

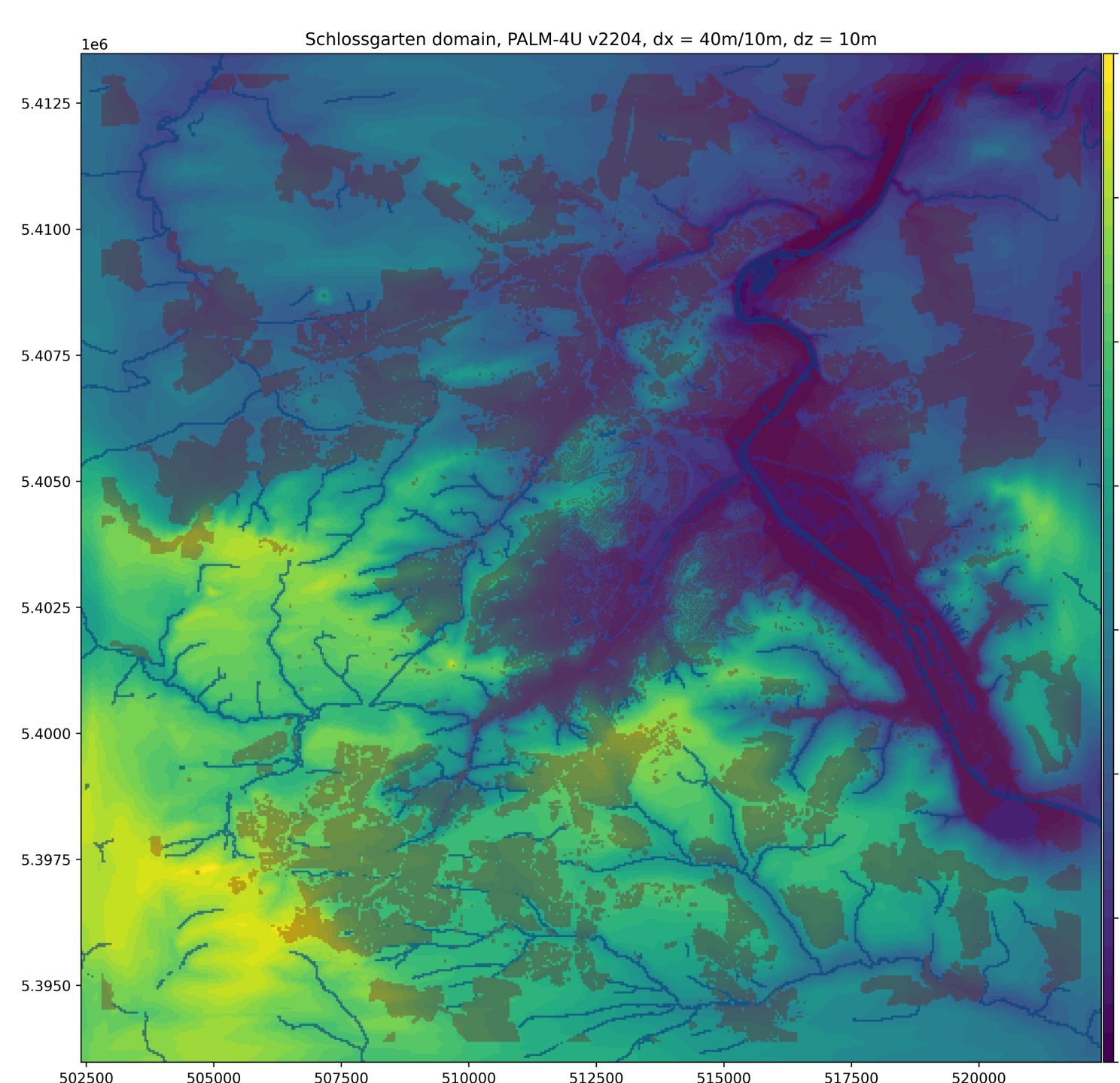


# Multiscale modelling with WRF-urban and PALM-4U: Workflow and first results a winter IOP case 2018

Simulating continental, regional and local scales across five orders of magnitude.

