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*Supplement of*

## **Aerosol optical properties over Europe: an evaluation of the AQMEII Phase 3 simulations against satellite observations**

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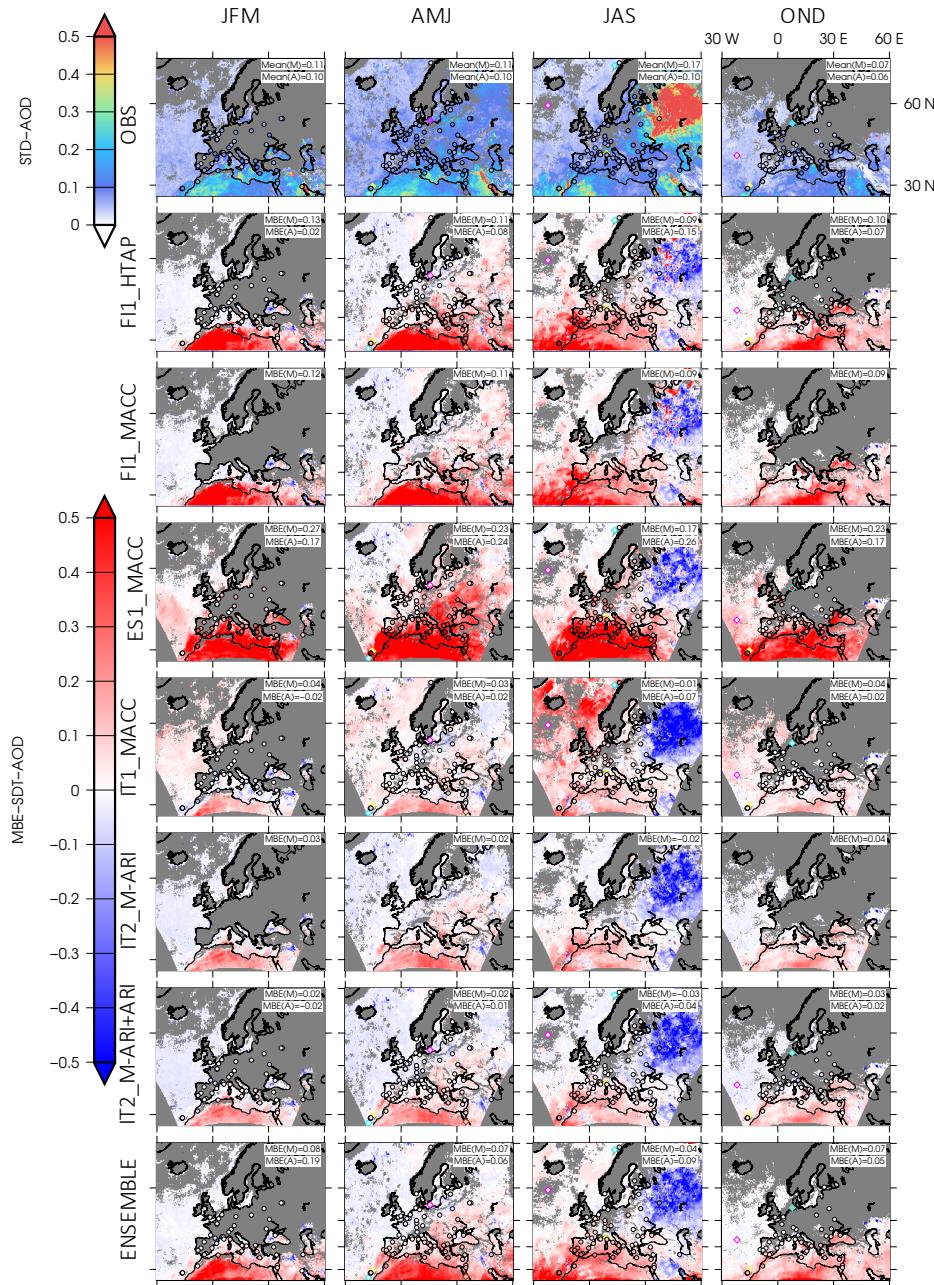
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**Table S1.** Summary of statistical analysis results for MODIS data.

