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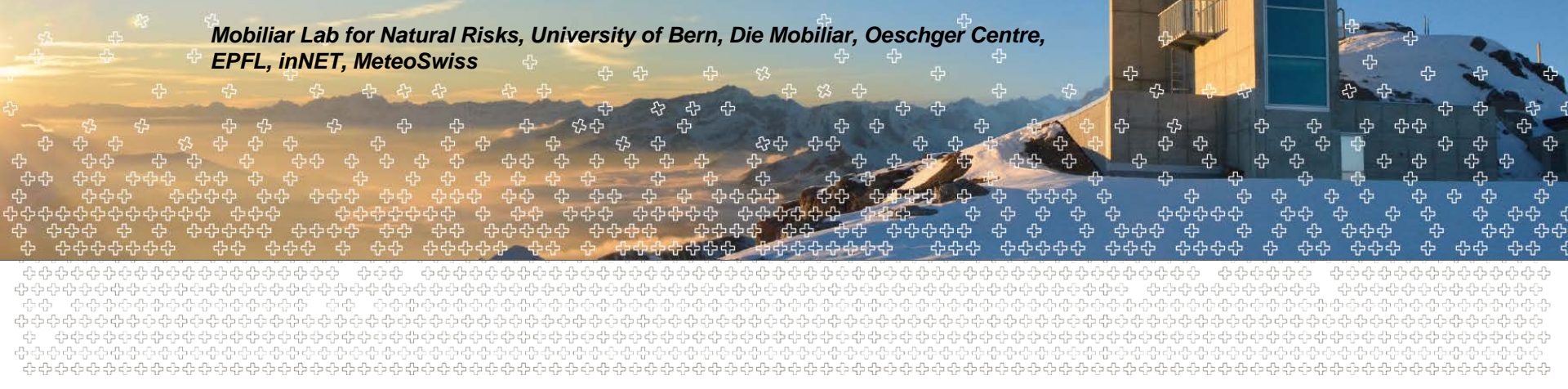
Federal Department of Home Affairs FDHA  
Federal Office of Meteorology and Climatology **MeteoSwiss**

# A new era of hail monitoring, forecasting and climatology in Switzerland

*Urs Germann, MeteoSwiss, Locarno-Monti*

*With: O Martius, M Aebischer, H Barras, A Berne, N Besic, J Figueras, O Fuhrer,  
M Gabella, M Gaia, U Hamann, A Hering, M Künzler, A Martynov, S Mattli, L Nisi, P Noti,  
C Schwierz, L Thomi, S Trefalt and B Calpini*

**Mobilier Lab for Natural Risks, University of Bern, Die Mobilier, Oeschger Centre,  
EPFL, inNET, MeteoSwiss**





# Long history of hail research in Switzerland



Field experiments  
«Grossversuche I-III»



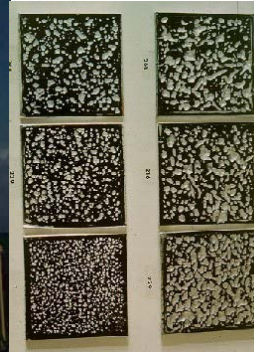
**1959**  
First operational  
weather radar  
generation



**1960ies**  
US air force radar  
for hail research  
in Locarno-Monti



**1970ies**  
Field experiment with radar and  
hailpads in «Grossversuch IV»

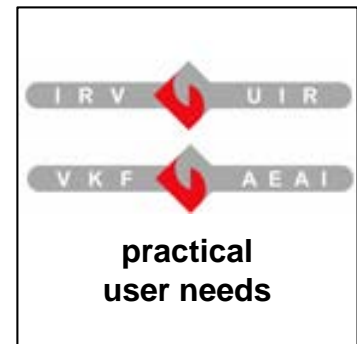
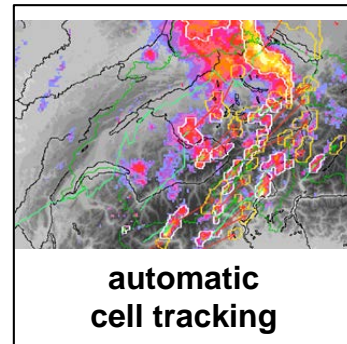
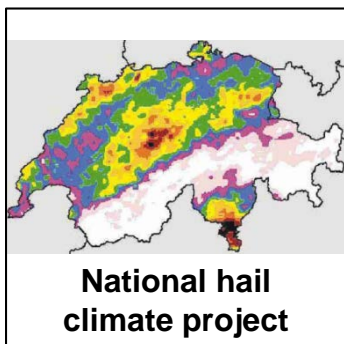
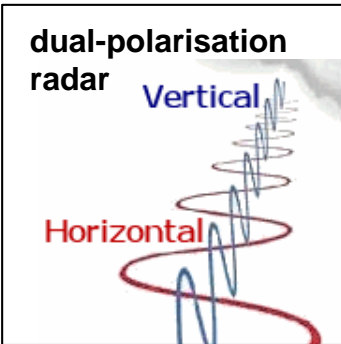
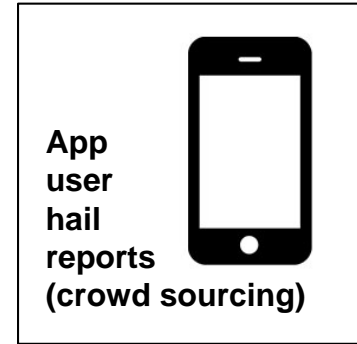
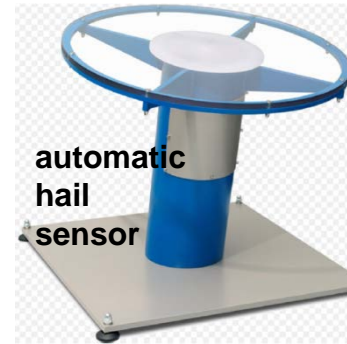
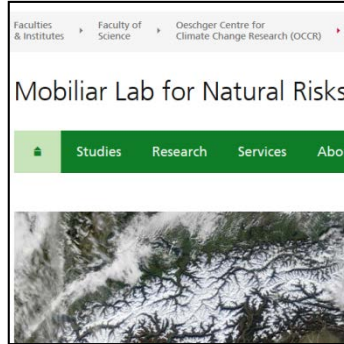


