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Comment on egusphere-2022-499

Anonymous Referee #2

Referee comment on "Dimethyl sulfide cycling in the sea surface microlayer in the southwestern Pacific – Part 1: Enrichment potential determined using a novel sampler" by Alexia D. Saint-Macary et al., EGU sphere,
<https://doi.org/10.5194/egusphere-2022-499-RC2>, 2022

Review:

Title: DMS cycling in the Sea Surface Microlayer in the South West Pacific: 1. Enrichment potential determined using a novel sampler
Author(s): Alexia D. Saint-Macary et al.
MS No.: egusphere-2022-499
MS type: Research article
Special Issue: Sea2Cloud (ACP/OS inter-journal SI)

General comments:

This study reports DMS and DMSP concentrations as well as environmental variables in the Chatham Rise region from the sea surface microlayer (SML) and subsurface water (SSW) at a depth of 0.5 m and 5m during the Sea2Cloud Voyage (March 2020). This study also compares two techniques for sampling DMS and DMSP from the SML: a novel gas-permeable tube technique and the more traditionally used glass plate technique.

Although this article presents valuable information that contributes to closing important knowledge gaps around DMS and DMSP cycling and DMS emission fluxes in the South West Pacific, it would benefit from some restructuring and more in-depth discussion (see specific comments below). I suggest that this article be published following major revision.

Specific comments:

- **Abstract**

In the abstract, it would be good to mention:

- that the SSW was sampled at a depth of 0.5 m **and 5m**
- that “enrichment” refers to “enrichment **of the SML**” relative to the SSW at a depth of 0.5 m
- outcomes of the method comparison between the gas-permeable tube and glass plate techniques

- **Introduction**

Line 25-27: I suggest being careful with the wording here: DMS is *mainly* derived from DMSP but not exclusively (e.g. DMSO is another precursor of DMS).

Also, DMSP is not only exclusively produced by phytoplankton but by other marine algae and higher plants (Stefels 2000), coral (Raina et al 2013) and bacteria (Curson et al., 2017). Unless the authors want to specifically describe the main source of DMSP in the SML? In which case, this should be mentioned and at the very least bacteria as a source of DMSP should also be accounted for.

Not all of the DMS produced is ventilated to the atmosphere. Only about ~ 10% of it (Malin et al., 1992).

Line 30: “...and consequently *decreasing/inhibiting* phytoplankton growth....”?

Line 33: “...elucidate *potential* feedbacks *of marine gas/DMS emissions on climate*.”?

Line 42: “...affect the *DMS* flux.”?

Line 66-68: please describe what these 2 approaches are so the reader doesn't have to read Walker et al 2016 to source the information.

Line 70: why the maintenance?

Line 71-74: here it would be helpful to mention that Walker et al. 2016 (SOAP Voyage) used both the plate and Garret screen methods in their study, and showed that the screen method led to an **overestimation** of DMS concentration. (On line 73 the authors are saying that the Garret screen may lead to an **underestimation** of DMS concentration. Did they mean **overestimation**?).

Line 74-76: This sentence is confusing. Did you mean: "To address this, a novel SML sampling technique using gas-permeable tube to minimize DMS loss was deployed **during the Sea2Cloud voyage**, and results compared to those obtained with the glass plate method **used during the SOAP Voyage**."?

Line 79: (see companion paper, Saint-Macary et al., **in revision**?)

Line 78: "...**estimate** EFs..."? Are you generating or estimating EFs through this study?

Line 88-89: Do you mean that SSW was collected with a Niskin bottle or a rosette? CTD only means "conductivity - temperature - depth". Also, it would be good to mention the depth (0.5 m? as mentioned in the abstract? Or 5 m as mentioned in the "CTD sampling" section)

- **Method**

Table 1: minor comment: it would look better to have the sampling time and average windspeed on one line instead of 2? (maybe by playing with font size)

Line 99-100: On the 26th of March sampling time was 09:50am - 11:38am, so later than 11:00. Maybe you could say in 0800 and 1200?

What was the approximate distance of the workboat from RV Tangaroa?

Line 100: There were only 6 sampling days out of a 13-day voyage, so I would write “on each **sampling** day”. Why sampling at 5-STW occurred at a different time of the day? It’s not clear if it was because of wind speed. Please specify.

Line 121: “...using Eq. (1)”

Line 123: “...where [DMS]_{MQ} and [DMS]_{tank} are the DMS concentrations in nmol L⁻¹ measured in the MQ and the calibration tank **at t_{+10min}** , respectively.” Is that correct?

