MAX-PLANCK-INSTITUT
FÜR METEOROLOGIE

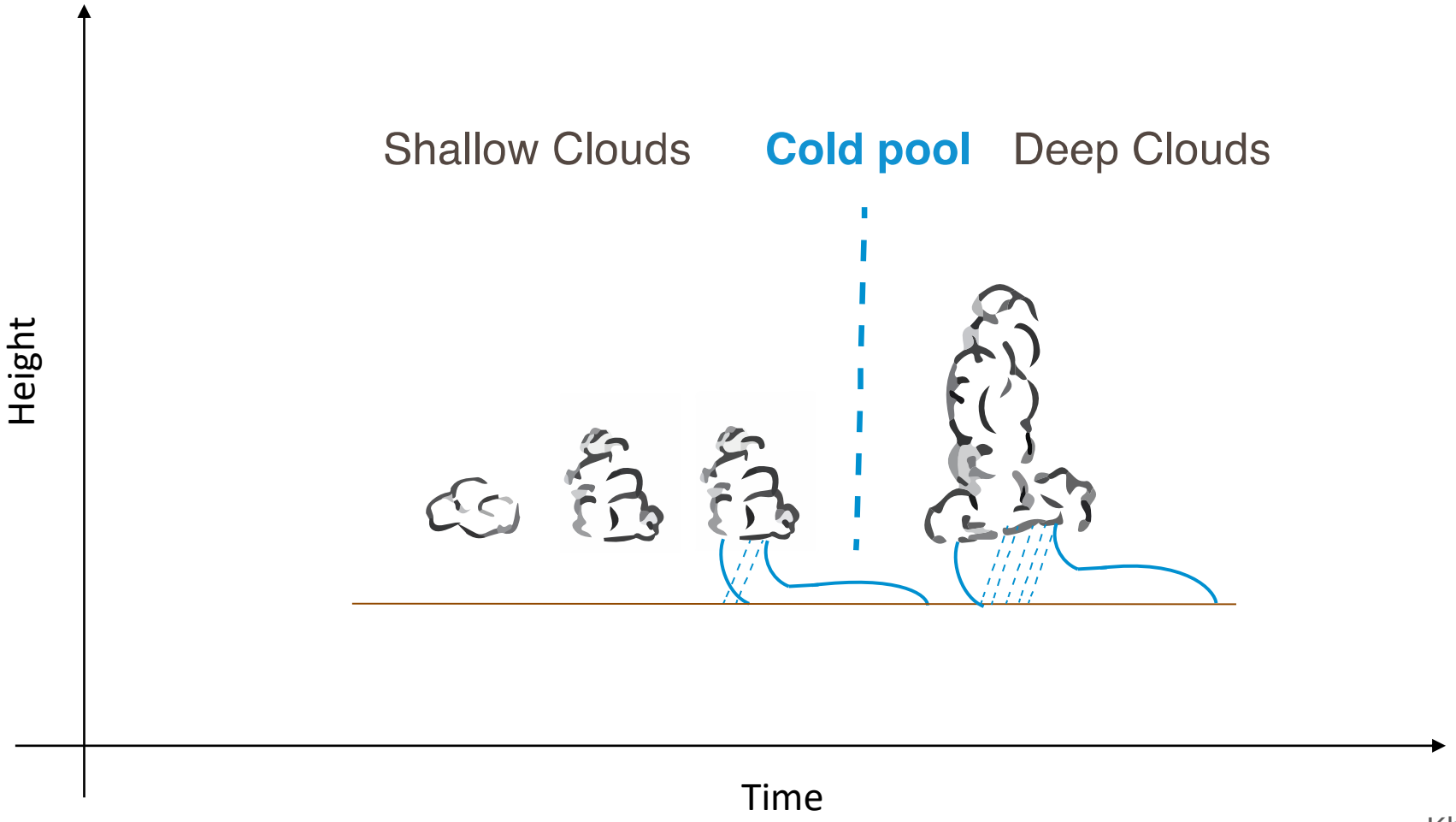
FESSTVaL

The field experiment on submesoscale spatio-temporal variability in Lindenberg

Hans-Ertel-Zentrum
für Wetterforschung

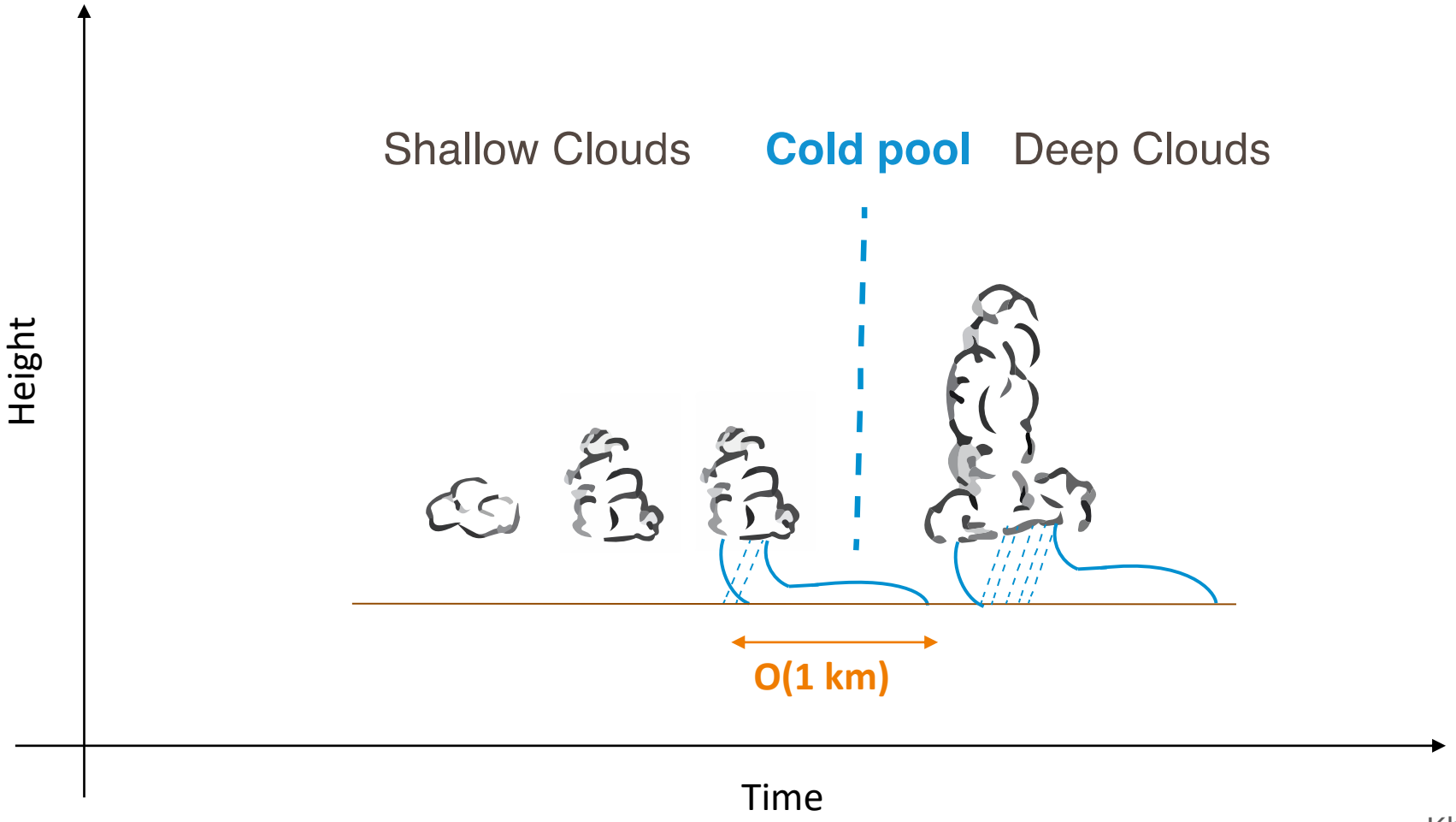
Cathy Hohenegger

The development of thunderstorms, a motivation for FESSTVaL



Khairoutdinov and Randall (2006)
Böing et al. (2012)
Schlemmer and Hohenegger (2014)

The development of thunderstorms, a motivation for FESSTVaL



Khairoutdinov and Randall (2006)
Böing et al. (2012)
Schlemmer and Hohenegger (2014)

Fazit:

- Important atmospheric proceesses happen at the **km scale**
- Limited-area weather forecast models employ grid spacings in the **km scale**
- But the **km scale** is not well observed by the surface observational network

