Hans-Ertel-Zentrum
für Wetterforschung

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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

FESSTVaL

Field **E**xperiment on **S**ubmesoscale **S**patio-**T**emporal **Va**riability in **L**indenberg

May-August 2020 with SOP in July

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FESSTVaL

Field **E**xperiment on **S**ubmesoscale **S**patio-**T**emporal **Va**riability in **L**indenberg

May-August 2020 with SOP in July

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all: **Hans-Ertel Centre for Weather Research (HErZ)**

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2) Deutscher Wetterdienst, Offenbach, Germany,
3) Goethe University, Frankfurt, Germany,
4) Bonn and University of Cologne, Germany,
5) LMU Munich, Germany,
6) Freie Universität Berlin, Germany,
7) Meteorological Institute, University of Hamburg, Germany

Hans-Ertel-Centre for Weather Research (HErZ)

- Basic research to improve weather forecasting and climate monitoring
- To strengthen met education and visibility of German weather research
- Joint effort of DWD, 6 German universities and 2 Max-Planck Institutes
- 3rd phase: 2019-2022

Hans Ertel, 1904 - 1971

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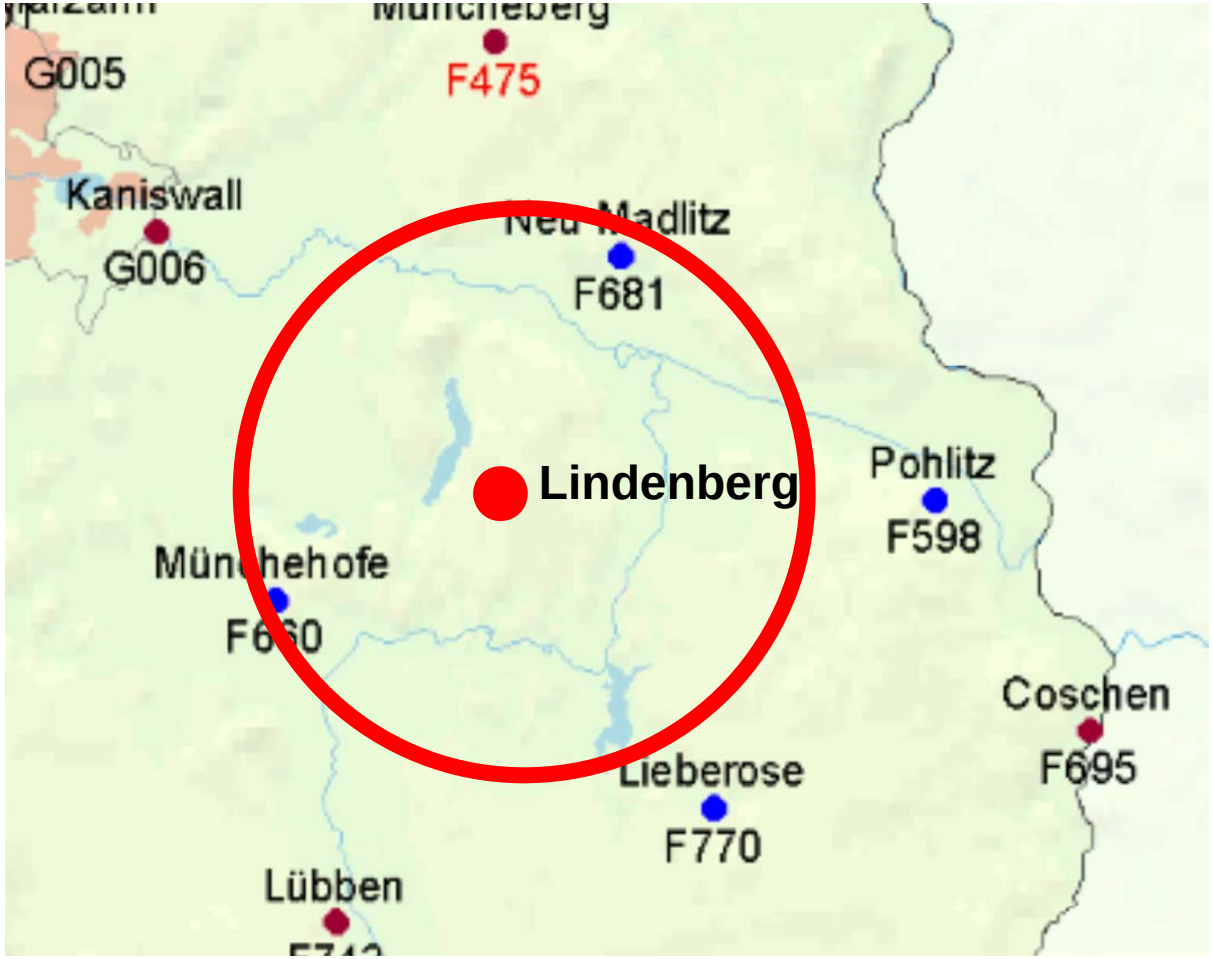
Convection-permitting scales not well observed…

