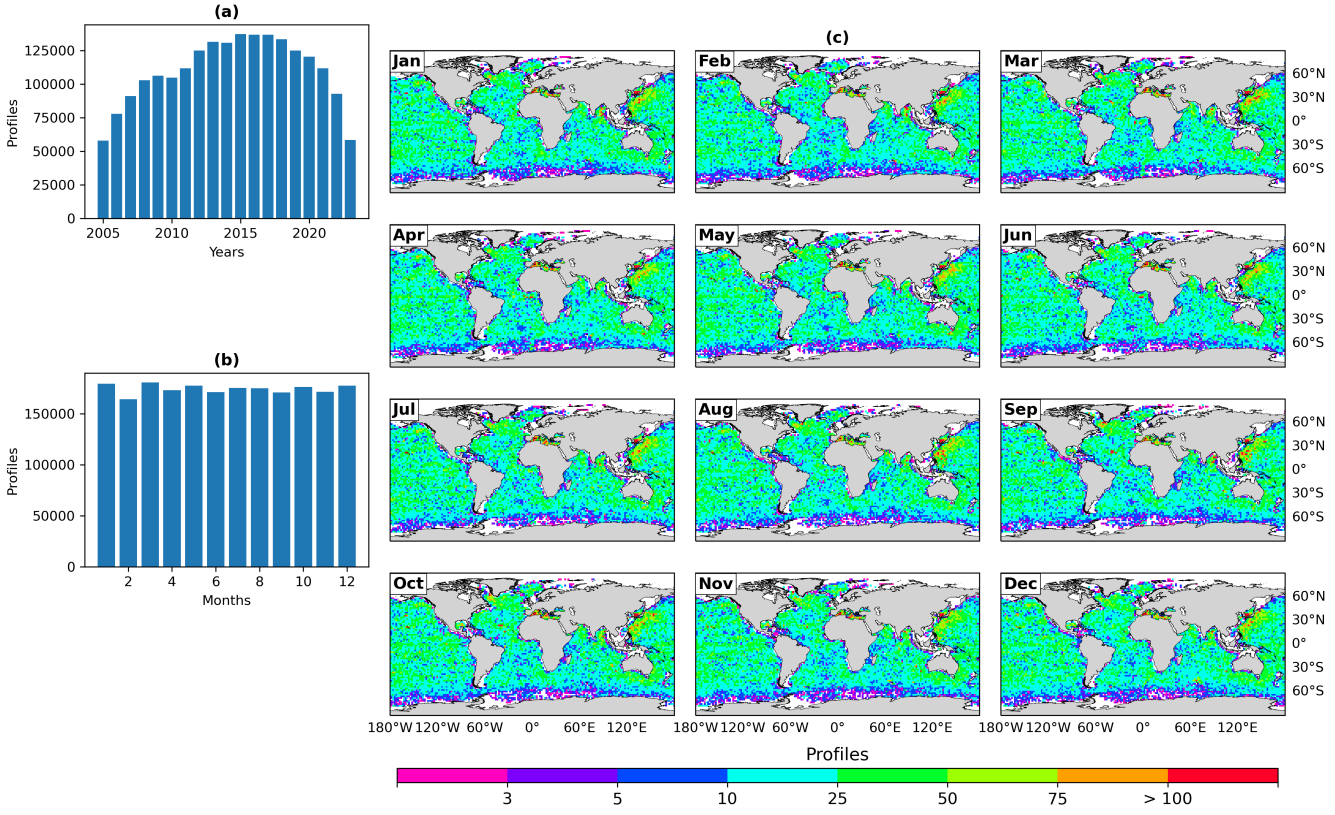

Figure S1. (a) Annual and (b) monthly histograms of the number of Argo profiles in the long-term record. (c) Monthly maps of the spatial distribution of the number of Argo profiles in the long-term record.

