Radar Observations of Convective Cells and Identification of Hotspots in Mountainous Terrain

Martin Hagen, Joël van Baelen, Evelyne Richard

DLR Oberpfaffenhofen, Germany
Université de Clermont-Ferrand, France
Observatoire Midi-Pyrénées, Toulouse, France

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

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

COPS

International field campaign in summer 2007 within the frame of the priority program 1167 of the German Science Foundation (DFG) „Quantitative Precipitation Forecast“

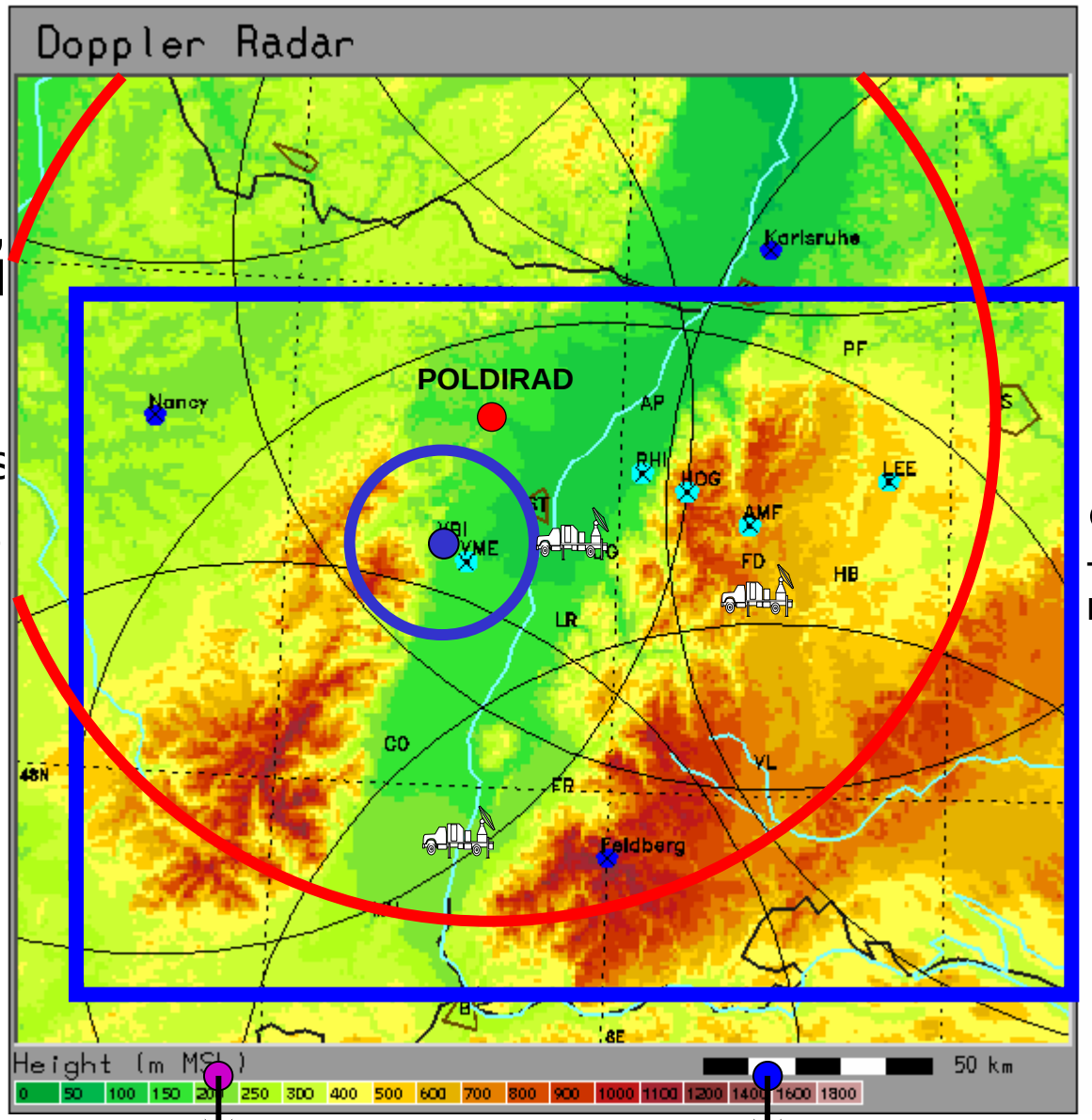
PQP
Praecipitationis Quantitativae Praedictio

Convective and
Orographically-induced
Precipitation **S**tudy

Radar coverage

COPS objectives require good radar coverage, polarimetric preferred

- several operational radars in the region
- all are Doppler radars
- none of them (except Montancy) is polarimetric
- X-band (r = 20 km)
- two mobile DOW's
- deployment of DLR polarimetric C-band Doppler radar POLDIRAD

