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Supplement of

Third revision of the global surface seawater dimethyl sulfide climatology (DMS-Rev3)

Shrivardhan Hulswar et al.

Correspondence to: Anoop Sharad Mahajan (anoop@tropmet.res.in)

Figures

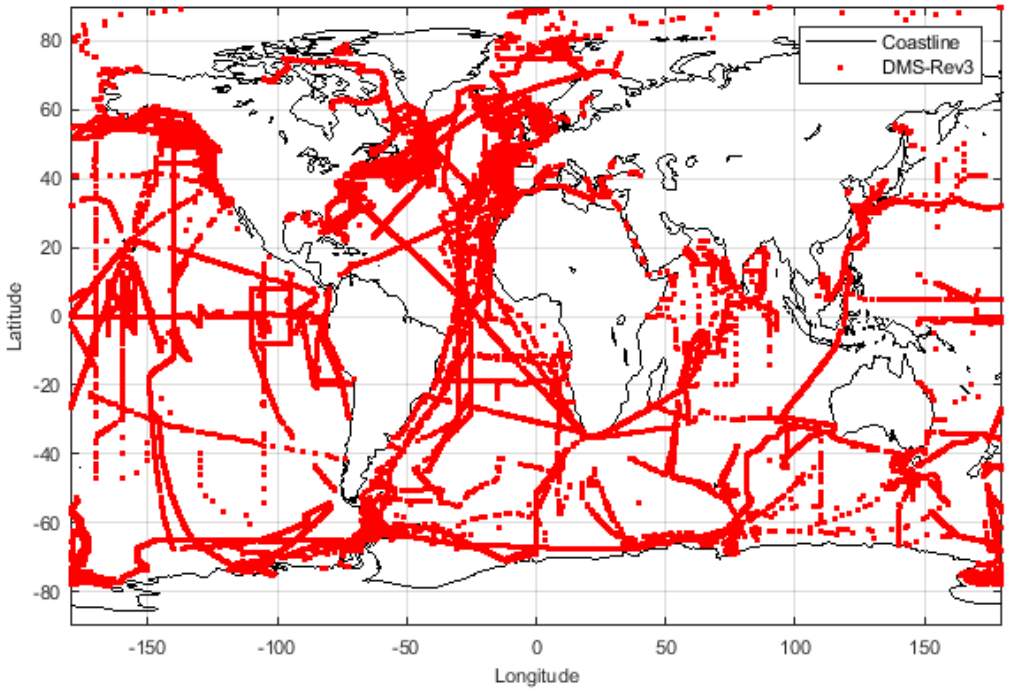


Figure S1: The raw seawater DMS observation data used for the calculation of the DMS-Rev3 climatology.

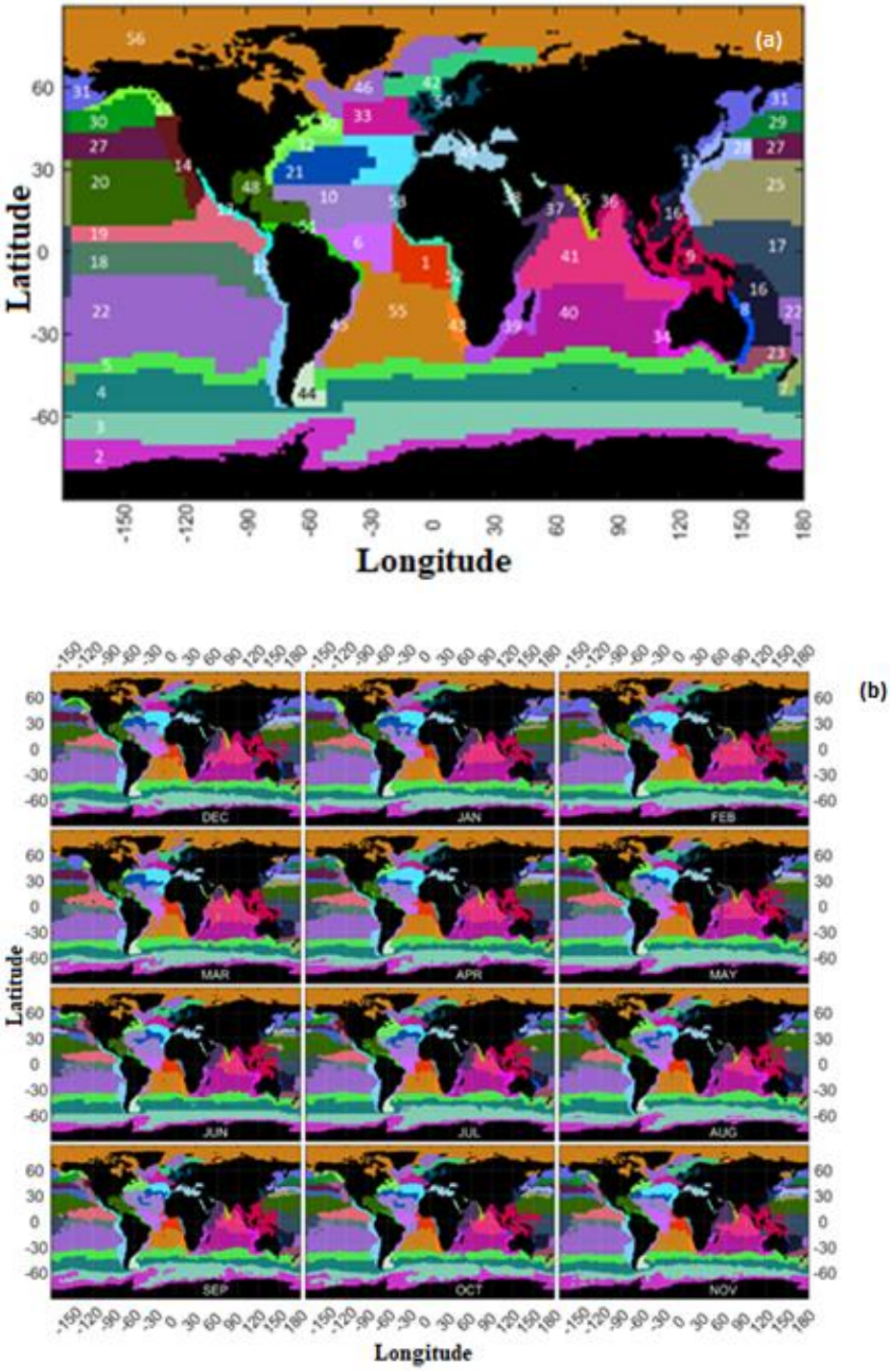


Figure S2: Static biogeochemical provinces (a) were used in the past for creating the DMS climatology and did not account for the monthly and seasonal variations in the biogeochemical properties of the ocean surface. The current estimate incorporated changing province boundaries (b) for sorting and processing the DMS data leading to a more realistic distribution. The numbers given in (a) represent the provinces as referred to in the DMS Rev3 code and manuscript. The names of the respective provinces are given in Table 1.

