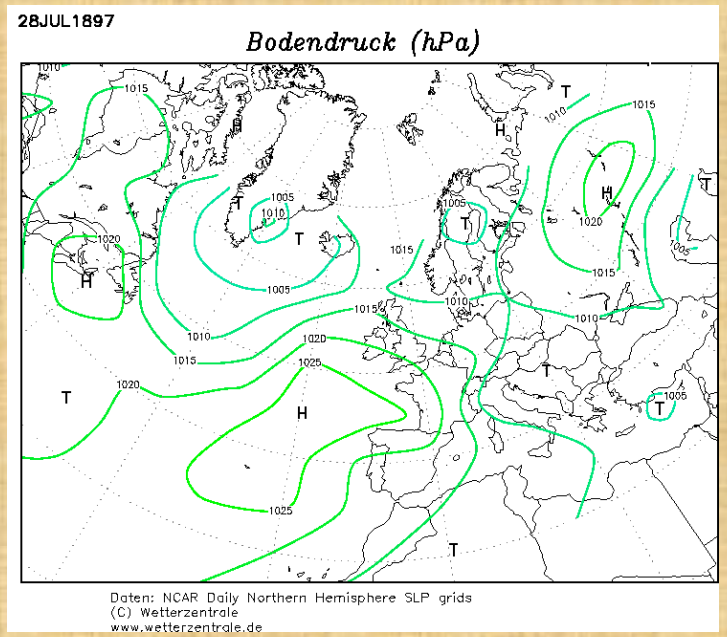


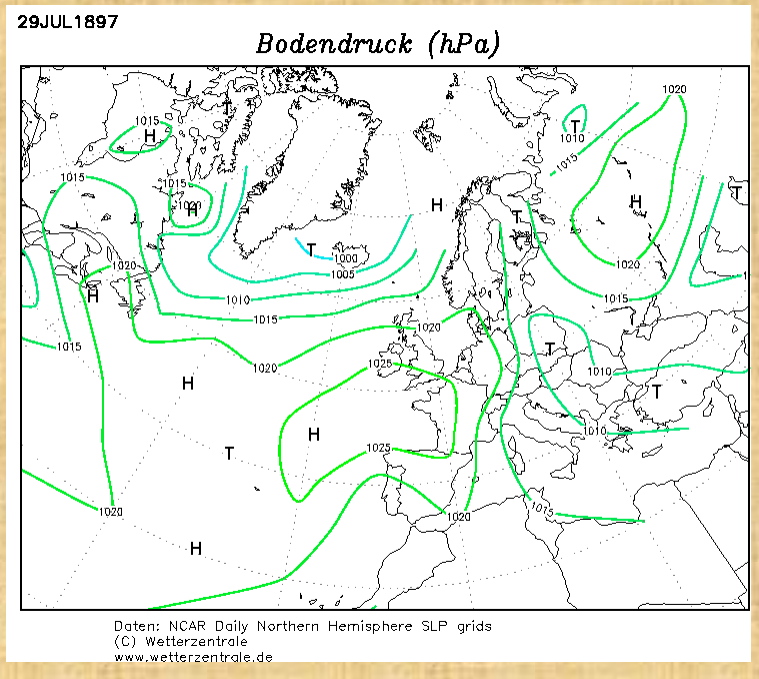
Izera Mts – net of experimental catchments CHMU

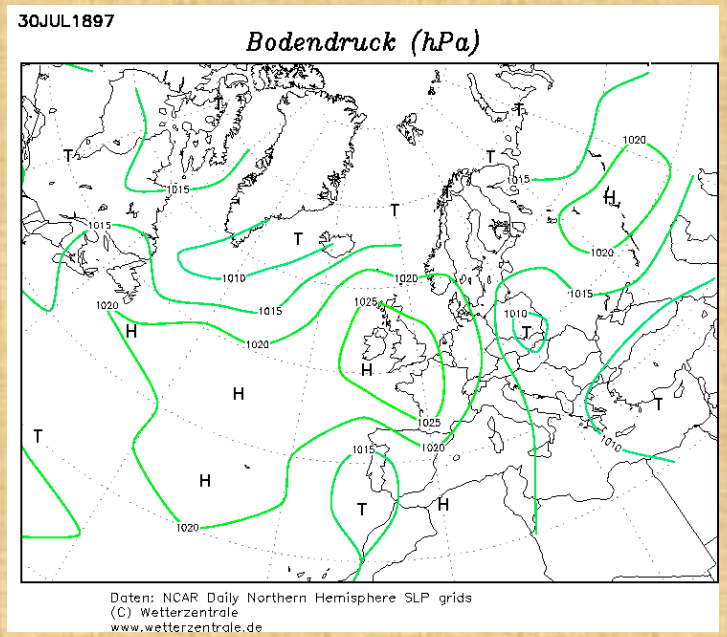


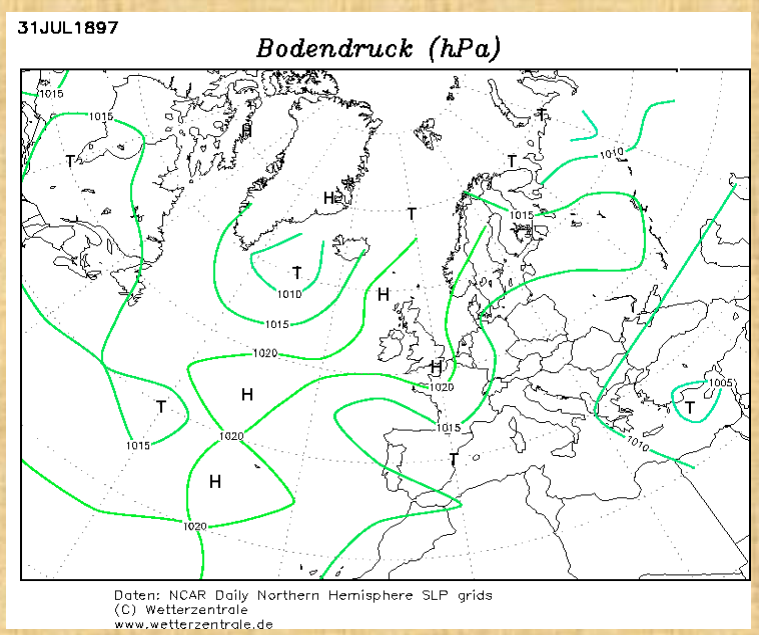
Two-days precipitation totals in the Izera Mts
12-13 VIII 2002