Climatologies of  
damage data

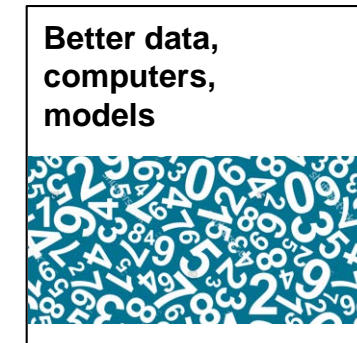
*Jürg Joss, ...*



# Triggers of new era of Swiss hail research



MeteoSwiss





# Operational Swiss weather radar network

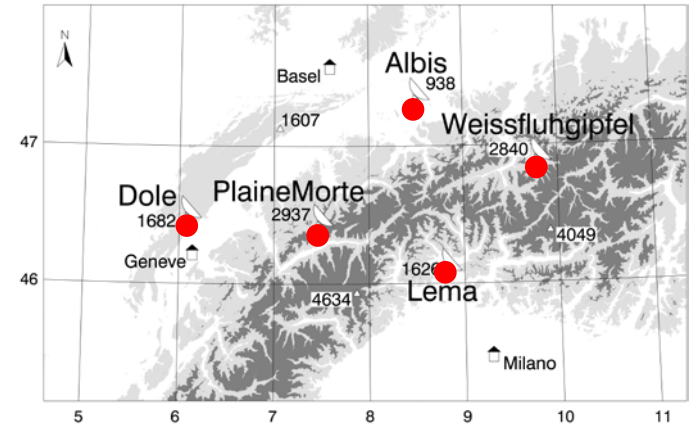
**1959** First Swiss radar generation

**Since 2002**

High data quality, stability and calibration  
3D reflectivity hail algorithms  
Automatic tracking of thunderstorms

**Since 2012**

4th Swiss radar generation  
Dual-polarisation hail algorithms



*Germann et al, MTI (2015, 2016, 2017)*

**Lema, 1626m**  
renewed 2011

**Dole, 1682m**  
renewed 2011

**Albis, 938m**  
renewed 2012

**Plaine Morte**  
**2937m, 2014**

**Weissfluh**  
**2850m, 2016**

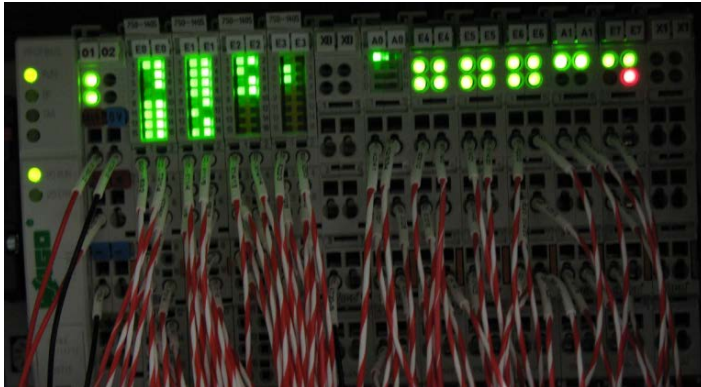




# Radar hardware monitoring and calibration

## **System health check**

*Every 15 seconds Swiss radars report  
>350 health parameters per radar*



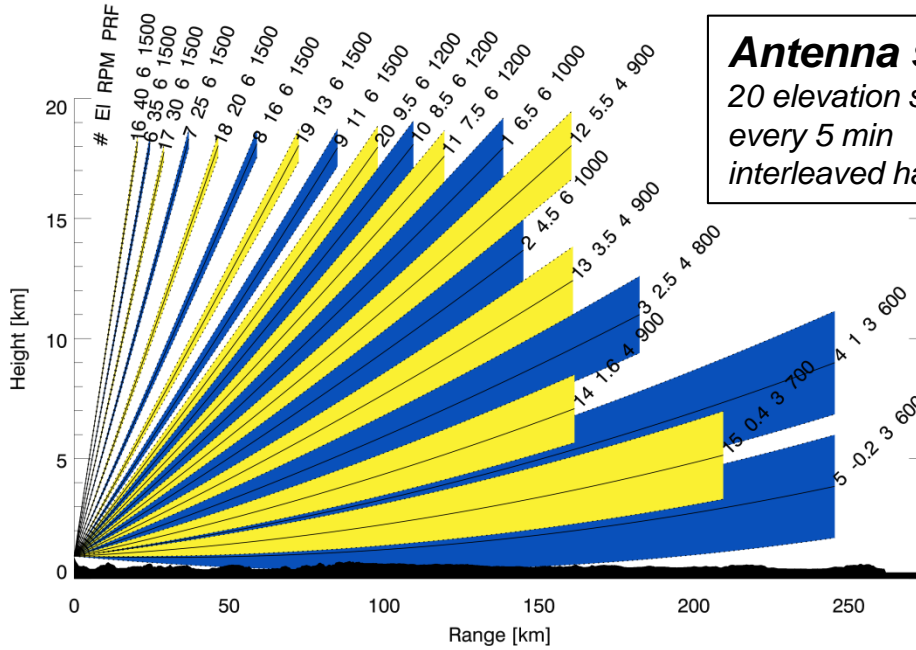
## **Calibration of Swiss radars**

- Internal noise source
- Integrated test signal generator
- Sun hits in operational scan
- Dedicated sun tracking
- Drizzle
- Rain gauges
- Dual-polarization consistency
- Ground clutter
  
- Manual test equipment
- External receiver
- External transponder
- External tower
- Sphere on balloon

*(some automatically and continuously, others periodically or during dedicated experiments)*