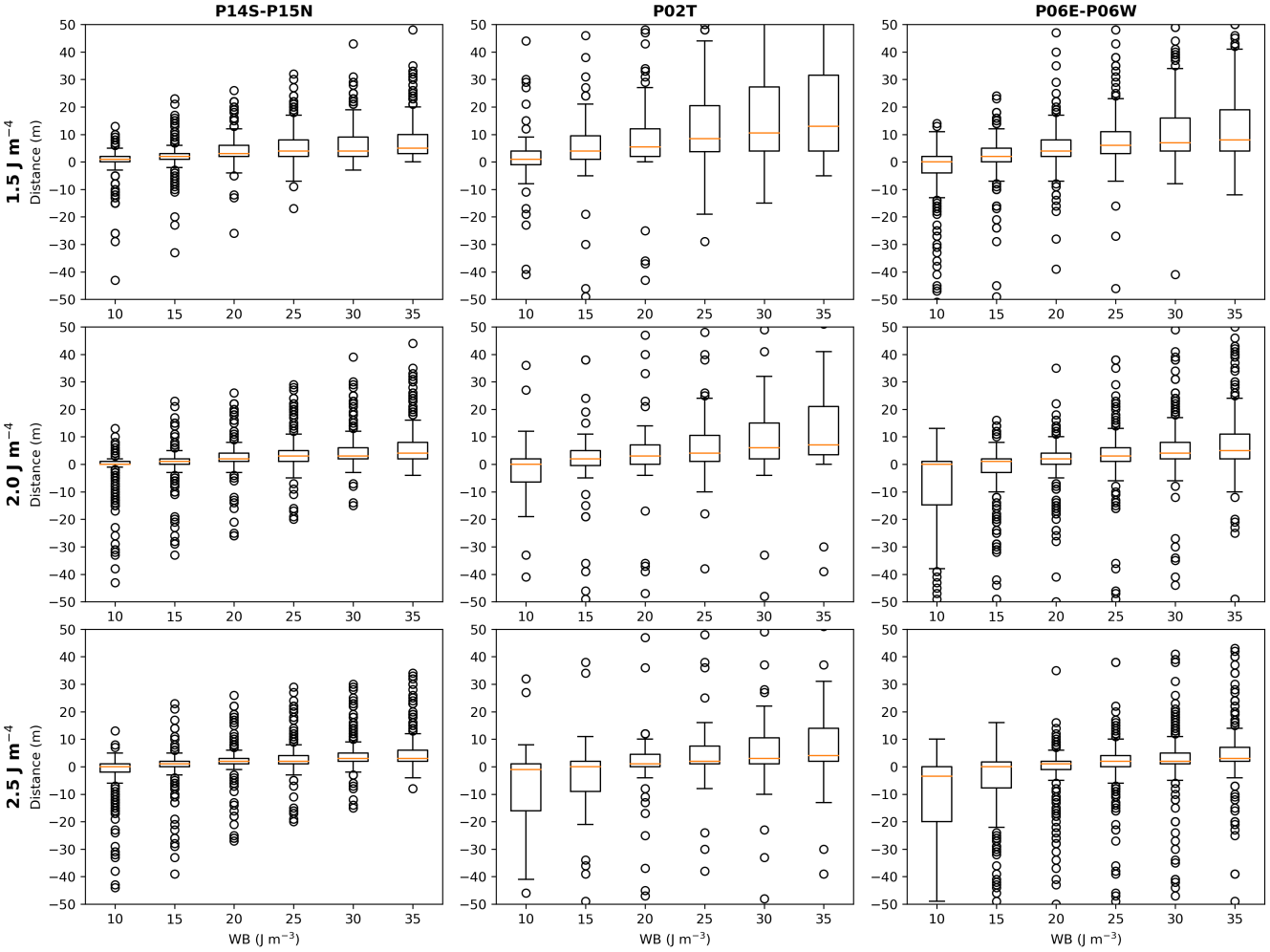

Figure S2. Boxplots of the differences in depth between the 1.5, 2.0, and 2.5 J m^{-4} WB$_z$ isolines and the 10, 15, 20, 25, 30, and 35 J m^{-3} WB isolines in the section transects P14S-P15N, P02T, and P06E-P06W. The plots in each row correspond to a single WB$_z$ isoline.

