Supporting Information for "Meridional transport of physical and biogeochemical tracers by Southern Ocean eddies south of Tasmania"

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Contents of this file

Table S1. Comparison between simulated cyclonic eddy census for various size of search windows (4×4, 7×7, and 10×10) and altimetry for the eddies that lived longer than 30 days. Tabulated values are (min-max), mean, median and standard deviation.

Cyclones	Altimetry	Model (4×4)	Model (7×7)	Model (10×10)
Amplitude (cm)	(0.72-95.06) 15.89, 12.60, 11.6	(0.06-59.6) 6.42, 2.75, 8.57	(0.23–59.62) 8.17, 4.12, 9.24	(0.56-59.62) 10.69, 6.90, 9.93
Diameter (km)	(95.28-380.15) 168.05, 160.82, 44.4	(37.67-356.6) 120.8, 112.35, 50.93	(66.67-356.6) 138.99, 130.51, 46.02	(95.12-356.6) 160.45, 153.07, 41.08
Rotational Speed (cm/s)	(0.80-2360.9) 136.12, 14.98, 307.16	(0.13-426.7) 9.5, 3.63, 16.4	(0.21-230.40) 10.85, 4.89, 15.82	(0.31-230.4) 13.24, 6.30, 17.66
Realisation	29529	45766	33932	22031
Eddies	379	666	489	331
Lifespan	(31-584) 77.91, 56, 69.56	(31-469) 68.72, 54, 47.05	(31-469) 69.39, 55, 47.72	(31-469), 66.56, 50, 45.52

Table S2. Comparison between simulated anticyclonic eddy census for various size of search windows (4×4, 7×7, and 10×10) and altimetry for the eddies that lived longer than 30 days. Tabulated values are (min-max), mean, median and standard deviation.

Anticyclones	Altimetry	Model 4×4	Model 7×7	Model 10×10
Amplitude (cm)	(0.5-62.98) 12.18, 10.18, 8.49	(0.05-53.35) 4.88, 2.57, 6	(0.24-53.35) 6.42, 4.14, 6.41	(0.42-53.35) 8.51, 6.17, 6.83
Diameter (km)	(93.94–443.75) 170.45, 163.53, 46	(38.03-424.97) 120.25, 112.21, 51.65	(66.43-424.97) 140.34, 132.94, 46.79	(95.09-424.97) 163, 154.36, 43.77
Rotational Speed (cm/s)	(0.44–1793.4) 68.99, 10.69, 185.10	(0.11-1017.5) 9.36, 3.33, 32.49	(0.19-1017.5) 11.36, 472, 36.53	(0.33-664.39) 12.34, 6.19, 27.05
Realisation	21492	41070	29756	18711
Eddies	322	672	484	304
Lifespan	(31-875) 66.75, 48.5, 67.19	(31-400) 61, 48, 41	(31-364) 61.48, 48.5, 41.23	(31-361), 61.55, 48.5, 41.79

