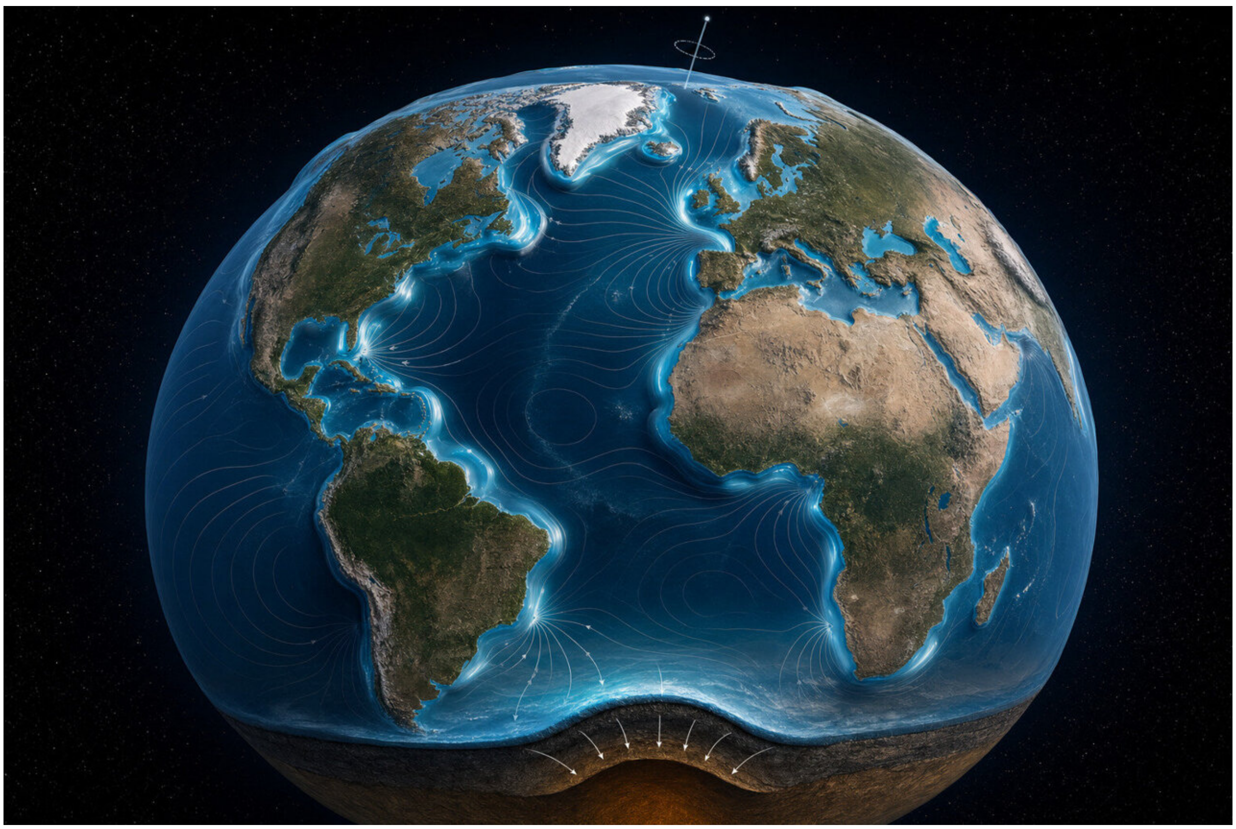
Sea-level rise may be even worse than expected thanks to hidden Earth physics

June 6 2026, by Sayan Tribedi



Credit: Image generated by the editorial team using AI for illustrative purposes.