Synoptic situation – 28-31 JUL 1897



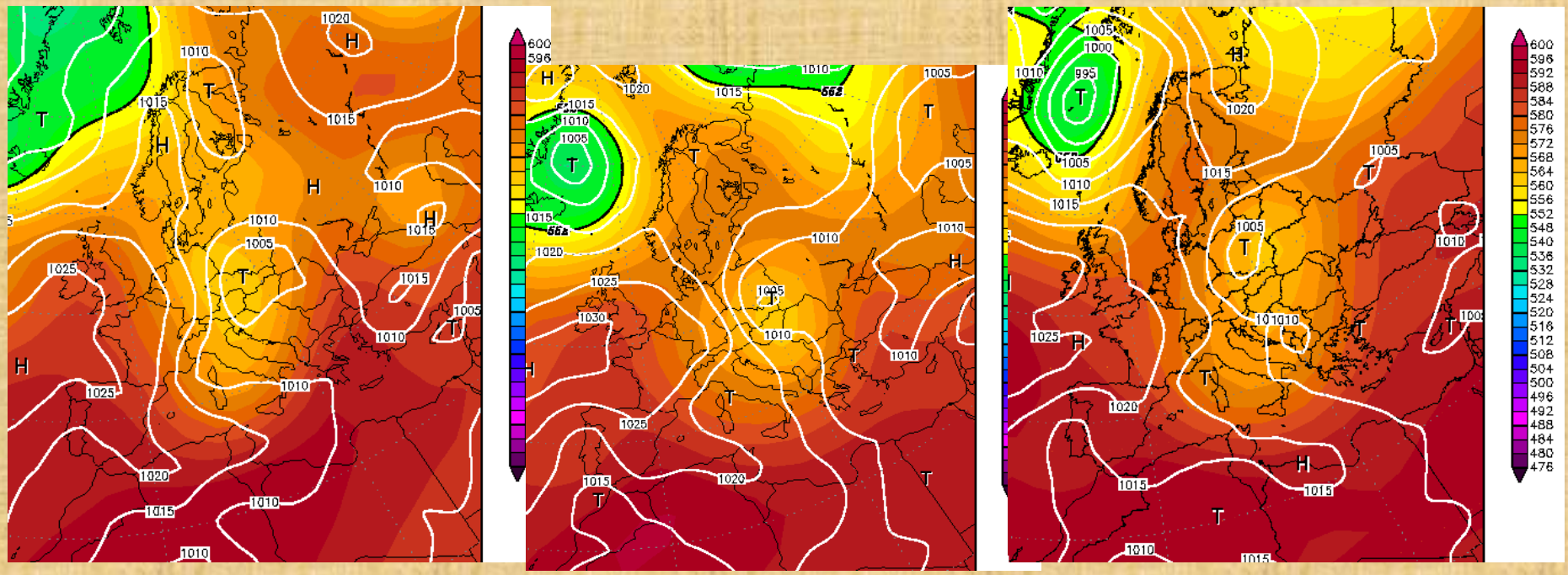






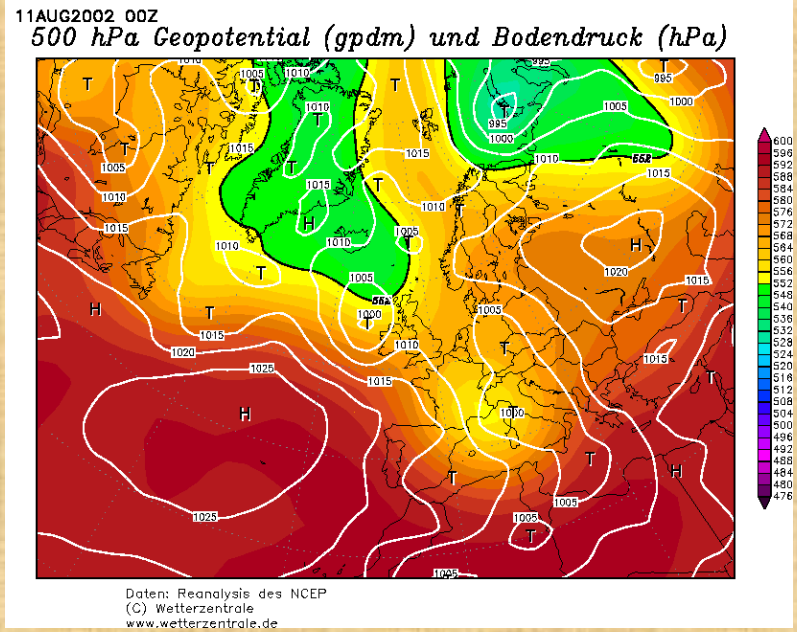
IPE – other examples

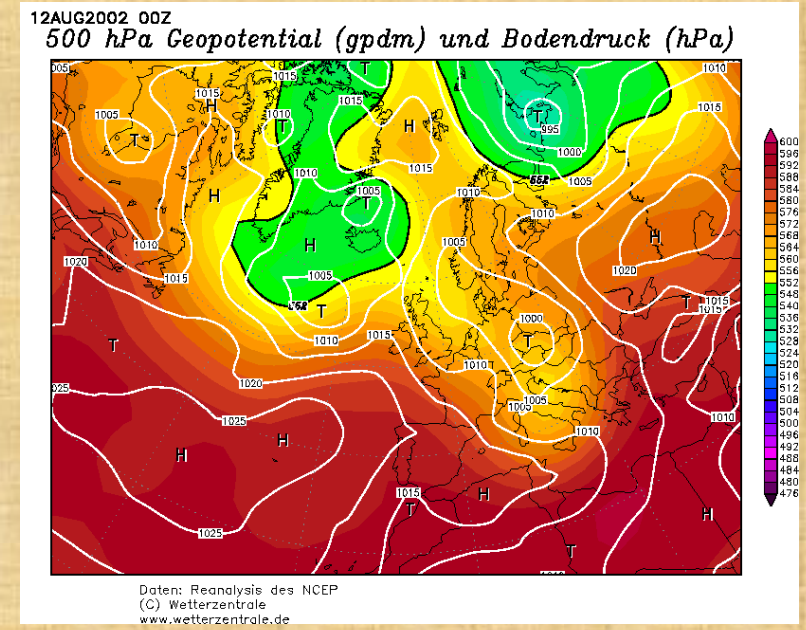