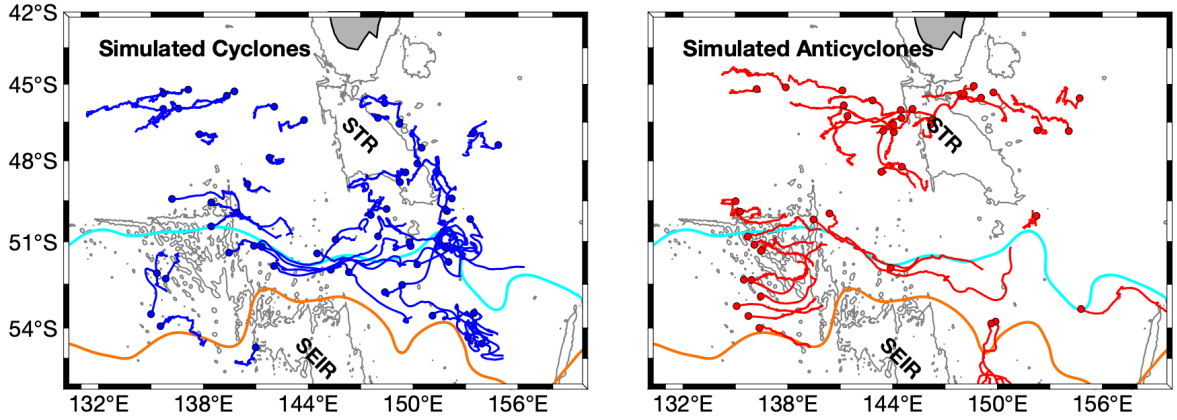

Figure S1. Simulated eddy trajectories. Dots denote formation point of eddies. Grey contour of the 3000 m bathymetry indicates the Southeast Indian Ridge (SEIR) and South Tasman Rise (STR). The mean position of the northern and southern branches of the Subantarctic Front, shown as contours (cyan and magenta, respectively).

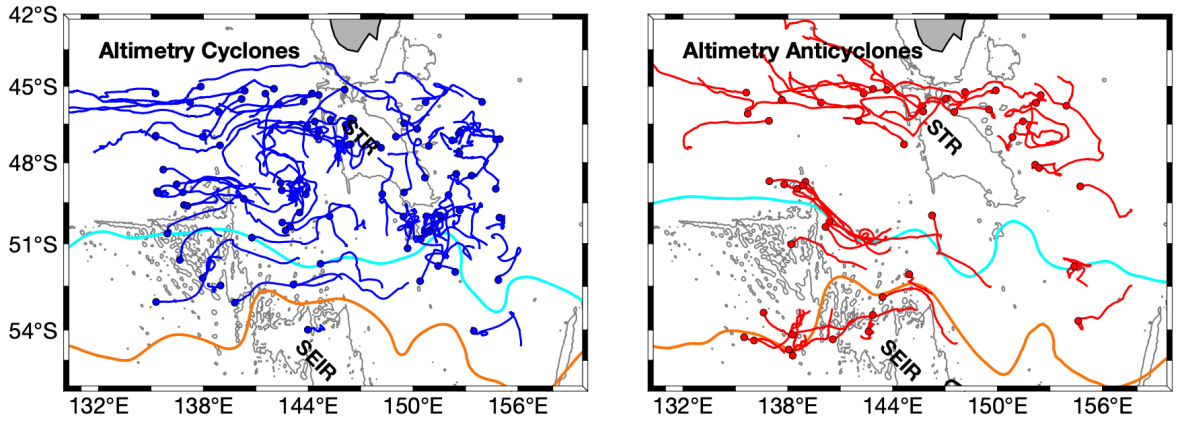

Figure S2. Altimetry eddy trajectories. Dots denote formation point of eddies. Grey contour of the 3000 m bathymetry indicates the Southeast Indian Ridge (SEIR) and South Tasman Rise (STR). The mean position of the northern and southern branches of the Subantarctic Front, shown as contours (cyan and magenta, respectively).

Table S3. Stability of the time-mean tracer transport by transient process of the study period of 8 years. The time-mean tracer transport is averaged over 47-55.5°S and 135-155°E.

Period	Heat (MW/m)	Salt (m^2/s PSU)	Nitrate (mmol/m/s)
2007-2014	−14.5	−0.098	6.61
2007-2010	−14.73	−0.096	6.69
2011-2014	−14.78	−0.099	6.87
2009-2012	−14.73	−0.097	6.67

