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# Analysis of non-tidal ocean loading for gravitational potential observations in northern Europe

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## Abstract

With the progress in clock technology heading towards a relative clock accuracy of  $10^{-18}$ , geodetic applications become feasible, such as determining gravity potential differences over large distances at the level of  $0.1 \text{ m}^2 \text{ s}^{-2}$ . In this context, the effect of temporal gravity field variations on the new observable has to be considered. This paper studies non-tidal ocean loading effects on the gravitational potential around the North Sea with respect to signal strength and temporal behavior. Ten years of gravitational potential variations caused by non-tidal ocean loading are calculated for five locations in Germany and France using the Green's function approach. The potential variations are discussed with respect to a static gravity field, the effect of different measurement durations and the differences between two locations. The gravitational potential variations reach values of  $0.2 \text{ m}^2 \text{ s}^{-2}$  to  $0.5 \text{ m}^2 \text{ s}^{-2}$  in coastal areas and decrease with increasing distance from the coast. Analyzing the potential variations for increasing measurement durations from 1 hour to 48 hours shows a decrease in magnitude. All investigated locations are strongly correlated. They differ mostly due to different magnitudes of the gravitational potential variations.

*Keywords:* relativistic geodesy, gravitational potential, non-tidal ocean loading, North Sea

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