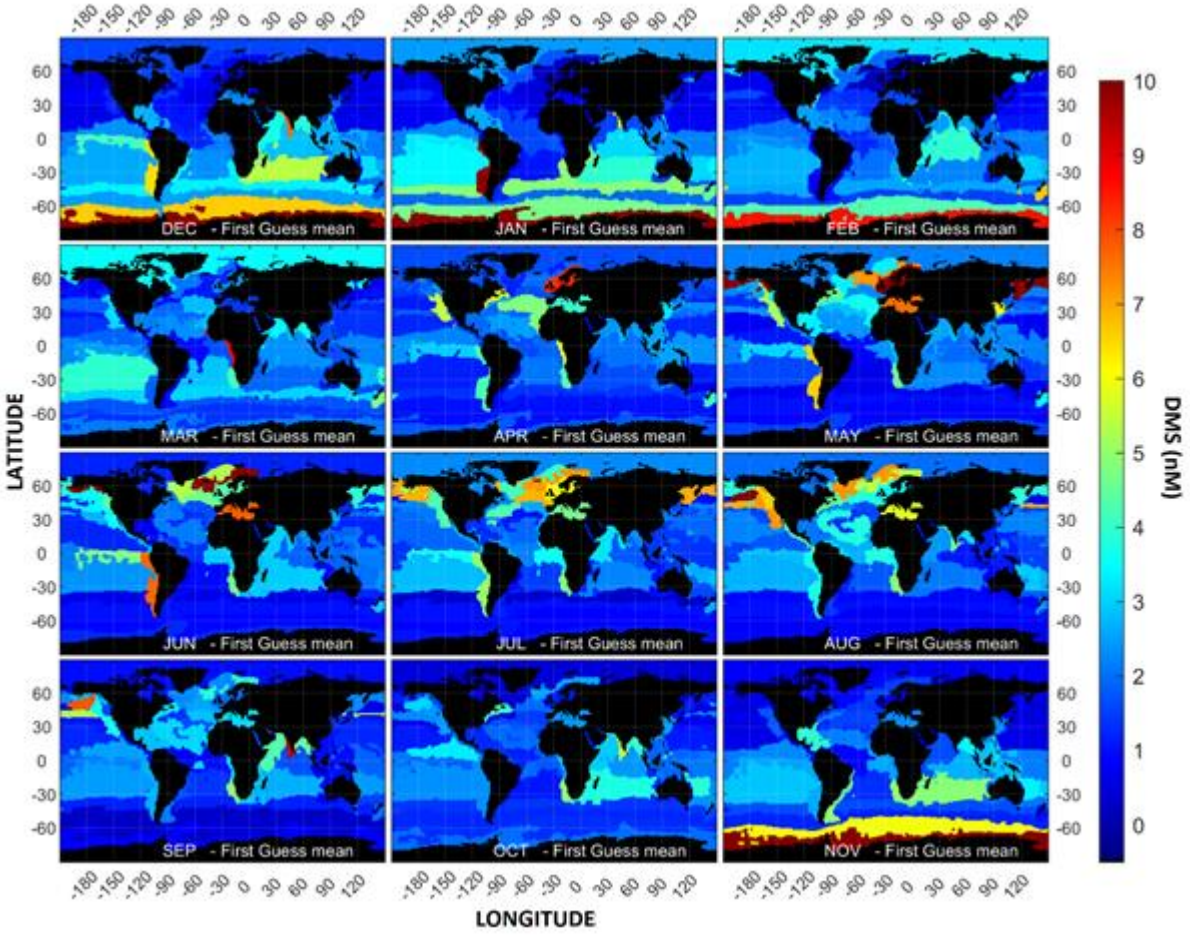


Figure S3: The unsmoothed 'first guess' DMS fields for all months using the dynamic biogeochemical province boundaries. This provided the first base for the seasonal changes in the regional as well as global DMS distribution.

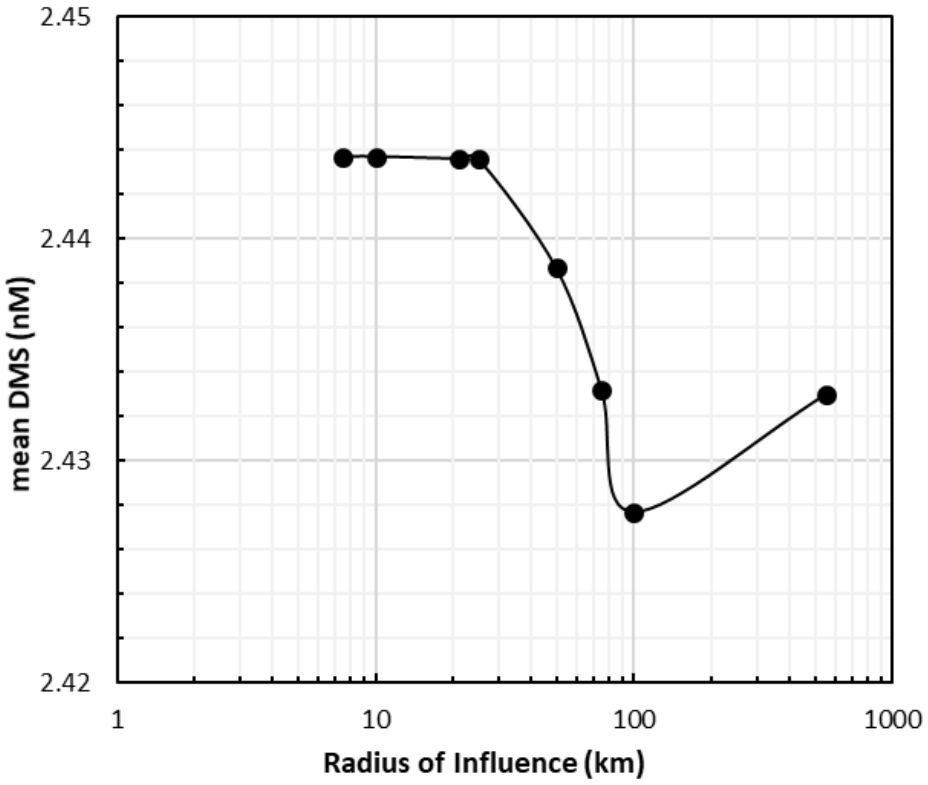


Figure S4: The global annual mean DMS values are obtained by varying ROI from 555 km to 7.5 km. The mean appears to stabilize above ~2.44 nM as the ROI reduces below 25 km.

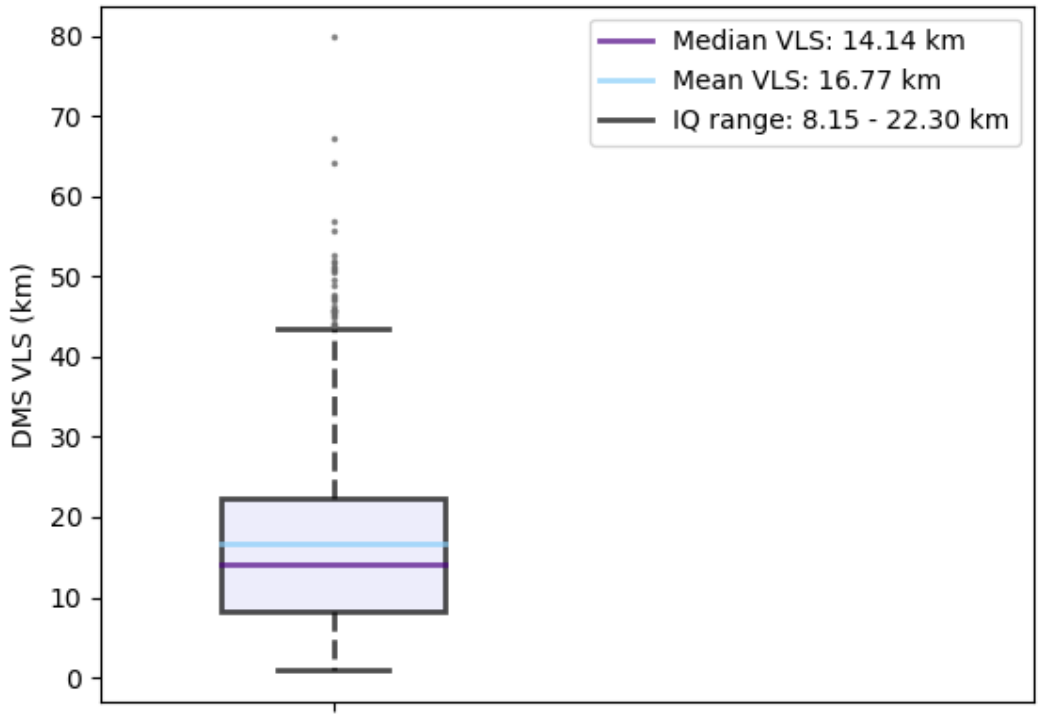


Figure S5: Box and whisker summary of a global analysis of DMS variability lengthscale (DMS VLS, km). VLS is calculated (Hales & Takahashi, 2004) for 763 high frequency seawater DMS data transects derived from 37 cruises between 2004 and 2019. Transects are defined as continuous data sections with a minimum temporal resolution of 1 hour between consecutive DMS observations, and a minimum total length of 100 km. The lines indicate global median (purple) and global mean (blue) DMS VLS, and the interquartile (IQ) range is delineated by the top box edge (75^{th} percentile) and bottom box edge (25^{th} percentile). Whiskers capture the range of data points that are not considered outliers. Outliers (grey dots) are defined as data that is greater than 1.5 times the 75^{th} percentile or less than 1.5 times the 25^{th} percentile (From Manville et al. in preparation)