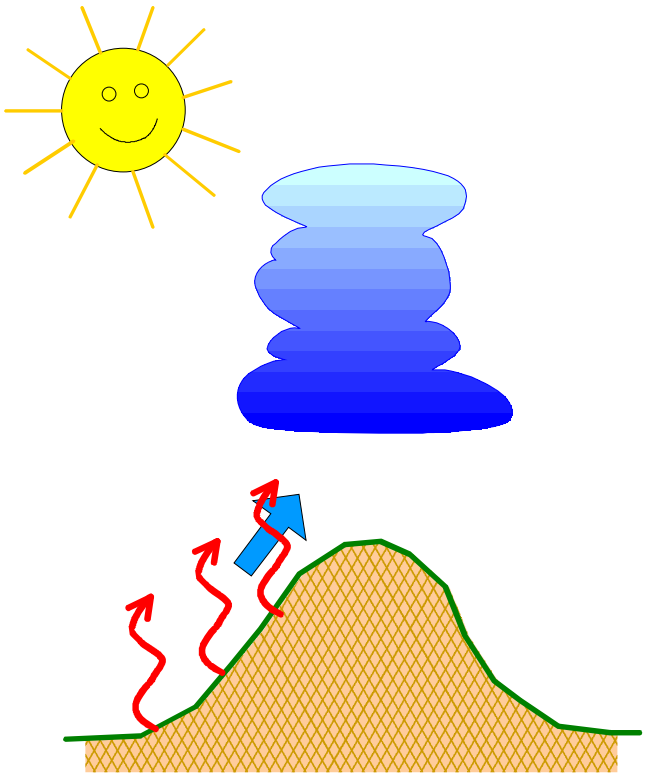


Deployment of DLR C-band polarimetric weather radar POLDIRAD at Waltenheim sur Zorn, Alsace, France

Photo: A. Behrendt

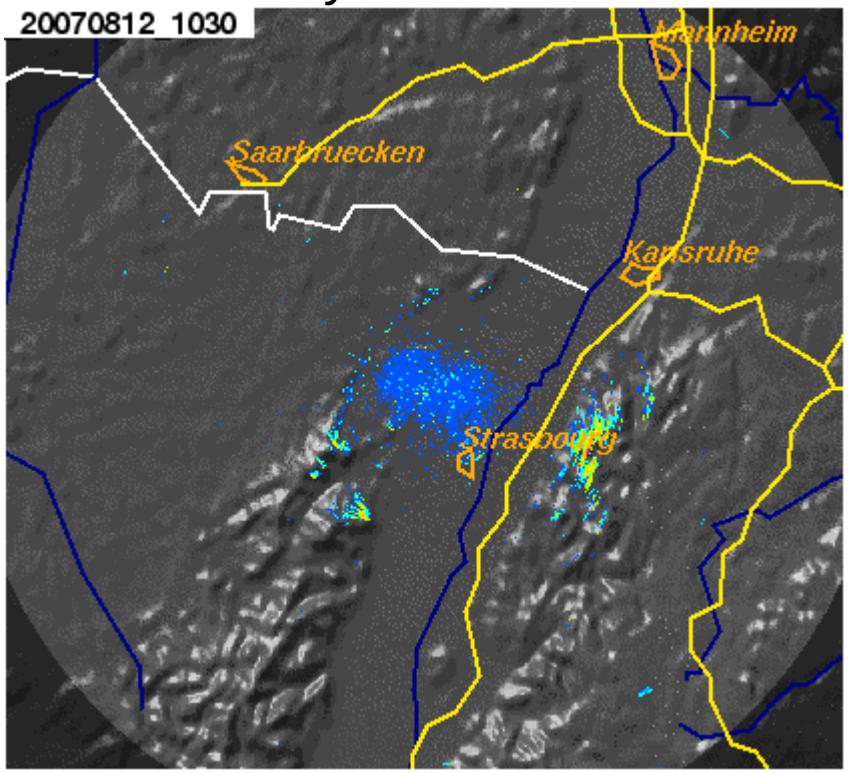
Orographic Effects on the Life Cycle of Convection

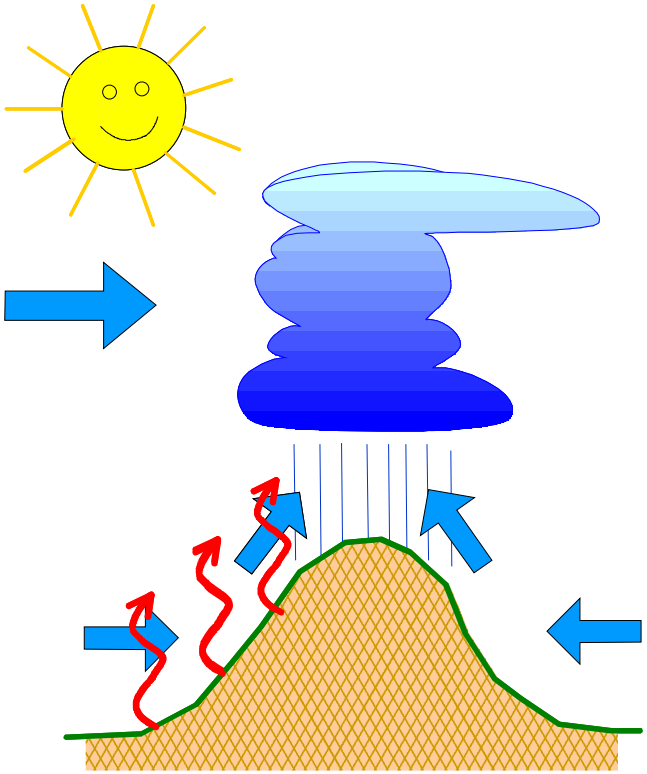
- One of the main objectives of COPS is to study the orographic effect on the initiation and life cycle of convective precipitation.



