SONATA

update on modelling the Southern Ocean CO_2 flux

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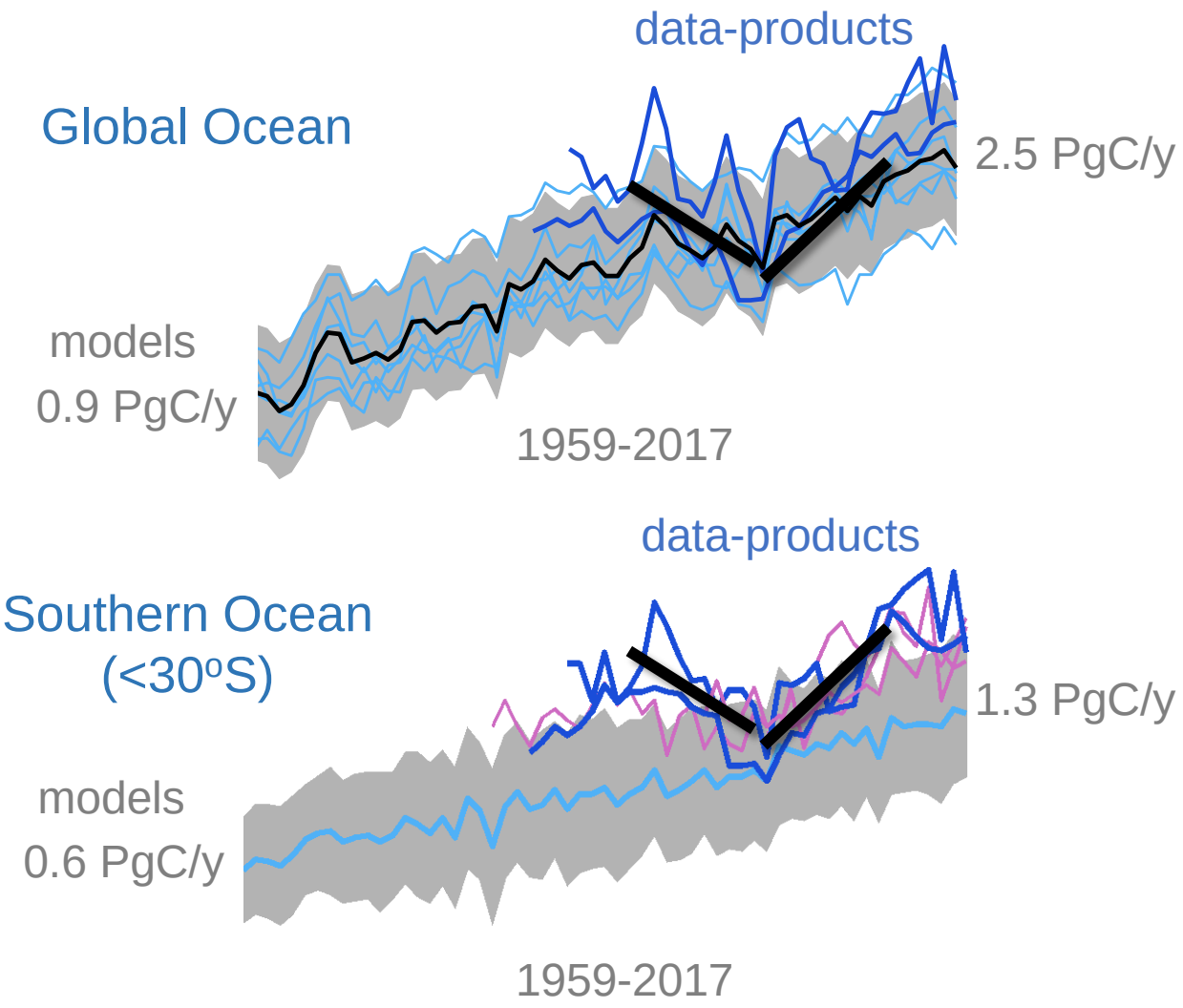
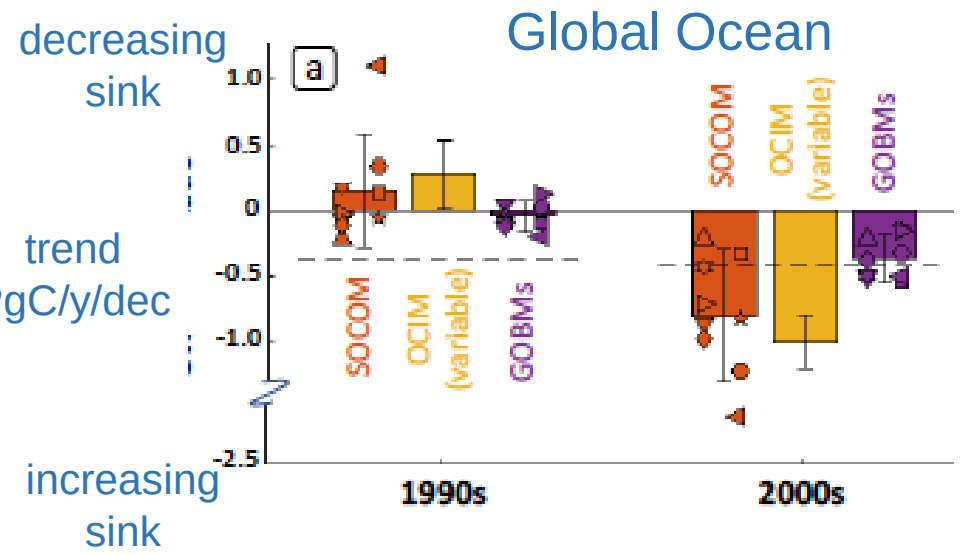
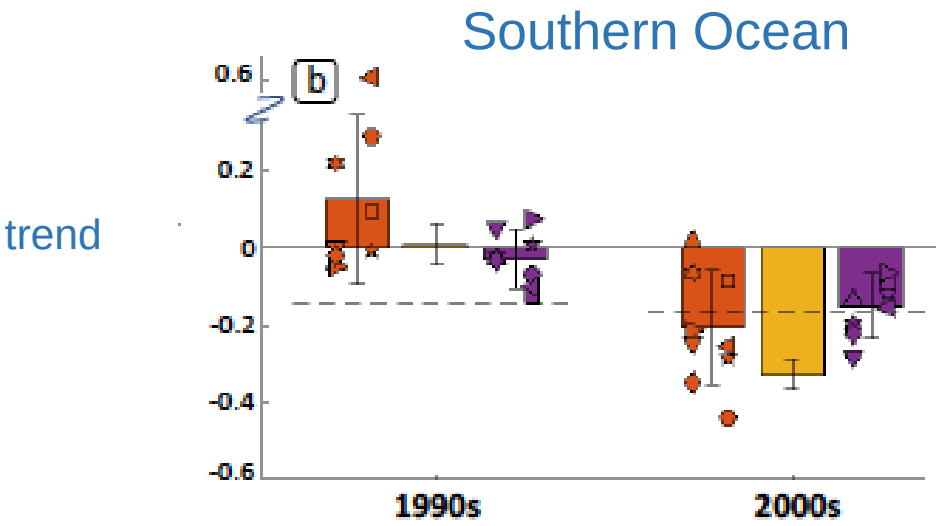
University of East Anglia