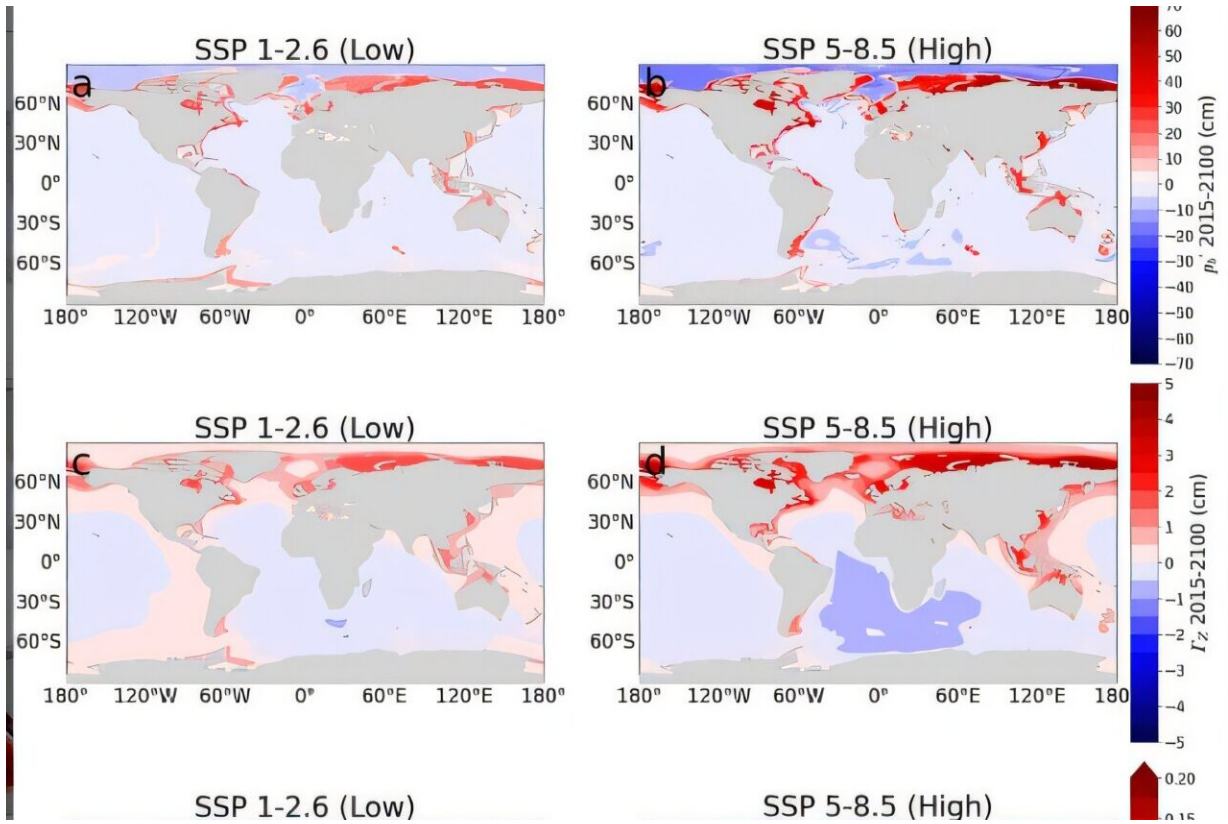
As the global temperature increases, Earth's oceans are experiencing a huge shift. In addition to commonly known effects, such as melting of ice caps and thermal expansion, there is an invisible factor that influences ocean levels and leads to further consequences, which researchers have just started to explore.

This invisible factor is a result of the planet's gravity and its flexibility, which provides an "extra push" to the ocean levels. It seems that the laws of physics are working against us as far as rising sea levels are concerned, as covered by a recent study featured in *Geophysical Research Letters*.

More than just melting ice

Coastal planners typically focus on thermal expansion and melting ice when projecting future flooding. But as Earth warms, changes in currents and density redistribute water around the globe. "This mass redistribution causes additional sea-level changes through variations in local gravity and deformation of the ocean floor," Grace Ertel and her team explain in their plain-language summary.

Piling water in one place slightly warps the crust and strengthens gravity there, while removing mass does the opposite. These GRD effects are rooted in fundamental physics: mass attracts, the solid Earth bends under loads, and even the planet's spin axis shifts slightly. Remarkably, the authors note, these processes aren't included in standard IPCC sea-level projections. This means forecasts to date have systematically missed a hidden wrinkle in how water height evolves.



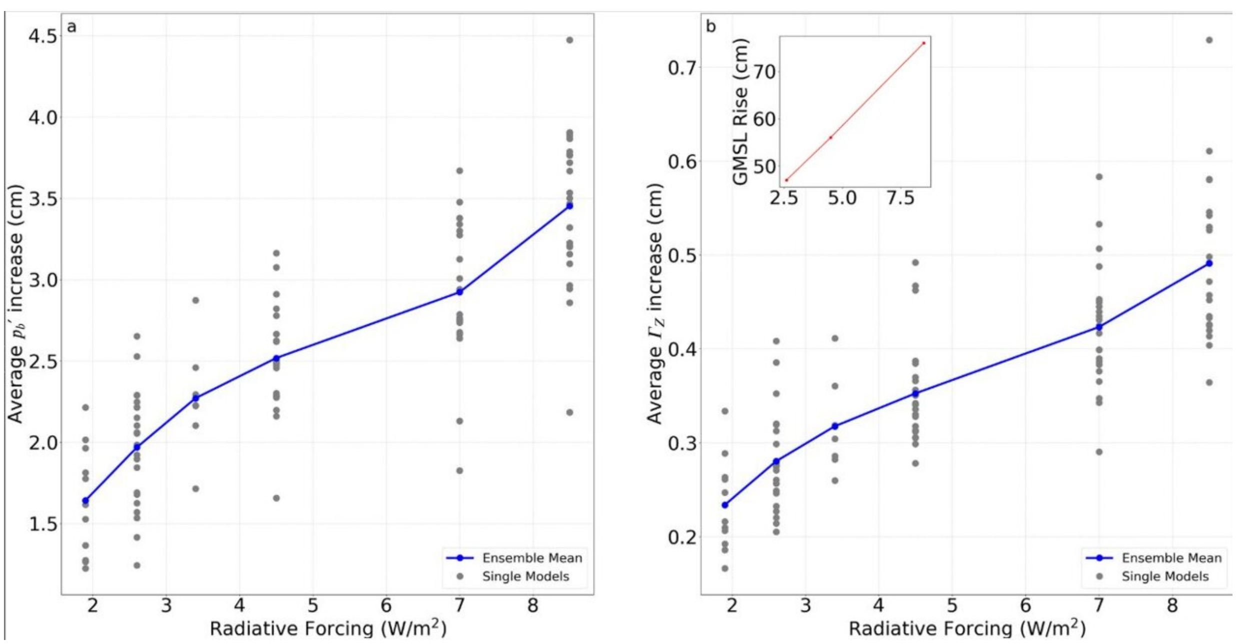
The Earth's Triple Response to Ocean Shifts. This graphic breaks down how the planet's physics contributes to regional sea-level changes. It shows the separate impacts of (a, b) gravity's pull, (c, d) the Earth's crust deforming, and (e, f) subtle shifts in the planet's rotation. Notice how these forces combine to reshape coastlines, with stronger effects under higher warming scenarios (right panels). Credit: Grace Ertel et al, Crustal Deformation and Gravitational Effects From Dynamic Ocean Mass Redistribution Impact Projected Sea-Level Change, *Geophysical Research Letters* (2026). DOI: 10.1029/2026gl122243

