

Emma Cavan

Institute for Marine and Antarctic Studies, UK

Exploring the ecological effects of warming temperatures on Southern Ocean carbon export

Phil Boyd, Emma Cavan, Stephanie Henson

Institute for Marine and Antarctic Studies, University of Tasmania, Tasmania, Australia; Antarctic Climate and Ecosystems CRC, University of Tasmania, Tasmania, Australia; National Oceanography Centre, Southampton, UK

Microbial respiration of particulate organic carbon (POC) is one of the key processes controlling how much POC is exported from the surface ocean and potentially stored on long time scales in the deep. Century-old ecological theory predicts respiration scales with temperature, hence rising sea temperatures would increase microbial respiration and likely reduce POC export. We tested this theory in the sub-Antarctic Southern Ocean by collecting large sinking particles and measured microbial oxygen uptake rates over a 10 °C temperature range. Applying metabolic theory of ecology (MTE) our novel results suggest net export could decrease by 17 % before the end of the century, depending on which Representative Concentration Pathway is applied. This is much higher than predicted by simple mechanistic models due to the high temperature sensitivity of the Southern Ocean. We apply these results and classical MTE to the rest of the globe to estimate how physiology alone will influence global carbon export in a warmer world and to see how the Southern Ocean will respond compared to other oceanic regions. The estimated decrease in exported POC would likely reduce carbon storage in the deep oceans and increase the amount of CO₂ that could be re-exchanged with the atmosphere.