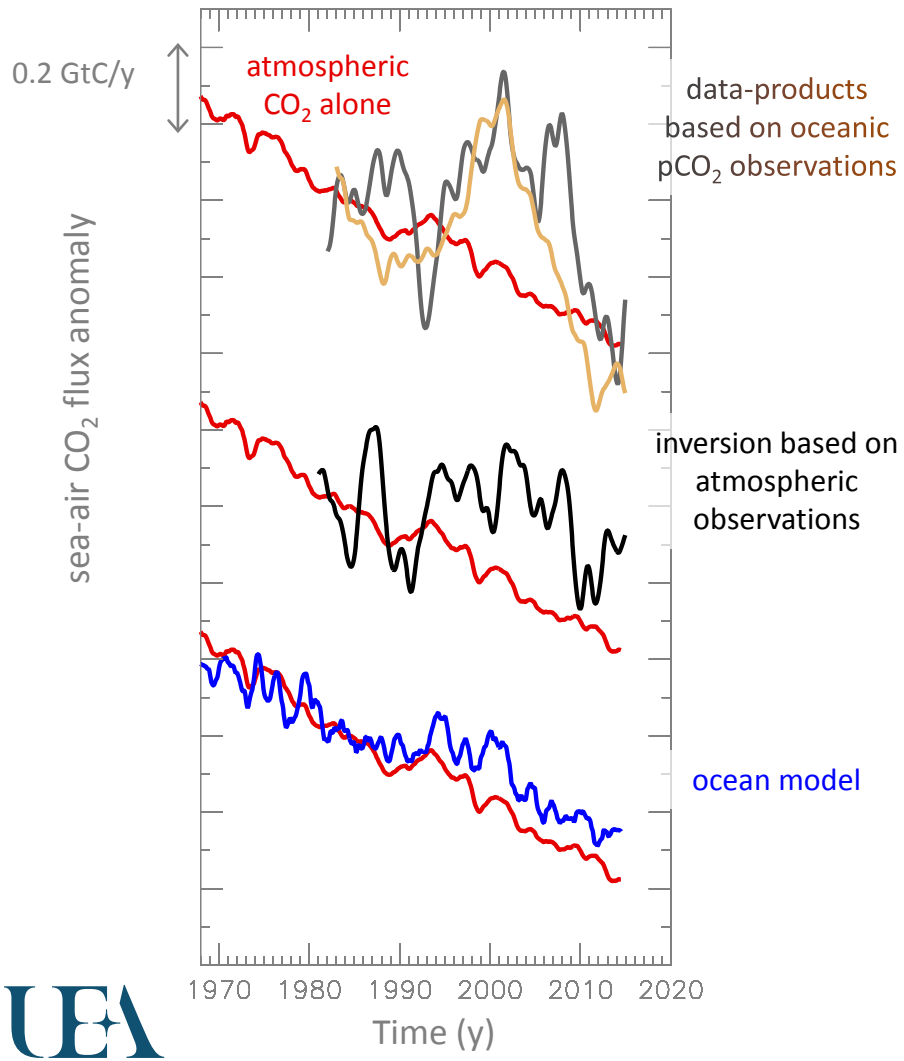
Challenge 1:
Analytical work proposed to help constrain the variability and climatic drivers of the SO carbon sink

Current state of knowledge
(data from Landschützer et al 2015 and updated from Le Quéré et al 2007)



Work proposed to constrain the variability and better understand the drivers:

1) optimal estimate across methods

   use existing and new pCO_2 observations to constrain data-products and hindcast models using parameter and process optimisation (Buitenhuis et al 2013) and further use atmospheric inversions and Bayesian approach to get optimal solution (Li et al in press)

2) detection and attribution of drivers (D&A)

   apply D&A methodology to observed fingerprints of DIC changes (N/S and surface/depth gradients) to separate the contributions of climate change, climate variability, and ozone depletion

3) assessment of amplitude with emergent properties

   link model simulations of ^{14}C / CO_2 and observed tree core data of ^{14}C trend gradient to quantify the direction and amplitude of the SO CO_2 variability (data from Chris Turney, UNSW)

4) repeated SO CO_2 budget to keep track of progress

This analytical framework requires existing and new pCO_2 (and possibly DIC) observations, atmospheric CO_2 inversions, and ocean biogeochemistry model hindcasts

C. Le Quéré and many others

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Challenge 2:
Key processes for SO carbon uptake

Dorothee Bakker, Jan Kaiser, James France et al.

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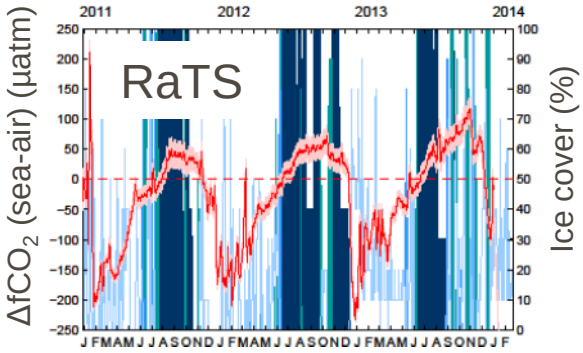
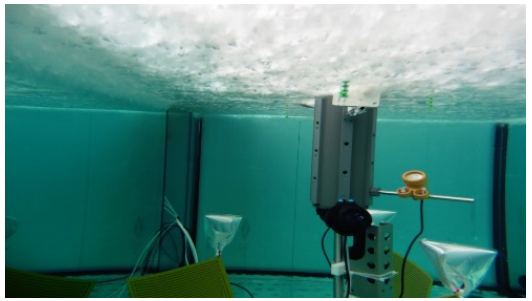
E.g. seasonal ice zone (SIZ)

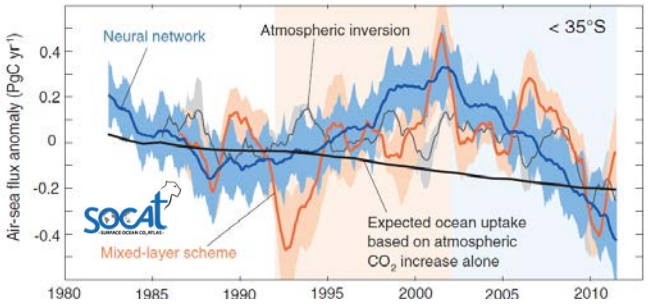
- Air-sea-ice CO_2 dynamics poorly quantified;
- Spatial separation of sea ice formation and melt;



Mechanistic understanding from:

- Boost systematic RaTS time series (coastal SIZ);
- Observing systems in open ocean & open SIZ;
- Process studies at open ocean & SIZ key sites;
- CO_2 flux experiments in air-sea-ice chamber;
- Ocean CO_2 synthesis (SOCAT), mapping (by season, location), model evaluation;
- Atmospheric observations & inversion (CO_2, O_2)





(Bakker et al., 2008; Lenton et al., 2013; Landschützer et al., 2015; Legge et al., 2015, accepted; Abernathy et al., 2016)