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Supplement of

Polarity and direction dependence of energetic cross-frontal eddy transport in the Southern Ocean's Pacific sector

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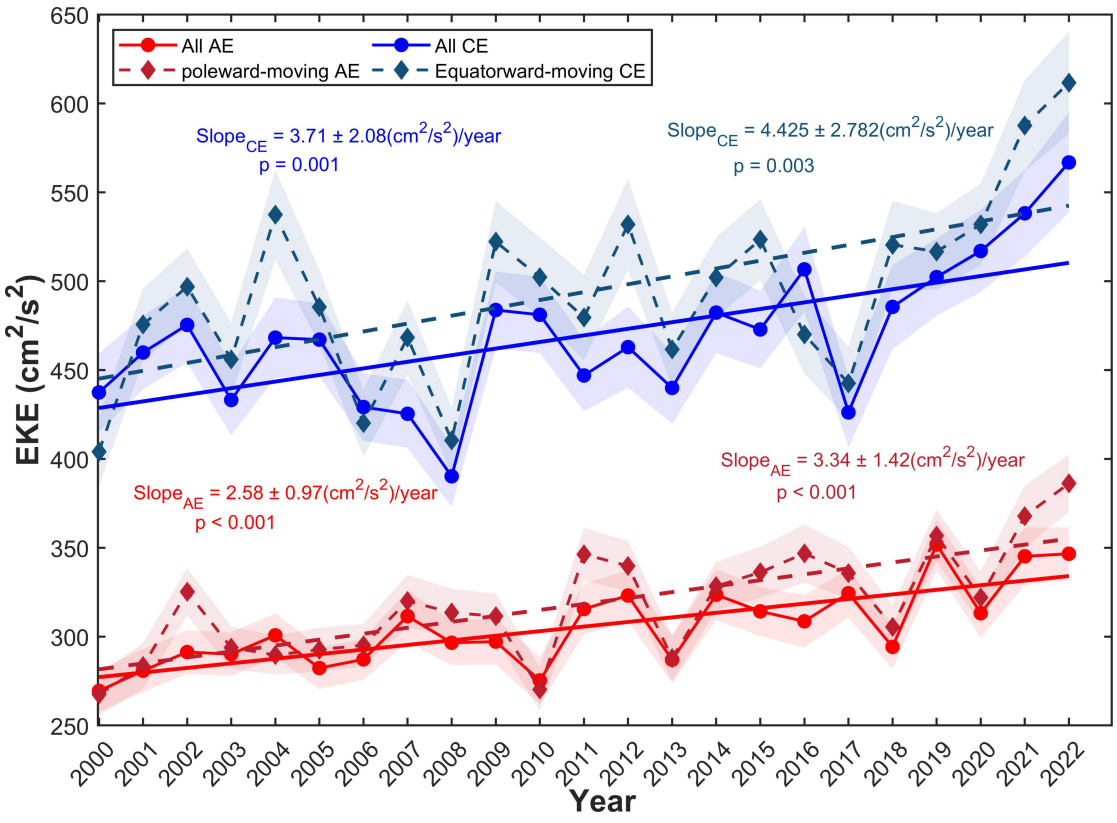

Figure S1. Time series of annual area-weighted mean *EKE* (calculated as EKE =EKE_T/S, where *S* is the total area of an eddy) for all AEs and CEs are depicted by light red and light blue solid lines, respectively, with their linear trends indicated by solid lines in the same colors. Superimposed are the extracted subsets of poleward-moving AEs and equatorward-moving CEs, depicted by light red and light blue dashed lines, with their linear trends shown by dashed lines in the same respective colors. Error shadings represent one standard deviation, and slope values are given with ±95% confidence intervals.