POLDIRAD observations during IOP 15 (daytime)

12 Aug. 2007 11-17 UTC
every 10 minutes



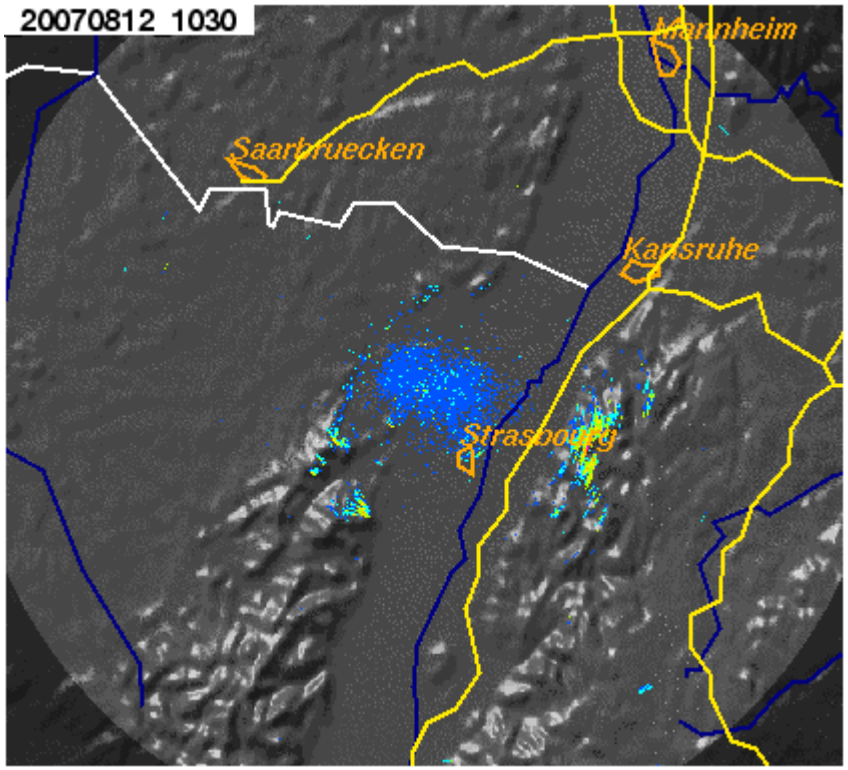


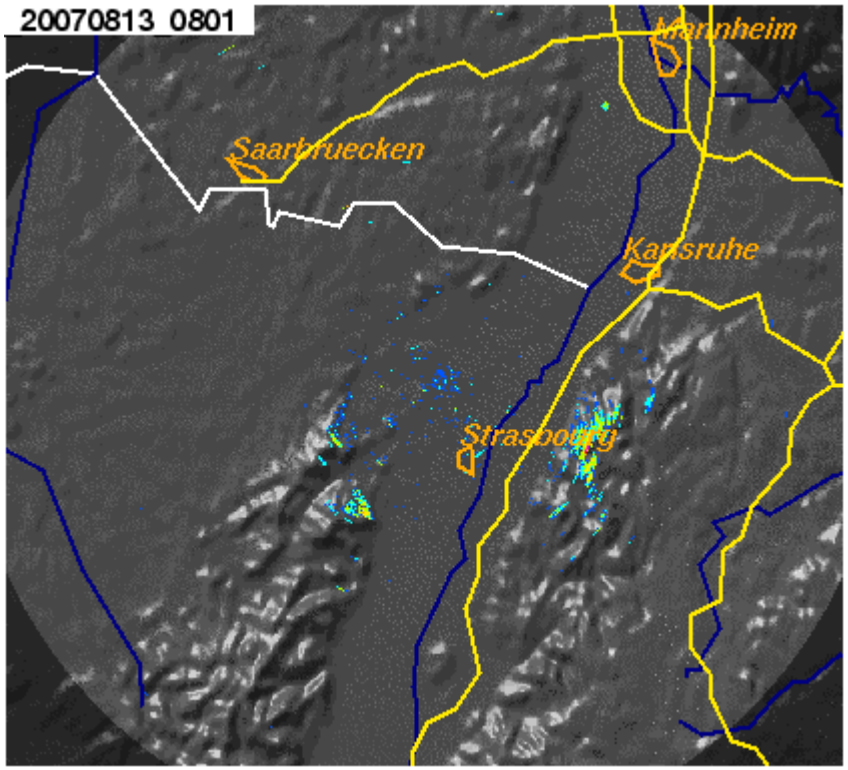
POLDIRAD observations during IOP 15 (daytime)

