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July 23, 2024

Estimating Basin-Scale Sea Level Budgets with Satellite Gravity

Ocean mass estimates from satellite gravimetry and steric-corrected altimetry often diverge, especially at the ocean-basin scale. We present a method to provide basin-scale ocean mass trends by using Slepian functions to spatially localise the mass density field obtained from the GRACE satellite better. A negative buffer kernel is conventionally applied around the coastline to reduce the land signal leakage, but it can affect the recovered signal by up to 50% in individual ocean basins. Through synthetic experiments, we determine the optimal kernel size for Slepian functions to be 1–2 degree, much smaller than the typically required 300–500 km. With this approach, we estimate that the global mean ocean mass between 2003 and 2022 is increasing at a rate equivalent to $2.26 \pm 0.05\,\mathrm{mm\,yr^{-1}}$ of sea level rise, consistent with previous studies. Regionally, the South Atlantic Ocean has the largest mass increase rate of $3.56 \pm 0.12\,\mathrm{mm\,yr^{-1}}$, while the North Pacific Ocean has the smallest rate ($0.90 \pm 0.09\,\mathrm{mm\,yr^{-1}}$). Our results suggest that the Slepian functions can be used to provide a more accurate estimate of the ocean mass trend at the basin scale, and the sea level change varies significantly across regions.

Acknowledgements

We thank the following individuals for the support of this research programme: Kirsten Limesand, PhD, Dean of the Graduate College, Frans Tax, PhD, Associate Dean of Student Affairs and Diversity & Inclusion, Donna Treloar, MA, UROC Director, Tianna Urrea MacMeans, UROC Coordinator, Jennifer Batchelder, PhD, ASEMS Director and PI, Nura Dualeh, MA, ASEMS STARS founder, and Leah Callovini, MS, ASEMS STARS Program Manager. We also thank Christopher Harig, PhD, Assistant Professor, Department of Geosciences and Eric Cicero, PhD student, Department of Geosciences, for their guidance and support. Finally, we thank Melinda Willett Struyk, MA, ABD, Lidia Azurdia Sierra, MPH, and Leah Callovini, MS for their feedback on the manuscript and presentation.

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