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A benchmark study of the sea-level equation in GIA modelling

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The sea-level load in glacial isostatic adjustment (GIA) is described by the so called sea-level equation (SLE), which represents the mass redistribution between ice sheets and oceans on a deforming earth. Various levels of complexity of SLE have been proposed in the past, ranging from a simple mean global sea level (the so-called eustatic sea level) to the load with a deforming ocean bottom, migrating coastlines and a changing shape of the geoid. Several approaches to solve the SLE have been derived, from purely analytical formulations to fully numerical methods. Despite various teams independently investigating GIA, there has been no systematic intercomparison amongst the solvers through which the methods may be validated. The goal of this paper is to present a series of benchmark experiments designed for testing and comparing numerical implementations of the SLE. Our approach starts with simple load cases even though the benchmark will not result in GIA predictions for a realistic loading scenario. In the longer term we aim for a benchmark with a realistic loading scenario, and also for benchmark solutions with rotational feedback. The current benchmark uses an earth model for which Love numbers have been computed and benchmarked in Spada et al (2011). In spite of the significant differences in the numerical methods employed, the test computations performed so far show a satisfactory agreement between the results provided by the participants. The differences found can often be attributed to the different approximations inherent to the various algorithms.

Literature G. Spada, V. R. Barletta, V. Klemann, R. E. M. Riva, Z. Martinec, P. Gasperini, B. Lund, D. Wolf, L. L. A. Vermeersen, and M. A. King, 2011. A benchmark study for glacial isostatic adjustment codes. Geophys. J. Int. 185: 106-132 doi:10.1111/j.1365-