Measurement stations:
About 25 km

FESSTVaL in a nutshell

Characterize and investigate submesoscale variability

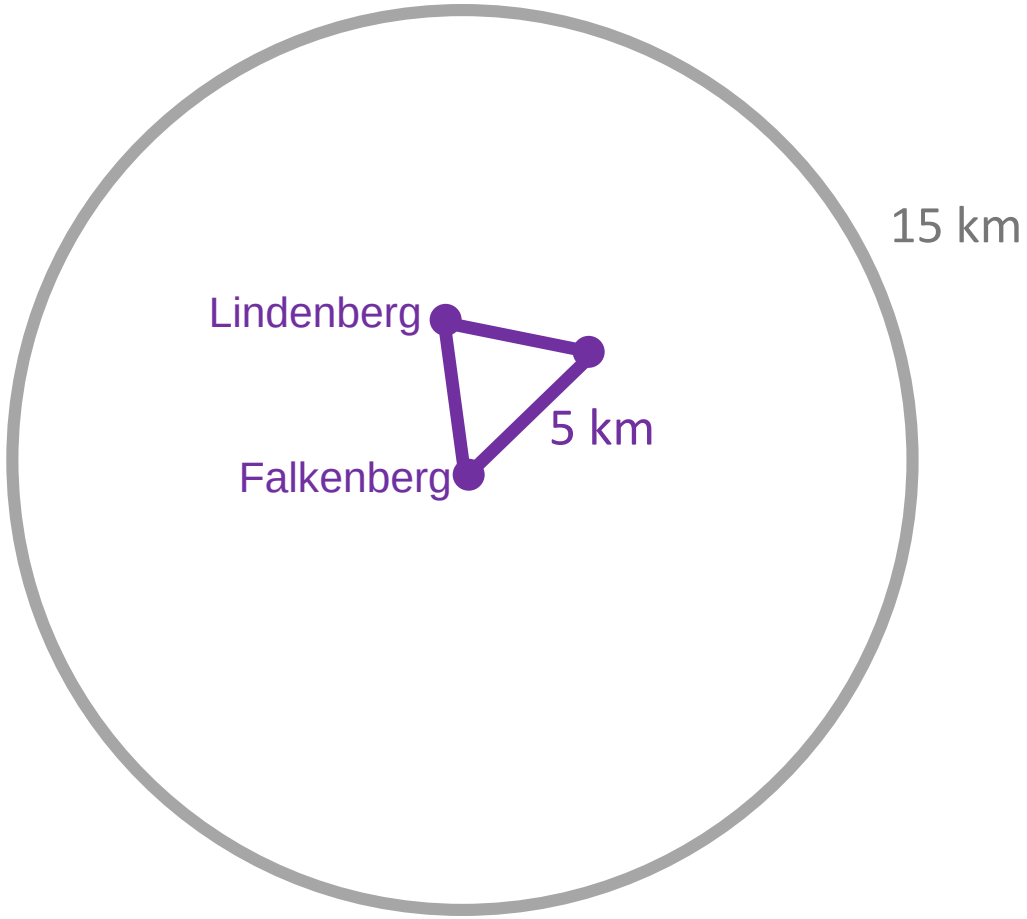
1. Measure submesoscale variability — *Technical side*
2. Quantify submesoscale variability — *Process understanding side*
3. Validate representation of submesoscale variability — *Modelling side*

FESSTVaL more concrete

had a particular emphasis on **cold pools**, their interactions with the land surface and the **planeteray boundary layer**, and **wind gusts**

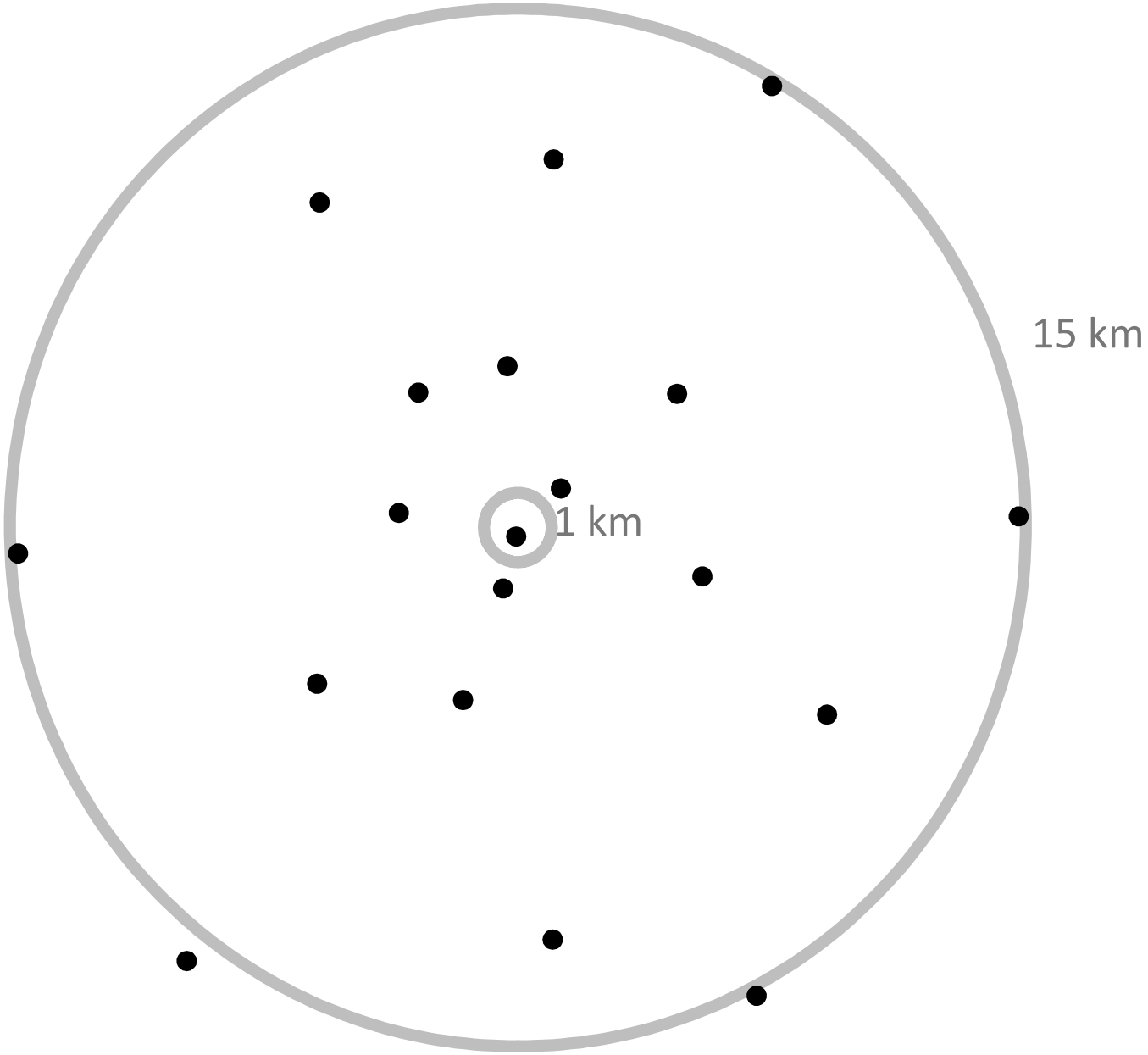
1. How big and how homogeneous are cold pools?
2. How frequent are coherent structures in the PBL?
3. How representative is the measurement of a wind gust at a point?
4. Spatial variability in low-level jet and effect on wind power?
5. Can submesoscale variability change domain-mean radiation?
6. Can we machine learn submesocale variability in soil moisture?

