

Slope on the ocean surface lowers the sea level in Europe

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Research at the National Oceanography Centre (NOC) has discovered that a 'slope' on the ocean surface in the Strait of Gibraltar is lowering the sea level in Europe by 7cm. This research, published today in *Geophysical Research Letters* by Prof Chris Hughes of the NOC and University of Liverpool, will help to more accurately predict future sea levels by providing a more complete understanding of the factors that control it.

Prof Chris Hughes said "Much in the same way that stirring a cup of tea makes it swirl around a low point in the middle of the cup, the rotation of the Earth causes [ocean](#) currents in the northern hemisphere to slope as they flow, with a low in the [sea level](#) on their left hand side."

A current of water, with a volume approximately equivalent to four Amazonian rivers, is currently flowing into the Mediterranean from the Atlantic, returning below the surface. This surface flow means that sea level must drop to the north, across the Strait of Gibraltar.

By studying ocean models Prof Chris Hughes and collaborators were able to discover a simple relationship between the drop in sea level and the strength of flow of the [ocean current](#). This relationship suggested that the sea level in Portugal should be about seven centimetres lower than that on the Moroccan coast.

With the help of new satellite gravity measurements, from the European Space Agency's GOCE satellite as well as the NASA/DLR GRACE

satellite, Prof Hughes was able to measure this sea level drop. The gravity field measured by these satellites provides data on where the sea surface would be if no slopes existed in the ocean. By comparing this with the actual sea [surface](#) level, measured using satellite altimetry and tide gauges, it was possible to estimate the drop in sea level caused by the swirling currents. This drop is a large fraction of the total fall in coastal sea level between the equator and high latitudes.

The tide gauge data used in this research was from the NOC's Permanent Service for Mean Sea Level, and is the only dataset capable of providing information on sea level changes at the coast that occur over long time scales. This research was funded through a combination of funding from the NOC, the National Environmental Research Council (NERC), and ESA. The work was undertaken at NOC, the University of Liverpool, and the University of Bristol.

More information: Chris W. Hughes, Rory J. Bingham, Vassil Roussenov, Joanne Williams and Philip L. Woodworth, "The effect of Mediterranean exchange flow on European time-mean sea level." (2015) *Journal of Geophysical Research Letters*, [DOI: 10.1002/2014GL062654](https://doi.org/10.1002/2014GL062654)

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