1 VIII 1977 **7 VII 1997** **7 VIII 2006**

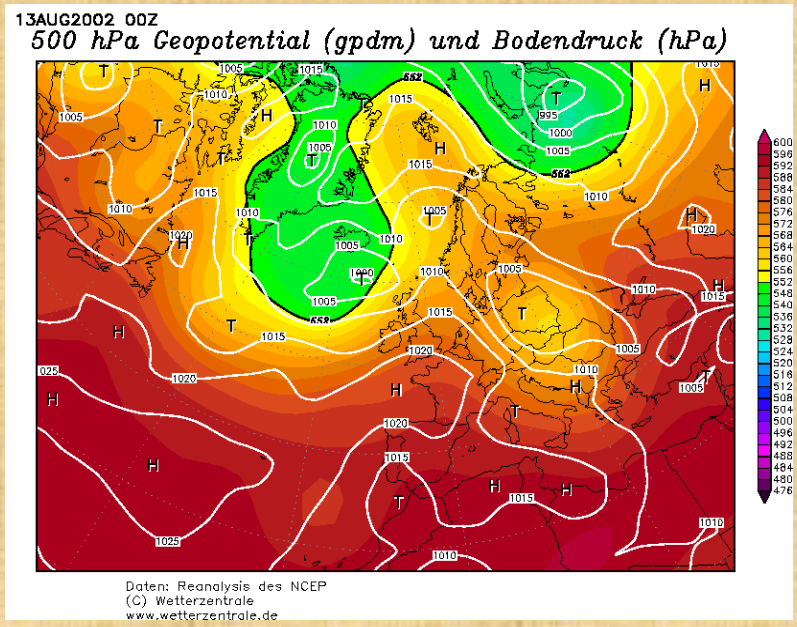


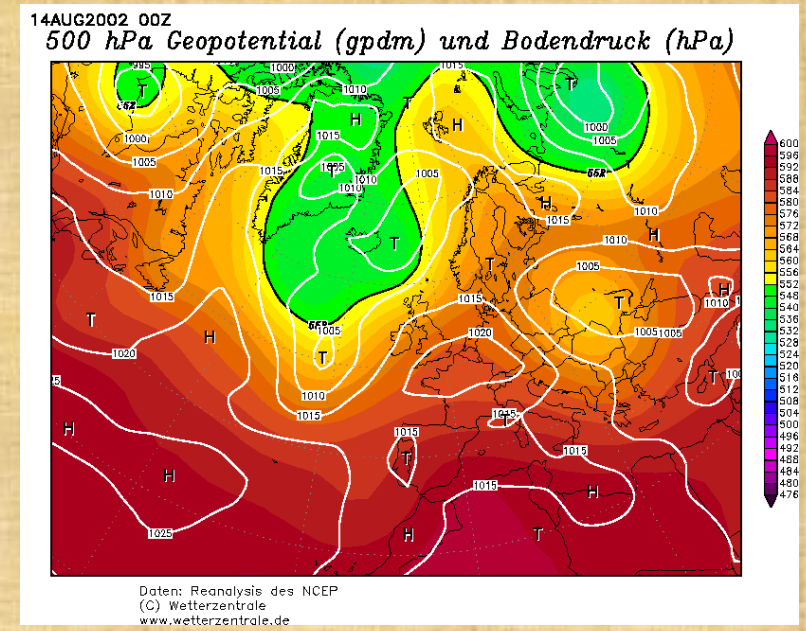
- Atmospheric circulation from northern sector