Overall measuring strategy: a circle and a triangle



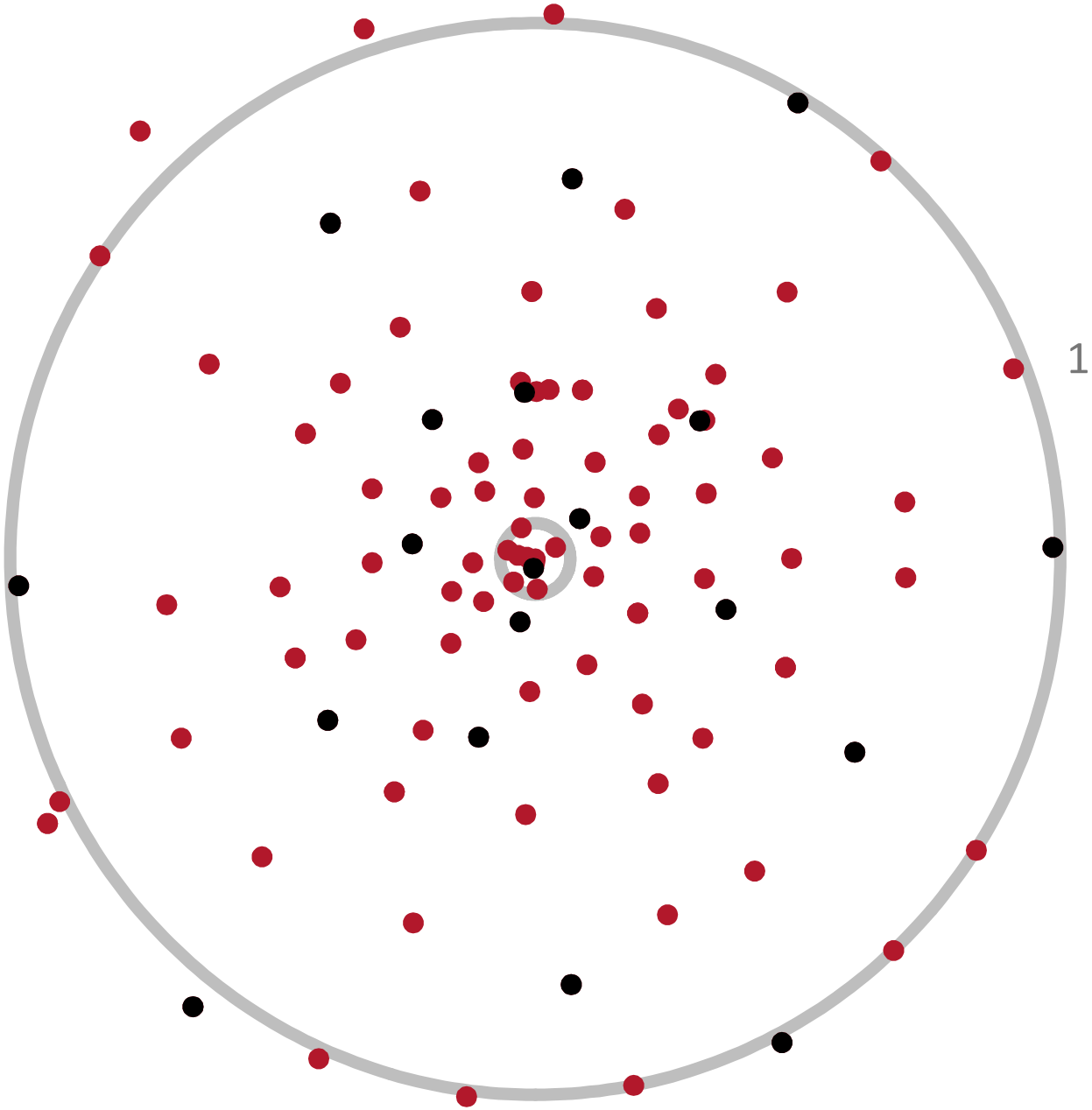
Standard weather stations

- 19 stations
- Min D : 1.5 km
- Max D : 9.6 km
- Median D : 4.9 km



Standard weather stations, self-built cold pool logger (T, p)

- 80 stations
- Min D : 0.1 km
- Max D : 4.8 km
- Median D : 1.8 km



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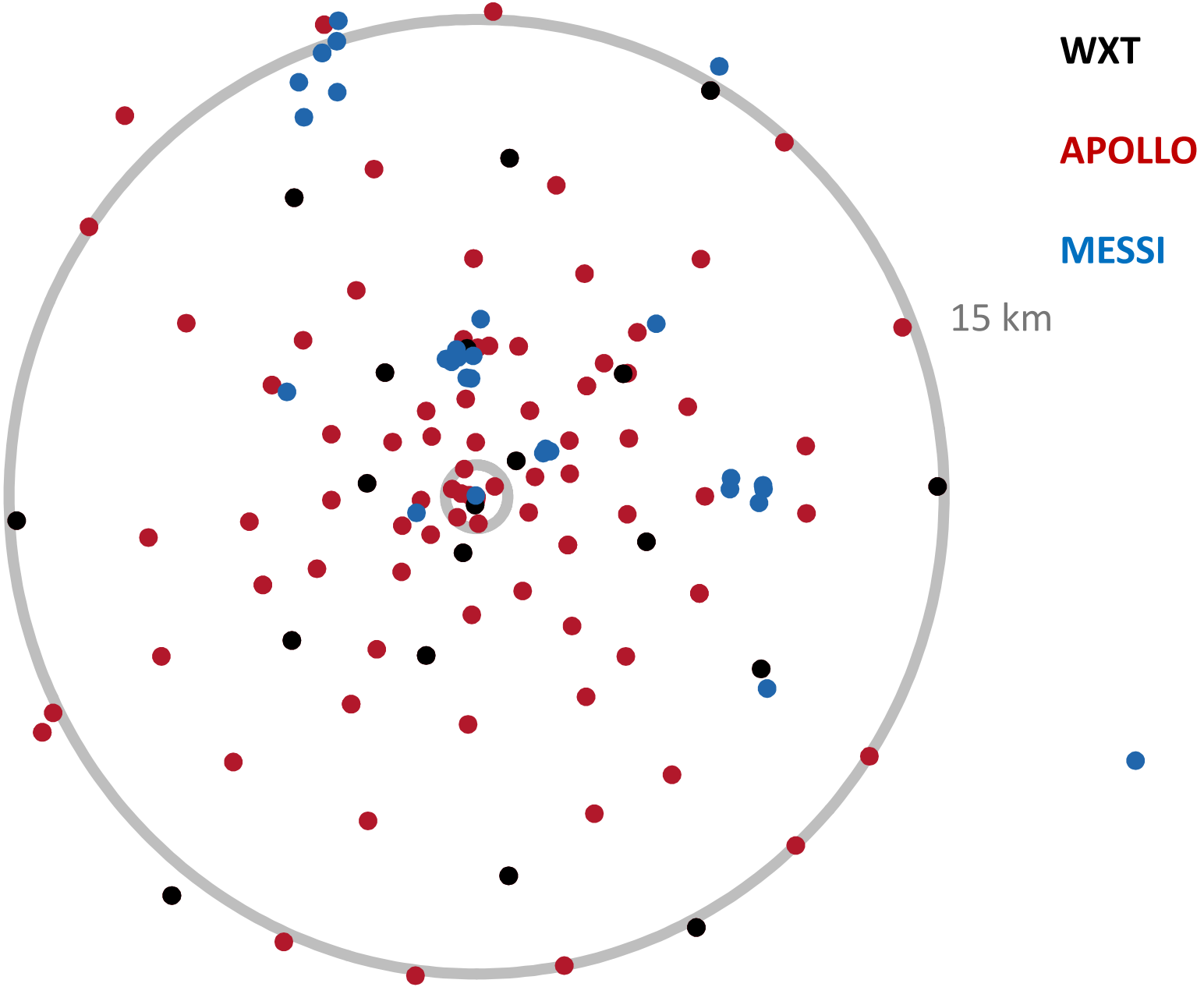
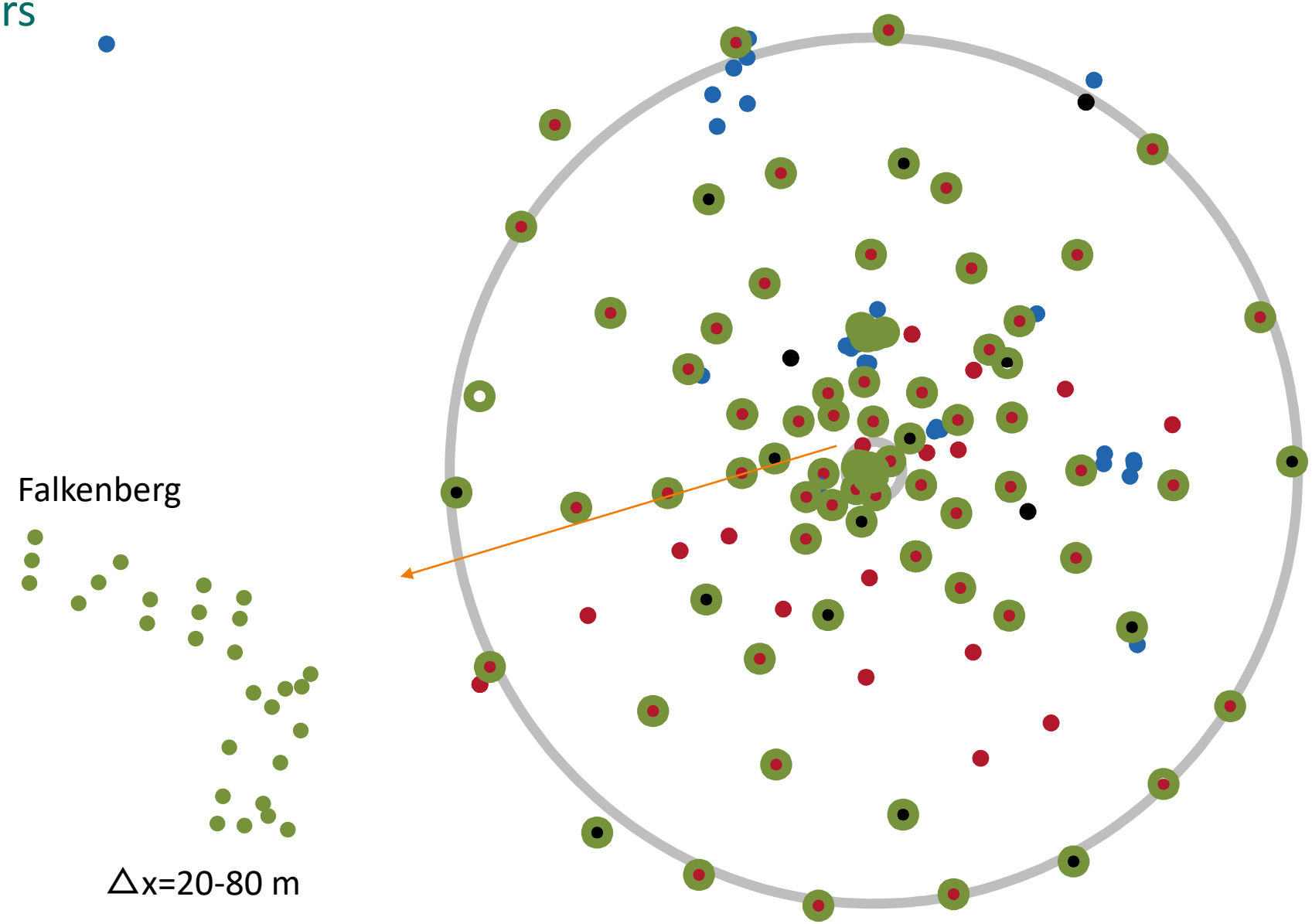
APOLLO

