

Manuscript egosphere 2022-504: **DMS cycling in the Sea Surface Microlayer in the South West Pacific: 2. Processes and Rates**

Answers to Reviewer 1

**General comments regarding the conclusions:**

Even though a number of SML physico-chemical variables were examined in the current study, the lack of replicate information in the form of duplicates six hours apart (T0 and T6) restricts the confidence that can be applied to the findings. Consequently, statements about observed correlations and what they imply need to be made with caution and words such as “confirms” (L 340) & “confirm” (L344) should be avoided. The statement “...the current study confirm that SML DMS enrichment is rare in the SW Pacific” (L344) is based on very limited data made at one location east of NZ in one season that may not be so at other locations at other times of the year in the broad study region.

Answer: The reviewer is correct that there were a limited number of experiments run in just one region of the SW Pacific and so the confidence of the study findings is equally limited. Consequently “confirm” was replaced by “suggest” L348 and L352. This was also confirmed in the additional text in the Conclusion section: L360-361 “Although these results are only representative of one region of the South West Pacific during the austral autumn...”

DMS process rates and turnovers (defined in Table 2) for the three seawater types sampled; however, clear conclusions derived from this analysis are lacking. I would like to see a conclusion (section 5) added that provides concise findings from the complex analysis of data undertaken.

Answer: a conclusion section was added to the manuscript:

“The current study presents the results of a comprehensive investigation into DMSP and DMS processes in the SML that is, to our knowledge, the first to assess DMSP cycling and the net effect of irradiance on both DMSP and DMS in the SML. Bacterial consumption of DMSP and dark production of DMS were the dominant processes in the SML, with irradiance having relatively minor impact on both species. Although these results are only representative of one region of the South West Pacific during the austral autumn, the combination of in situ SML observations in S-M1 and process rates in the current study indicate that DMS enrichment in the SML is rare and that net accumulation of DMS in the SML is insufficient to balance DMS air-sea loss.”

This report is identified as a companion to a more substantial part-1 report referred to as S-M1 that is under revision (L85-86). The many references to S-M1 for methodology (e.g. details about the new sipper collection technique, L101-103) and DMS flux results (L158, 205-207) and references to S-M1 throughout the discussion leave the reader wondering about aspects of the study that are not available. The publication status of SM1 is unclear. Is it possible to include an Ocean Science manuscript number or information that it has been or will be accepted for publication at L452?

Answer: the companion paper is currently under review, and can be accessed at <https://egusphere.copernicus.org/preprints/2022/egusphere-2022-499/>

### **Specific comments:**

General answer: the grammatical mistakes and unclear sentences were modified in the manuscript as suggested.

L56-57: I suggest it would be better to say, “due to stabilization by dissolved organic substances ...”. Please clarify what the dissolved DMSP is adsorbed to. I presume it is the stabilised dissolved organic substances.

Answer: added L58 “high surface tension which energetically favours dissolved DMSP adsorption to dissolved organic substances”.

L67: what sort of “material”? particulate organic materials?

Answer: added L70-71 “particulate organic material in surface patches”.

L97-99: It is stated here that were six workboat deployments but information is not included for 6 stations in Table 1. If the workboat went out isn't there a sampling time and data from the vessel sampling system for the parameters given in Table 1 for 5-STW? Even though there was no deck-board incubation carried out for station 5 (L107) the reader would expect to see data in Table 1. I suggest that L107 in the caption for Fig 1 and L114-115 are moved together into L97-99 to explain up front the circumstances for station 5 (STW).

Answer: added in Table 1 a line with station 5-STW parameters. A sentence was also added L103-105 to explain why there was no deck-board incubation carried out at station 5-STW.

L135: What type of Tenax? TA? TC?

Answer: “TA” added L140.

L136: Please change “chromatography” to “chromatograph”. Was a chromatography column used? If so please specify the column type and the applied chromatographic conditions.

Answer: precision on the chromatograph column added L141 “DB-megabore sulfur SCD column, 70 m length, 0.530 megabore diameter and film thickness 4.30  $\mu\text{m}$ ”.

L139: It should be explained for those unfamiliar with the analytical approach that DMSP is base catalysed to DMS by the addition of alkali that allows DMSP to be indirectly measured in the form of DMS on a molar conversion basis.

Answer: added L145 “For DMSP measurements, 20-mL glass vials were filled and 2 pellets of NaOH added, to hydrolyse DMSP to DMS”.

L141: add “DMS” before “calibration”. Add “water” after “Milli-Q”. Was it an actual Millipore water system? If not, say “deionised water”.

Answer: yes, it was an actual Millipore water system.

L150: There is inconsistency in the description “net DMSP dark bacterial consumption rate,” with what is shown in Table 2. L154.

Answer: corrected to “the DMSP dark bacterial consumption rate” L156, and to “The DMS dark bacterial consumption rate” L160.

Table 2: Air-sea turnover in minutes is not shown to be so where turnover is (d).

Answer: added in Table 2 caption “Definition and calculation of DMSP and DMS process rates in  $\text{nmol L}^{-1} \text{d}^{-1}$  and turnovers in d and min for air-sea turnover.”

L185: The shading in Fig 2 is confusing because shading is usually used to represent night-time periods on plots. This is most confusing for Fig 4 where light and dark treatments are compared. I recommend that the shading is removed and the water mass types are separated by vertical dashed and/or dotted lines in Figs 2, 3 and 4.

Answer: the shading from figures 2, 3 & 4 were removed and replace by dashed vertical lines. The figure captions were modified accordingly.

Please comment on the significance of the average values shown in Tables 3 &4.

Answer: a sentence was added in the Table 3 and Table 4 captions “Results are the mean value of duplicate incubations.”

L233: Please define “EF DMS” here in the caption. Was EF previously defined? I presume it means enrichment factor?

Answer: EF defined L239 “enrichment factor”.

L274: Define the “SOAP” experiment and where it was conducted.

Answer: added L279-280 “the Surface Ocean Aerosol Production voyage (SOAP) conducted in the same region of the South West Pacific”

L339: State the correlation value/s.

Answer: added L345 and 347-348 “between  $k_{\text{DMSP}_{\text{cn}}}$  with DMS ( $\rho = -0.87$ ;  $p = 0.05$ ; Spearman’s rank correlation; Suppl. Info. Table S1) and  $k_{\text{DMSP}_{\text{cn}}}$  with DMSP concentration, dinoflagellates and *Gymnodinium* biomass ( $r = -0.92$ ;  $p = 0.03$ ,  $r = -0.99$ ;  $p = 0.01$ , and  $r = -0.95$ ;  $p = 0.05$ , respectively, Pearson tests, Suppl. Info. Table S1, S-M1)”.

L346: Please check the spelling of Theresa B?

Answer: the spelling is correct.

Some of the references have DOIs inserted but many do not. Please complete the referencing by including all available DOIs.

Answer: the available DOIs have been added in the references.

The SI requires the same attention to detail as the manuscript. Please include a title and authors heading for the SI document.

Answer: the title of the manuscript, authors’ names and affiliations were added.

Fig S1 caption: Please provide a legend to explain each abbreviation and also specify what the different treatments are, and I recommend changing the shading to vertical dashed lines to avoid night/day confusion.

Answer: more explanation in the figure captions were given, such as an explanation of each treatment, definition of the abbreviations. The shaded areas were replaced by vertical dashed lines.