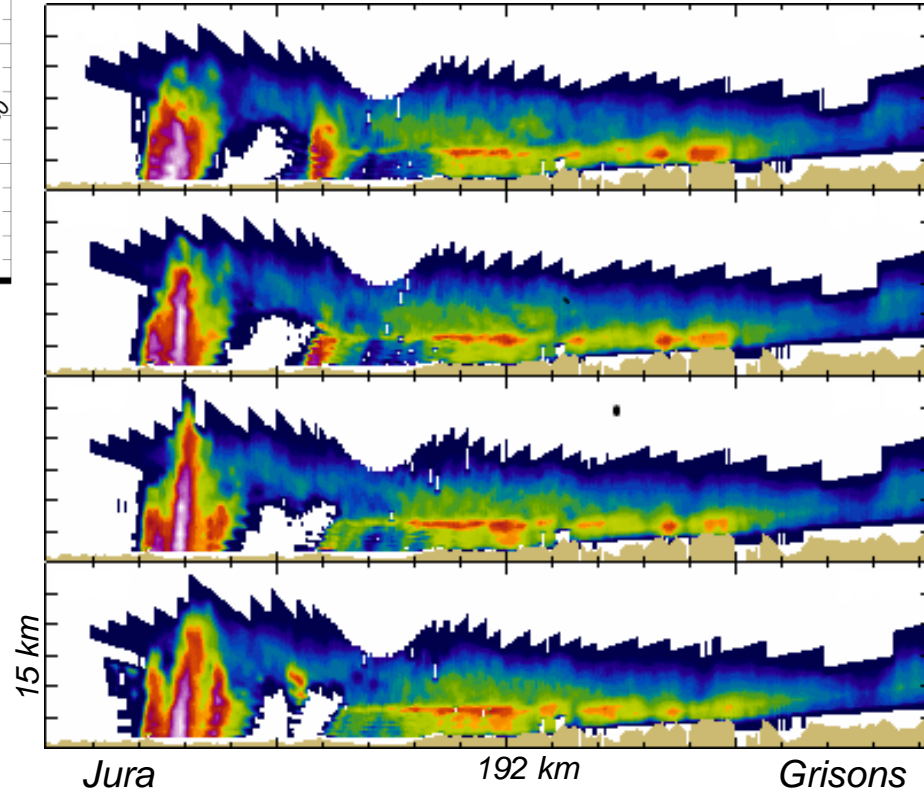


# Volumetric and temporal resolution



**Antenna scan program**  
20 elevation sweeps  
every 5 min  
interleaved half-scan every 2.5 min

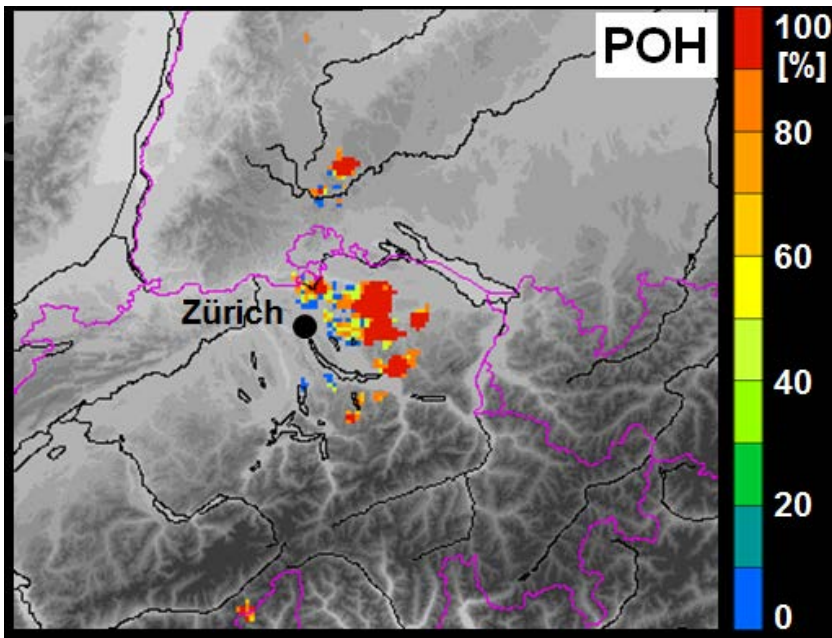
**Vertical cross section**  
Albis, 13 June 2014  
5 min steps





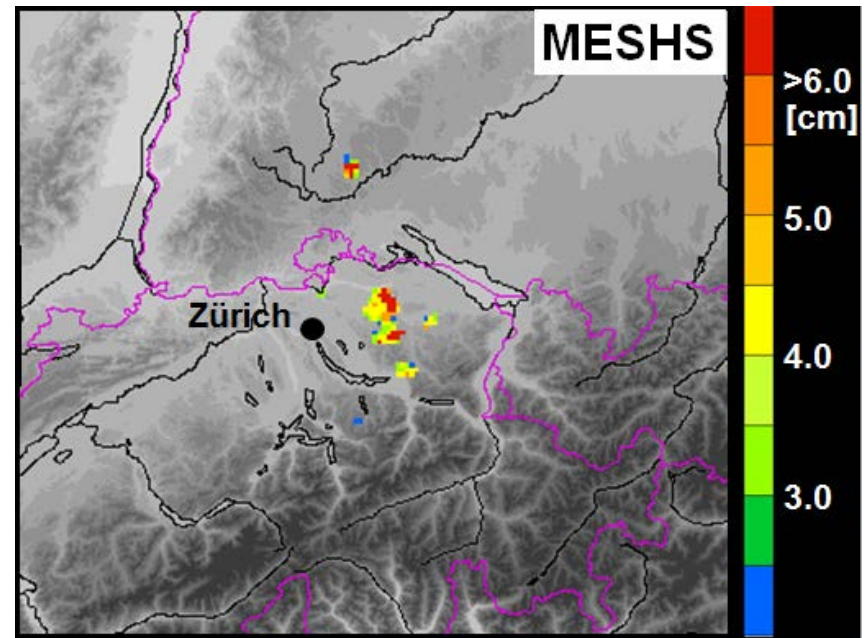
# Volumetric single-polarization hail algorithms

(operational, national 3D reflectivity composite)



Probability of hail

(Foote et al., 2005 based on Waldvogel et al., 1979)

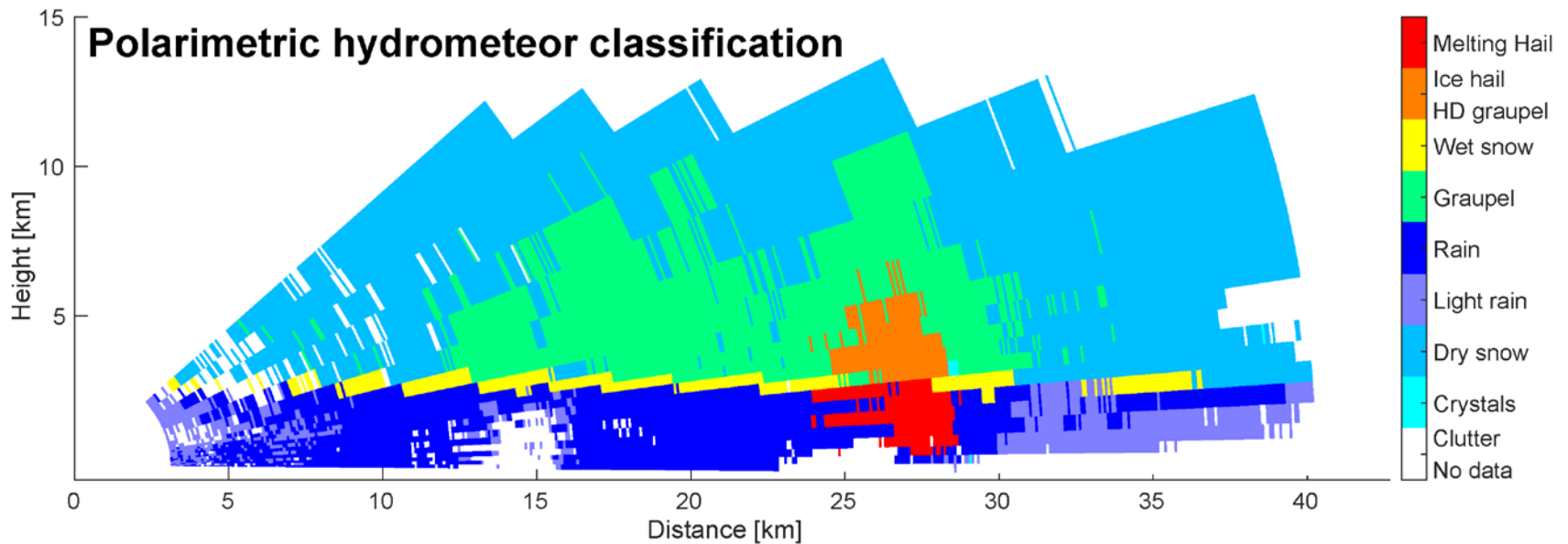


Maximum expected severe hail size

(Treloar, 1998)