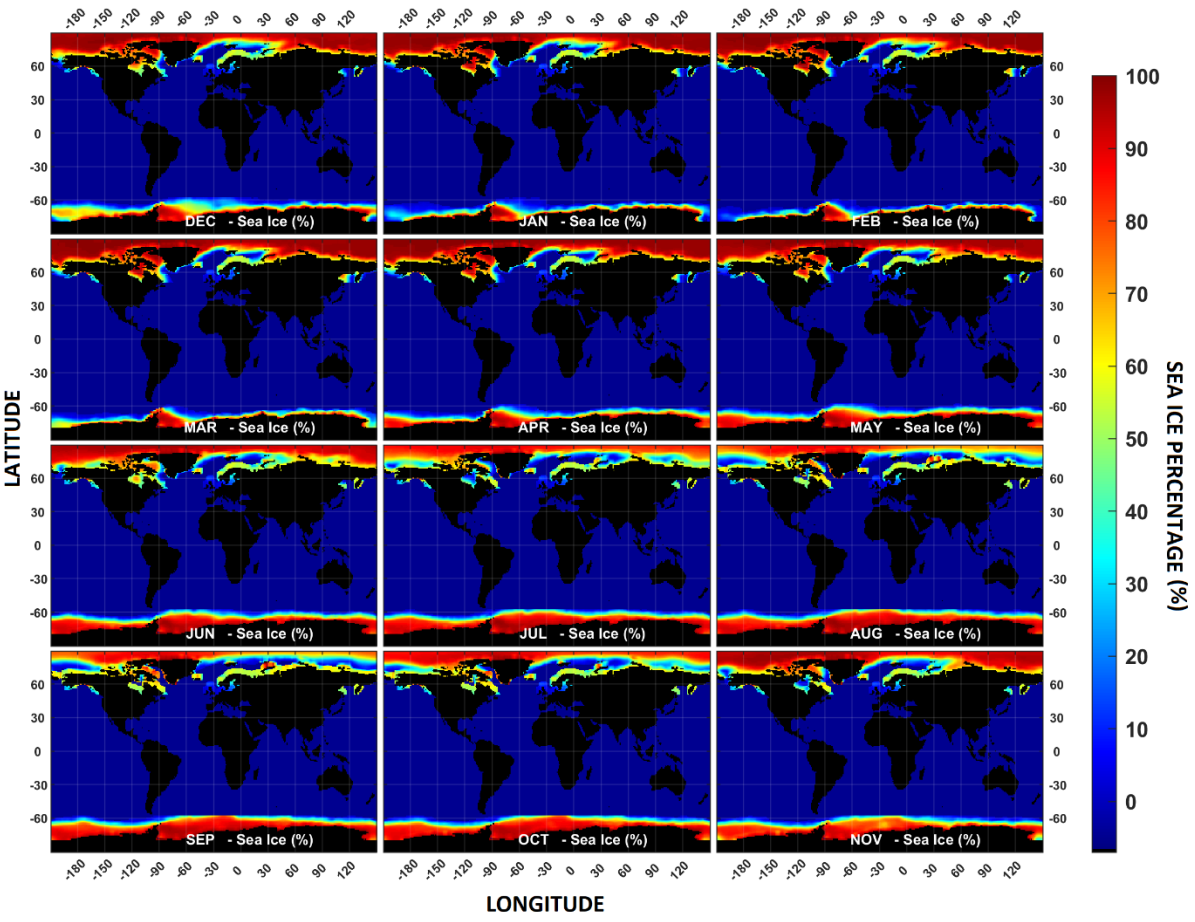
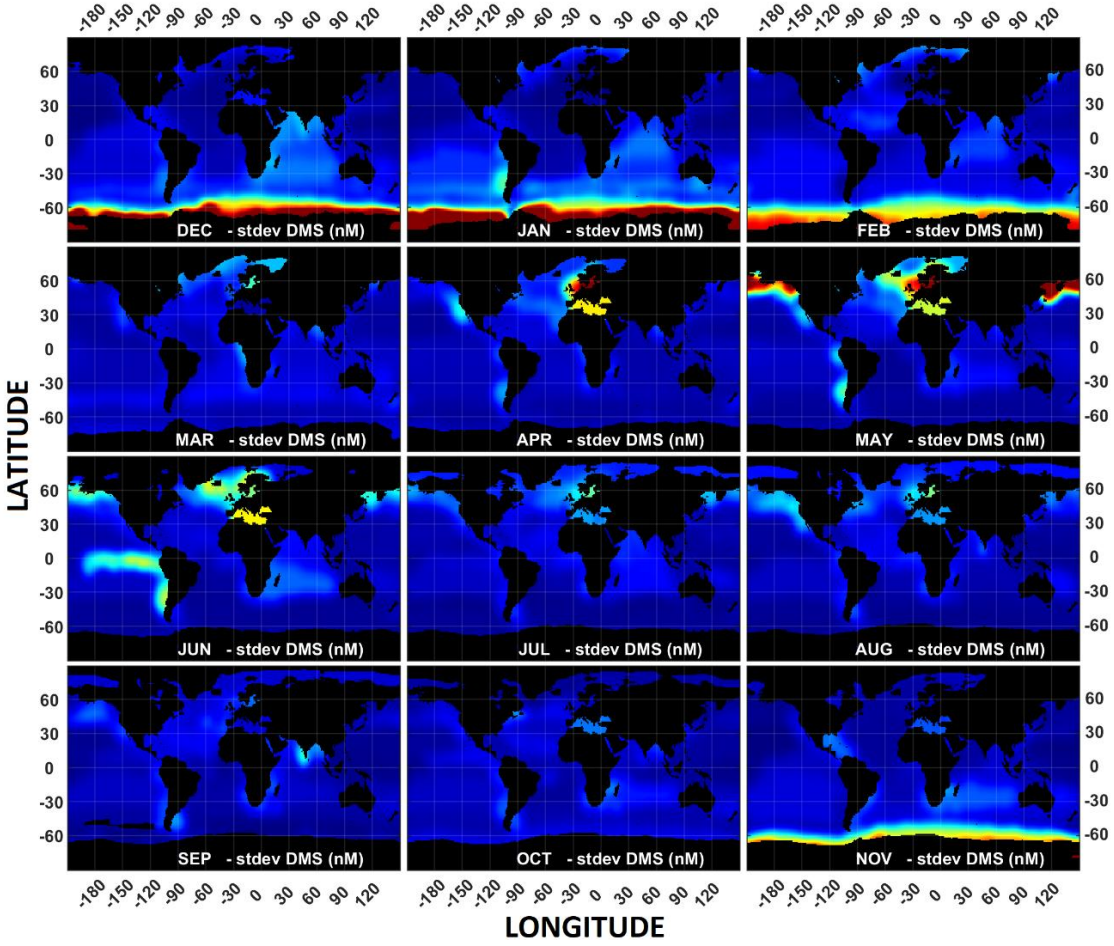


Figure S6: A sea-ice filter was used to filter out the data which possibly were under the sea-ice and hence not considered while calculating the global monthly, seasonal and annual climatology.



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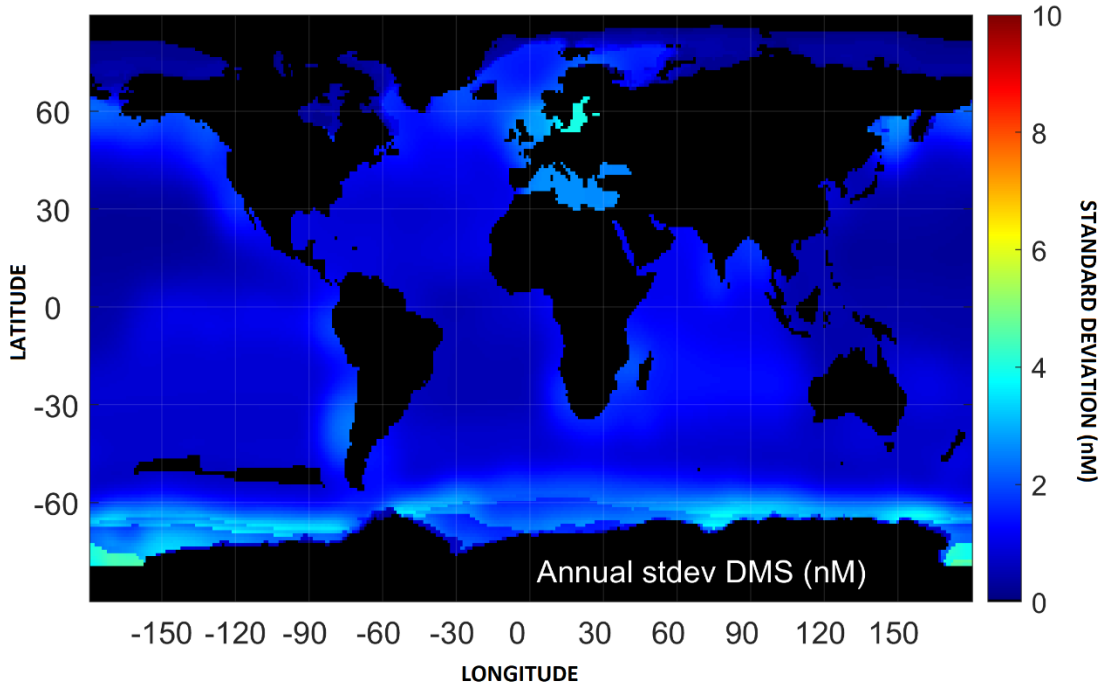