Missing variability in ocean carbon models confirmed with multiple data streams







DeVries, Le Quéré et al, *PNAS*, 2019

Models: CCSM-BEC | CSIRO | MITgem-REcoM2 | MICOM-HAMMOC | NEMO-PISCES (CNRM)| NEMO-PlankTOM5 | NorESM-OC; pCO_2-based products from C. Rödenbeck and P. Landschützer with SOCATv5; Ref: Global Carbon Budget 2017; Le Quéré et al. ESSD 2018

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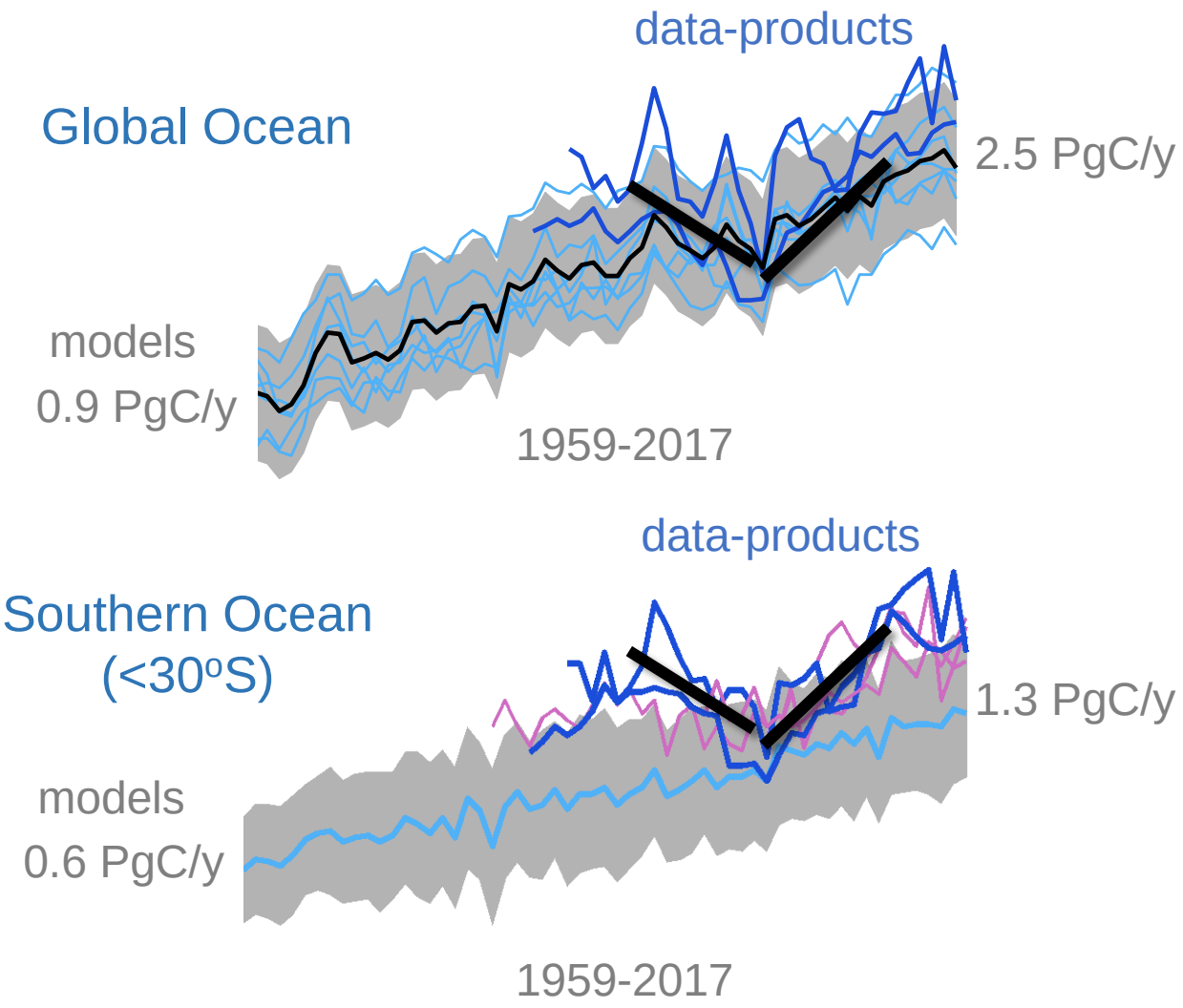
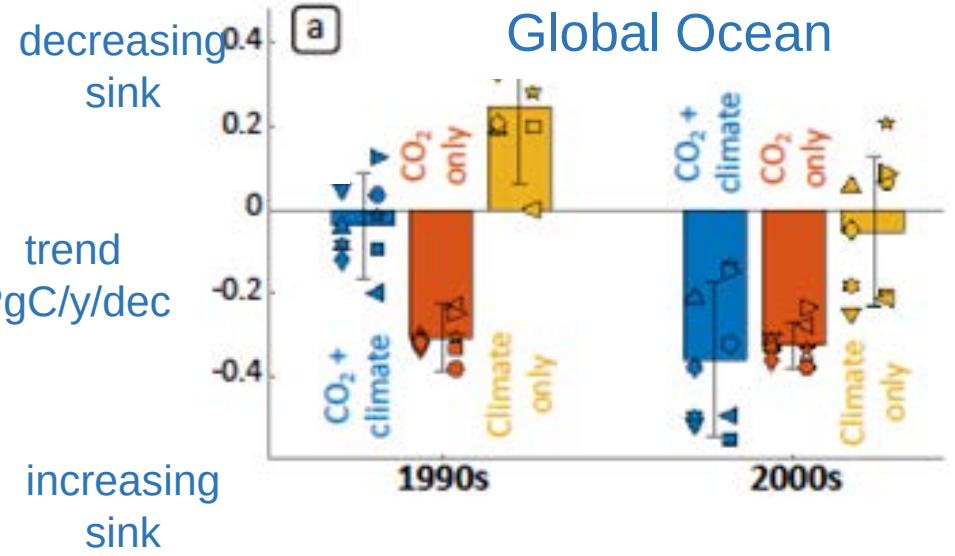
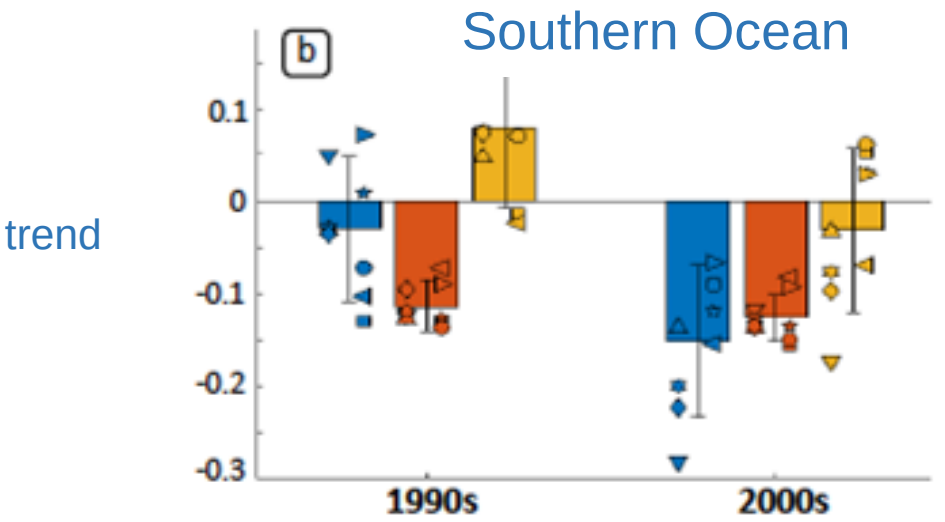
Variability in ocean carbon models from climate variability







