Benchmarking GPS stations: an improved way to identify the GPS sensitivity

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Introduction:

1. **Facts.**
   - Processes occurring at various spatial and temporal resolutions are well-observed by Global Positioning System (GPS).
   - Temporal resolutions: weekly up to interannual/secular changes resolved well using **daily-sampled GPS displacements**.
   - Spatial resolutions: site-dependent phenomena up to regional- or continental-scale changes resolved from **single GPS stations** or from **distributed networks of stations**.
2. **Limitations?**
   Hardly distinguishable set of contributors in GPS displacements: **plurality of geophysical effects**, systematic errors or system-related signals.
3. **Challenges?**
   Sensitivity of GPS in various temporal resolutions remains unrecognized.

Chasing the GPS sensitivity:

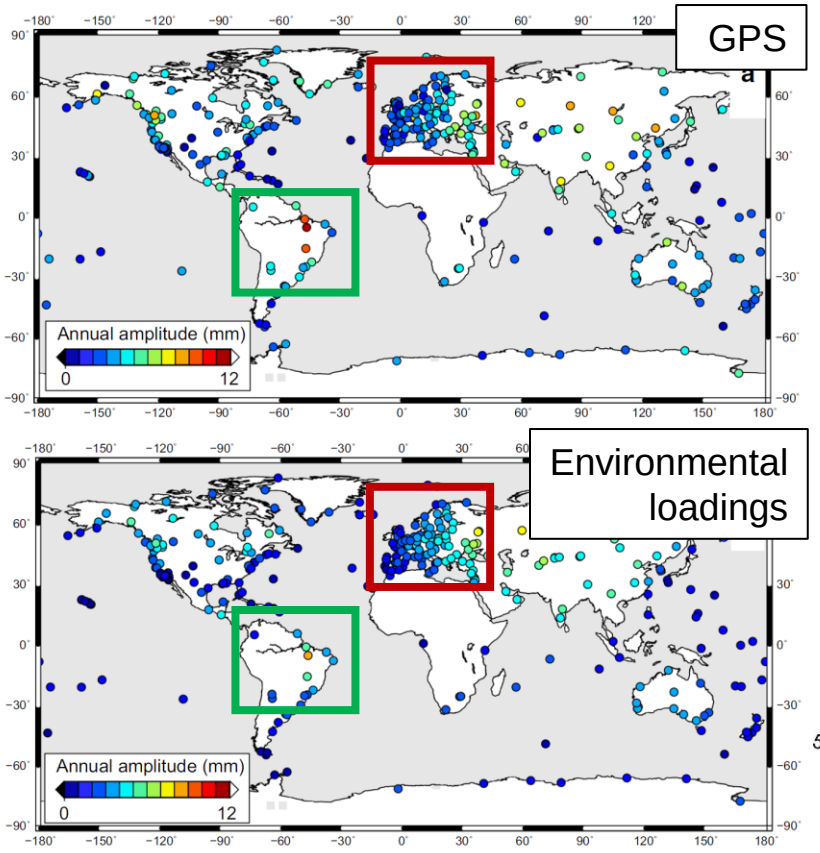
GPS is sensitive to geophysical effects.

1. **Sensitivity:**
   comparison to geophysical models or other observations:
   global versus regional studies.