Synoptic situation– 11-14 AUG 2002



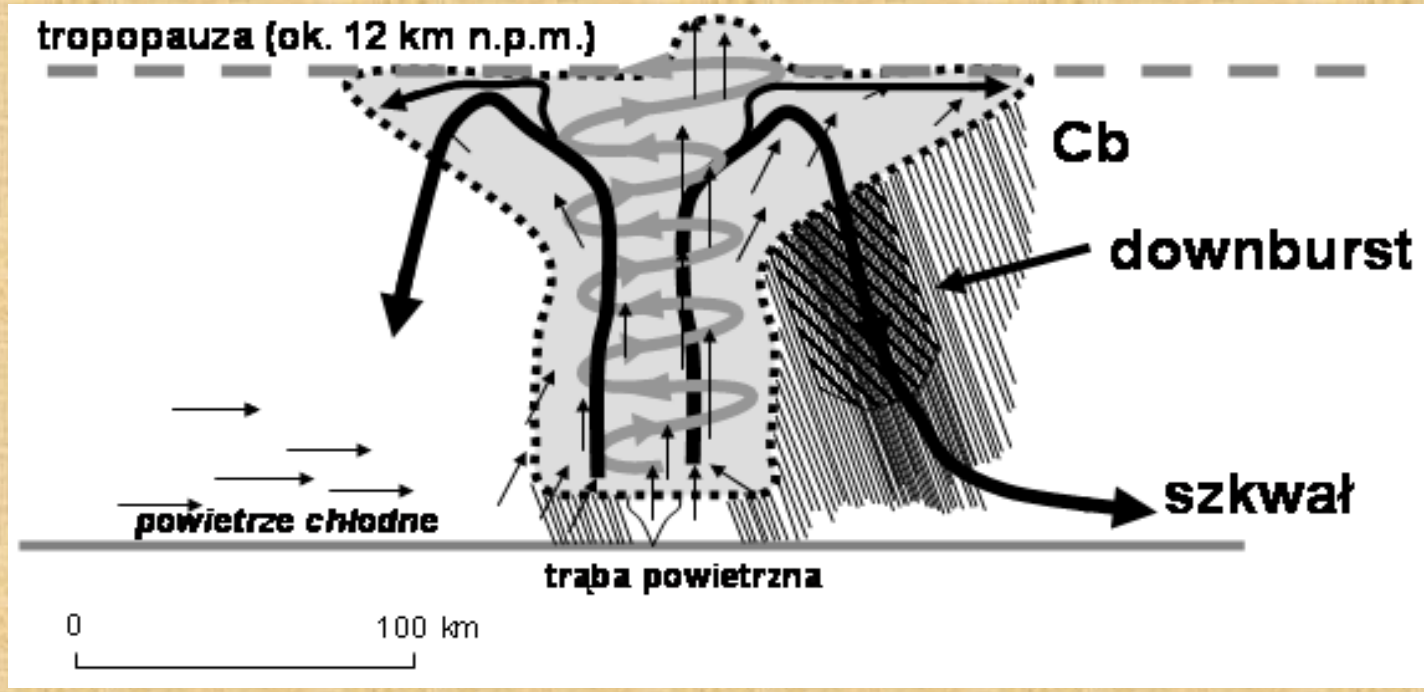




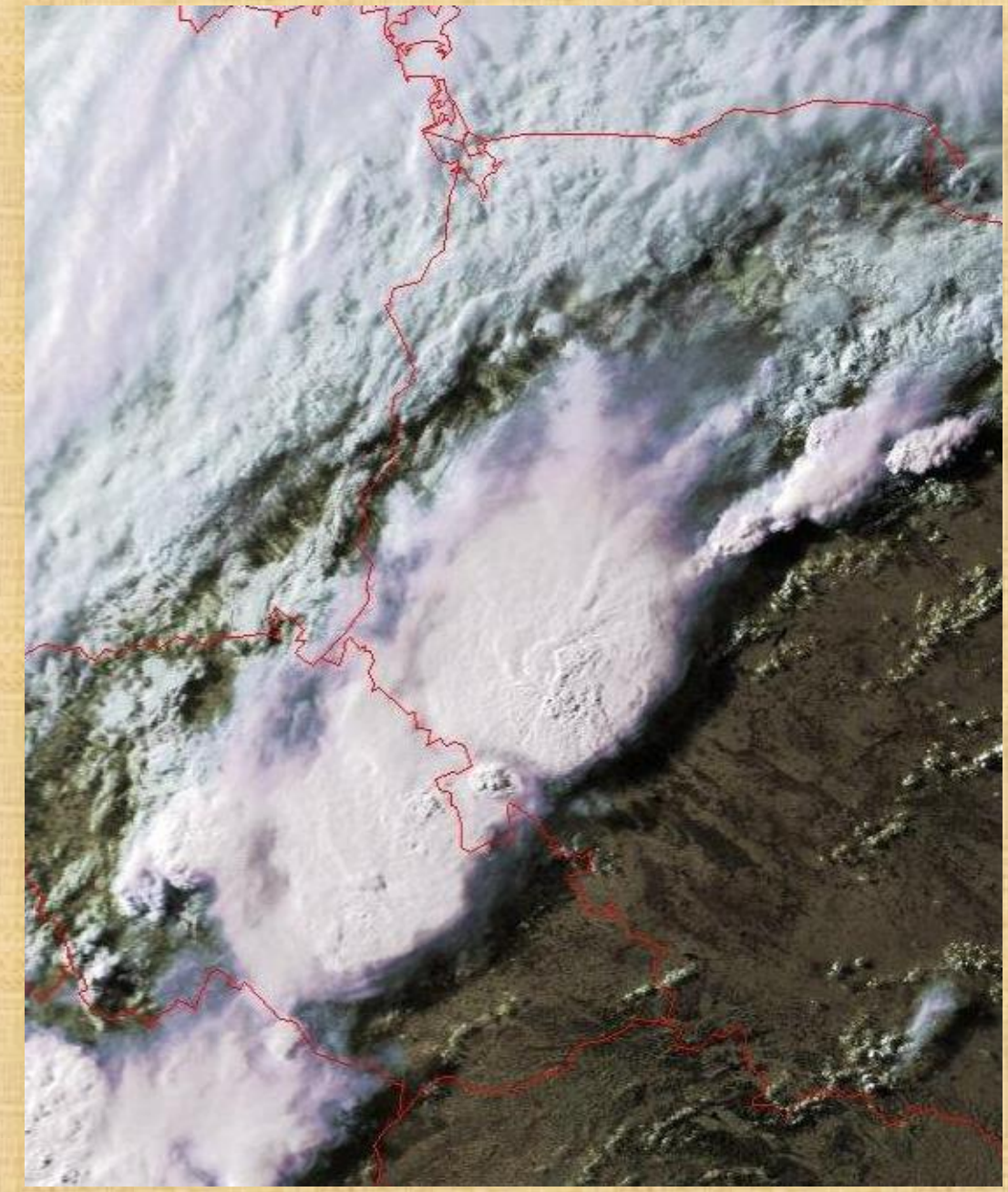


Convection of different intensity

MCS – mesoscale convective system



