# Relative sea-level changes and sediments deposition: a first step toward a fully coupled system

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## Abstract

Marine sediments play a fundamental role in reconstructing past ice-sheets fluctuations. These are responsible for global ocean volume variations, which can be extracted from the isotope record and that show up as relative sea-level (RSL) changes. The consequent bathymetric variations, which result in changes of accommodation space and distance from shore, affect the deposition of marine sediments. The RSL changes that stem from the exchange of mass between the continental ice-sheets and the oceans are not globally uniform. According to the theory of glacial isostatic adjustment (GIA), the meltwater redistribution is accompanied by solid Earth deformations and perturbation of the gravity field. These decay exponentially in time as a consequence of the viscous behavior of the Earth's mantle. The GIA signal, therefore, is a function of the ice-sheets thickness chronology as well as of the solid Earth's rheology and it strongly depends on the distance with respect to the ice sheets. The geological record across the Eocene-Oligocene Transition (~34.0 Ma) shows that first appearance of the Antarctic Ice Sheet (AIS) was accompanied by a regressive phase in the northern hemisphere while sediments were deposited and preserved in the proximity of the AIS margins in response to local RSL rise and increase of accommodation space. In this work the contribution of of GIA-driven RSL changes in drawing the architecture of stratigraphic sections is investigated by means of a novel numerical modeling approach. The latter consists in the full coupling between a GIA model, which based on the Sea Level Equation, and a sedimentation model that is based on fuzzy logic. Among the several variables that regulate marine sedimentation, changes in bathymetry and distance from shore and ice-sheet margin account for the gravitationally self-consistent RSL changes that are driven by GIA. The sediments also contribute to solid Earth and gravitational perturbations. The proposed algorithm, therefore, handles the bi-univocal communication between RSL changes and sediment loading in a synergistic manner. This model is proposed as a tool for the geology community.

**Keywords**
Glacial isostatic adjustment, relative sea-level changes, sedimentation, sediments isostasy, dynamical coupling, Antarctic Ice Sheet