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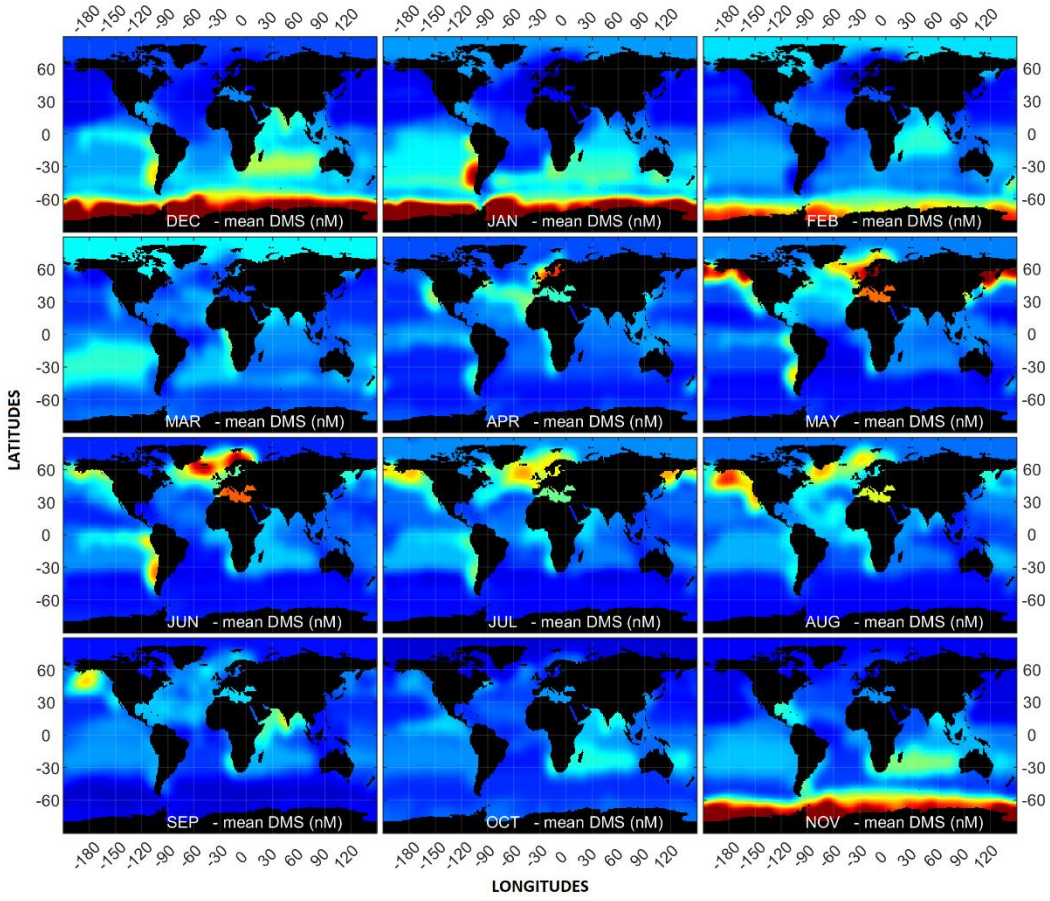
56 **Figure S7:** Distribution of the monthly and annual standard deviations for the DMS
57 concentrations as estimated by the DMS-Rev3 climatology without the sea ice mask.



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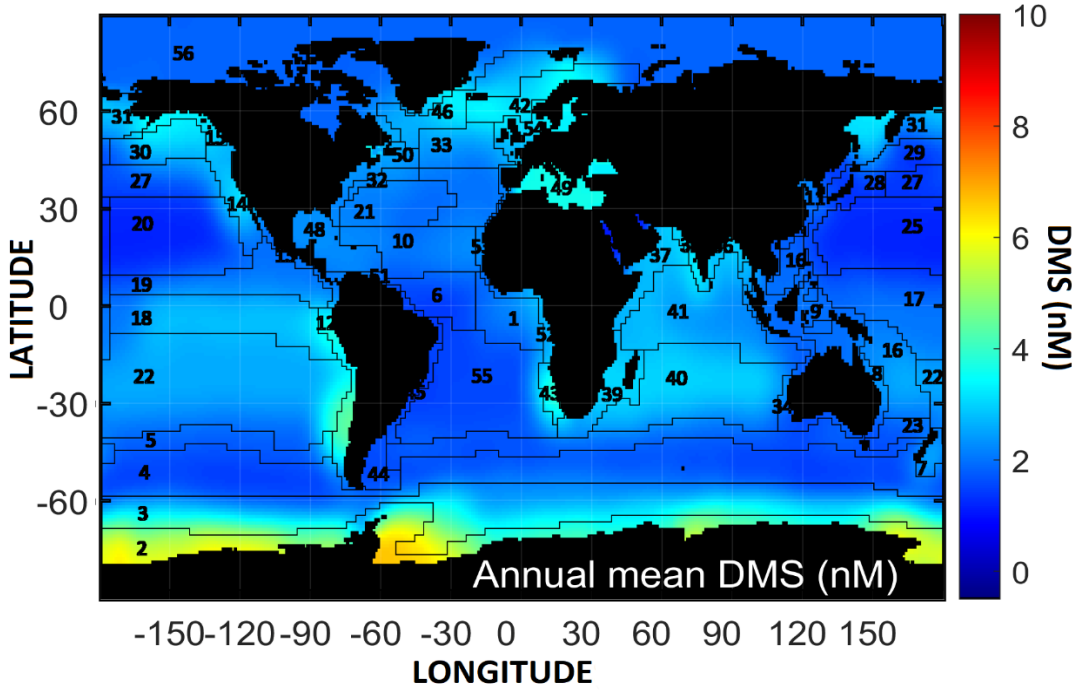

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60 **Figure S8:** Distribution of the monthly and annual means for the DMS concentrations as
61 estimated by the DMS-Rev3 climatology without the sea ice mask.

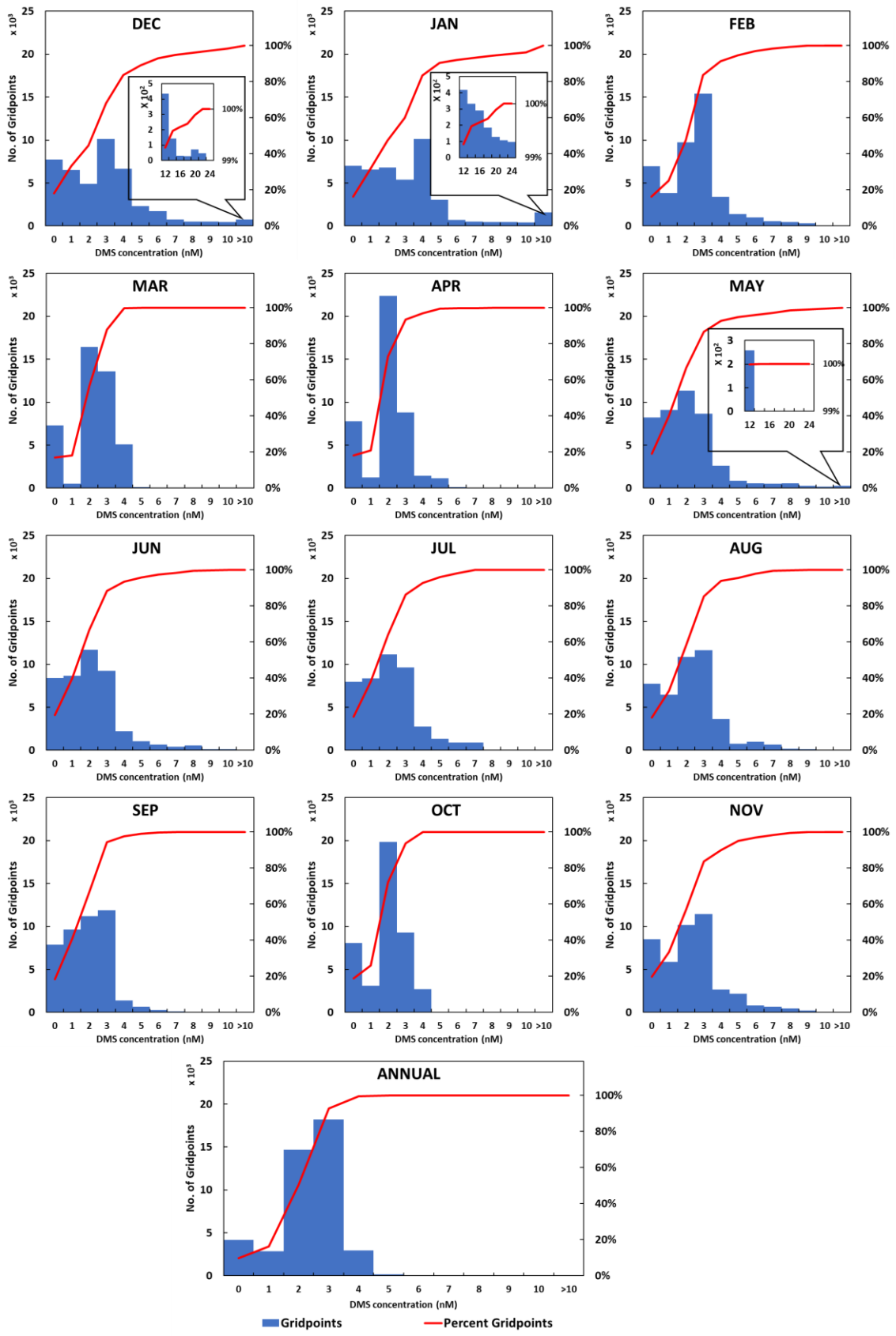


Figure S9: Grid-wise binned concentration distribution of DMS data for individual months and annually.