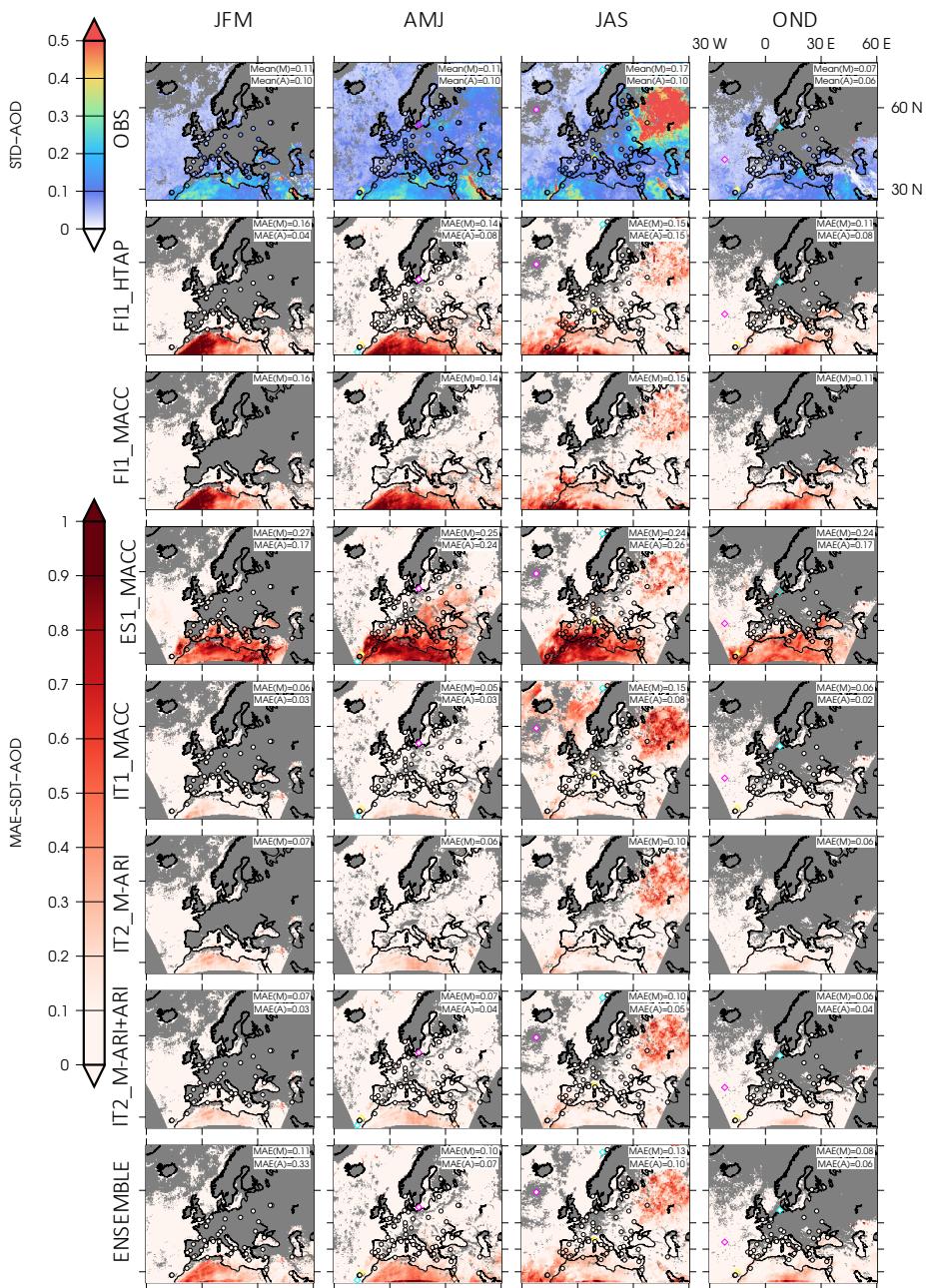
Model	Season	AOD				AE			
		Obs.	MBE	MAE	R <sup>2</sup>	Obs.	MBE	MAE	R <sup>2</sup>
FI1-HTAP	JFM	0.15	-0.01	0.14	0.44	0.64	-0.30	0.36	0.64
	AMJ	0.17	0.02	0.15	0.40	0.90	-0.62	0.64	0.59
	JAS	0.22	0.08	0.19	0.43	1.00	-0.61	0.63	0.52
	OND	0.12	0.04	0.12	0.38	0.66	-0.32	0.37	0.58
FI1_MACC	JFM	0.15	-0.01	0.14	0.44				
	AMJ	0.17	0.02	0.15	0.40				
	JAS	0.22	0.08	0.19	0.44				
	OND	0.12	0.03	0.12	0.38				
ES1_MACC	JFM	0.15	0.23	0.28	0.40	0.64	0.14	0.33	0.57
	AMJ	0.17	0.21	0.29	0.36	0.90	-0.11	0.37	0.50
	JAS	0.22	0.25	0.35	0.37	1.00	-0.09	0.31	0.51
	OND	0.12	0.25	0.28	0.35	0.66	0.19	0.33	0.54
IT1_MACC	JFM	0.15	0.01	0.09	0.46	0.64	0.52	0.59	0.60