# Dual-polarization hail identification



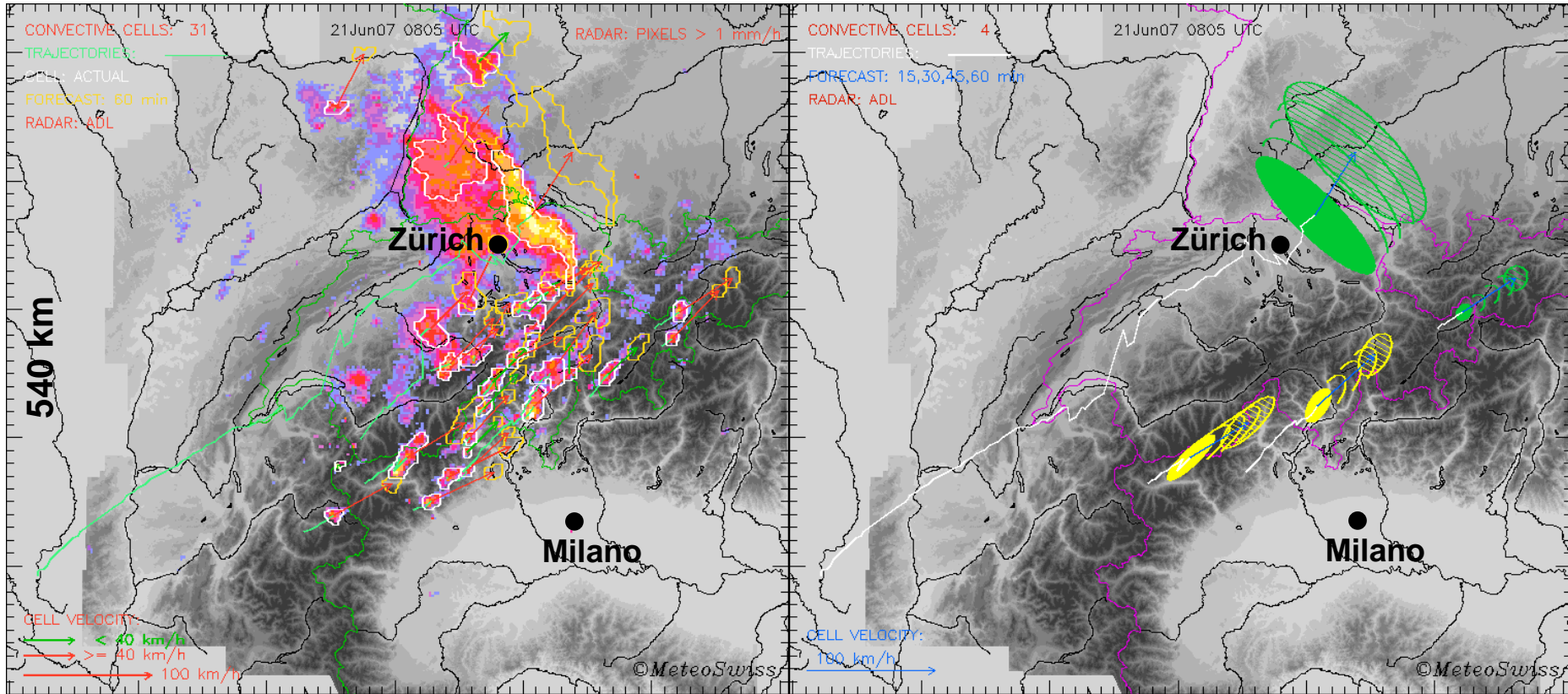




# Automatic cell tracking (operational, 3D, composite)

## Cell tracking

## Cell severity ranking



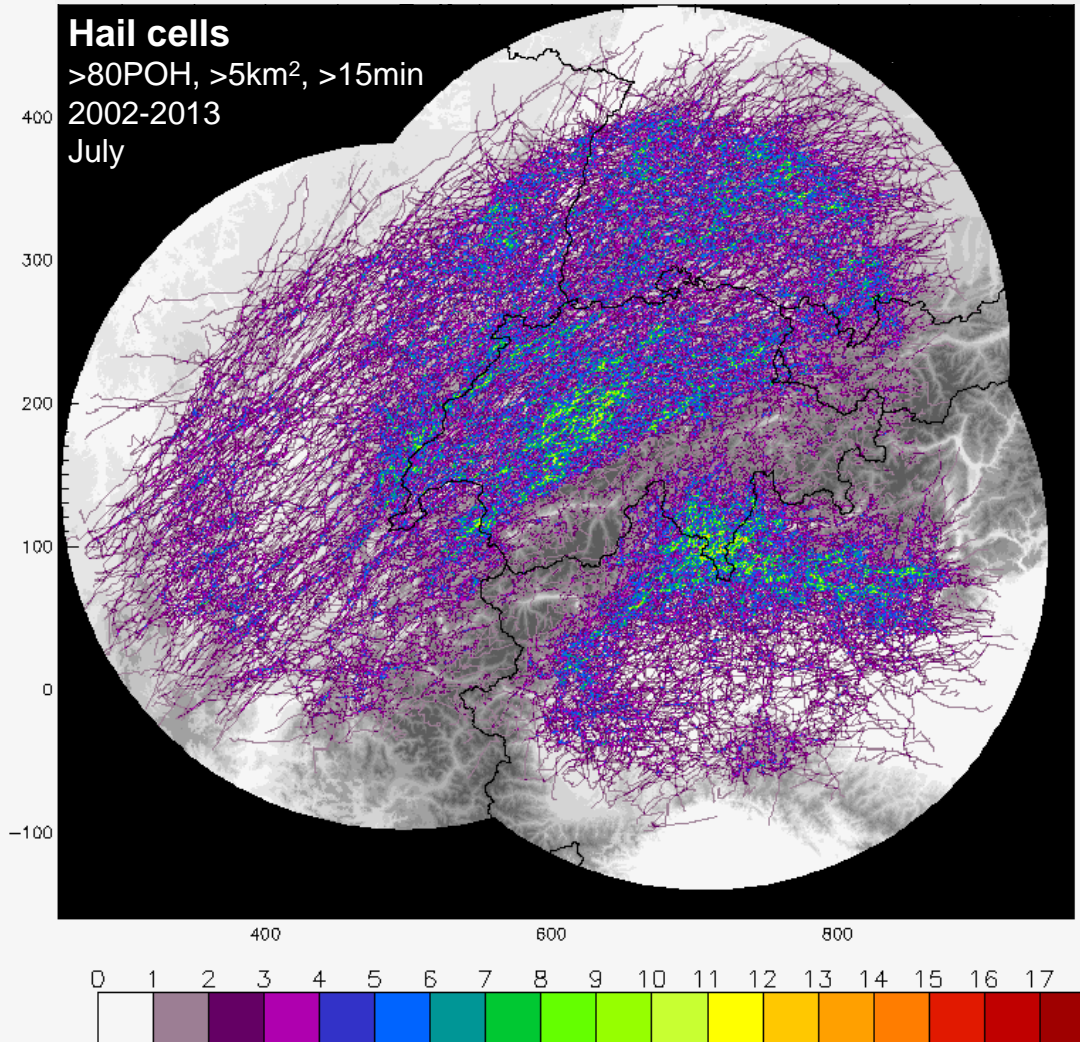
Cell severity:

