

# An observational large ensemble for air-sea CO<sub>2</sub> flux



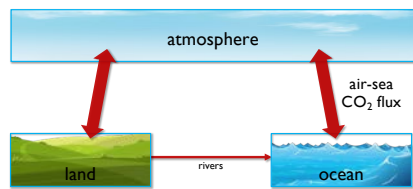
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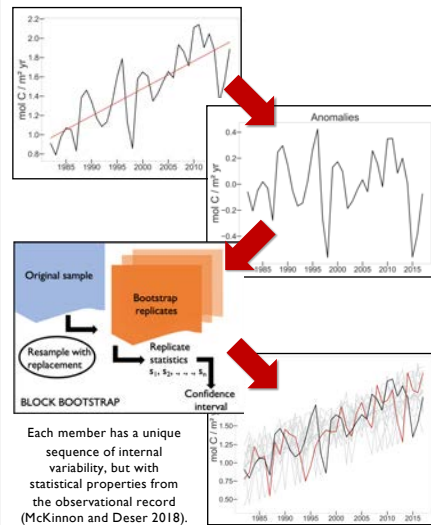
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## Introduction

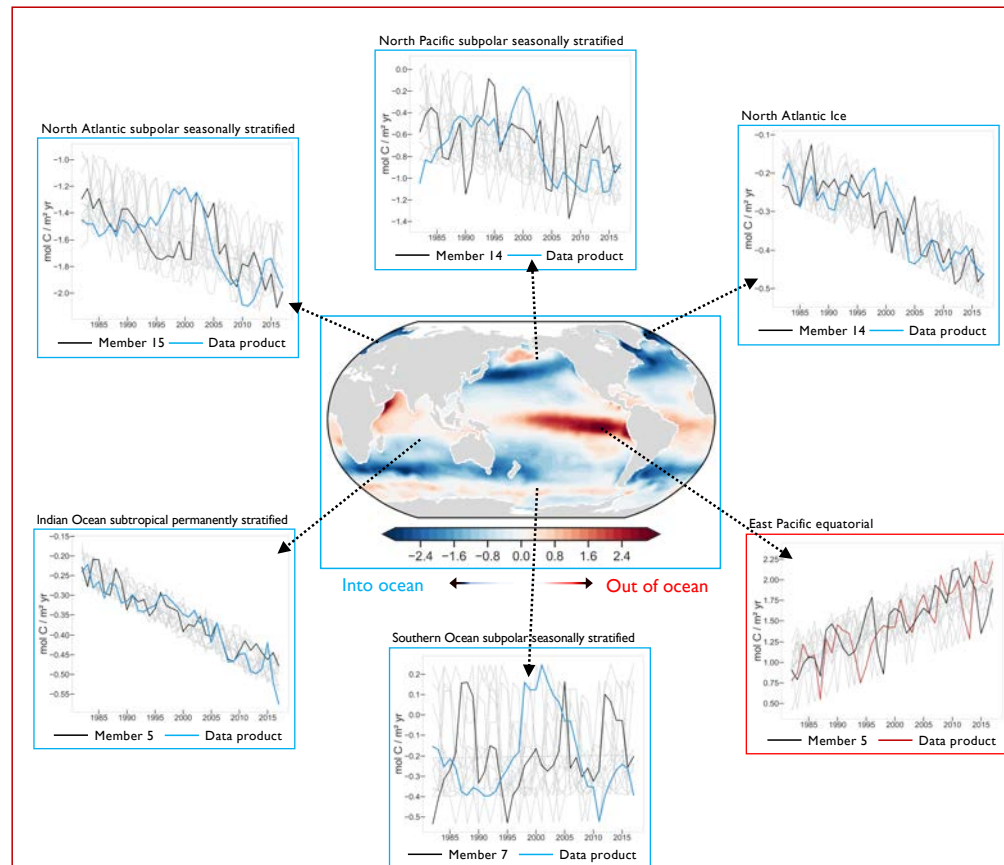
Currently the global ocean is absorbing nearly 25% of annual carbon dioxide emissions (Le Quéré et al. 2018). Observation-based, gap-filled estimates suggest substantial past variations in the rate of exchange, or flux, of carbon dioxide (CO<sub>2</sub>) from air-to-sea on interannual and decadal timescales (Landschützer et al. 2019). We seek to understand the causes of these variations in an attempt to make better near-term predictions and long-term projections of the future climate system.



## Synthetic ensemble

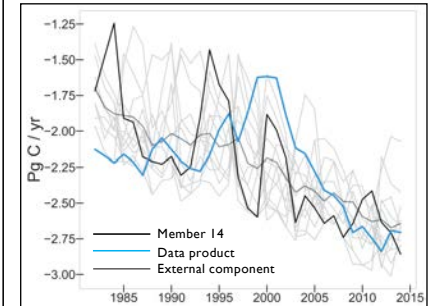


## Results



**Above center:** Average sea-air CO<sub>2</sub> flux from 1982-2018. Positive represents outgassing. Units are in mol C m<sup>-2</sup> yr<sup>-1</sup>.  
**Surrounding time series:** Temporal evolution of air-sea CO<sub>2</sub> flux in various regions with linear least-squares trend. Regions are defined according to the corresponding location of the biogeographical biomes as presented by Fay and McKinley (2014). Self-Organizing Map Feed-Forward Neural Network (SOM-FFN) data product provided by Landschützer et al. 2017.

## The question



**Above:** Temporal evolution of globally-integrated air-sea CO<sub>2</sub> flux with externally forced trend from IPSL-LR ensemble overlain. Units are in Pg C yr<sup>-1</sup>.

Is the observed air-sea CO<sub>2</sub> flux variability of **internal** (i.e., large-scale climate patterns such as El Niño Southern Oscillation (ENSO) or Southern Annular Mode (SAM)) or **external** (i.e., driven by volcanic eruptions/anthropogenic emissions) origin?

## Next: observational large ensemble

Future work will consider other ways to derive the externally-forced component of air-sea CO<sub>2</sub> flux including multiple large ensembles of Earth system models.

## References

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