	AMJ	0.17	0.02	0.10	0.42	0.90	0.30	0.48	0.50
	JAS	0.22	0.06	0.17	0.37	1.00	0.06	0.39	0.50
	OND	0.12	0.04	0.09	0.37	0.66	0.49	0.54	0.55
IT2_M-ARI	JFM	0.15	-0.03	0.10	0.48				
	AMJ	0.17	-0.02	0.11	0.42				
	JAS	0.22	-0.02	0.14	0.43				
	OND	0.12	0	0.09	0.39				
IT2_M-ARI+ACI	JFM	0.15	-0.05	0.11	0.48	0.64	0.51	0.55	0.59
	AMJ	0.17	-0.03	0.12	0.41	0.90	0.17	0.42	0.51
	JAS	0.22	-0.04	0.14	0.43	1.00	0.11	0.32	0.54
	OND	0.12	-0.01	0.09	0.39	0.66	0.49	0.55	0.53
ENSEMBLE	JFM	0.15	0.02	0.12	0.46	0.64	0.20	0.43	0.48
	AMJ	0.17	0.04	0.14	0.42	0.90	-0.01	0.45	0.44
	JAS	0.22	0.08	0.18	0.45	1.00	-0.20	0.40	0.45
	OND	0.12	0.06	0.11	0.40	0.66	0.04	0.37	0.46

