Supplementary material for "Influence of Atmospheric Circulation on the Interannual Variability of Transport from Global and Regional Emissions into the Arctic" by Zheng et al.,

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DJF Correlation	Global (GLB)	East Asia (EA)	Europe (EUR)	North America (NAM)	Tibetan Plateau & South Asia (TPSA)	Middle East (ME)	Central Asia & Siberia (CAS)	Southeast Asia (SEA)	Africa (AFR)	South America (SAM)	Remaining regions (REM)
Global (GLB)	—	***0.51***	0.26	***0.45***	***0.58***	***0.42***	0.09	0.26	0.24	-0.06	0.01
East Asia (EA)	—	—	***-0.56***	0.08	***0.33***	***0.47***	-0.20	***0.57***	0.27	0.06	0.18
Europe (EUR)	—	—	—	0.08	-0.09	-0.22	***0.34***	-0.27	-0.07	-0.23	***-0.31***
North America (NAM)	—	—	—	—	-0.08	-0.11	-0.12	-0.10	-0.03	-0.09	0.05
Tibetan Plateau & South Asia (TPSA)	—	—	—	—	—	0.26	-0.12	0.11	0.26	0.18	0.18
Middle East (ME)	—	—	—	—	—	—	0.09	0.26	0.07	0.02	0.00
Central Asia & Siberia (CAS)	—	—	—	—	—	—	—	-0.02	***-0.41***	-0.25	-0.21
Southeast Asia (SEA)	—	—	—	—	—	—	—	—	***0.32***	0.01	0.10
Africa (AFR)	—	—	—	—	—	—	—	—	—	0.29	0.27
South America (SAM)	—	—	—	—	—	—	—	—	—	—	**0.59**
Remaining regions (REM)	—	—	—	—	—	—	—	—	—	—	—

Table S1: Summary of correlation of Arctic tracer mass between different tracers. The bold values indicate that the correlation is statistically significant at 95%.

JJA CO50	EOF1 spatial (grid-point) variance explained	EOF1 (horizontally and vertically integrated) Arctic tracer mass variance explained	Correlation: EOF1 vs Arctic tracer mass
East Asia (EA)	51.6%	97.4%	0.987
Europe (EUR)	61.5%	97.3%	0.987
North America (NAM)	44.9%	98.9%	0.994
Tibetan Plateau & South Asia (TPSA)	43.3%	98.6%	0.993
Middle East (ME)	60.9%	99.9%	0.999
Central Asia & Siberia (CAS)	43.3%	89.2%	0.944
Southeast Asia (SEA)	71.8%	98.5%	0.992
Africa (AFR)	38.2%	99.6%	0.998
South America (SAM)	50.7%	97.7%	0.988
Remaining regions (REM)	62.5%	98.7%	0.994

Table S2: Similar to Table1, but for summer (JJA).

JJA Correlation	Global (GLB)	East Asia (EA)	Europe (EUR)	North America (NAM)	Tibetan Plateau & South Asia (TPSA)	Middle East (ME)	Central Asia & Siberia (CAS)	Southeast Asia (SEA)	Africa (AFR)	South America (SAM)	Remaining regions (REM)
Global (GLB)	—	***0.48***	***0.46***	0.08	***0.42***	0.26	0.15	***0.39***	0.07	0.01	-0.18
East Asia (EA)	—	—	***-0.32***	-0.19	0.11	0.11	0.07	***0.45***	-0.19	0.00	0.03
Europe (EUR)	—	—	—	***-0.30***	0.13	-0.05	0.07	-0.11	0.00	0.02	-0.19
North America (NAM)	—	—	—	—	-0.14	-0.00	-0.31	-0.22	0.11	-0.07	-0.15
Tibetan Plateau & South Asia (TPSA)	—	—	—	—	—	0.17	0.27	***0.46***	0.09	-0.11	-0.06
Middle East (ME)	—	—	—	—	—	—	***0.40***	0.18	0.31	0.03	-0.13
Central Asia & Siberia (CAS)	—	—	—	—	—	—	—	0.11	0.25	0.10	-0.00
Southeast Asia (SEA)	—	—	—	—	—	—	—	—	0.15	-0.04	0.24
Africa (AFR)	—	—	—	—	—	—	—	—	—	***0.35***	***0.47***
South America (SAM)	—	—	—	—	—	—	—	—	—	—	***0.70***
Remaining regions (REM)	—	—	—	—	—	—	—	—	—	—	—

Table S3: Similar to Table S1, but for summer (JJA).