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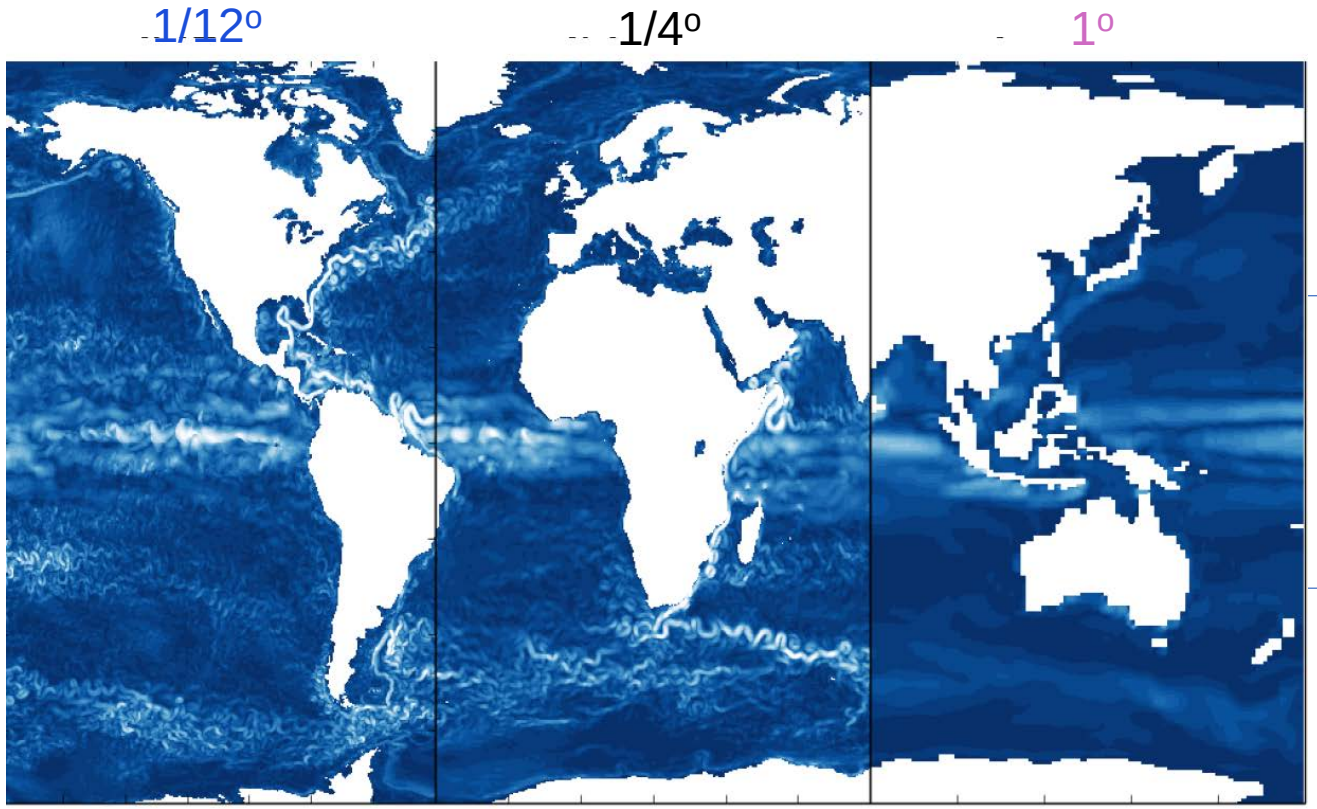
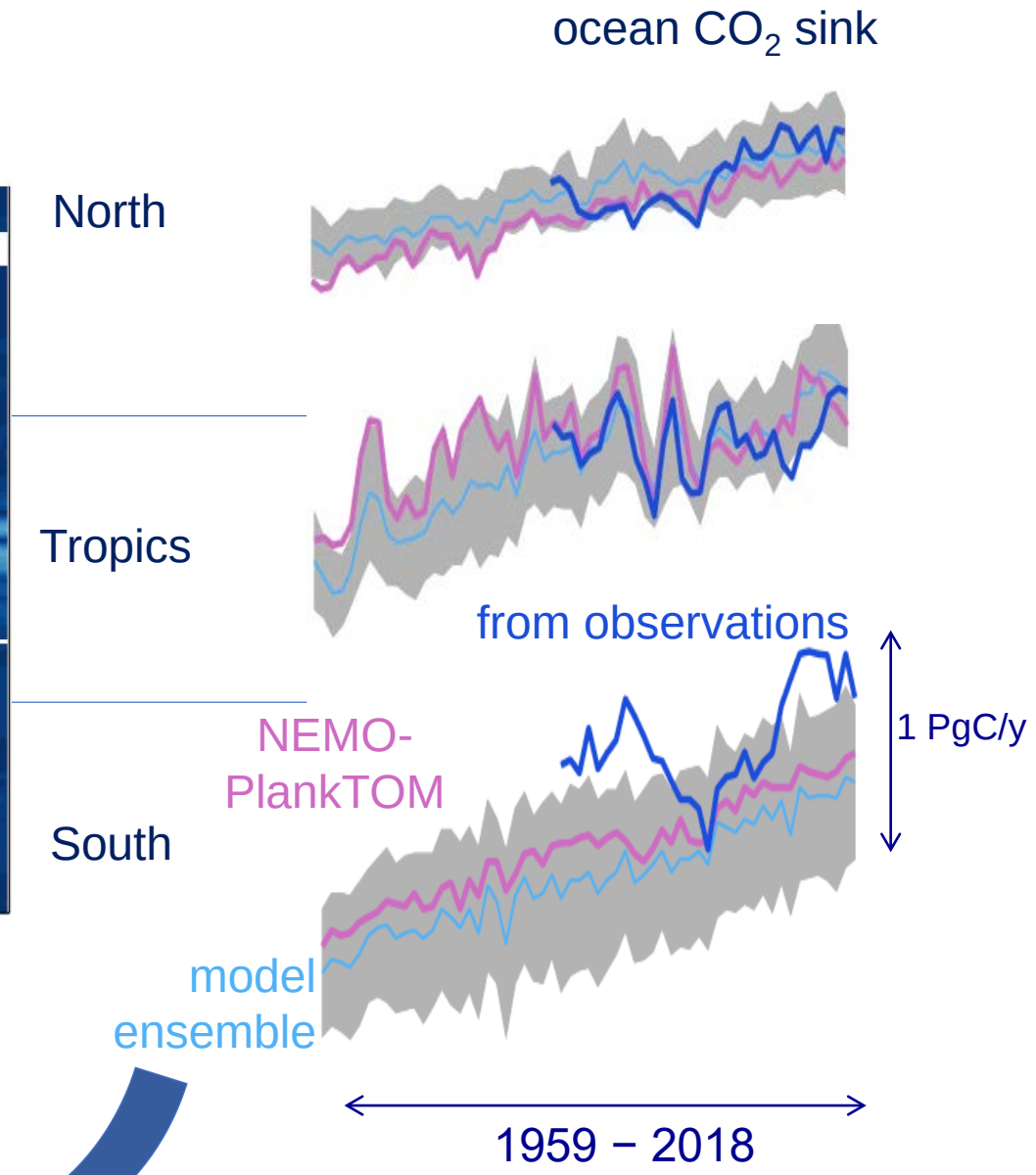
Missing variability in ocean carbon models originates at high latitudes, especially in the SO





