



*Supplement of*

## **Global analysis of the controls on seawater dimethylsulfide spatial variability**

**George Manville et al.**

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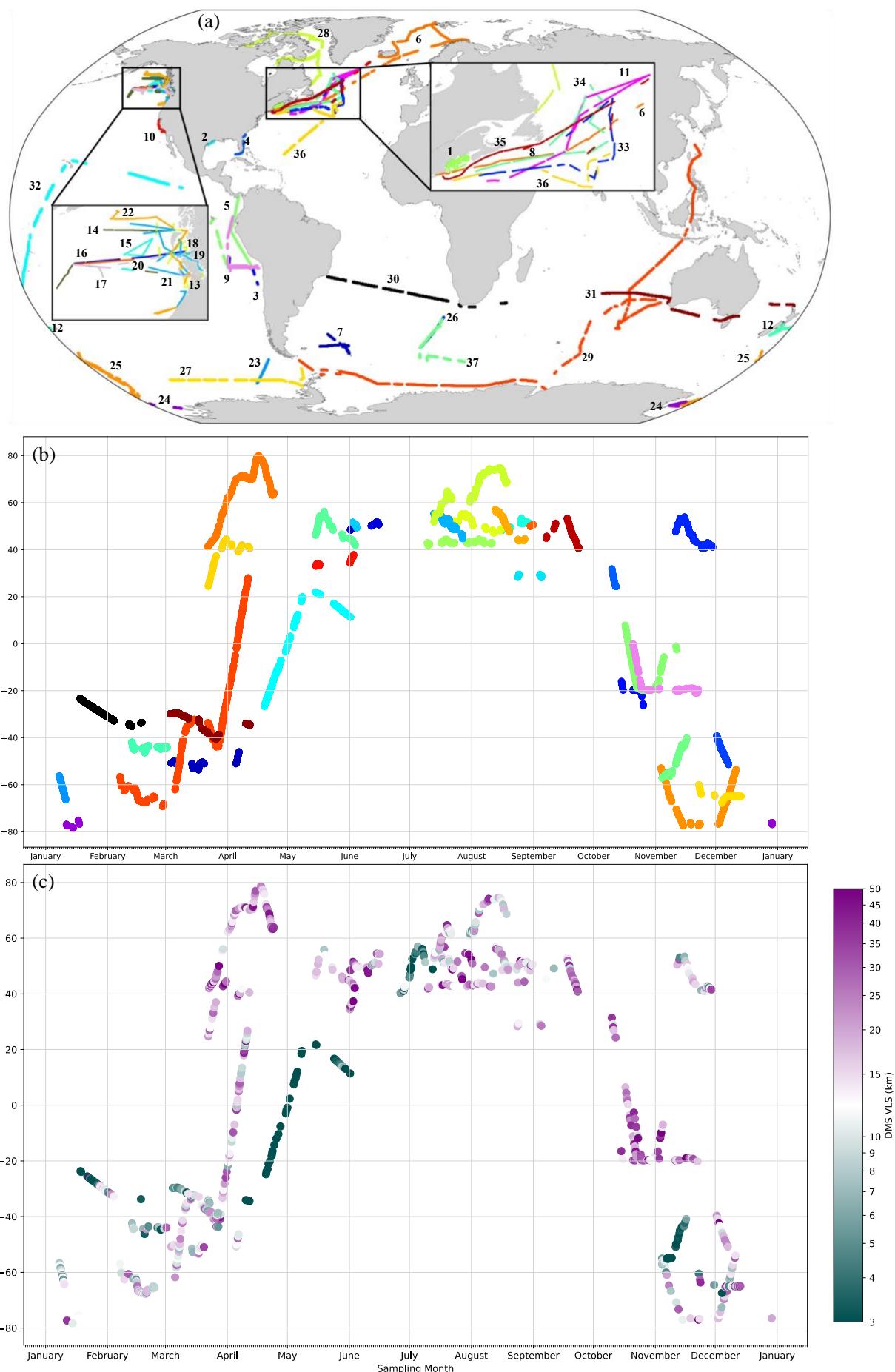
**Table S1: Summary of previous VLS studies**

