Realization of the geospatial reference in Germany: alternative approach for the transformation from ITRF to ETRS89/DREF91

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Reliable, highly-precise and geo-referenced information is getting more and more important because of the rapid development in geodesy, remote sensing, geo-information and other fields of science and economy. The uniform geospatial reference in Germany is realized by permanent and stable marked stations (i.e. stations of the Integrated Geodetic Reference Network (GREF) operated by BKG), that are permanently observed and inspected. The reference points are a connection between ellipsoidal and physical heights through GNSS observations and gravity measurements. The large-scale movement and changes can be detected by monitoring the coordinates over many years. The reference points are the so-called geo-sensors and contribute to the realization of an integrated reference system in Germany.

The coordinates of reference stations are computed in a higher-level reference frame (International Terrestrial Reference Frame (ITRF)) using GNSS observations, and they have to be transformed to ETRS89 (European Terrestrial Reference System 1989), and, for practical purposes, to DREF91_R16 (official realization of ETRS89 in Germany), respectively. The prevailing and official approach used in Germany is a transformation with fixed transformation parameters ([Boucher & Altamimi 2011] + three rotations) which is disturbed by many systematics (artificial trends in height, jumps at change of datum) and therefore distorts the station coordinates.

An alternative approach is the seven parameter Helmert transformation with time-variable transformation parameters. For a qualitative and quantitative evaluation of the advantages and disadvantages of this alternative transformation approach, in comparison to the official transformation, a series of investigations are performed. Based on simulations and analysis of time series from GREF stations the correlation between the quality of the coordinate time series and the following parameters are investigated:

1) Number and spatial distribution of reference stations
2) Distance to the center point of the reference network
3) Performance and quality of marking of reference points

The issue of antenna changes on GNSS reference stations and the quality of coordinate time series in higher-level reference frames are considered and their influence on transformed time series are illustrated.

Ref: [Altamimi, Boucher 2011]: C. Boucher, Z. Altamimi – Memo: Specifications for reference frame fixing in the analysis of a EUREF GPS campaign, Version 8 (18-05-2011) (http://etrs89.ensg.ign.fr/memo-V8.pdf)