**Table S2.** Summary of statistical analysis results for AERONET data.

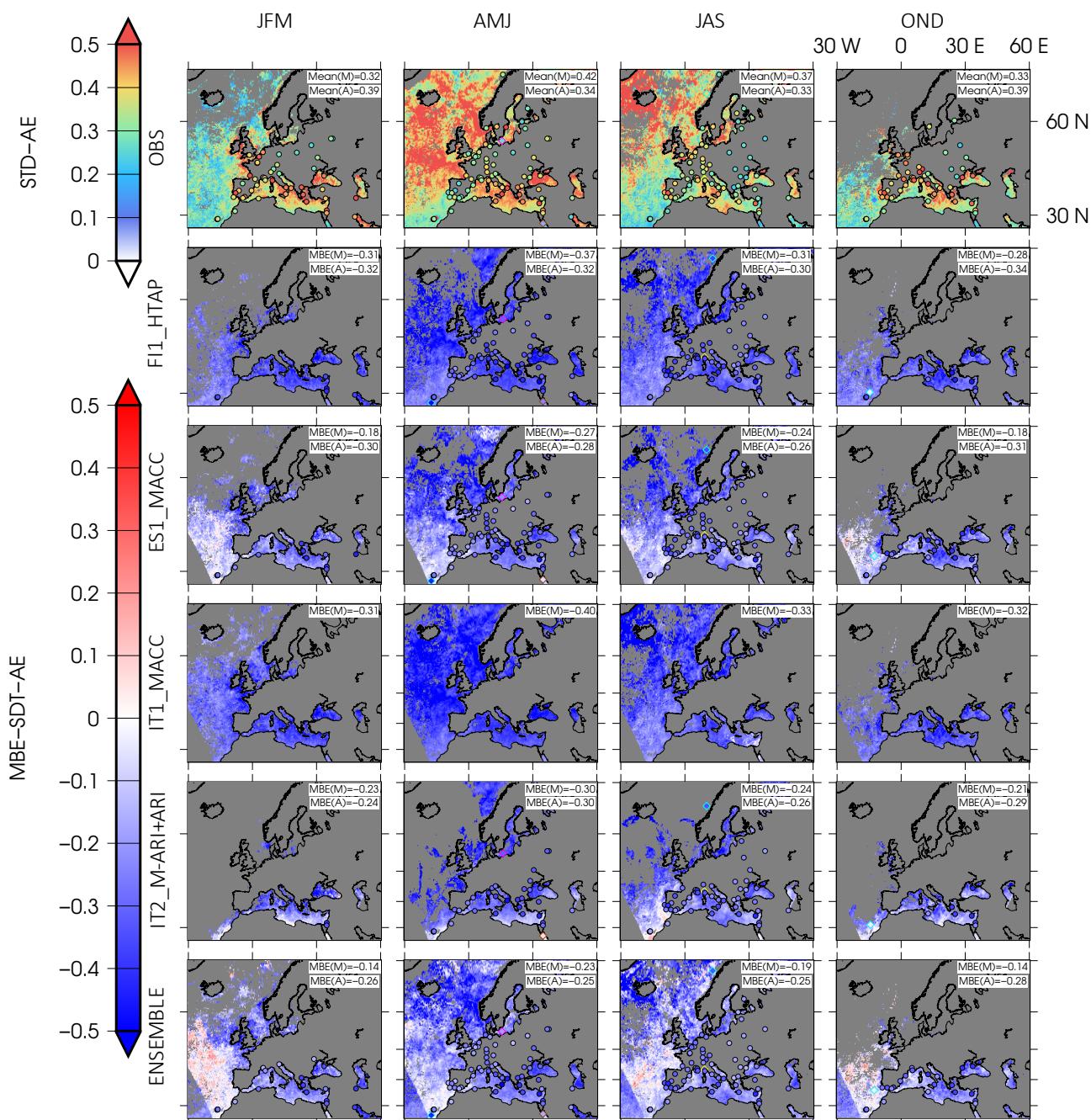
Model	Season	AOD				AE			
		Obs.	MBE	MAE	R <sup>2</sup>	Obs.	MBE	MAE	R <sup>2</sup>
FI1-HTAP	JFM	0.12	-0.02	0.07	0.37	1.06	-0.46	0.46	0.19
	AMJ	0.15	0.02	0.10	0.31	1.15	-0.99	0.99	0.29
	JAS	0.14	0.12	0.15	0.42	1.22	-1.07	1.07	0.26
	OND	0.08	0.02	0.06	0.39	1.10	-0.58	0.58	0.18
ES1_MACC	JFM	0.12	0.07	0.13	0.23	1.05	-0.32	0.40	0.20
	AMJ	0.15	0.13	0.19	0.25	1.15	-0.76	0.78	0.21
	JAS	0.14	0.18	0.21	0.32	1.22	-0.86	0.87	0.22
	OND	0.08	0.10	0.13	0.33	1.10	-0.41	0.45	0.19
IT1_MACC	JFM	0.12	0	0.05	0.32				
	AMJ	0.15	0.02	0.06	0.35				
	JAS	0.14	0.10	0.11	0.32				
	OND	0.08	0.03	0.05	0.30				
IT2_M-ARI+ACI	JFM	0.12	-0.05	0.06	0.37	1.05	0	0.13	0.05
	AMJ	0.15	-0.03	0.08	0.31	1.15	-0.47	0.53	0.26
	JAS	0.14	0.01	0.08	0.39	1.22	-0.71	0.73	0.28
	OND	0.08	-0.01	0.05	0.36	1.10	-0.31	0.37	0.07
ENSEMBLE	JFM	0.12	0	0.06	0.39	1.06	-0.58	0.62	0.12
	AMJ	0.15	0.04	0.09	0.37	1.15	-0.85	0.86	0.07
	JAS	0.14	0.10	0.12	0.46	1.22	-0.94	0.94	0.10
	OND	0.08	0.03	0.06	0.44	1.10	-0.55	0.58	0.07