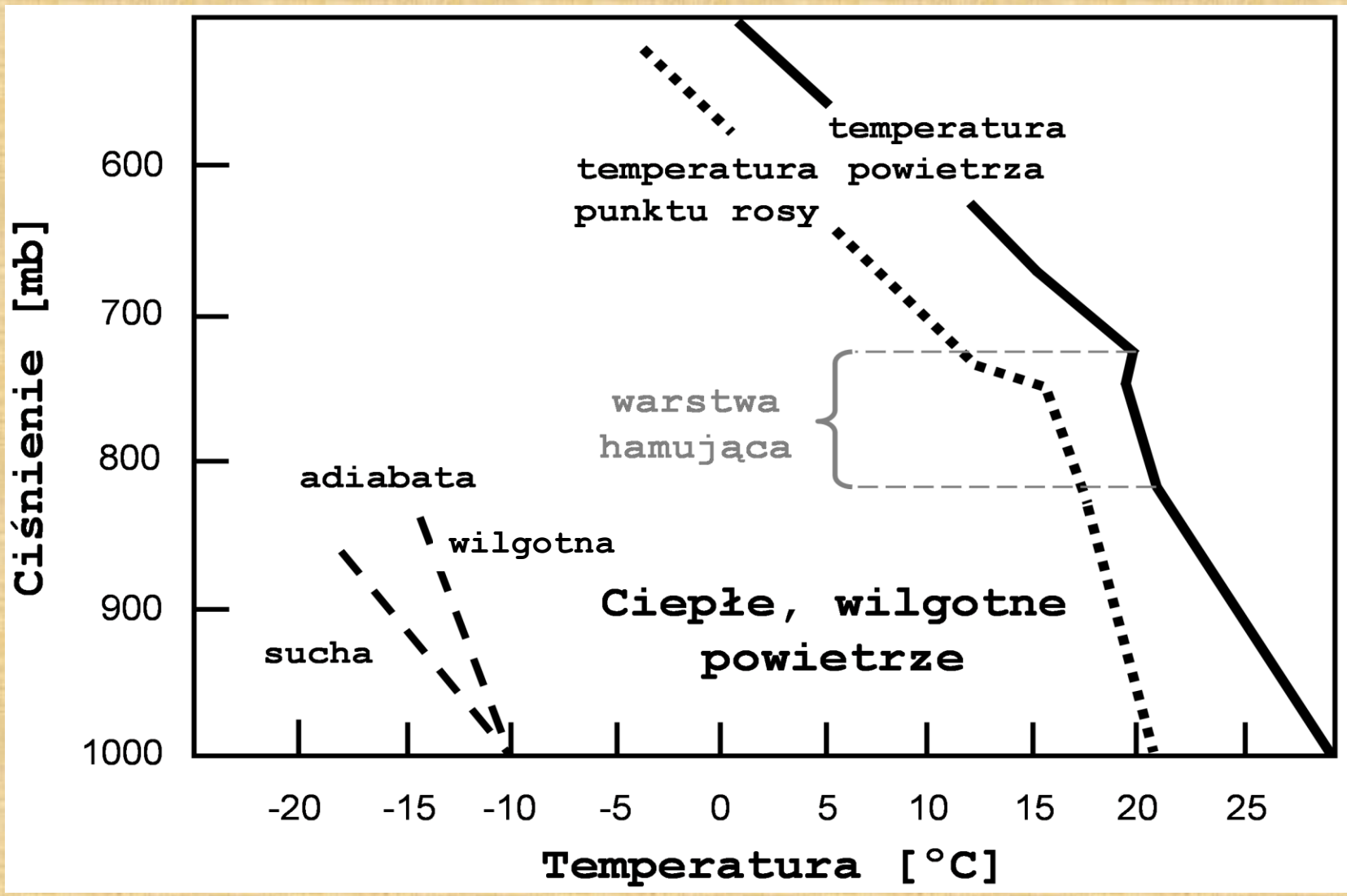
30 May 2005



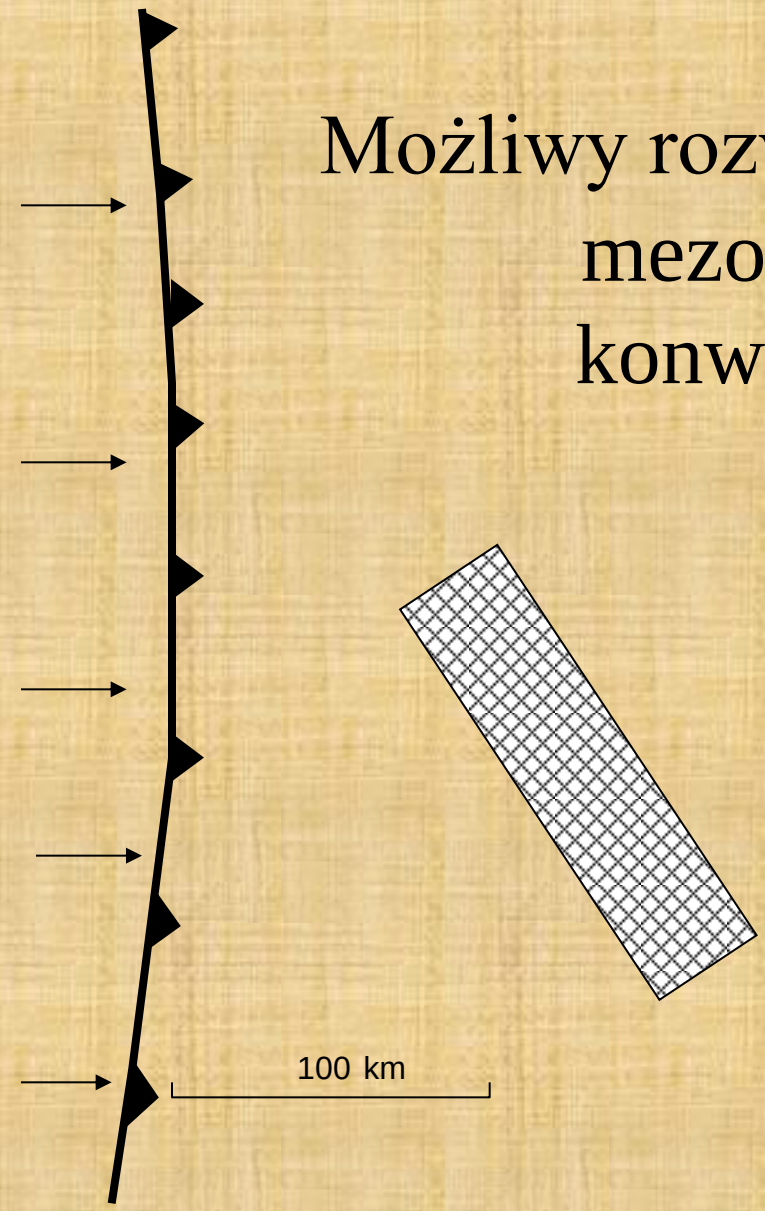
Convective IPE

- The highest precipitation totals at the Sudetes Forefield or in the Sudetes;
- Weak horizontal pressure gradient;
