Gravity variations and displacements caused by storm surge loading on the north-west European shelf.

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Superconducting gravity, absolute gravity and space geodetic measurements have to be corrected for various surface loading signals in order to obtain improved time series of long term crustal deformations due to tectonic or glacial isostatic adjustment (e.g in the UK, a network of continuous GPS stations and a smaller number of absolute gravity stations have been set up in order to monitor vertical land movements due to post-glacial rebound/subsidence and to provide corrections for vertical crustal movements at tide gauges; see Teferle et al., 2006).

These loading corrections are usually made by using global loading models e.g. atmospheric pressure, hydrological, tidal and non-tidal loading models. In the work described here we concentrate on the corrections for non-tidal ocean mass variations. Most of the global non-tidal ocean loading models that have been used for correcting geodetic measurements have a fairly low resolution e.g. 1 x 1 degrees and these are not able to adequately resolve the large mass variations on shallow continental shelves. In the present work, we compute the non-tidal ocean loading deformations caused by storm surges on the north-west European shelf using the output from a 12 km grid storm surge model. The spatial distributions of the vertical and horizontal displacements and the gravity variations caused by a typical storm surge event are computed in order to show the magnitudes of the effects that can be expected in space geodetic or gravity measurements. A storm surge of just over 2 m in the southern North Sea produces vertical displacements of -20 to -30 mm and increases of gravity of 6 to 8 µgal in the coastal areas of Denmark, Germany, the Netherlands and the east coast of England. It is shown that the loading deformations due to surges affect a wide area of north-west Europe. Although the GGP station at Membach, in Belgium, is about 200 km from the North Sea, there is evidence for storm surge loading in the gravity data. This type of high resolution non-tidal loading model is required for correcting geodetic measurements made in all areas of the world near shallow continental shelves.

A paper has recently been published in Geophysical Research Letters, which gives further information on this work (Fratepietro et al., 2006).

REFERENCES

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