EGU22-8895
https://doi.org/10.5194/egusphere-egu22-8895
EGU General Assembly 2022

Reconstructing upper ocean carbon variability using ARGO profiles and CMIP6 models

Katherine Turner[1], Richard G. Williams[1], Anna Katavouta[1,2], and Doug M. Smith[3]
[1]University of Liverpool, Department of Earth, Ocean, and Ecological Sciences, Liverpool, United Kingdom
[2]National Oceanography Centre, Liverpool, United Kingdom
[3]Met Office Hadley Centre, Exeter, United Kingdom

Historically, ocean carbon content has been poorly sampled due to the logistical difficulties inherent in carbonate chemistry measurements. As a result, global products of ocean carbon content observations have been restricted to calculate climatologies or long-term trends. Recent innovations with machine learning have provided for observational reconstructions of multidecadal and interannual carbon variability. In this work, we create a complementary method for reconstructing historical carbon variability by drawing upon the Ensemble Optimal Interpolation method used for reconstructing historical ocean heat and salinity [1-3]. Ensemble Optimal Interpolation draws upon first-order relationships between variables and use covariances from model ensembles to propagate information from data-rich to data-sparse regions.

We test our method by conducting synthetic reconstructions of upper ocean carbon content using ARGO-style sampling distributions with CMIP6 ensemble covariance fields. Sensitivity tests of local carbon reconstructions suggest that around 50% of ocean carbon variability can be reconstructed using temperature and salinity measurements. Expanding the synthetic reconstructions to include irregular sampling consistent with ARGO profile locations results in a similar capacity to reconstruct ocean carbon variability, as the increased information provided from multiple sampling locations compensates for the propagation of errors within the CMIP6 covariance fields. Our initial results indicate that the first-order relationships between temperature, salinity, and carbon can be used to describe a substantial proportion of historical carbon variability. In addition to showing promise for a new historical reconstruction complementary to current products, our work emphasises the important links between hydrographic and carbon variability for much of the global ocean.

References

[1] D. M. Smith and J. M. Murphy, 2007. "An objective ocean temperature and salinity analysis using covariances from a global climate model," *JGR Oceans*.

[2] L. Cheng, K. E. Trenberth, J. T. Fasullo, T. Boyer, J. T. Abraham and J. Zhu, 2017. "Improved

estimates of ocean heat content from 1960 to 2015," *Science Advances*.

[3] L. Cheng, K. E. Trenberth, N. Gruber, J. P. Abraham, J. T. Fasullo, G. Li, M. E. Mann, X. Zhao and J. Zhu, 2020. "Improved Estimates of Changes in Upper Ocean Salinity and the Hydrological Cycle," *Journal of Climate*.