DJF EOF1	EOF1 Arctic tracer mass variance explained					
	CO_100	CO_50	CO_25	CO_15	CO_10	CO_05
East Asia (EA)	99.9%	99.5%	98.1%	96.0%	94.5%	93.9%
Europe (EUR)	94.6%	93.6%	91.3%	88.1%	84.6%	78.5%
North America (NAM)	96.3%	93.2%	88.5%	85.0%	82.3%	76.7%
Tibetan Plateau & South Asia (TPSA)	99.9%	99.9%	99.9%	99.9%	99.8%	97.2%
Middle East (ME)	99.9%	99.9%	99.9%	99.9%	99.8%	98.0%
Central Asia & Siberia (CAS)	99.8%	99.6%	99.1%	98.6%	97.3%	87.2%
Southeast Asia (SEA)	99.4%	98.3%	95.4%	92.0%	89.4%	87.8%
Africa (AFR)	99.9%	99.9%	99.8%	99.4%	99.0%	96.7%
South America (SAM)	97.5%	96.7%	95.3%	94.0%	92.7%	90.9%
Remaining regions (REM)	99.6%	99.1%	99.1%	98.4%	87.9%	86.6%
East Asia (EA)	99.4%	99.3%	98.0%	91.4%	79.0%	54.8%

Table S4: Arctic tracer mass variance explained by regional tracer EOF1 during winter (DJF) with tracer different lifetimes.

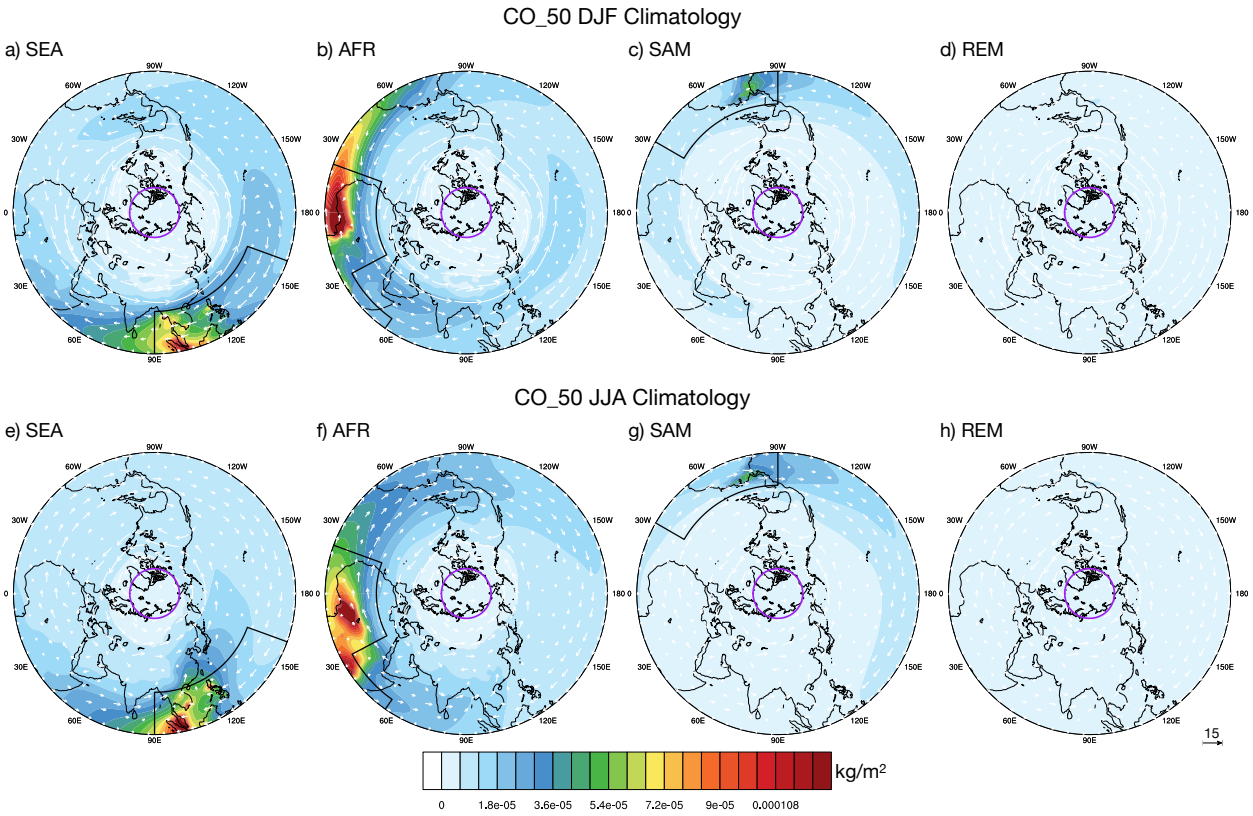


Figure S1: Similar to Fig. 3, but for the SEA, AFR, SAM an REM tracers.

