Strategies for the optimal combination between local 3D modern GNSS and 2D classical networks, expressed in different reference frames: Case study in Greece

Dimitrios Ampatzidis (GenieLab, Department of Surveying and Geomatiscs Engineering, International Hellenic University), Eleni Tzanou (GenieLab, Department of Surveying and Geomatiscs Engineering, International Hellenic University), Nikolaos Demirtzoglou (GenieLab, Department of Surveying and Geomatiscs Engineering, International Hellenic University) and Georgios Vergos (GravLab, Department of Geodesy and Surveying, Aristotle University of Thessaloniki)

Abstract. The advent of GNSS during the last three decades facilitated a lot the daily geodetic/surveying practice, giving the opportunity of estimating coordinates in 3D (or even 4D) in a straightforward way. Nevertheless, the main geodetic/surveying infrastructure of a country/region relies even at present on classical 2D networks, i.e., network which has been observed and adjusted based on classical observations like angles, directions, and spatial distances. A major, and sometimes cumbersome, issue is the combination of the new 3D information into the existing 2D one. A basic tool in this direction is the Helmert-type transformation (3D/2D options), which is commonly used worldwide. However, a Helmert-type transformation cannot be applied in all cases, for it carries some significant drawbacks, which may distort the accuracy. The present study deals with a variety of strategies for the optimal combination of 3D and 2D reference frames in a rigorous way. The methodological variations stem from the (un)availability and types of the 2D network observables. The various strategies are tested in Drama region, Northern Greece, where two local networks were established; A 3D one expressed in ITRF2008 and a 2D one which refers to the official Greek Geodetic Reference System. The results show that the combination schemes provide in general improved accuracies compared to using solely one of the networks.