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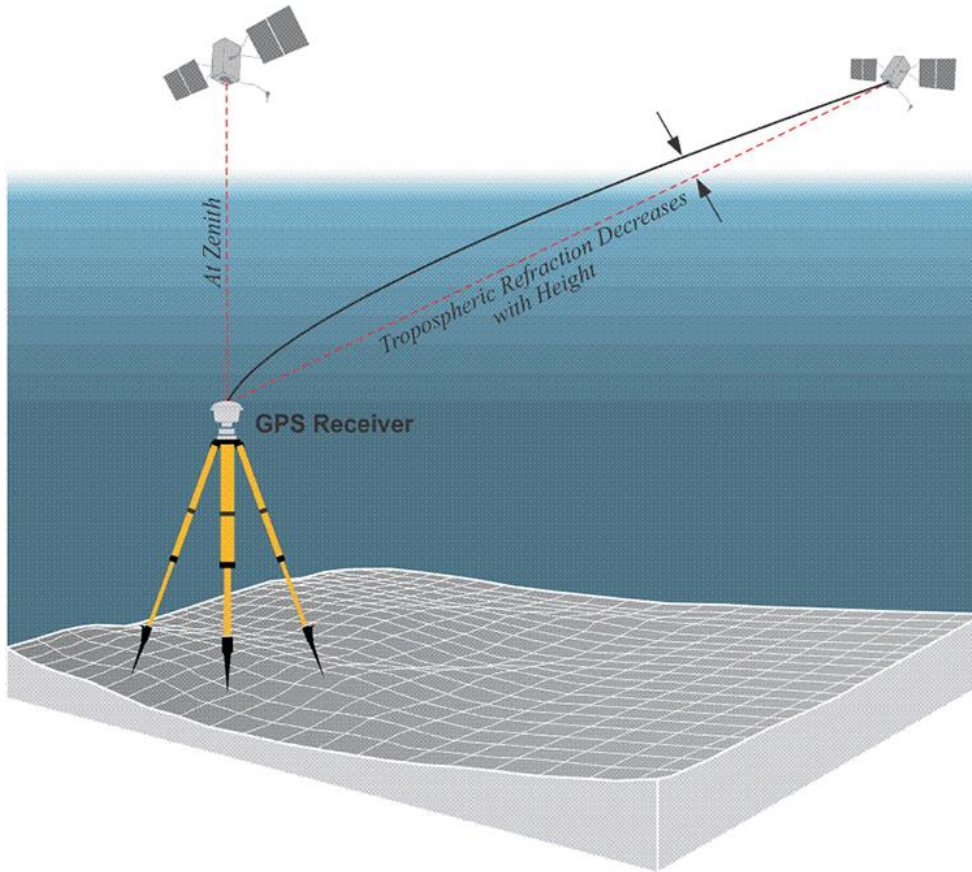
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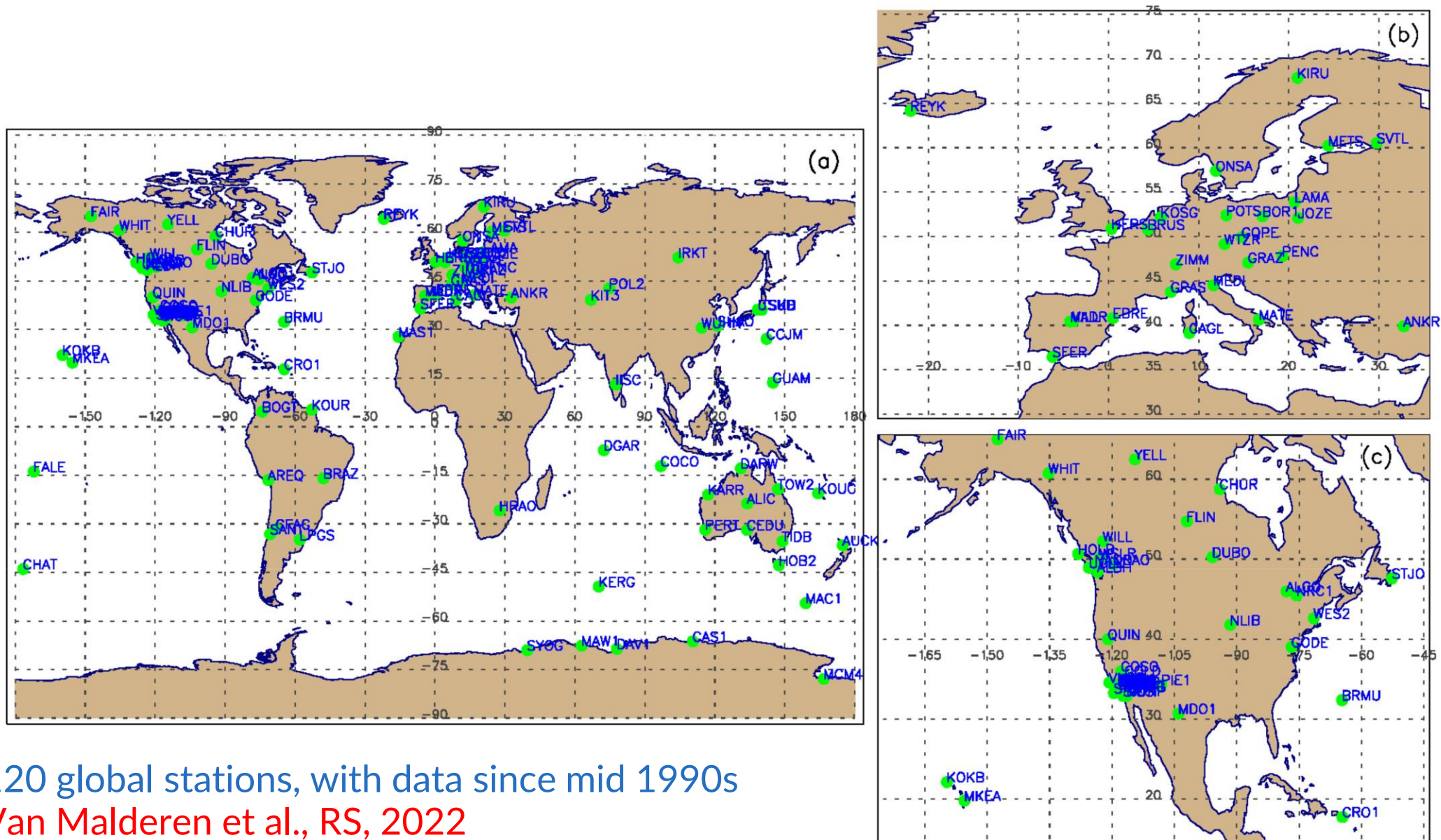
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Long-term Global Navigation Satellite System (GNSS) retrievals of total column water vapour