Measurement stations: within 25 km

COSMO-model grid: 2.2 km



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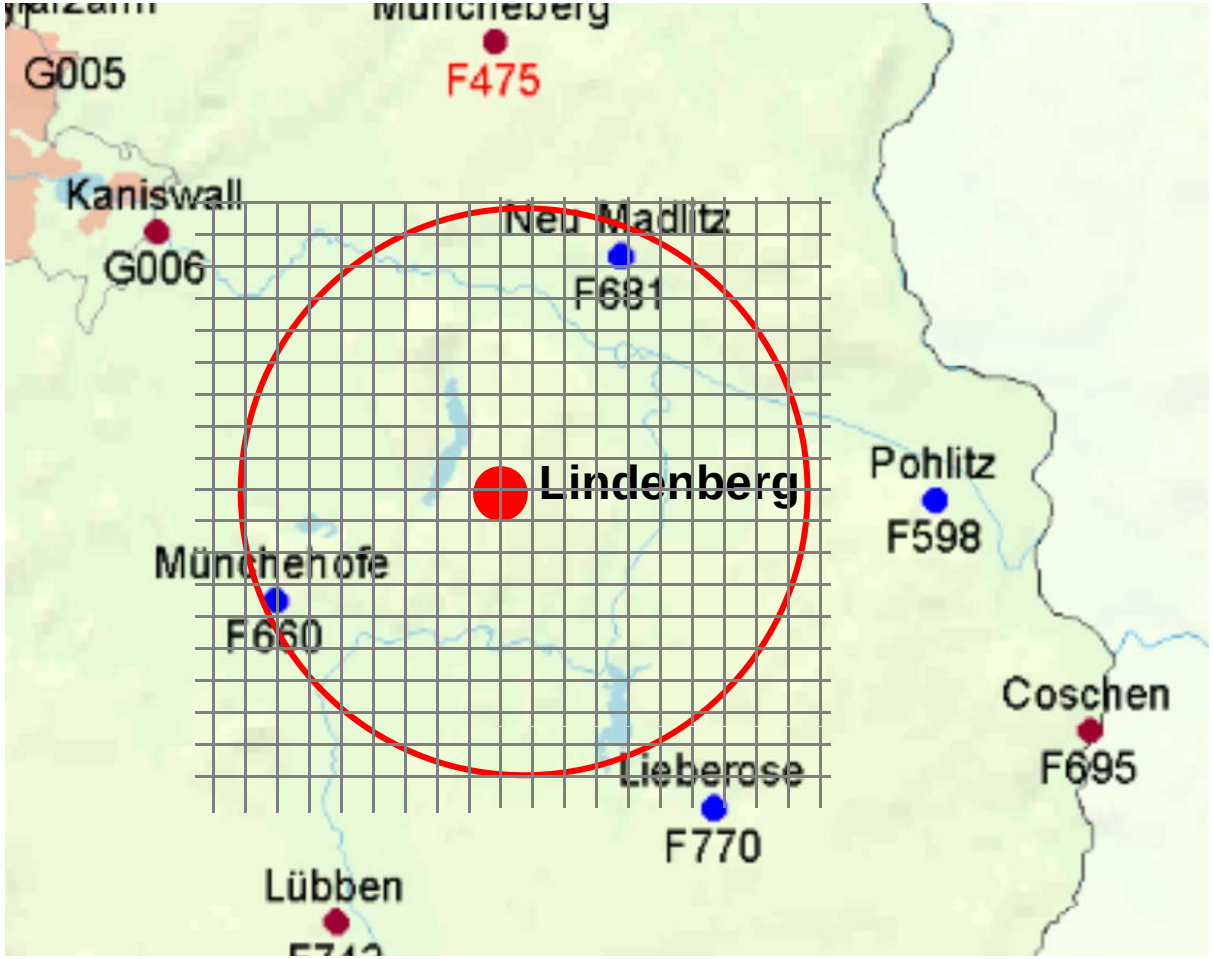