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The state-of-the-art micrometeorological process model system PALM consists of a turbulence-resolving large-eddy-simulation model and the PALM-4U urban components. PALM can be used to simulate atmospheric processes and fluxes of mass, energy, moisture and trace materials, including gas-phase and aerosol chemistry, radiative transfer and interactions the land-surface (urban, vegetation, soil, ocean). To compute an urban case study with such detail, initial- and boundary conditions are required with adequate representativeness of the processes, which drive the synoptic and mesoscale flow.



## Pipeline

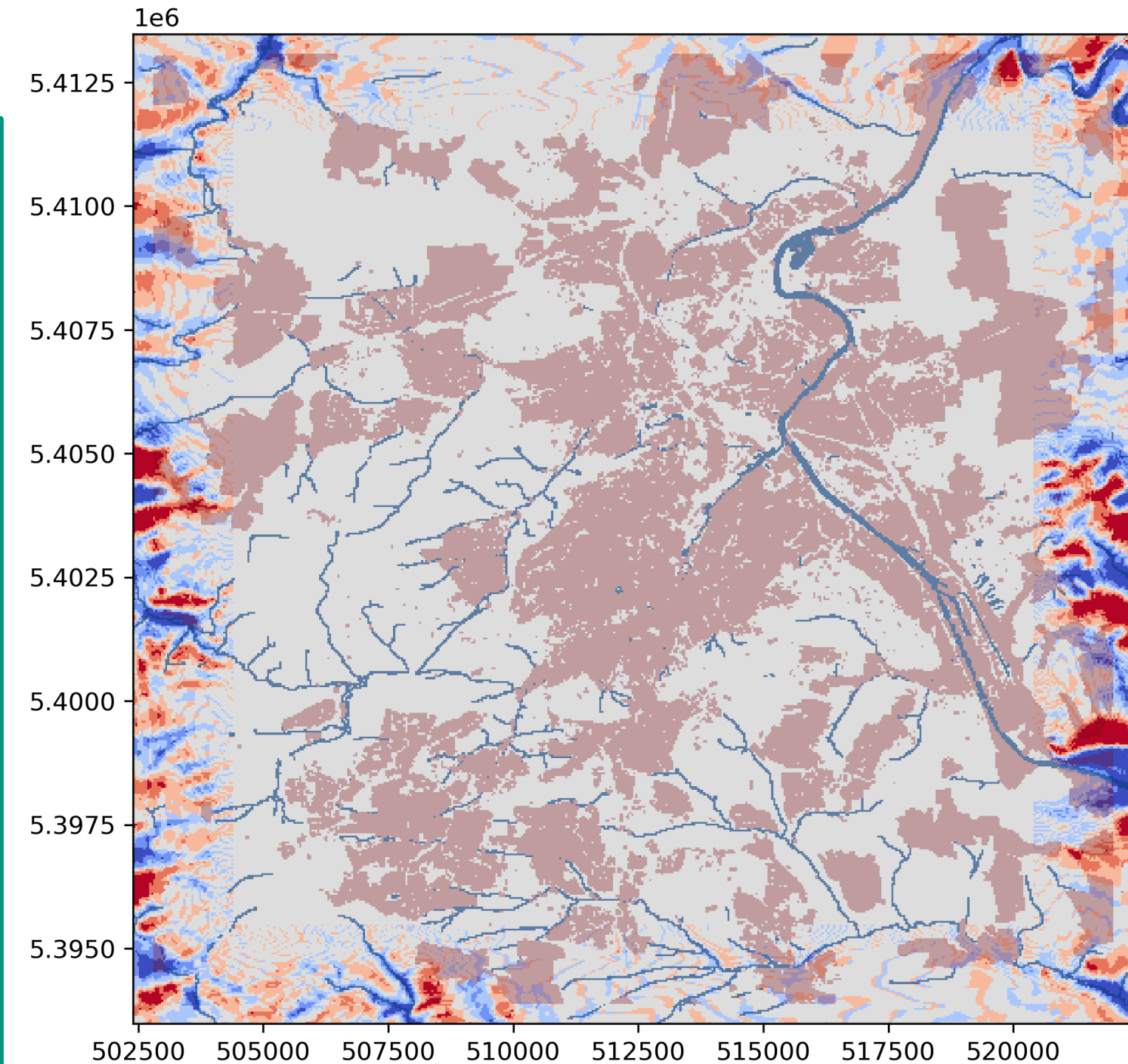
### WRF-urban V4.5.1

- ERA-5 reanalysis data
- WUDAPT LCZ data

### PALM v22\_10

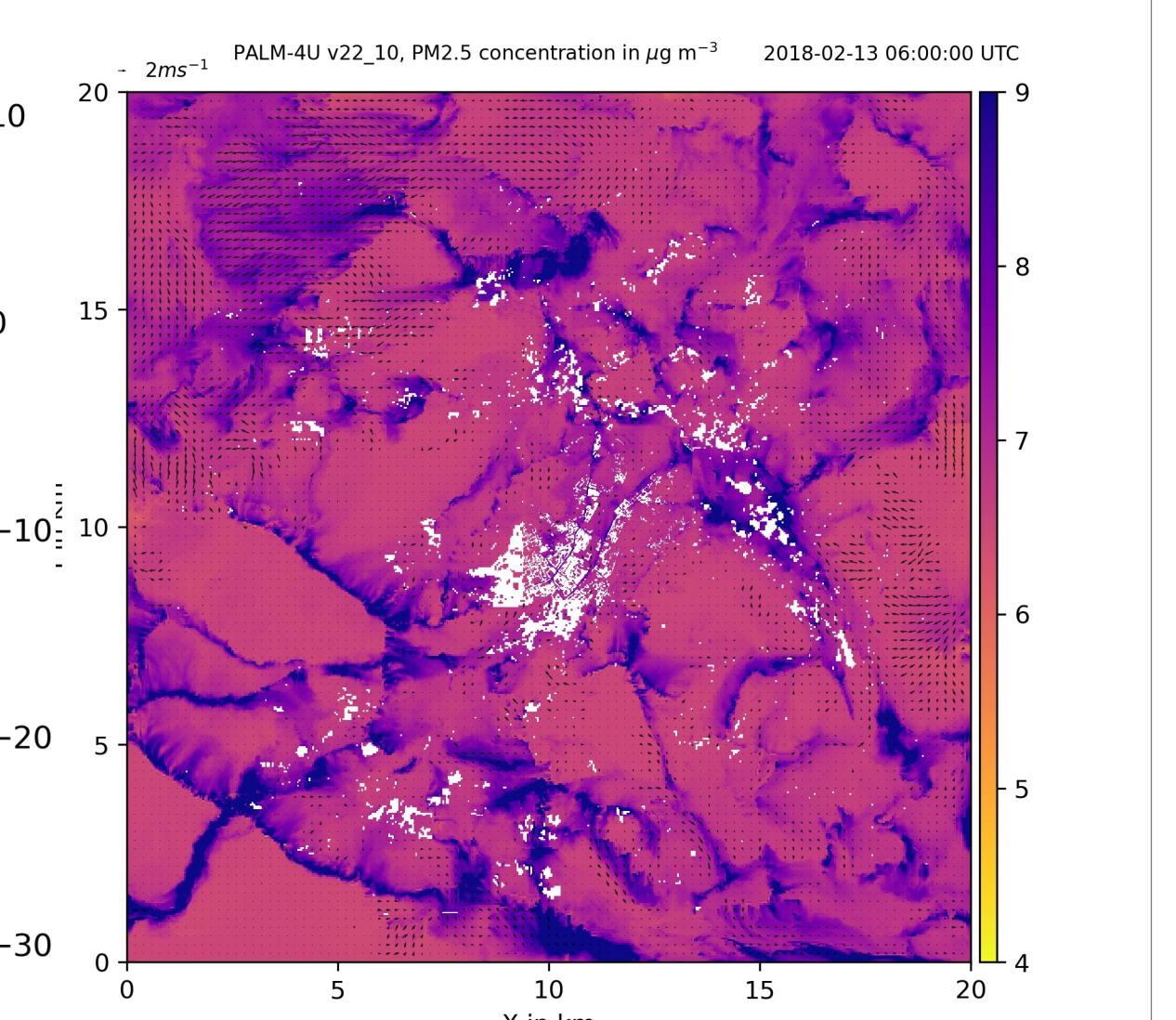
- [UC]<sup>2</sup> data:
  - Winter IOP data from 2018
  - Static data from DLR and LUH