Standard weather stations, self-built cold pool logger (T, p), self-built weather stations



Standard weather stations, self-built cold pool logger (T, p), self-built weather stations, soil sensors



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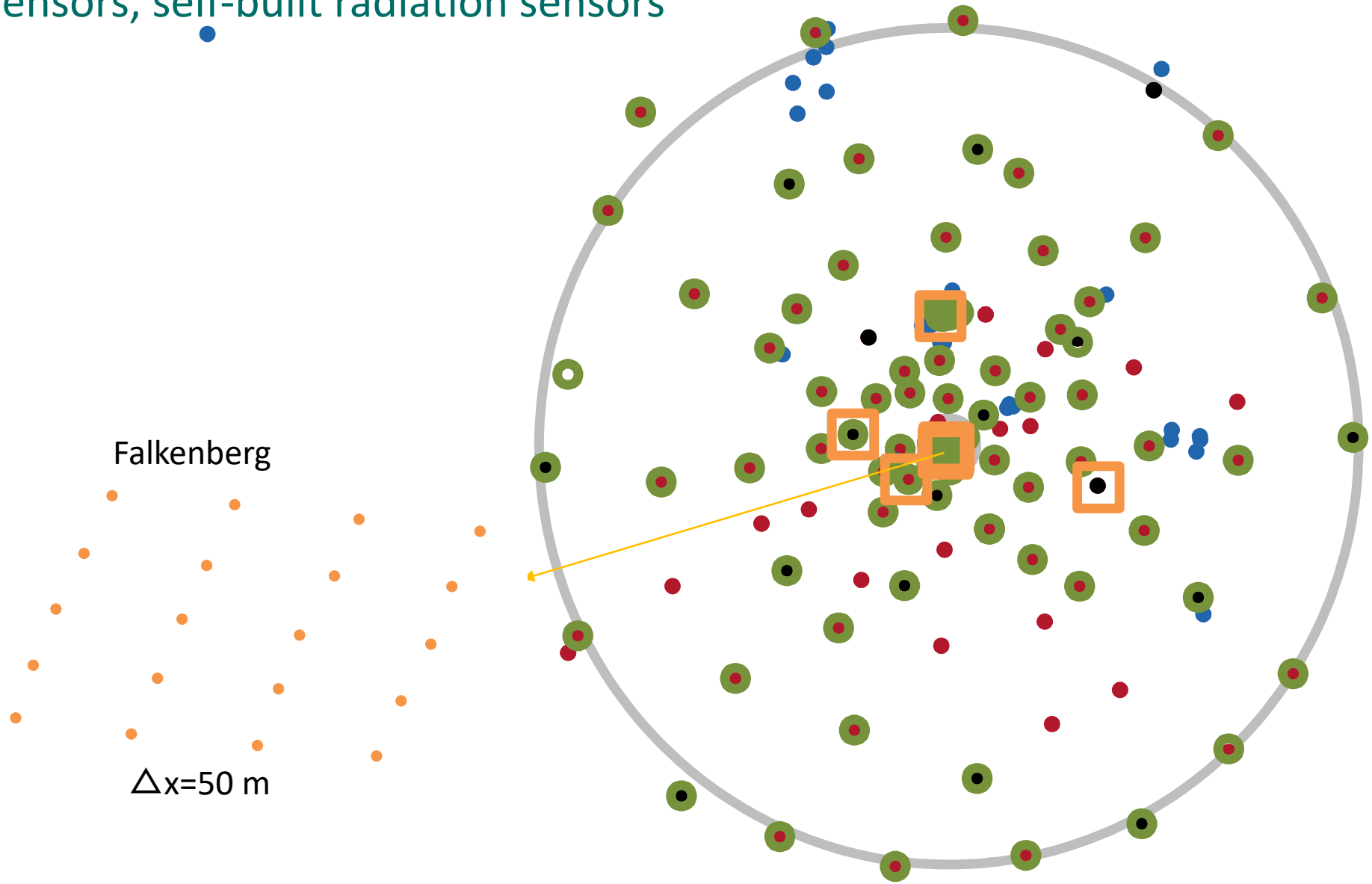
Soil sensors

Standard weather stations, self-built cold pool logger (T, p), self-built weather stations, soil sensors, self-built radiation sensors



