Geoscientific
Model Development

Supplement of

Exploring the ocean mesoscale at reduced computational cost with FESOM 2.5: efficient modeling strategies applied to the Southern Ocean

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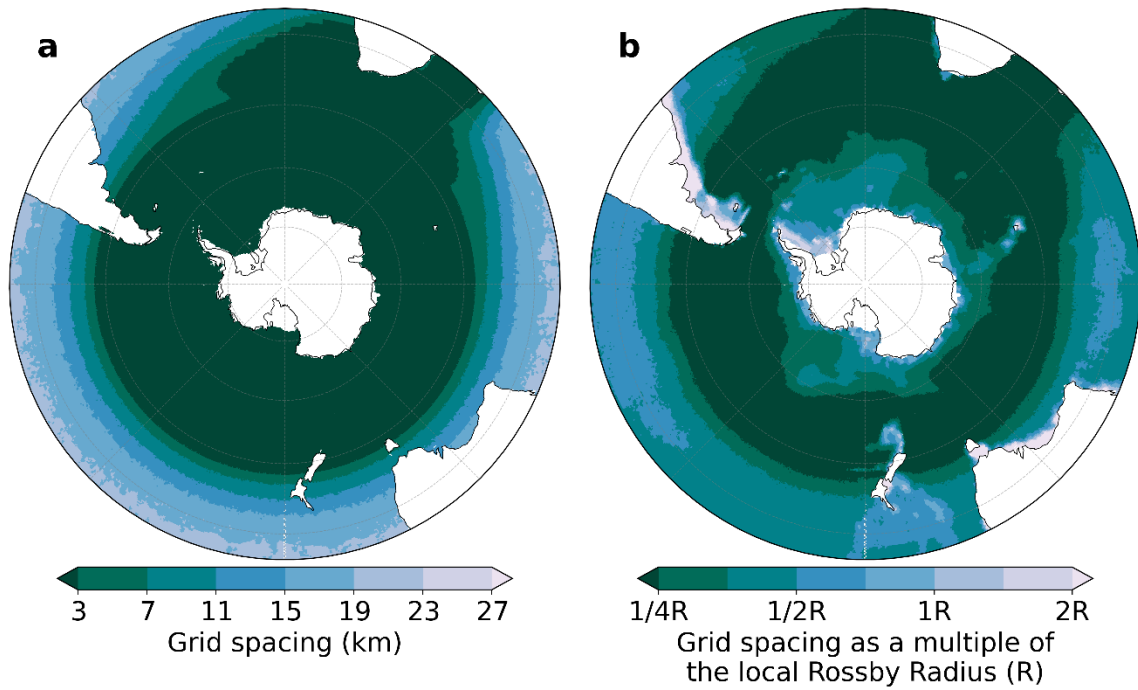**Supplementary figures**