- Typically cold front slow motion from W to E;
- Lack of clear dependence on altitude;
- Inhibition layer present.

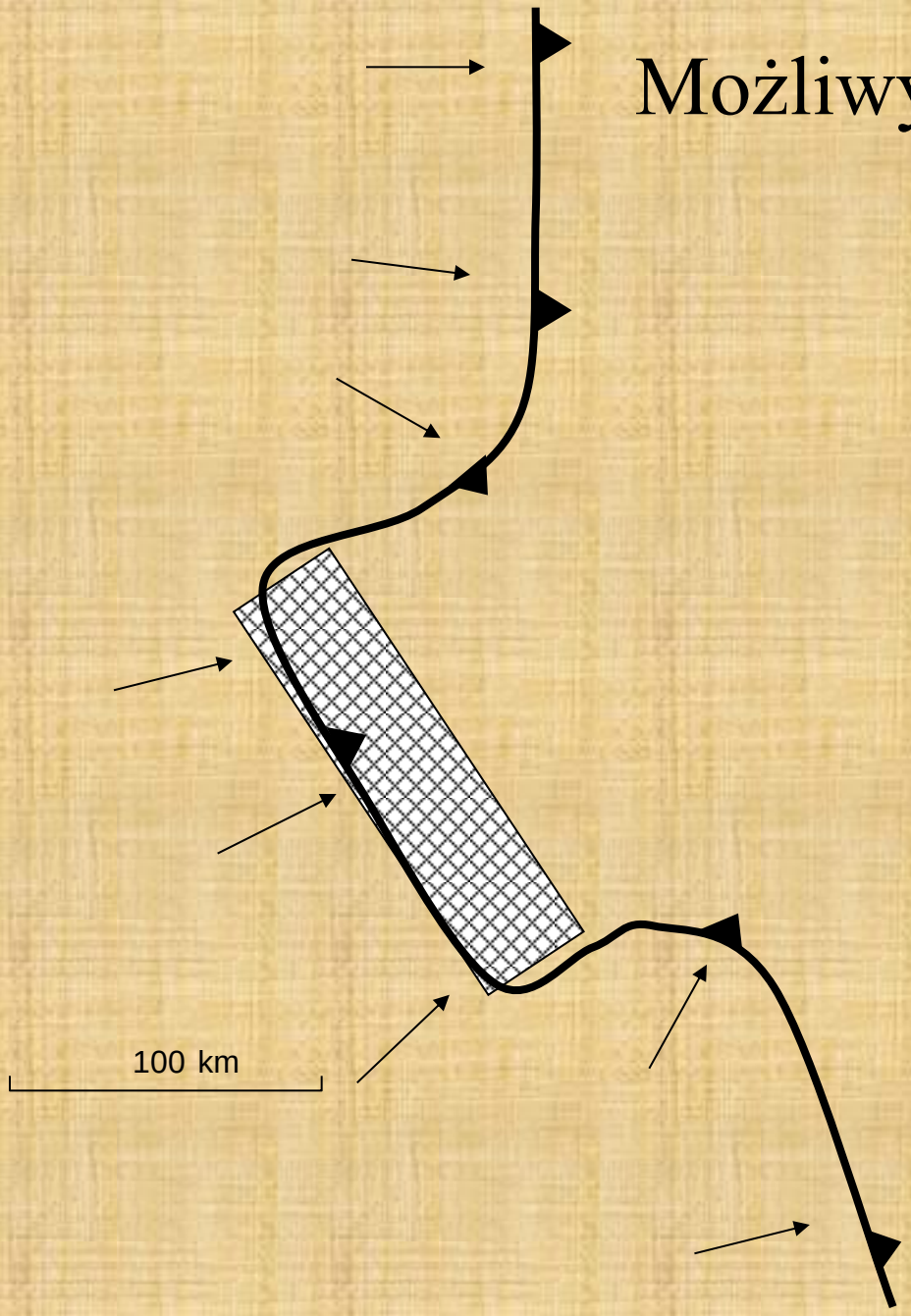
Inhibition layer
with conditional instability below



