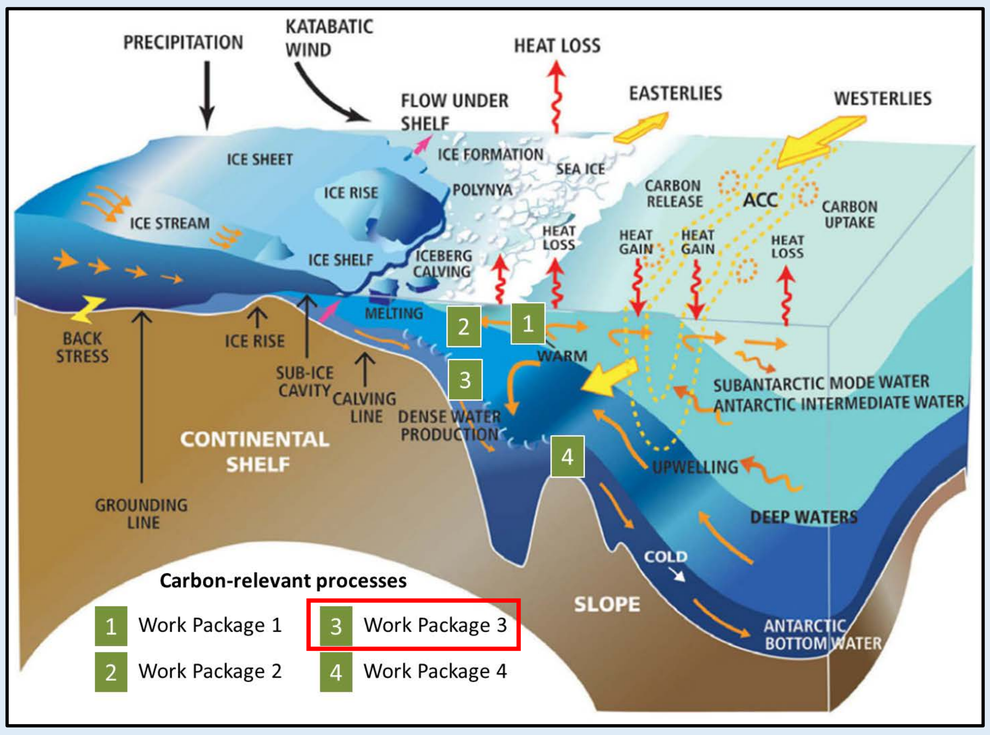
PICCOLO Workpackage 3

Biological mechanisms regulating POC export towards Antarctic Bottom Water

PICCOLO is a RoSES project designed to define, quantify and provide mechanistic understanding of the key processes controlling the rate of carbon uptake in the lower limb of the Southern Ocean overturning circulation.

