Missing carbon source or methodological bias?

ROUKAERTS, A.*[1], ZHOU, J.[23], FRIPIAT, F.[1], TISON, J. L.[2] AND DEHAIRS, F.[1]

[1]AMGC & ESS, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Elsene, Belgium

[2]Glaciology lab, Université Libre de Bruxelles, Belgium

[3]Division of Earth and Ocean Sciences, Nicholas school of the Environment, Duke University, USA (*correspondence: arnout.roukaerts@vub.ac.be)

Primary production (PP) was measured at Scott Base during the YROSIAE campaign between 24th Oct and 24th Nov using tracer ($H^{13}CO_3^-$) experiments in *in-situ* incubations (crushed ice). Maximal PP rates reached 4 μmol L^{-1} d^{-1} in the bottom of the sea ice by the 14th Nov while particulate organic carbon (POC) increased with approximately 1300 μM during the one-month period. This means biomass was accumulating 10-fold faster than measured in our incubation experiments. Parallel to this, PP was derived from O_2/Ar measurements in ice cores from a nearby location. Results show rates comparable to the incubation experiment ranging between 1.3 and 8.4 μmol L^{-1} d^{-1}. Two hypotheses could explain the discrepancy between the observed PP rates and POC accumulation:

1) A methodological bias, implying a large under-estimation of primary production from both isotopic-tracer incubations (poor homogenization of the ^{13}C-tracer in the crushed ice) and O_2/Ar ratio (brine convection and gas exchanges).

Large amounts of dissolved organic carbon (DOC) have been observed in sea ice and could explain the apparent deficit in production of POC, via two possible processes (1) Direct assimilation of DOC by mixotrophic algae; this was not accounted for during the tracer addition experiment and since this carbon is already in the reduced form, the process would less affect O_2/Ar ratios compared to the assimilation of CO_2;

2) A strong remineralisation of DOC into DIC could dilute the tracer and result in an under-estimation for uptake measurements if not taken into account. The latter process also would consume part of the oxygen produced by photosynthesis and result in a smaller net O_2-production)$_)$. Both pathways would require that a significant fraction of dissolved organic carbon is supplied from seawater and transformed to POC within the ice.