12 Aug. 2007 11-17 UTC

13 Aug. 2007 8-15 UTC

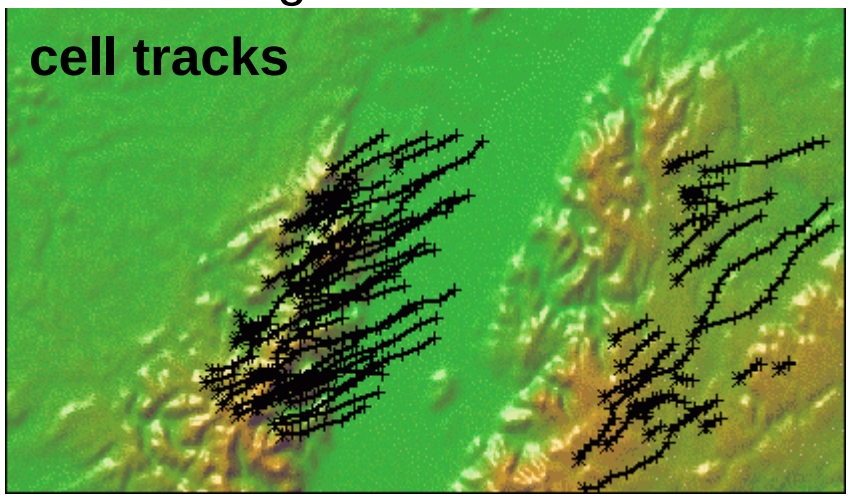
every 10 minutes

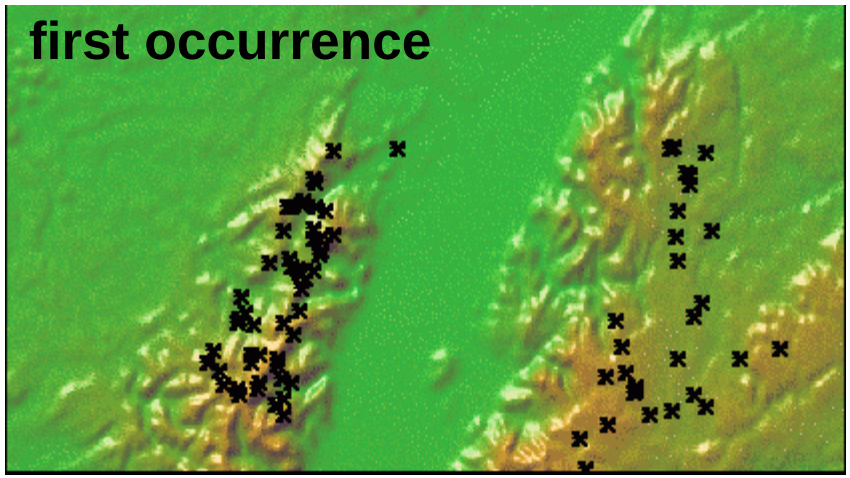




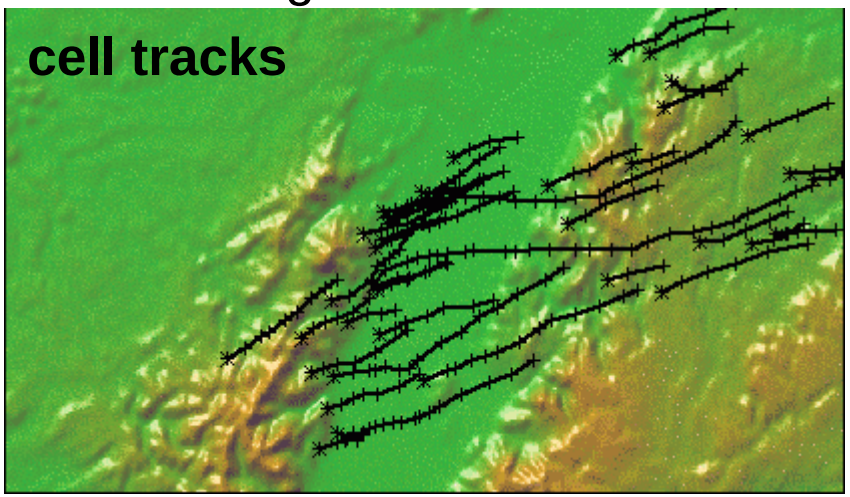
Cell Tracking IOP 15 using POLDIRAD Observations

