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Fingerprinting sea-level variations in response to continental ice loss: a benchmark exercise

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Understanding the response of the Earth to the waxing and waning ice sheets is crucial in various contexts, ranging from the interpretation of modern satellite geodetic measurements to the projections of future sea level trends in response to climate change. All the processes accompanying Glacial Isostatic Adjustment (GIA) can be described solving the so-called Sea Level Equation (SLE), an integral equation that accounts for the interactions between the ice sheets, the solid Earth, and the oceans. Modern approaches to the SLE are based on various techniques that range from purely analytical formulations to fully numerical methods.

Here we present the results of a benchmark exercise of independently developed codes designed to solve the SLE. The study involves predictions of current sea level changes due to present-day ice mass loss.

In spite of the differences in the methods employed, the comparison shows that a significant number of GIA modellers can reproduce their sea-level computations within 2% for well defined, large-scale present-day ice mass changes. Smaller and more detailed loads need further and dedicated benchmarking and high resolution computation.

This study shows how the details of the implementation and the inputs specifications are an important, and often underappreciated, aspect. Hence this represents a step toward the assessment of reliability of sea level projections obtained with benchmarked SLE codes.