Study	Interpolation measure	Characteristic lengthscale	DMS variability lengthscale (range)
Hales & Takahashi, 2004	Absolute error	63% of the asymptotically approached maximum (under)sampling error	—
Tortell, 2005	Correlation coefficient	First zero crossing of autocorrelation function	$15 \pm 4$ km
Nemcek et al., 2008	Mean absolute error. Relative standard error	63% of the asymptotically approached maximum (under)sampling error. Error magnitude compared to DMS concentration (as a %)	7.4 km
Tortell & Long, 2009	Standard error	Semivariogram analysis. Distance beyond which samples become uncorrelated	250 km
Tortell et al., 2011	Root mean squared error	63% of the asymptotically approached maximum (under)sampling error	$14.5 \pm 3.4$ km
Asher et al., 2011	Mean squared error	Change in slope (heuristic)	$7.4 \pm 2.2$ km
Royer et al., 2015	Mean squared error	Change in slope (by eye) after averaging over increasing bin widths (only binning approach)	(15–50 km)

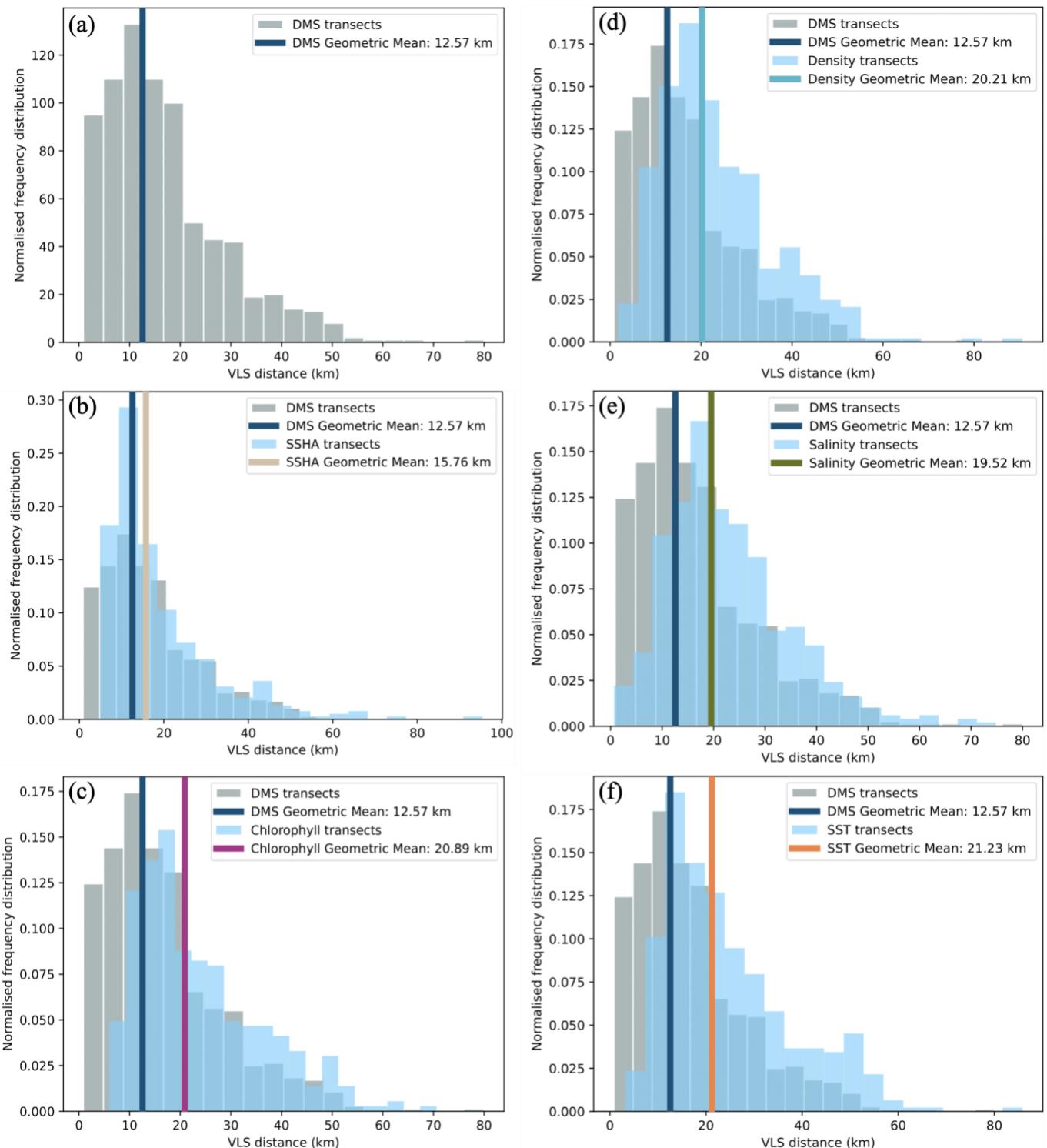
**Table S2: Summary of mean DMS concentration (nM) and VLS (km), and metadata for each sampling campaign used in this study. Data are sourced from the global surface seawater DMS database (GSSDD, see <https://saga.pmel.noaa.gov/dms/> last access: 15 April 2022), Malaspina Expedition in 2010 – split into three subsets (M10 a, b, c, Royer et al., 2015), the four North Atlantic Aerosol and Marine Ecosystem Study campaigns 2015–2018 (NAAMES, Bell et al., 2021), and the Southern oCeAn SeAsonal Experiment in 2019 (SCALE, Manville and Bell, 2023). References are provided for published datasets, and those highlighted in bold are the previous DMS VLS studies from Table S1.**