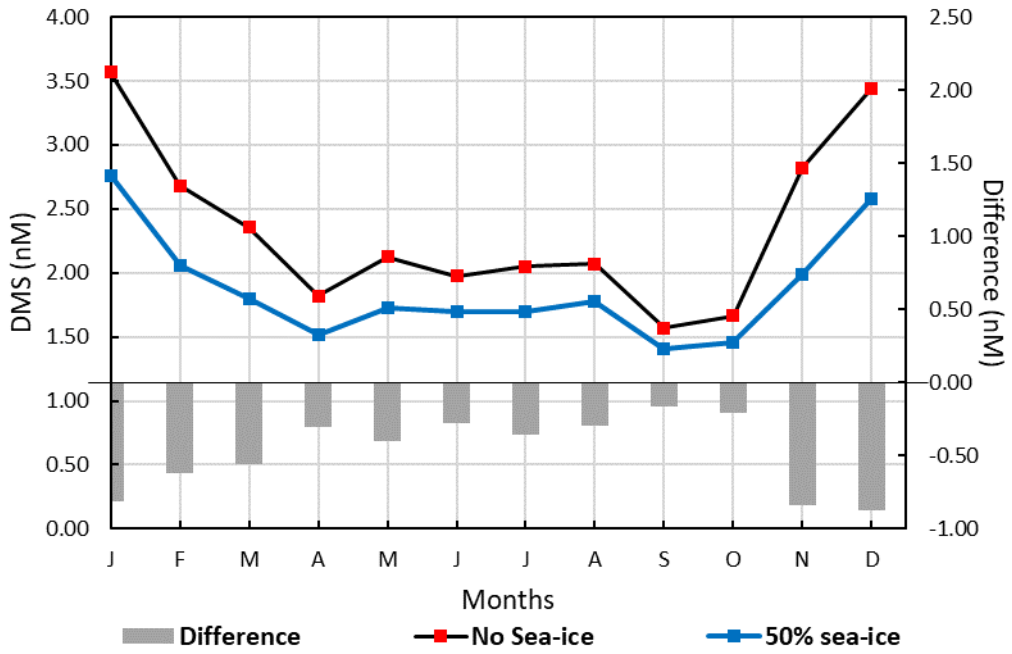


Figure S10: Monthly global mean DMS concentrations as estimated by DMS-Rev3 considering the effect of presence (blue line with blue markers) and absence (black line with red markers) of sea-ice cover with 50% threshold is shown. The difference (grey bars) that is observed between the two estimations shows a larger reduction in DMS concentration during southern hemisphere summer as compared to the northern hemisphere summer.

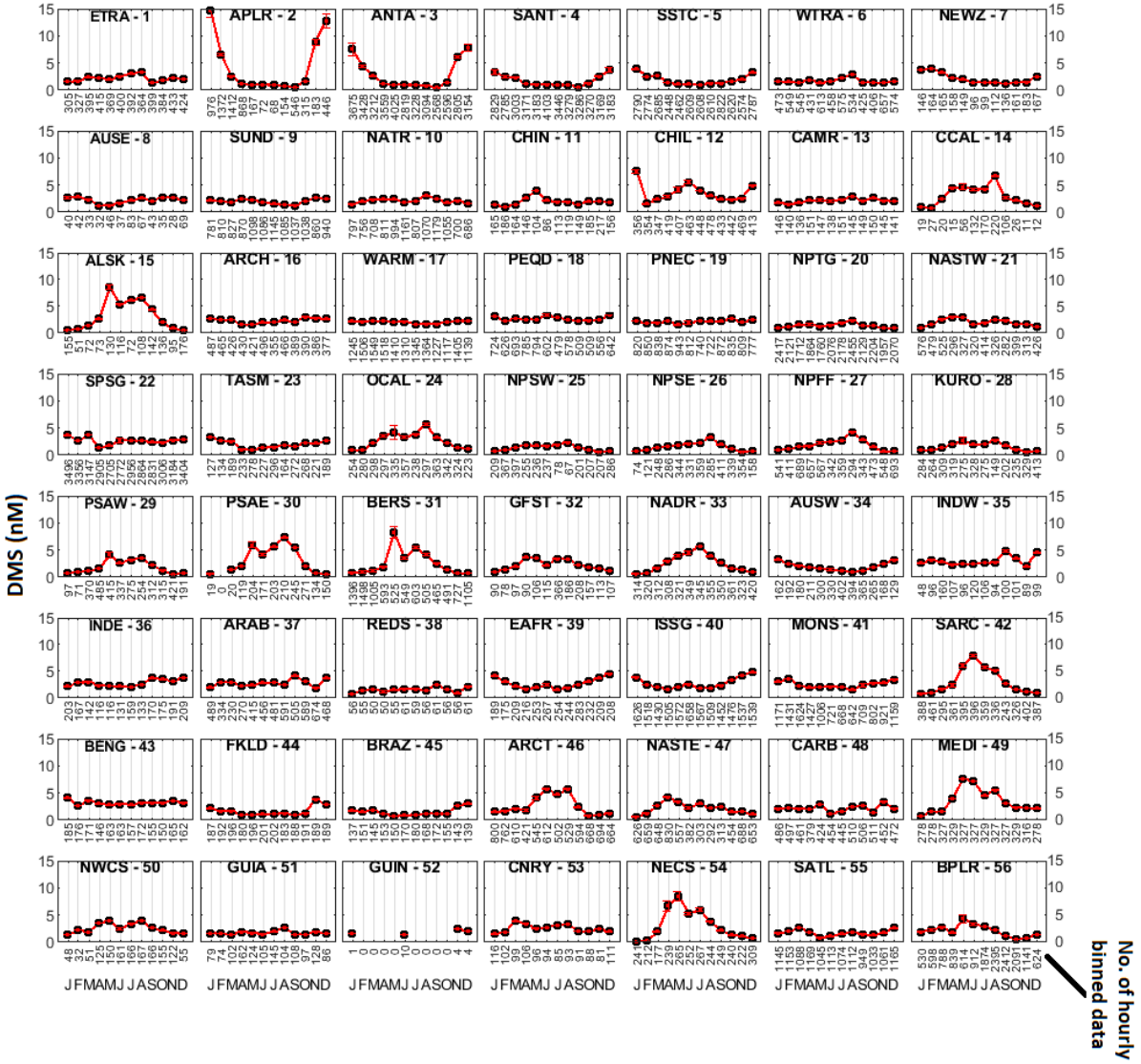
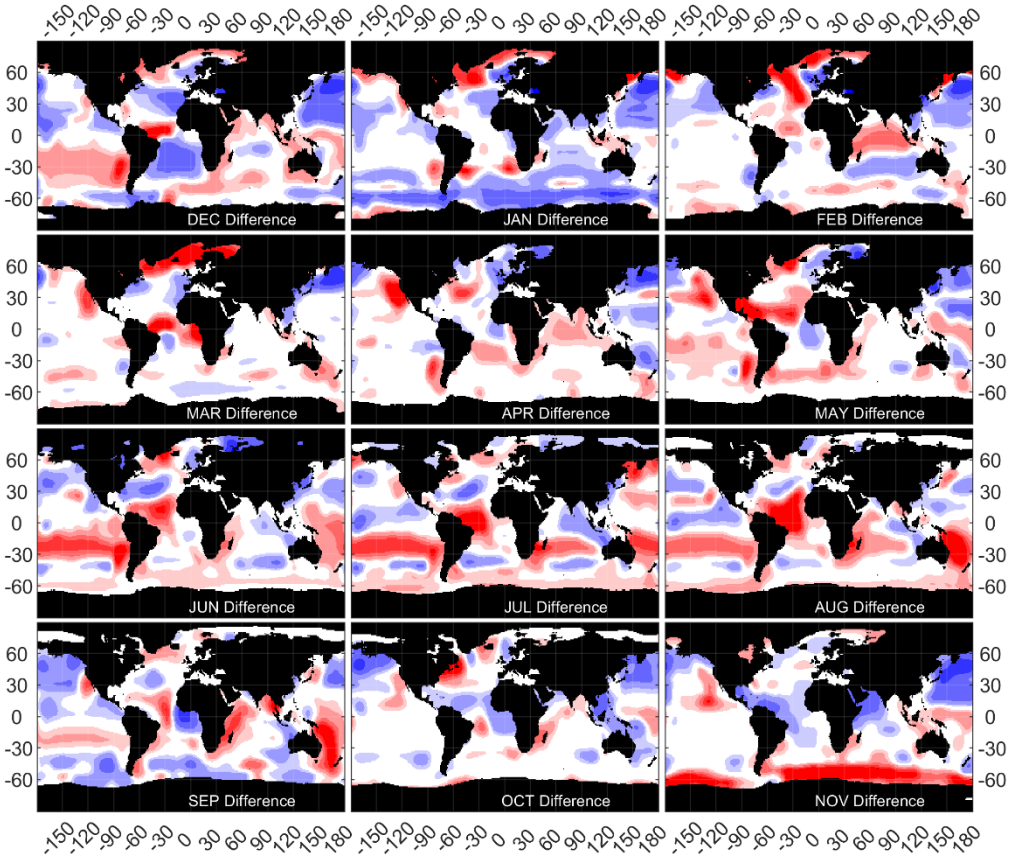


Figure S11: Final output of the DMS-Rev3 algorithm is shown in the figure. The GUIN province shows a lack of data besides January and August because it does not exist according to the dynamical province boundaries for those months. The numbers on the x-axis show the number of hourly binned observations per month.