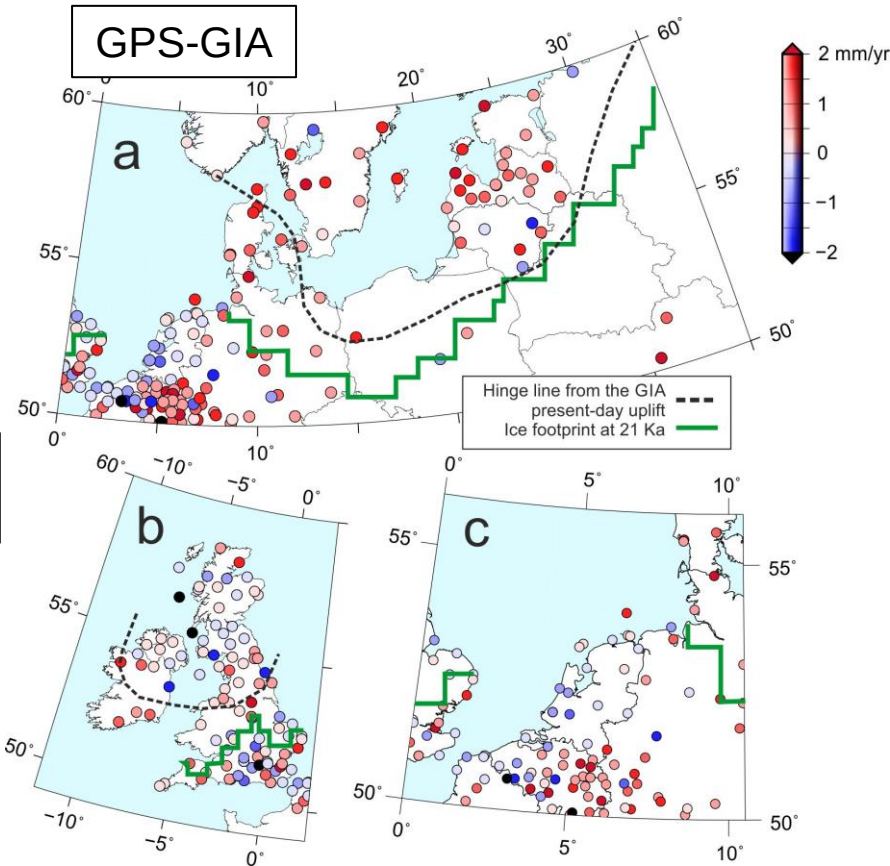
2. **Global studies:**
   parameter-based comparison,
   neglecting outlying stations,
   matching areas.

3. **Regional studies:**
   pinpointing „bad" stations
   by retrieveing spatial
   patterns / comparing
   parameters.

