

Seeking congruency and consistent precision among geoid modelling methods: Conceptualising an Asia-Pacific Height Reference Frame (APHRF)

Ropesh Goyal^{1,*}, Aniket Mishra²

¹Department of Civil and Environmental Engineering, Indian Institute of Technology Delhi, India

ropeshgoyal2809@gmail.com

²Department of Civil Engineering, Indian Institute of Technology (BHU), Varanasi, India

aniketmishra.rs.civ24@itbhu.ac.in

Abstract

The major motivations behind this study are following two observations: (i) suggested approaches of calculating the geopotential value within IHRF framework includes use of GGM+topographic gravity signals (in terms of RTM) for regions without surface gravity data and precise regional geoid/quasigeoid models for regions where surface gravity data is available (or made available after improving the data availability), and (ii) first solution of IHRF demonstrates that almost all the IHRF sites from Asia-Pacific region (except from Australia and Japan) are the least accurate with mean accuracy of $4.0 \text{ m}^2\text{s}^{-2}$, calculated using XGM2019, although Asia-Pacific region demonstrates a highly reliable regional reference frame, APREF.

Considering that (i) Asia-Pacific region has relatively complex and heterogenous topographical landforms and geodynamical phenomena, (ii) numerous geoid modelling methods have been used in different countries of this region, (iii) meaningful realisation of targeted cm-level geopotential-based heights requires congruency among different geoid/quasigeoid modelling methods, and (iv) many regions have unknown quality and coverage of gravity data, this study will demonstrate-through-quantification a few sources of differences in geoid/quasigeoid solutions and the idealisation of consistently precise and accurate geoid/quasigeoid model that could be the basis of the IHRF targeted cm-level geopotential-based heights. Further, for the regions with limitations in data coverage and quality, one of the suggested methods by IHRF of using GGM+RTM-based topographic gravity signals (following spectral enhancement method (SEM)) will be revisited and instead a method of GGM+Spectral Topographic Replacement (STR) based incorporation of topographic effect will be presented as an alternative method for calculating precise geopotential values at the Asia-Pacific IHRF sites for the proposed second realisation of IHRF and first realisation of proposed Asia-Pacific Height Reference Frame (APHRF).