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Spatio-temporal variability of relative sea-level change across the Eocene-Oligocene transition

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The first glaciation of Antarctica marks the Eocene-Oligocene transition (EOT; $\sim$34 Myr ago) with a contrasting signal of relative sea-level (rsl) change between the ice-sheet proximal and the far-field marginal marine settings. The Northern Hemisphere sites (New Jersey, Alabama, Northern Italy) record, in fact, a 50 – 80 m rsl drop, which is in line with the eustatic trend. Conversely, the sedimentary facies in the proximity of the Antarctic ice-sheet show that rsl locally rose up to 150 m. Accounting for the mutual gravitational attraction between the Antarctic ice-sheet and the ocean is a necessary first requirement to solve this apparent paradox. The newly formed ice-sheet, in fact, would cause the sea level to rise in the proximity of the ice-sheet margins while poles apart the sea-level drop would be $\sim$20% larger than the eustatic. Furthermore, the uneven redistribution of the surface load (ice and meltwater) between the continents and the oceans would cause the solid Earth to deform and consequently the equipotential surface of gravity (mean sea surface) to change. At last, but not least, the ice-sheet thickness variations and the consequent meltwater redistribution would cause the rotation pole to move, with a consequent effect on the sea level. In this work we account for these intimately related feedbacks which define the Glacial Isostatic Adjustment (GIA process by solving the gravitationally self-consistent Sea Level Equation (SLE) for a Maxwell viscoelastic and rotating earth model. We force the SLE with a new thermo-mechanical ice-sheet model for the EOT glaciation driven by the variations of atmospheric CO_2 concentrations. We show that the geological data are sensitive to the strong latitude-dependent GIA process.