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Soil sensors

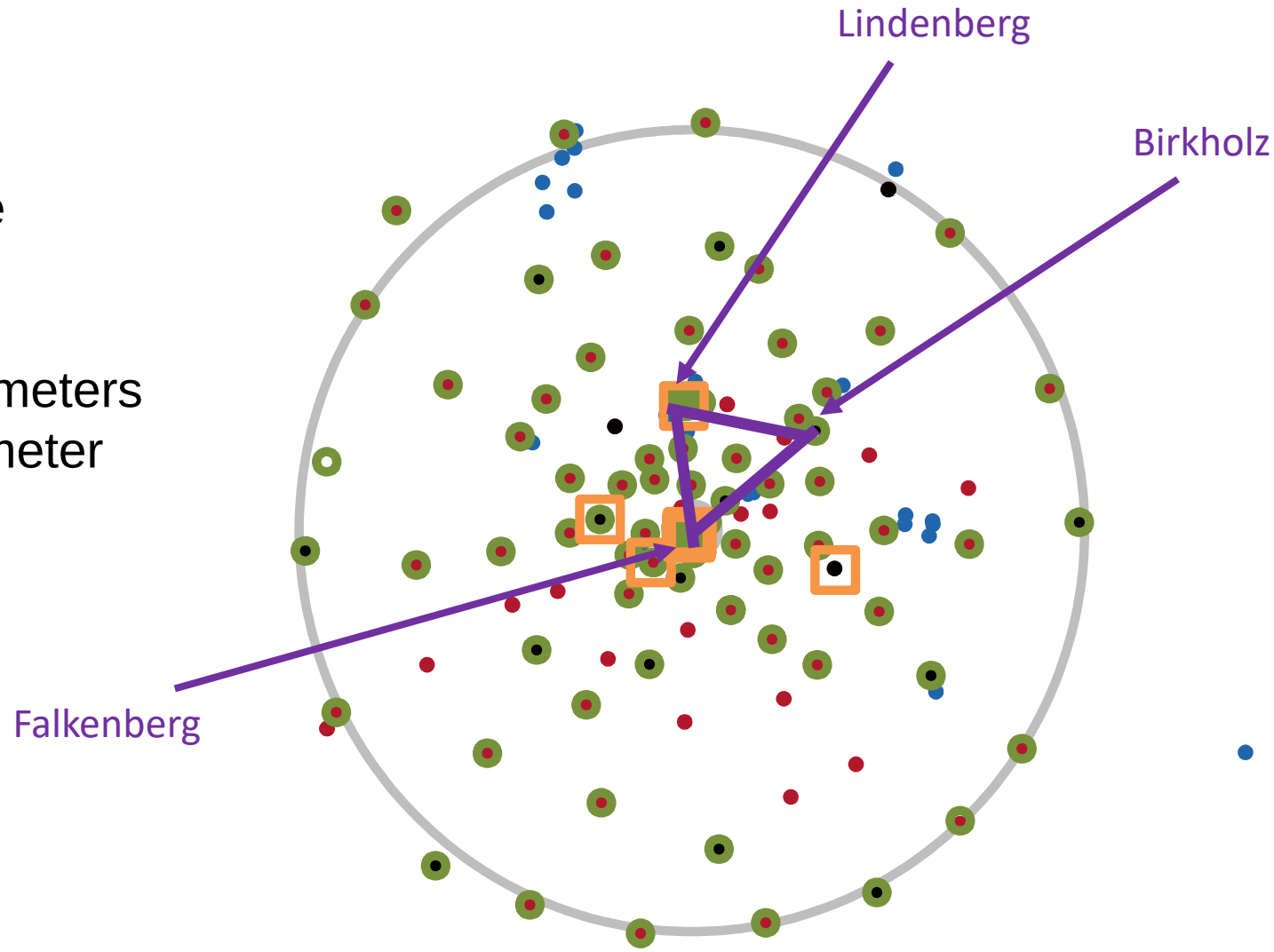
FROST

Measuring submesoscale variability in the vertical

Measuring submesoscale variability in the vertical

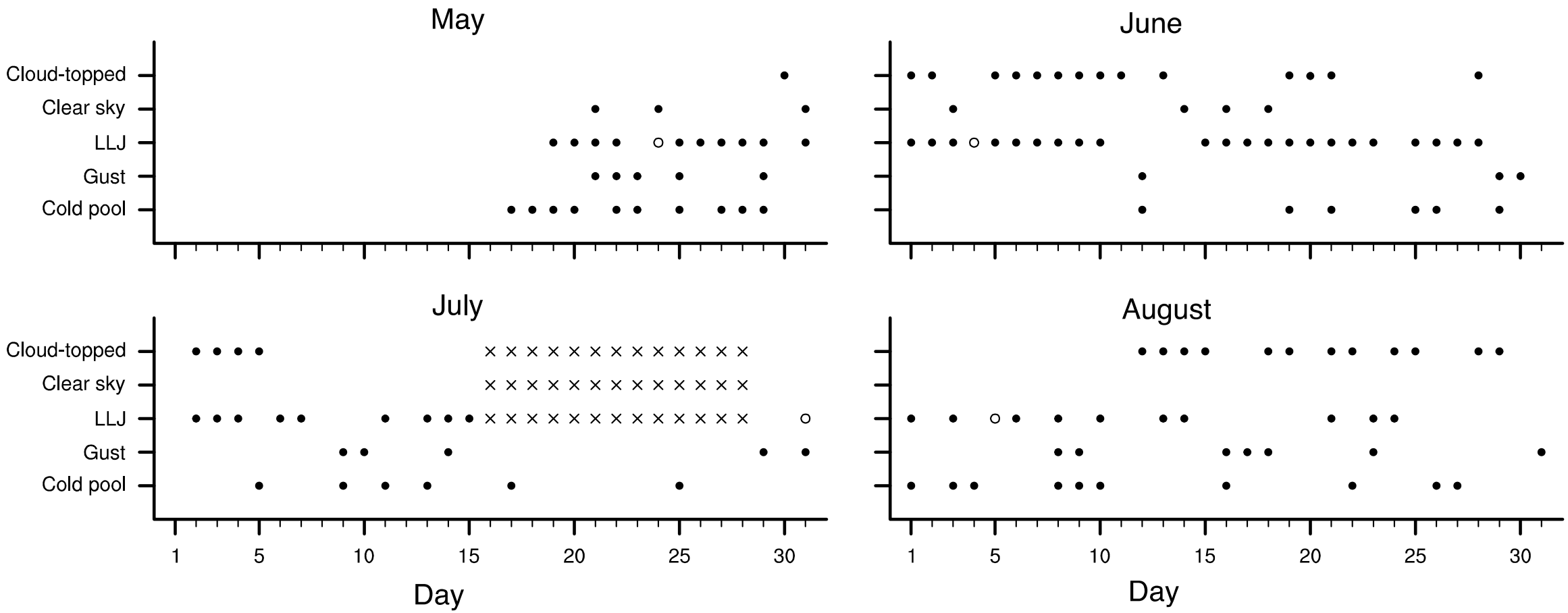
- 3 Supersites
  FESSTVaL triangle

- 9 Wind lidars
- 4 Microwave radiometers
- 1 Infrared spectrometer
- 1 x-band radar
- 1 UAV
- Drones

