

Time-resolved air pollution simulations at the city scale



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Motivation and summary

The **temporal** and **spatial variability** of air pollution in cities is **very high**.

Detailed **maps of air pollution** can be used

- to give **medical advice** to sensitive persons, e.g., to plan their outdoor activities.
- to assess air pollution **exposure** of the urban population.
- for **regulatory purposes**, e.g., urban planning.
- to **forecast air pollution**.
- for **source apportionment**.



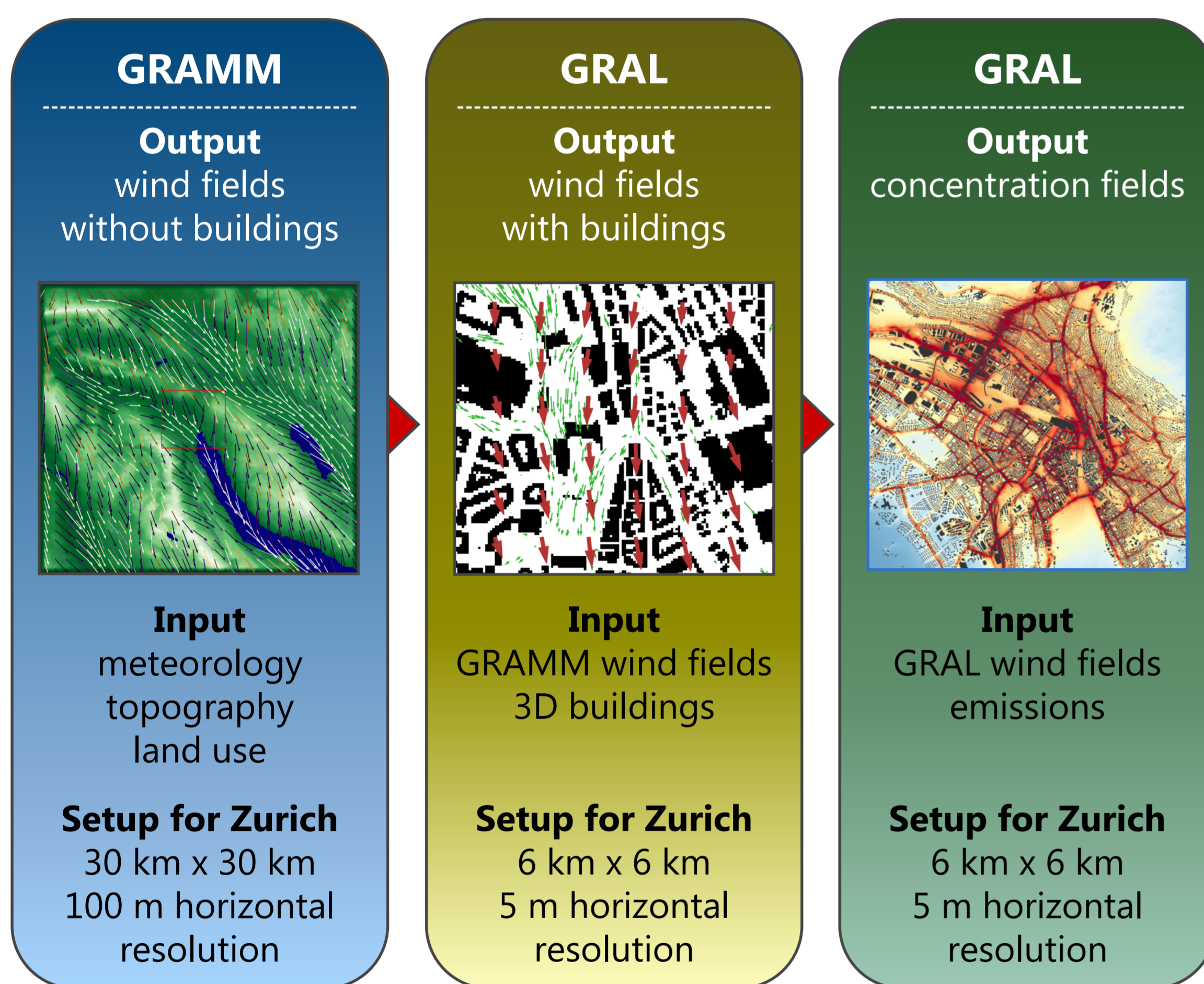
We simulate concentrations of **NO_x** and **PM₁₀** for **Zurich** and **Lausanne** (Switzerland) at a spatial **resolution of 5 m** for **many different source categories**. Time series and consecutive maps **covering many years** at **hourly resolution** can be produced rapidly at low costs.