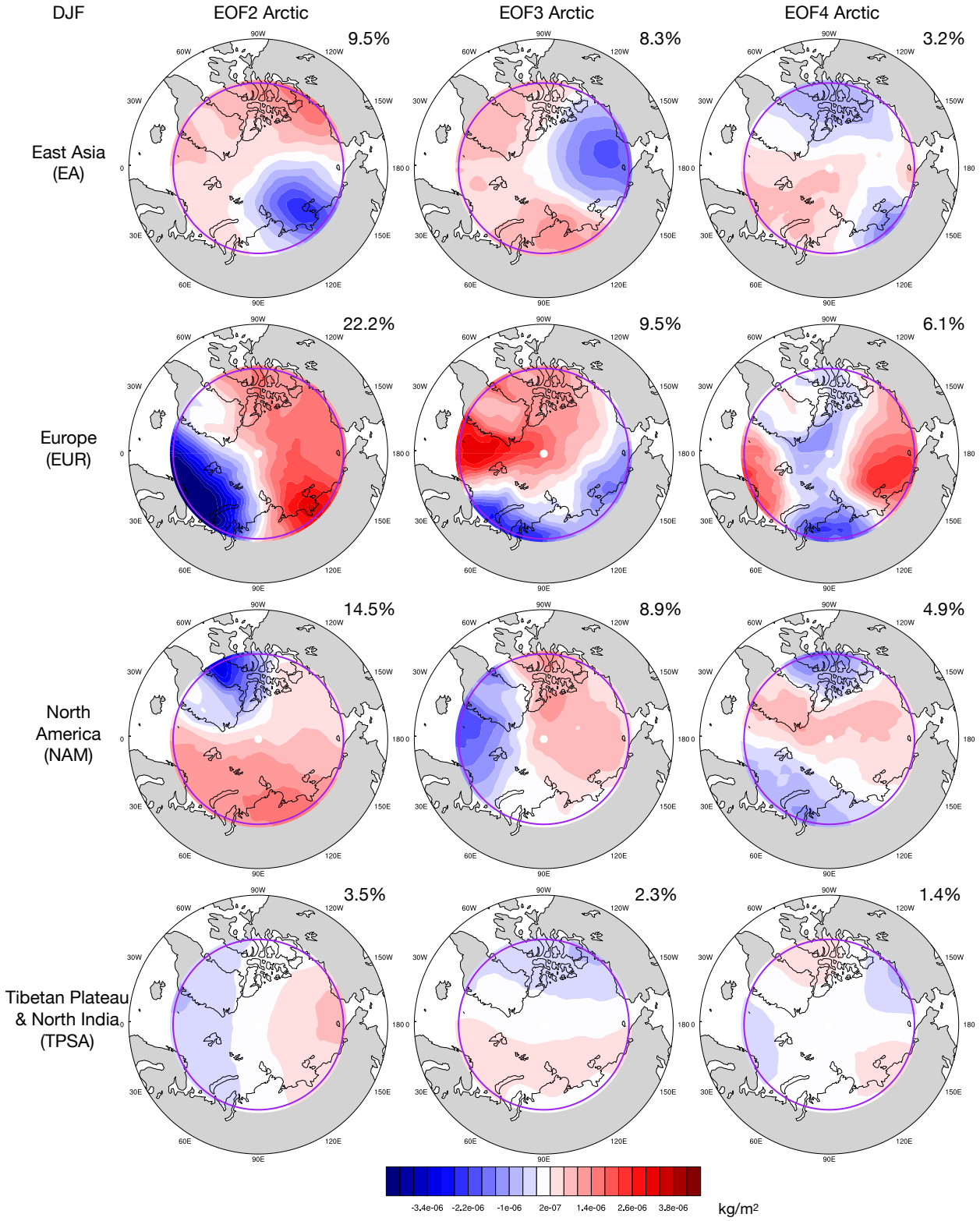


Figure S2: Similar to Fig. 7a-d, but for EOF2, EOF3 and EOF4.

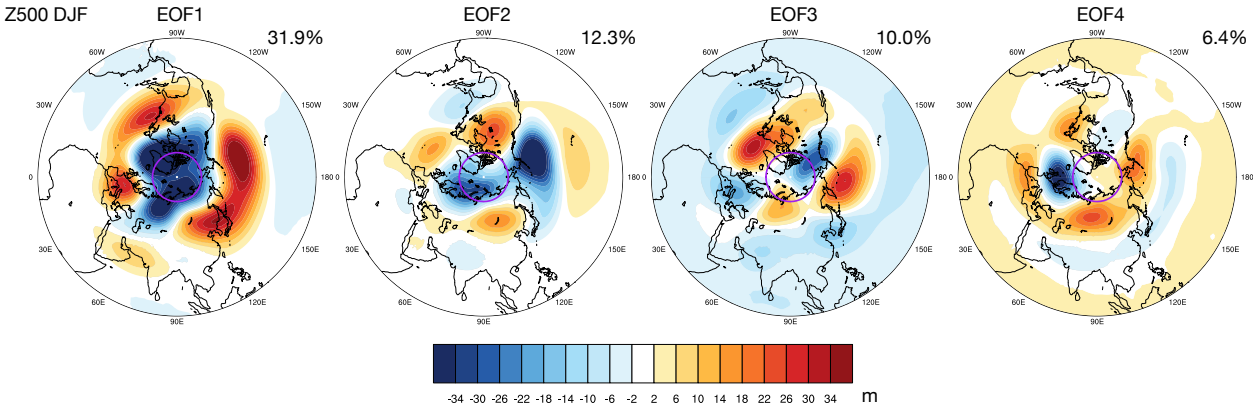


Figure S3: The first 4 EOF patterns of northern hemisphere Z500 (0°-90°N). Spatial variance explained by each EOF is shown on the top-right corner of each panel. Unit in m.

