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Impact of baseline geometry in processing of regional networks on resulting coordinates and ZTD time series

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The goal of this work is to determine the most accurate and homogeneous processing strategy to reprocess ground-based GNSS data from national networks for precise positioning and climate monitoring applications. We investigate the influence of the network geometry design strategy on the estimated coordinates of permanent stations and Zenith Total Delay (ZTD) time series.
Three variants of processing were carried out and analyzed: 1) pre-defined network which usually contains baseline skeletons of reference stations and baselines to secondary stations forming a star-like structures with the main nodes connected to the reference skeleton; 2) the standard "obs-max" strategy available in Bernese GNSS Software; 3) a newly developed baselines design strategy optimized for ZTD estimation.
The study shows that the network design has a strong impact especially on the quality and continuity of ZTD estimates. In case of sub-daily gaps in the measurements at reference stations, small clusters of stations can be disconnected from the main network in the first network strategy. This has little impact on coordinates, but offsets of a few centimeters in ZTD estimates and spikes in their formal errors can appear at all stations of the disconnected cluster. It is also responsible for significant discontinuities in the estimated ZTD series. Using the new developed network design strategy the reprocessed ZTD time series as well as time series of station positions are much more continuous and homogeneous in comparison to the standard approaches.
Moreover, a post-processing screening procedure applied for ZTD and coordinates was applied to remove remaining outliers in time series. As a final screening and validation step, GNSS ZTD estimates were compared to ERA-Interim. The agreement between GNSS and ERA-Interim results with the new baseline design strategy and screening show a significant improvement.