Fig. 1 Colour & No.	Data Source (Contribution)	Contributor	Region	Period	Geometric Mean DMS conc. (nM)	Geometric Mean DMS VLS (km)	Reference(s)
1	GSSDD (164)	Johnson	Gulf of Maine	2004/07/09 – 2004/08/12	2.09	19.99	Unpublished
2	GSSDD (165)	Johnson	Gulf of Mexico	2006/08/23 – 2006/09/11	2.25	16.72	Unpublished
3	GSSDD (166)	Johnson	E Equatorial Pacific	2006/10/14 – 2006/10/26	1.85	24.19	Unpublished
4	GSSDD (173)	Johnson	Atlantic Ocean	2007/10/09 – 2007/10/12	1.19	24.83	Unpublished
5	GSSDD (174)	Johnson	E Tropical Pacific	2007/10/16 – 2007/11/11	2.30	25.21	Unpublished
6	GSSDD (175)	Johnson	N Atlantic	2008/03/21 – 2008/04/24	1.27	22.57	Unpublished
7	GSSDD (196)	Archer	Southern Ocean	2008/03/03 – 2008/04/07	1.44	14.09	Unpublished
8	GSSDD (233)	Saltzman	N Atlantic	2007/07/17 – 2007/07/24	3.80	29.34	Marandino et al., 2008
9	GSSDD (243)	Johnson	E Equatorial Pacific	2008/10/20 – 2008/11/22	2.57	23.38	Unpublished
10	GSSDD (244)	Johnson	California coast	2010/05/14 – 2010/06/07	5.10	29.00	Unpublished
11	GSSDD (246)	Bell	N Atlantic	2011/06/30 – 2011/07/14	2.82	4.11	Bell et al., 2013
12	GSSDD (247)	Bell	Southern Ocean	2012/02/15 – 2012/03/06	5.13	7.47	Bell et al., 2015
13	GSSDD (248)	Herr	NE Pacific	2004/08/12 – 2004/08/19	2.96	18.73	<b>Nemcek et al., 2008</b>
14	GSSDD (249)	Herr	NE Pacific	2007/06/01 – 2007/06/16	2.33	21.94	<b>Asher et al., 2011</b>
15	GSSDD (250)	Herr	NE Pacific	2007/08/16 – 2007/08/30	4.28	19.80	<b>Asher et al., 2011</b>
16	GSSDD (251)	Herr	NE Pacific	2008/06/01 – 2008/06/15	3.64	12.61	<b>Asher et al., 2011</b>
17	GSSDD (252)	Herr	NE Pacific	2008/08/14 – 2008/08/30	5.22	13.58	<b>Asher et al., 2011</b>
18	GSSDD (253)	Herr	NE Pacific	2010/07/22 – 2010/08/15	7.39	19.71	Asher et al., 2017
19	GSSDD (254)	Herr	NE Pacific	2010/06/01 – 2010/06/04	2.51	24.45	Tortell et al., 2012a
20	GSSDD (256)	Herr	NE Pacific	2014/08/29 – 2014/08/31	3.99	13.24	Asher et al., 2015
21	GSSDD (257)	Herr	NE Pacific	2016/07/12 – 2016/07/27	2.50	14.75	Herr et al., 2019
22	GSSDD (258)	Herr	NE Pacific	2017/08/12 – 2017/08/27	2.80	16.26	Herr et al., 2019
23	GSSDD (259)	Jarníková	Southern Ocean	2009/01/07 – 2009/01/19	4.49	9.30	Tortell et al., 2012b