**WEAK MOD**

More about thunderstorm and hail nowcasting by **Ulrich Hamann 11:35**



# Climatology of hail, hail cells, swaths, ...



Automatic  
objective cell  
identification

2002-now

**Totally**  
**> 30'000 hail cells**

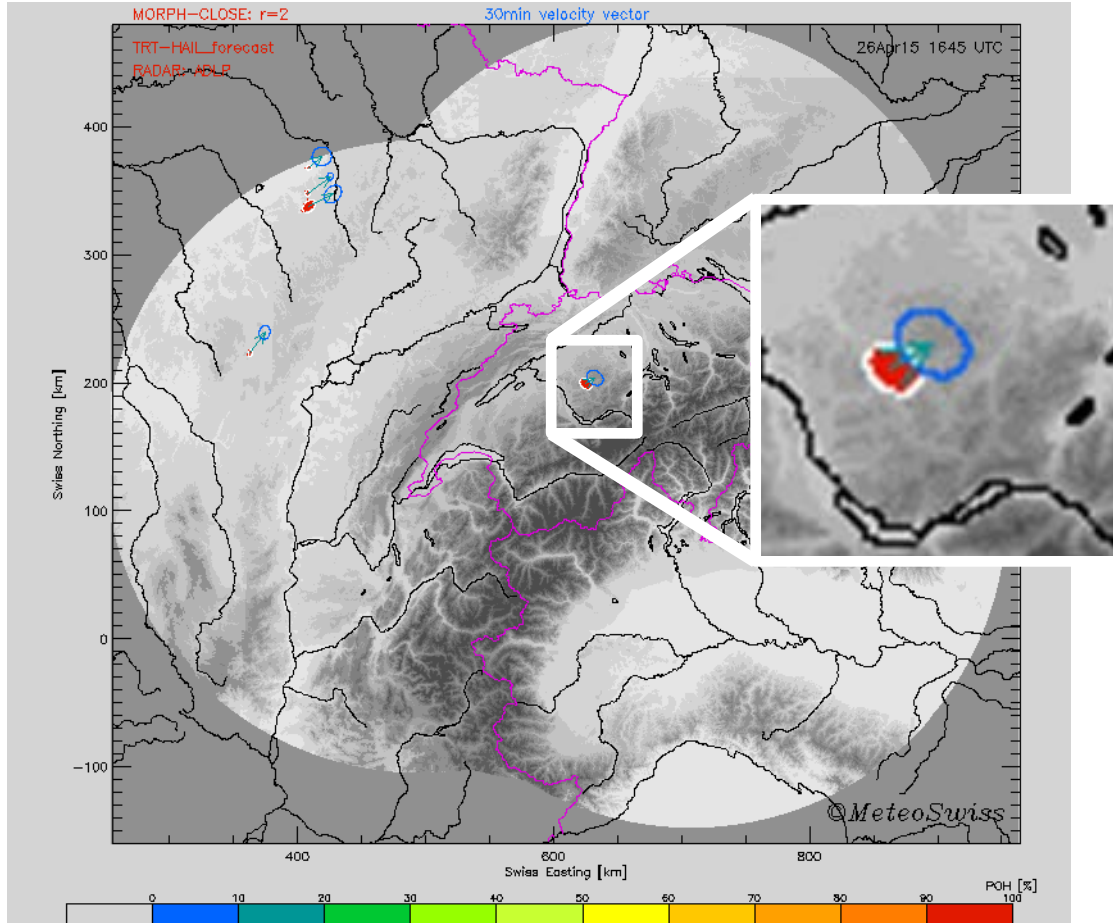
**MeteoSwiss**

*Mobililar Lab, Uni Bern, MeteoSwiss; Nisi et al (QJRM, 2016)*

Talk by **Luca Nisi**,  
yesterday



# Thunderstorms radar tracking + POH + MESHS = automatic hail alert

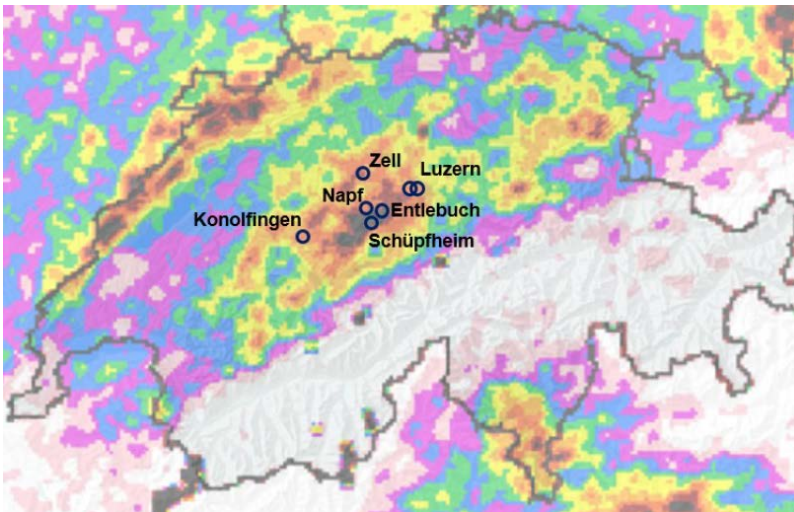
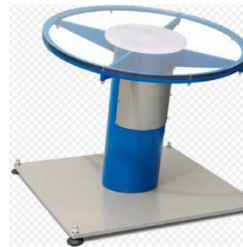




# Automatic hail sensors: pilot network



Sensor developed by  
Prof M Löffler-Mang  
and inNET Monitoring AG

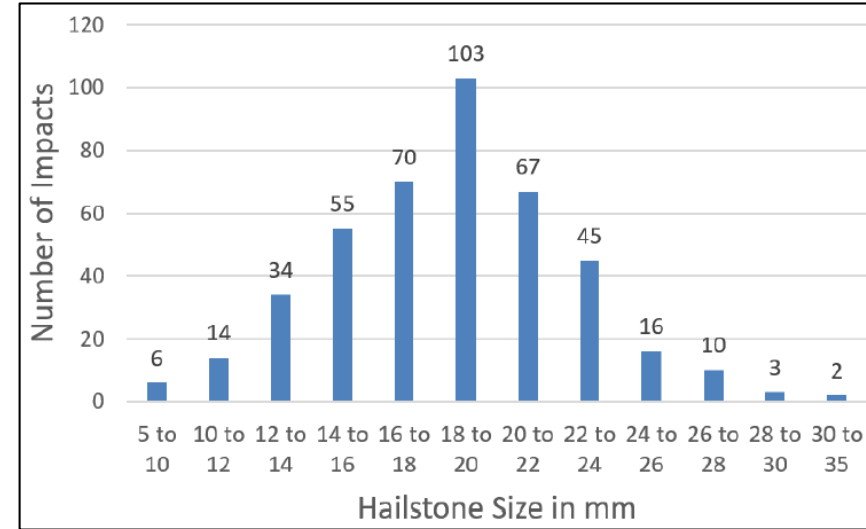
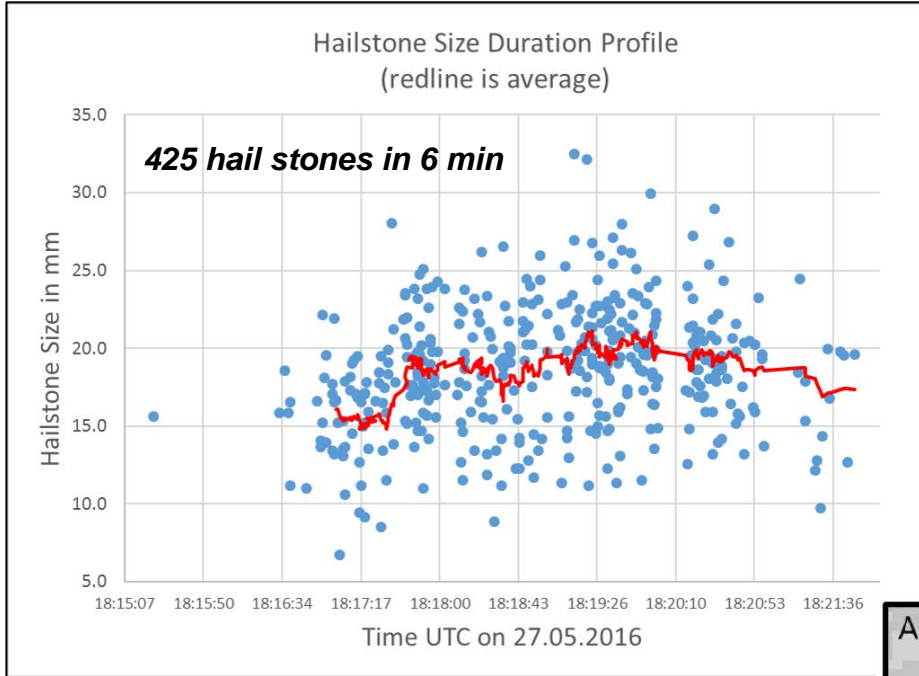