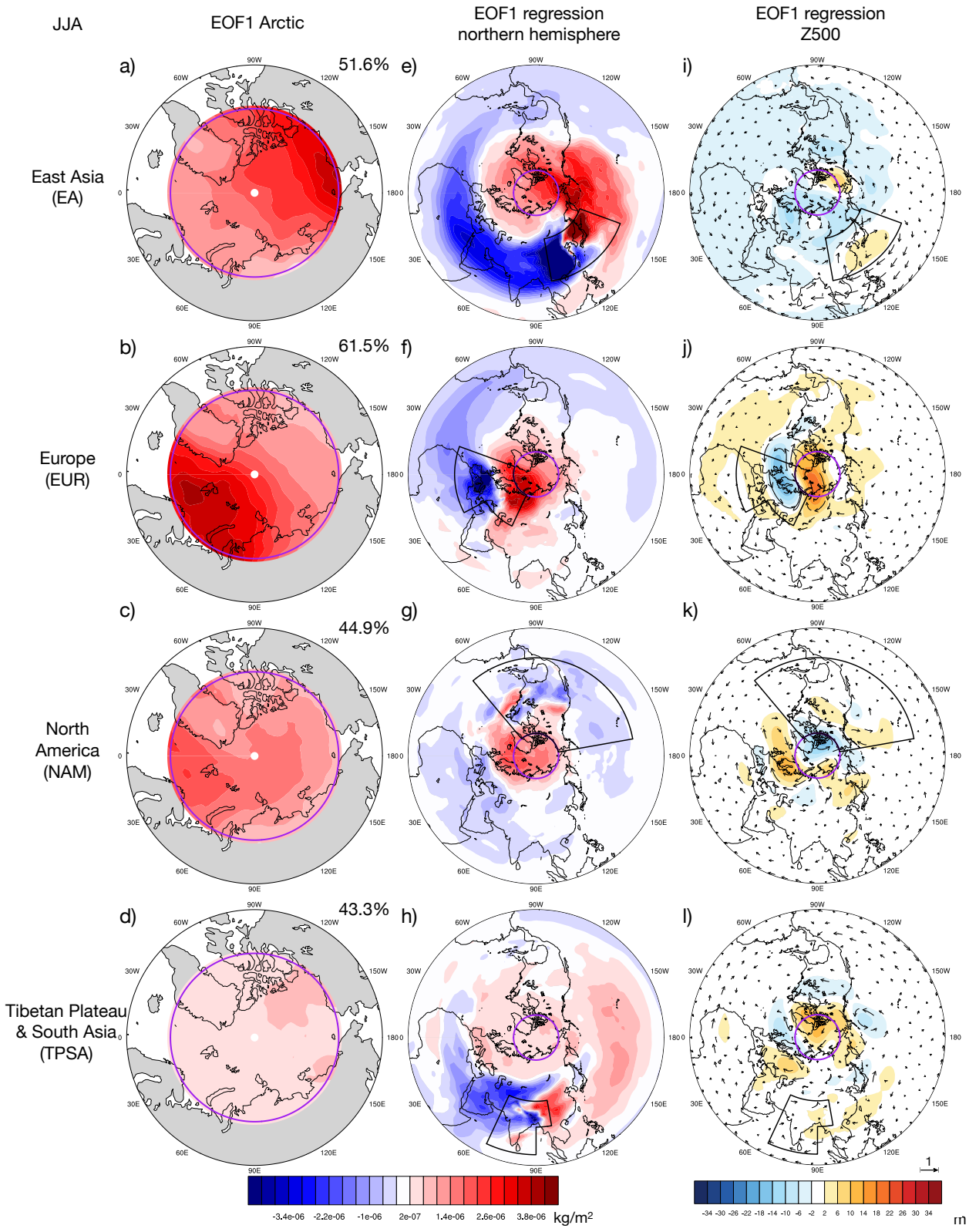


Figure S4: Similar to Fig. 7, but for summer (JJA).