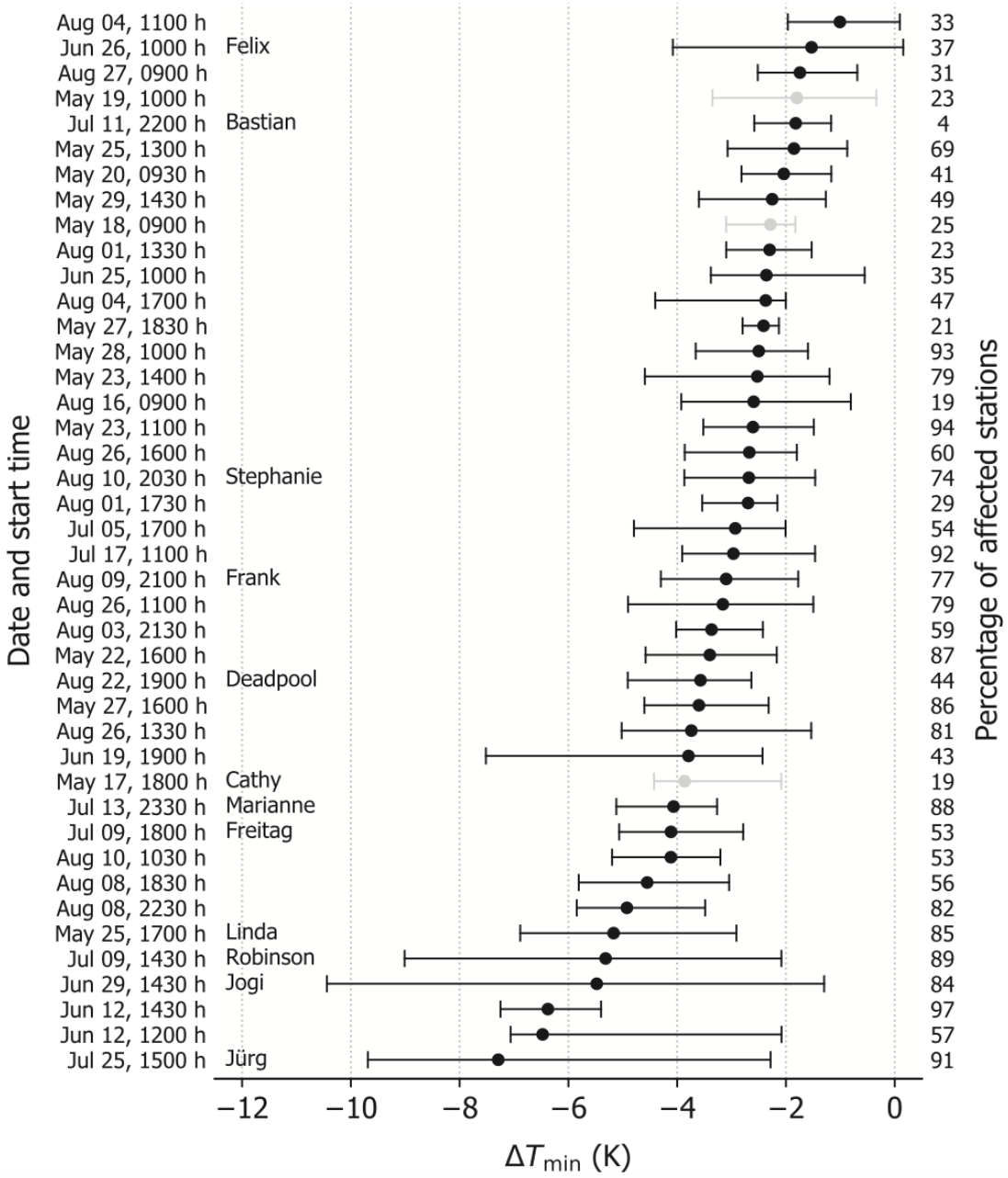


Measuring submesoscale variability in the vertical

Captured events

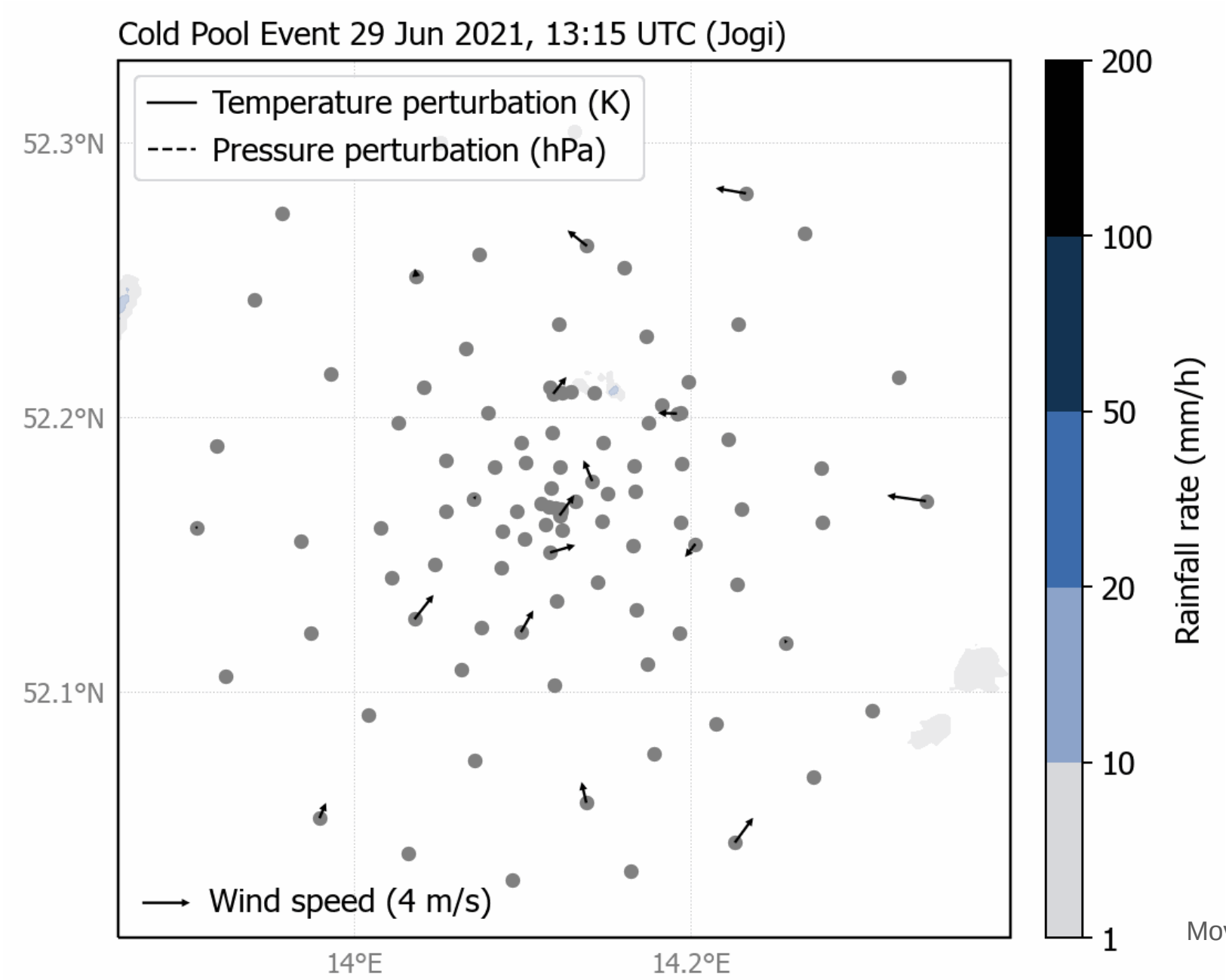


Rather weak cold pools



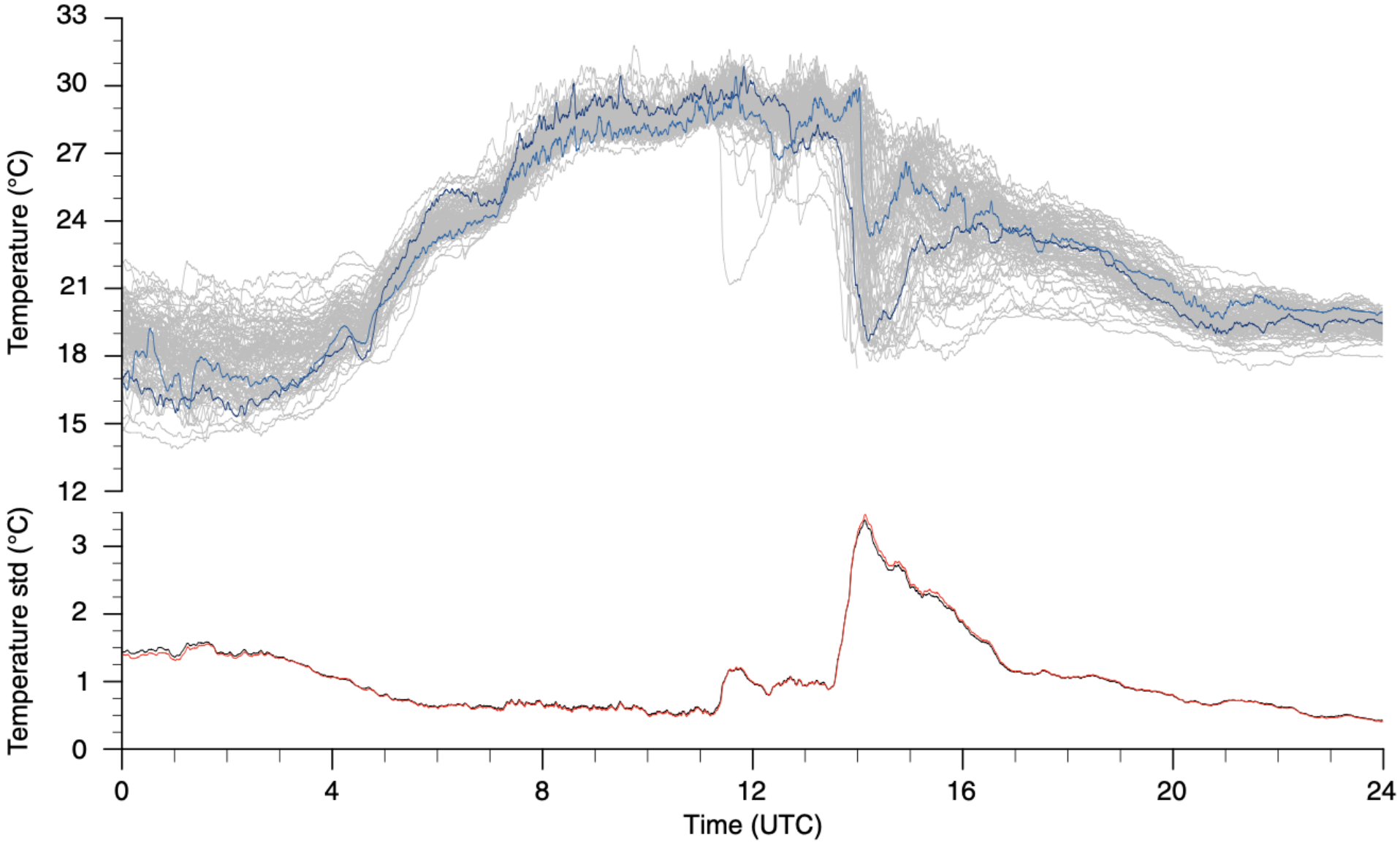
From Kirsch et al. (2024)