Pilot network operational since 2015.

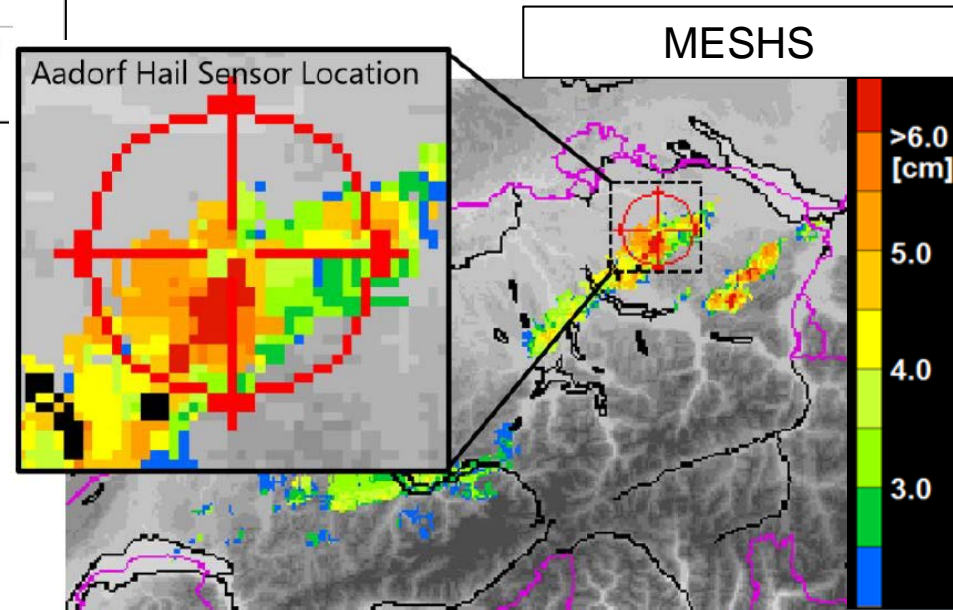
Registered hail during 20 events.



# Aadorf hail cell - 27 May 2016

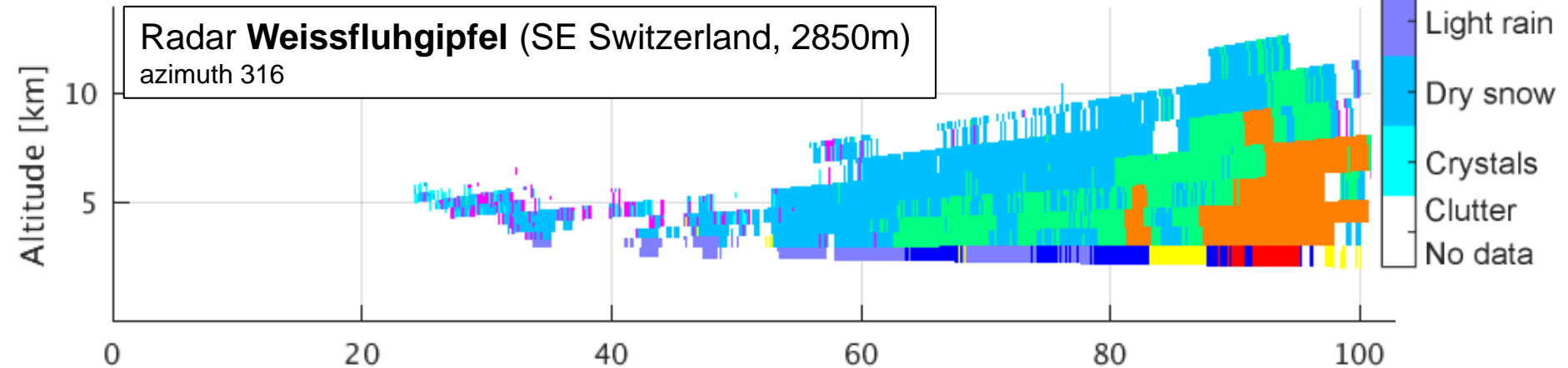
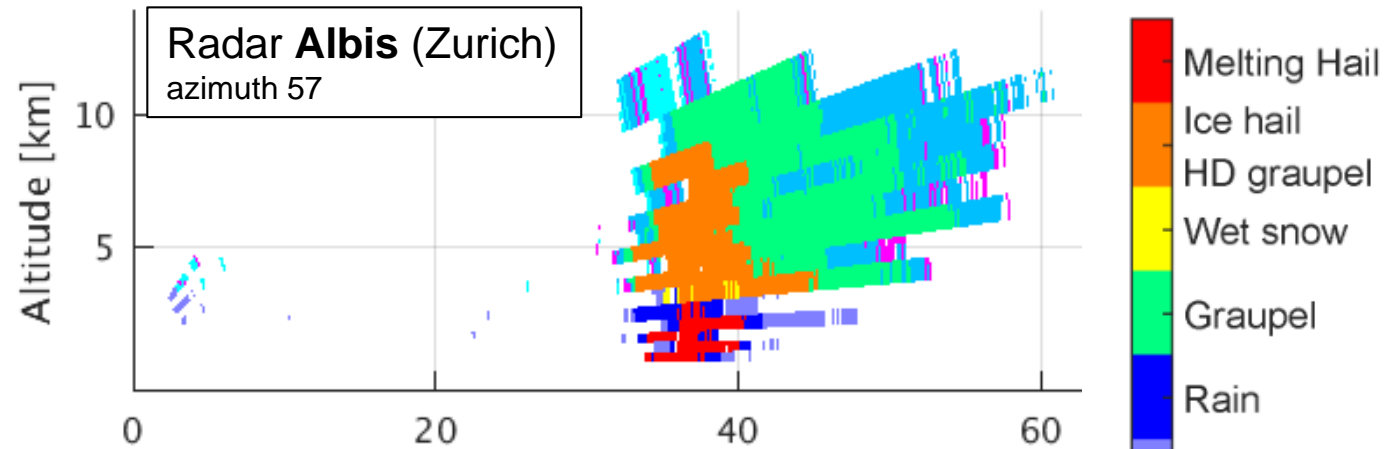