Roeland Van Malderen & Eric Pottiaux

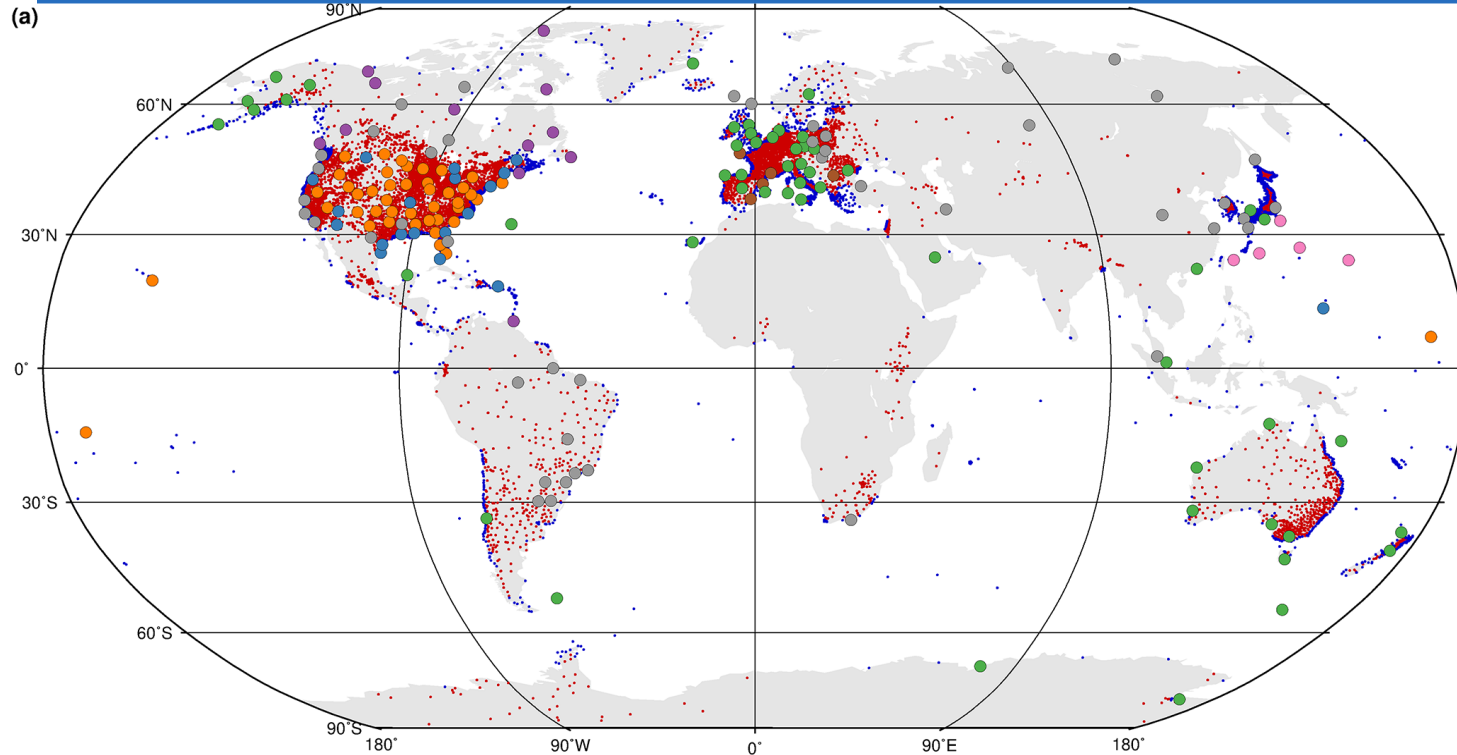


- delay of signal between a Global Navigation Satellite System (GNSS) satellite & ground-based receiver along its path by
 - *ionosphere*
 - “neutral” atmosphere
 - ✓ density of dry air (“hydrostatic” delay → surface pressure)
 - ✓ water vapour (“wet” delay → humidity weighted mean temperature)
- Zenith Wet Delay (ZWD) = Zenith Total Delay (ZTD) – Zenith Hydrostatic Delay (ZHD)
- + all-weather, high-precision, high temporal resolution (every 5 minutes), and relatively cheap technique, since mid 90s
- - coarse spatial resolution, additional meteorological information, inhomogeneities