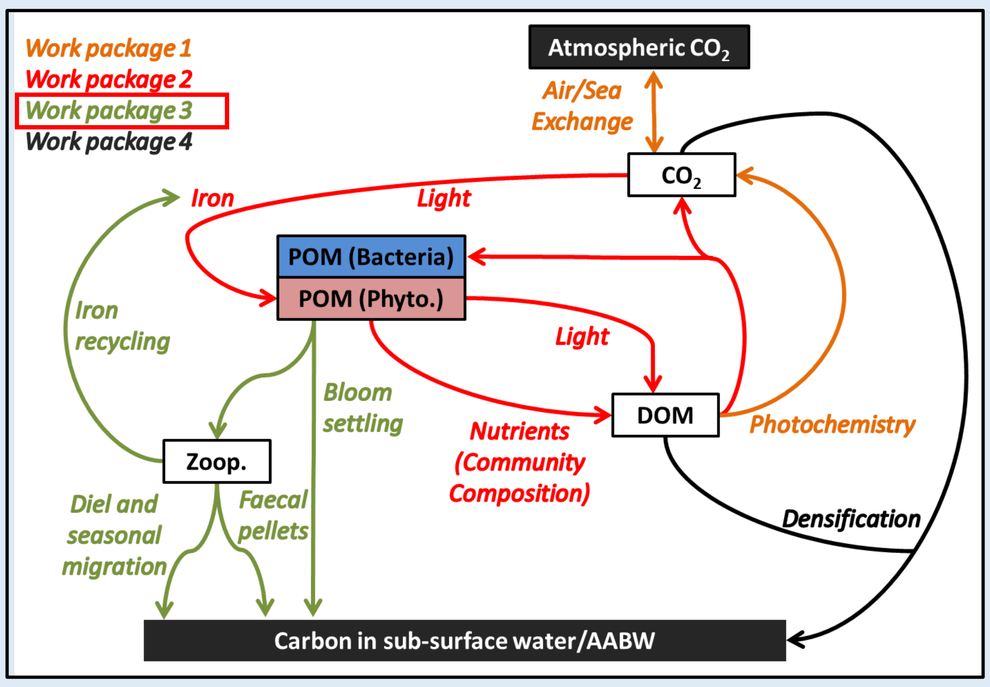


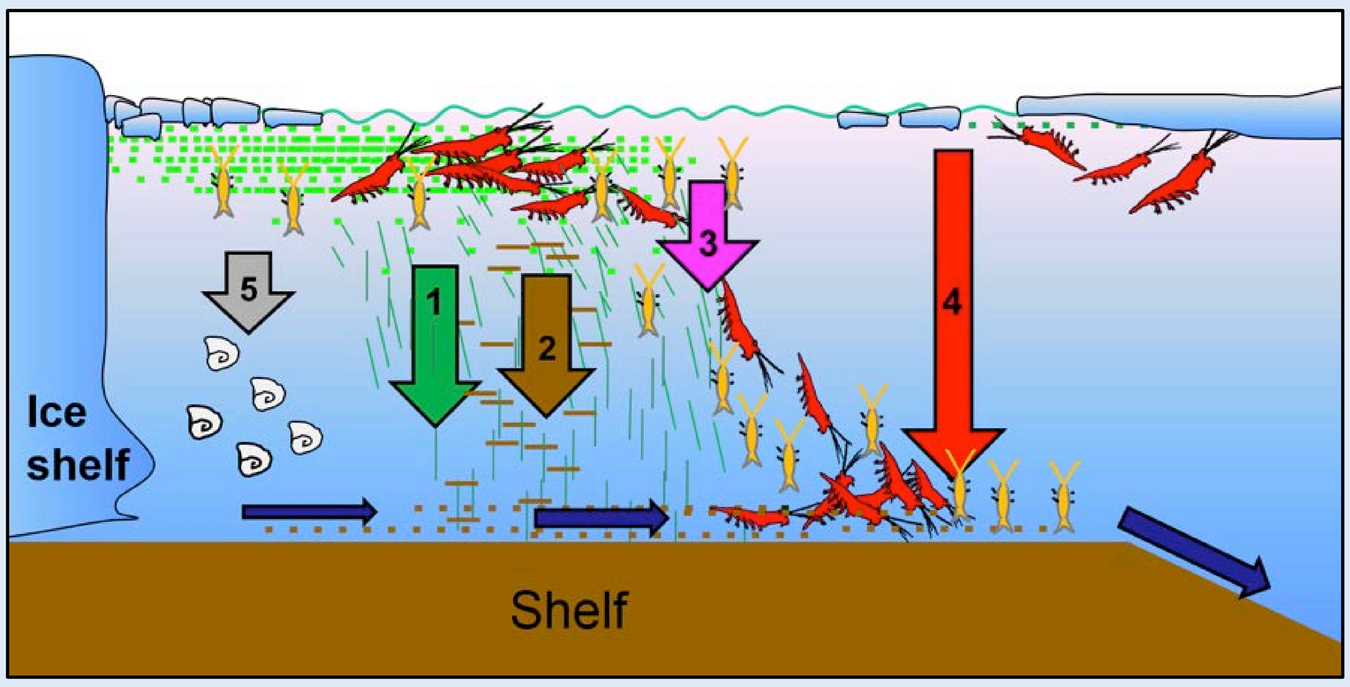
Workpackage 3 will target key processes that contribute to POC export. We will intensively sample the export mechanisms from ship and gliders along a transect between the shelf and the Weddell Gyre, by exploiting seasonal acoustic data from Autosub Long Range and by using year-round BGC-Argo data.

Hypothesis 1. Ice-edge food webs (diatoms and large grazers) promote efficient vertical transfer of carbon.

Hypothesis 2. Zooplankton guts enhance the particulate carbon/iron ratio, efficiently cycling iron.

Hypothesis 3. The lipid pump, mediated by seasonal vertical migration of large zooplankton, is a major contributor to POC export.





WP3 will quantify key biological particulate carbon export mechanisms. Pump mechanisms in the right-hand figure are denoted by numbered arrows: (1) passive sinking of un-grazed phytoplankton and (2) faecal pellets; (3) active diel vertical migration of zooplankton; (4) seasonal migration of large zooplankton (lipid pump); and (5) PIC export (carbonate counter pump). Lower limb circulation (blue arrows) transports carbon off the shelf to form AABW. These various export processes will be measured using acoustics, nets, water sampling and drifting sediment traps. Experimentation on krill and other key zooplankton, plus particle imaging, will help us to understand the roles and stoichiometry of Fe, C, N and Si in exporting and cycling nutrients. We will measure elemental transfer efficiencies and gauge the relative strengths of the component pump mechanisms.

Deliverable 1. We will upscale our POC export data to wider scales using Autosub Long Range and gliders to provide respective temporal and spatial information on zooplankton and their vertical migration. BGC-Argo, autonomous vehicle and satellite data will be used to derive export of large and small particles, based on optical backscattering and fluorescence.

Deliverable 2 We will combine our estimates of the POC pumps to calculate total POC export, thus allowing its comparison with the magnitude DOC and DIC export (Synthesis WP5)

The Piccoliños:
Karen Heywood , Carol Robinson, Elena Garcia-Martín, Dorothee Bakker, Rob Hall University of East Anglia
Tom Bell, Ming Yang, Jo Dixon, Vassilis Kitidis, Ruth Airs, Giorgio Dall'Olmo, Malcolm Woodward, Glen Tarran, Claire Widdicombe, Elaine Fileman, **Angus Atkinson (aat@pml.ac.uk)**, Robert Brewin, Peter Land, Sévrine Sailley Plymouth Marine Laboratory
Sophie Fielding, **Clara Manno (clanno@bas.ac.uk)**, Ryan Saunders, Keith Nicholls British Antarctic Survey
Simon Ussher, Angela Milne University of Plymouth
Will Homoky Oxford University
Lars Boehme, Mike Fedak University of St. Andrews
Plus project partners from Alfred Wegener Institute, University of Miami, UK Met Office, Caltech, Scripps Institution of Oceanography, VIMS, MBARI, NOC, University of Genoa, UPMC, University of Tromsø, University of Bologna, Old Dominion University, and the Australian ACE CRC

University of East Anglia
PML Plymouth Marine Laboratory
British Antarctic Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
UNIVERSITY OF PLYMOUTH
UNIVERSITY OF OXFORD
University of St Andrews