Figure S1. Grid resolution of the SO3 mesh. a) grid resolution expressed as approximate element height following Danilov (2022). **b)** Grid resolution expressed as a multiple of the local Rossby radius.
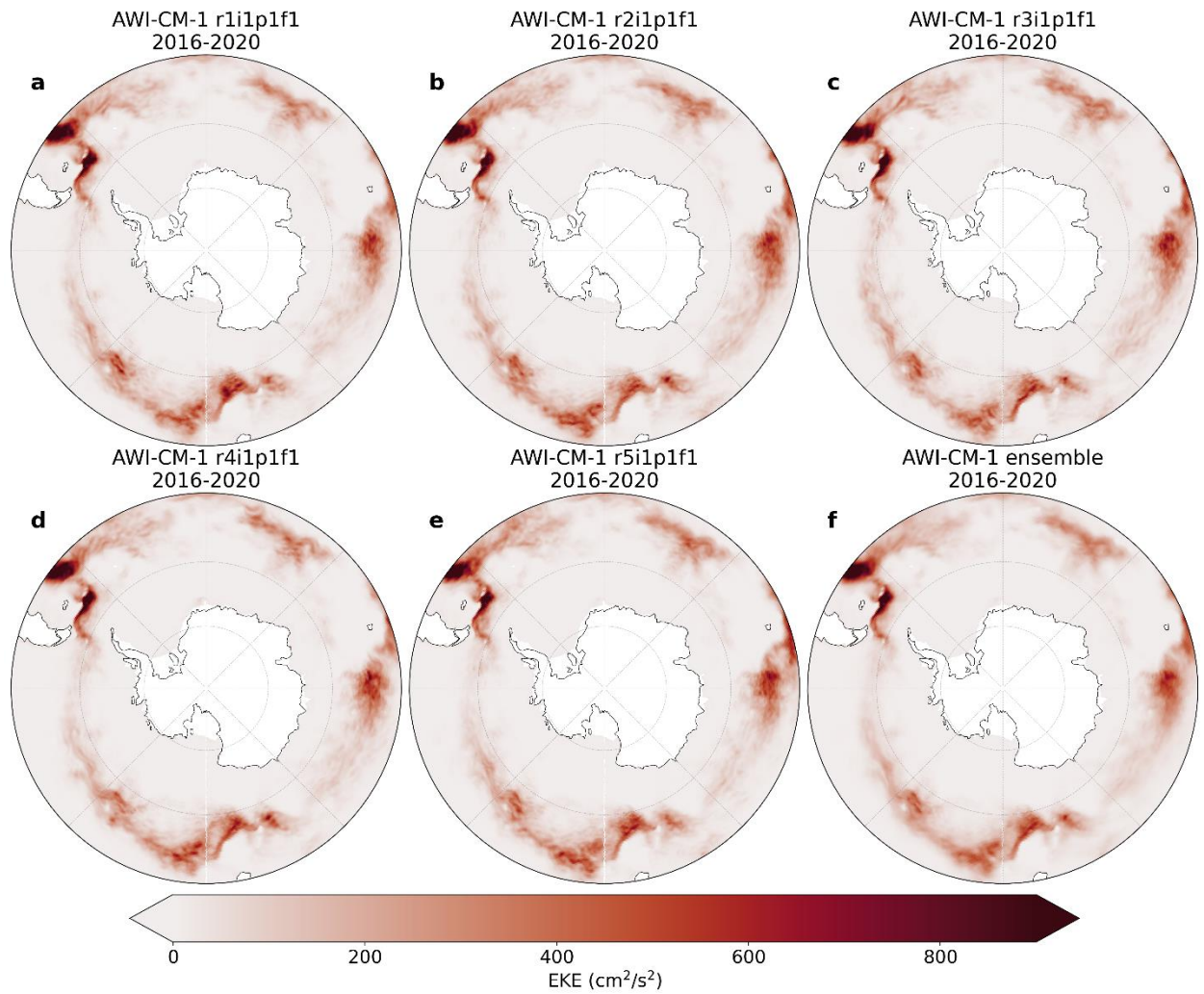
Figure S2. Ensemble spread of mean EKE. Mean EKE during 2016-2020 in **(a-e)** each member of the AWI-CM-1 ensemble and **(f)** the ensemble mean.
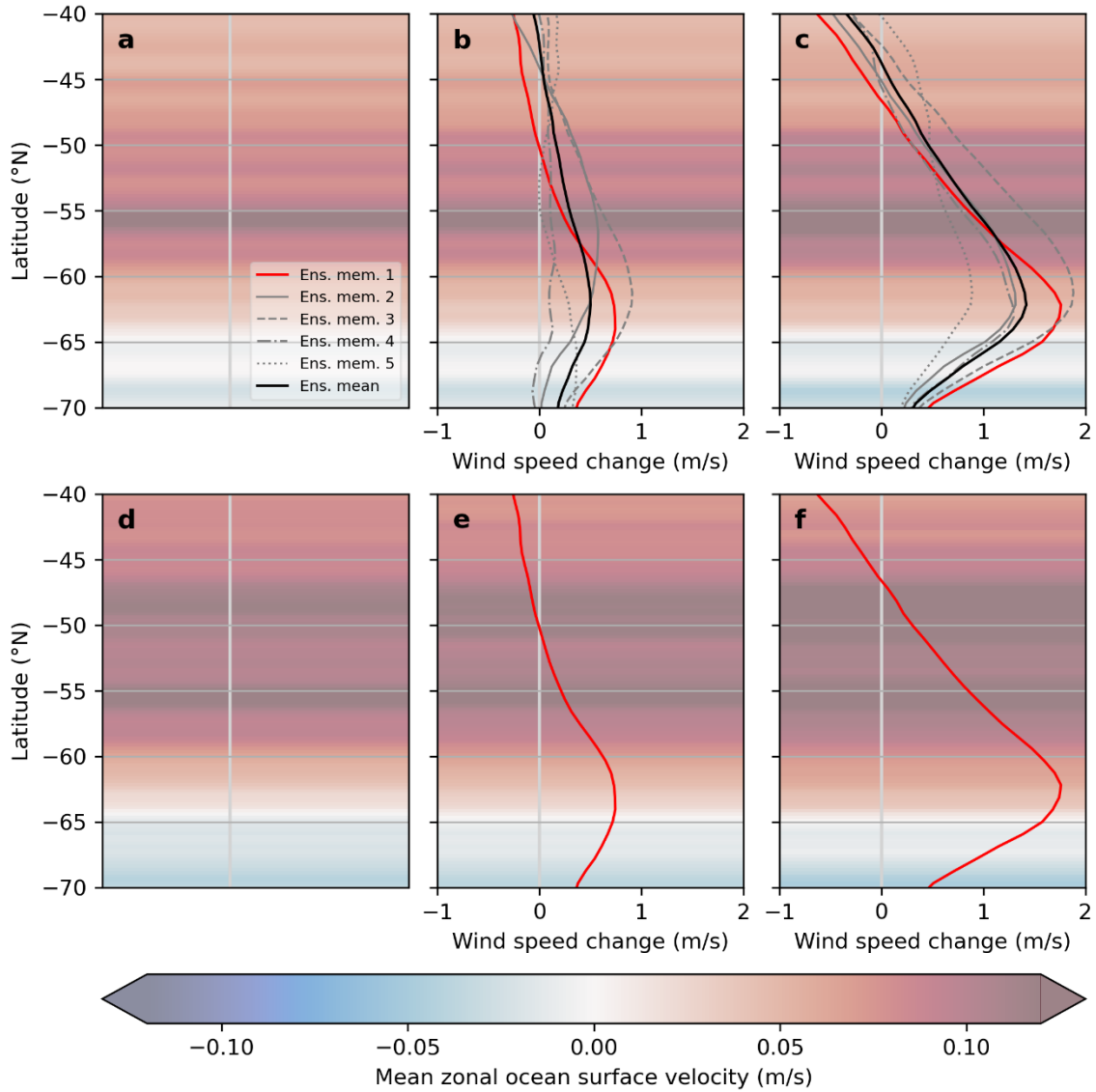
Figure S3. Zonal mean wind speed and surface velocities. Mean zonal surface velocities during the 