M.Sc. project

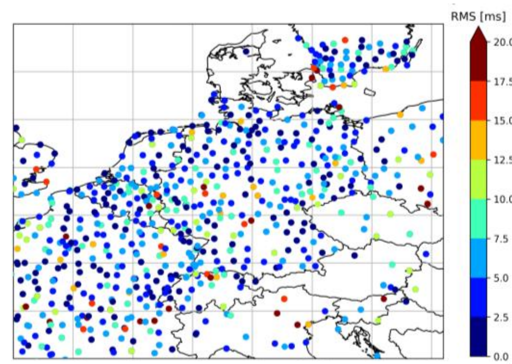
Can we improve the water vapor in high-resolution NWP systems by assimilating GNSS ground-station observations?

Welcome to the **junior research group** *„Mesoscale Processes & Predictability“*! Join our **team meetings**, **lunches**, and **excursions**!

What makes this question important?

Accurate representation of water vapour in numerical weather prediction (NWP) models is crucial for reliable forecasts because it affects cloud formation, precipitation and energy exchange in the atmosphere. Yet, it is often not adequately represented in the models. To improve this, so-called Zenith Path Delay (ZPD) measurements from the Global Navigation Satellite Systems (GNSS) can be used which provide a proxy for atmospheric water vapor.

In the “Swabian MOSES 2023” (SWM2023) field campaign reanalysis we assimilate, among others, ZPD measurements from a dense European GNSS network over a 3-month period. Two reanalysis experiments were conducted: a control experiment (CTRL) without GNSS data and a campaign experiment (CMPG) including GNSS and the other additional campaign observations.



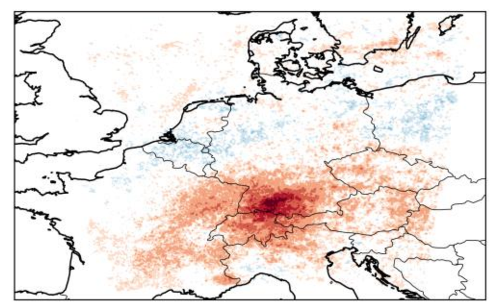
RMSE of observations and reanalysis

What are the open questions? We want to understand …

- when and how the assimilated GNSS ZPD observations influence the reanalysis
- in which situations their influence is particularly valuable and how long this influence lasts

What are your tasks? You will …

- compare CMPG and CTRL humidity fields from the SWM2023 reanalysis using statistics of water vapor related quantities (vertical and horizontal cross-section of specific and relative humidity, vertically integrated water vapor, water vapor flux, water vapor gradients)
- select interesting case studies for in-depth investigation of the influence of GNSS observations, e.g. by characterizing the (pre-)convective environment in CMPG and CTRL
- compute and analyse high-resolution reforecasts with the NWP model ICON for the selected events together with us and DWD colleagues


Water vapor differences between CNTRL and CMPG experiments illustrating the influence of campaign observations

Which skills will you obtain? You will …

- learn how a high-resolution numerical weather prediction and data assimilation system works
- work on a topic that is vitally discussed and worked on by weather services all around the globe
- deal with different data types and advance your skills in statistical and event based data analysis
- deepen your knowledge about the dynamics of atmospheric water vapor & its role for convective initiation

Useful references | doi.org/10.1029/92JD01517, doi.org/10.5194/gmd-17-3599-2024

Supervisors | Julia Thomas, Annika Oertel