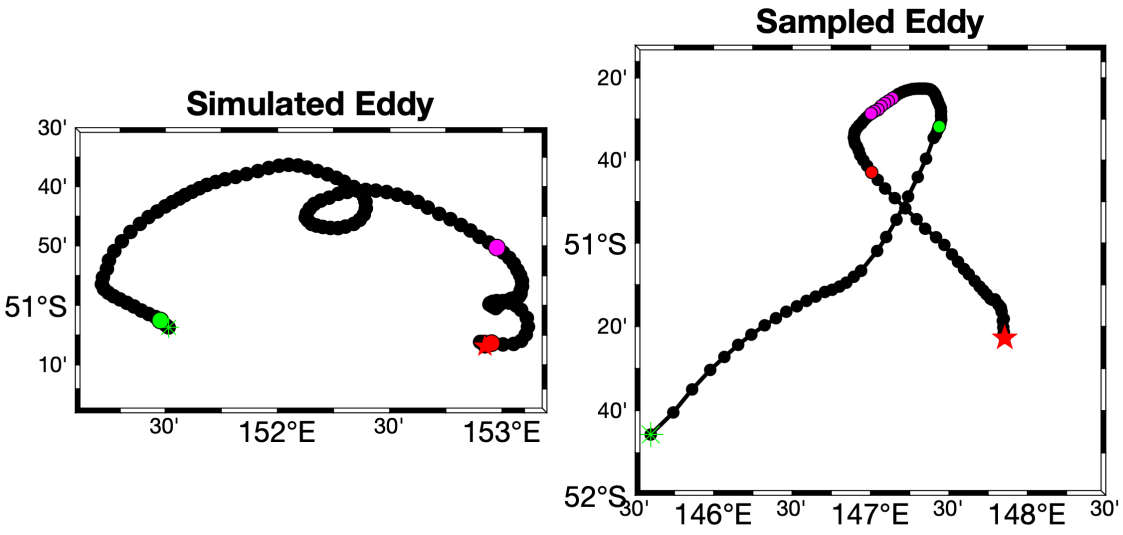

Figure S3. Simulated and sampled eddies track. Daily position is marked as black dots. Magenta dots represent the period over which the transect is made. Green and red dots represent detachment from and reattachment to the meander, respectively. The asterisk and star denote formation and dissipation of the eddies, respectively.