Klos et al. (2018),
https://doi.org/10.1007/s00024-017-1494-1



Bogusz et al. (2019),
https://doi.org/10.3390/rs11101209

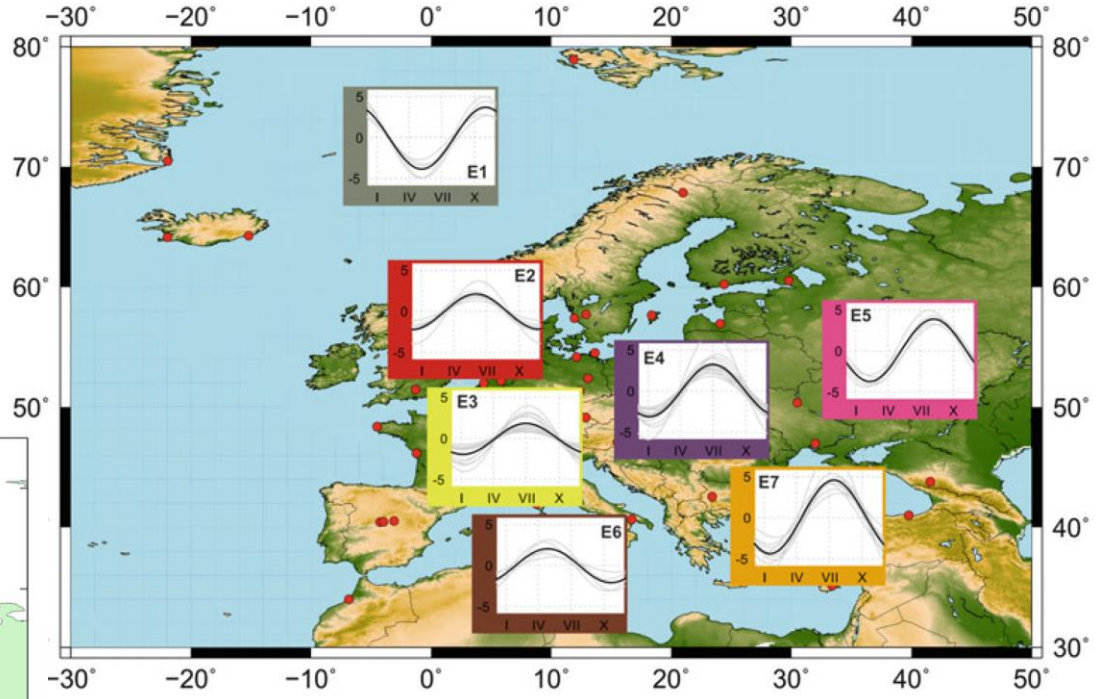


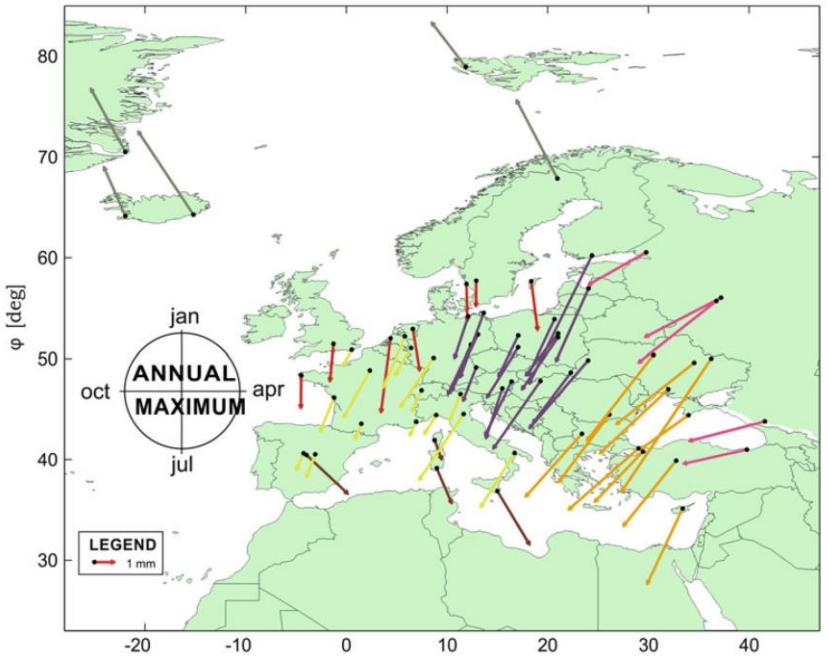
Chasing the GPS sensitivity:

4. **Clustering**: deterministic parameters + inter-station distance.