1951-1955 (**a,d**), 2016-2020 (**b,e**), and 2091-2095 (**c,f**) periods in the AWI-CM-1 ensemble (**a-c**) and the SO3 simulations (**d-f**). Changes in mean zonal wind speeds relative to the 1951-1955 mean are overlaid.
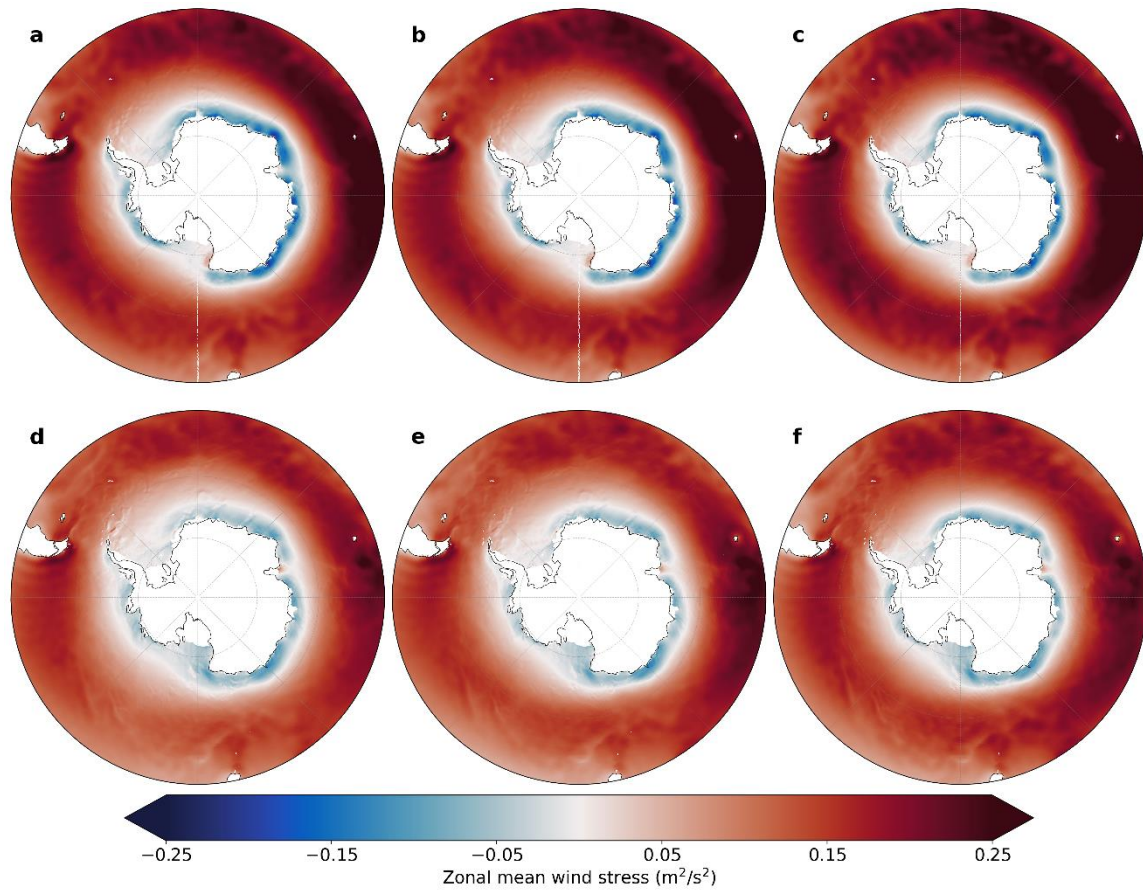
Figure S4. Zonal mean wind stress. Zonal mean wind stress to the ocean surface in AWI-CM-1 ensemble member 1 (a-c) and the SO3 simulations (d-f) during the periods 1951-1955 (a,d), 2016-2020 (b,e) and 2091-2095 (c,f). Positive values indicate an eastward direction.