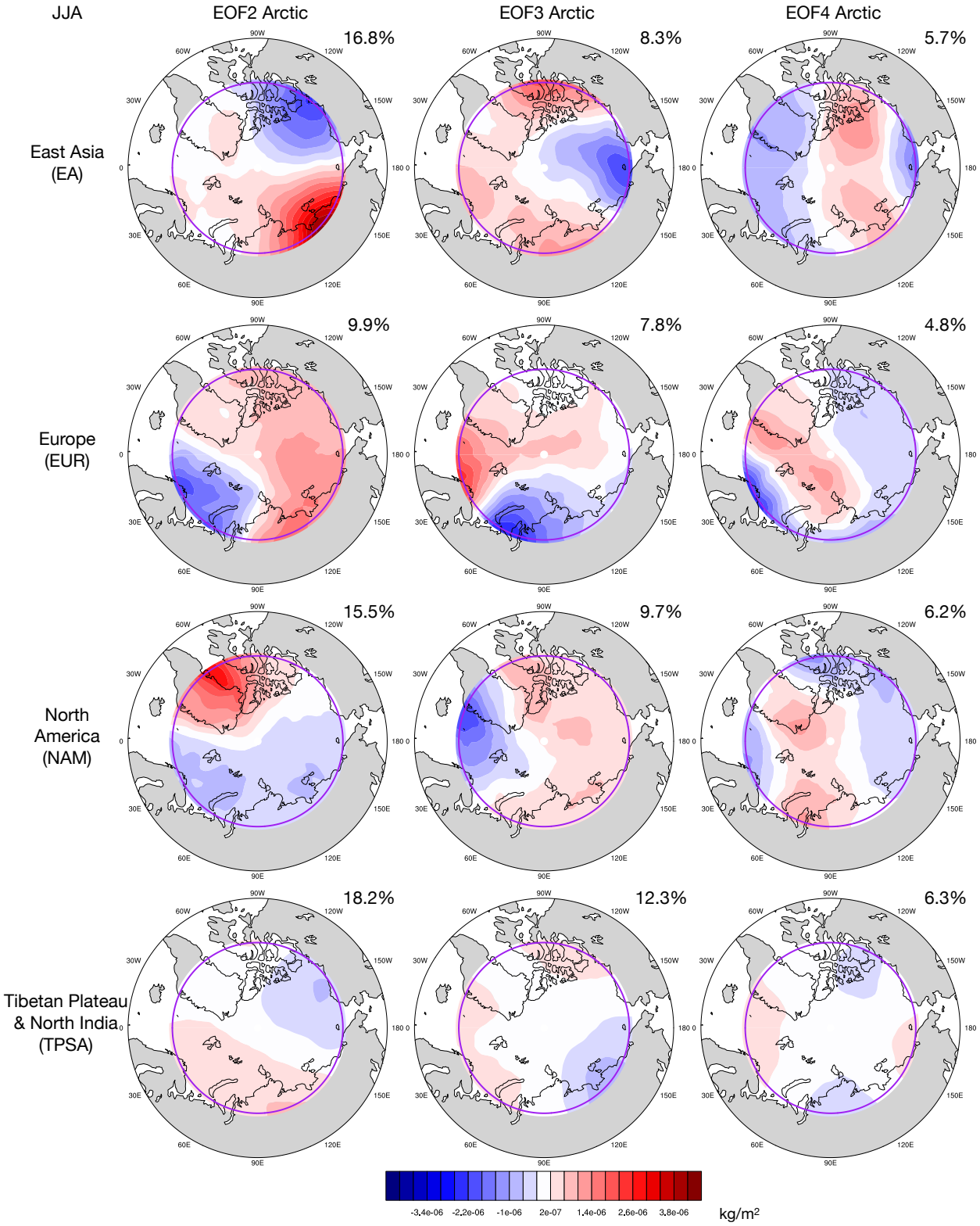
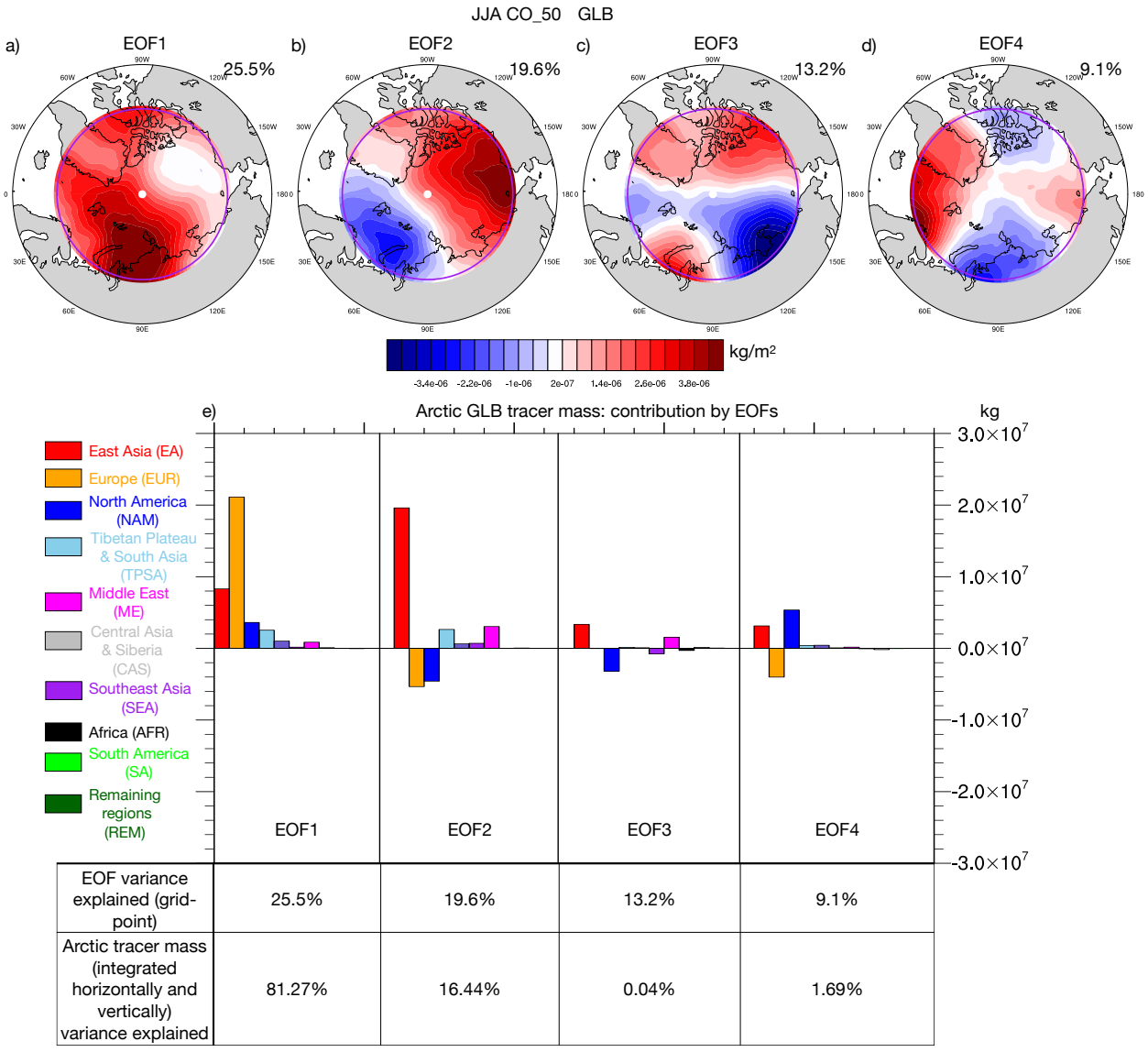