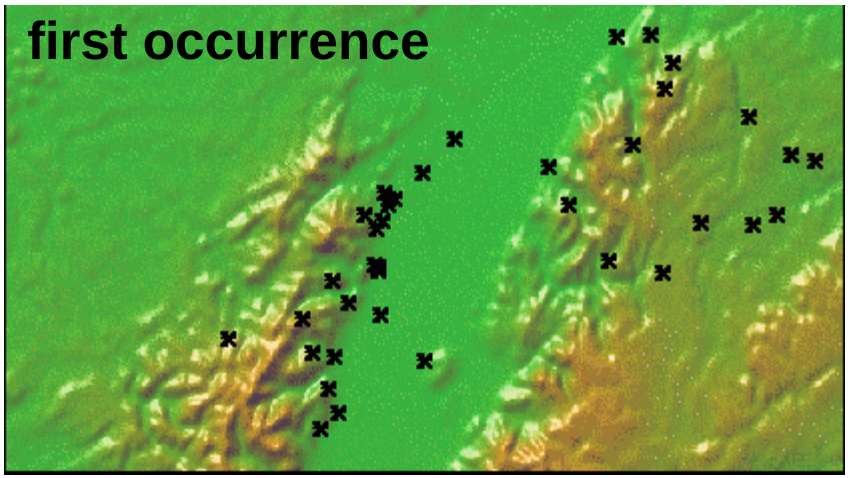
12 Aug. 2007 11-17 UTC





13 Aug. 2007 8-15 UTC

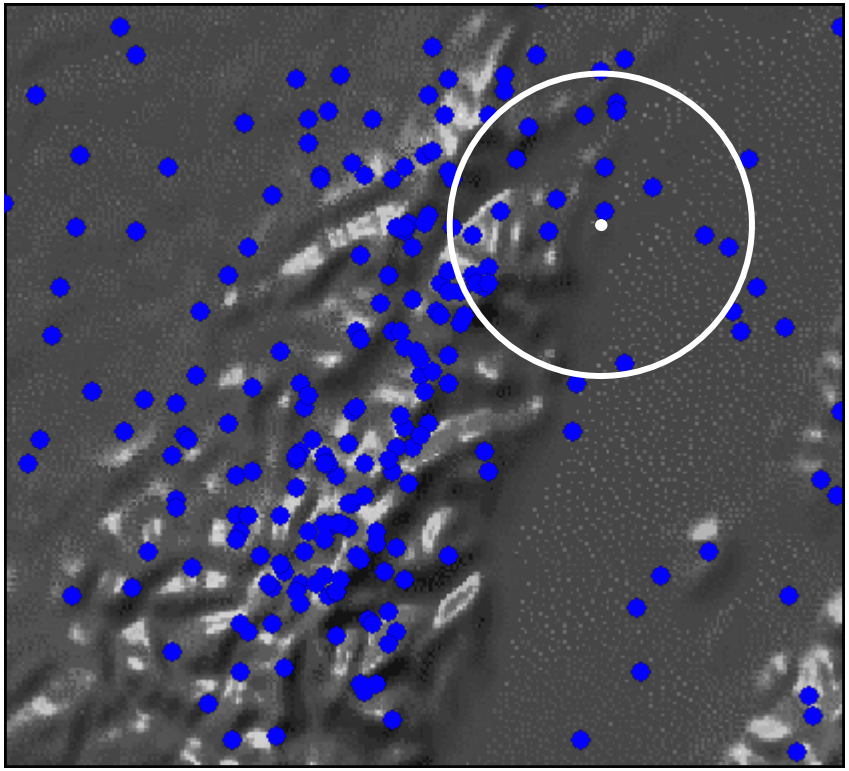


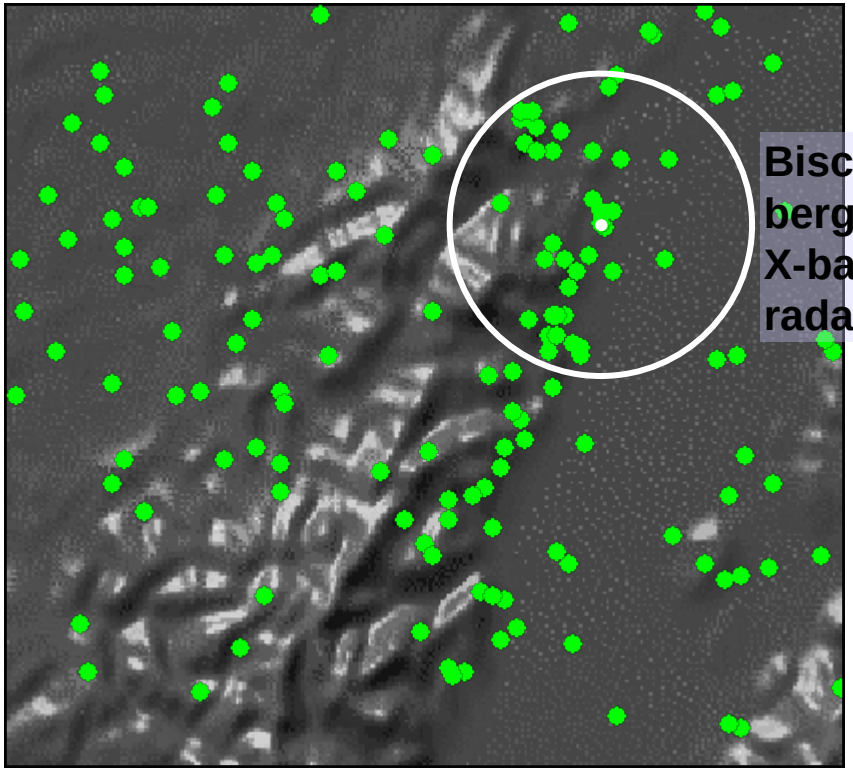


First Occurrence of Small Cells on some other Days

"Ridge and upslope" days:
June 8, 9, 10; Aug. **12**, 23, 24

"Lee" days:
June 5; July 18; Aug. 3, 6, **13**, 17

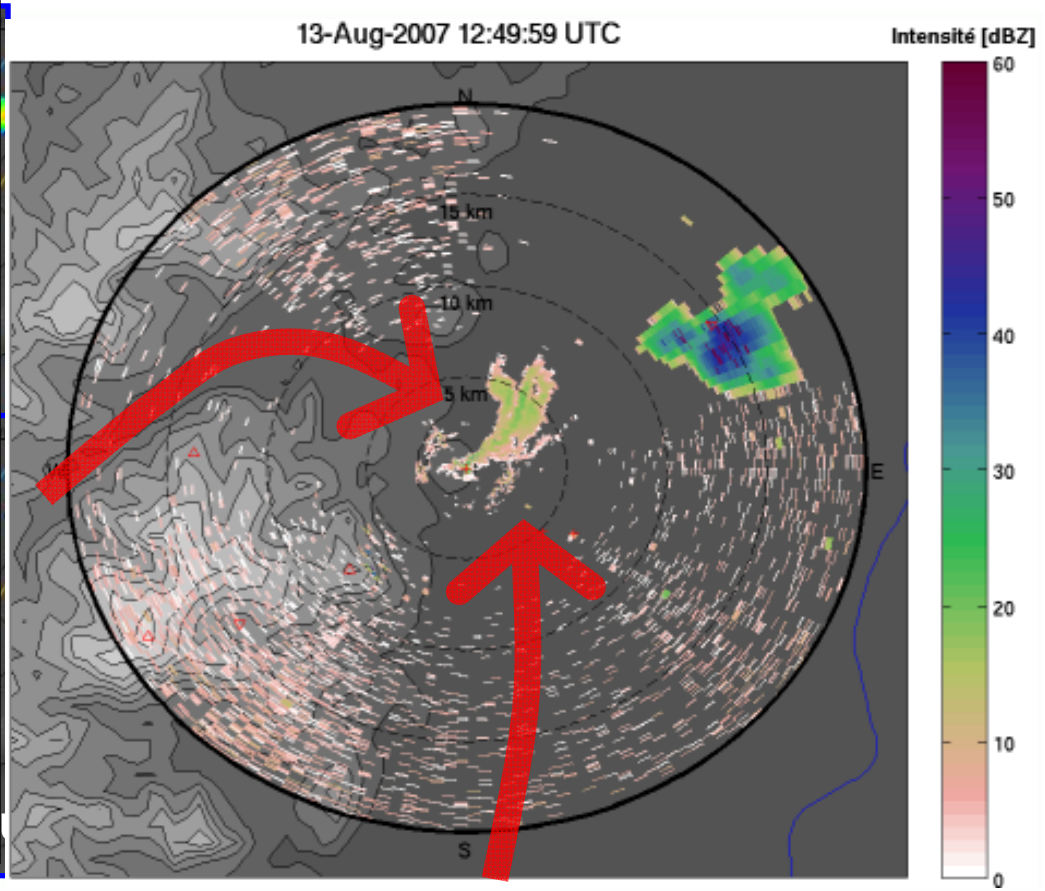




Bischen-berg X-band radar

X-Band Radar Bischenberg (30 km south of POLDIRAD)

X-Band 1246 – 1321 every 1 min.