Cold pool Jogi

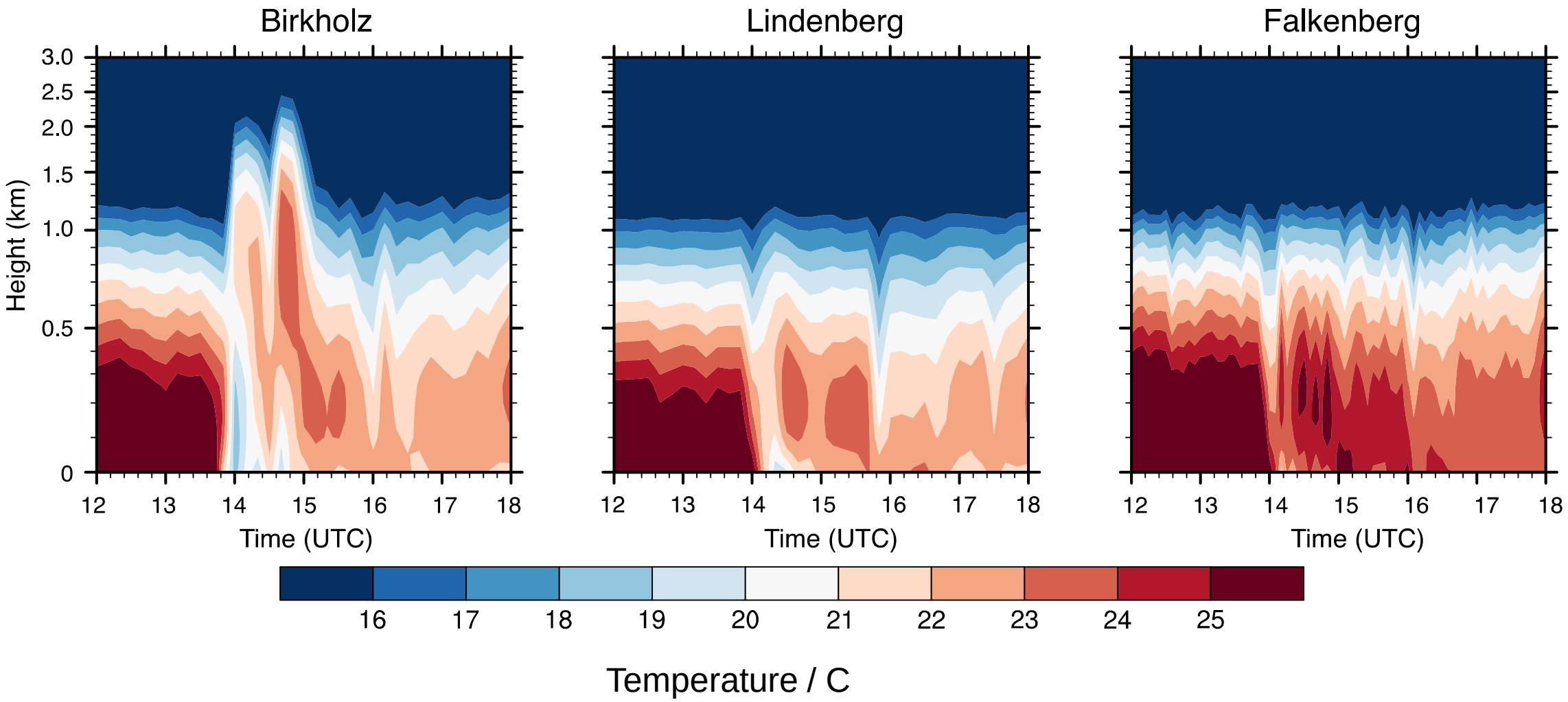


Movie by Bastian Kirsch

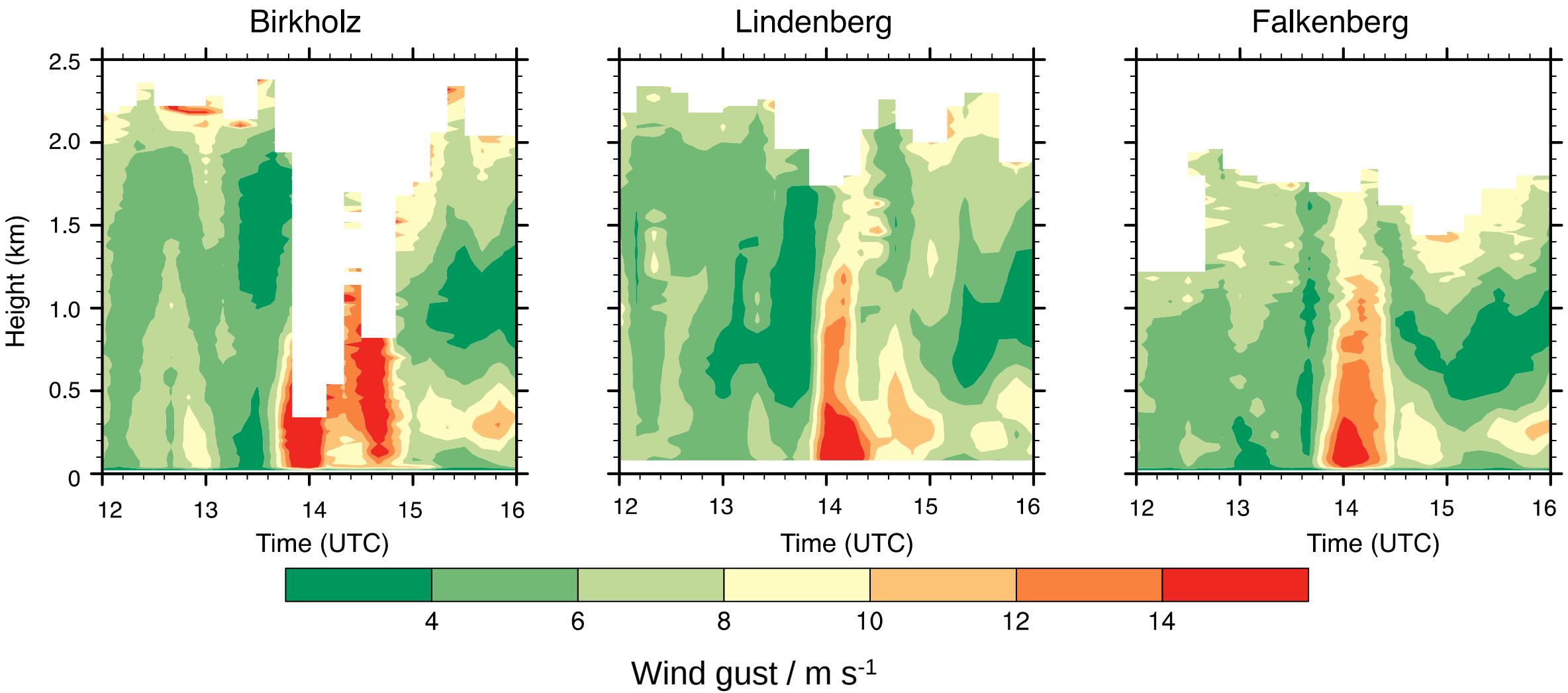
Cold pool Jogi



Cold pool Jogi



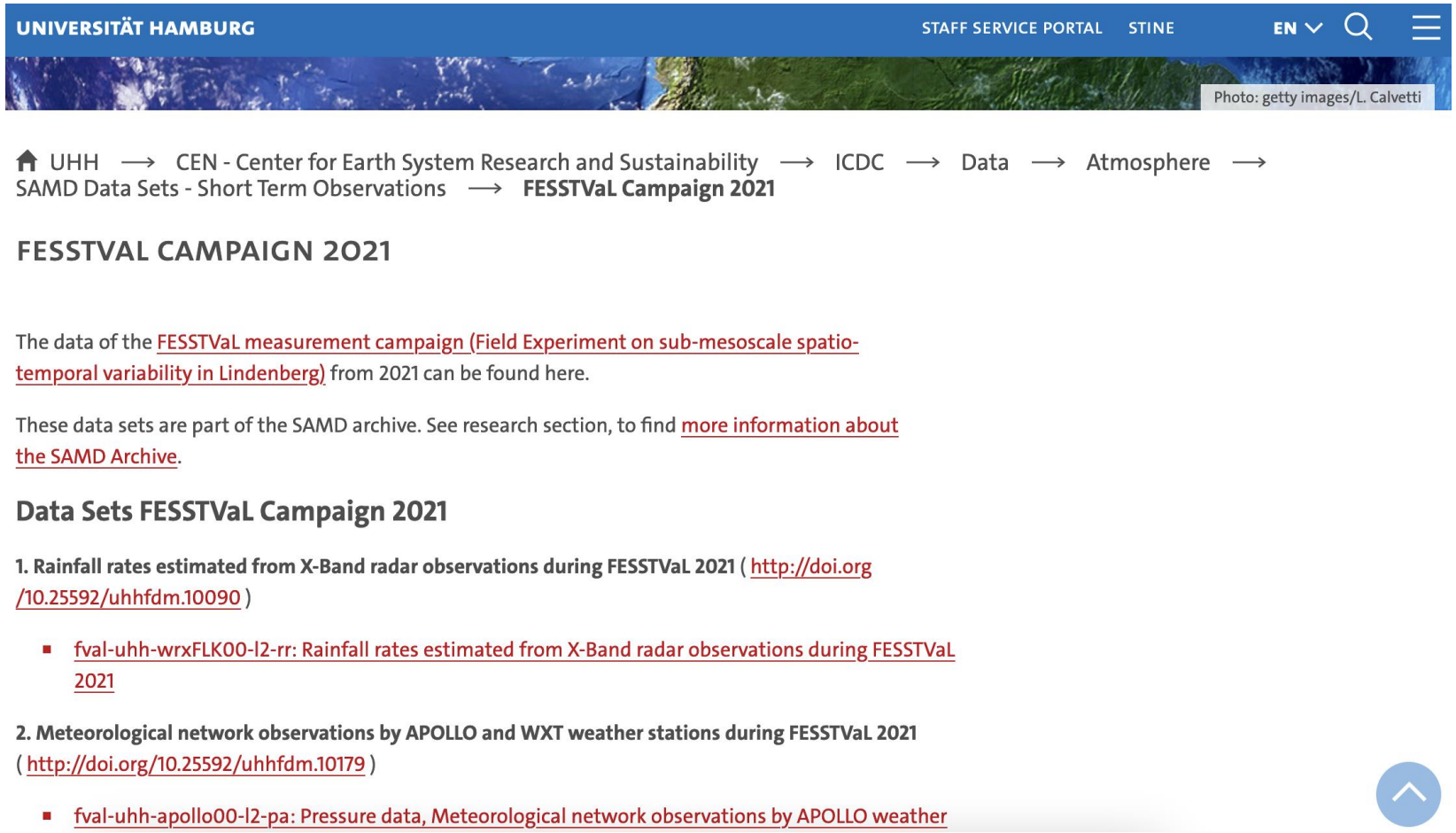
Cold pool Jogi



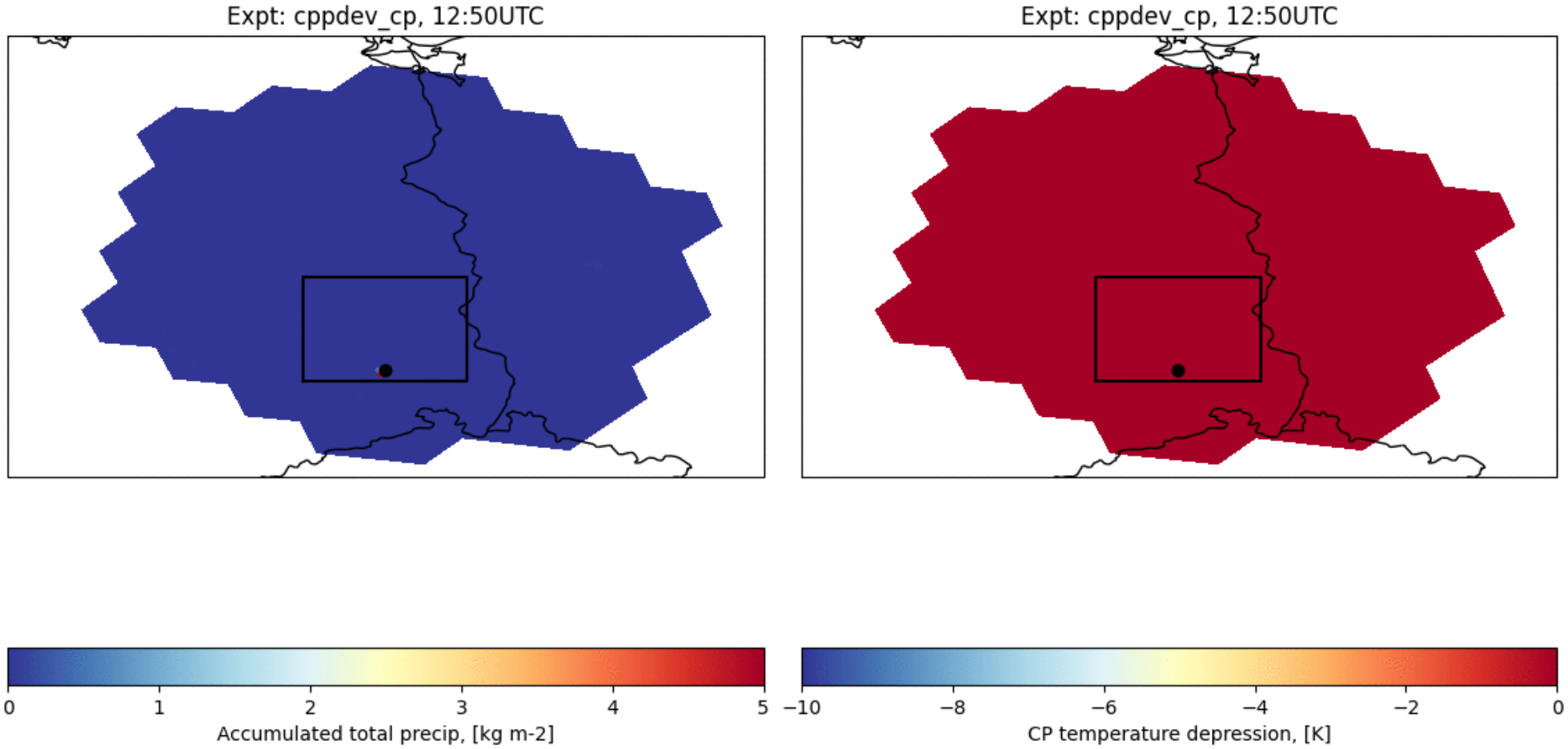
Where to find the data?