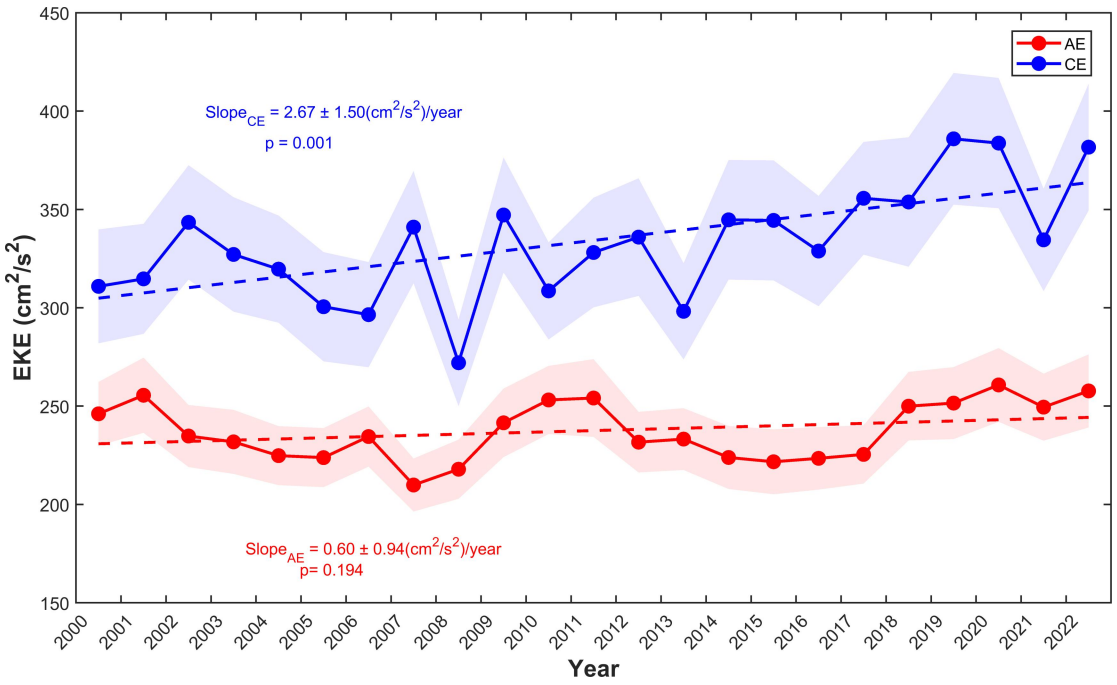

Figure S2. Time series of annual area-weighted mean *EKE* for eddies in the interfrontal zones. *EKE* is shown by blue solid line for CEs and red solid line for AEs, with linear regression indicated by dashed lines, error shadings representing one standard deviation, and slope values given with ±95% confidence intervals.

Table S1. Proportions of numbers of different eddy types relative to the total number of CFEs at each frontal zone.

Type	Eddy polarity	NB	SAF	PF	SACCF	SB
(1) Front-generated eddies	AE	9.89%	10.53%	9.88%	6.45%	5.47%
	CE	9.06%	12.31%	11.26%	10.59%	8.42%
(2) Front-dissipated eddies	AE	7.26%	7.89%	7.67%	5.89%	7.09%
	CE	11.82%	10.10%	11.89%	4.77%	5.02%
(3) Transient frontal eddies	AE	26.57%	27.26%	25.78%	33.73%	37.08%
	CE	28.65%	23.09%	26.40%	35.63%	34.85%
(4) Complete CFEs	AE	3.72%	3.50%	3.07%	1.61%	0.89%
	CE	3.03%	5.32%	4.05%	1.33%	1.18%