5. Long periods resolved.
6. **Problems?** GPS **sensitivity in short periods**…

Clusters – benchmarks.

Bogusz et al. (2015), https://doi.org/10.1007/1345_2015_191





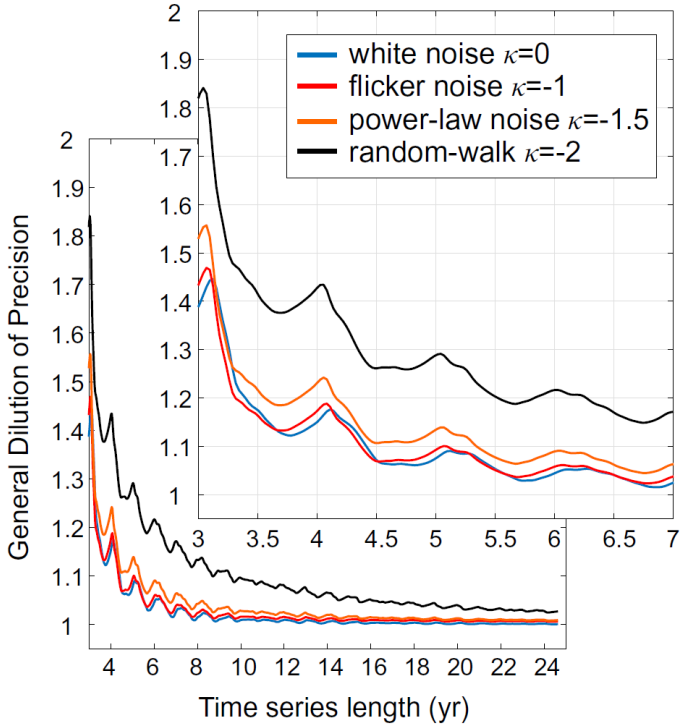
Clusters: an insight on regional phenomena.