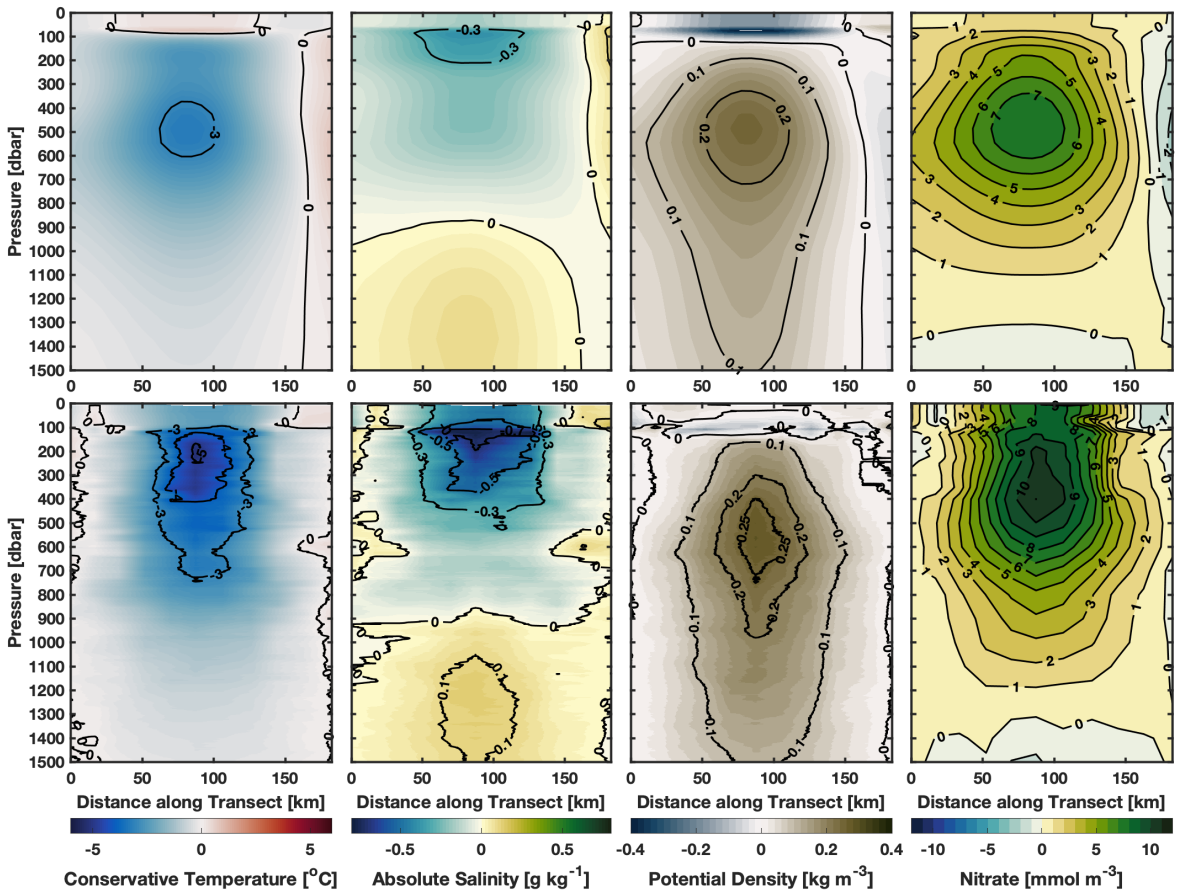

Figure S4. Vertical distribution of temperature, salinity, density, and nitrate anomalies of the simulated eddy (top) and the sampled eddy (bottom)in pressure coordinate. The anomalies are computed with respect to the surrounding environment. The temperature, salinity, density, and nitrate anomaly contours were plotted at the intervals of 0.25 °C, 0.05 g/kg, 0.05 kg/m^3 and 1 mmol/L, respectively.

