



Current topic for a Master's Thesis

Signatures of post-seismic relaxation in station motions of Terrestrial Reference Frames

Post-seismic relaxation is a non-linear geophysical motion of the Earth's crust subsequent to an earthquake. They can dominate the motion of observing stations located in affected regions over years.

The International Terrestrial Reference System (ITRS) is realized from observation time series of up to 40 years of the space geodetic techniques GNSS, VLBI, SLR and DORIS. The ITRS realization, the so-called International Terrestrial Reference Frame (ITRF), is computed every 5 to 6 years by the three ITRS Combination Centres of the International Earth Rotation and Reference Systems Service (IERS). The DGFI-TUM is one of them, and thus in charge of the ITRF.

Each ITRF station is parameterized by a mean 3D position and a constant 3D velocity, describing the long-term linear station motion. Therefore, the observations are initially reduced for non-linear station motions as far as those can be modelled with high accuracy (e.g. Earth tides or seasonal effects).

The displacement through an earthquake is considered as a discontinuity of the station motion, and a new mean station position is estimated for the time after the event. But the non-linear post-seismic relaxation cannot be approximated sufficiently by the linear parameter model of the ITRF.

DGFI-TUM has developed an approach to approximate post-seismic station motions by logarithmic and exponential functions. The approach was already successfully tested for some stations affected.

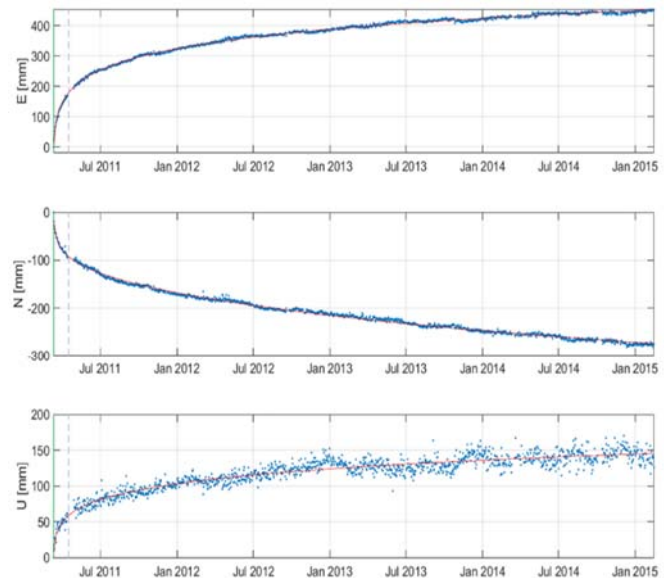
In this thesis, the approach shall be implemented and tested in the ITRS realization process exemplarily for GNSS in preparation for the next ITRS realization in 2021. This topic is at the forefront of the scientific activities in the field of reference frame determination.

Main tasks:

- To approximate the relaxation motion for all GNSS stations in ITRF affected by earthquakes.
- To study, if stations located in a region and affected by the same earthquake can be treated in the same way using identical approximation functions.
- Computation of a GNSS-based reference frame (TRF) from input data that has initially been reduced by the station motions derived from the best-fitting approximation functions.
- Comparison with a classical GNSS TRF based on a piece-wise linear approximation.

References:

- Angermann D., Seitz M., et al.: Comparison of latest ITRS realizations: ITRF2014, DTRF2014 and JTRF2014. IERS Tech. Note 40, 2020.
- Bloßfeld M., Seitz M., Angermann D., Seitz F.: DTRF2014: DGFI-TUM realization of the ITRS. IERS Technical Note 40, 2020.
- Seitz M., Bloßfeld M., Angermann D., Seitz F.: DTRF2014: The first secular ITRS realization considering non-tidal station loading, Journal of Geodesy, 2020.



Approximation of the post-seismic station motion (in East-, North- and Up-direction) of the GNSS station Kashima (Japan) after the Tōhoku-Earthquake 2011