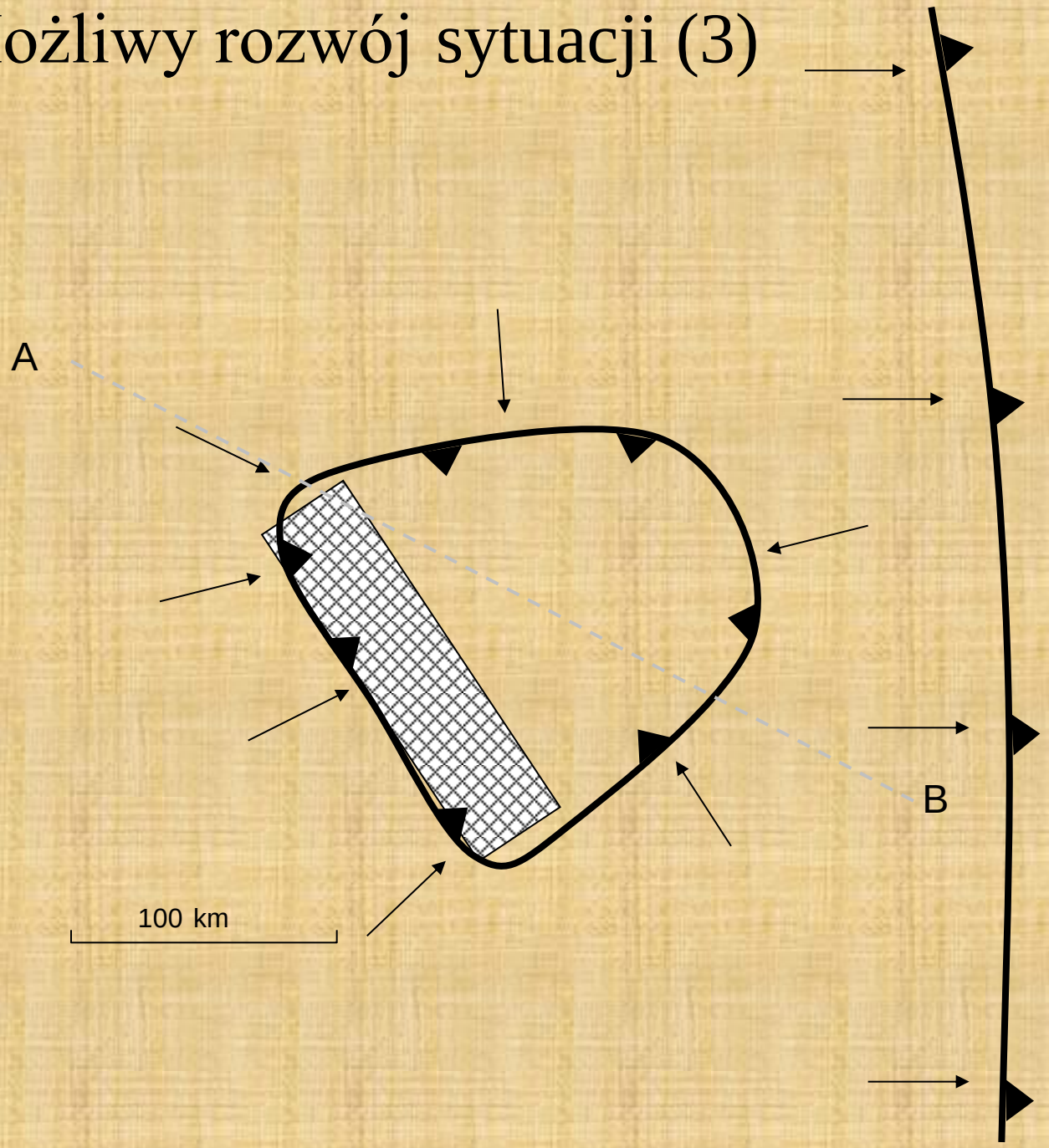
Możliwy rozwój sytuacji z powstaniem mezoskalowego systemu konwekcyjnego MCS (1)



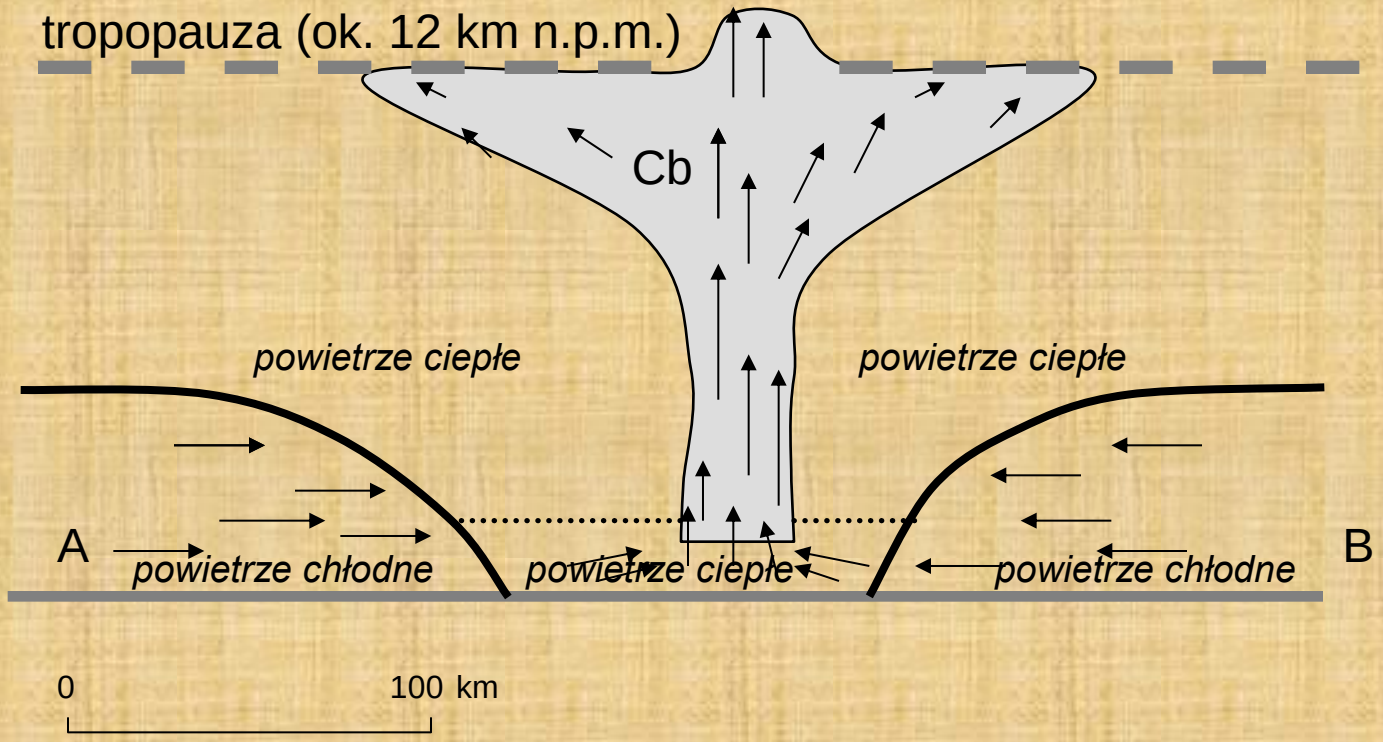
Możliwy rozwój sytuacji (2)