Figure S5: Similar to Fig. S2, but for summer.



	EOF1	EOF2	EOF3	EOF4
EOF variance explained (grid-point)	25.5%	19.6%	13.2%	9.1%
Arctic tracer mass (integrated horizontally and vertically) variance explained	81.27%	16.44%	0.04%	1.69%

Figure S6: Similar to Fig. 8, but for summer (JJA).

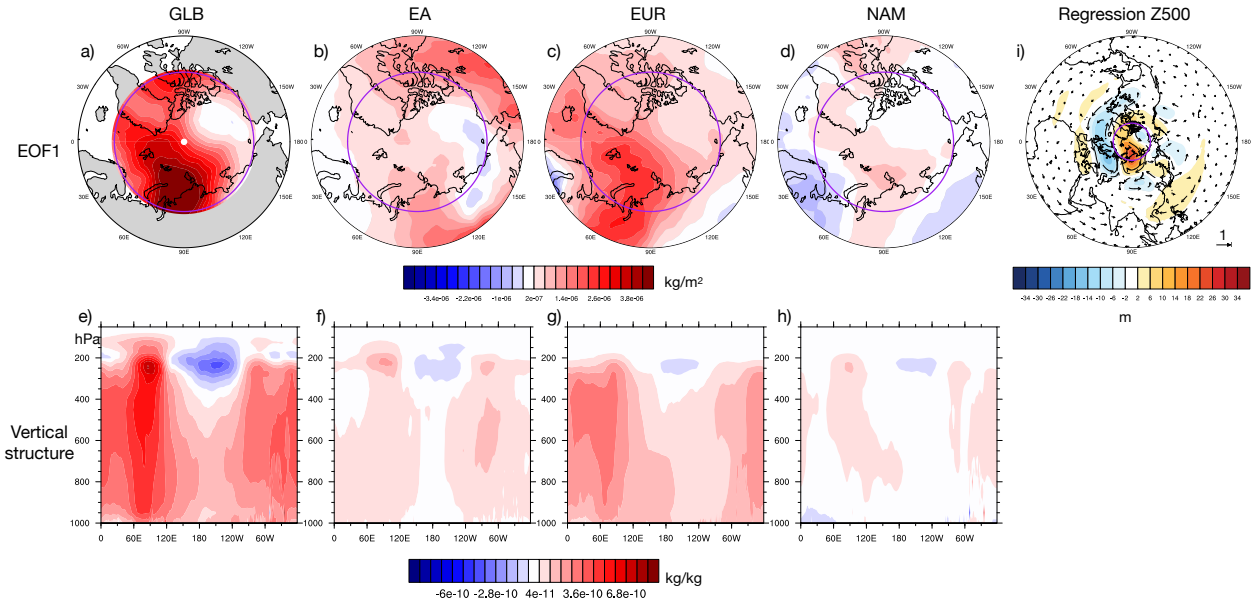


Figure S7: Similar to Fig. 10, but for summer EOF1.

