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Monthly sea level fingerprints from 1992-2017, utilising ESA CCI Essential Climate Variables in an ensemble modelling framework

Stephen Chuter[1], Andrew Zammit-Mangion[2], Jonathan Bamber[1,3], and Jérôme Benveniste[4]
[1]School of Geographical Sciences, University of Bristol, Bristol, United Kingdom
[2]School of Mathematics and Applied Statistics and Securing Antarctica's Environmental Future, University of Wollongong, Wollongong, New South Wales, Australia
[3]Department of Aerospace and Geodesy, Data Science in Earth Observation, Technical University of Munich, Ottobrunn, 85521, Germany
[4]ESA ESRIN, Frascati, Rome, Italy

Sea level rise is one of the greatest socio-economic impacts of climate change in the 21st Century. Whilst global mean sea level is an essential climate variable (ECV) for assessing the integrated response of the Earth system to climate change, regional sea level variability is of primary concern for policy-making decisions and the development of adaptation strategies in coastal localities. Redistribution of terrestrial mass, in the form of hydrological and land ice mass fluxes, partly drives this regional sea level variability due to its impact on the Earth's gravity, rotation and deformation (GRD), termed 'Sea Level Fingerprints' or Barystatic-GRD fingerprints. With increasing mass losses projected from ice sheets and glaciers over the coming centuries, the magnitude and relative contribution of these Barystatic-GRD fingerprints to regional sea level change are expected to increase. As a result, accurately quantifying this phenomenon and its uncertainty is critical when assessing contemporary and future regional sea level variability.

Current contemporary Barystatic-GRD fingerprints are typically either calculated using a single mass loading observation source or provide discontinuous coverage since 1992 (the satellite altimetry era). Here, we present a continuous monthly Barystatic-GRD fingerprint product from 1992-2017, computed from an ensemble of mass loadings derived from differing observation techniques. To achieve this, we use the Ice Sheet and Sea Level Model (ISSM) sea level equation solver, which uses a finite element approach to solving the sea level equation at high spatial-temporal resolution, whilst maintaining computational efficiency. This enables us to use an ensemble modelling framework, ensuring the computed Barystatic-GRD fingerprint encompasses the variability between differing observation techniques. Additionally, it allows us to propagate the observation uncertainties into the fingerprint uncertainty in a robust manner. As well as the total Barystatic-GRD fingerprint, we assess the contribution of individual terrestrial components (Antarctica, Greenland, Glaciers, and hydrological mass change). This work is part of the Fingerprinting Approach to Close Regional Sea Level Budgets using ESA-CCI (FACTORS), a European Space Agency Climate Change Initiative Research Fellowship.