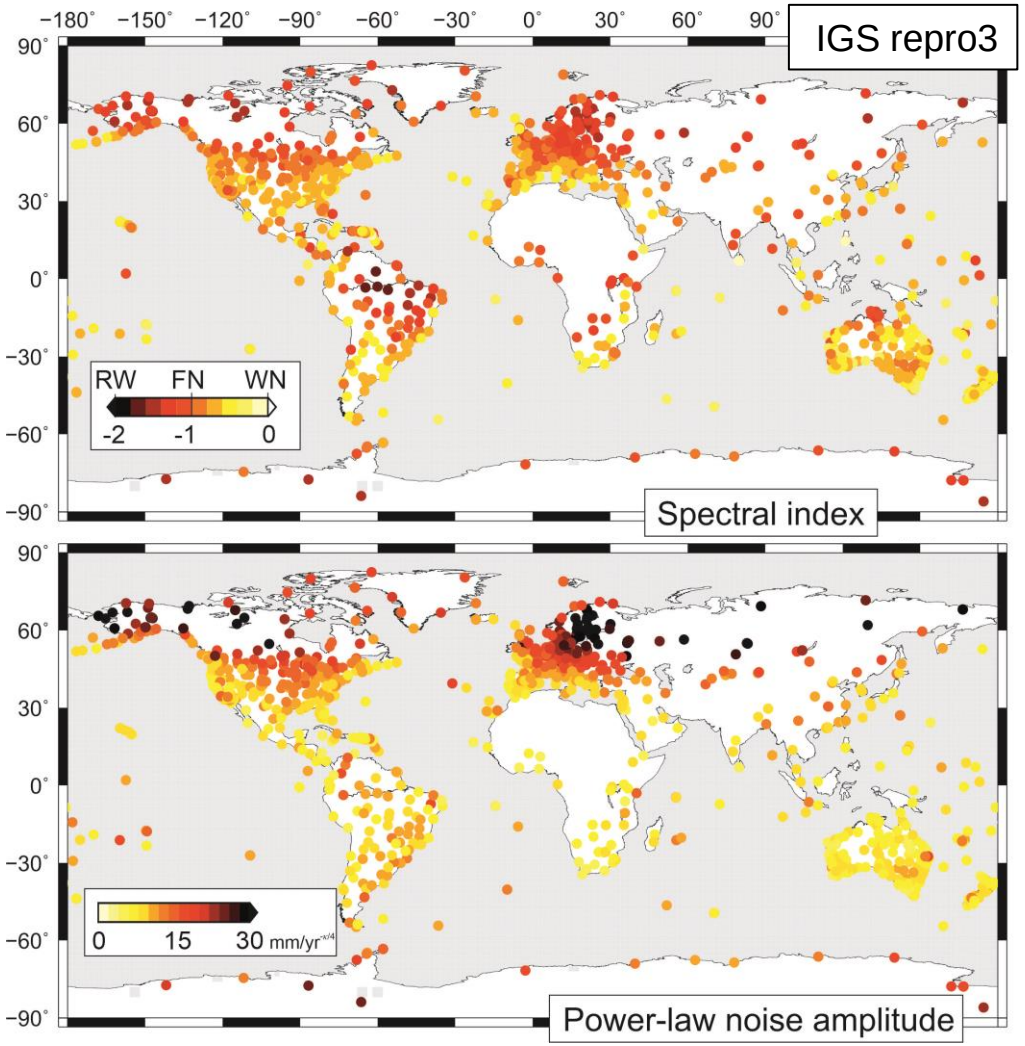
Chasing the GPS sensitivity:

6. The short-term part of the spectra of the GPS displacements remains regularly **unexplained;** often explored under the term **“noise”**.
7. Estimates applying **simple** time series model.

Precision of velocity is noise-dependent.

Chameleonic noise.
(Santamaría-Gómez and Ray, 2021)



