Term project for GES-02 Advanced Data Analysis, Summer 2025

Title: Modeling the elastic response of Earth's crust to hydrological loading using GRACE data and comparison with GPS observations

Summary: The Earth deforms elastically under gravitational force of surface loads including atmospheric, oceanic and hydrological masses. The hydrological loading is often the largest component of surface mass changes. GRACE satellites provide monthly variations of total water storage at scales of 300 – 500 km. Using the elastic loading theory, these forcing data can be used to model crustal deformation. As an independent technique, GPS is capable of measuring crustal deformation resulting – among many other processes – from hydrological loading. In this project, the student will use monthly GRACE spherical harmonic coefficients from 2002 to 2017 and model the vertical deformation using a PREM Earth model. The modeled deformation are compared with GPS height time series at GPS sites in a study area.

Data for this project is available at:
Ecampus/Advanced Data Analysis/Physical Geodesy/Term project/Loading deformation

References:

Wahr, J., Molenaar, M., & Bryan, F. (1998). Time variability of the Earth's gravity field: Hydrological and oceanic effects and their possible detection using GRACE. Journal of Geophysical Research: Solid Earth, 103(B12), 30205-30229.

Fu, Y., & Freymueller, J. T. (2012). Seasonal and long-term vertical deformation in the Nepal Himalaya constrained by GPS and GRACE measurements. Journal of Geophysical Research: Solid Earth, 117(B3).

Karegar, M. A., Dixon, T. H., Kusche, J., & Chambers, D. P. (2018). A new hybrid method for estimating hydrologically induced vertical deformation from GRACE and a hydrological model: An example from central North America. Journal of Advances in Modeling Earth Systems, 10(5), 1196-1217.

Deadline: 01.09.2025

Responsibility: The student presents and discusses the results and his/her codes to the mentor.

Mentor: Dr. Makan Karegar, karegar@uni-bonn.de