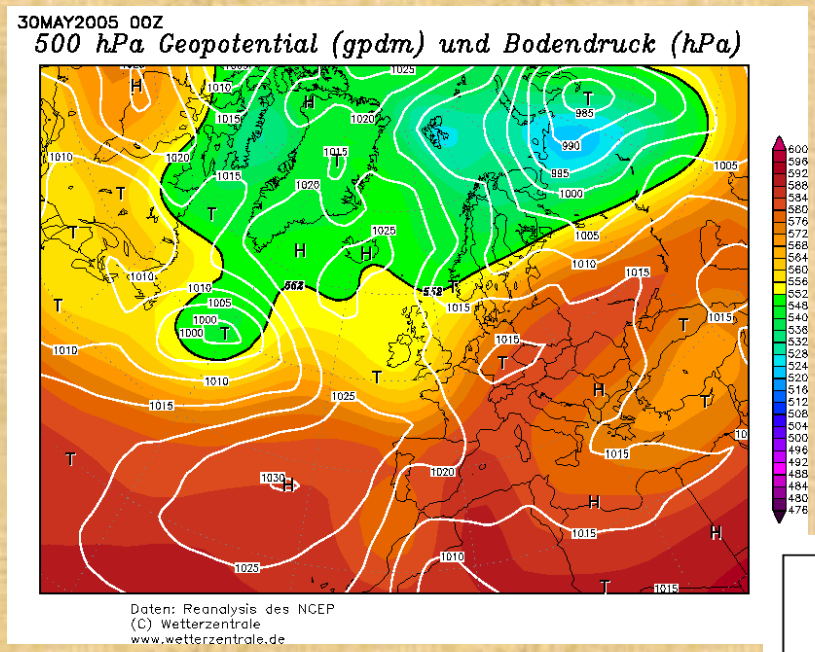
Możliwy rozwój sytuacji (3)

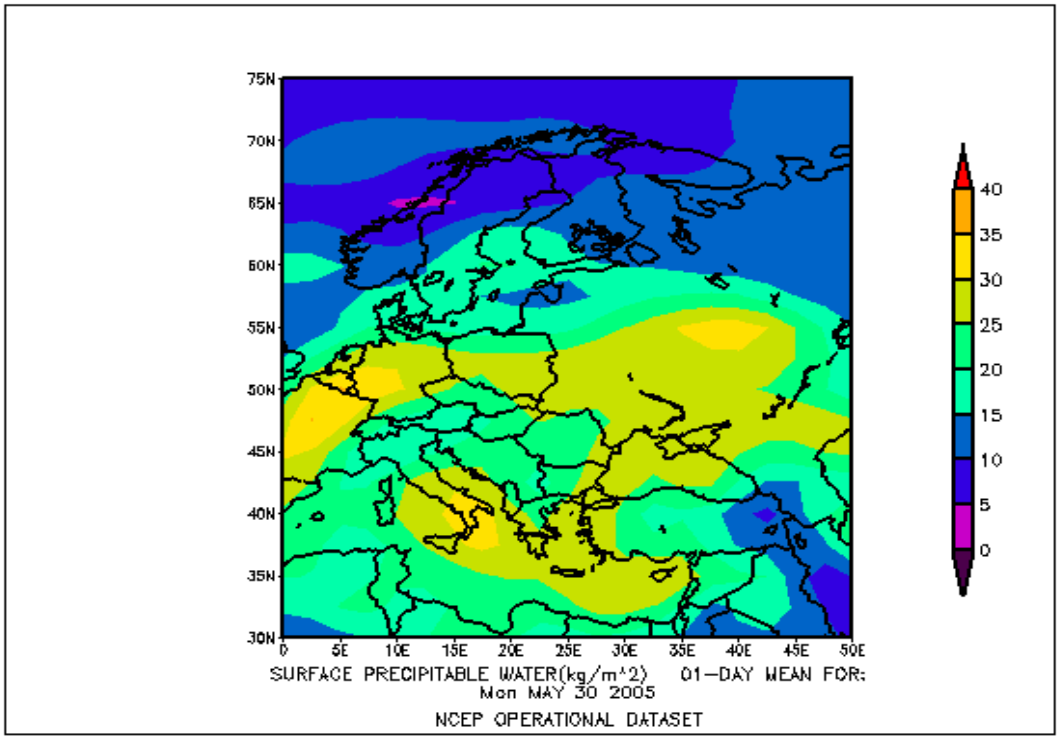


Możliwy rozwój sytuacji (4)



Synoptic situation and PWAT 30 V 2005





Conclusion - plans

- Precipitation field analysis of future IPE with the use of high resolution PWAT data
- Verification of existing ideas
- Spatial modeling of IPE with the use of DEM
- Alternative scenarios for various:
  - PWAT
  - low tropospheric airflow direction and speed
  - rainfall intensity from the upper level

Thank

you

for

your

attention