MeteoSwiss, inNET Monitoring AG, VKF



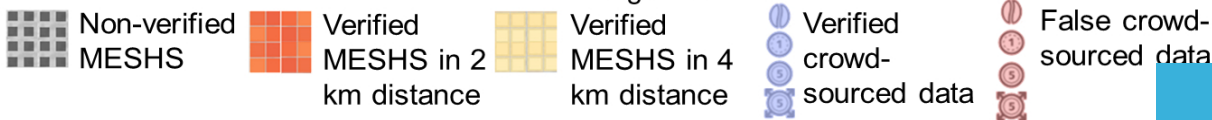
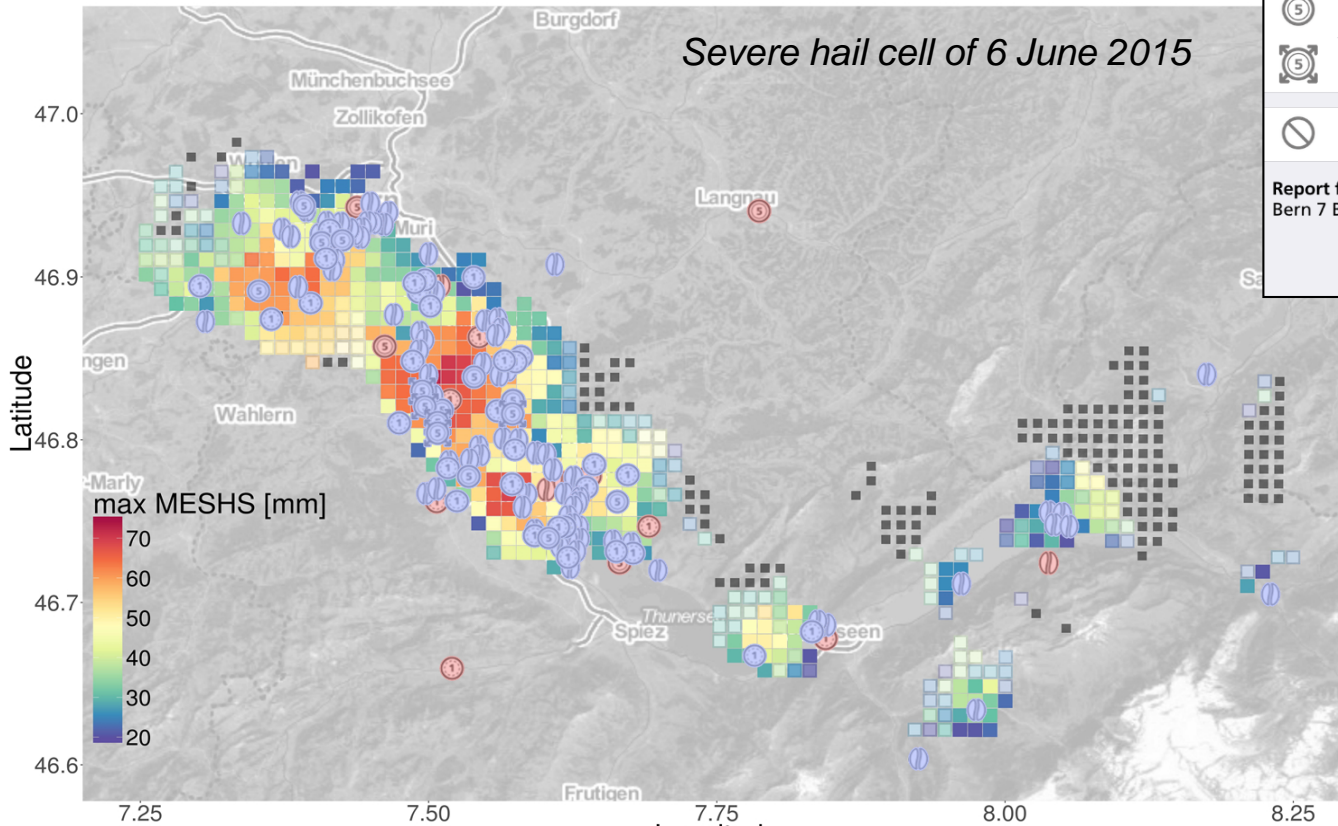


# Aadorf hail cell - 27 May 2016





# Hail reports from app users (crowd sourcing)



Hail - User reports  
Report hail

**Report hail observation!**  
Your information will be used to display on the map and to support research projects. Thank you for your help.

Choose size of the hailstone:

- Coffee beans
- One franc coin
- Five francs coin
- Bigger than five francs coin
- No hail