Table S1. MLD and the differences in Θ, σ_0, and WB from the MLD calculated with each methodology to the reference depth of 10 m. Results for the random profiles in the Southern Ocean shown in Fig. 4a-e.

	Profile a				Profile b				Profile c				Profile d				Profile e			
Method	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})
B04T	395	-0.20	0.20	519	50	-0.20	0.09	14	378	-0.20	0.12	306	367	-0.20	0.12	340	139	-0.20	0.02	21
B04D	147	0.30	0.03	39	17	-0.02	0.03	1	222	0.20	0.03	49	251	-0.10	0.03	61	152	-0.21	0.03	28
HT09	139	0.01	0.02	25	45	-0.08	0.08	10	222	0.20	0.03	49	293	0.20	0.05	124	139	-0.20	0.02	21
R23	138	0.01	0.02	24	54	-0.24	0.09	17	nan	nan	nan	nan	237	-0.18	0.02	48	215	-0.34	0.04	51
EBM	136	0.01	0.01	20	63	-0.27	0.10	20	188	-0.01	0.01	20	198	-0.07	0.01	20	138	-0.20	0.02	20

Table S2. MLD and the differences in Θ, σ_0, and WB from the MLD calculated with each methodology to the reference depth of 10 m. Results for the random profiles in the North Atlantic shown in Fig. 4f-j.

	Profile f				Profile g				Profile h				Profile i				Profile j			
Method	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})
B04T	76	-0.20	0.01	5	1440	-0.20	0.01	27	270	-0.20	0.07	68	nan	nan	nan	nan	nan	nan	nan	nan
B04D	177	-0.38	0.03	28	nan	nan	nan	nan	82	-0.07	0.03	14	84	0.45	0.03	14	1432	0.29	0.03	372
HT09	176	-0.38	0.03	28	119	-0.05	0.01	4	82	-0.07	0.03	13	80	0.40	0.03	10	1375	0.32	0.02	298
R23	202	-0.41	0.04	38	nan	nan	nan	nan	423	-0.31	0.08	107	60	0.20	0.01	3	1270	0.20	0.01	168
EBM	156	-0.35	0.02	20	1097	-0.15	0.01	20	93	-0.08	0.04	20	90	0.53	0.04	20	1135	0.05	0.00	20

Table S3. MLD and the differences in Θ, σ_0, and WB from the MLD calculated with each methodology to the reference depth of 10 m. Results for the random profiles in the subtropical eastern Pacific shown in Fig. 4k-o.

	Profile k				Profile l				Profile m				Profile n				Profile o			
Method	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})	MLD (m)	Θ (°C)	σ_0 (kg m^{-3})	WB (J m^{-3})
B04T	100	-0.20	0.21	79	117	-0.20	0.04	31	131	-0.20	0.04	20	44	-0.20	0.04	6	91	-0.20	0.07	31
B04D	22	-0.01	0.03	3	98	-0.15	0.03	19	80	-0.09	0.03	11	34	-0.14	0.03	3	49	-0.13	0.03	7
HT09	27	0.13	0.11	13	98	-0.15	0.03	19	130	-0.20	0.04	20	34	-0.14	0.03	3	96	-0.21	0.08	34
R23	76	0.04	0.14	25	69	-0.03	0.01	2	89	-0.11	0.04	15	58	-0.28	0.05	10	88	-0.19	0.07	29
EBM	50	0.09	0.14	20	106	-0.14	0.03	20	108	-0.17	0.04	20	85	-0.30	0.07	20	71	-0.19	0.06	20