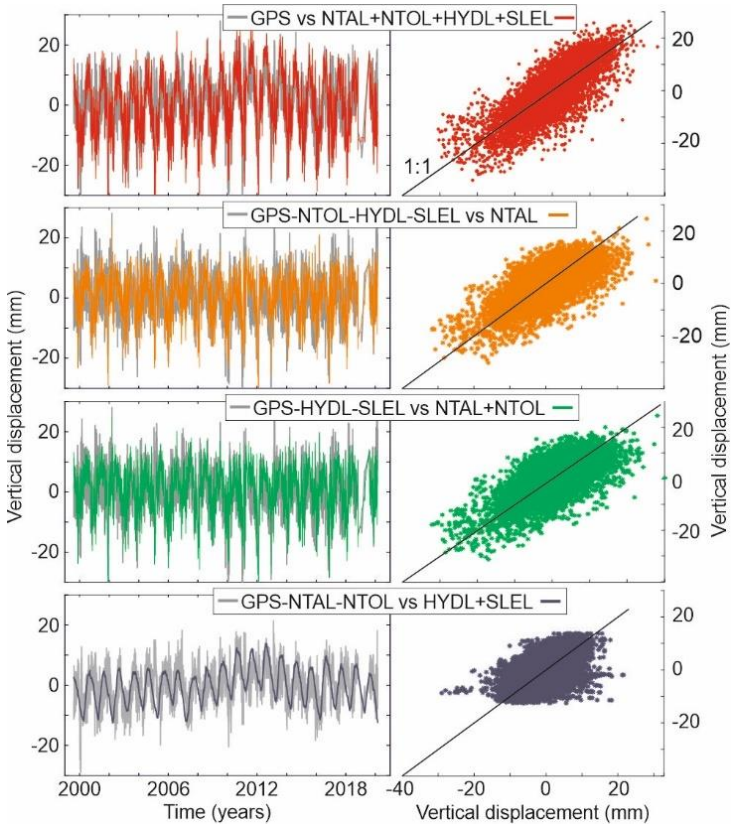


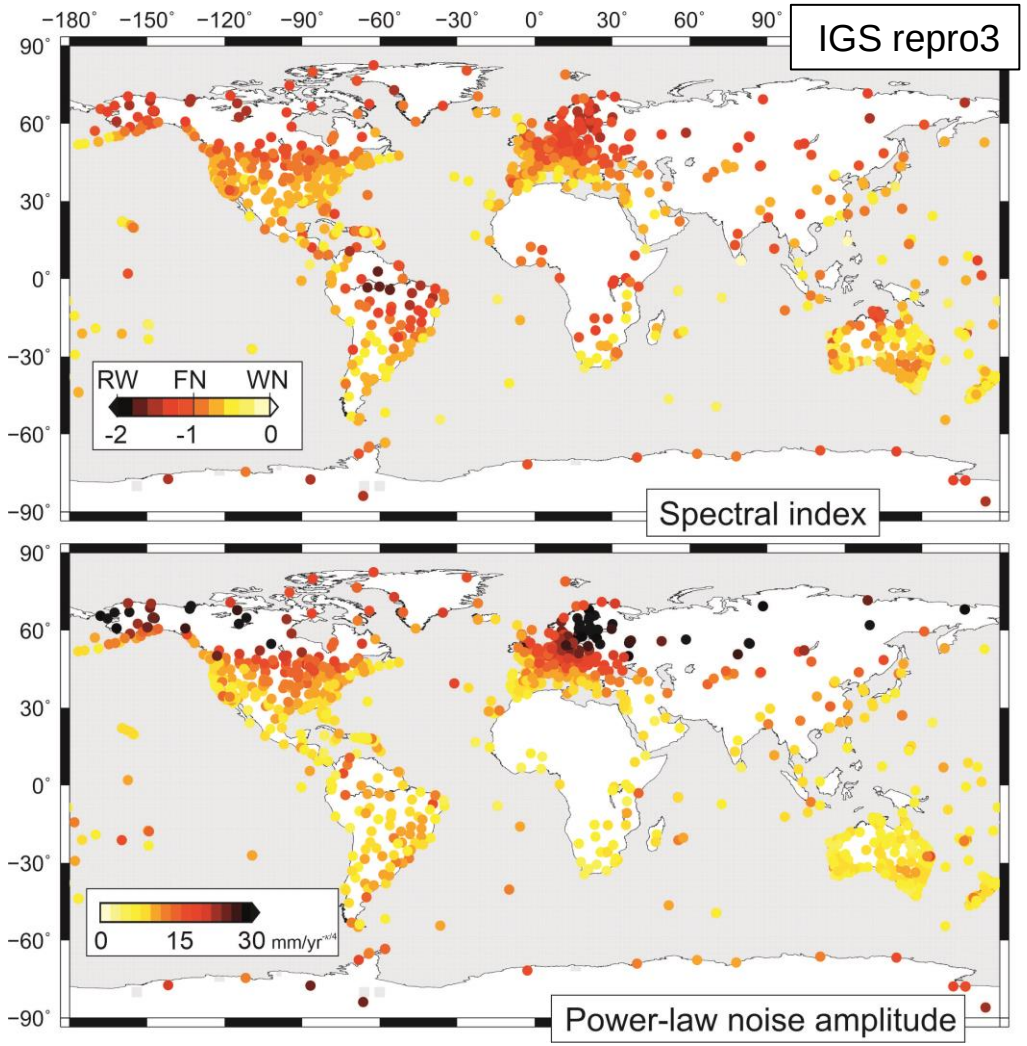
Klos et al. (2018), https://doi.org/10.1007/s10291-017-0674-x