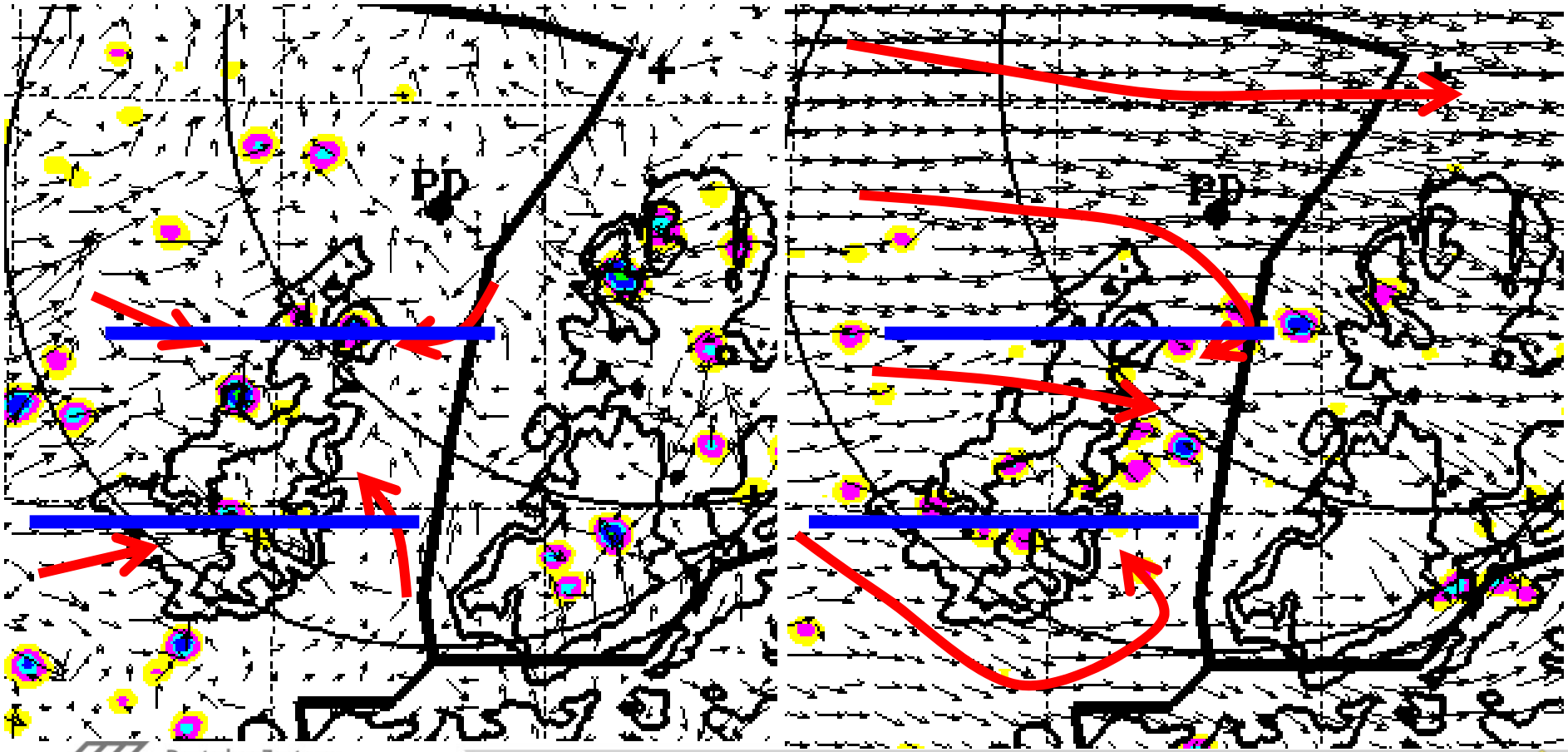


MesoNH Simulations

12. Aug. 2007 15 UTC

13. Aug. 2007 11 UTC

wind field (1000m MSL) and rain rate



MesoNH Simulations

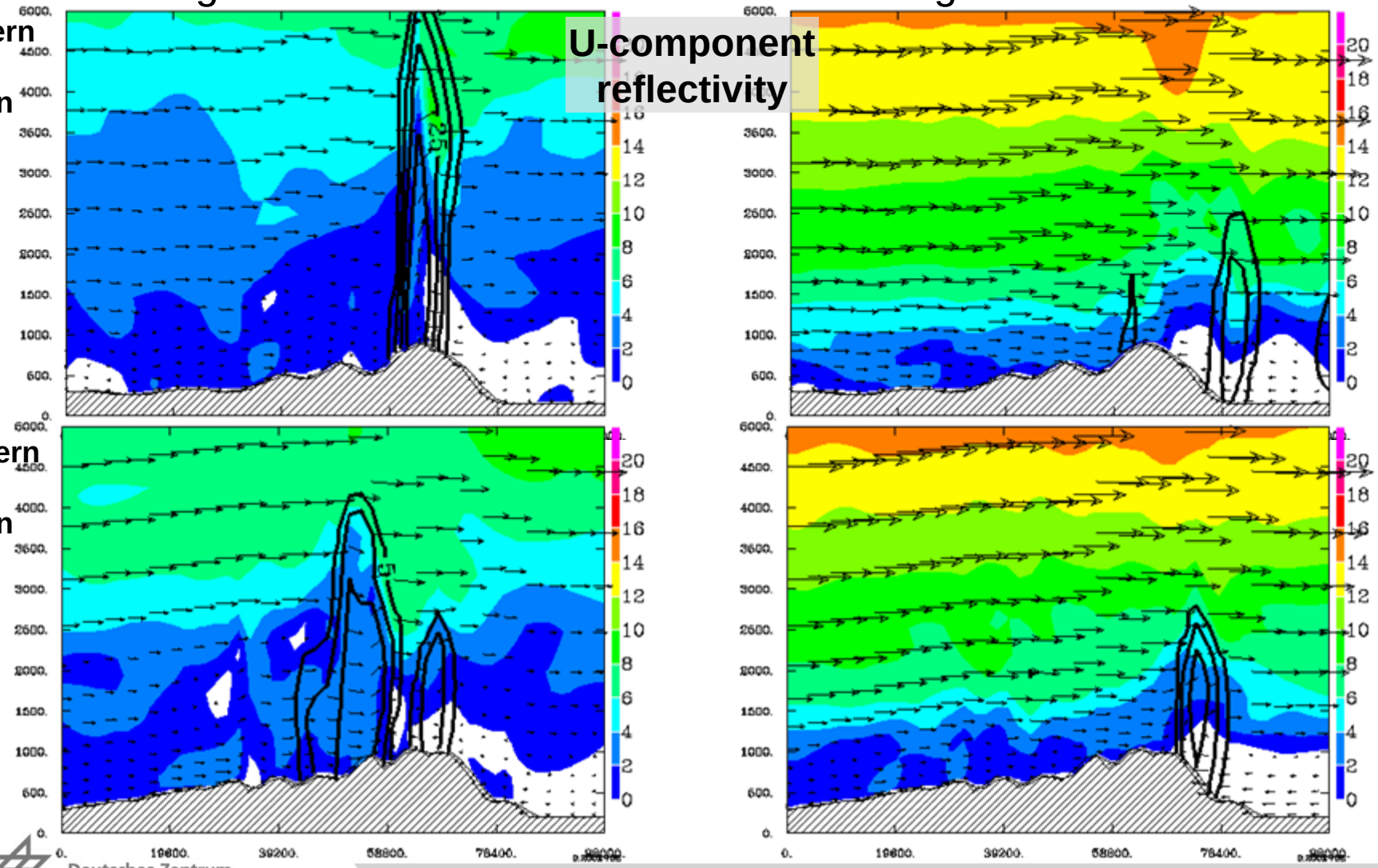
12. Aug. 2007 15 UTC

13. Aug. 2007 10 UTC

Northern cross-section

Southern cross-section

U-component reflectivity

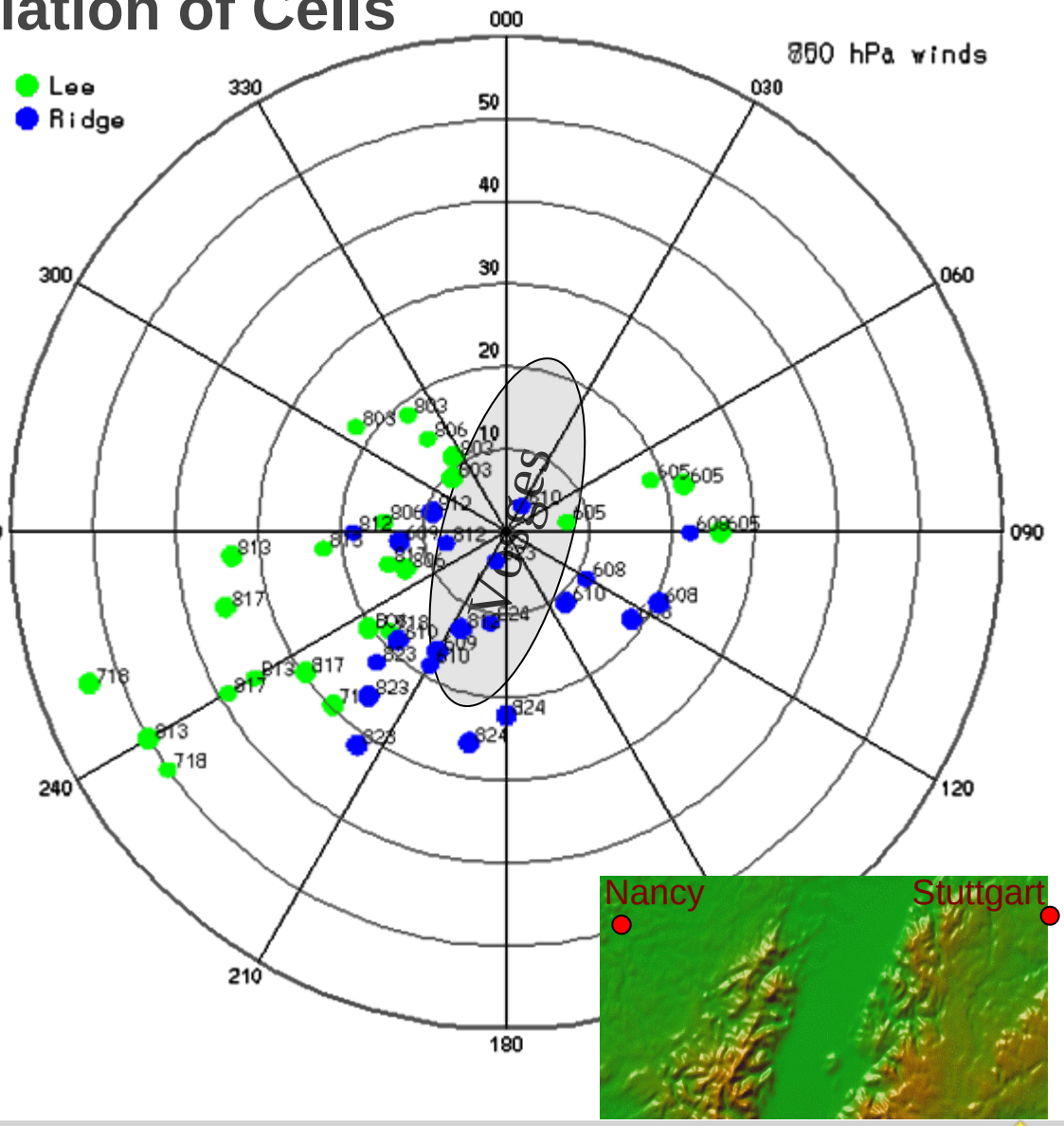


Wind Direction and Initiation of Cells

- Wind from 12 UTC soundings
  - Nancy and Stuttgart
  - 850 hPa and 700 hPa