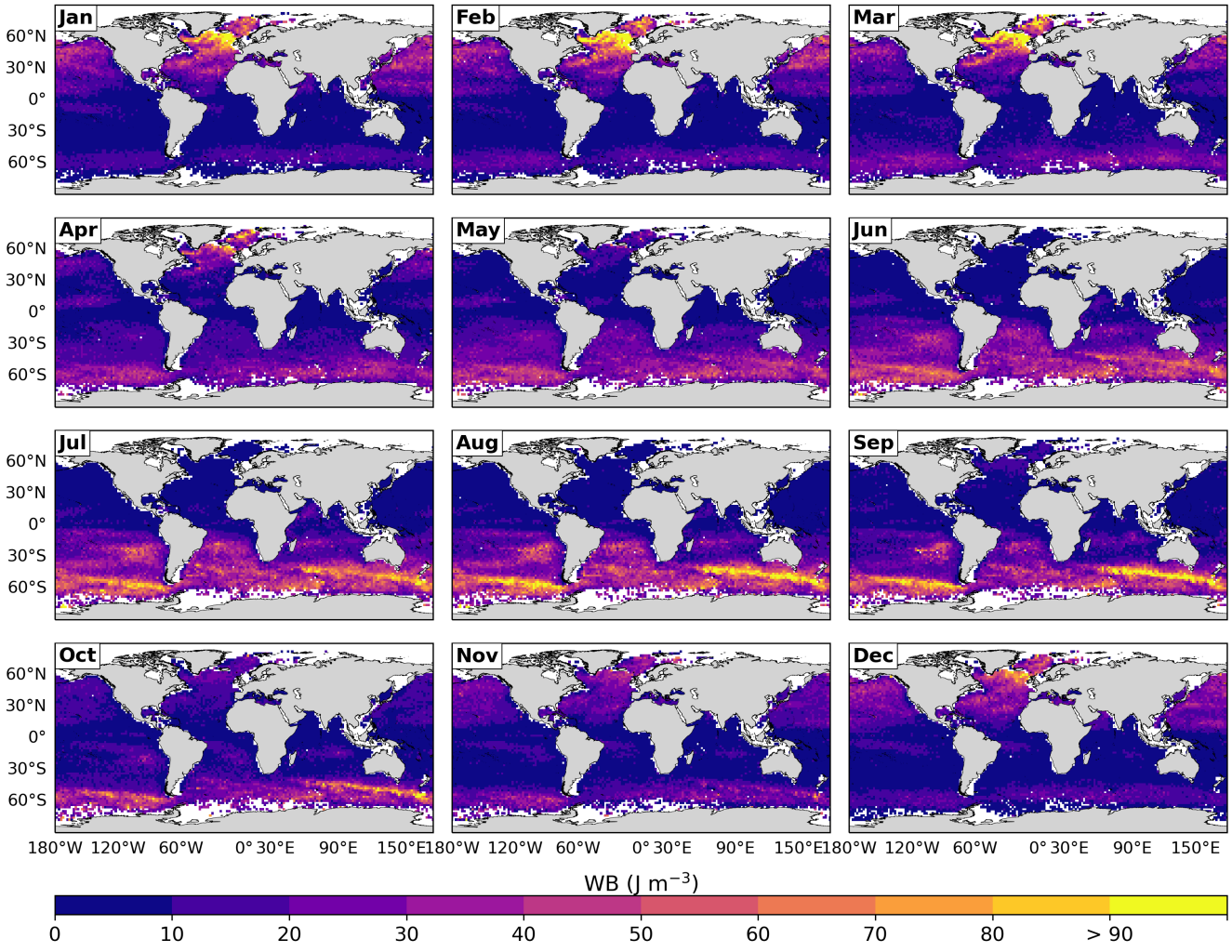

Figure S3. Global monthly climatology of the work done by buoyancy (WB) at the MLD calculated with B04D.