next step: more analysis & 1/4º resolution

Surface current speeds
Source: Met Office Hadley Centre Science Strategy 2016-2020.

Le Quéré et al *ESSD* 2018

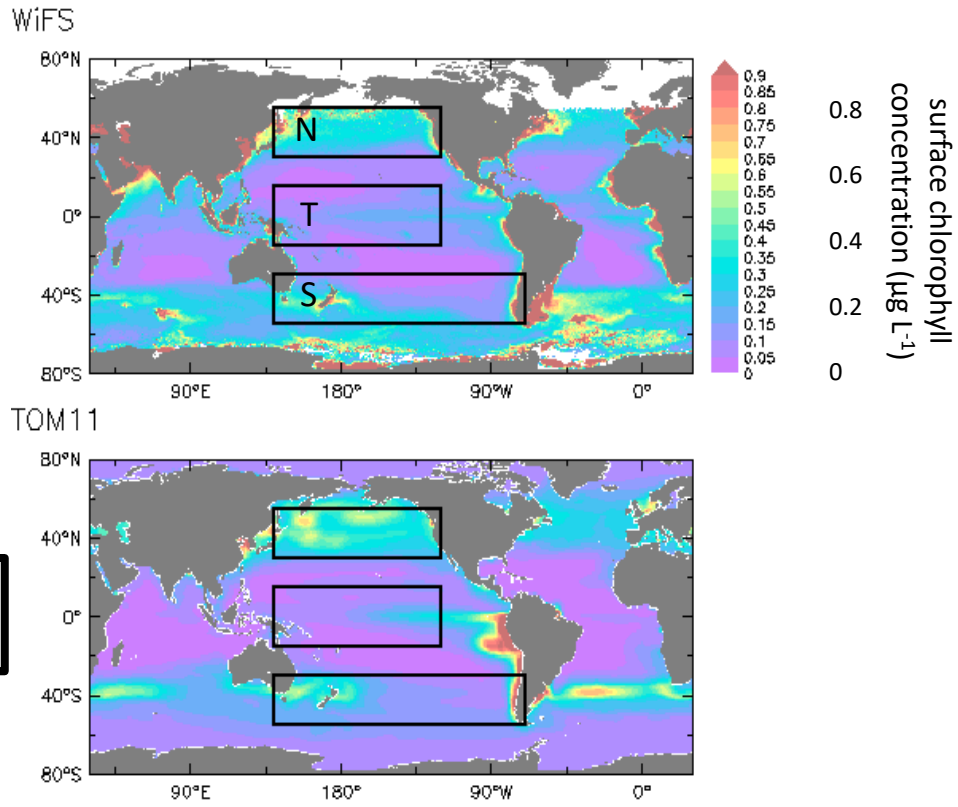
Development in ecosystem model: addition of jellyfish improves representation of surface chla

(extra piece of work by Becci Wright)

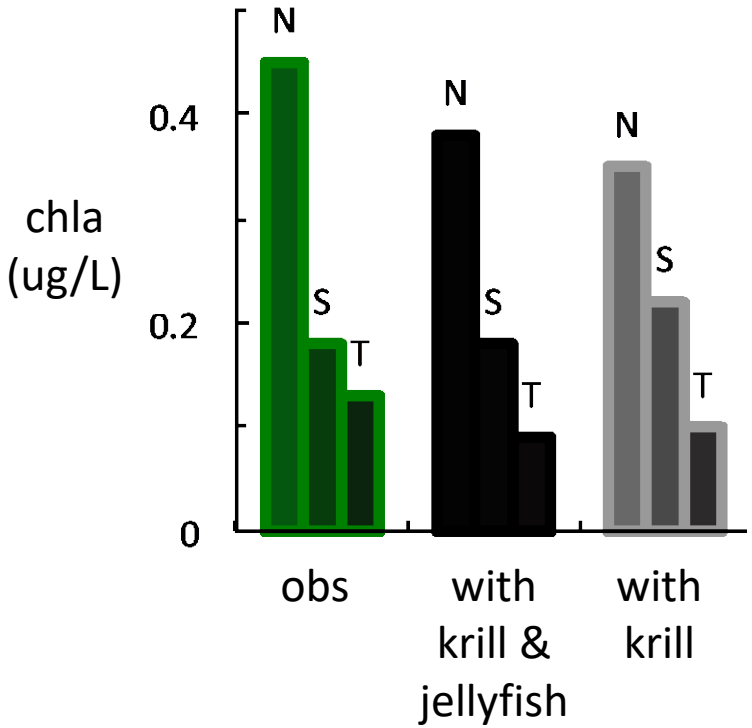
SeaWiFS
satellite observations

PlankTOM11
model results

Surface Chlorophyll



North/South chla ratio enhanced and better aligned with observations when top grazers are included (krill & jelly)