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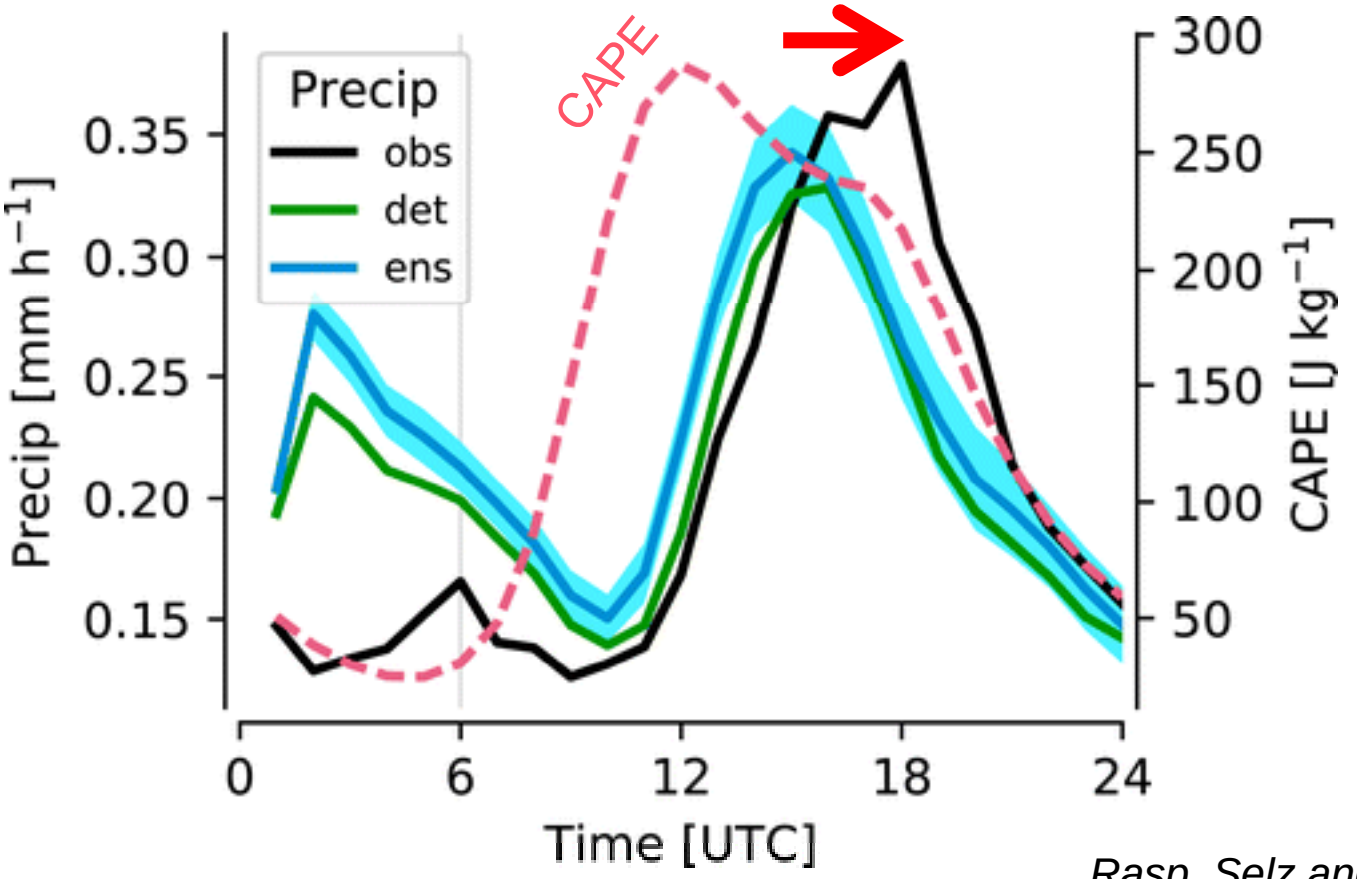
…and several processes remain under-resolved