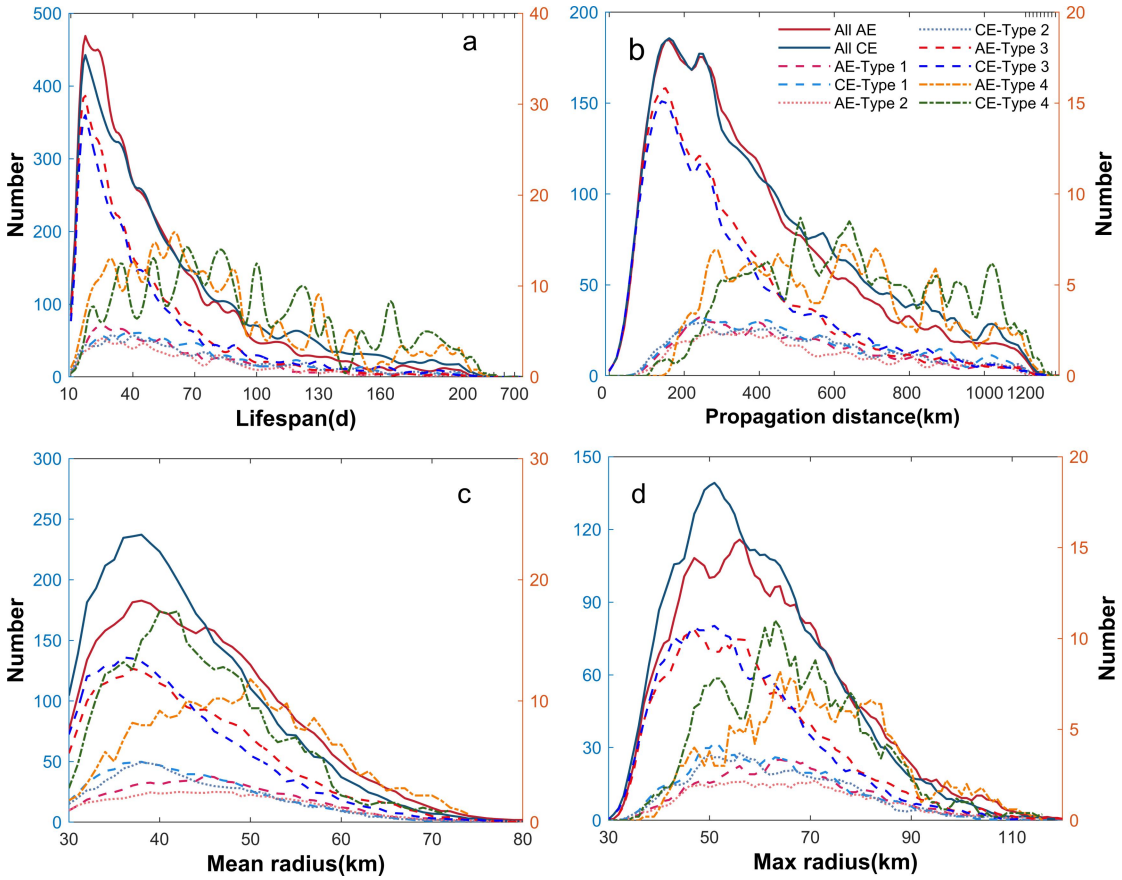

Figure S3. Statistical characteristics of different types of CFEs (a–d), time series of annual CFE counts (e) and annual mean EKE_T (f). Eddy counts according to (a) eddy lifespan, (b) propagation distance, (c) mean radius over lifespan, (d) maximum radius in the lifespan. In (a–d), "All" represents all CFEs, "Type 1" denotes eddies front-generated and subsequently transported away, "Type 2" indicates eddies transported into the frontal zone and dissipated there, "Type 3" represents eddies generated and dissipated within the same frontal zone, and "Type 4" shows complete CFEs experiencing pre-crossing, crossing and post-crossing phases. The left Y-axis is for the first three subsets, and the right axis is for the Type 4 eddies to clarify its distribution. The x-axes in (a) and (b) are plotted on a nonlinear scale by compressing the long-tail distribution.

