

*Global Biogeochemical Cycles*

Supporting Information for

**Quantifying errors in observationally-based estimates of ocean carbon sink variability**

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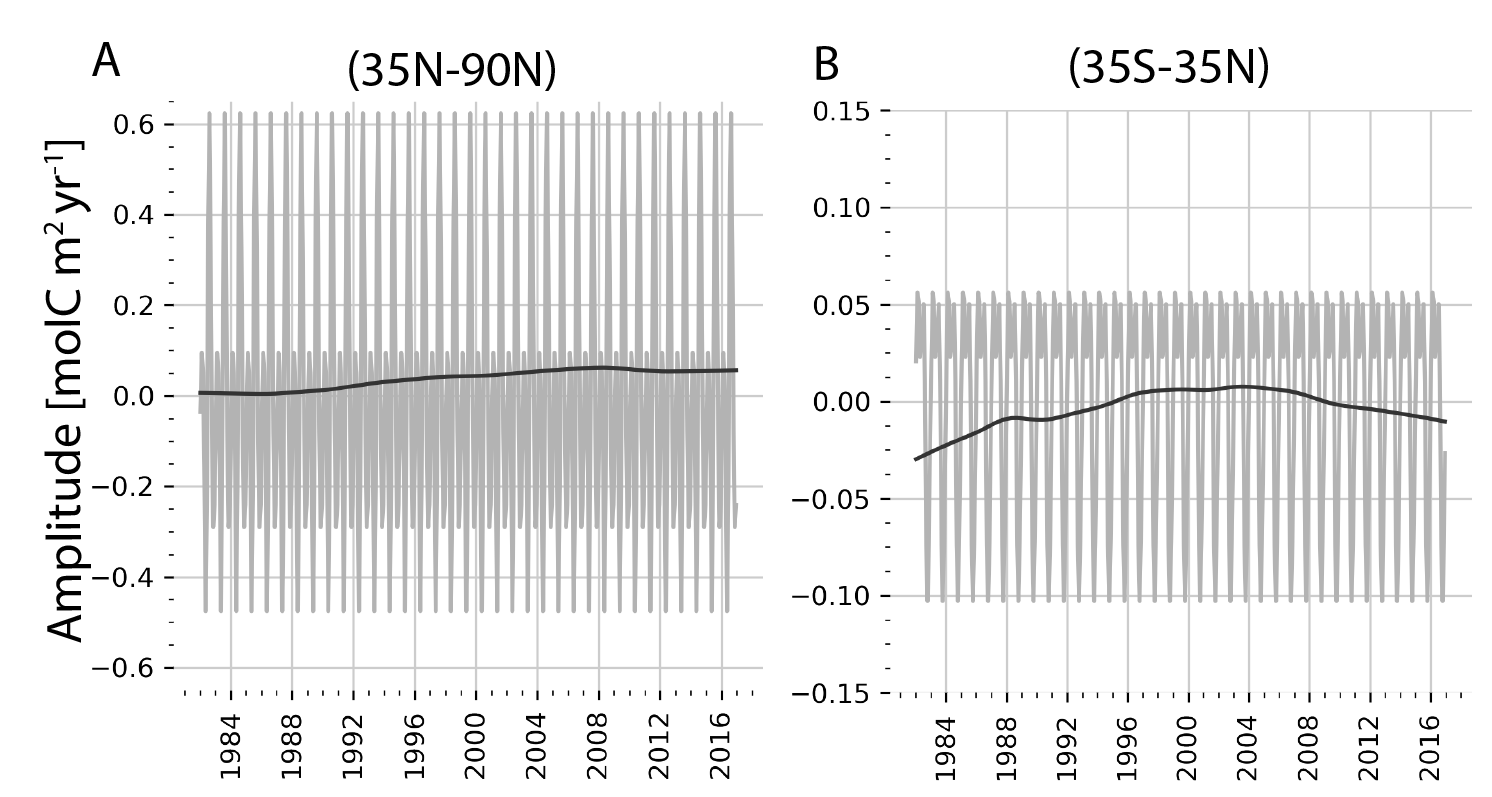
Air-sea CO2 flux () is calculated in mol C m-2 yr-1 for each month at each 1°x1° spatial location using the [(Wanninkhof, 1992)](https://www.zotero.org/google-docs/?DiEkKU) parameterization (Equation 1).

which parameterizes as a function of the gas transfer velocity (), CO2 solubility (), ice fraction (), and partial pressure of CO2 in moist air () and surface ocean (). Overbars denote monthly averages. We use the [(Wanninkhof, 1992)](https://www.zotero.org/google-docs/?WcNCDm) gas transfer velocity with the [(Sweeney et al., 2007)](https://www.zotero.org/google-docs/?mPlyW0) scale factor of 0.27 (Equation 2).

Because high-frequency output is not available for all large ensemble members, and to be consistent with the flux calculation used in the real-world application of the SOM-FFN flux product, we use ERA-interim 6-hourly global atmospheric reanalysis [(Dee et al., 2011)](https://www.zotero.org/google-docs/?XpoLNa) as an estimate for the wind-speed variance ().

Solubility is calculated following [(Weiss, 1974)](https://www.zotero.org/google-docs/?Y4jFy8) with the [(Wanninkhof, 1992)](https://www.zotero.org/google-docs/?0hm7Cj) Schmidt number (Sc). Partial pressure of moist air () is calculated following Equation 3.

Where is the dry air mixing ratio of atmospheric CO2, is the total atmospheric pressure, and is the saturation vapor pressure [(Dickson et al., 2007)](https://www.zotero.org/google-docs/?Ys4wQ4).

Figure S1. The average seasonal cycle (gray) and decadal component (black) is displayed across A) 35°N - 90°N and B) 35°S - 35°N. Note different y-axis scales.

[Dee, D. P., et al. (2011). The ERA-Interim reanalysis: Configuration and performance of the data assimilation system. *Quarterly Journal of the Royal Meteorological Society*, *137*(656), 553–597.](https://www.zotero.org/google-docs/?mrmQ2U) <https://doi.org/10.1002/qj.828>

[Dickson, A. G., Sabine, C. L., Christian, J. R., Bargeron, C. P., & North Pacific Marine Science Organization (Eds.). (2007). *Guide to best practices for ocean CO2 measurements*. North Pacific Marine Science Organization.](https://www.zotero.org/google-docs/?mrmQ2U)

[Sweeney, C., Gloor, E., Jacobson, A. R., Key, R. M., McKinley, G., Sarmiento, J. L., & Wanninkhof, R. (2007). Constraining global air-sea gas exchange for CO2 with recent bomb 14C measurements. *Global Biogeochemical Cycles*, *21*(2).](https://www.zotero.org/google-docs/?mrmQ2U)

[Wanninkhof, R. (1992). Relationship between wind speed and gas exchange over the ocean. *Journal of Geophysical Research: Oceans*, *97*(C5), 7373–7382.](https://www.zotero.org/google-docs/?mrmQ2U)

[Weiss, R. F. (1974). Carbon dioxide in water and seawater: The solubility of a non-ideal gas. *Marine Chemistry*, *2*(3), 203–215. https://doi.org/10.1016/0304-4203(74)90015-2](https://www.zotero.org/google-docs/?mrmQ2U)