Rasp, Selz and Craig, 2018

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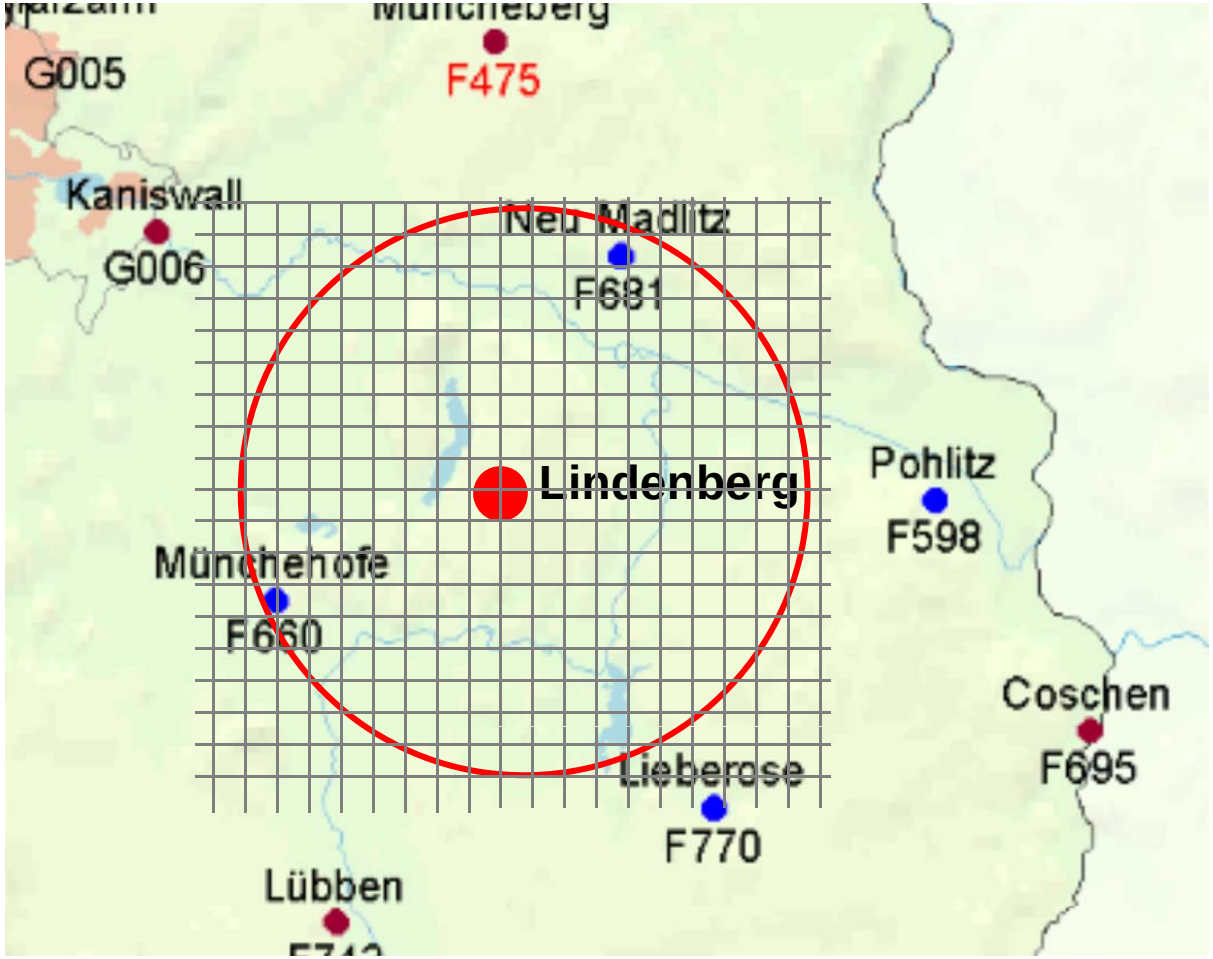
What if measuring every 100 m in few grid boxes?

Measurement stations:
About 25 km

COSMO-model:
2.8 km



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Focus

➔ Submesoscale variability: O(100 m) on a O(10x10 km^2) region

Goals

➔ How to measure submesoscale variability?

➔ Does NWP models correctly capture submesoscale variability?

➔ Process understanding: do observations support previous hypotheses derived from models?

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Three subtopics….

…that are an expression or a source of submesoscale variability

1. Submeso boundary layer patterns
2. Cold pools
3. Wind gusts
4. Using citizen observations

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1. Submeso boundary layer pattern

- **Characterize** submeso-scale boundary layer patterns ← using lidars and further instruments
- **Evaluate** ICON SCM with different boundary layer schemes ← against profiles of mean observations and of turbulent quantities
- Process **understanding** ← Identification of processes causing submesoscale variability

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2. Cold pool

Cold pools are important for convection, but how big are they really?

