



Magnitude, trends, and variability of the global ocean carbon sink from 1985-2018

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The RECCAP2 global ocean project provides an assessment of the mean, trends, and variability of the global ocean carbon sink for the period 1985-2018. The analysis is based on a comprehensive assessment of models and observation-based products, including global ocean biogeochemical models (GOBMs), pCO₂ observation-based air-sea CO₂ flux products, ocean data assimilation models, and DIC-observation based products. We find that the mean ocean CO₂ sink from 1985-2018 is -1.7 ± 0.3 PgC yr⁻¹ as diagnosed by pCO₂-observation based air-sea CO₂ flux products. The dominant component of the global air-sea CO₂ flux is the oceanic uptake of anthropogenic CO₂, which is estimated at between -2.0 to -2.6 PgC yr⁻¹ using a range of GOBMs, assimilation models and DIC-based products. The second largest component of the global air-sea CO₂ flux is the outgassing of terrestrially-derived CO₂, which is estimated at 0.65 ± 0.3 PgC yr⁻¹ but is not yet fully resolved by RECCAP2 models. The trend in the global air-sea CO₂ flux from 1985-2018 ranges from -0.26 PgC yr⁻¹ decade⁻¹ in the GOBMs to -0.39 PgC yr⁻¹ decade⁻¹ in the pCO₂ products. Over the 2001-2018 period, when the pCO₂-based estimates benefit from improved data coverage, they predict a strengthening trend in the ocean carbon sink of -0.63 PgC yr⁻¹ decade⁻¹. This is driven primarily by the trend in anthropogenic carbon uptake of -0.41 PgC yr⁻¹ decade⁻¹, and secondarily by a climate-forced trend of -0.28 PgC yr⁻¹ decade⁻¹. This climate-forced strengthening of the ocean carbon sink since 2001 is not diagnosed in the GOBMs, and the reasons for this trend remain unclear. We find that the interannual to decadal variability of the global carbon sink is mainly driven by climate variability, with the climate-driven variability exceeding the CO₂-forced variability by 2-3 times. GOBMs suggest that the climate-driven variability is about 4-8% of the global mean carbon sink, while the climate-driven variability is about 9-14% of the global mean flux in the observation-based pCO₂ products. In all, the RECCAP2 analysis provides a state-of-the-art summary of our current knowledge of the ocean carbon sink, and the mechanisms driving its magnitude, trends, and variability over time.

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