New realization for European vertical reference system; a first attempt to include the **Hydrodynamic Leveling** data

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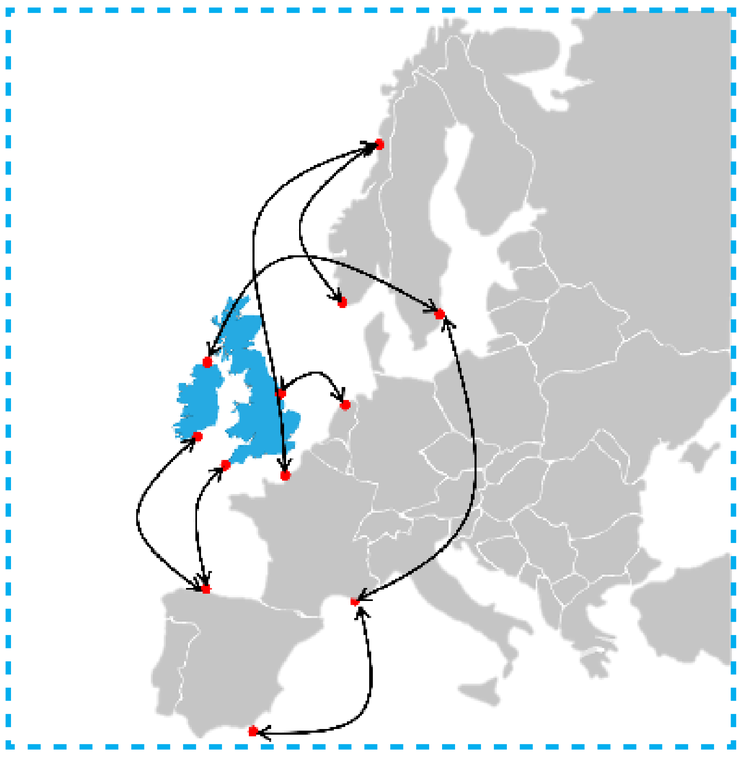
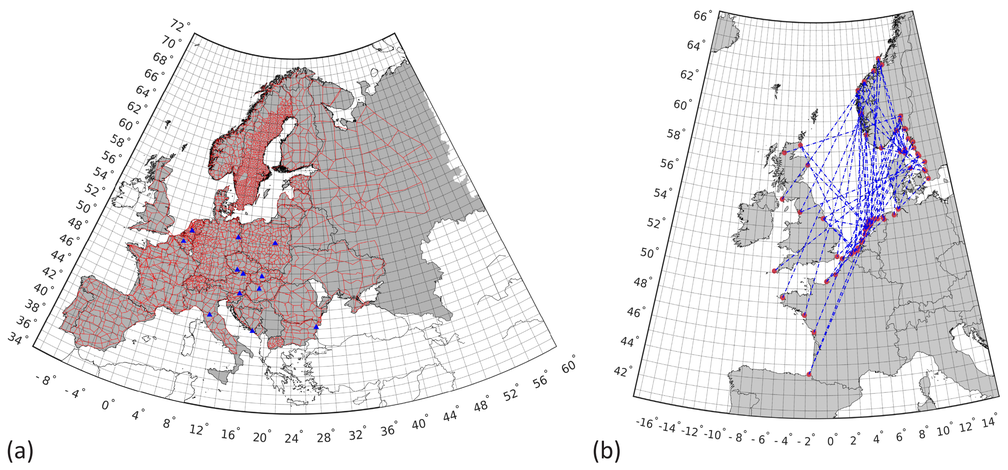
INTRODUCTION

Model-based hydrodynamic leveling is an efficient and flexible method to connect islands and offshore platform tide gauges with the height system on land. The technique uses mean water level (MWL) differences between tide gauges obtained by a regional, high-resolution hydrodynamic model (Slobbe et al. 2018).

A recent study by Afrasteh et al. (2021) showed great potential in enlarging the extent and improving the quality of the European Vertical Reference Frame (EVRF) using the model-based hydrodynamic leveling technique.

Aim of this study is to combine model-based hydrodynamic leveling and Unified European Leveling Network (UELN) data and compute a new realization for the European Vertical Reference System (EVRS).





(a) Spirit leveling network; blue triangles show the location of the datum points. (b) the plot of 62 hydrodynamic leveling connections added to the network. For all tide gauges, there is a UELN benchmark closer than 4 km.