Figure S5. Ensemble spread of EKE change between 1951-1955 and 2016-2020. EKE change in **(a-e)** each member of the AWI-CM-1 ensemble and **(f)** the ensemble mean.
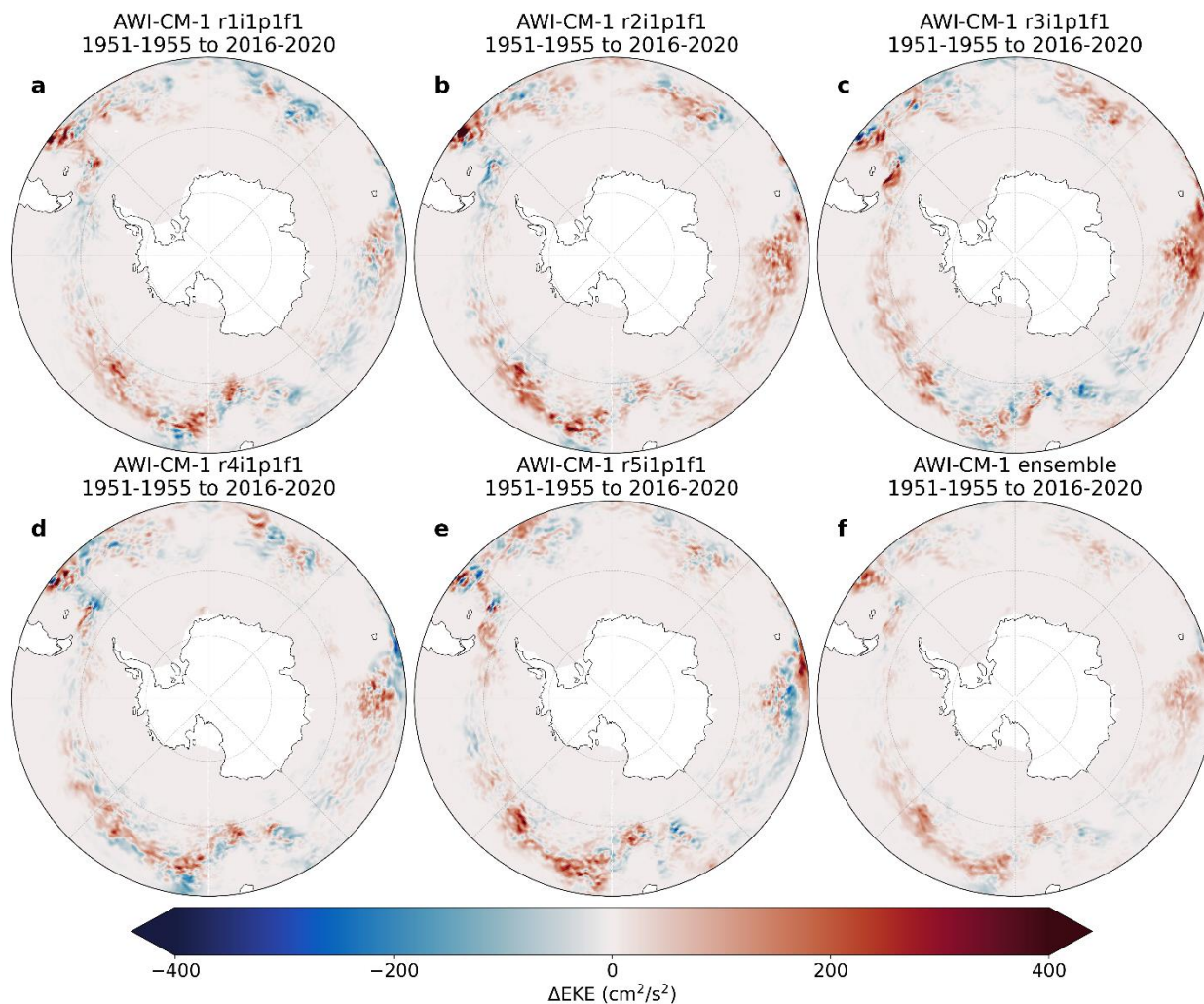