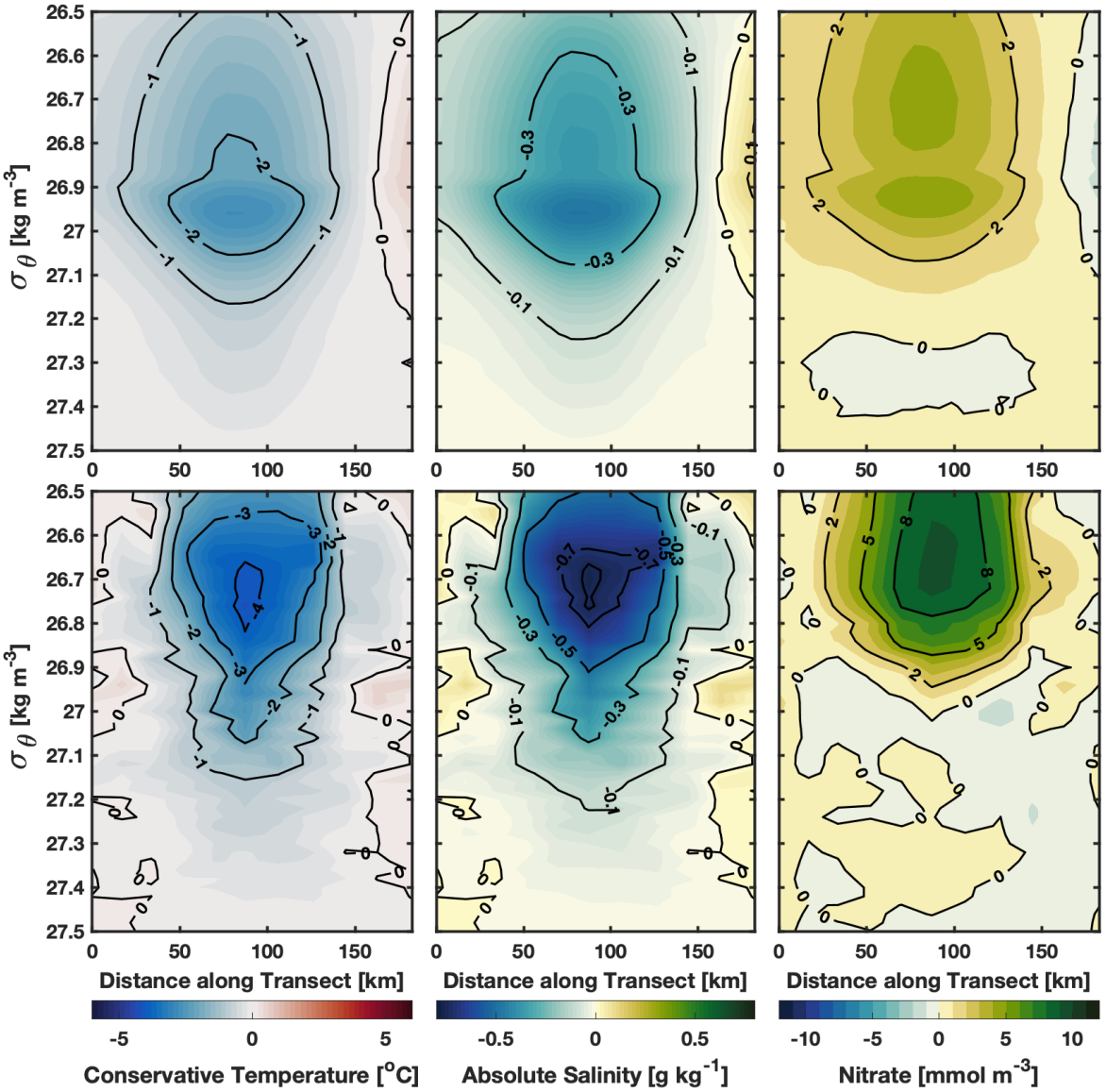

Figure S5. Vertical distribution of temperature, salinity, and nitrate anomalies of the simulated eddy (top) and the sampled eddy (bottom)in density coordinates. The temperature, salt and nitrate anomaly contours were plotted at the interval of 0.2 °C, 0.02 g/kg and 1 mmol/L, respectively.

Table S4. Comparing characteristics of the simulated case study eddy to the sampled eddy.

Attributes	Simulated eddy	Sampled eddy
Birth	11 Jan – Summer	3 Feb – Summer
Demise	8 May – Autumn	21 May – Autumn
Lifespan	119 days	109 days
Pathway	Formed in the SAF – visited the SAZ – reabsorbed to the front	
Travelled distance	285 km from the formation,	371 km from the formation
Rotational Speed (median)	22.2 cm/s	43.6 cm/s
Amplitude (median)	21.2 cm/s	35.5 cm/s
Diameter (median)	154 km	179 km

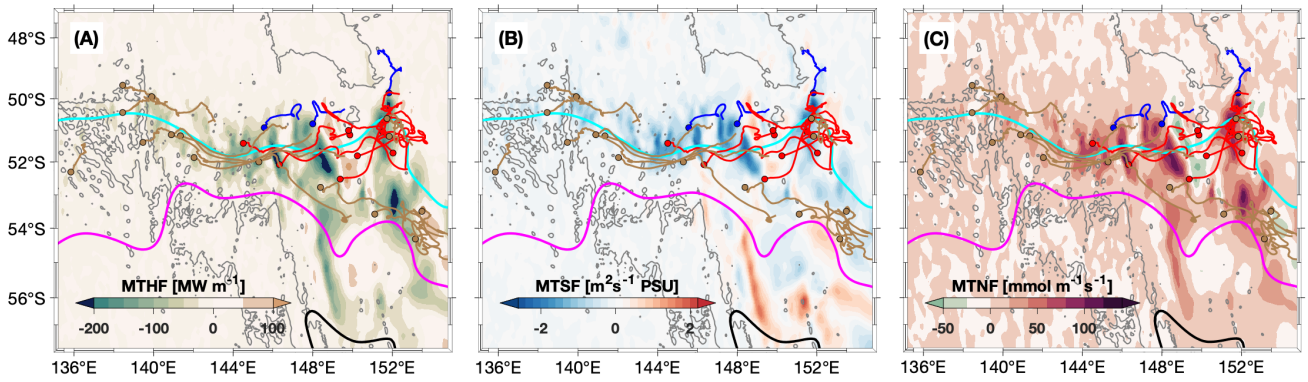

Figure S6. Transient heat, salt and nitrate transport south of Tasmania (shading) overlain by trajectories of 26 long-lived cyclonic eddies formed due to Subantarctic Front instability. A dot represents the eddy formation site. Dissipating frontal eddies, return frontal eddies, and frontal mixing eddies denoted in blue, red and light brown, respectively. The northern and southern branches of the Subantarctic Front and Polar Front represented as cyan, magenta and black contours, respectively.