Schlossgarten domain, PALM-4U v2204, dx = 40m/10m, dz = 10m



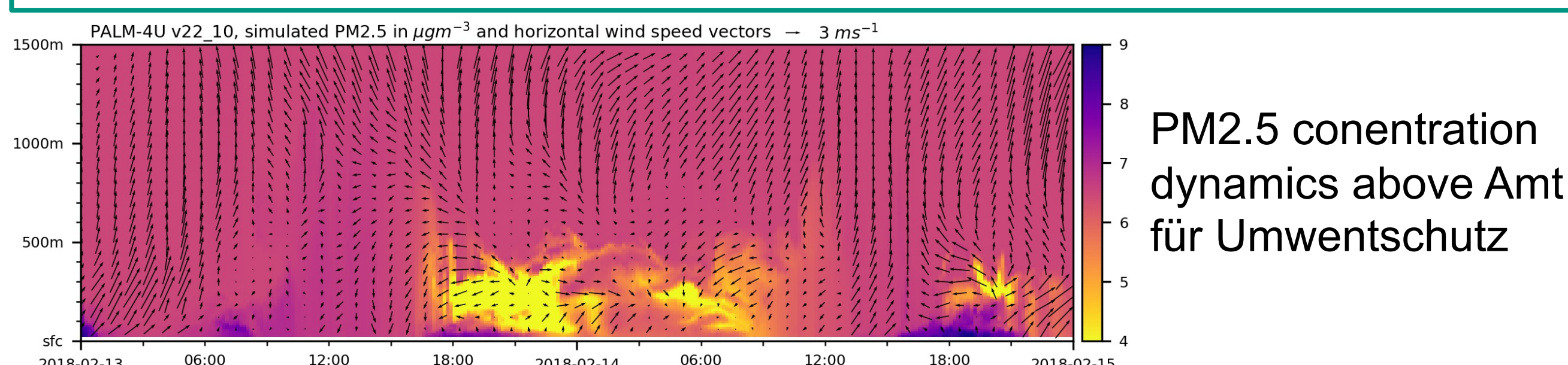
## Static driver processing:

- Remove metal
- Flatten boundaries
- Remove buildings
- Adjust LU types
- Adjust LU fractions
- Consistency checks



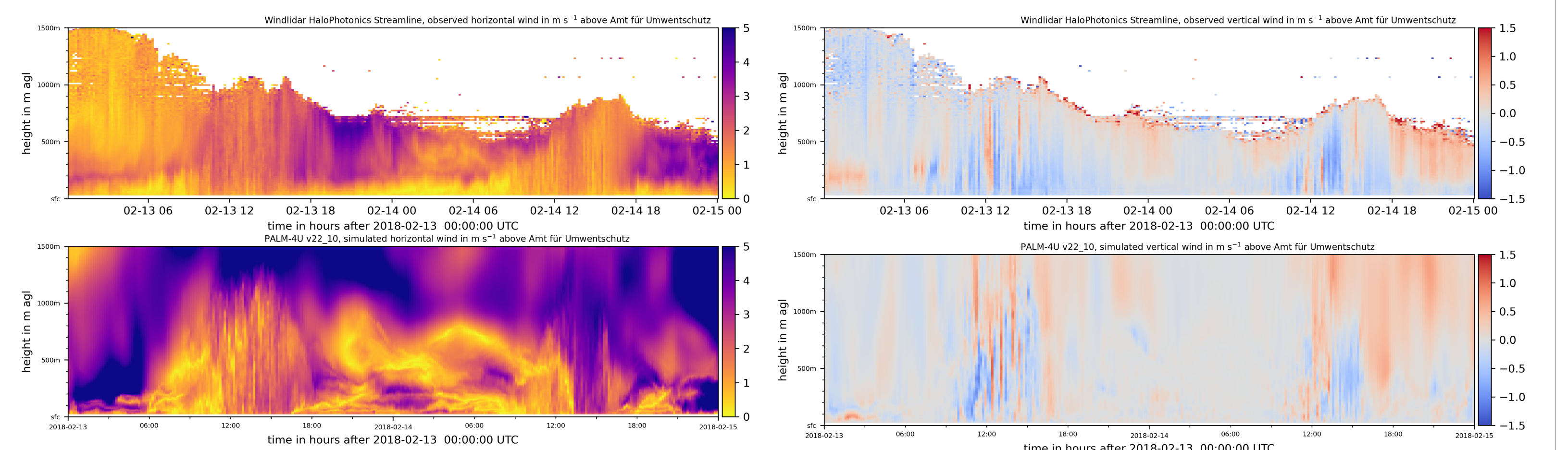
## Findings and challenges

- Winter simulation:
  - Stability, saturation, clouds
  - Requires finer grid spacing compared to summer
- Evaluation with observations difficult:
  - Site-specific geographic forcing, breaking symmetry assumptions wrt. eddy motion
  - Footanalysis required for both, model and obs independently and then combined.