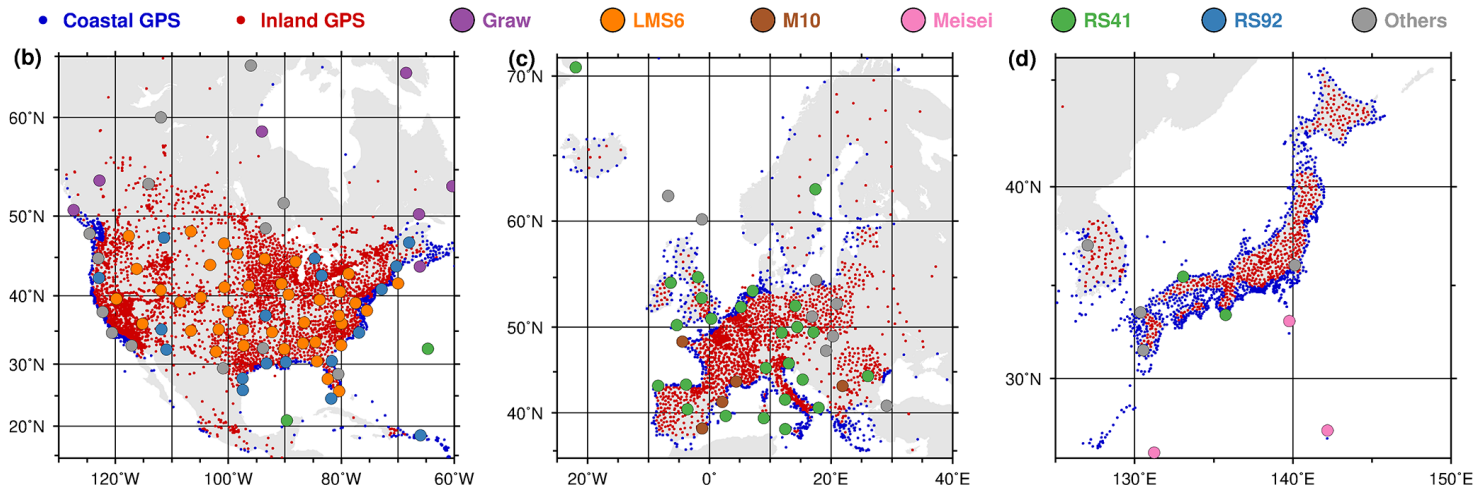
- 120 global stations, with data since mid 1990s
 Van Malderen et al., RS, 2022