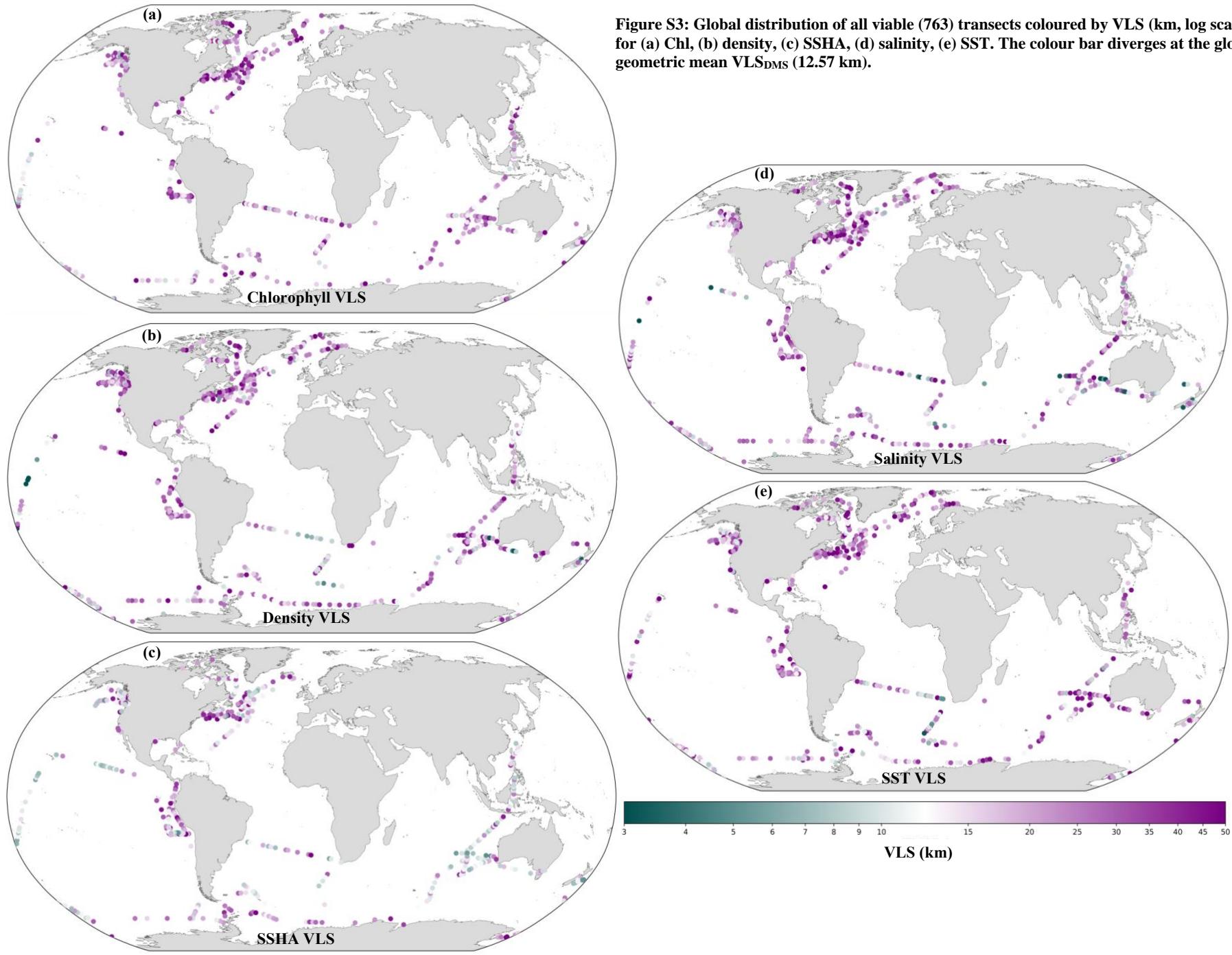
24	GSSDD (260)	Jarníková	Southern Ocean	2005/12/27 – 2006/01/17	5.05	15.76	Tortell et al., 2011; Tortell & Long, 2009
25	GSSDD (261)	Jarníková	Southern Ocean	2006/11/03 – 2006/12/11	4.93	13.22	Tortell et al., 2011; Tortell & Long, 2009
26	GSSDD (262)	Jarníková	Southern Ocean	2010/11/30 – 2010/12/14	1.40	18.87	Jarníková & Tortell, 2016
27	GSSDD (263)	Jarníková	Southern Ocean	2013/11/22 – 2013/12/13	7.18	13.39	Jarníková & Tortell, 2016
28	GSSDD (264)	Jarníková	Labrador Sea	2015/07/13 – 2015/08/18	2.03	13.05	Jarníková et al., 2018
29	GSSDD (265)	Zhang	Southern Ocean, E Indian, W Pacific	2014/02/07 – 2014/04/11	2.17	13.47	Zhang et al., 2017
30	M10 (a)	Royer, Galí, Mahajan, and Simó	S Atlantic	2010/12/17 – 2011/02/18	1.09	5.93	Royer et al., 2015
31	M10 (b)	Royer, Galí, Mahajan, and Simó	S Indian, S Australia coast, Tasman Sea	2011/03/03 – 2011/04/12	1.00	6.67	Royer et al., 2015
32	M10 (c)	Royer, Galí, Mahajan, and Simó	Tropical & sub- tropical Pacific	2011/04/19 – 2011/07/12	0.93	1.86	Royer et al., 2015
33	NAAMES (1)	Bell	N Atlantic	2015/11/11 – 2015/11/29	1.28	11.93	Bell et al., 2021
34	NAAMES (2)	Bell	N Atlantic	2016/05/14 – 2016/06/03	2.02	18.40	Bell et al., 2021
35	NAAMES (3)	Bell	N Atlantic	2017/09/06 – 2017/09/23	2.98	20.89	Bell et al., 2021
36	NAAMES (4)	Bell	N Atlantic	2018/03/21 – 2018/04/12	3.20	21.94	Bell et al., 2021
37	SCALE	Manville	Southern Ocean	2019/10/18 – 2019/11/18	3.28	3.78	Manville & Bell, 2023