Chasing the GPS sensitivity:

6. The short-term part of the spectra of the GPS displacements remains regularly **unexplained;** often explored under the term **“noise”**.
7. Estimates applying **simple** time series model.

GPS noise is also environmentally-driven.

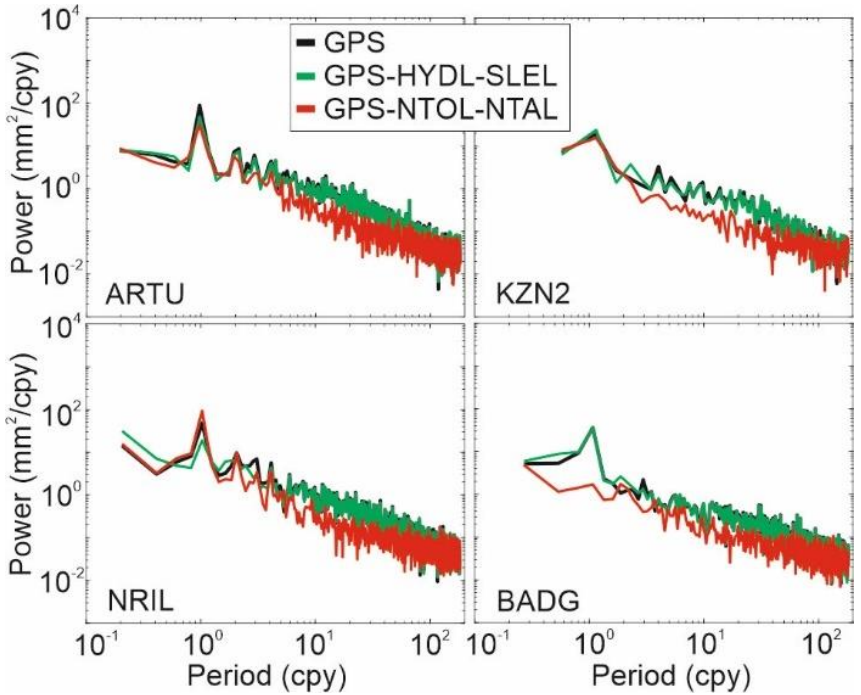




Klos et al. (2021), https://doi.org/10.1007/s10291-021-01135-w

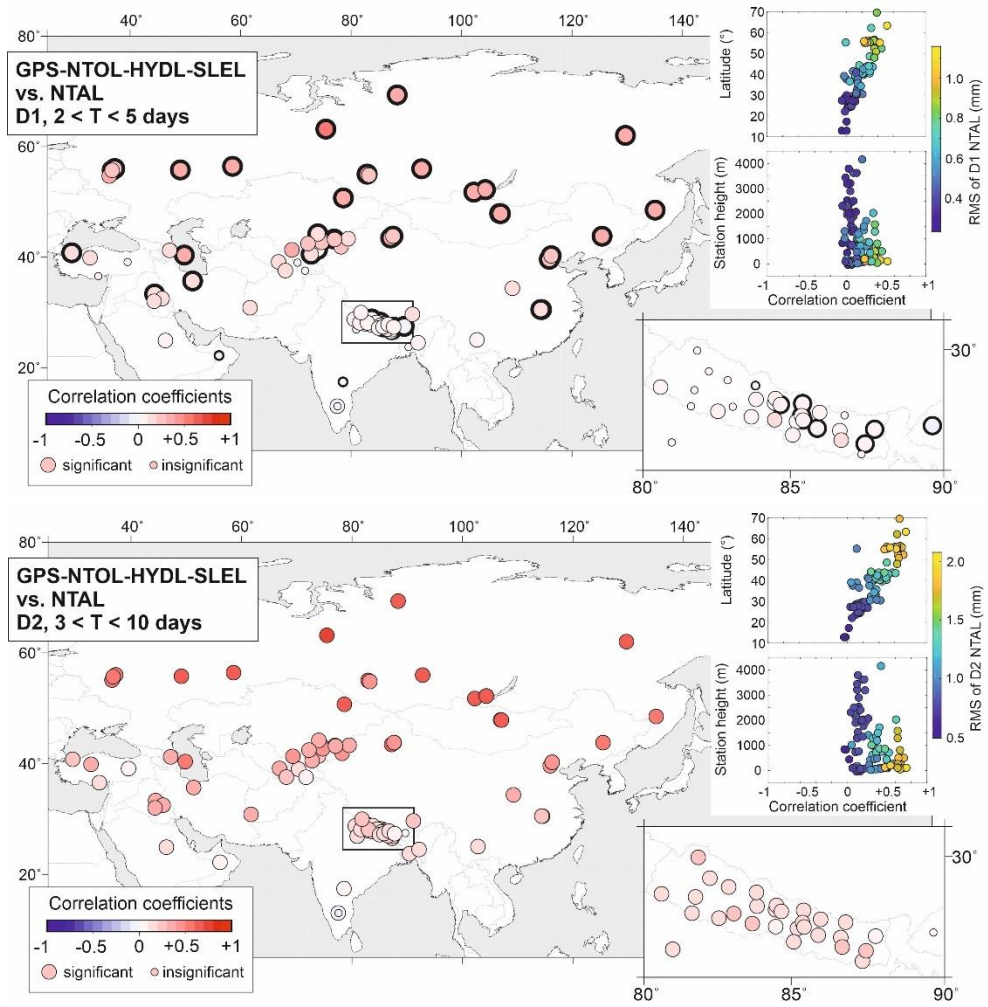
Chasing the GPS sensitivity:

8. Atmospheric loading as a main contributor to noise: **high sensitivity** of GPS to short-term atmosphere changes.
9. Reducing the impact of atmosphere: **reliability** of GPS velocity.



Klos et al. (2021), https://doi.org/10.1007/s10291-021-01135-w

Asian stations may serve as a benchmark for atmospheric analyses.