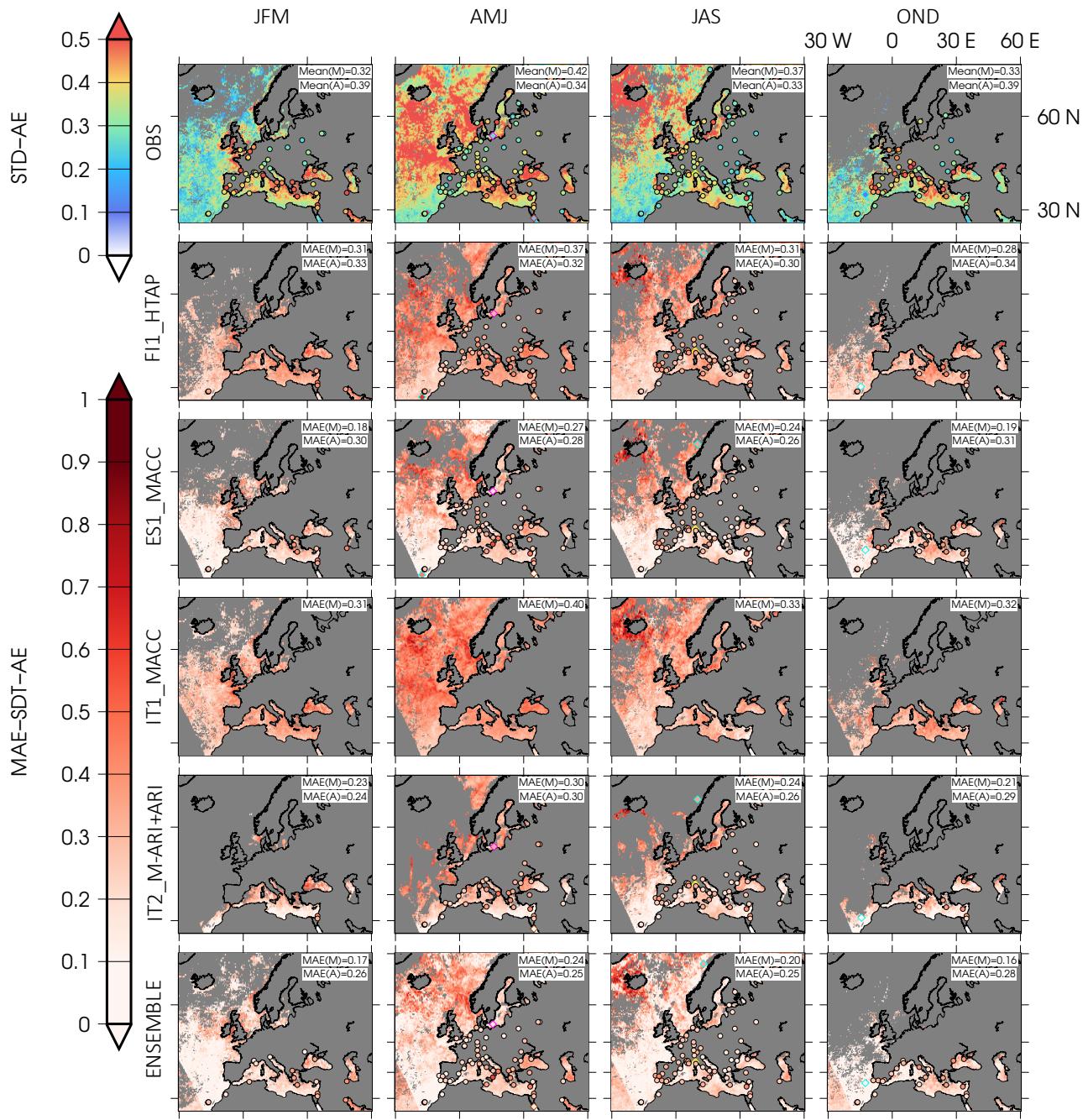
**Figure S1.** The MBE results of standard deviation of AOD at 550nm satellite and AOD at 675 nm AERONET (points) values vs. simulations. Columns from left to right, temporal mean of: whole year (2010), winter (JFM), spring (AMJ), summer (JAS) and autumn (OND). First row: satellite values; and from second row to the bottom, the MBE values of: FI1\_HTAP, FI1\_MACC, ES1\_MACC, IT1\_MACC, IT2\_M-ARI, IT2\_M-ARI+ACI and ENSEMBLE. MAM value are represented by colored lines. In JFM: Ak Fedorov (yellow), Oceania (magenta), Polarstern (cyan) and Zim Iberia(chocolate). In JAS: Alliance (yellow), Ak Ioffe (magenta) and Oceania (cyan). And in OND: Ak Fedorov (yellow), James Cook (magenta) and Polartstern (cyan).



