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Mapping global sea level rise: new gravity data help provide more accurate predictions

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Research from the US helps paint a clearer picture of the extent of global sea level rise, by considering new satellite data on the Earth's gravity. Its findings support reports of accelerating ice melt and suggest that most of the change in sea levels is caused by receding polar ice sheets and mountain glaciers.

One of the most important factors in monitoring the global climate is measuring global sea level change. This is a complex endeavour and developing a model which can accurately assess such sea level rise (SLR) is challenging. Information to help us estimate SLR comes from a variety of sources, including different types of satellite data and measurements taken by ocean floats, and estimates naturally vary depending on which sources are used.

Altimetry satellites, which measure distance between the satellite and the sea's surface, suggest that, between 2005 and 2011, the global sea level rose by about 2.39 mm per year. However, this is much higher than estimates provided by ocean floats, under the Argo Project. This global network of 3500 floats measure changes in temperature and salt levels in the upper layer of the ocean. Float data suggest temperature and salinity changes have been responsible for SLR of 0.6 mm per year during the same period.

To improve estimates of SLR, the researchers used a forward modelling technique, which previously has only been used regionally, but in this case it was applied on a global scale. They combined the Argo data with data from the GRACE satellite mission, a joint project of NASA and the German Aerospace Centre. GRACE observes changes in gravity and can be used to help us understand how mass, such as ice and the ocean, is redistributed around the Earth. The forward modelling technique can help improve the accuracy of GRACE-observed oceanic mass change.

Both satellite and float methods have some weaknesses, for example, data from Argo lack complete information on both the deep seas and the Polar regions, and the floats were not evenly distributed in their early days. GRACE data also tend to underestimate ocean mass. Thus, these data are combined to try and maximise accuracy.

The results indicated an SLR of around 2.4 mm a year, i.e. essentially matching estimates from the altimetry satellite data. Based on the GRACE data, the researchers conclude that melting ice sheets and mountain glaciers are about three times larger than 'steric' influences (i.e. thermal and salinity changes as monitored by ocean floats) on global SLR for the period of assessment. This is in contrast to the Fourth Intergovernmental Panel on Climate Change (IPCC) Assessment Report, which found that ice melting and steric effects on global sea level were largely comparable in scale. The GRACE data also support other observations that polar ice sheets and mountain glaciers are melting at an accelerated rate.

The researchers believe the difference between the two sets of findings is attributable to the new information provided by the Argo and GRACE projects, which was not available at the time of the Fourth IPCC Report. It may also indicate increasing melting of polar ice sheets and mountain glaciers, which could be a sign of accelerated climate change. The ability to predict future sea level rise more accurately, matching the satellite data, will assist in detecting such patterns more quickly in the future.