    (crest height) (1500 m above)

- "Ridge" initiation related to weaker winds, and flow perpendicular or parallel to the Vosges

- "Lee" initiation related to higher south-westerly (or NE, NW) winds



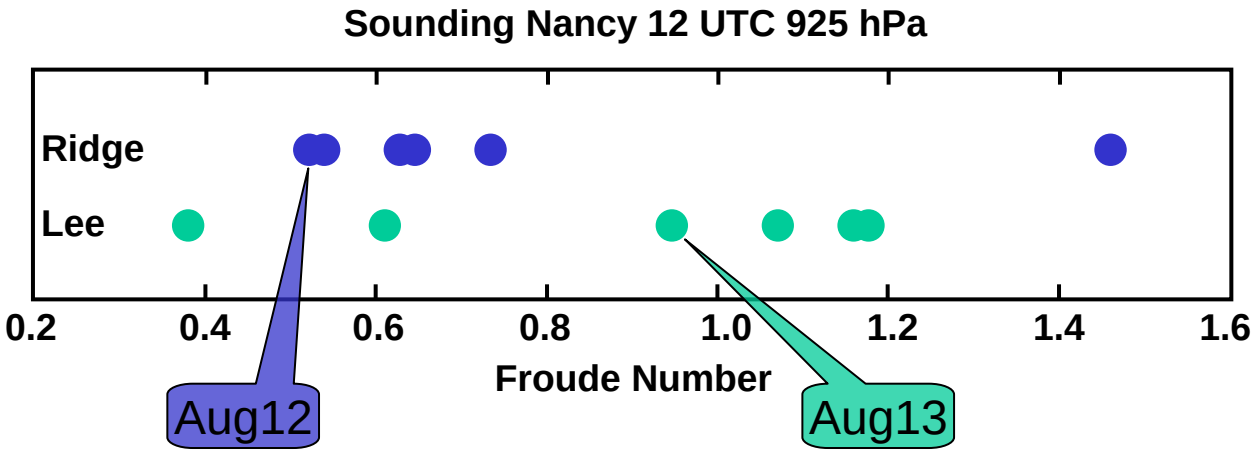
Flow over Mountains

- Froude Number indicates whether flow is over mountains or flow is diverted around mountains.

$$Fr = \frac{U}{NH}$$

U = characteristic flow speed
N = Brunt-Väisälä-Frequency
H = Height of obstacle

- Fr < 1 around mountains Fr > 1 flow over mountains

