General Comments

The paper describes a series of high pCO2 incubation experiments performed on three cruises in temperate, Arctic and Southern Ocean waters during the summer period in each location. Studied in the incubations are the changes in DMS and DMSP over the short term (hours to days), and the changes in production rates of these compounds. The manuscript is clear and well written, and highlights the regional differences in the response to elevated pCO2, and attributes the differences to the variability in the carbonate system. Given that two of the environments studied were in polar regions, discussion of the effect of sea ice on the carbonate chemistry and the existing response of the phytoplankton community to extreme environments was lacking within the manuscript, particularly a mention of the pH changes experienced by cells while living within the sea ice.

A number of technical and specific comments arose on reading of the manuscript, and I recommend publication if these can be addressed.

Check pCO_2 is in italics, as there were instances where it was not.

Specific comments

L28. 'This implies that…' The previous sentence did not suggest this implication, so needs rewording. It seems like a sentence is missing here, which actually describes your findings, and is followed by the implication.

L71 Please highlight that the 3.4 Tg S is from the whole southern ocean, as calculated by JT16.

L88. Is there a concurrent predicted decrease in the southern polar region pH as well?

L96. During the introduction there is very little mention of DMSP, other than it is the precursor for DMS. Given that DMSP is one of your measured parameters in the experiments this requires further elaboration in the introduction, in particular the changes in DMSP as identified from the existing mesocosm experiments. This is important given that DMSP showed increases during the Arctic mesocosm.

L100-117. This section on mesocosms is interesting, but slightly irrelevant to the paper as a whole given that your studies are microcosm incubations. As the introduction is already very long, this section could be shortened to one or two sentences describing previous OA responses.

L114 High cost is also a significant factor in why mesocosm experiments are so limited!

L120. Please clarify that the temperate experiments shown here are in addition to those in Hopkins and Archer 2014; ie this manuscript includes four previously unpublished temperate experiments, as well as those previously published.

L136, remove additional comma before reference.

L142 What are the main differences in the environment between temperate and polar environments? You have not mentioned the distinct seasonal cycle of sea ice formation and retreat, different at both poles, which will likely also alter the carbonate chemistry. Does the acclimation of polar phytoplankton to the physiological stress of survival through the polar winter give them an added advantage when it comes to acclimating to OA? Is DMSP produced by polar phytoplankton (i.e. osmoregulation during periods of extreme salinity shift) for a different reason than temperate phytoplankton?

L190 *p*CO2

L222. In the southern ocean, was this acidification fixing method used for the DMSP samples, given previous issues highlighted by del Valle et al 2011 in samples containing Phaeocystis antarctica?

L253 spaces missing between mass 63 etc.

L281 composition used twice in the sentence.

L317. Please state the station where 1.5 µg L-1 was identified, as you have for the minimum.

L318.'reflected in'. Please reword, firstly as reflected implies light reflectance (given the topic of irradiance), and secondly it reads oddly with two instances of 'in'.

L320 – 328. Use of nM when the following paragraph uses nmol L^{-1}

L327. Could not understand the significance of the superscript 1, is it a typo?

L480. Should P be lower case?

L485. In this section I would like to see more discussion of sea ice and the extreme environment is imposes on the cells, which could account for some of their resilience to change. Many polar phytoplankton survive the extreme cold of the polar winter by living within the sea ice itself, in an extremely changeable habitat, and these cells seed the surface waters in summer time on melting of the sea ice. Cells are regularly exposed to hypersaline and highly nutrient variable environments, at temperatures below freezing, and in highly elevated pH environments (Thomas and Dieckmann 2002, Rysgaard et al 2012). Although your experiments were not associated directly with the polar sea ice and occurred during summer, the influence of the ice on the phytoplankton population will be dependent on the seed populations, and allow for greater tolerance of the incubation perturbation than in temperate communities. In the seasonal cycle of the Antarctic, the behaviour of the summer phytoplankton community development is dependent on the conditions experienced the previous winter (Venables et al 2013).

L523. P in italics

L561. Hopkins reference is 2010b, but only 1 Hopkins 2010 ref is present.

L609 italic p

L626, commas missing from references.