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The topography as a geoid validation problem

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Introduction

- **Determining the geoid and orthometric heights are inverse problems caused by the partly unknown topographic density distribution.**
- **The geoid problem is a free bvp.**
- **The total topographic correction to Stokes formula is of order 1, 4 and 28 dm for H = 1, 2 and 5 km for the standard topographic density.**

1. Geoid validation problem in GNSS-leveling

Geodetic height = geoid height + orthometric height:

$$h = N(\mu) + H(\mu) \qquad (1)$$

If density μ is in error by $d\mu$, then

$$dh = 0 = dN(d\mu) + dH(d\mu) \qquad (2)$$

or

$$dN(d\mu) = -dH(d\mu) \qquad (3)$$

Hence, GNSS-levelling ignores the error in topographic density.

2. Astro-geodetic leveling

The same problem as above occurs in astrogeodetic leveling, e.g., by using zenith camera.

3. Overdetermination and least-squares adjustment

Foroughi et al. (2019) claimed that the UNB group got cm geoid accuracy in the Auvergne test network when employing a least-squares adjustment when dwc of overdetermined gravity data in Stokes integration. However, the reported accuracy can only be internal accuracy that lacks the density uncertainty.

Discussion

Reconsider the equation:

$$dN = -dH \quad (4)$$

and consider the following facts:

The geoid and H problems are inverse problems:

- **(4) is true only for equal density models for N and H.**
- **The density models need not be true to satisfy (4).**
- **If the density models differ for N and H, (4) is false and the validation test fails.**

Conclusion

Precise geoid validation in high mountain areas suffer from imprecise knowledge of topographic density distribution.

This is not a problem in quasigeoid determination.

Thank you for your attention!