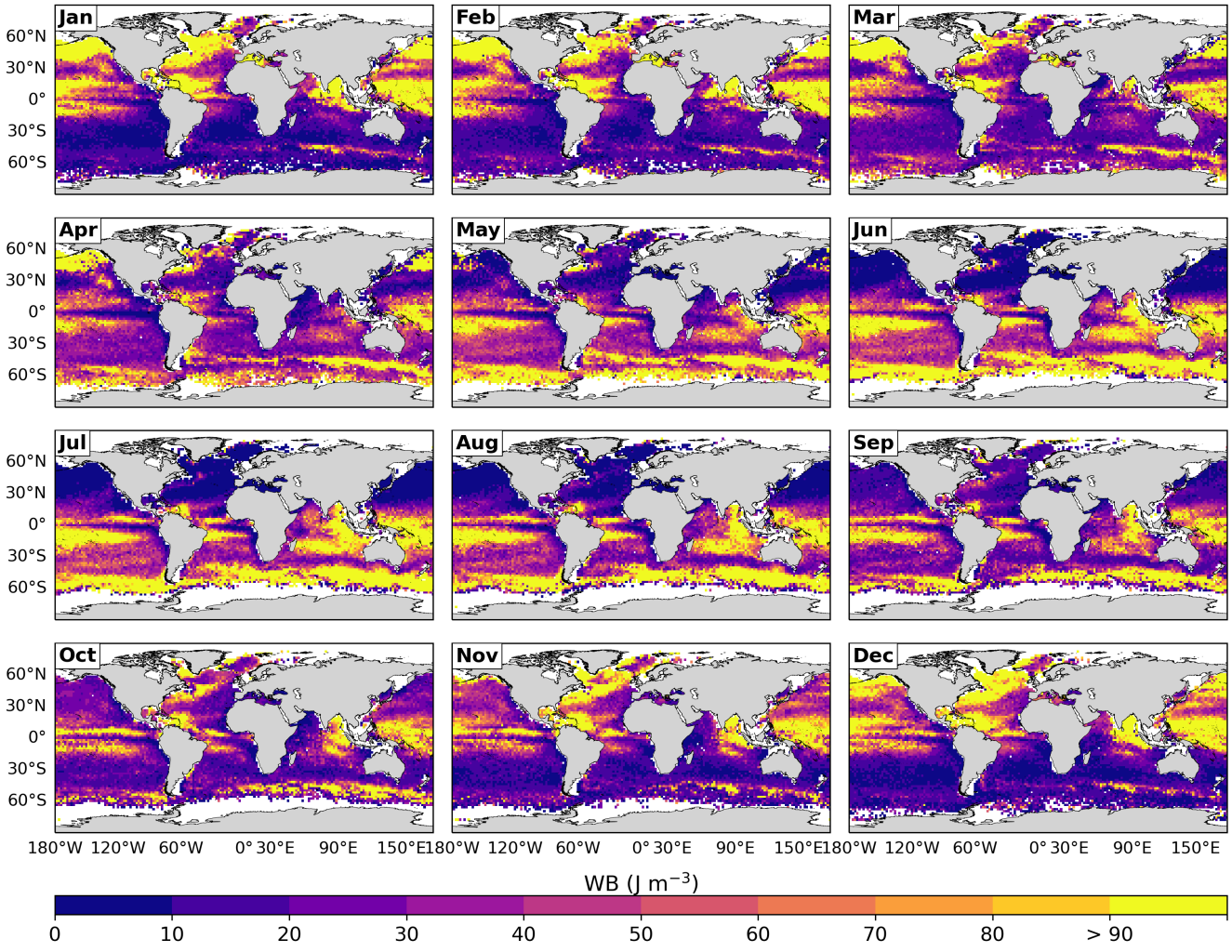

Figure S4. Global monthly climatology of the work done by buoyancy (WB) at the MLD calculated with B04T.