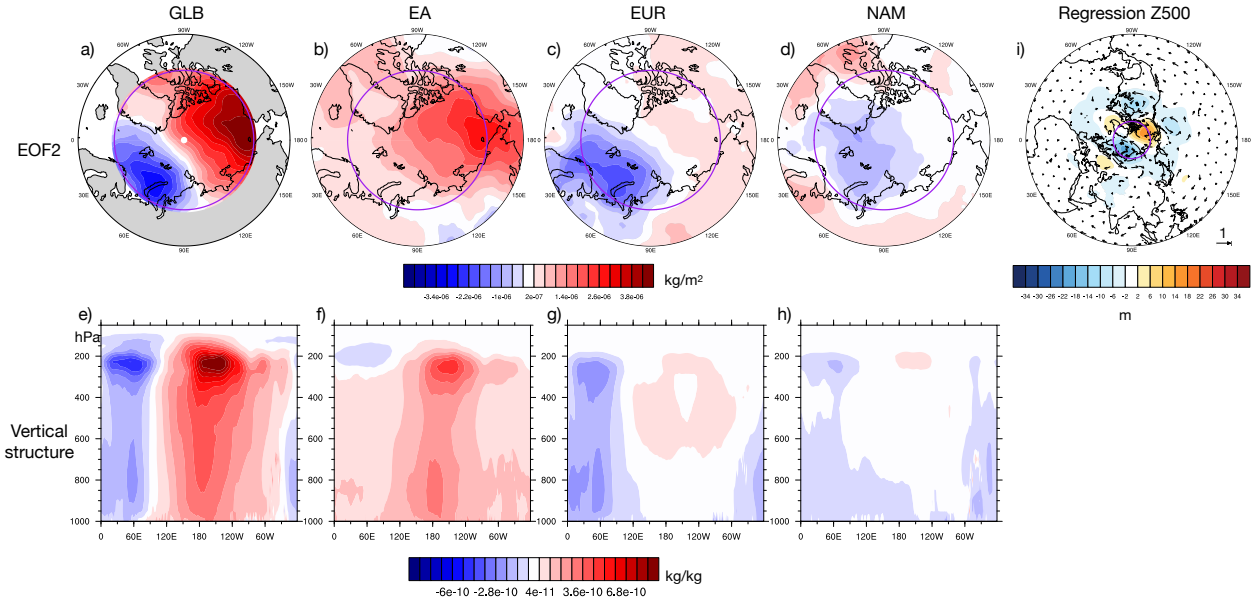


Figure S8: Similar to Fig. S4, but for summer EOF2.

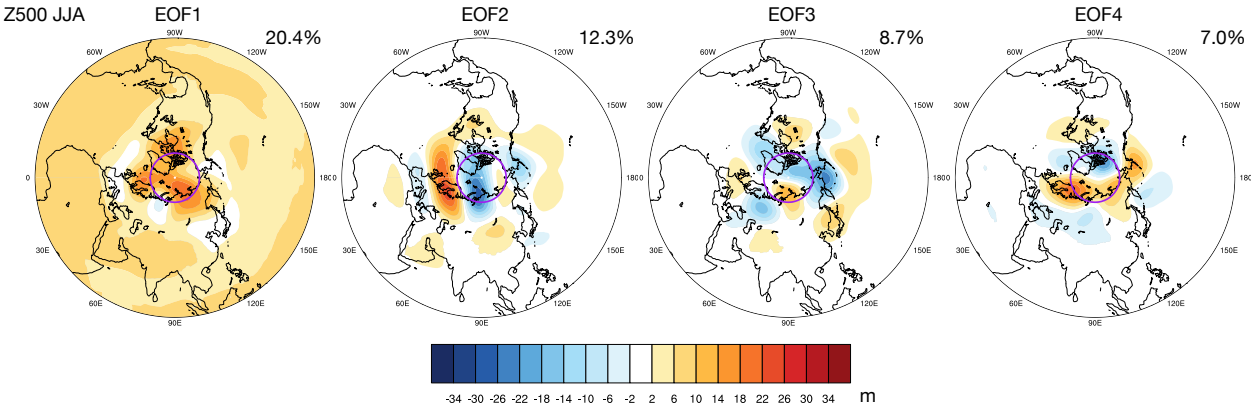


Figure S9: Similar to Fig. S3, but for summer.