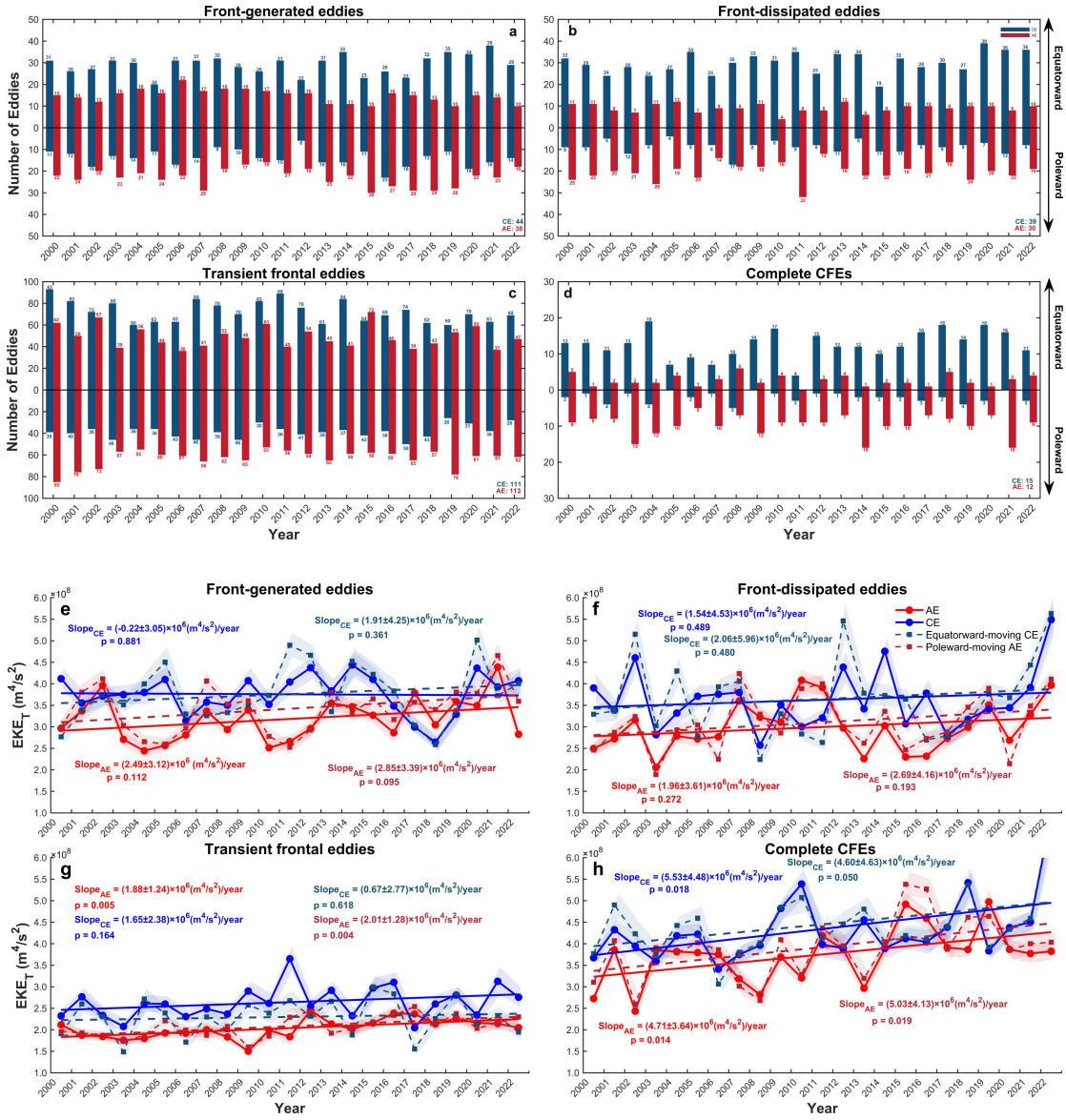

Figure S4. Statistical characteristics of four types of CFEs. (a–d) Time series of annual counts for (a) Front-generated eddies, (b) Front-dissipated eddies, (c) Transient frontal eddies, and (d) Complete CFEs. (e–h)annual mean EKE_T for (e) Front-generated eddies, (f) Front-dissipated eddies, (g) Transient frontal eddies, and (h) Complete CFEs. The dashed lines in (e–h) show the linear trends, with colors matching their respective time series. The slope values of the trends are provided with ±95% confidence intervals.

Table S2. Changes in mean EKE_T during different phases for complete cross-frontal eddies (CFEs) relative to pre-crossing values (+: increase; −: decrease). Crossing phases represent when eddies are in the frontal zones, while post-crossing phases indicate when eddies are moving away from the frontal zones. '-' denotes no data.

