EGU22-6326
https://doi.org/10.5194/egusphere-egu22-6326
EGU General Assembly 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Interannual-to-decadal variability of the Southern Ocean carbon uptake in a high-resolution ocean biogeochemistry model

Lavinia Patara[1], Jan Klaus Rieck[2], Toste Tanhua[1], Malin Ödalen[1], and Andreas Oschlies[1]
[1]GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel, Ocean Circulation and Climate Dynamics, Kiel, Germany (lpatara@geomar.de)
[2]Department of Atmospheric and Oceanic Sciences, McGill University, Montreal, Quebec, Canada

Recent studies point to pronounced decadal variability in the Southern Ocean carbon sink over the past decades, but the mechanisms are still not fully understood. In this study, the regional patterns and bio-physical drivers of the interannual-to-decadal variability of the air-sea CO_2 fluxes in the Antarctic Circumpolar Current (ACC) are investigated. A suite of global ocean biogeochemistry configurations (based on the NEMO-MOPS model) is used to perform hindcast experiments covering the period 1958-2018. The configurations include a non-eddying 0.5° model, an eddy-permitting 0.25° model, and a global 0.5° model featuring an eddy-rich 0.1° nest between 30°S and 68°S. The 0.25° model is also used to perform additional sensitivity experiments, where the variability of the wind stress or of the buoyancy forcing is suppressed on interannual time scales. All simulations show a positive trend in the air-sea CO_2 fluxes over ACC, with a weaker rate of increase in the 1970s and in the 1990s, and a stronger rate of increase in the 1980s and 2000s. The interannual and decadal variability of air-sea CO_2 fluxes is highest in frontal regions of the ACC, especially in the Southeast Pacific basin. Wind stress emerges as the dominant driver of the large interannual and decadal variability of air-sea CO_2 fluxes at subpolar latitudes. On the other hand, air-sea buoyancy fluxes gain more relevance at middle latitudes. The simulations highlight the relevant role of explicitly simulating ocean mesoscale eddies for the Southern Ocean carbon uptake. Indeed, the 0.1° model shows a steeper trend of the Southern Ocean carbon uptake with respect to the lower-resolution models, driven to a large extent by a higher uptake of anthropogenic carbon.