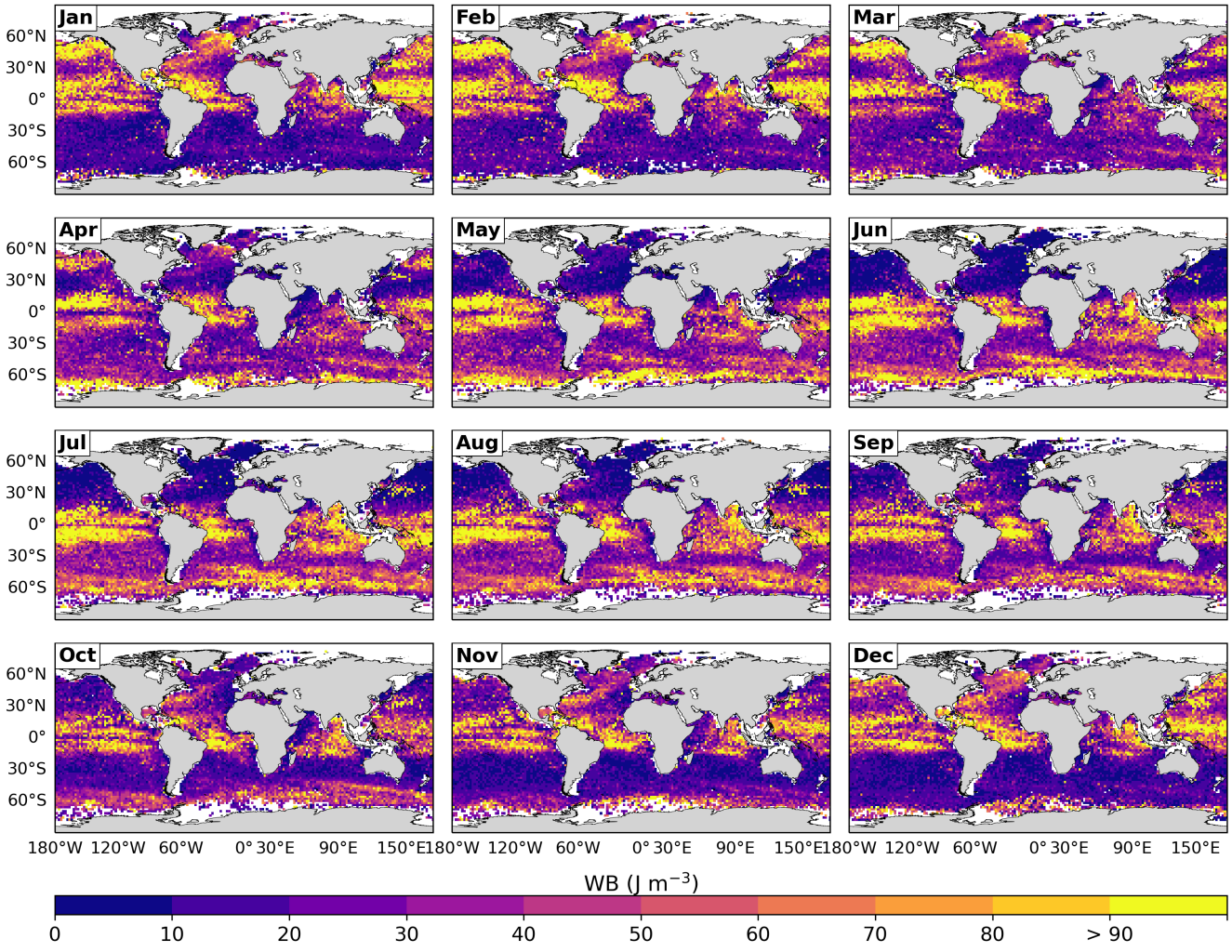

Figure S5. Global monthly climatology of the work done by buoyancy (WB) at the MLD calculated with HT09.