Direction	Eddy polarity	Phase	**NB**	**SAF**	**PF**	**SACCF**	**SB**
poleward-moving	AE	crossing	+22.30%	+23.77%	+4.10%	+5.28%	+2.15%
		post	+24.68%	+25.22%	+18.19%	−1.50%	+41.08%
	CE	crossing	−10.56%	−10.31%	−31.19%	−3.66%	-
		post	−31.24%	−16.54%	−52.24%	−32.28%	-
equatorward-moving	AE	crossing	−9.10%	−6.06%	−5.81%	-	−2.21%
		post	−32.85%	−18.90%	−21.9%	-	−10.58%
	CE	crossing	+19.47%	+1.31%	+20.25%	+57.70%	+9.81%
		post	+31.47%	+15.39%	+26.27%	+88.70%	+17.24%

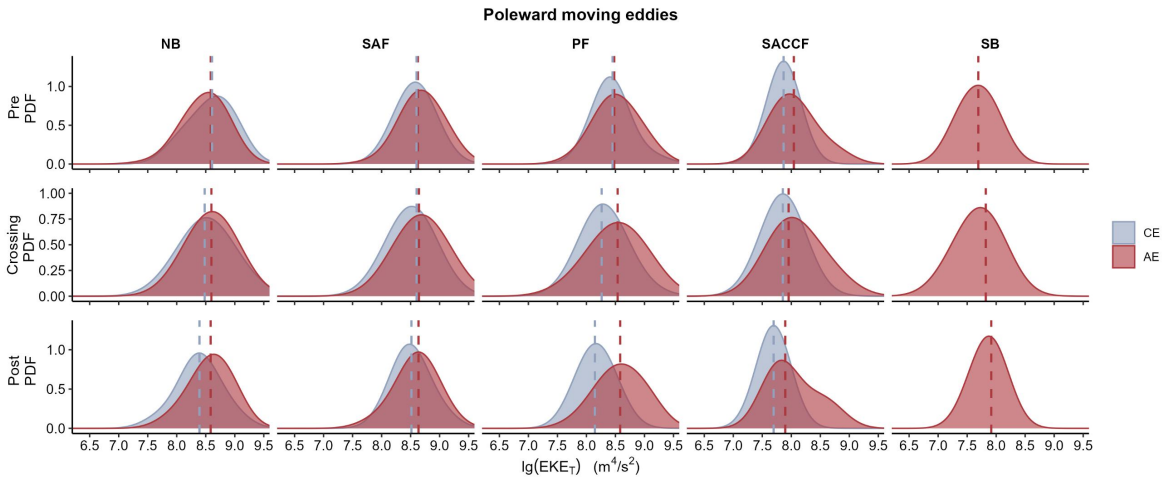

Figure S5. Probability density function (PDF) of EKE_T for poleward-moving CFEs in pre-crossing, crossing, and post-crossing phases. Dashed lines indicate median EKE_T values. Blue and red colors represent CEs and AEs, respectively.

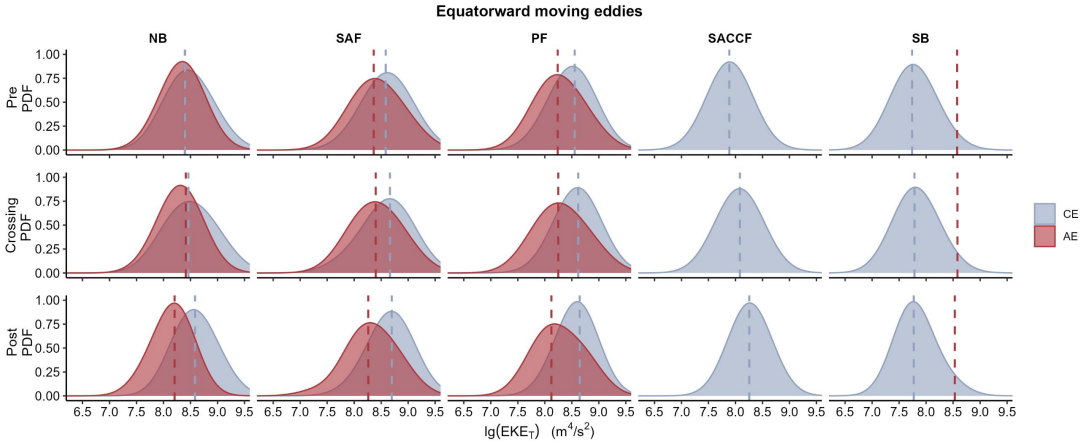

Figure S6. Probability density function (PDF) of EKE_T for equatorward-moving CFEs in pre-crossing, crossing, and post-crossing phases. Dashed lines indicate median EKE_T values. Blue and red colors represent CEs and AEs, respectively.