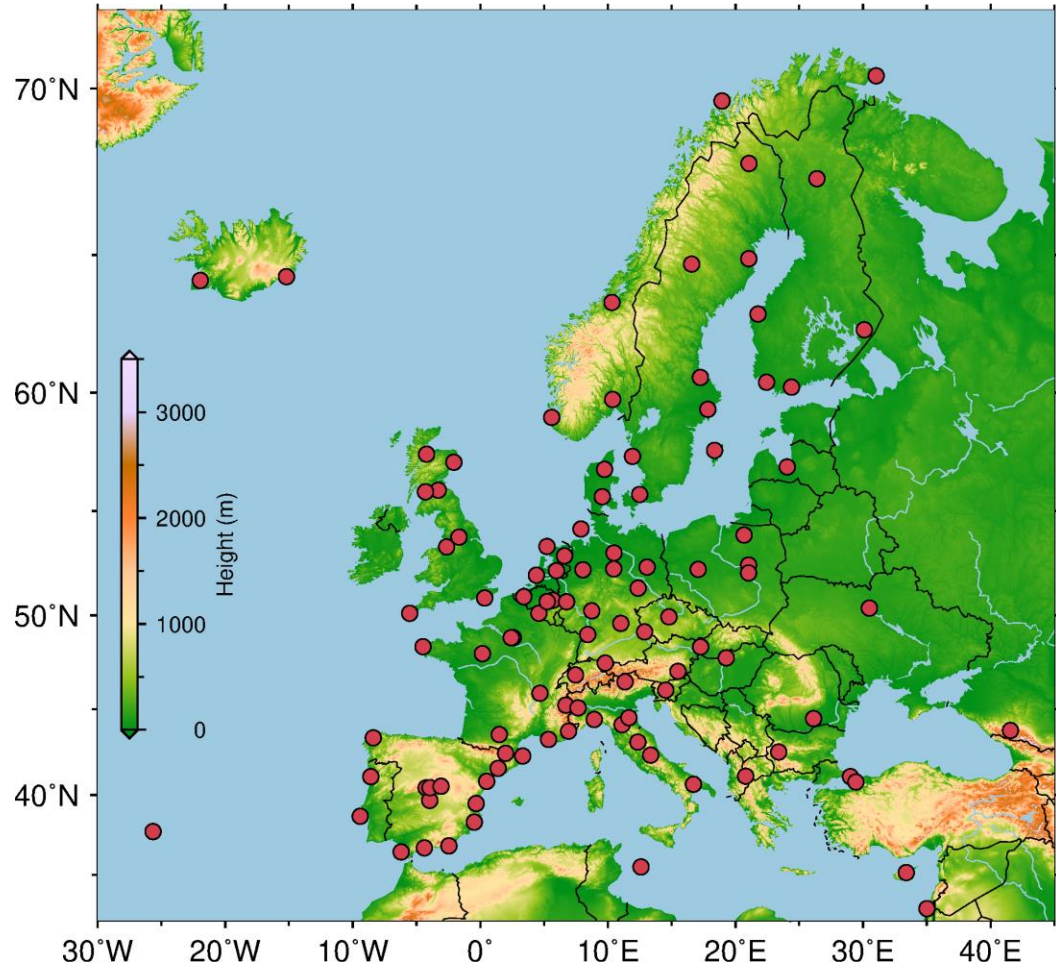
Data availability: global



- > 10000 global GNSS stations in 2020!