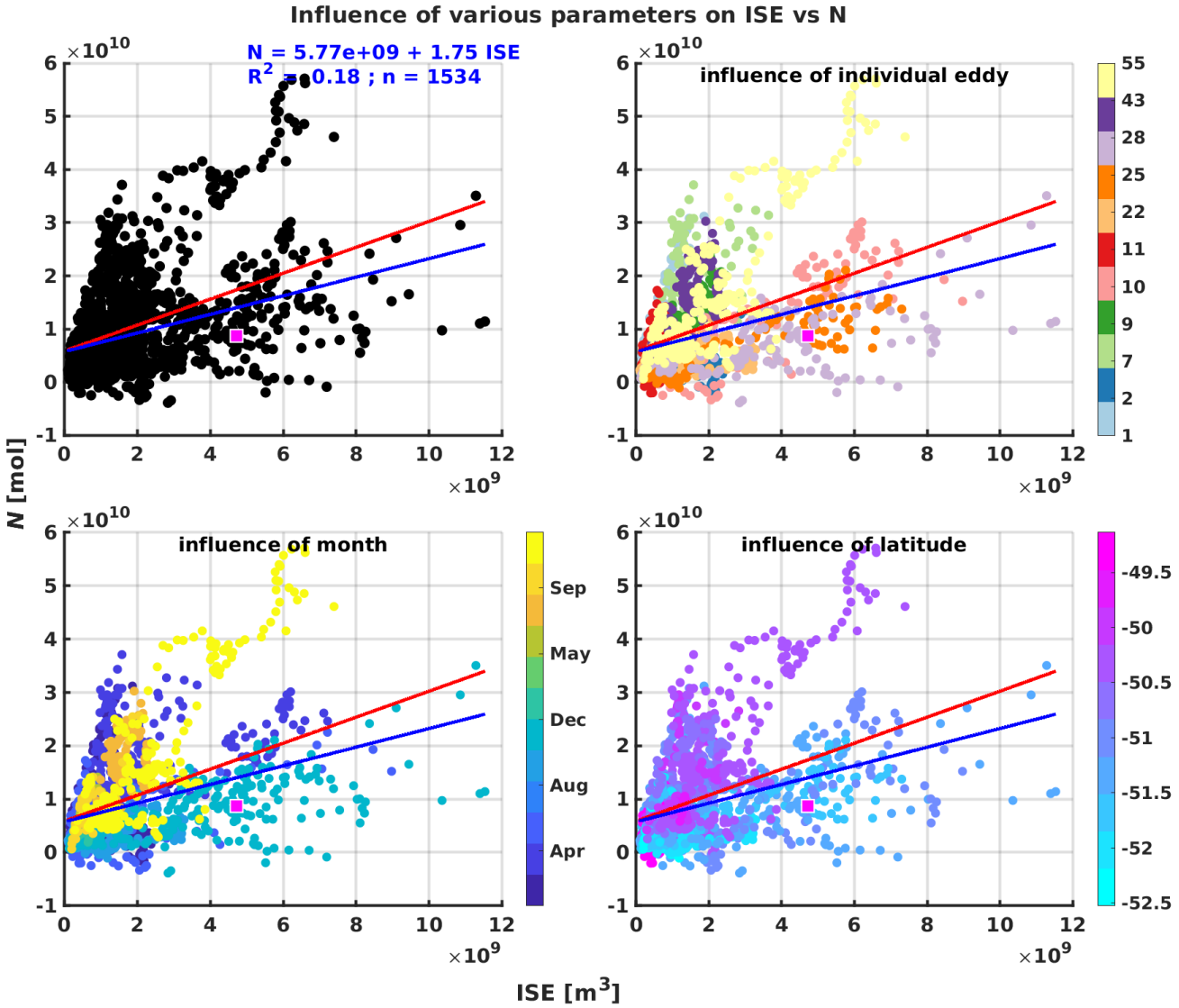

Figure S7. Influence of individual eddy, month in which a realise detected, and latitude on the empirical relationship between integrated surface elevation (ISE) and total available nitrate content of an eddy. The red and blue line represents linear and robust linear fit to the empirical relationship, respectively. The magenta dot denotes observed ISE and total available nitrate content of an eddy of Patel et al. (2020).

Table S5. The mean and standard deviation of the total available heat (TAHA), total available salt (TASA), and total available nitrate (TANA) anomalies introduced by long-lived coherent eddies for each year in the Subantarctic Zone (SAZ) south of Tasmania. The region is bounded by 47°S-52°S and 135°E-155°E.