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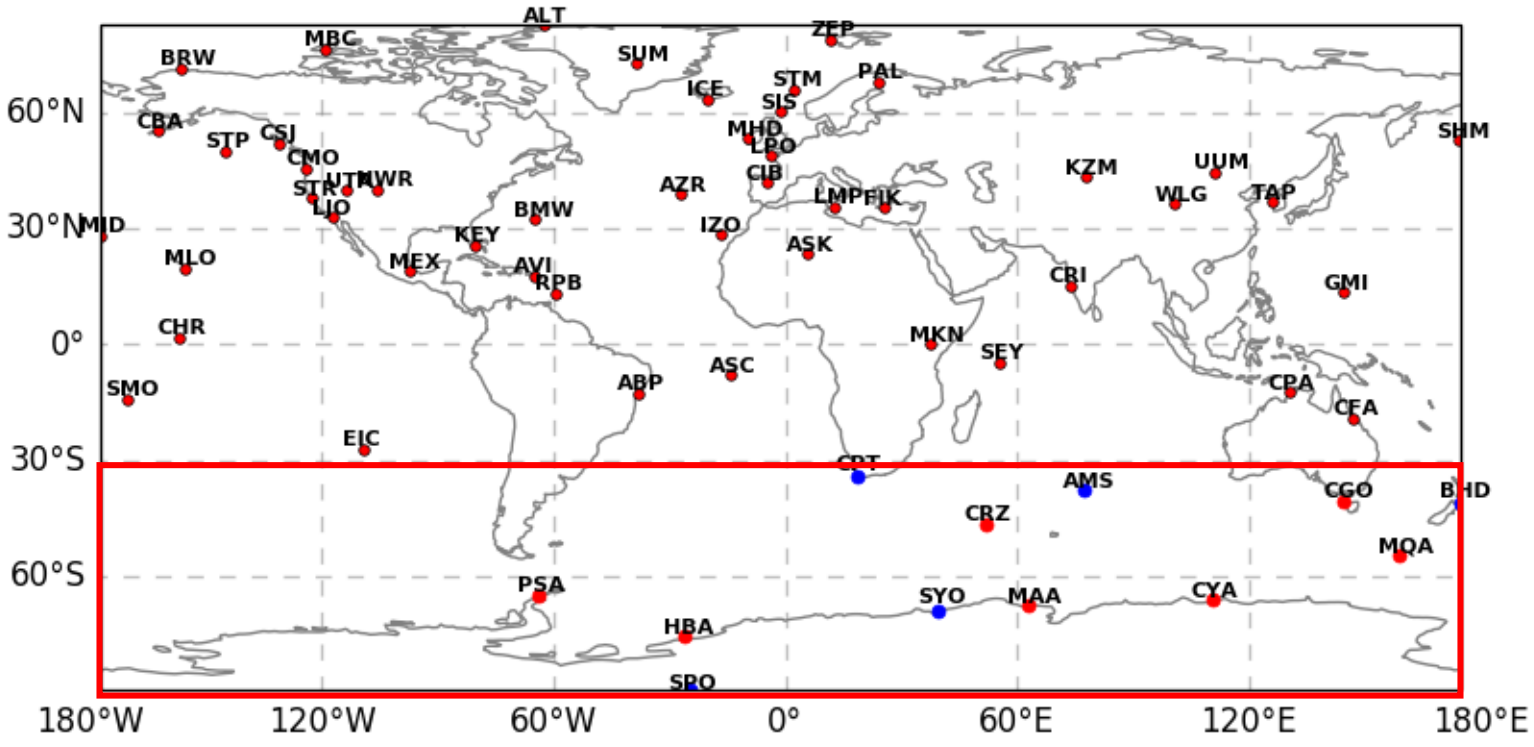
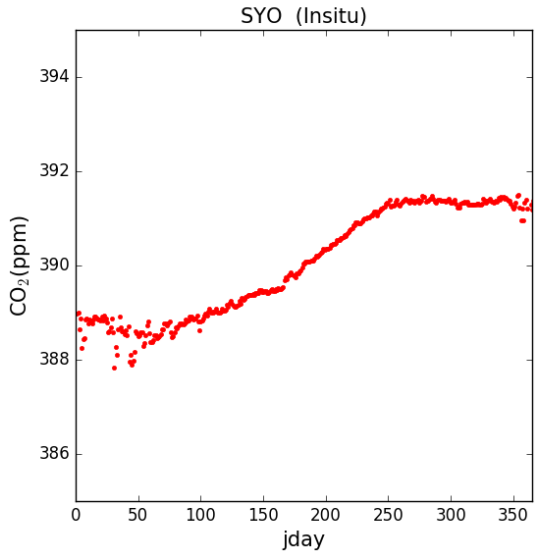
Following Le Quéré et al., 2016 Biogeosciences

Constraints from the atmosphere

Atmospheric CO_2 Measurements used as Data Constraints in the GEOS-Chem LETKF System





Flask+ Insitu

Continuous observations from Obspack_v2019 (Year=2012)