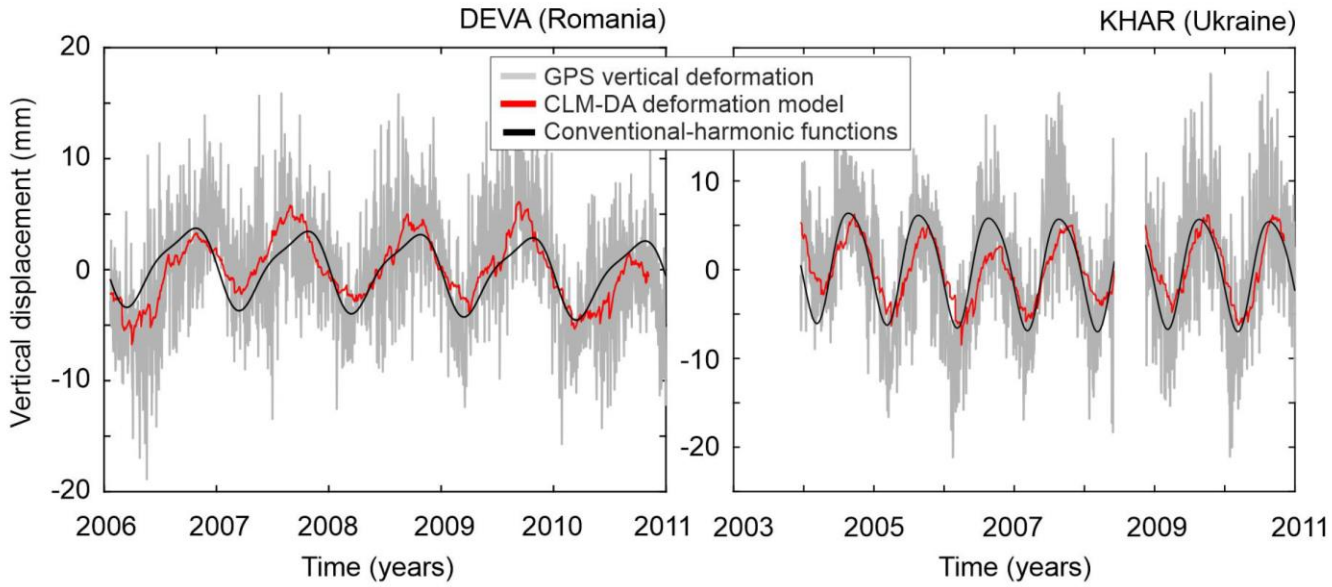


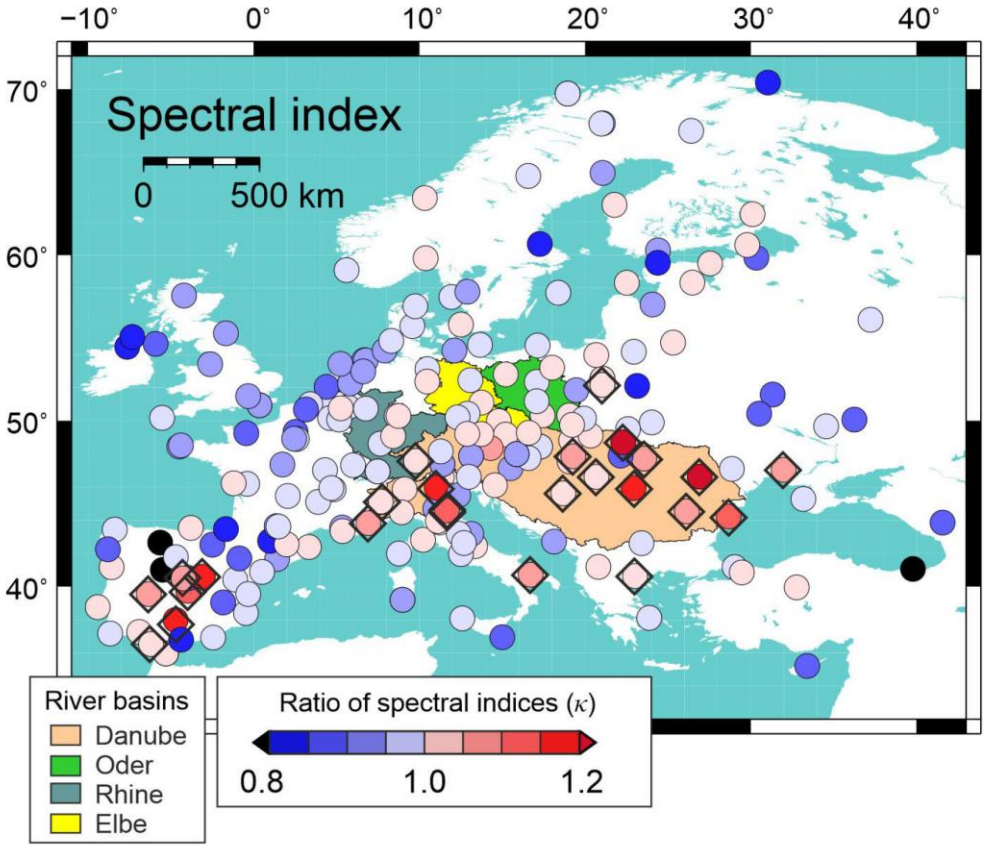
Chasing the GPS sensitivity:

10. Impact of hydrosphere?
11. Mainly seasonal band, but prominent also in short-terms for some individual stations.
12. Reducing the impact of hydrosphere: **reliability** of GPS velocity.

European GPS benchmark for hydrospheric analyses.

Klos et al. (2021), https://doi.org/10.1109/LGRS.2020.2983045





Conclusions:

1. **GPS sensitivity** needs to be examined in various time resolutions.
2. Recognition of **entire spectra** of GPS displacements.
3. Contributors to both long-term and short-term bands.
4. Many other contributors to GPS displacements: systematic errors: common mode error, draconitic frequencies; local effects: real (monumentation, anthropogenic impact) or artificial (multipath).
5. **Benchmarks** of GPS stations are recommended to properly indicate contribution of individual effects.

THANK YOU VERY MUCH FOR YOUR ATTENTION!