Was there any difference between DMS concentration in the calibration tank at t_0 and t_{10} ? It would be important to mention this result, even if it is not shown.

Line 126: “...in Saint-Macary (2022).”

Line 127: “...using Eq. (2)”

Line 138: “...following Eq. (3)”

Line 139: I am questioning the validity of this equation. Reproducibility is usually measured as the standard deviation of the difference between multiple measurements. Please provide source for equation 3.

Also, the term “reproducibility” is commonly used when comparing the difference in measurements from different laboratories using the same technique whereas “repeatability” is more commonly used to describe the difference in measurements between different techniques within the same laboratory.

Also, it would be good here to give the level of replication, which I believe is 5-6 based on paragraph 211-221.

Line 140-145: I think this section and the “CTD sampling” should go under “2.3. Sampling of the SSW”, so then it is clear that the SSW was sampled with the Teflon tube

at 0.5m and with the CTD Rosette at 5m depth.

Line 147: since the SML sampling didn't always happen at the same time (especially at 5-STW and 6-Mix), it would make more sense to say that "...CTD sampling occurred in **between XXh and XXh following SML sampling.**"

Line 193: Please provide source for equation 4

▪ Results

Line 212-214: It seems like the lowest reproducibility for DMSP was obtained with the sipper and not the plate. I thus don't understand this sentence.

Caption, Fig.3: "(a) DMSP concentrations, sampled in the SML **and in the SSW by the sipper**"

I would remove "depth" and "method" at the bottom of each graph as it is clear what is being compared here.

Lines 243-245: Or could it be that the gas-permeable tube leads to an overestimation of DMS concentrations?

This is consistent with the Garret screen/plate comparison in Walker et al. 2016 (lower concentrations measured by the plate)

Caption, Fig.4: "(a) DMS concentrations in the SML, SSW, **and at 5 m depth...**"

Same here, I would remove "depth" and "method" at the bottom of each graph so it doesn't get mixed up with the legend.

Line 251-260: why is it that EF for chl-a is relative to 5m and 0.5 SSW whereas DMS and DMSP EF are only relative to 0.5 m?

Same for the phytoplankton community: it seems like only the populations of the SML and SSW at 0.5m depth are compared. Is there a point showing the data at 5m depth if it's only used for one variable?

Line 256: Suggest adding the value for the "very high enrichment at 2-STF (XX)" (2.88, is that right?)

Caption, Fig.5: Same comment as for Fig. 3 and 4: "5 m depth" and removing "depth" and "EF relative to" labels at the bottom.

Fig. 7: what's the reason for SML 2-STF data being missing? (please, provide brief explanation, either here or in the method section)

Line 307: "...and the biomass of the dinoflagellate *Gymnodinium* ($\rho = 0.95$; $p = 0.05$; Spearman's rank test; **Supplementary material**)"

Line 307-309: this is interpretation and it should be left to the discussion. Also, Table 2 provides information on fractions and not groups, so why is the diatom biomass mentioned here?

Line 309-310: I didn't understand this sentence? Is that based on the correlation between SSW chl a and the 20-50 μm fraction in Table 2? I cannot see the correlation with the $>50 \mu\text{m}$ size.

Table 2. caption: here phytoplankton is sorted by size not group.

Table 3. caption: here phytoplankton is sorted by group not size.

Table 2 & 3: just to be clear, are these correlations within or between water masses? (e.g. does **0.93 (<0.01)** in Table 2, Row 2, column 4 represents a correlation between DMS and chl a in the SML or between SML's chl a and SSW's DMS?)

If it's the latter, it's a bit of a stretch to correlate e.g. chl a in the SSW with the microbial size fraction in the SML. If it's the former, I suggest making 2 tables (2 and 3) for SML and SSW with all the ancillary variables (both microbial fractions and groups). Otherwise, this part in Table 3 is a repeat of table 2:

Line 324: "ranged"? (not ranging). And why "over the previous 12h."? With respect to what time?

Line 325: "...were 3.68 $\mu\text{mol m}^{-2}\text{d}^{-1}$ (range: 2.45 – 6.96 $\mu\text{mol m}^{-2}\text{d}^{-1}$) **for the SML** and 5.32 $\mu\text{mol m}^{-2}\text{d}^{-1}$ (range: 2.49 – 11.56 $\mu\text{mol m}^{-2}\text{d}^{-1}$) **for the SSW**"?