Year	Eddy Realisation	TAHA ($\times 10^{19}$ J)	TASA ($\times 10^{12}$ kg)	TANA ($\times 10^{10}$ mol)
Cyclonic eddies in the SAZ				
2007	316	-3.85 ± 2.70	-1.71 ± 1.21	1.31 ± 1.62
2008	763	-3.78 ± 2.92	-1.70 ± 1.30	1.47 ± 1.24
2009	681	-2.85 ± 3.41	-1.23 ± 1.50	0.87 ± 1.18
2010	952	-3.11 ± 2.33	-1.34 ± .95	0.76 ± 0.6
2011	432	-4.03 ± 3.08	-1.81 ± 1.4	1.40 ± 0.94
2012	506	-3.35 ± 3.08	-1.56 ± 1.44	1.24 ± 1.46
2013	1067	-2.51 ± 2.09	-1.16 ± 0.96	1.07 ± 1.11
2014	270	-3.55 ± 2.97	-1.67 ± 1.35	1.52 ± 1.29
per year		-3.38	-1.52	1.21
Anticyclonic eddies in the SAZ				
2007	357	5.70 ± 5.57	2.49 ± 2.56	-1.55 ± 2.30
2008	64	0.62 ± 0.65	0.23 ± 0.24	0.14 ± 0.17
2009	400	3.48 ± 4.36	1.60 ± 2.02	-1.02 ± 1.73
2010	422	2.04 ± 3.65	0.86 ± 1.64	-0.17 ± 1.82
2011	113	1.29 ± 1.09	0.57 ± 0.49	-0.29 ± 0.51
2012	358	0.58 ± 1.52	0.26 ± 0.67	0.22 ± 0.66
2013	23	2.08 ± 1.68	1.07 ± 0.86	-1.03 ± 0.64
per year		2.25	1.01	-0.53
Net	in SAZ	-1.13	-0.51	0.68

Table S6. The mean and standard deviation of the total available heat (TAHA), total available salt (TASA), and total available nitrate (TANA) anomalies introduced by long-lived coherent eddies for each year in the Subantarctic front (SAF) south of Tasmania. The region is bounded by 50°S-55.5°S and 135°E-155°E.

Year	Eddy Realisation	TAHA ($\times 10^{19}$ J)	TASA ($\times 10^{12}$ kg)	TANA ($\times 10^{10}$ mol)
Cyclonic eddies in the SAF				
2007	396	-2.95 ± 2.24	-1.23 ± 0.95	0.60 ± 0.82
2008	777	-4.14 ± 2.89	-1.74 ± 1.24	1.04 ± 1.02
2009	204	-3.42 ± 2.47	-1.45 ± 0.98	0.78 ± 0.65
2010	1026	-3.57 ± 2.44	-1.45 ± 0.98	0.70 ± 0.65
2011	429	-3.55 ± 2.60	-1.41 ± 1.06	0.72 ± 0.74
2012	438	-3.71 ± 3.71	-1.63 ± 1.71	1.21 ± 1.75
2013	548	-3.69 ± 2.68	-1.57 ± 1.17	1.12 ± 1.79
2014	89	-1.95 ± 0.47	-0.85 ± 0.19	0.82 ± 0.61
per year		-3.37	-1.42	0.87
Anticyclonic eddies in the SAF				
2007	371	4.97 ± 3.97	2.09 ± 1.81	-1.15 ± 1.83
2008	175	1.62 ± 1.27	0.58 ± 0.51	-0.1 ± 0.25
2009	343	3.71 ± 4.42	1.55 ± 1.92	-0.75 ± 1.51
2010	286	3.65 ± 4.02	1.48 ± 1.80	-0.63 ± 1.64
2011	115	5.55 ± 4.02	1.79 ± 1.28	-0.1 ± 0.57
2012	539	4.56 ± 3.61	1.72 ± 1.32	-0.36 ± 0.88
2013	41	1.13 ± 1.80	0.47 ± 0.73	-0.1 ± 0.15
per year		3.60	1.38	-0.46
Net	in SAF	0.23	-0.04	0.41