**Figure S1:** (a) Global extent of the 37 high frequency DMS campaigns included in this analysis (coloured and numbered), (b) spatiotemporal distribution of DMS campaigns, highlighting acute seasonal sampling bias, (c) spatiotemporal distribution of 763 transects coloured by VLSdMS (km, log scale) (see Table S2 for metadata relating to each sampling campaign). The colour bar diverges at the global geometric mean VLSdMS (12.57 km).



**Figure S2:** All panes: Frequency distribution of variability lengthscales (VLS, km) for all DMS transects (grey bars), with the global geometric mean VLS<sub>DMS</sub> (dark blue line). Panes b-f: Frequency distribution of transect VLS for each variable (light blue bars), normalised to the maximum transect frequency of the VLS<sub>DMS</sub> and superimposed on the VLS<sub>DMS</sub> frequency distribution. Vertical coloured lines correspond to global geometric mean from all transects for (a) VLS<sub>DMS</sub> (dark blue), (b) VLS<sub>SSHA</sub> (beige), (c) VLS<sub>Chl</sub> (magenta), (d) VLS<sub>Density</sub> (cyan), (e) VLS<sub>Salinity</sub> (green), (f) VLS<sub>SST</sub> (orange).



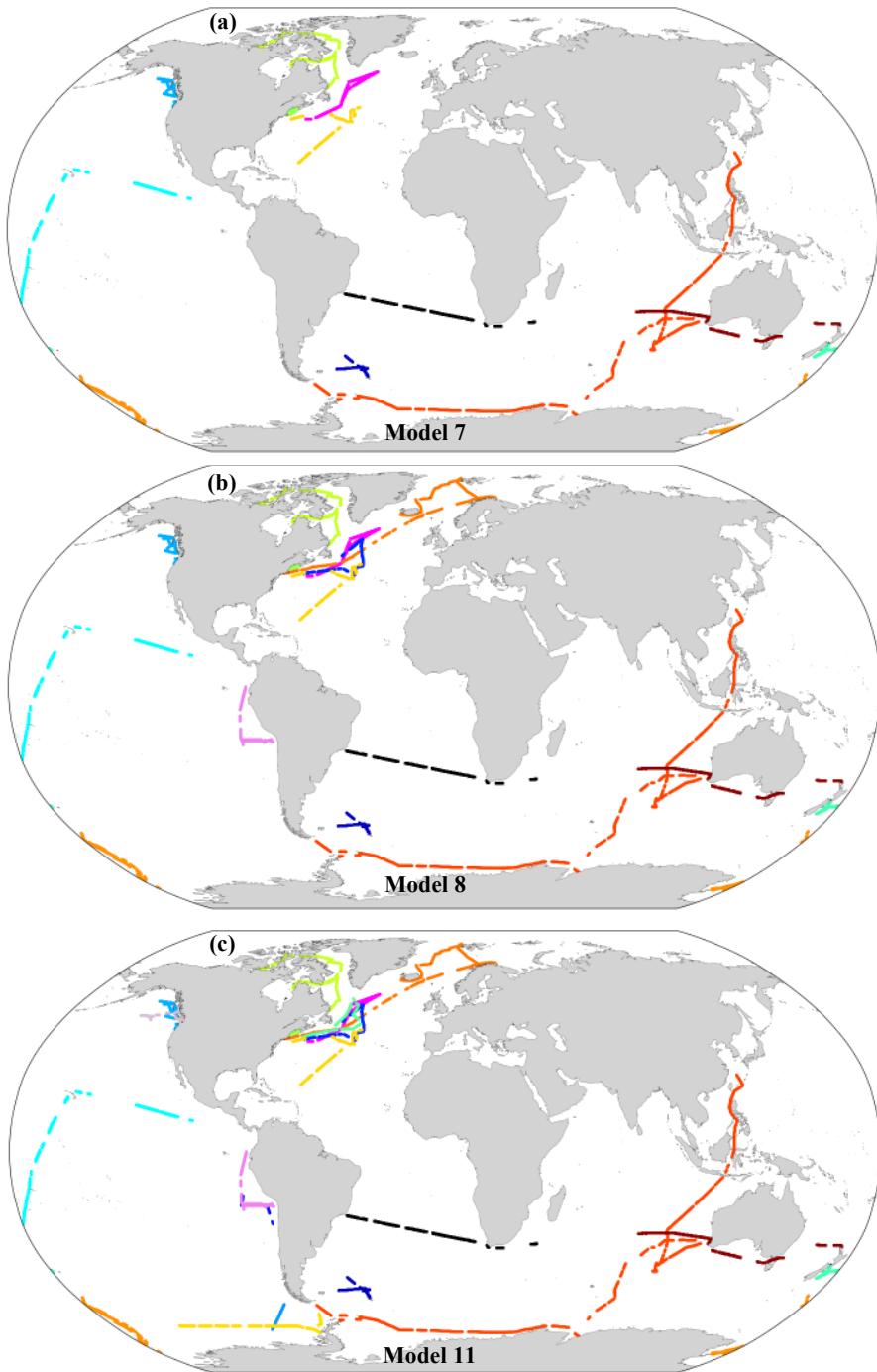
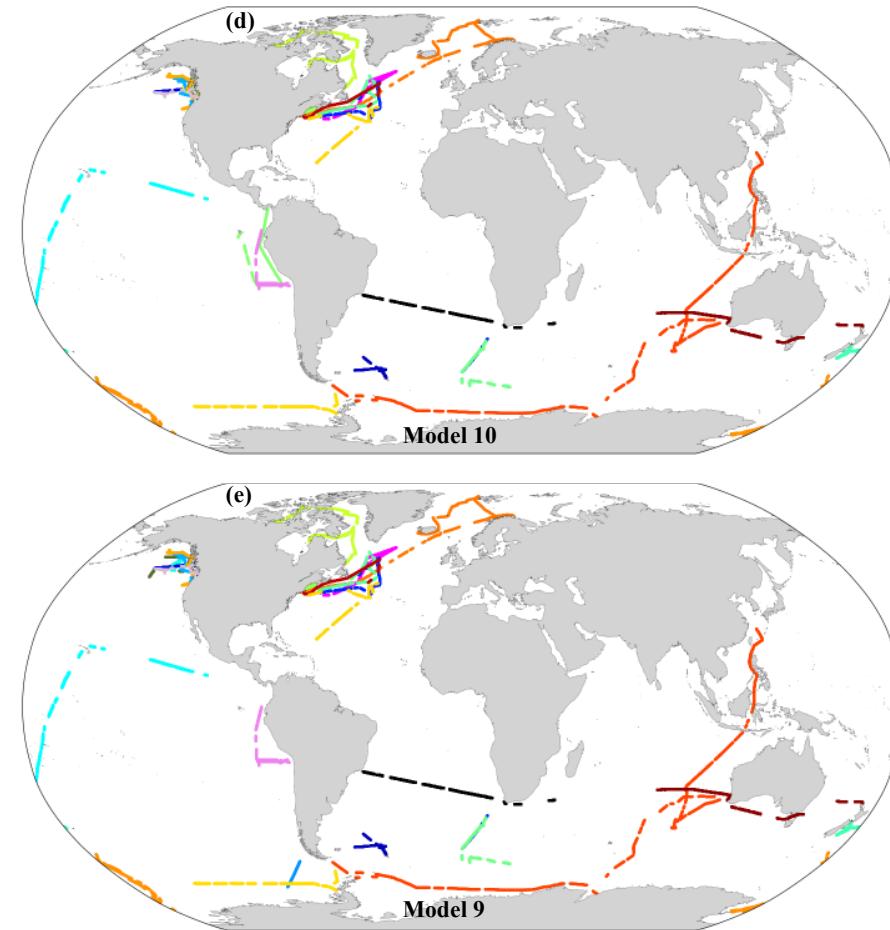
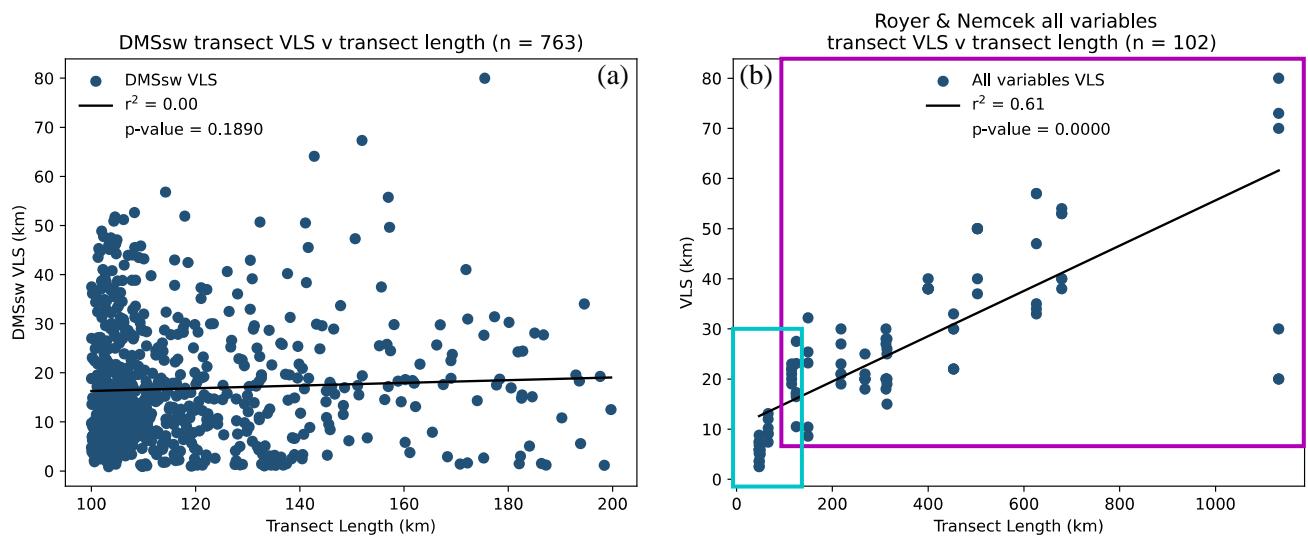