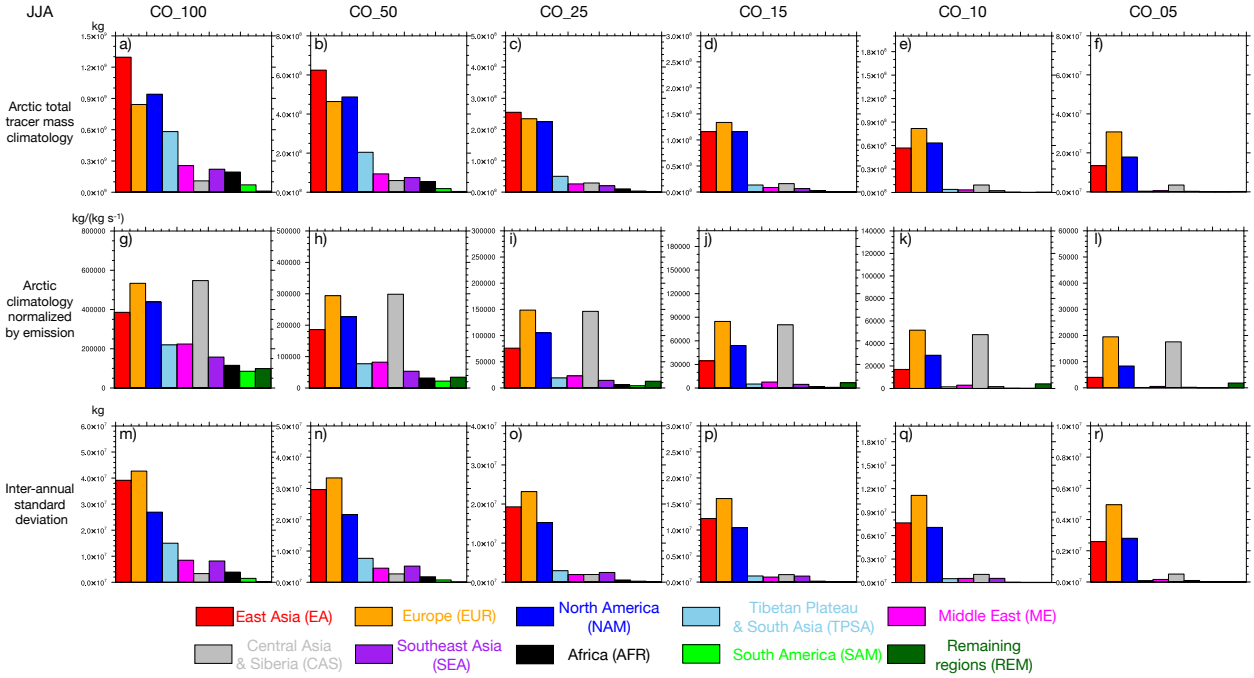


Figure S10: Similar to Fig. 12, but for summer.

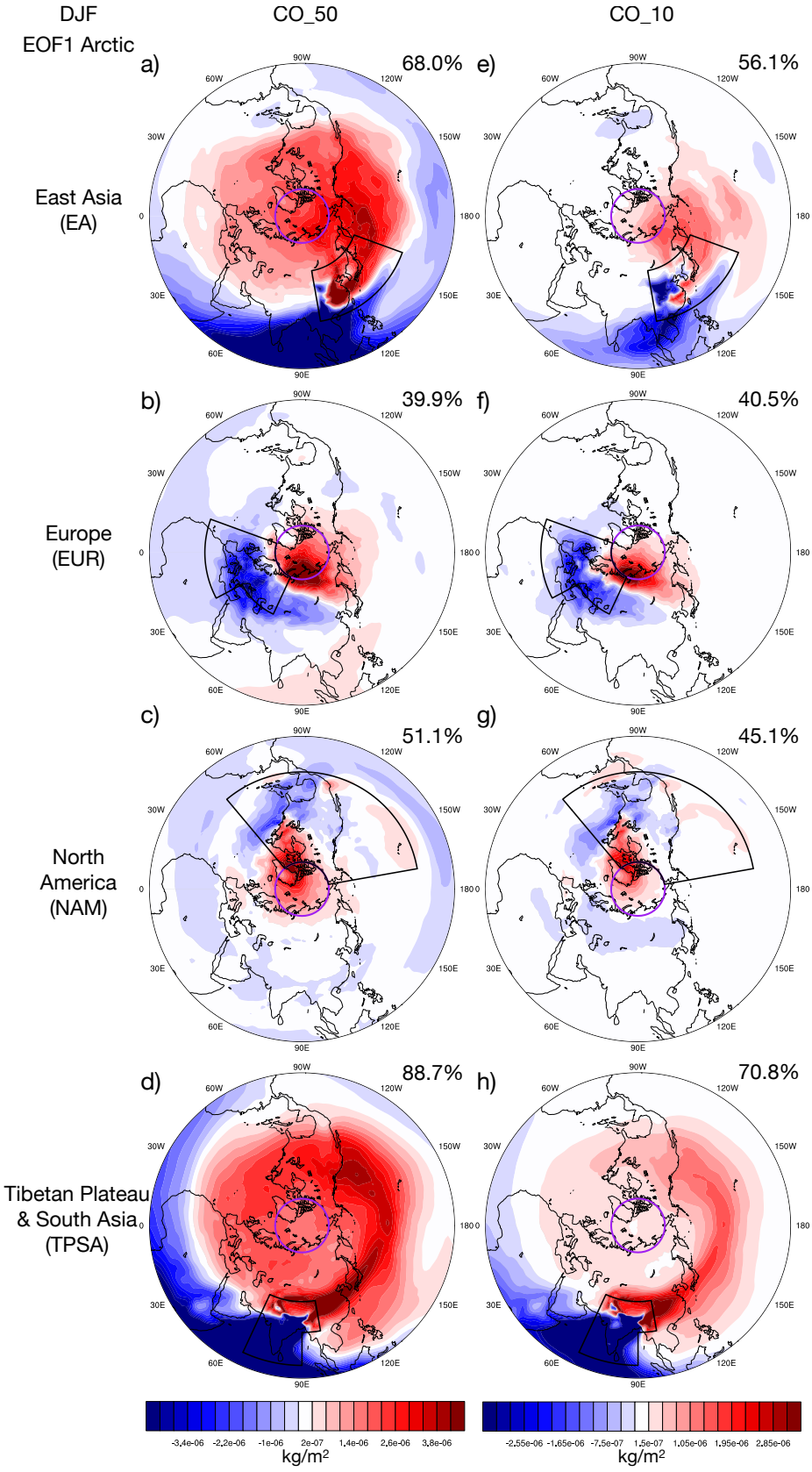


Figure S11: (a-d) The same as Fig. 7e-h. The spatial variance explained by EOF1 is shown in the top-right corner. (e-h) Similar to (a-d), but for CO10.