Yuan et al., ESSD, 2023

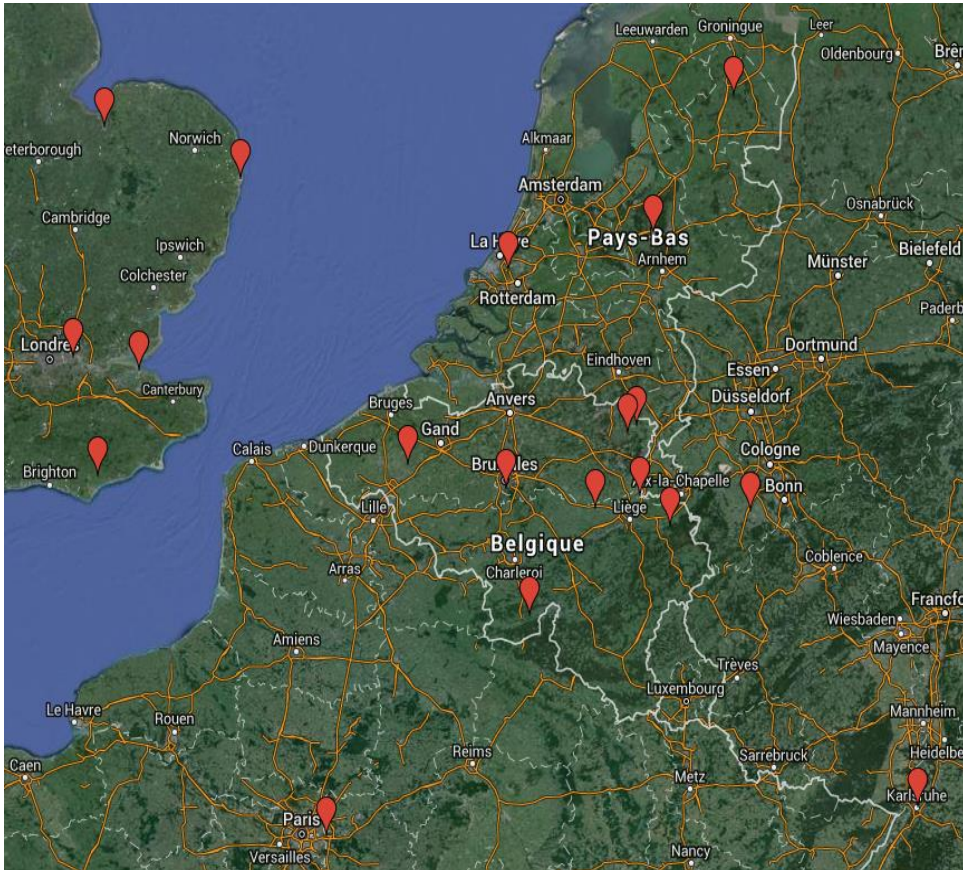




- > 100 European stations, with data since mid 1990s

Yuan et al., ACP, 2023

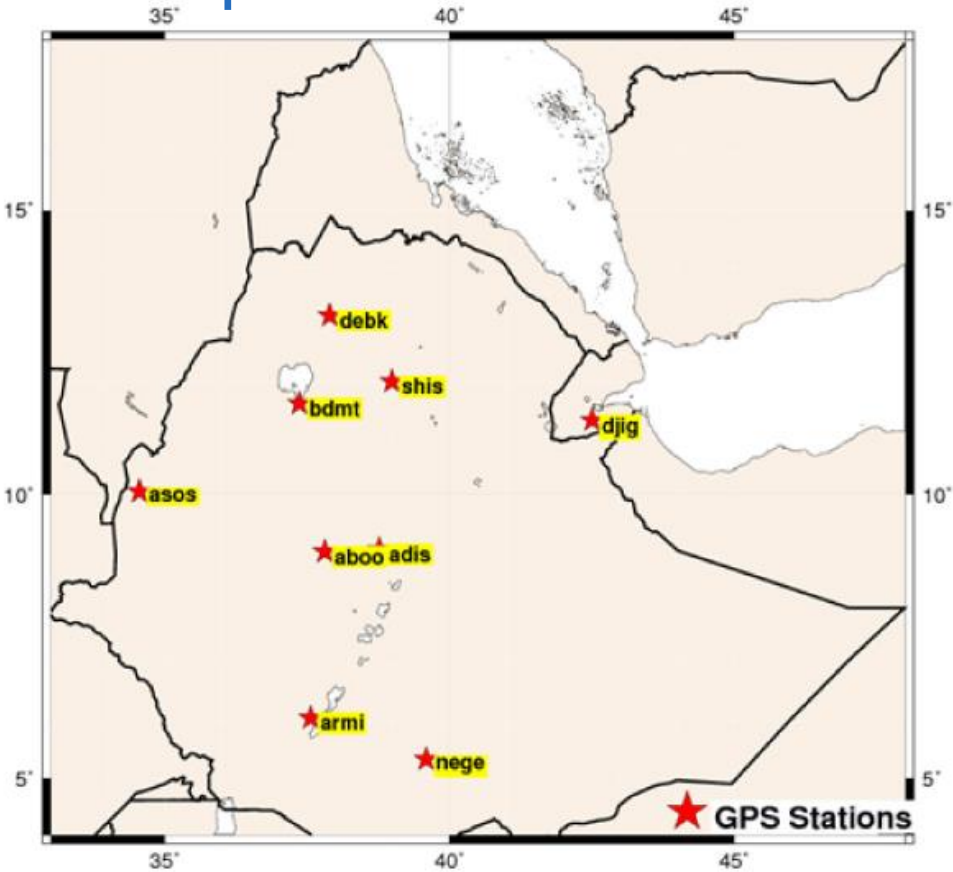
Belgium



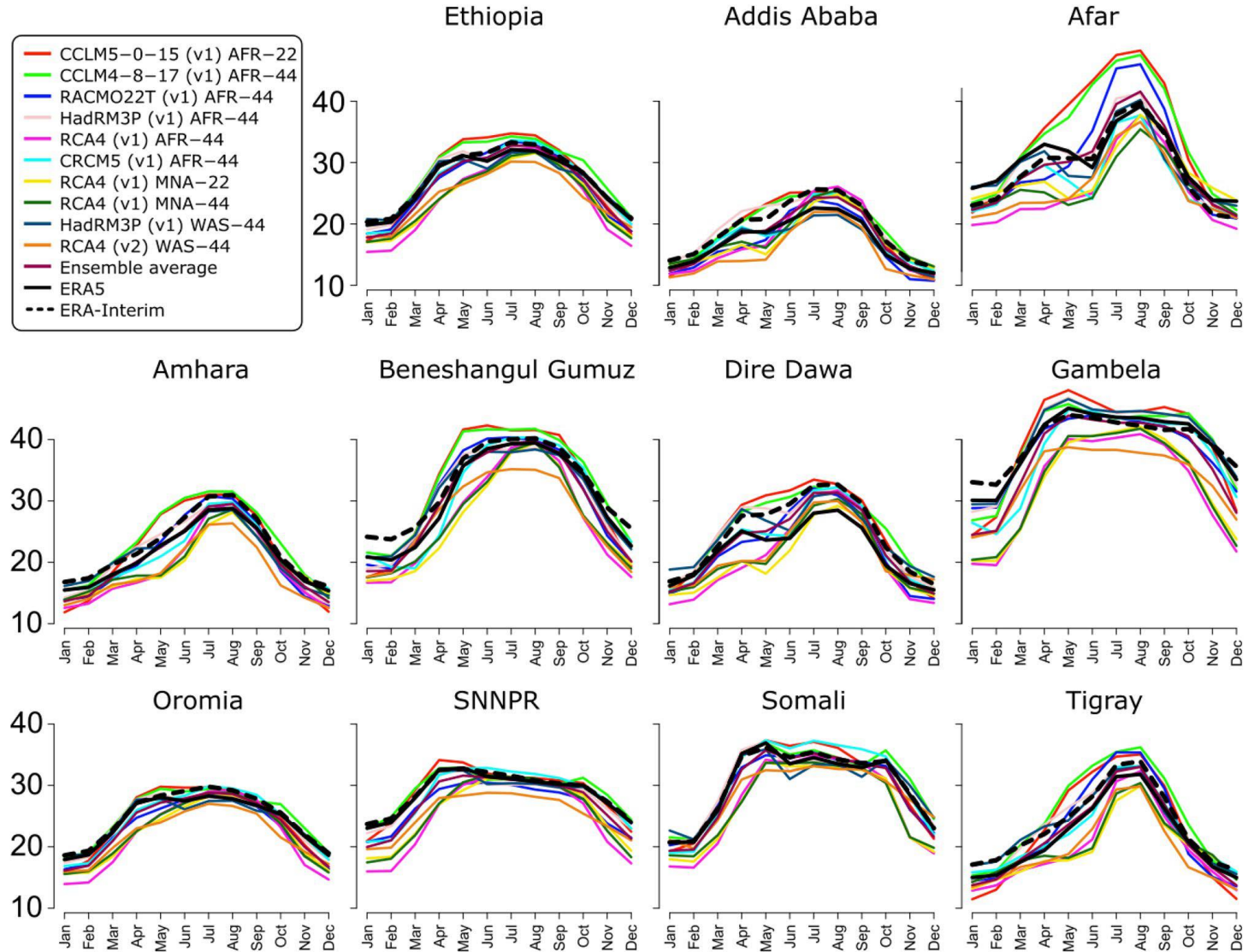
- GNSS stations within the CORDEX.be high-resolution domain
- GNSS stations were used on humidity field assessment of high-resolution climate model runs in Belgium (ALARO, COSMO-CLM, and MAR)
- Those models showed a remarkable good correlation with observations and are able to represent properly the diurnal and annual cycles.