**Figure S2.** Idem as S1 but for the MAE results.



**Figure S3.** The MBE results of standard deviation of AE between 550 and 860nm satellite and AE between 440 and 870 nm AERONET (points) values vs. simulations. Columns from left to right, temporal mean of: whole year (2010), winter (JFM), spring (AMJ), summer (JAS) and autumn (OND). First row: satellite values; and from second row to the bottom, the MBE values of: FI1\_HTAP, ES1\_MACC, IT1\_MACC, IT2\_M-ARI+ACI and ENSEMBLE. MAM value are represented by colored lines. In JFM: Oceania (magenta), Polarstern (cyan) and Zim Iberia(chocolate). In JAS: Alliance (yellow) and Oceania (cyan). and in OND: Polartstern (cyan).



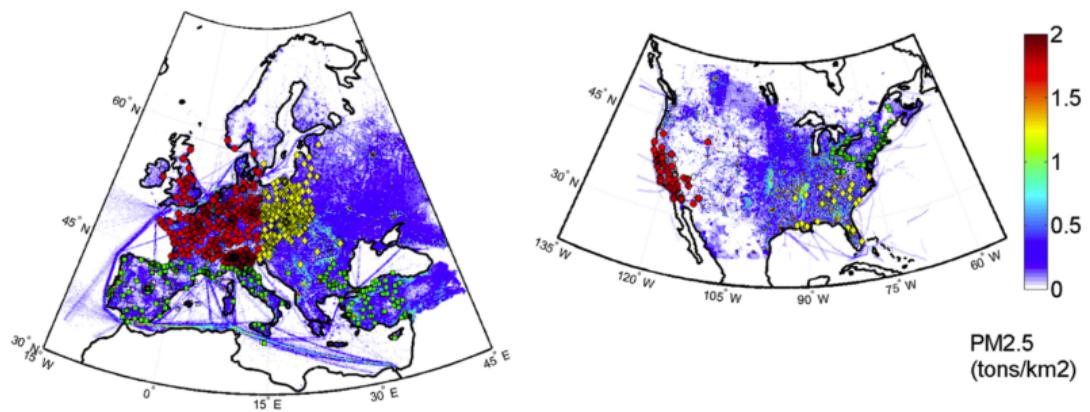
**Figure S4.** Idem as S3 but for the MAE results.

