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Geoid-type surface determination using wavelet-based combination of gravimetric quasi/geoid and GPS-levelling data

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Over the last decade, there has been an increased interest in the determination of the quasi/geoid. This is mainly due to the demands for height transformation from users of GPS. The geoid can directly be observed through a combination of GPS ellipsoidal heights and levelling heights (normal/orthometric). However, there are always discrepancies between a gravimetric quasi/geoid model and the quasi/geoidal heights derived from GPS-levelling. Therefore, using a gravimetric quasi/geoid model to transform ellipsoidal heights to normal/orthometric height does not always yield results that are compatible with the local vertical datum. To improve this transformation, the gravimetric quasi/geoid model can be fitted to the GPS-levelling data. The new hybrid surface (importantly which is no longer the classical quasi/geoid) can then be used to give a more direct height transformation. This study describes the fitting of gravimetric quasi/geoid models to GPS-levelling using second-generation wavelets. The classical wavelet transform is not directly applicable to this problem as it requires regularly spaced data. This procedure is realized over Norway and Australia, and the results are cross validated. The wavelet-based results are also compared to those from least squares collocation (LSC) merging. This comparison shows that the second-generation wavelet method can be used instead of LSC with similar results, but the assumption of stationarity for LSC is not required. It is also shown that the wavelet method is better at decreasing the maximum and minimum differences between the merged geoid and the cross-validating GPS-levelling data.