Line 326: this is also true for other water masses. I would rephrase this argument: "...with generally higher DMS fluxes recorded at higher wind speeds combined with higher DMS concentrations."

Line 328: "F5m resulted in an average flux of 3.87 $\mu\text{mol m}^{-2}\text{d}^{-1}$ (range: 2.28 – 8.80 $\mu\text{mol m}^{-2}\text{d}^{-1}$), **which was** consistent with **the average** FSML."

Line 329: why do you only concentrate on data points where FSML was lower than F5m? What about times when FSML was higher? And does it really matter since the average flux for SML and 5m were similar?

If so, you could just say "although FSML and F5m exhibited differences across workboat stations, average F5m (average 3.87 $\mu\text{mol m}^{-2}\text{d}^{-1}$, range: 2.28 – 8.80 $\mu\text{mol m}^{-2}\text{d}^{-1}$) **was** consistent with **the average** FSML."

▪ Discussion

Line 335-336: At station 2 Chl-*a* was enriched in the SML relative to 5m. This is confusing to then read this sentence in the discussion. It might be better not to present the chl-*a* EF relative to 5m depth. See previous comment.

Line 339-341: I think it would be better rephrased as "...however it appears that the major diatom bloom of 4.3 $\mu\text{g L}^{-1}$ chl-*a* at 2-STF (Sellegri et al., in revision), which exceeded the maximum chl-*a* concentrations recorded during the previous SOAP voyage (2.8 $\mu\text{g L}^{-1}$; (Lizotte et al., 2017)), was insufficient to generate chl-*a*, DMS or DMSP enrichment in the SML."

Line 348-350: so what does it say about the correlation between DMSP and dinoflagellates abundance? Was it a positive or negative correlation?

In fact, I think it is very important to mention whether correlations are negative or positive in your results section.

Line 350: "the lowest"

Line 353: it would be good to read more suggestions of what these specific factors may be. Light availability? nutrients? Or is it that DMSP concentration in the SSW is dictated by the presence of other microbes?

Line 363-364: what does "Spearman's rank test for both studies, $\rho = 0.60$; $p = 0.01$ " correspond to? Is it by pulling the data together? Maybe this value is not necessary?

Line 363: I would remove "pressure"

Line 368: Physical and...?

Line 379: So which temperature did you use for your flux calculation in Equation (5) then?

Line 389: What was the surfactant?

Line 391: data not shown?

Line 395: "...SML **sampling** techniques..."

Do you mean that the gas-permeable tube allows for a reduced exposure of the water sample to air? Or is it the other way around? On line 398-399 you say that "DMS is potentially lost with the gas permeable tube, as the upper surface is exposed to the atmosphere"...so in that case why do you say in line 394 that higher DMS concentrations are obtained with the gas permeable tube relative to with the plate?

Line 401: I don't understand how the variation due to environmental conditions reflects that the plate samples a thinner layer than the gas-permeable tube. You might have to develop this argument so it makes sense.

Line 407: if anything, I would have thought that the gas-permeable tube would have decreased this variability as it allows to sample a larger surface area.

Line 410-414: But I thought that you had also used the plate for this study. Can you then compare your plate data with other studies that have also used the plate sampling technique?

Line 423: It is hard to judge without being able to read Saint-Macary et al but I would tune this argument down: "most likely reflect" or "may reflect"?

Line 426: Is it really more accurate? I thought that both the plate and gas-permeable tube showed good reproducibility and agreement with actual DMS/DMSP concentrations measured by GC analysis during method testing?

Line 428: wasn't there DMS enrichment at station 6 as well?

Also, there was chl_a enrichment at station 1, 2 (relative to 5m depth only), 3 and 4, right (relative to SSW only)?

Line 430: *Gymnodinium* is a dinoflagellate.

Line 431: DMS and DMSP production

Line 431: by "regional", do you mean in the same region?

Line 431: I guess that the authors meant "complement"?

Line 434: Why not since you say on line 330 that "The difference in DMS air-sea flux calculated for the three different depths was primarily due to the higher DMS concentration in the SSW" and that "higher FSSW were found at higher wind speeds and

DMS concentrations" (line 326)?

General Conclusion and summary comment: maybe it would be important to talk about DMSP enrichment as well here. DMSP is not volatile (so there is no loss to the atmosphere), however there was no DMSP enrichment either. How do you interpret that?

Supplementary material: my suggestion is the same as for other figures: I would remove "depth" and "species" from the legend as it is clear what is being compared.