EGU23-4184, updated on 06 Jun 2023
https://doi.org/10.5194/egusphere-egu23-4184
EGU General Assembly 2023

A spatially explicit uncertainty analysis of the air-sea CO2 flux from observations

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The ocean is a critical component of the global carbon budget. With a carbon reservoir substantially larger than the atmosphere's and an air-sea carbon flux absorbing approximately 25% of anthropogenic carbon annually, understanding and quantifying the air-sea carbon dioxide (CO_2) flux and ocean carbon storage is essential for climate research. With this in mind, we developed a two-step neural network approach (SOM-FFN) to reconstruct the partial pressure of carbon dioxide (pCO_2) at a 1°x1° resolution, providing an important global observational resource. Uncertainties in neural network and other interpolation techniques are, however, still substantial and remain poorly quantified, especially for remote or infrequently sampled regions. These uncertainties, which include mapping or extrapolation uncertainties as well as uncertainties in wind and gas transfer formulations, have a significant effect on our ability to balance regional and global carbon budgets. Therefore, we are reporting on the development of a two dimensional (longitude and latitude) gridded uncertainty product, available publicly alongside our standard neural network air-sea CO_2 flux output from the SOM-FFN method. This dataset will pave the way for a better guided use of the computed air-sea CO_2 fluxes and their regional uncertainties, taking into account major sources of air-sea CO_2 flux uncertainty. Early analysis presented here allows for identification of regions of higher uncertainty, such as high latitude open ocean, and points to areas within the flux calculation where uncertainty must be further constrained in order to contribute to improving balance of regional carbon budgets in support of the UN stocktake.