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A boundary value problem approach to height datum unification

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A Geodetic Boundary Value Problem (GBVP) approach has been formulated which can be used for solving the problem of height datum unification in both absolute and relative modes: (1) In the case of having gravity and precise leveling data of the two countries (not necessarily be connected to each other) the relative shift between the zero point of the height datums can be estimated after correcting their reference potential values using the estimated potential bias terms for each country separately within the two GBVP's. (2) In the absolute sense the shift of the reference potential of a height datum can be computed after correcting the reference potential value of the country by the estimated potential bias term within the GBVP. The comparison of the corrected reference potential with the geoid's potential, provides the offset of the zero point of the height datum with respect to the geoid's potential value. In both cases the key point is the introduction of the unknown bias terms for the gravity and potential (geopotential numbers) data in the setup of the GBVP. Therefore, in this way the reference potential of the height system as well as the reference gravity can be corrected so that its comparison with another corrected reference potential (in the relative case) or with the geoid's potential (in absolute case) can provide the offset of the height datums with respect to each other (in the relative case) or with respect to the geoid (in the absolute case). The computed offset for the zero point of the height datum can also be converted into physical height quantity in order to derive the offset of the datum in metric units. Estimation of the gravity bias allows the combination of the gravity data

coming from different sources. The developed technique is applied to a test region in Southwest Finland with approximate size of and both absolute and relative height datum unification cases are tested as follows: (1) The test area is divided into two parts and the gravity and precise leveling data of the parts are introduced into two GBVP's and the bias of the reference gravity and potential of the two parts are computed separately. Since these two parts have been a part of one leveling network there should be no offset between their corrected reference potential values, which has been confirmed by the numerical results. (2) The precise leveling and gravity data of the test region are used within one GBVP and the offset of the height datum is computed with respect to the potential value of Normaal Amsterdams Peil (NAP) and almost zero offset has been derived from the numerical computations, which confirms the fact that current Finnish Height datum at the epoch of 2000 (N2000) is at the same level as NAP reference station.