- **Measure** the two-dimensional structure of cold pools using a high-density surface network made of new (and cheap) sensors

- **Compare** simulated cold pool statistics (size, temperature depression) to observations

- Process understanding: **Test** some of the following hypotheses:
- Larger cold pools have stronger temperature perturbations (Schlemmer and Hohenegger 2014)
- Larger cold pools lead to larger clouds (Schlemmer and Hohenegger 2014)
- Cold pool properties are drastically impacted by the surface fluxes (Gentine et al. 2016)
- Stronger sensible heat fluxes lead to a faster dissipation of cold pools (Grant and van den Heever 2016)
- Recovery of the sensible heat flux is fast

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3. Wind gust

How representative is a simulated wind gust in a 2.2 x 2.2 km^2 cell at a given height?

- ➔ Use of doppler lidars to **measure** wind gusts
- ➔ **Evaluate** simulated wind gusts and develop new wind gust diagnostics
- ➔ Process understanding: **Study** the effect of the environment on wind gusts at different heights

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4. Citizen network

How useful are low cost sensors built by citizen and for what?

- **Build** low cost weather stations in dedicated workshops
- Statistical post-processing of the data to **integrate** it in measurement network
- To what extent does the involvement of citizen **raises** the interest in weather?

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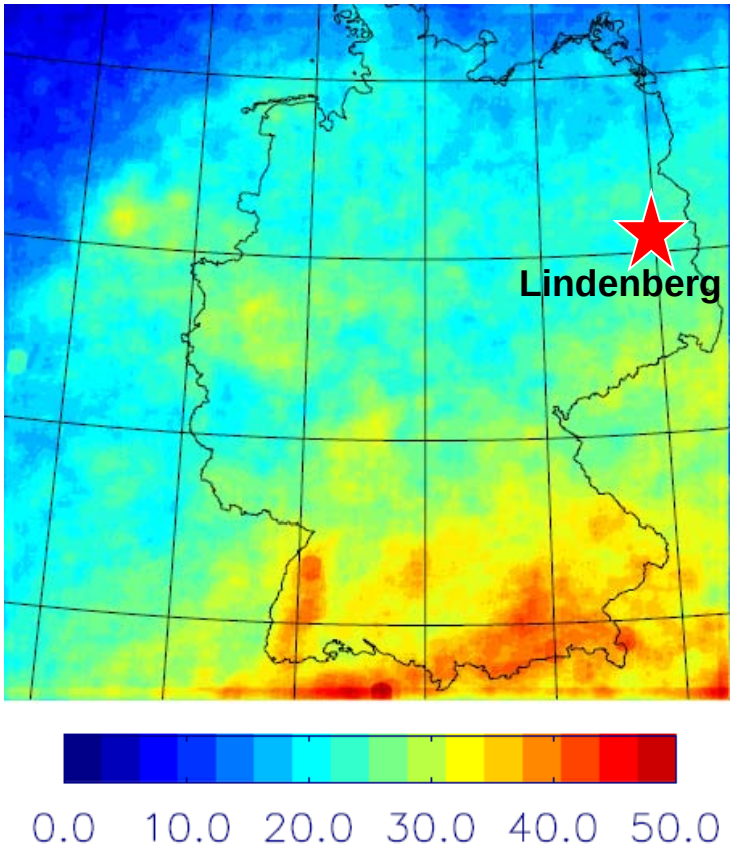
Measurement strategy

Number of days with thunderstorm



Wapler, K., James, P., 2015:
Thunderstorm occurrence and characteristics in Central Europe under different synoptic conditions. Atmospheric Research, 158–159, 231-244.