Report for  
Bern 7 Bärenplatz, Wed, 19 Apr, 22:18

send

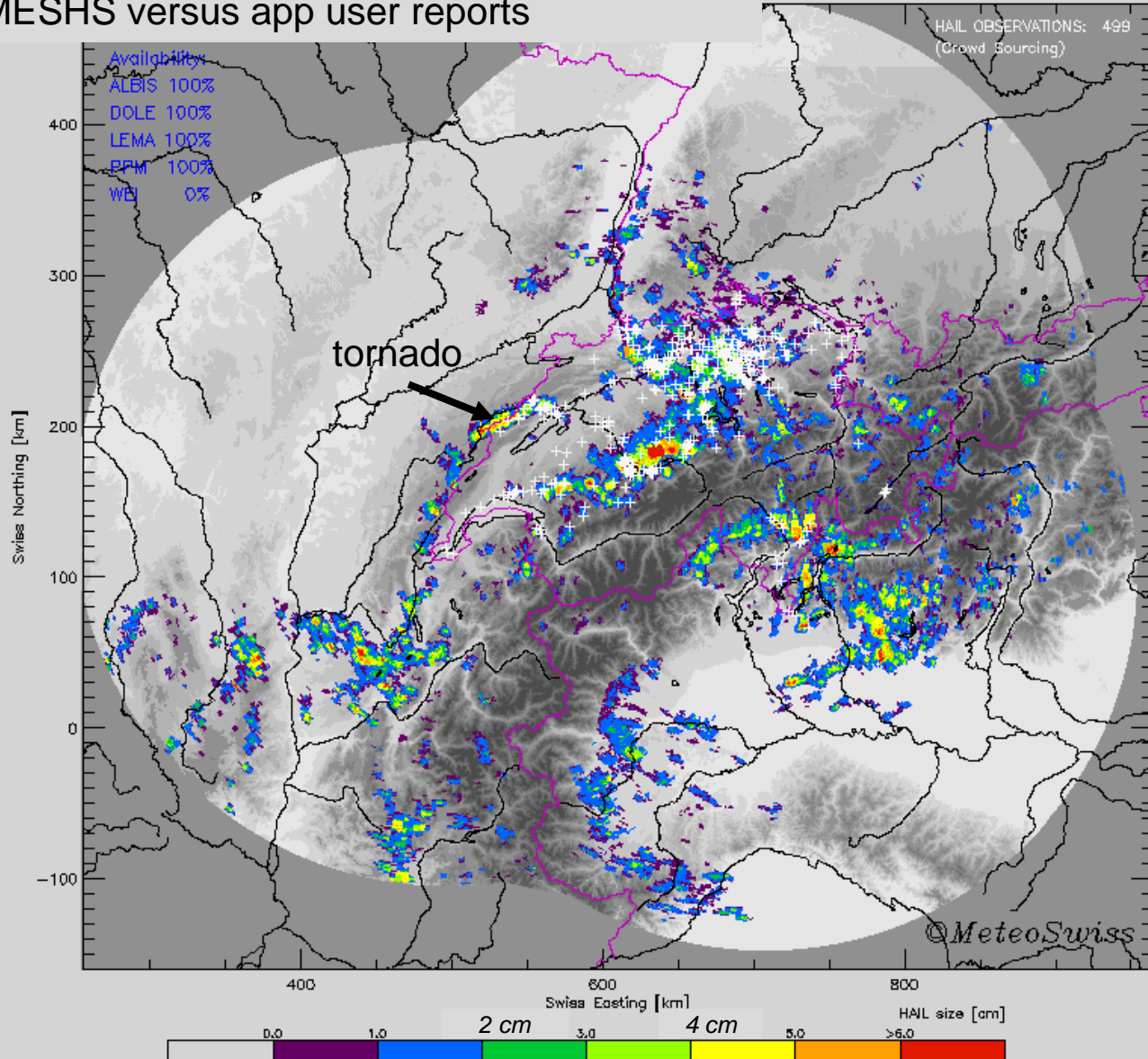
14'000 hail reports  
from app users  
per year

Talks by  
**Simona Trefalt 9:55**  
**Pascal Noti 12:20**



# Hail reports from app users (crowd sourcing)

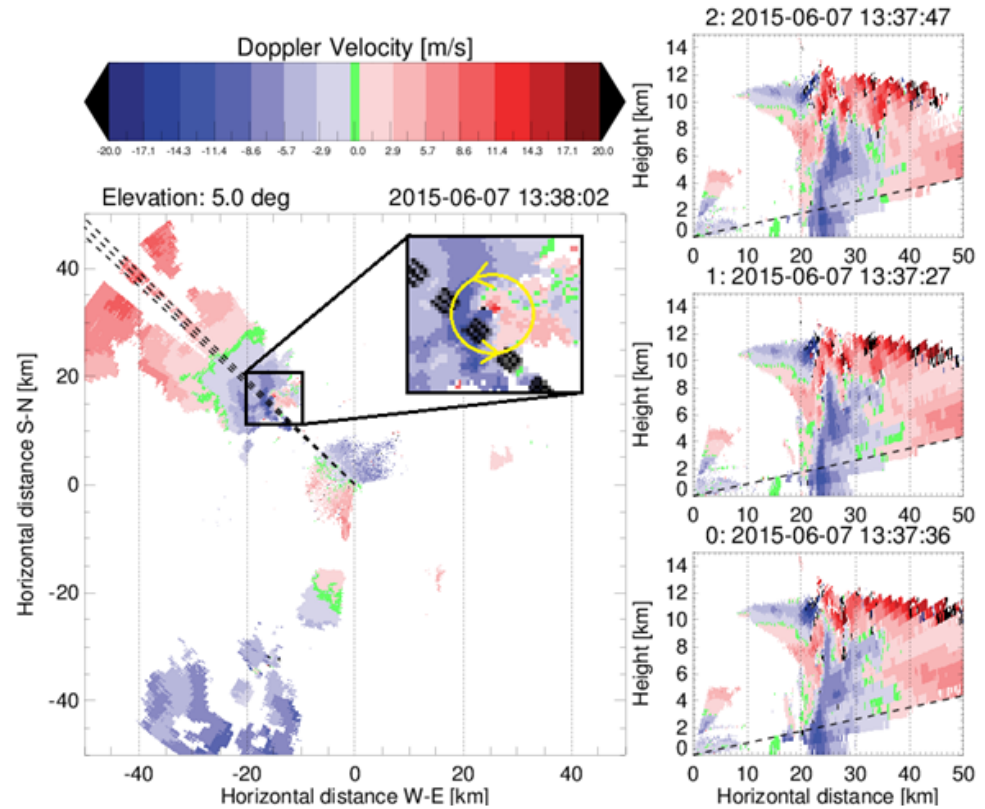
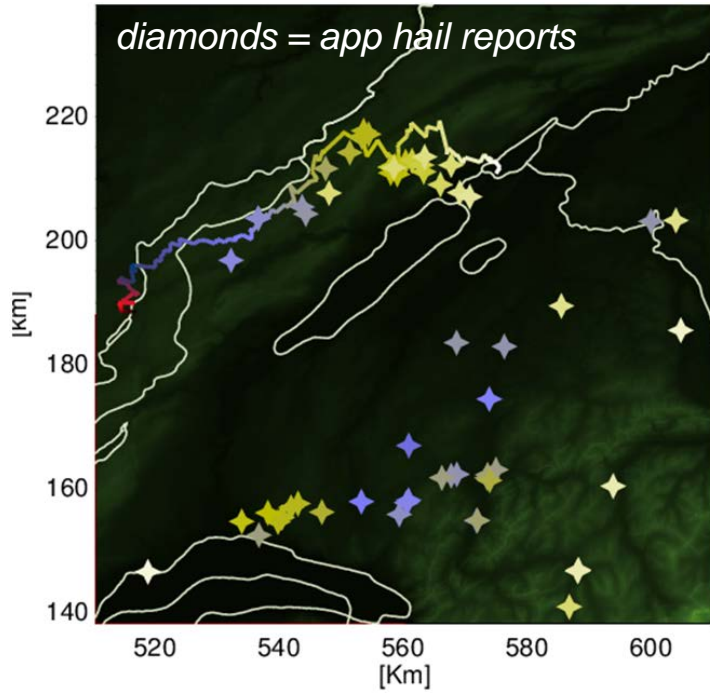
MESHES versus app user reports







# Adaptive high-resolution radar scanning



*Mobile Dual-Pol Doppler X-band radar*



Grazioli, Hering, Leuenberger et al



© SturmArchiv  
Lydia de Buisson



# New Swiss hail climatology (draft project)

**Initiator:** VKF (M Jordi), IRV (M Imhof)

**Users:** IRV, VKF, SIA, SVV, Schweizer Hagel, BAFU, BABS, BLW

**Project:** MeteoSwiss, Meteotest/H2016



**Goal:** Official Swiss hail climatology.

- Satisfying today's and tomorrow's needs from insurance sector.
- Modern data sets and methods.
- Close interaction with users.
- Regularly updated in future.

**Work packages:**

- Data base
- Statistical methods
- Implementation and dissemination



*Soccer ball hail*



void