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Interactive comment on "Quantification of dimethyl sulfide (DMS) production in the sea anemone *Aiptasia* sp. to simulate the sea-to-air flux from coral reefs" *by* Filippo Franchini and Michael Steinke

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Review of: "Quantification of DMS production in the sea anemone Aiptasia sp. to simulate the sea-to-air flux from coral reefs" by F. Franchini and Michael Steinke.

General: The authors use a sea anemone as a model organism to study DMS flux from coral reefs. There are major deficiencies in this approach and I cannot recommend this manuscript for publication. If anything the results are very preliminary and a gross approximation of DMS flux from coral reefs. This is only superficially acknowledged.

Author response (AR) 1: We thank referee 1 for their comments and can provide reassurance that our results are based on a suitable experimental design where none of the measured data are of preliminary nature. The simulation is based on a series of assumptions that we have clarified in the Results and Discussion section of the revised version. Since information on DMS cycling is severely limited for tropical reefs, we used our model simulation to estimate the flux of DMS from corals and the outcome of our simulation is in excellent agreement with the very few data from previous studies that quantified DMS flux from coral directly (e.g. Fischer and Jones 2012) and with calculated fluxes based on continuous atmospheric DMS measurements at Heron Island (Swan et al., 2017). We added information on the study by Swan et al. (2017) and highlighted the limitations of our study in the revised section 3.3.

Using artificial seawater and cold shock to 4oC to compare bleached and unbleached samples is not realistic. Generally only a 2oC shock above or below ambient seawater temperatures should be used to stress a coral and would be comparable to studies by Fischer and Jones (2012).

AR2: We did not use acute cold shock in any of our experiments. We merely used a widely accepted cold-chock protocol for anemones to bleach Aiptasia and reduce the number of endosymbionts to compare the production of DMS between symbiotic and bleached individuals. After the cold shock, there was a period of 3 months where the bleached and non-bleached Aiptasia were acclimated to our experimental conditions.

No measurements seem to be made on the actual Symbiodinium concentrations in samples and results are expressed per gram.

AR3: Our model simulation does not require data on Symbiodinium concentrations but uses measurements of the holobiont DMSP concentration (DMSPH ; a proxy for Symbiodinium concentration in the anemone holobiont) and net DMS production rate (net DMSaq). Other required information was taken from the literature (see Table 1). Following the conventions in previously published studies (Van Alstyne et al. 2009;

Yancey et al. 2010), we expressed DMSP data in units of μmol g-1 DW (Table 3).

Conversion to surface areas should be shown in a table and compared with other available data so that good comparisons can be made.

AR4: All key data on fluxes normalised to coral surface area and sea surface area in our dataset are clearly presented in the text and compared with data in the literature (Fisher and Jones, 2012; Swan et al., 2017). We also discuss information on the global DMS flux estimates (Lana et al., 2012) and from measurements in the North Atlantic and high latitudes (Holligan et al., 1993; Levasseur et al., 1994). We do not feel that the manuscript would benefit from including a table with this information.

The authors should discuss in length two other important papers that have made good measurements and assessments of DMS flux from coral reefs. These are:

Hopkins, F.E., Bell, T.G., Yang, M., Suggett, D.J. and Steinke, M. (2016) Air exposure of coral is a significant source of dimethylsulphide (DMS) to the atmosphere. Scientific Reports, 6:36031,doi:1038/srep36031.

Swan, H.B., Jones, G.B., Deschaseaux, E.S.M and Eyre, B.D. (2017) Coral reef origins of atmospheric dimethylsulfide at Heron Island, southern Great Barrier Reef, Australia. Biogeosciences, 14, 1-11. Doi 10.5194/bg-14-1-2017

DMS flux can be estimated by both atmospheric and seawater measurements of DMS and the two papers above have shown that corals emit DMS directly to the atmosphere. The submitted paper makes no mention of this in their article.

AR5: Information from the publication by Hopkins et al. (2016) was included in our initial submission of the manuscript. We provide more information on their findings in the revised Results and Discussion section to highlight the importance of short 'bursts' of DMS during periods of aerial exposure. The paper by Swan et al. (2017) was not included in our initial submission (it was published one month before our initial submission). We apologise for this oversight and have included a discussion of their

relevant key findings in the revised version.

Their measurements from a sea anemone are therefore a gross underestimate. This is not helped by arbitrarily estimating the number of clade types in the anemone and not measuring them in the anemone. Different clades of zooxanthellae contain different levels of DMSP and produce variable levels of DMS. What data is available and published on DMS and DMSP production from coral reefs and discrete corals (e.g. Acropora-the most abundant coral in the Indo-Pacific) is not used or quoted (see Jones et al. (2007); Jones and King (2015).

AR6: Results from our flux simulation are in excellent agreement with the very few published datasets that empirically quantified fluxes from coral based on water and air measurements (see Results and Discussion). Our calculations are based on few parameters including the net DMS production rate that is also used to infer gross DMS production rate. This approach suggests that the potential for DMS production in coral reefs is very high but much of the climatically important flux of DMS to the atmosphere, where it exerts its cooling activity, is driven by the consumption of DMS through microbial processes. Hence, we use our research to stress the requirement for a better understanding of these consumption processes if we were to improve our forecasting ability of DMS fluxes under ongoing/future environmental change.

We now include reference to the more recent publication by Jones and King (2015). Data from the chamber experiments presented in the paper by Jones et al. (2007) would have been very useful for inclusion in our manuscript. However, as far as we are aware, these experiments were conducted without biological replication, hence lack statistical analysis of the results (e.g. no error presented in their Figure 7) and are presented with confusing (erroneous?) units. Taken together, this precluded us using data from their study as an authoritative reference to enhance our discussion.

END OF RESPONSE TO REFEREE 1

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