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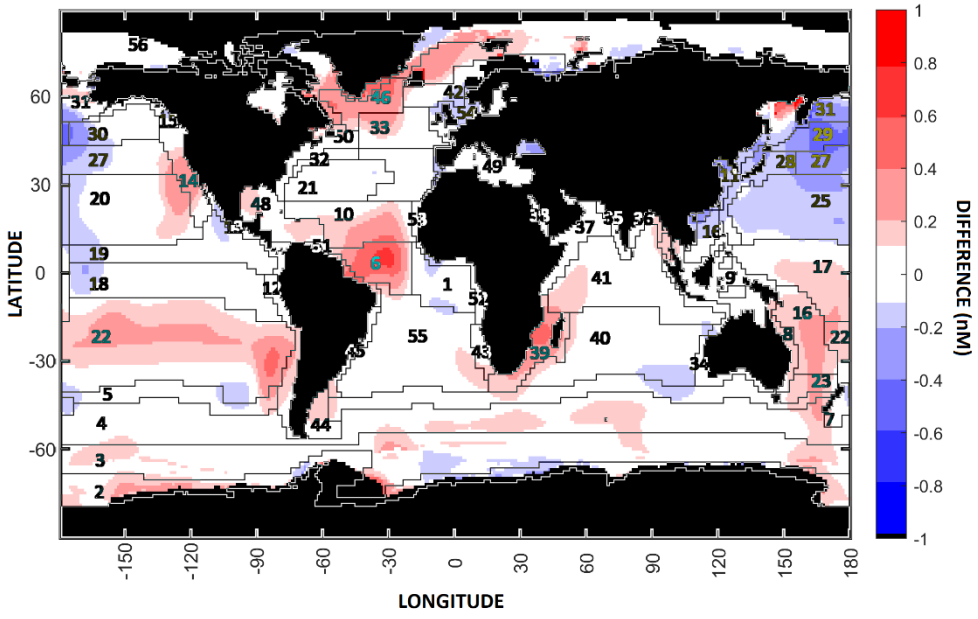

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79 **Figure S12a:** Percentage difference between the monthly and annual mean DMS concentration
80 estimated using dynamic and static biogeochemical province boundaries highlight the higher
81 regional differences on a monthly scale and lower on an annual scale along the borders of the
82 provinces.

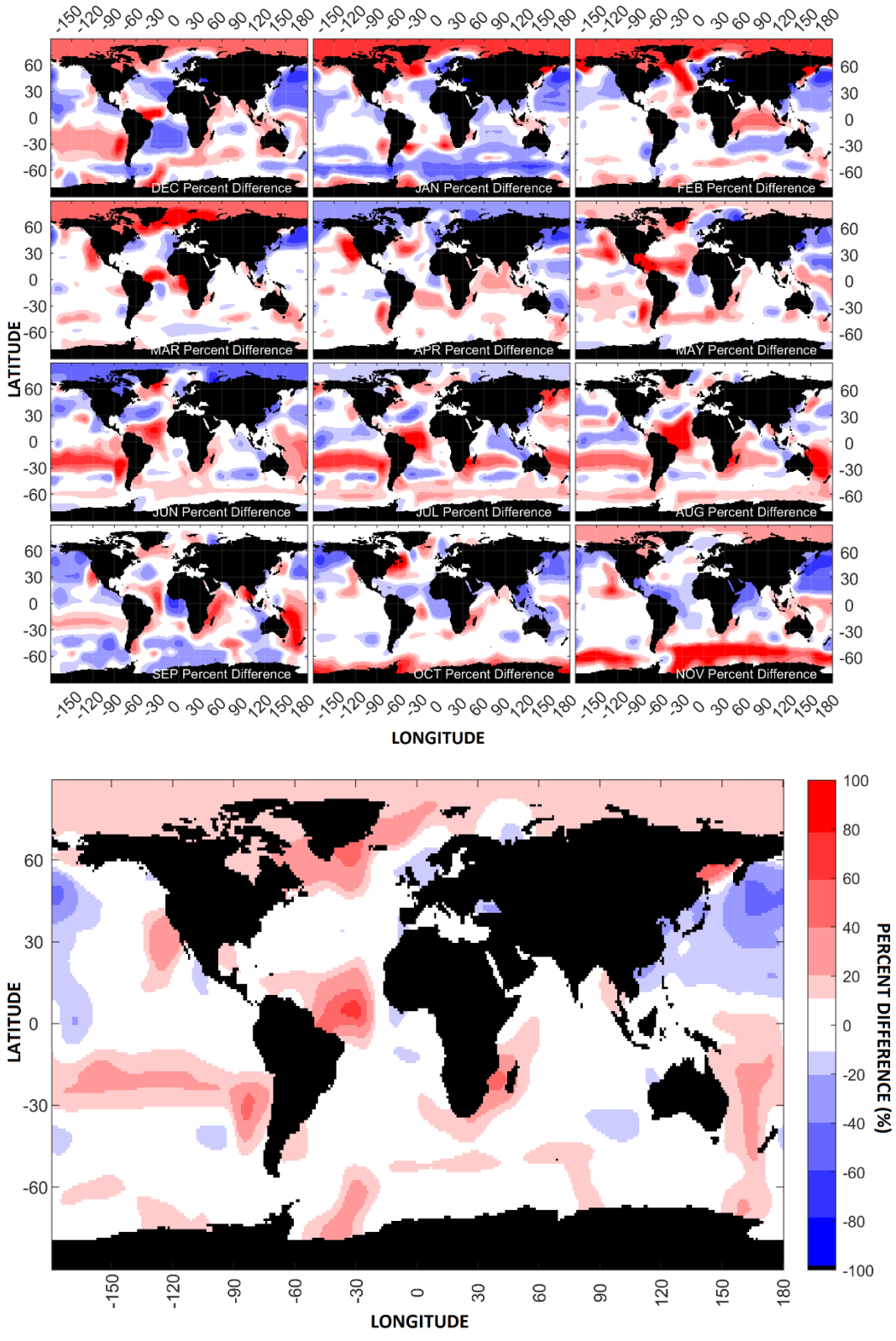
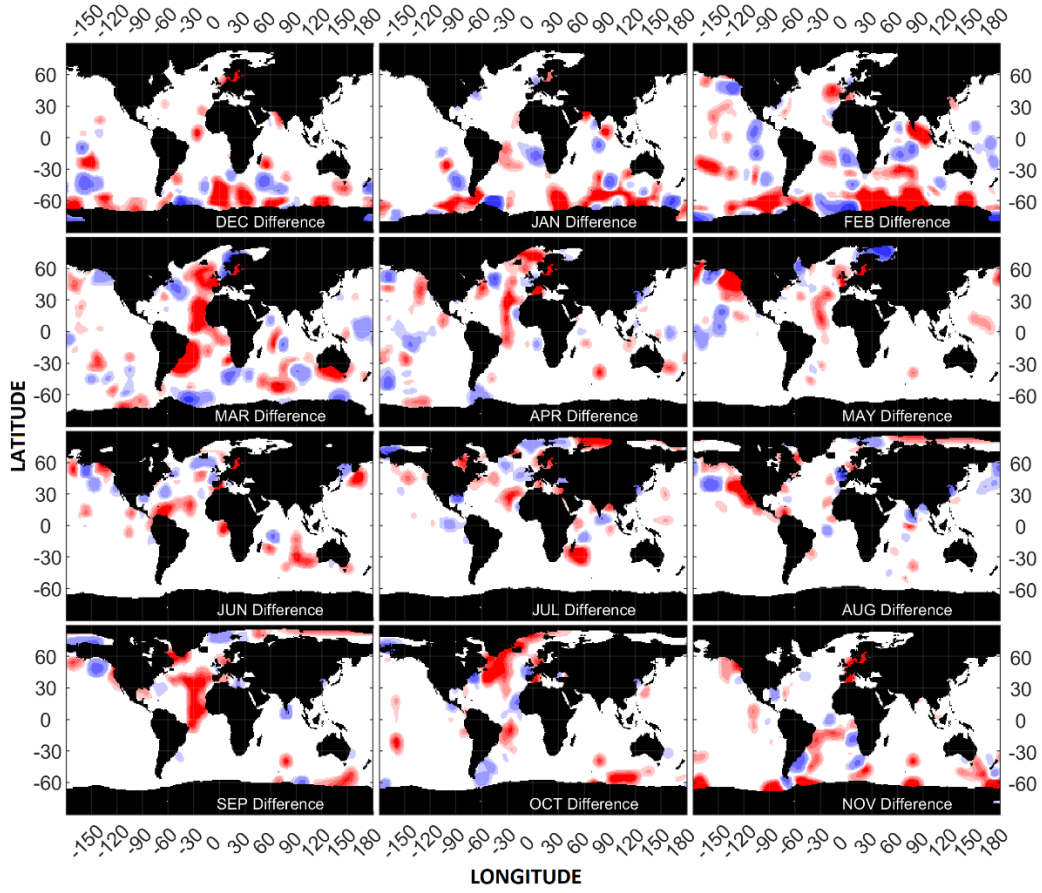


Figure S12b: Percentage difference between the monthly and annual mean DMS concentration estimated using dynamic and static biogeochemical province boundaries without considering sea ice cover.