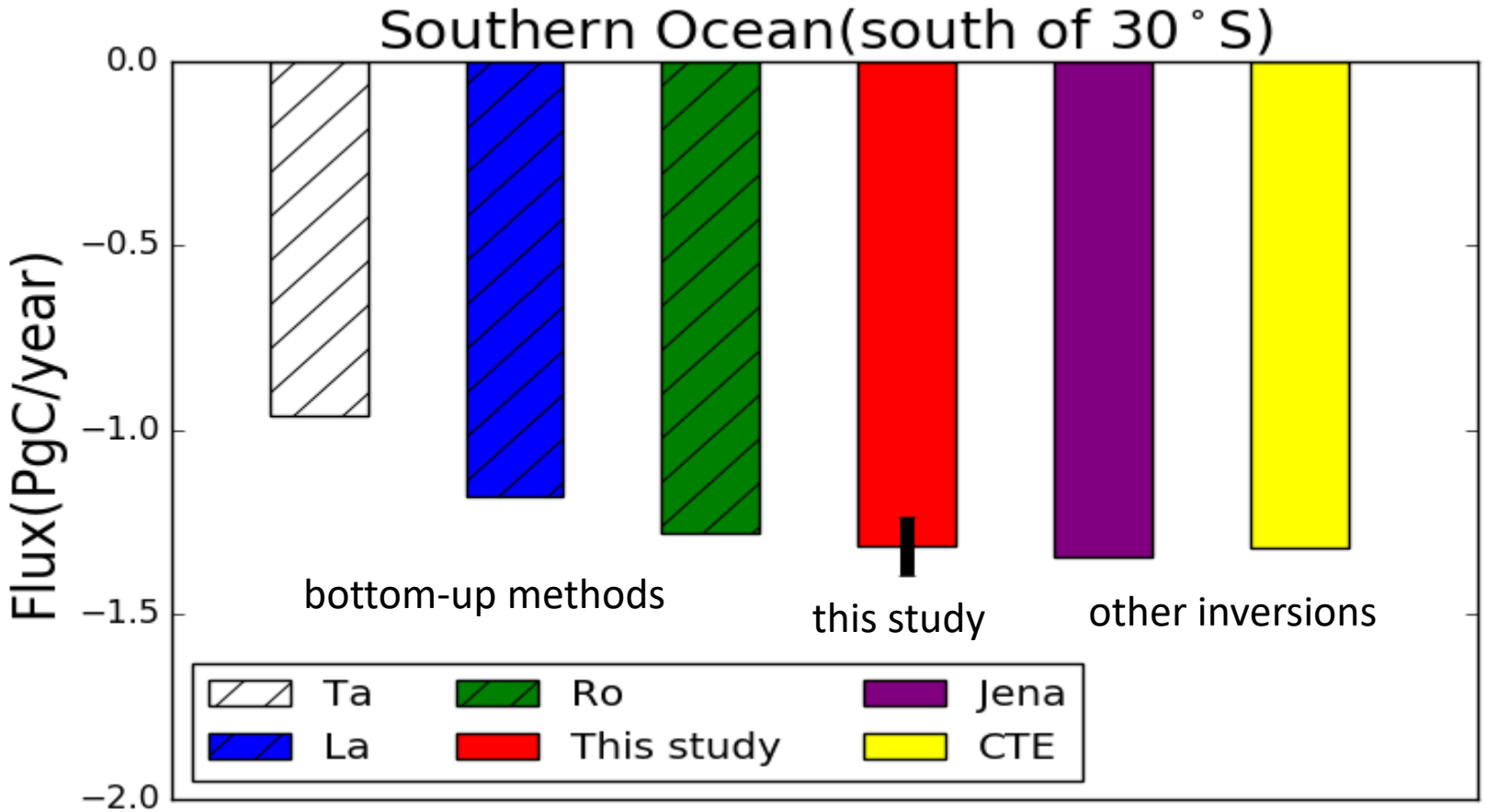
Red: Flask

Blue: Flask+ Insitu (CPT,AMS,SPO,SYO,BHD)

Slides: Chen and Suntharalingam

Constraints from the atmosphere

Southern Ocean Flux Estimates : Decadal Mean (2003-2012)