Figure S4: Cruise tracks of the DMS data sampling campaigns included in multiple linear regression (MLR) models (a) Model 7: 12 datasets, (b) Model 8: 15 datasets, (c) Model 11: 20 datasets, (d) Model 10: 25 datasets, (e) Model 9: 26 datasets. See Table S1 for metadata regarding each sampling campaign.



**Table S3: Regression results for the prediction of campaign average VLS<sub>DMS</sub>, equivalent to Table 1 in the main text but using the ‘relaxed criterion’ approach (see main text Section 3.3.2 for details). Models that are significant ( $p < 0.01$ ) are denoted using \*.**

Model no.	Input parameters	R <sup>2</sup>	Adj. R <sup>2</sup>	p	Relative importance (%)	N (no. of campaigns)	No. transects used to calculate campaign averages (of 760)
<b>Linear Regression</b>							
1	VLS <sub>Chl</sub>	0.2	—	<0.01*	100	35	361
2	VLS <sub>SSHA</sub>	0.31	—	<0.01*	100	34	387
3	VLS <sub>density</sub>	0.41	—	<0.01*	100	35	486
4	VLS <sub>salinity</sub>	0.25	—	<0.01*	100	35	496
5	VLS <sub>SST</sub>	0.25	—	<0.01*	100	35	462
6	Latitude (abs.)	0.02	—	0.375	100	35	760
<b>Multiple Linear Regression</b>							
	VLS <sub>Chl</sub>				21		361
7	VLS <sub>SSHA</sub>	0.61	0.58	<0.01*	37	34	387
	VLS <sub>density</sub>				42		486
	VLS <sub>Chl</sub>				26		361
8	VLS <sub>SSHA</sub>	0.46	0.4	<0.01*	54	34	387
	VLS <sub>salinity</sub>				20		496
9	VLS <sub>Chl</sub>	0.5	0.47	<0.01*	29	35	361
	VLS <sub>density</sub>				71		486
10	VLS <sub>salinity</sub>	0.44	0.41	<0.01*	49	35	496
	VLS <sub>SST</sub>				51		462
11	VLS <sub>Chl</sub>	0.45	0.41	<0.01*	35	34	361
	VLS <sub>SSHA</sub>				65		387
12	VLS <sub>Chl</sub>	0.3	0.25	<0.01*	42	35	361
	VLS <sub>salinity</sub>				58		496
13	VLS <sub>SSHA</sub>	0.37	0.33	<0.01*	65	34	387
	VLS <sub>salinity</sub>				35		496
14	VLS <sub>Chl</sub>	0.41	0.38	<0.01*	44	35	361
	VLS <sub>SST</sub>				56		462
15	VLS <sub>SSHA</sub>	0.42	0.39	<0.01*	60	34	387
	VLS <sub>SST</sub>				40		462
16	VLS <sub>SSHA</sub>	0.52	0.5	<0.01*	45	34	387
	VLS <sub>density</sub>				55		486
	VLS <sub>Chl</sub>				27		361
17	VLS <sub>SSHA</sub>	0.56	0.51	<0.01*	44	35	387
	VLS <sub>SST</sub>				29		462