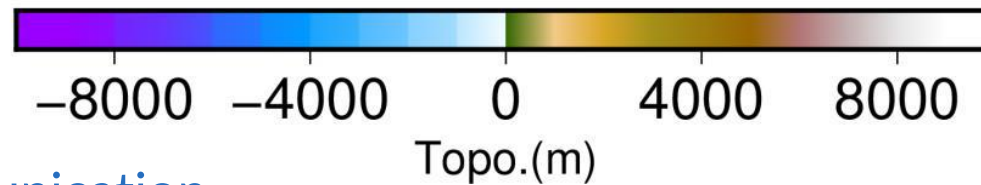
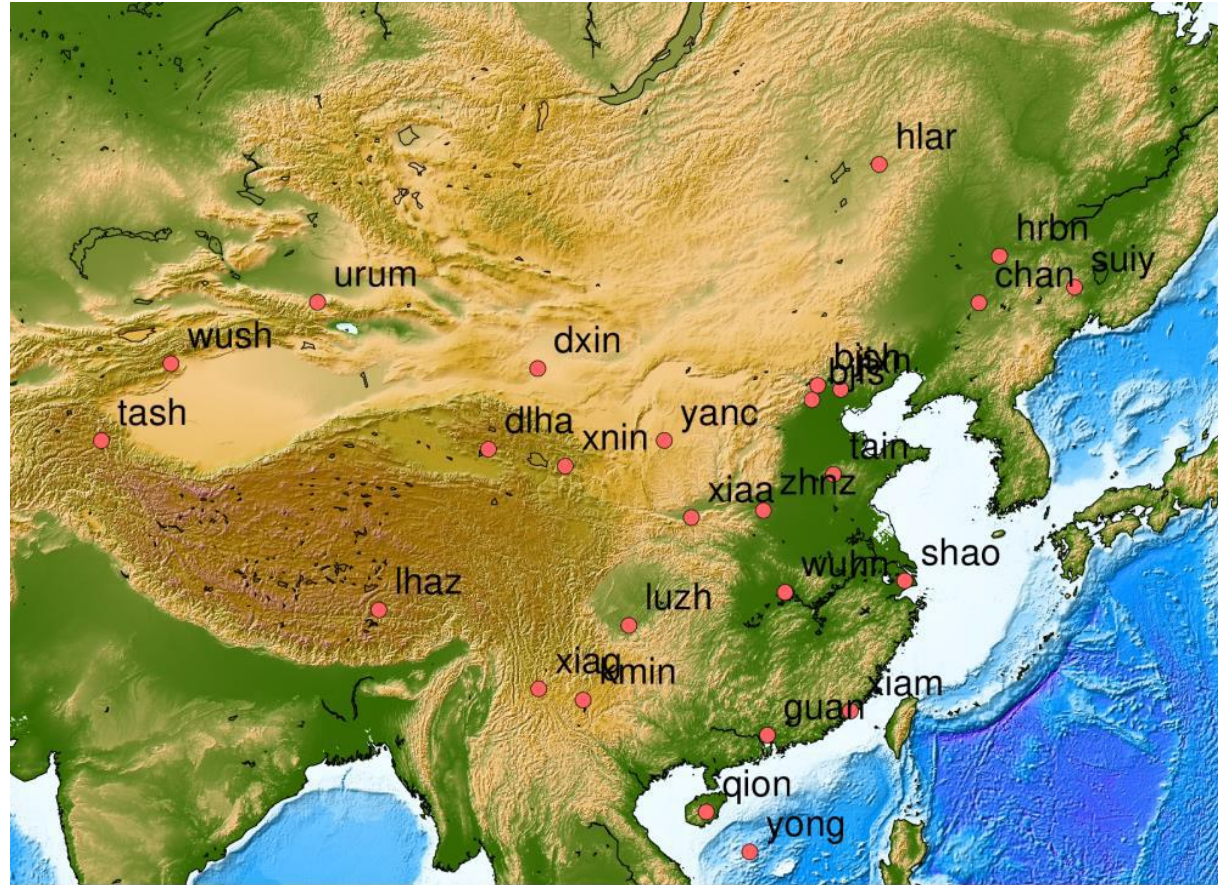
Ethiopia



Kawo et al., RS, 2022
 Kawo et al., Clim. Dyn., 2023



China



- ✓ Lots of long-term, high (temporal) resolution, high accuracy total column water vapour data is available, on different spatial scales
- ✓ Data has been used for intercomparisons (radiosondes, satellite retrievals), reanalyses & climate model validations, trend estimations, links with surface warming (Clausius-Clapeyron relationship) and, to some extent, extreme precipitation
- ✓ Geodetic community is really looking for interactions with climate community

THANK YOU

Het Koninklijk
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