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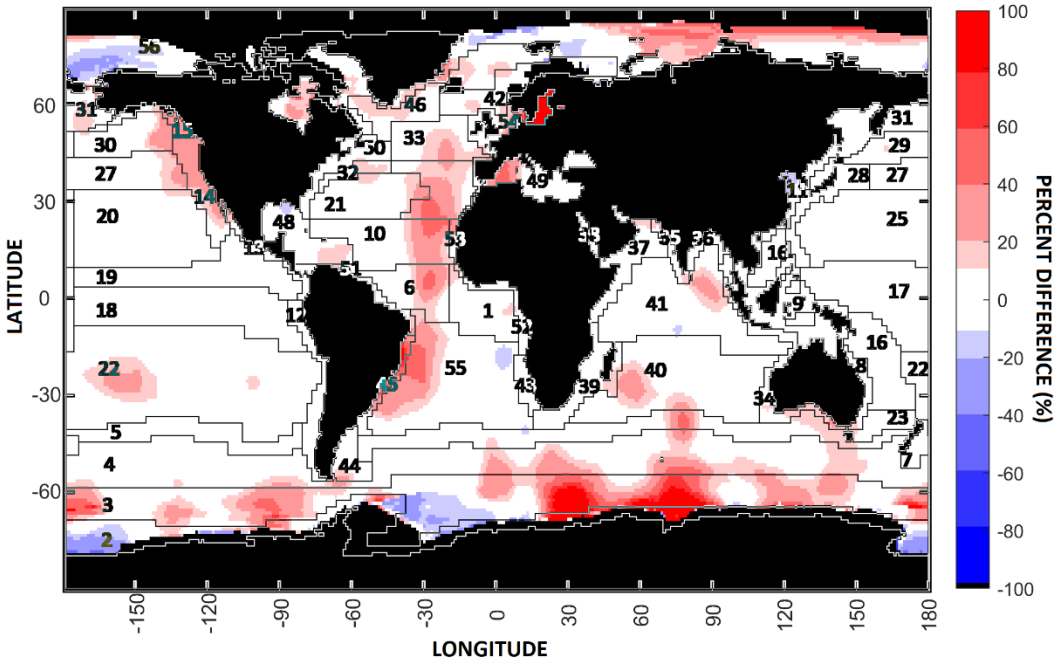

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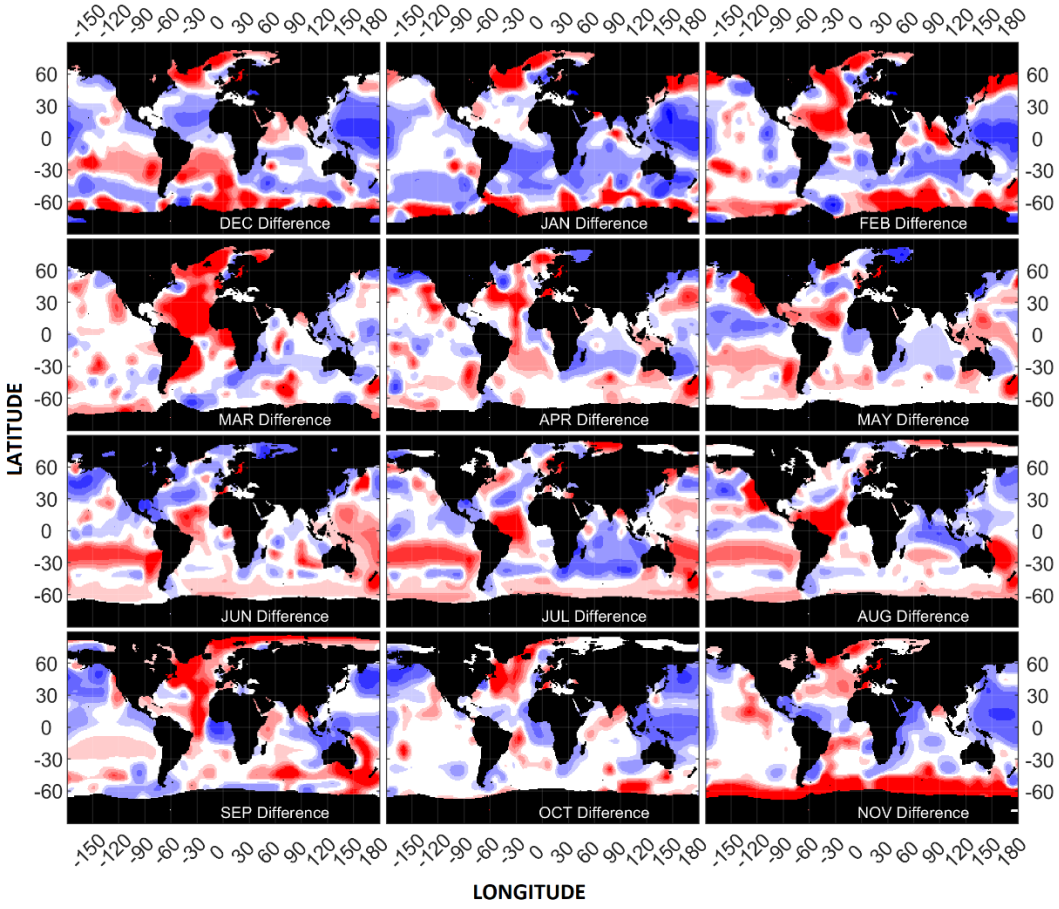
90 **Figure S13:** Percentage differences between using the Variability Length Scale (VLS) and a
91 fixed value for Radius of Influence as used by L11 (555 km) shows that the usage of VLS leads
92 to significant differences on a regional scale.



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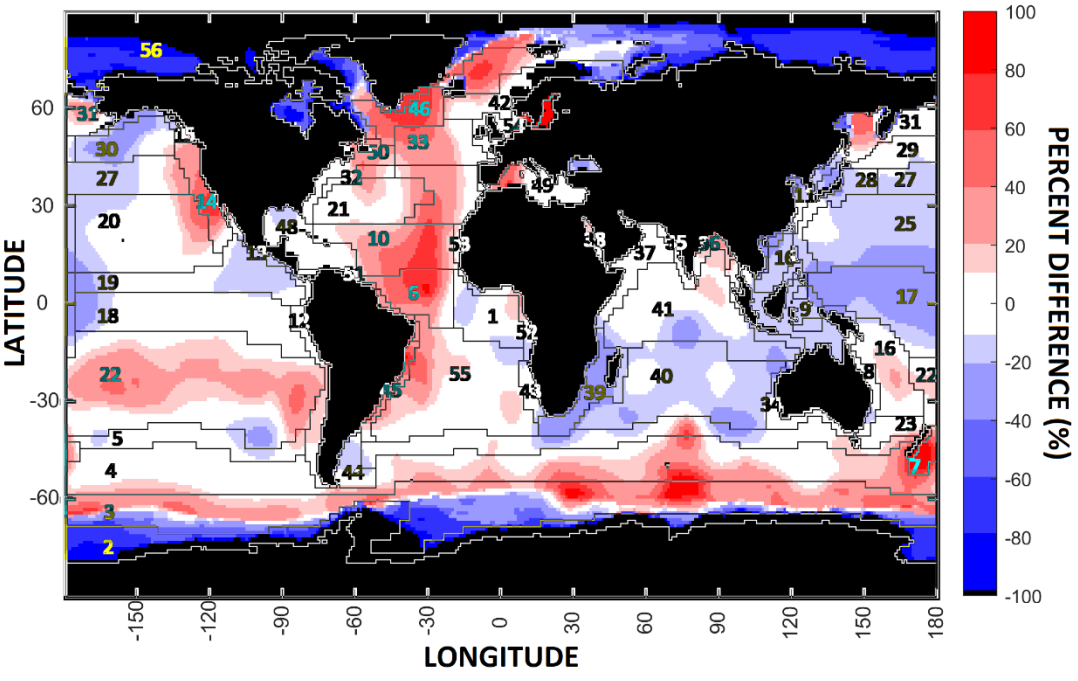

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95 **Figure S14:** Percentage difference between the monthly and annual mean DMS estimated by
96 Rev3 and L11 climatology mainly point towards the large differences observed in the polar
97 regions in the monthly means.