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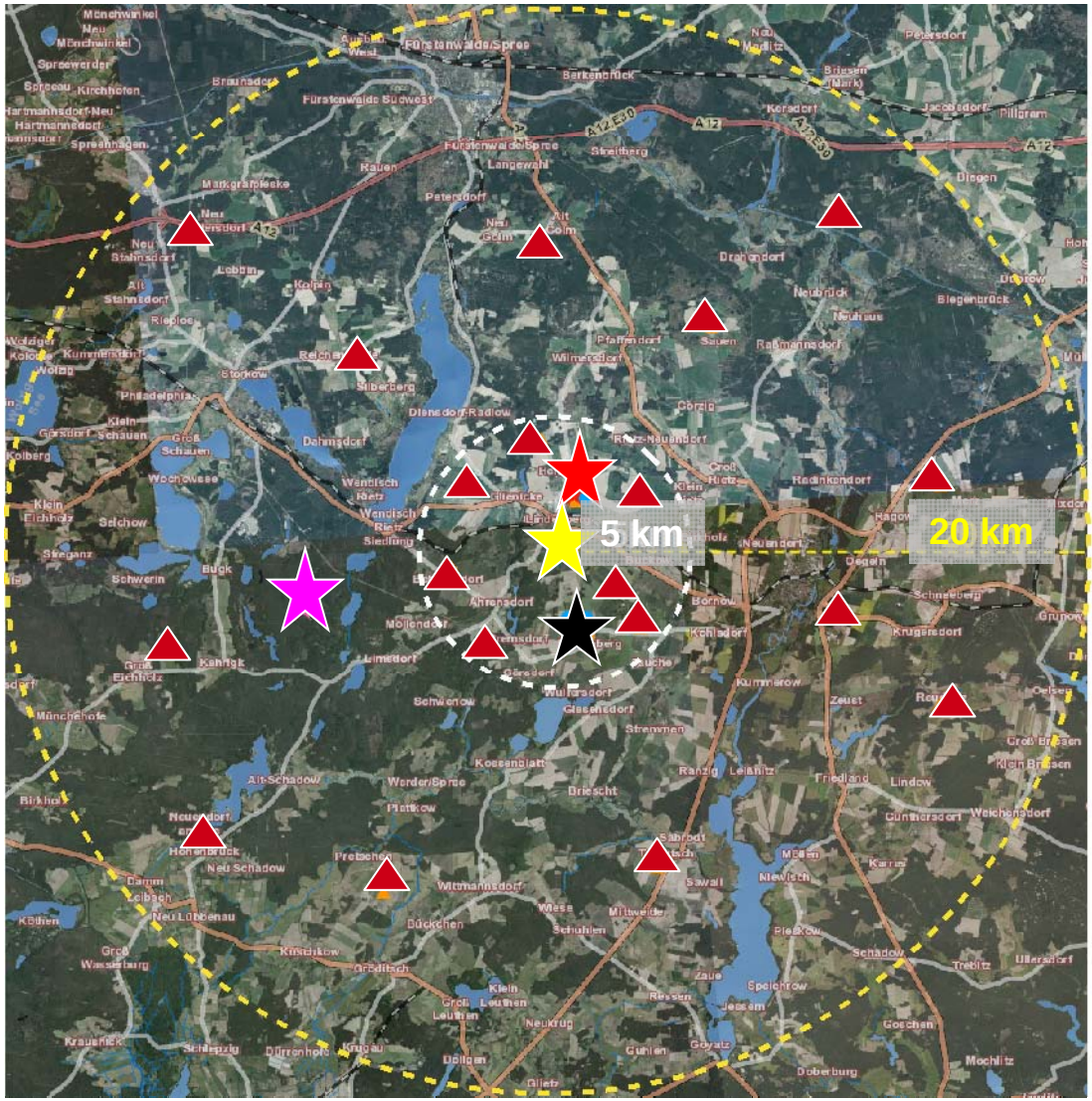

Super sites

- ★ Lindenberg
- ★ Falkenberg
- ★ Forest station
- ★ X-Band radar

Profiling stations

- ● Doppler lidar (#5)
  DIAL water vapor lidar
  Energy balance stations

Low-resolution network

- ▲ WXT (#25)

High-resolution network

Polls (#100)

Citizen network

Low cost stations (#100)

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Doppler lidar

- To measure mean wind, turbulence quantities and wind gusts
- At least 3 Doppler lidars close together
- Test in 2019 to determine the optimal scanning strategy
- For 3D wind and TKE, strategy made of a vertical stare followed by about 5 scans at different azimuth angles with fixed elevation

