Wind induced changes in the ocean carbon sink

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Overview

### Metrics and uncertainties

1. *Observed* and *simulated* changes in the SH westerlies.

2. Ocean carbon uptake in an OBGCM driven by specified winds, with uncertainties due to...
   - model parametrization of mesoscale eddies.
   - poorly constrained winds.
Historical and future changes
CMIP5 jet position and strength

Historical changes
CMIP5 vs 6 reanalyses
Historical trends (1979-2010)
CMIP5 vs reanalyses

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Historical trends (1979-2010)
Zonal mean trends in u10m
Carbon uptake in an OBGCM forced with 20CR winds

N. C. Swart et al. (2014), Wind-driven changes in the ocean carbon sink, *Biogeosciences, 11*.,
Carbon uptake in an OBGCM
Net global carbon flux and wind feedback

Carbon uptake in an OBGCM
Wind induced flux anomaly

Carbon uptake in an OBGCM
Wind induced trends in Southern Ocean surface flux

Carbon uptake in an OBGCM
Changes in eddy diffusivity and MOC

N. C. Swart et al. (2014), Wind-driven changes in the ocean carbon sink, *Biogeosciences*, **11**.
Carbon uptake in an OBGCM
Uncertainty in reanalysis winds

6 Reanlyzes winds → UVic ESCM → Ocean carbon uptake

Carbon uptake in an OBGCM
Effect of reanalysis wind uncertainty on carbon uptake trends

Carbon uptake in an OBGCM
The bias in CMIP3 pre-industrial winds

Carbon uptake in an OBGCM
The effect of CMIP3 wind-stress biases on ocean carbon

Carbon uptake in an OBGCM
The effect of CMIP5 wind biases on ocean carbon

![Graph showing ocean carbon uptake over time](image-url)
Conclusions

1. Intensifying westerlies reduce ocean carbon uptake, but...

2. **observed** and **simulated** changes in the westerlies are highly uncertain.
   - OBGCM estimates of ocean carbon uptake depend on choice of forcing.
   - Carbon uptake differences in CMIP ESMs stem partly from wind spread.

3. the wind feedback is sensitive to the eddy parameterization scheme in coarse resolution models.