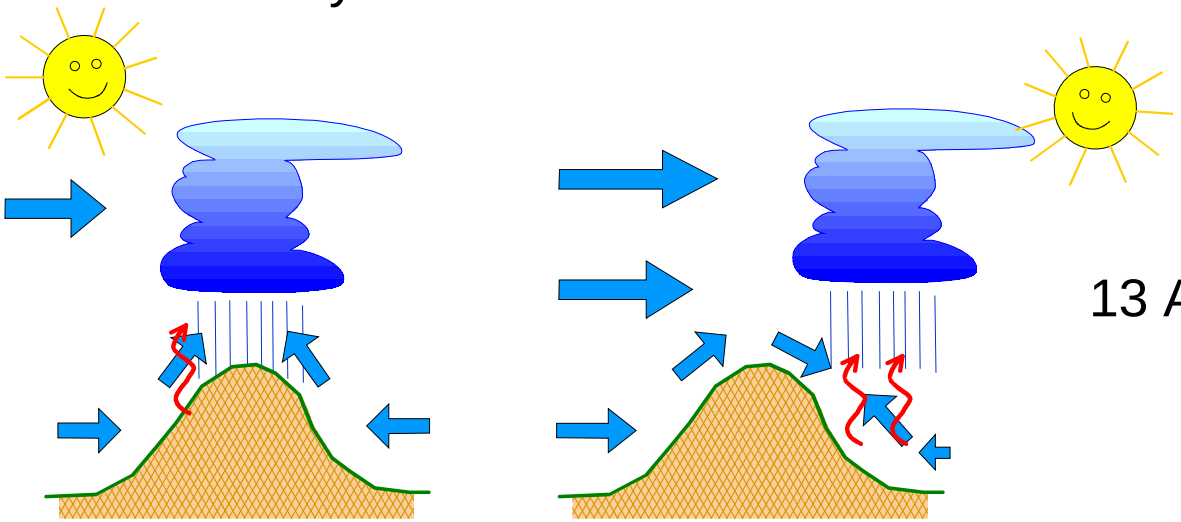


- How representative is the Nancy sounding ?

Conclusions

- Differences are caused by the wind field

12 Aug. 07



13 Aug. 07

- Lower wind speeds and parallel or perpendicular to the ridge favour the initiation over the ridge,
  Higher wind speeds and flow around the Vosges favour the initiation in the lee of the mountain
- Models are able to simulate the situation and can provide additional information about the background fields of observed situation