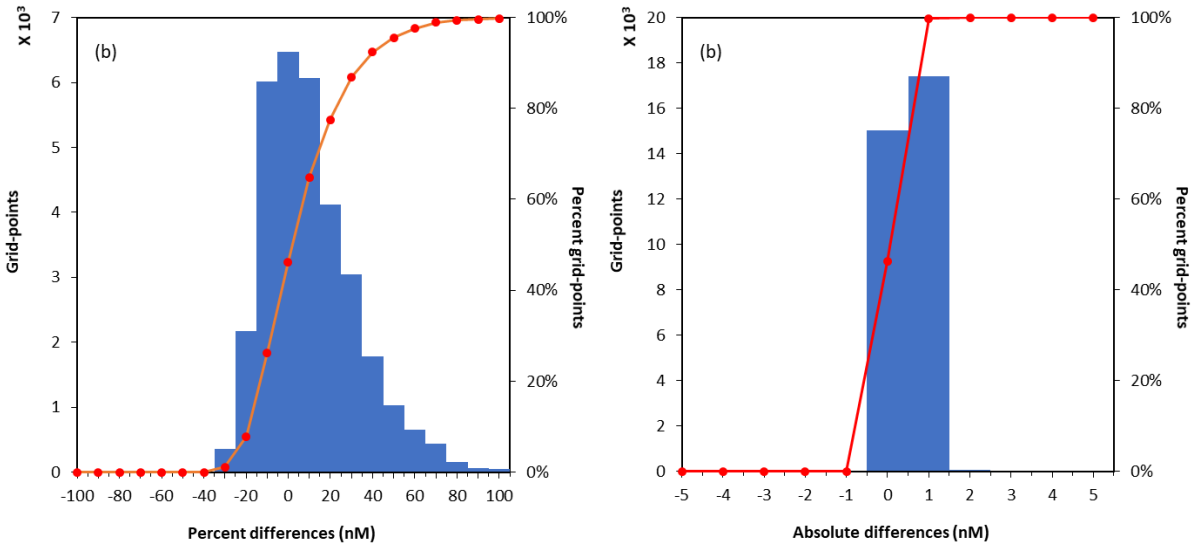
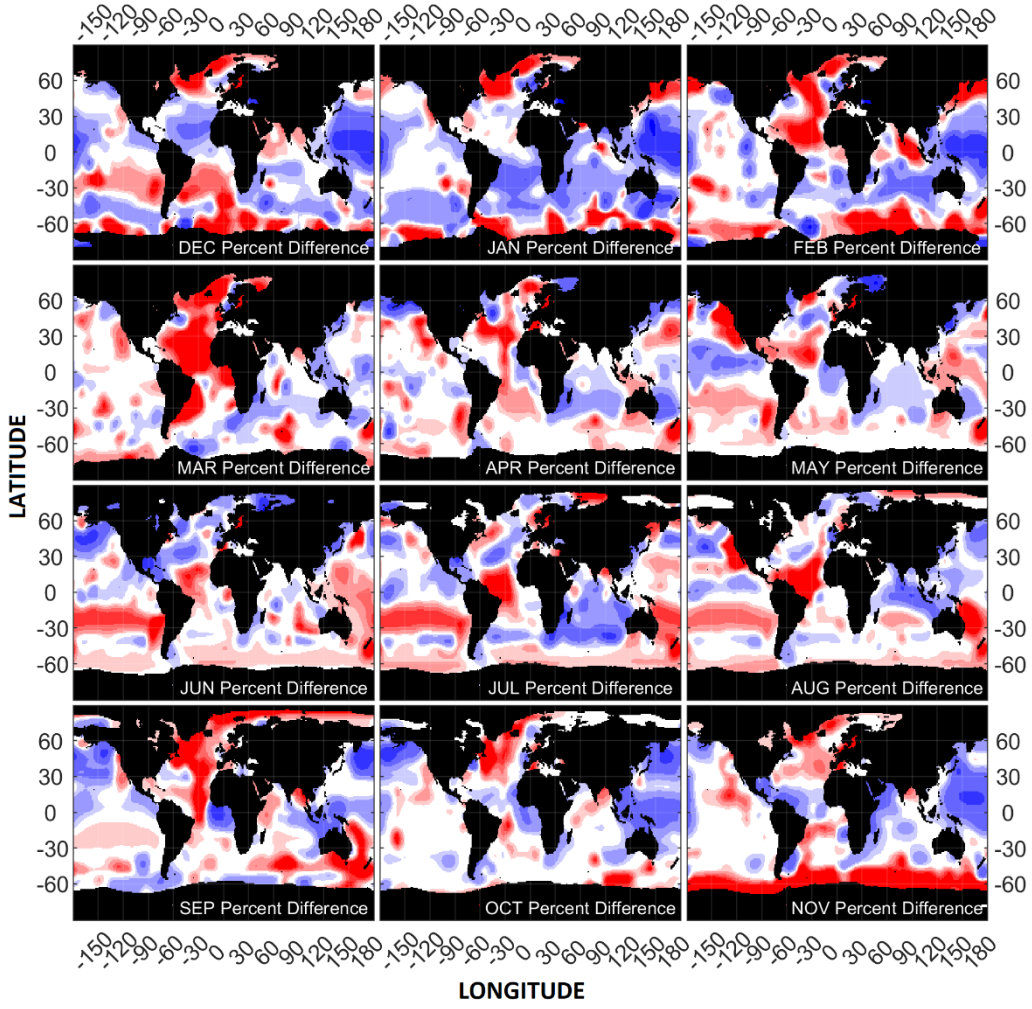


Figure S15: Grid-wise binned (a) percentage differences and (b) differences between DMS-Rev3 and L11



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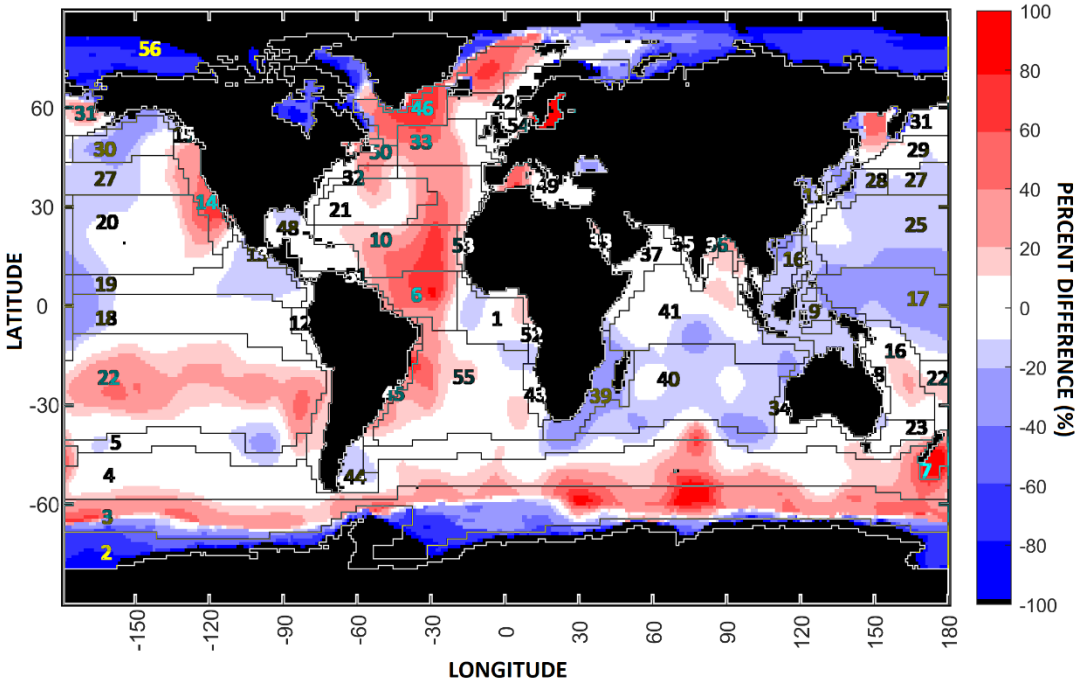

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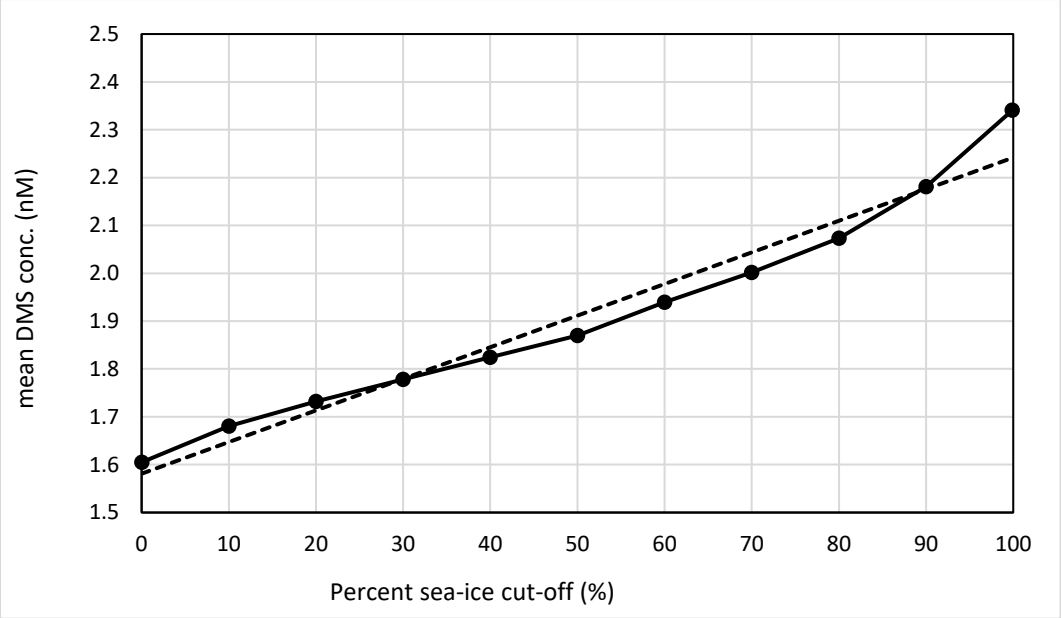
105 **Figure S16**: Percent difference between flux estimations of DMS-Rev3 and L11.



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107 **Figure S17:** The response of the averaged global DMS concentration as a response to the sea-ice
108 cutoff used to mask the polar regions.

Table S1: Globally averaged differences between the DMS-Rev3 climatology and the L11 climatology, using 555 km as the ROI distance and between using the dynamic and static province boundaries for each month and annually.

Month	REV3-L11 (nM)	VLS-555 km (nM)	dynamic-static (nM)
January	0.04	-0.17	-0.50
February	-0.03	0.05	0.21
March	0.15	0.00	0.22
April	-0.21	0.03	-0.15
May	-0.22	-0.01	0.00
June	-0.22	0.01	-0.08
July	-0.08	0.09	0.07
August	-0.03	0.03	0.11
September	-0.03	0.00	-0.03
October	-0.17	0.02	-0.06
November	0.31	0.19	0.36
December	-0.05	0.05	0.06
Annual	**-0.05**	**0.02**	**0.02**