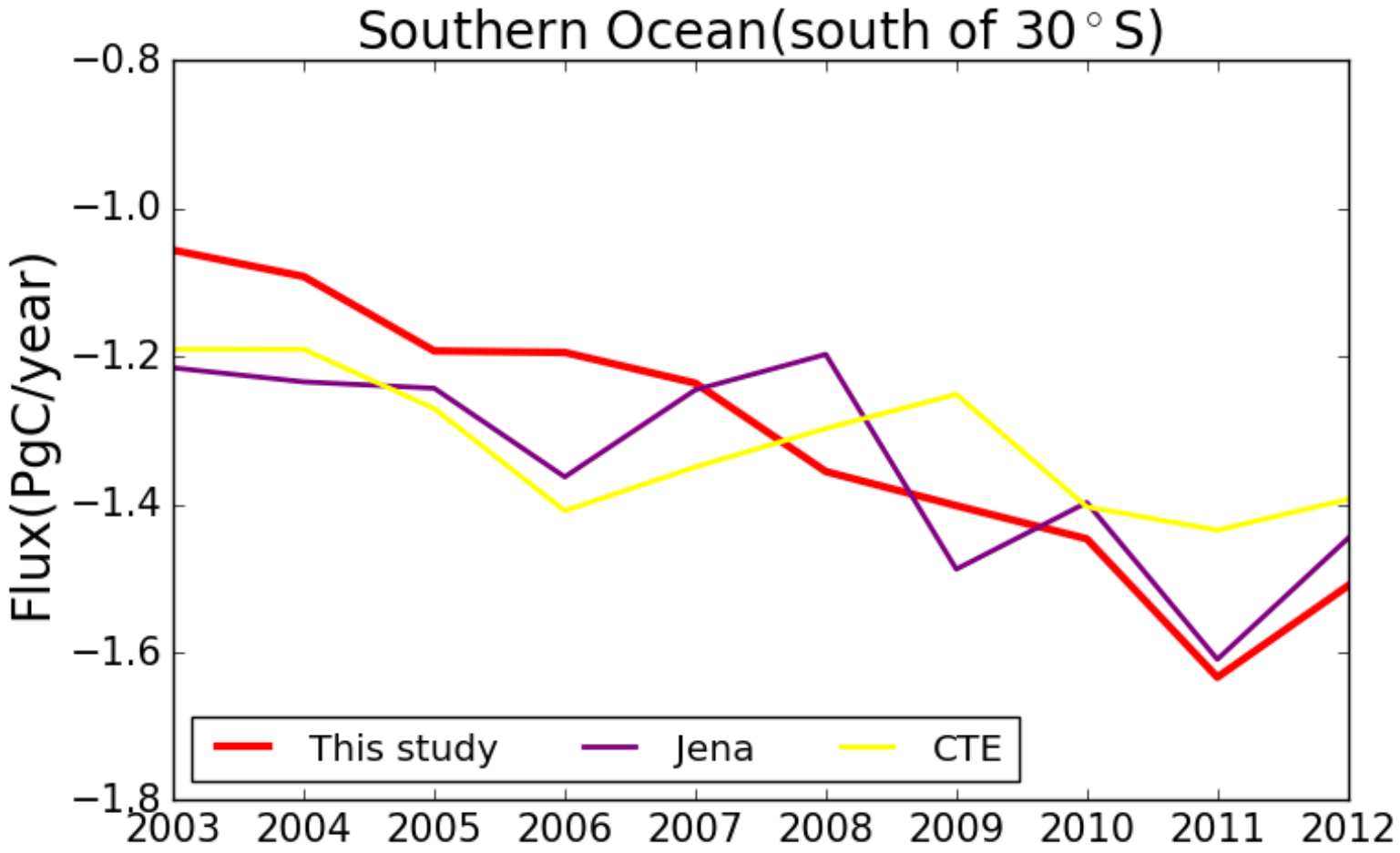


range in this study based on spread
using different prior estimates

Slides: Chen and Suntharalingam

Constraints from the atmosphere

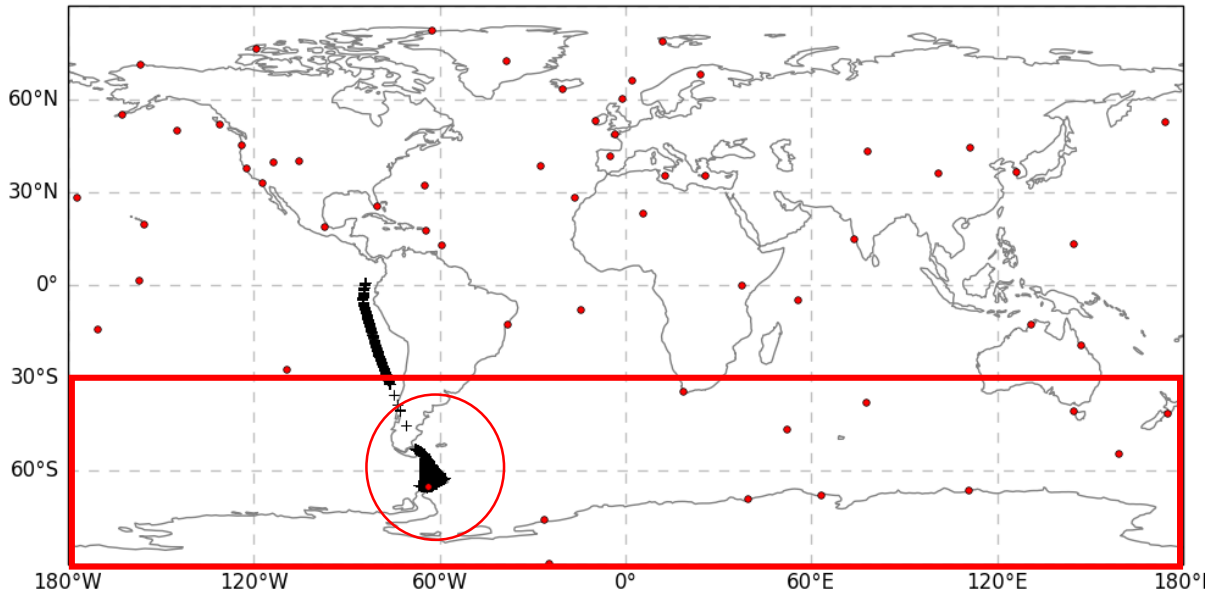
Comparison with other inverse studies 2003-2012

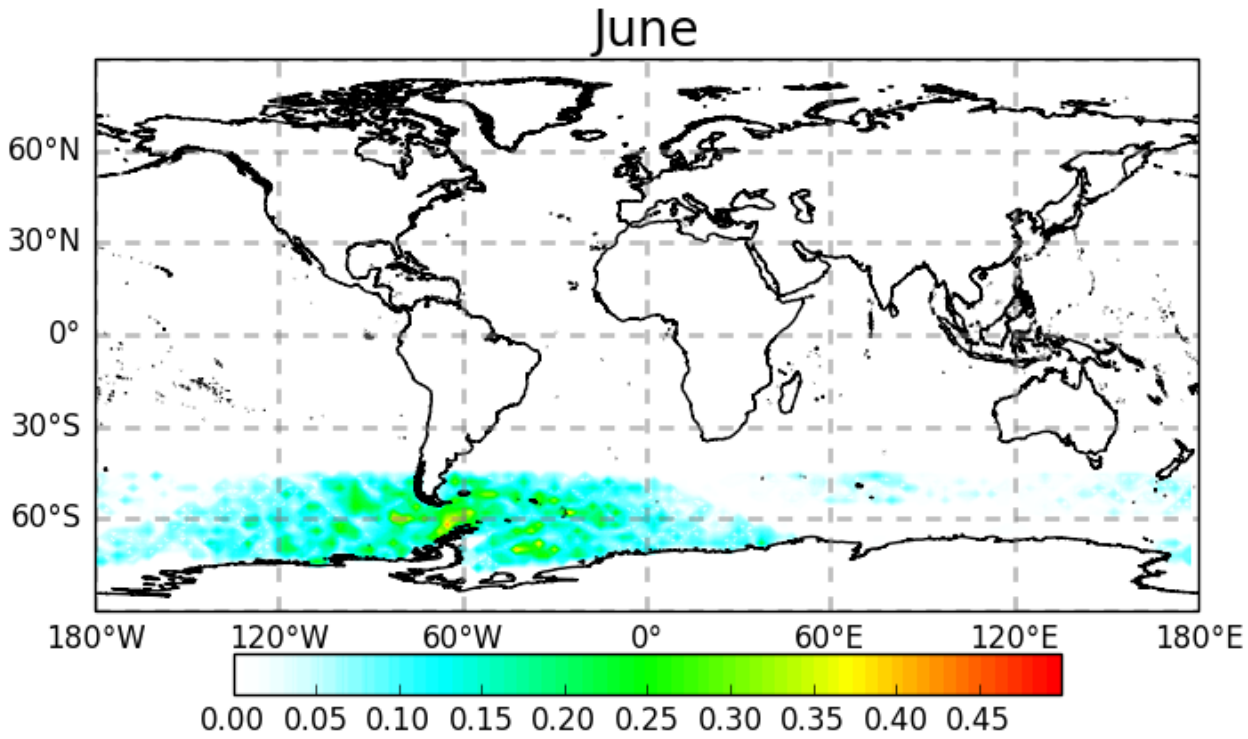


Slides: Chen and Suntharalingam

Constraints from the atmosphere

Influence of Shipboard measurements on CO_2 Flux Estimates





Fraction of Rmse reduction

Change in posterior flux uncertainty reduction metric (of Chevallier et al.2010)

Slides: Chen and Suntharalingam

Results so far and next steps

Results so far:

- shown that decadal variability in ocean carbon models is much less than inferred by data-based products in the Southern Ocean
- quantified uncertainty and added-value of new data for Southern Ocean CO_2 flux based on atmospheric CO_2 concentrations

Next steps:

- ocean model work: finish optimising coarse resolution model and more analysis, start with use of 0.25 G06 model
- atmospheric inversion work: integrate all in-situ and shipboard CO_2 observations and cover 1990-2018 period

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Three post-doc positions available in modelling ocean carbon cycle at UEA

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