Lindenberg Doppler lidar

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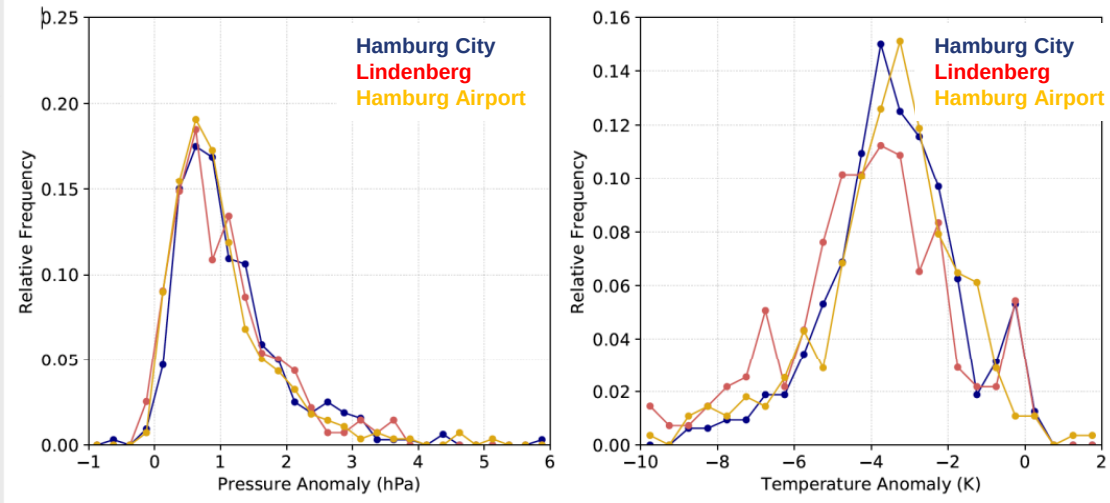
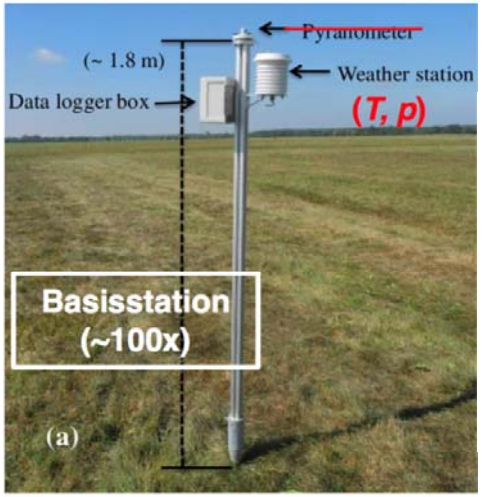
WXTs and Polls

- To measure cold pools and wind gusts
- WXT stations (t, p, RH, precip, wind)
- Pool with a temperature and pressure sensor



~ 0.5 – 1 hPa

~ - 4 K



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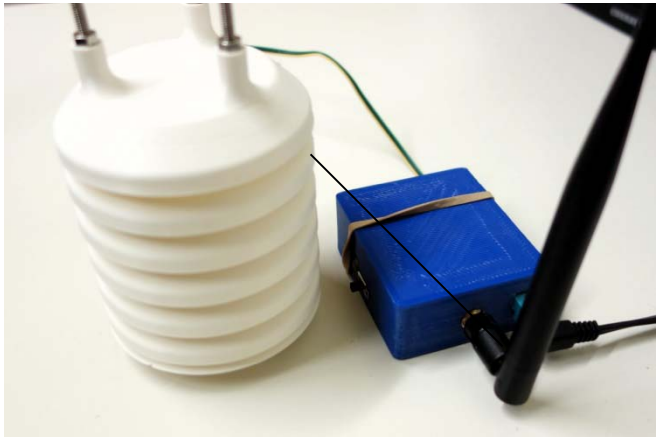
Citizen network

- Low-cost sensors for temperature, humidity, pressure and radiation with housing 3D-printed (Rust et al. 2018)
- Data communication based on LoRaWAN, a long-range wireless data communication protocol with low power consumption
- Instruments built with citizen in workshops



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Modeling support

- Operational weather forecasts form DWD; SINFONY
- ICON-SCM (Frankfurt)
- Large-eddy simulations around Lindenberg (Hamburg)
- Reanalysis (Bonn/Köln) and assimilation (Münich)

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Timeline

- Summer 2019: Test field campaign in Lindenberg
- May – August 2020: FESSTVaL
  - Special Observing Period: July
  - Summer school: July

External Participation

- Interested in similar questions ?
- Complementary instruments ?
- Students for summer school ?
- **Contact**: *Daniel.Klocke@dwd.de ; Cathy.Hohenegger@mpimet.mpg.de*
  - *https://www.dwd.de/EN/research/researchprogramme/herz/herz_node.html*