**Figure S5:** The importance of consistent transect lengths for analysing VLS. (a) VLS<sub>DMS</sub> in this study is not significantly correlated to transect length for the 763 consistent (100-200 km) transects, (b) VLS of all parameters is dependent on transect length from both Nemcek et al. (2008) (~50-150 km, cyan box) and Royer et al. (2015) (~100-1100 km, magenta box).

**Table S4 – Regression results for the prediction of campaign average VLS<sub>DMS</sub>, equivalent to Table 1 in the main text but including regression coefficients. Input variables and coefficients can be applied for the prediction of VLS<sub>DMS</sub> following Eq. (S1):**

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$$

where  $\beta$  corresponds to the coefficient for each input variable  $x$ , and  $\beta_0$  is the constant.

Model no	Input parameters ( $x_1, x_2, x_3$ )	R <sup>2</sup>	Adj. R <sup>2</sup>	p	Coefficients ( $\beta_1, \beta_2, \beta_3$ )	Constant ( $\beta_0$ )
Linear Regression						
1	VLS <sub>Chl</sub>	0.47	—	<0.01*	0.8099	-2.991
2	VLS <sub>SSHA</sub>	0.46	—	<0.01*	0.642	2.8003
3	VLS <sub>density</sub>	0.37	—	<0.01*	0.6524	1.1319
4	VLS <sub>salinity</sub>	0.33	—	<0.01*	0.7393	0.0703
5	VLS <sub>SST</sub>	0.21	—	0.014	0.6055	1.8129
6	Latitude (abs.)	0.02	—	0.375	-0.0703	19.0409
Multiple Linear Regression						
	VLS <sub>Chl</sub>				0.3262	
7	VLS <sub>SSHA</sub>	0.83	0.77	<0.01*	0.8791	-11.0697
	VLS <sub>density</sub>				0.1725	
	VLS <sub>Chl</sub>				0.6863	
8	VLS <sub>SSHA</sub>	0.77	0.71	<0.01*	0.5683	-9.5223
	VLS <sub>salinity</sub>				0.0153	
9	VLS <sub>Chl</sub>	0.66	0.63	<0.01*	0.6256	
	VLS <sub>density</sub>				0.3953	-7.178
10	VLS <sub>salinity</sub>	0.62	0.59	<0.01*	0.9182	
	VLS <sub>SST</sub>				0.1269	-7.1162
11	VLS <sub>Chl</sub>	0.51	0.46	<0.01*	0.2456	
	VLS <sub>SSHA</sub>				0.5247	-0.5942
12	VLS <sub>Chl</sub>	0.50	0.45	<0.01*	0.6606	
	VLS <sub>salinity</sub>				0.1557	-3.5472
13	VLS <sub>SSHA</sub>	0.49	0.44	<0.01*	0.5444	
	VLS <sub>salinity</sub>				0.1747	1.3005
14	VLS <sub>Chl</sub>	0.46	0.4	<0.01*	0.6509	
	VLS <sub>SST</sub>				0.3517	-7.6643
15	VLS <sub>SSHA</sub>	0.43	0.36	<0.01*	0.5456	
	VLS <sub>SST</sub>				0.3233	-2.5339
16	VLS <sub>SSHA</sub>	0.41	0.35	<0.01*	0.5475	
	VLS <sub>density</sub>				0.2495	-0.6278
	VLS <sub>Chl</sub>				1.028	
17	VLS <sub>SSHA</sub>	0.50	0.29	0.156	-0.7187	7.282
	VLS <sub>SST</sub>				-0.2228	

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