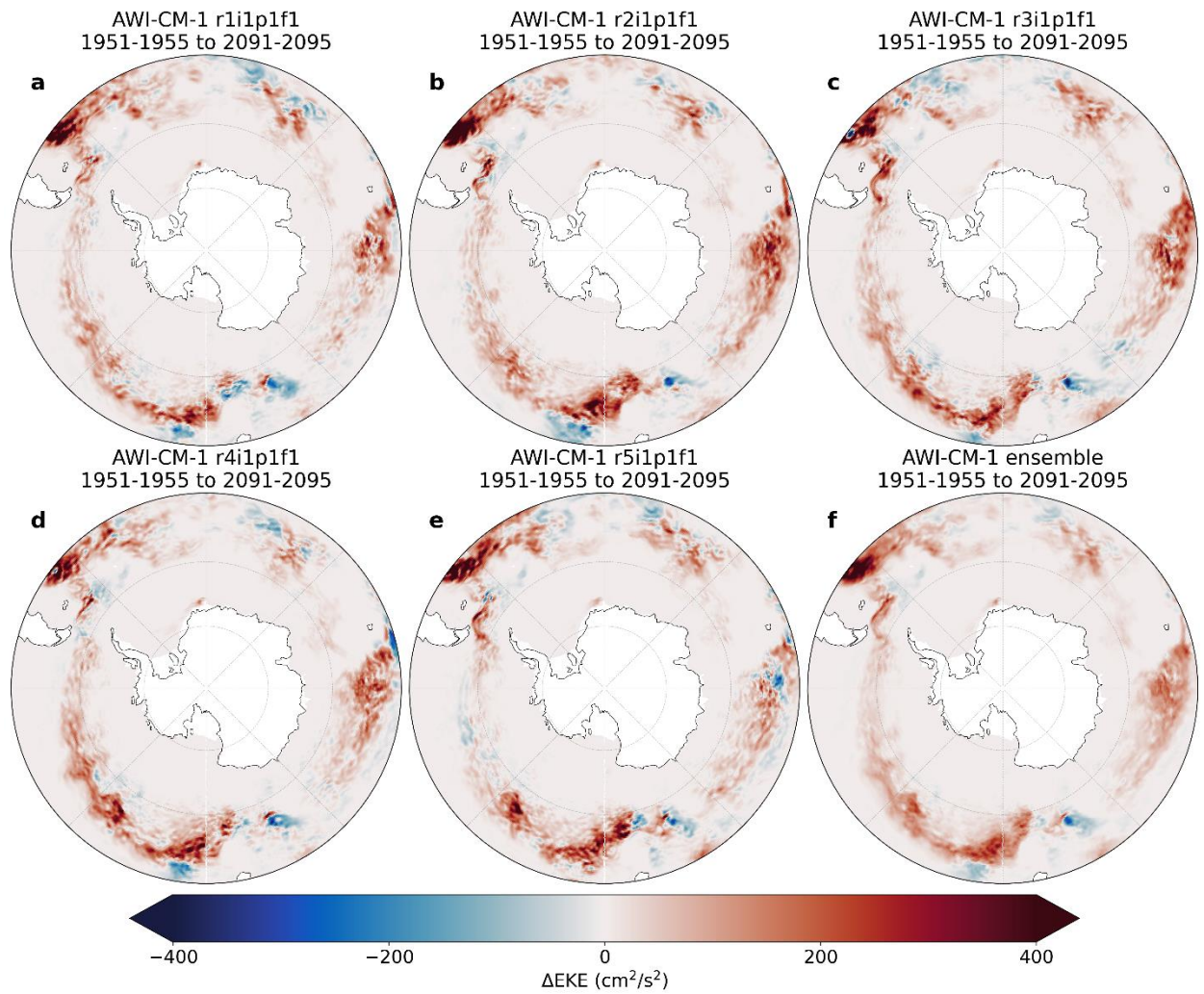
Figure S6. Ensemble spread of EKE change between 1951-1955 and 2091-2095. EKE change in **(a-e)** each member of the AWI-CM-1 ensemble and **(f)** the ensemble mean.