Gravity, crust and the wobble

Imagine adding weight to a rubber balloon: the balloon sags and water sloshes. On Earth, extra ocean mass does three things: it locally pulls more strongly on the water (raising nearby sea level), it makes the crust bulge under the weight (also raising relative water height), and it nudges Earth's rotation axis (redistributing water toward new "high gravity" areas).

The study used a suite of global climate models (CMIP6 scenarios) to track how bottom pressure—essentially ocean mass—changes by 2100, then ran those changes through a sea-level model with GRD physics. The result: everywhere water piles up, the GRD tweak pushes it even higher.

"Our results show additional sea-level rise along coastlines and sea-level fall in the deep ocean," the team reports. Coastal shelves and polar seas experience a bit more water, while distant deep ocean regions actually sit a bit lower than expected.



GRD's Growing Influence with Warming. This chart illustrates how the impact of dynamic ocean mass redistribution (pb') and its resulting GRD effects (Γz) on sea levels increases with higher global warming scenarios. The blue line shows the average trend across many climate models, while gray dots represent individual model projections, highlighting the range of possibilities. The inset reveals how these GRD effects, though small globally, add to the total global sea-level rise. Credit: Grace Ertel et al, Crustal Deformation and Gravitational Effects From Dynamic Ocean Mass Redistribution Impact Projected Sea-Level Change, *Geophysical Research Letters* (2026). DOI: 10.1029/2026gl122243

Amplified coasts and shelves

The extra rise isn't uniform. Wide continental shelves and high-latitude coasts feel it most strongly. By 2100, the authors estimate that some coastal areas could be ~5 cm higher than forecasts that ignore GRD effects would say.

On the flip side, regions where water mass is lost can see sea level drop by ~1 cm more than expected. On average across the ocean, the GRD-induced change is about 15% of the dynamic-ocean-mass signal. In practice, this means a city that thought it would face a certain rise might actually see roughly one-sixth more flood risk if these effects are included.

Many tropical and Arctic coasts see the biggest impact. The study notes that sea-level rise from water shifts is amplified on broad, shallow shelves (where the ocean warms and expands differently than in the deep). Indeed, earlier work hinted that places like the Siberian or Russian Arctic coasts and the marginal seas of Southeast Asia might feel the strongest deviations.

The team found those regions also showed the greatest uncertainty in models—underscoring the need for better high-resolution data there. Nevertheless, the takeaway is clear: standard projections have been underestimating the local sea rise.

"Omitting these processes causes a ~15% underestimation of the sea-level variability due to mass shifts associated with ocean dynamics," the authors warn.

Implications for planners

These GRD effects are small on a global scale compared to melting ice or thermal expansion—but they can matter regionally. Coastal cities and island nations may now face slightly higher waters than official scenarios suggest. For example, an extra 5 cm can translate into larger storm surges or a higher baseline for king tides.

The study's authors stress that future forecasts and adaptation plans should incorporate GRD physics. Doing so will "improve model resolution" and give policymakers a more accurate picture of flood risk. In short, the "extra" rise found by this research isn't a new driver of climate change, but a missing piece in our calculations.

As one researcher puts it, if we leave out these hidden forces, we are simply blind to some of the water's behavior. The findings serve as a reminder: Earth's own gravity and wobbles can steer seas—a curiosity-driven twist on the familiar tale of rising oceans. Ignoring them means undercounting the future threat by roughly 15%, and we would do well to heed this newly uncovered clue when preparing for the next high tide.

More information: Grace Ertel et al, Crustal Deformation and Gravitational Effects From Dynamic Ocean Mass Redistribution Impact Projected Sea-Level Change, *Geophysical Research Letters* (2026). DOI: 10.1029/2026gl122243