**Table S3.** Summary of statistical analysis results of standar deviation for MODIS data.

Model	Season	AOD				AE			
		Obs.	MBE	MAE	R <sup>2</sup>	Obs.	MBE	MAE	R <sup>2</sup>
FI1-HTAP	JFM	0.11	0.13	0.16	0.40	0.32	-0.31	0.31	0.10
	AMJ	0.11	0.11	0.14	0.38	0.42	-0.37	0.37	0
	JAS	0.17	0.09	0.15	0.17	0.37	-0.31	0.31	0.01
	OND	0.07	0.10	0.11	0.16	0.33	-0.28	0.28	0.01
FI1_MACC	JFM	0.11	0.12	0.16	0.40				
	AMJ	0.11	0.11	0.14	0.37				
	JAS	0.17	0.09	0.15	0.17				
	OND	0.07	0.09	0.11	0.15				
ES1_MACC	JFM	0.11	0.27	0.27	0.41	0.32	-0.18	0.18	0
	AMJ	0.11	0.23	0.25	0.35	0.42	-0.27	0.27	0.02
	JAS	0.17	0.17	0.24	0.03	0.37	-0.24	0.24	0.04
	OND	0.07	0.23	0.24	0.23	0.33	-0.18	0.19	0.03
IT1_MACC	JFM	0.11	0.04	0.06	0.47	0.32	-0.31	0.31	0.24
	AMJ	0.11	0.03	0.05	0.41	0.42	-0.40	0.40	0.01
	JAS	0.17	0.01	0.15	0	0.37	-0.33	0.33	0
	OND	0.07	0.04	0.06	0.14	0.33	-0.32	0.32	0.08
IT2_M-ARI	JFM	0.11	0.03	0.07	0.60				
	AMJ	0.11	0.02	0.06	0.46				
	JAS	0.17	-0.02	0.10	0.29				
	OND	0.07	0.04	0.06	0.23				
IT2_M-ARI+ACI	JFM	0.11	0.02	0.07	0.61	0.32	-0.23	0.23	0.01
	AMJ	0.11	0.02	0.07	0.46	0.42	-0.30	0.30	0
	JAS	0.17	-0.03	0.10	0.28	0.37	-0.24	0.24	0.08
	OND	0.07	0.03	0.06	0.23	0.33	-0.21	0.21	0.01
ENSEMBLE	JFM	0.11	0.08	0.11	0.47	0.32	-0.14	0.17	0.01
	AMJ	0.11	0.07	0.10	0.41	0.42	-0.23	0.24	0.01
	JAS	0.17	0.04	0.13	0.11	0.37	-0.19	0.20	0.01
	OND	0.07	0.07	0.08	0.18	0.33	-0.14	0.16	0

**Table S4.** Summary of statistical analysis results of standar deviation for AERONET data.

Model	Season	AOD			AE		
		Obs.	MBE	MAE	Obs.	MBE	MAE
FI1-HTAP	JFM	0.10	0.02	0.04	0.39	-0.32	0.33
	AMJ	0.10	0.08	0.08	0.34	-0.32	0.32
	JAS	0.10	0.15	0.15	0.33	-0.30	0.30
	OND	0.06	0.07	0.08	0.39	-0.34	0.34
ES1_MACC	JFM	0.10	0.17	0.17	0.39	-0.30	0.30
	AMJ	0.10	0.24	0.24	0.34	-0.28	0.28
	JAS	0.10	0.26	0.26	0.33	-0.26	0.26
	OND	0.06	0.17	0.17	0.39	-0.31	0.31
IT1_MACC	JFM	0.10	-0.02	0.03			
	AMJ	0.10	0.02	0.03			
	JAS	0.10	0.07	0.08			
	OND	0.06	0.02	0.02			
IT2_M-ARI+ACI	JFM	0.10	-0.02	0.03	0.39	-0.24	0.24
	AMJ	0.10	0.01	0.04	0.34	-0.30	0.30
	JAS	0.10	0.04	0.05	0.33	-0.26	0.26
	OND	0.06	0.02	0.04	0.39	-0.29	0.29
ENSEMBLE	JFM	0.10	0.02	0.04	0.39	-0.26	0.26
	AMJ	0.10	0.06	0.07	0.34	-0.25	0.25
	JAS	0.10	0.09	0.10	0.33	-0.25	0.25
	OND	0.06	0.05	0.06	0.39	-0.28	0.28



**Figure S5.** Figure from ?: Standard annual PM2.5 emissions in Europe and North America overlaid with monitoring stations in the sub-regions (the red circles show EU1/NA1, yellow diamonds show EU2/NA2 and green squares show EU3/NA3)

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