Supplementary tables

Data	Durbin-Watson	Skew	p(Skew)	Kurtosis	p(Kurt)
Ens. 1	0.169	0.867	p<0.001	0.536	0.056
Ens. 2	0.232	-0.075	0.549	-0.156	0.623
Ens. 3	0.283	0.198	0.119	-0.270	0.289
Ens. 4	0.179	0.176	0.165	-0.220	0.423
Ens. 5	0.214	0.400	0.002	-0.439	0.040
Ensemble	0.206	0.381	p<0.001	0.237	0.052
SO3	0.44	0.432	0.001	0.013	0.813

Table S1. EKE statistics for the 1951-1955 period. Statistical properties reported are autocorrelation (Durbin and Watson, 1950), skewness (D'Agostino and Belanger, 1990), and kurtosis (Fisher, 1997). Statistics are calculated using 5-day mean EKE data with linear trends removed as in Figures 1a,b,c and Figure 3.

Data	Durbin-Watson	Skew	p(Skew)	Kurtosis	p(Kurt)
Ens. 1	0.226	0.295	0.021	-0.335	0.157
Ens. 2	0.255	0.451	0.001	-0.454	0.031
Ens. 3	0.245	-0.175	0.167	-0.220	0.425
Ens. 4	0.216	0.022	0.860	-0.480	0.020
Ens. 5	0.267	0.339	0.009	0.164	0.427
Ensemble	0.251	0.179	0.002	-0.263	0.010
SO3	0.387	0.417	0.001	-0.509	0.011
Obs.	0.499	0.032	0.801	-0.146	0.658

Table S2. EKE statistics for the 2016-2020 period. Statistical properties reported are autocorrelation (Durbin and Watson, 1950), skewness (D'Agostino and Belanger, 1990), and kurtosis (Fisher, 1997). Statistics are calculated using 5-day mean EKE data with linear trends removed as in Figures 1a,b,c and Figure 3.

Data	Durbin-Watson	Skew	p(Skew)	Kurtosis	p(Kurt)
Ens. 1	0.14	-0.085	0.502	-0.329	0.167
Ens. 2	0.15	0.331	0.010	-0.698	p<0.001
Ens. 3	0.264	-0.150	0.235	-0.27	0.289
Ens. 4	0.199	0.134	0.289	-0.472	0.023
Ens. 5	0.133	-0.031	0.806	-0.981	p<0.001
Ensemble	0.168	0.067	0.244	-0.476	p<0.001
SO3	0.219	-0.345	0.008	-0.484	0.018

Table S3. EKE statistics for the 2091-2095 period. Statistical properties reported are autocorrelation (Durbin and Watson, 1950), skewness (D'Agostino and Belanger, 1990),

and kurtosis (Fisher, 1997). Statistics are calculated using 5-day mean EKE data with linear trends removed as in Figures 1a,b,c and Figure 3.

References

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