



Definition, Realization and Future Development of the European Terrestrial Reference System (ETRS89)

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The European Terrestrial Reference System 1989 (ETRS89) was defined and adopted by EUREF in 1990 and since then is largely used by most of European countries as the basis of their national geodetic systems.

The ETRS89 definition specifies two main conditions which are:

(1) the ETRS89 should coincidence with International Terrestrial Reference System (ITRS) at epoch 1989.0 and (2) the ETRS89 is co-moving with the stable part of the Eurasian tectonic plate. From that definition rigorous mathematical transformation formula are deduced, allowing to derive from each ITRF_{yy} frame a corresponding ETRF_{yy} frame, having a specific origin, scale and orientation. This paper re-discusses the ETRS89 definition, its mathematical link to the ITRS, focuses on the main ways allowing its realization and raises the awareness of possible misinterpretation of its definition and in particular the misuse of the epoch 1989.0 inherent in its definition. Some numerical examples are provided in order to illustrate the discussion. Particular focus is given to the ETRF2005 and its consequences in terms of frame shifts (origin, scale and orientation) as well as consequent station coordinate changes with respect to ETRF2000. Nonetheless, a mathematically sound alternative of the ETRS89 realization is also proposed, leading to frame definition changes due to the well known estimation process, while perfectly satisfying the ETRS89 definition. Given the fact that the ETRS89 is designed primarily for practical georeferencing applications where these frame shifts are not desired, it is therefore recommended to adopt, conventionally, the ETRF2000 as the basic frame of the ETRS89 realization for future adoption by the European National Mapping Agencies. Procedure on how to access the ETRF2000 frame from any ITRF version is described.