Data are stored at ICDC (U Hamburg) and freely available

https://www.cen.uni-hamburg.de/en/icdc/data/atmosphere//samd-st-fesstval.htmlsamd-st-datasets



Using FESSTVaL data to validate km-scale model

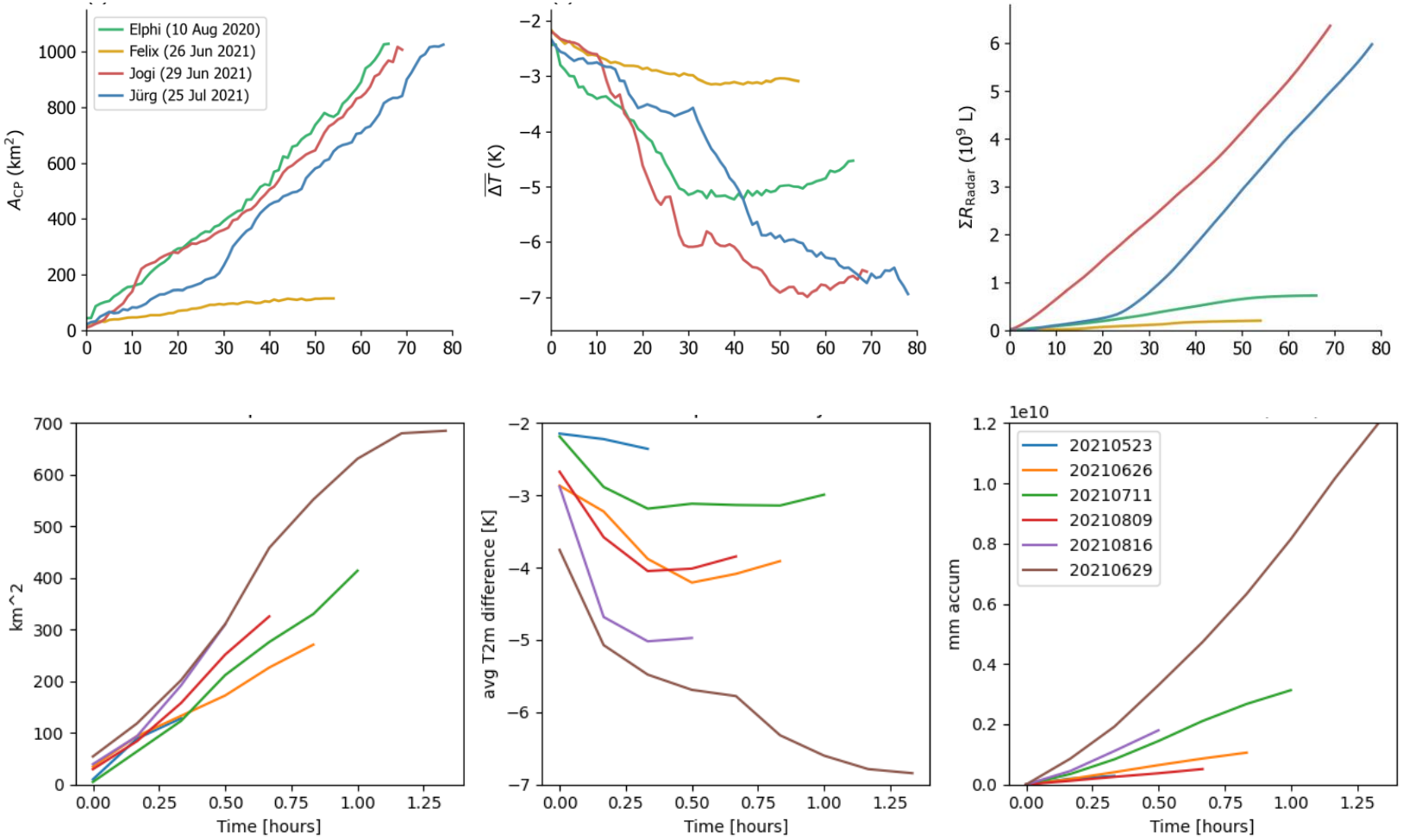


Using FESSTVaL data to validate km-scale model

Area

Intensity

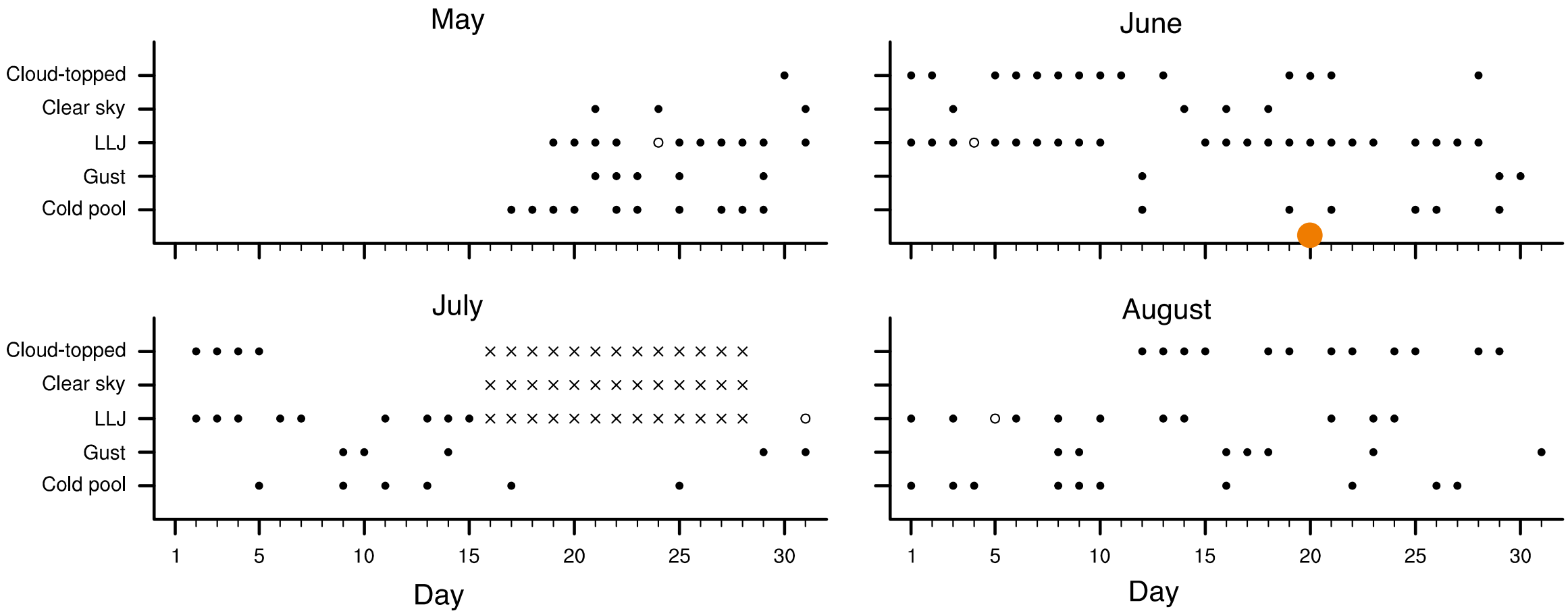
Accumulated precipitation



From Kirsch et al. (2024)

Maike Ahlgrimm

Using FESSTVaL data to validate km-scale model: looking at missforecasts?



Conclusions

FESSTVaL

https://www.cen.uni-hamburg.de/en/icdc/data/atmosphere//samd-st-fesstval.htmlsamd-st-datasets

BAMS Article

FESSTVaL

The Field Experiment on Submesoscale Spatio-Temporal Variability in Lindenberg

Cathy Hohenegger, Felix Ament, Frank Beyrich, Ulrich Löhnert, Henning Rust, Jens Bange, Tobias Böck, Christopher Böttcher, Jakob Boventer, Finn Burgemeister, Marco Clemens, Carola Detring, Igor Detring, Noviana Dewani, Ivan Bastak Duran, Stephanie Fiedler, Martin Göber, Chiel van Heerwaarden, Bert Heusinkveld, Bastian Kirsch, Daniel Klocke, Christine Knist, Ingo Lange, Felix Lauermann, Volker Lehmann, Jonas Lehmke, Ronny Leinweber, Kristina Lundgren, Matthieu Masbou, Matthias Mauder, Wouter Mol, Hannes Nevermann, Tatiana Nomokonova, Eileen Päschke, Andreas Platis, Jens Reichardt, Luc Rochette, Mirjana Sakradzija, Linda Schlemmer, Jürg Schmidli, Nima Shokri, Vincent Sobottke, Johannes Speidel, Julian Steinheuer, David D. Turner, Hannes Vogelmann, Christian Wedemeyer, Eduardo Weide-Luiz, Sarah Wiesner, Norman Wildmann, Kevin Wolz, and Tamino Wetz