- Effects of **topography** and **land use** are properly accounted for.
- **Flow** and **dispersion in the city** are simulated by solving the Reynolds Averaged Navier Stokes (RANS) equations.
- A **detailed emission inventory** allows analyses based on individual source categories.
- **Seasonal** and **day-to-day variations** in the concentrations are captured well.
- Improvement is needed for **hourly variations**.

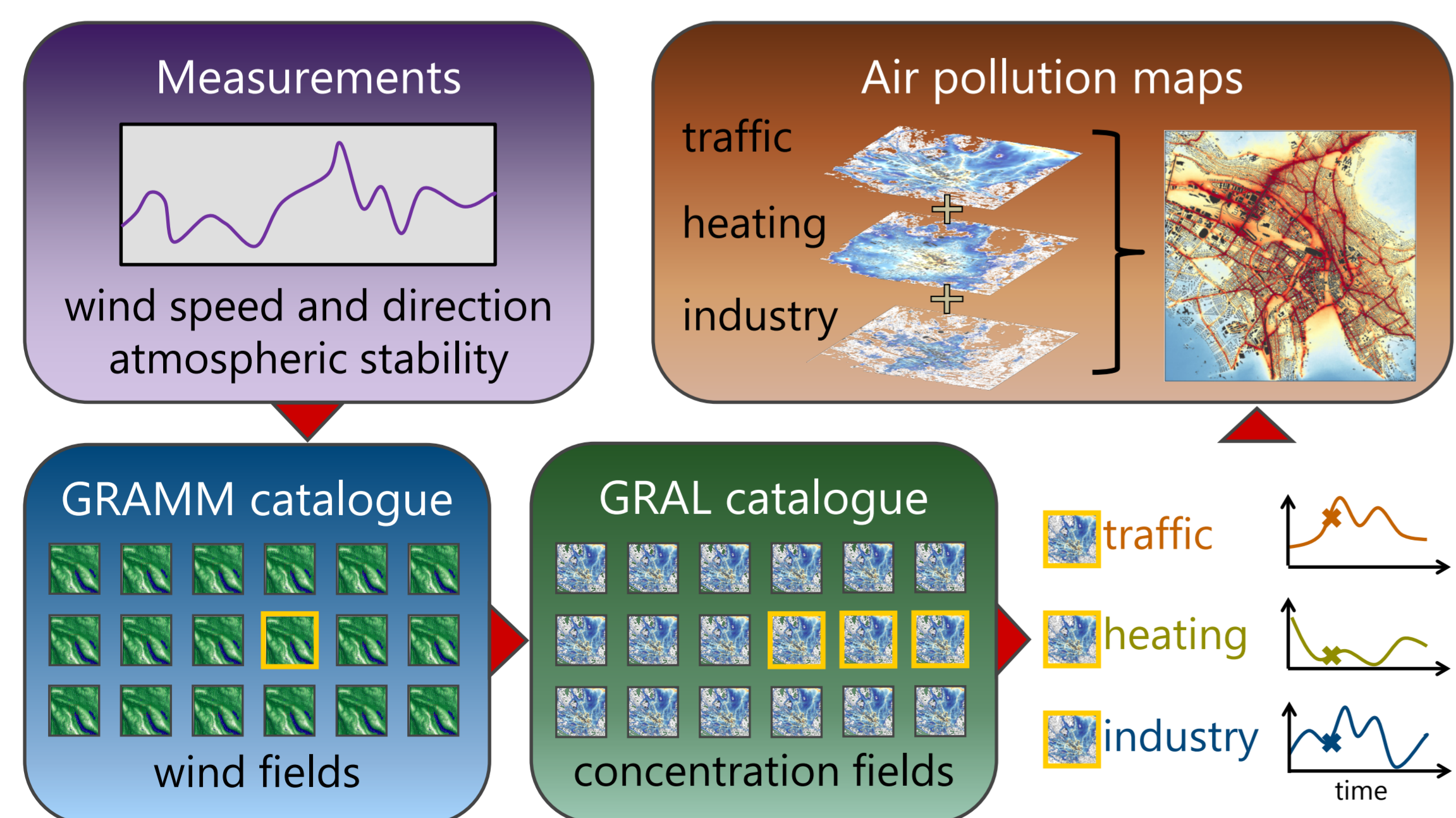
The model system GRAMM/GRAL

GRAMM – Graz mesoscale model (Oettl et al., 2001)
GRAL – Graz Lagrangian model (Almbauer et al., 2000; Oettl, 2015)

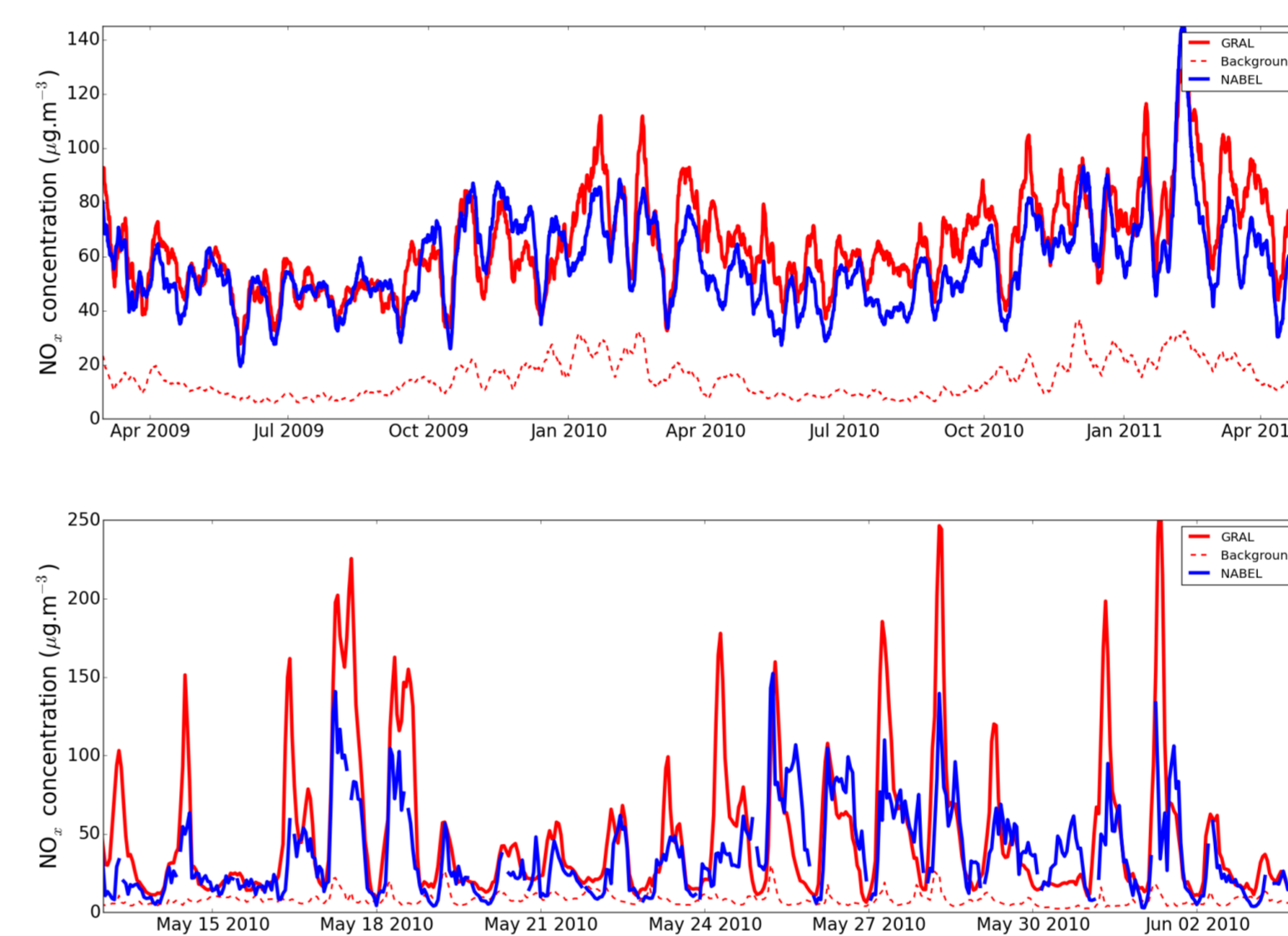
Computation of catalogues of wind and concentration fields



