A New Transformation Including Deformation Model for the Nordic and Baltic Countries

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SUMMARY

The ETRS89 is defined to be co-moving with the rigid Eurasian plate to minimize the coordinate variations in time. However, in the Fennoscandian area postglacial rebound causes intraplate deformations up to about 10 mm/yr that needs to be taken into account in maintenance of the national reference frames and in the most accurate georeferencing applications. The Nordic Geodetic Commission (NKG) has developed a common Nordic deformation model NKG_RF03vel that is comprised of GIA models and GNSS, levelling and tide gauge observations to describe these motions. There are several possible ways to implement such a model into the transformation from the global ITRF to the national ETRS89 realizations. In this paper we present a new transformation strategy based on the solution of the common Nordic-Baltic-Arctic GPS campaign NKG2008. Together with the transformation, also a new common Nordic-Baltic reference frame, designated as the NKG_ETRF00, was realized.

The selected transformation follows the recommendations of the EUREF as much as possible. Consequently, the transformation utilizes the de facto transformation formulae and parameters and the conventional frame of the ETRS89, ETRF2000, as recommended by the EUREF. However, additional intraplate corrections and national transformation parameters were applied to serve the requirements of the Nordic/Baltic countries. For correcting the intraplate deformations in the Nordic-Baltic area we have used the existing NKG_RF03vel model. The selected transformation supports any ITRF realizations and observation epochs and can be used to transform coordinates either to national ETRS89 realizations or to the common NKG_ETRF00 reference frame. The NKG_ETRF00 was aligned to ETRF2000 at epoch 2000.0 in order to be close to the national ETRS89 realizations and to coincide with the land uplift epoch of the national height systems.

The results show that the NKG_RF03vel model is working very well as a deformation model; the

national transformation residuals are below 5 mm (rms) for most of the Nordic-Baltic countries. However, in this study the model was re-aligned to the ETRF2000 velocities in order to obtain accurate NKG_ETRF00 coordinates (in ETRF2000 at epoch 2000.0). The results show that the re-aligned velocities of the model are below 0.5mm/yr level (rms) compared to the observed ETRF2000 velocities of the EPN cumulative solution. Also the resultant common frame NKG_ETRF00 is well-aligned to the ETRF2000; a comparison to EPN cumulative solution shows an agreement of about 5 mm (rms). Well-aligned intraplate velocities ensure a good overall transformation accuracy also for several years or decades ahead.