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

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
Challenge 2: Key processes for SO carbon uptake
Dorothee Bakker, Jan Kaiser, James France et al.

E.g. seasonal ice zone (SIZ)
- Air-sea-ice CO₂ 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;
- CO₂ flux experiments in air-sea-ice chamber;
- Ocean CO₂ synthesis (SOCAT), mapping (by season, location), model evaluation;
- Atmospheric observations & inversion (CO₂, O₂).

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