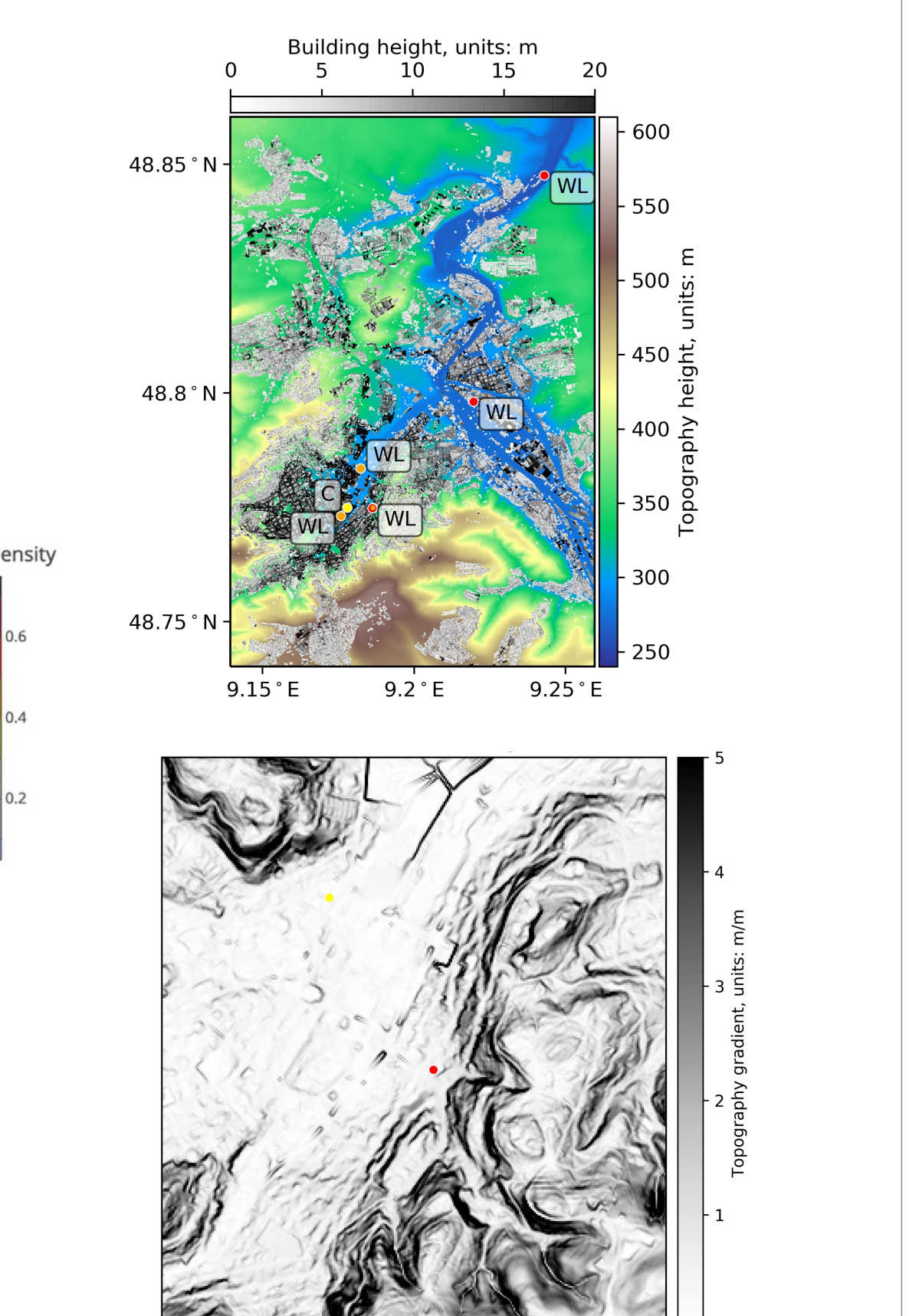
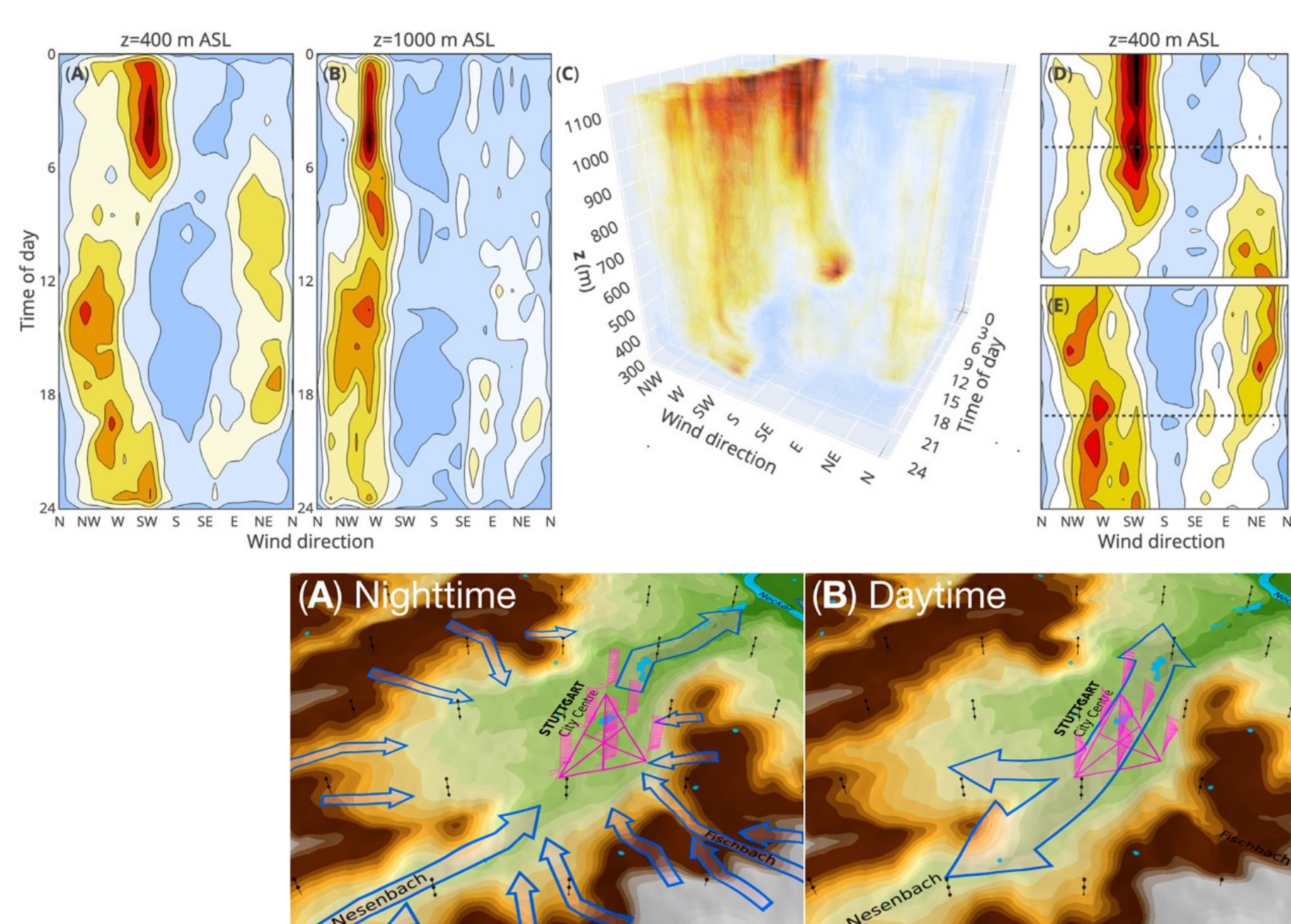
## Key insights

- Certain processes require much finer grid spacing than we used, especially in winter
- Local emission accuracy largely affects the resulting concentrations
- Computational effort is much larger for PALM, compared to WRF
- Evaluating with observations requires extra care



## Orographic Flows in Stuttgart

- 3 Doppler Wind Lidar: Urban Valley, Stuttgart
- Campaigns 2017 (yellow dot) and 2018 (red dot)
- Heterogeneity and orographic effects
- 14 March 2017 to 29 June 2017
- Persistent low-level up-valley channelling



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