Generation of concentration maps based on meteorological observations or weather forecasts

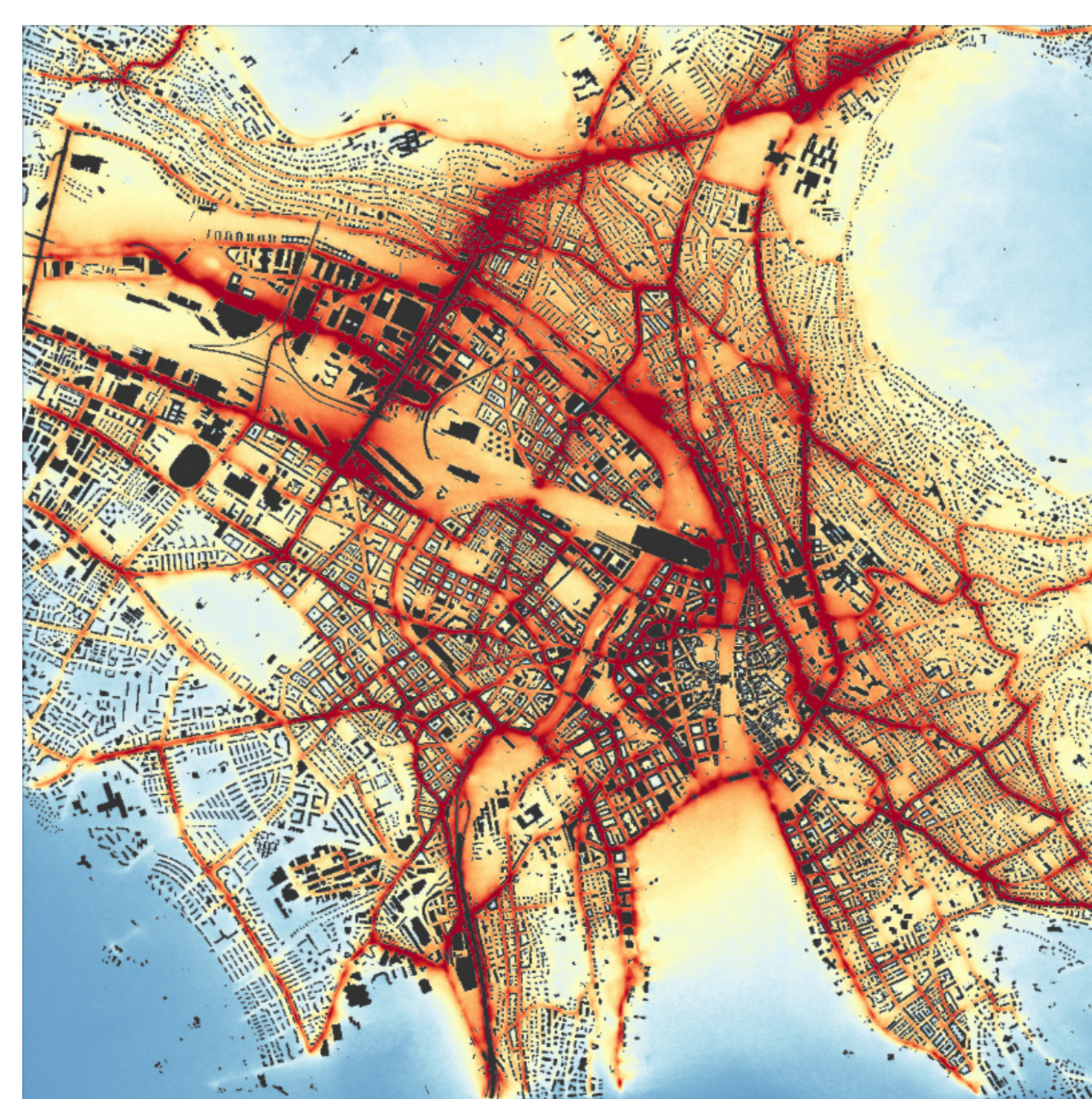


Time series of NO_x concentrations



Comparison between measured and simulated values of NO_x in Lausanne:

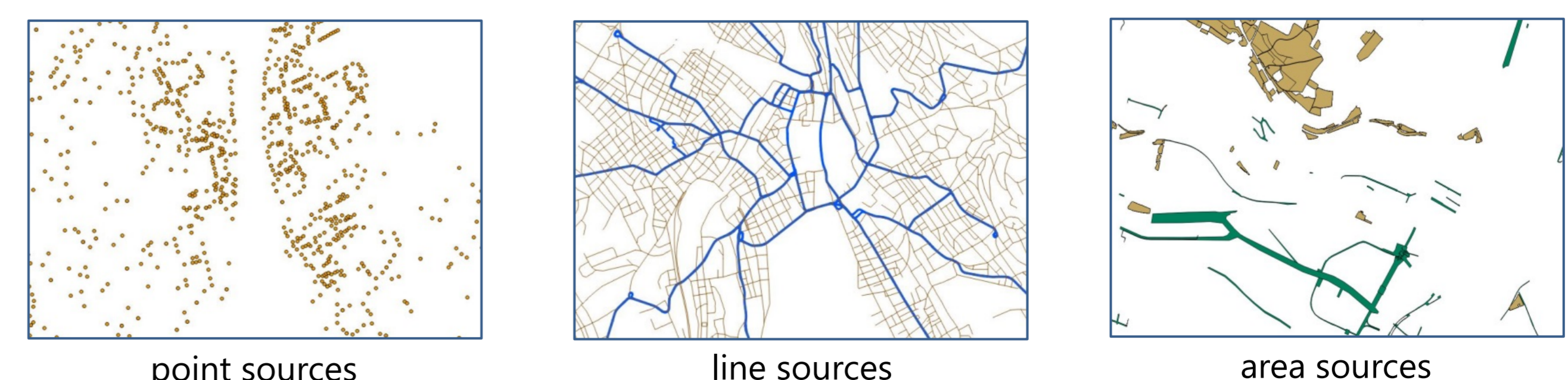
- observations: NABEL site LAU
- seasonal and weekly cycle reproduced well (upper panel)
- daily cycle (up- and downswing) nicely captured
- peak values are frequently overestimated (lower panel)



Air pollution maps

Please look into the box to find maps of the NO_x concentration in Zurich and Lausanne for many different source groups!

The emission inventories



The **municipality of Zurich** provides the exact location and yearly emission rates for 9 pollutants divided into 60 source groups.

The **environmental office of the Canton de Vaud** delivered a detailed inventory of emissions in the city of Lausanne for two pollutants and 15 emission groups.

Acknowledgements

We thank Dietmar Öttl (Graz University of Technology) for his support while setting up the model system GRAMM/GRAL. This work has been funded by the Swiss Nano Tera project in the framework of the OpenSense 2 initiative.

References

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Oettl D., Almbauer R. A., Sturm P.J., Piringer M. and Baumann K. (2001): *Analysing the nocturnal wind field in the city of Graz*. Atmos. Environ. 35, 379-387.
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