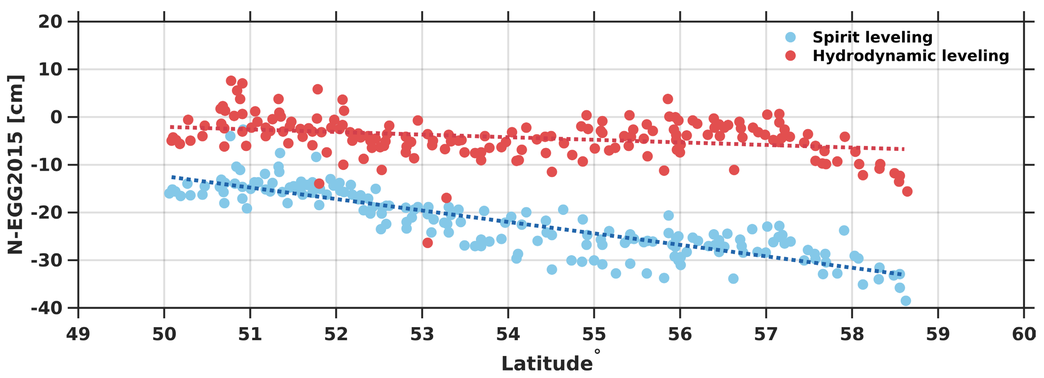
METHOD & DATA

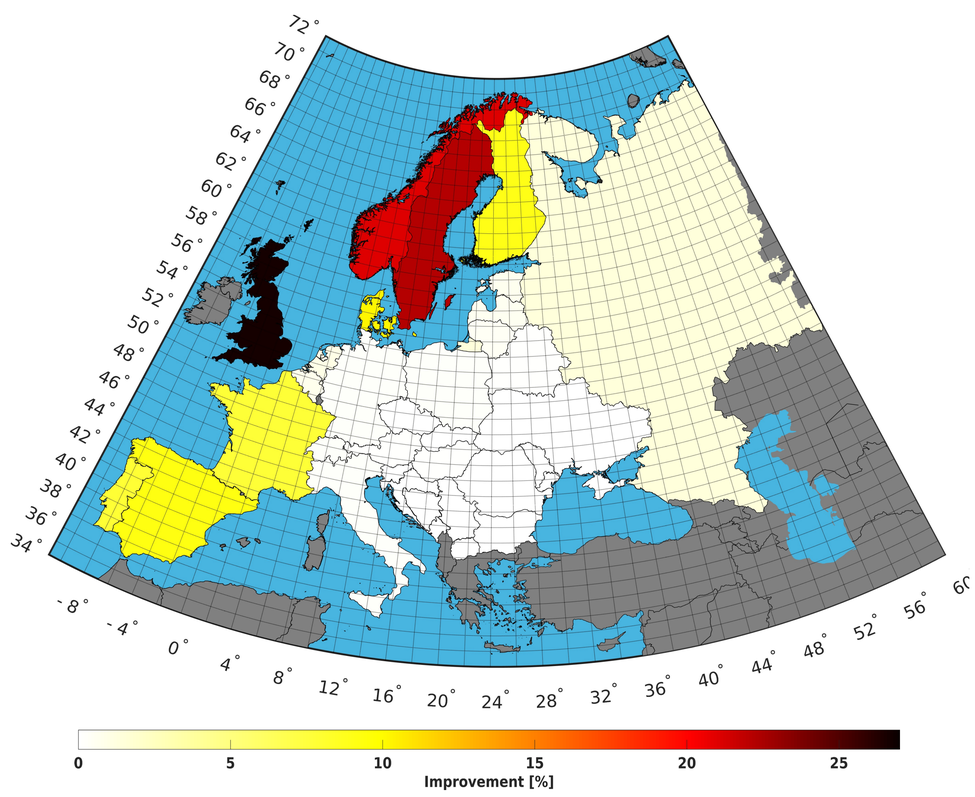
- The spirit leveling plus gravimetric data comprises the geopotential differences including the variances of UELN. In this study the data of Great Britain have been included.
- The **hydrodynamic leveling** data are obtained from the 3D DCSM-FM model. This model covers the north-east Atlantic Ocean including the North Sea, Wadden Sea and Kattagat/Skagerrak. We simulated the MWL over 2006--2012. The tide gauges records covering the same period have been collected for the countries inside the model domain. Variance values are computed using the difference between model- and observation-derived MWLs at the tide gauges locations.

A new realization of the EVRS computed using weighted least-squares. The variance component estimation is applied to estimate the relative weighting of hydrodynamic and spirit leveling data.

RESULTS & CONCLUSIONS

- By combining the hydrodynamic leveling and the UELN data, we observe a 21% improvement in the quality of the EVRF estimated heights in terms of precision.
- The improvement differs per country. The most significant improvement is observed for Great Britain.
- Addition of hydrodynamic leveling data reduces the south-north slope in Great Britain leveling network from 22 to 4 cm. Moreover, the difference between estimated geoid heights (ellipsoidal heights - new EVRF heights) and EGG2015 quasi geoid heights significantly reduces.





WHAT NEXT?

- Computing and using the full noise variance-covariance matrix in the combination.
- Extend the anlysis by including the tide gauges located in other Europan sea basins.

REFERENCES

- Slobbe, D. C., et al. “Height system connection between island and mainland using a hydrodynamic model: a case study connecting the Dutch Wadden islands to the Amsterdam ordnance datum (NAP).” Journal of Geodesy 92.12 (2018): 1439-1456.
- Afrasteh, Y., et al. “The potential impact of hydrodynamic leveling on the quality of the European vertical reference frame.” Journal of Geodesy 95.8 (2021): 1-18.