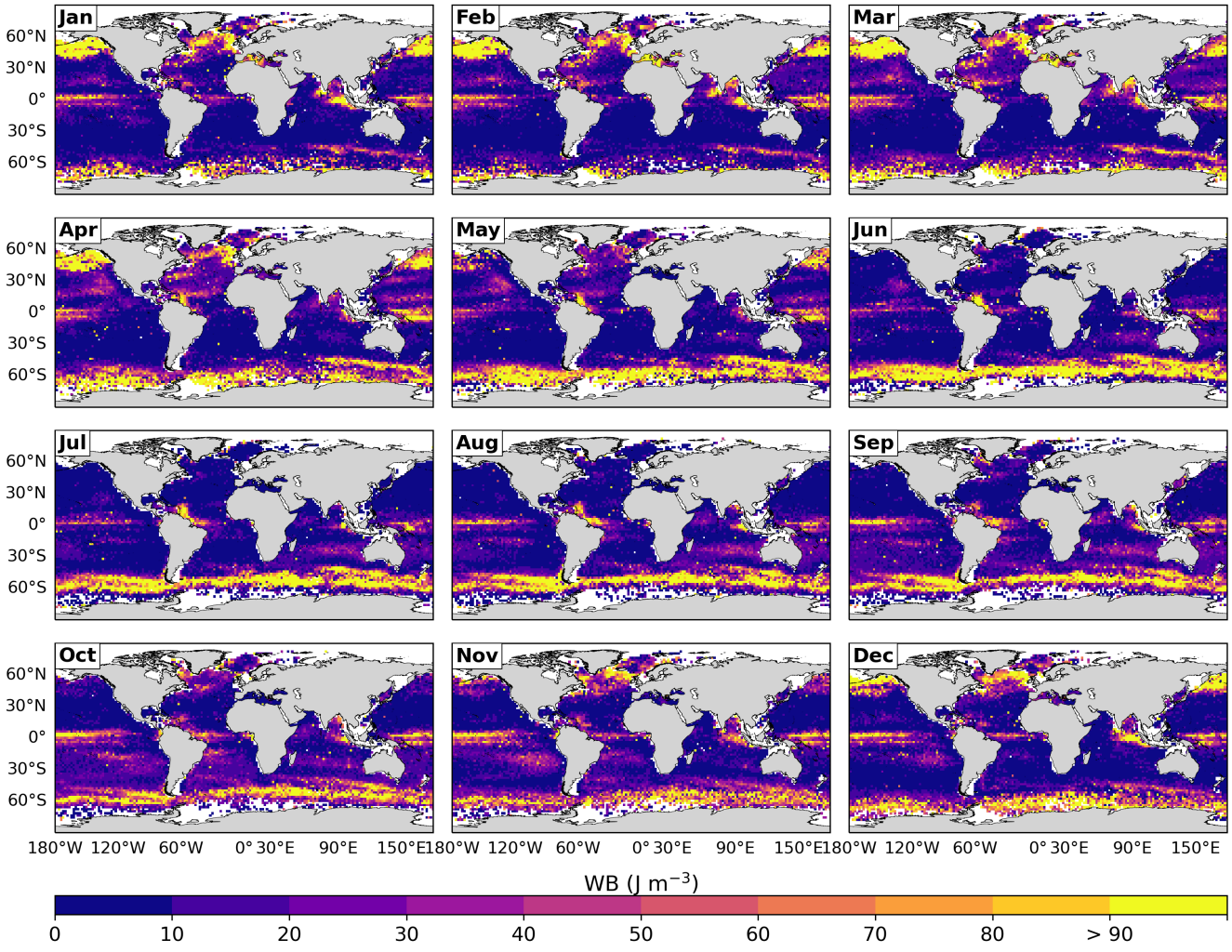

Figure S6. Global monthly climatology of the work done by buoyancy (WB) at the MLD calculated with R23.