Vertical Retrieval of AOD using SEVIRI data, Case Study: European Continent

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Table S1. Statistical Metrics for 16 Cases Using Various Combinations of Meteorological and Land Cover Features with *Bi* as Input Features for the XGB Model.

XGB		MAE × 10^{-2}																			
		winter				spring				summer				autumn				annual			
Features	ID	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}
B_i	1	2	0.9	0.6	0.3	1.6	0.7	0.4	0.4	1.4	1	0.7	0.5	1.6	0.5	0.4	0.3	1.8	0.8	0.5	0.5
B_i, LC	2	2	0.9	0.6	0.3	1.6	0.7	0.5	0.4	1.4	1	0.7	0.5	1.6	0.5	0.4	0.3	1.8	0.8	0.5	0.5
B_i, P	3	1.8	0.5	0.4	0.3	1.6	0.7	0.4	0.4	1.2	0.7	0.4	0.4	3.6	0.9	0.4	0.2	1.6	0.6	0.4	0.4
B_i, T	4	1.7	0.4	0.3	0.2	1.5	0.6	0.3	0.3	1.1	0.6	0.4	0.3	1.5	0.5	0.2	0.2	1.4	0.5	0.3	0.3
B_i, Ws, Wd	5	1.7	0.4	0.2	0.1	1.5	0.6	0.3	0.2	1.1	0.6	0.3	0.2	1.5	0.4	0.2	0.1	1.4	0.5	0.3	0.2
B_i, LC, P	6	2	0.9	0.6	0.3	1.6	0.7	0.5	0.4	1.4	1	0.6	0.5	1.6	0.5	0.4	0.3	1.8	0.8	0.5	0.5
B_i, LC, T	7	1.8	0.5	0.4	0.3	1.6	0.7	0.4	0.4	1.2	0.7	0.5	0.4	1.6	0.5	0.2	0.2	1.6	0.6	0.4	0.4
B_i, LC, Ws, Wd	8	1.7	0.4	0.3	0.2	1.5	0.7	0.3	0.3	1.2	0.6	0.4	0.3	1.6	0.5	2	0.3	1.5	0.5	0.3	0.3
B_i, P, T	9	1.8	0.5	0.4	0.3	1.6	0.7	0.4	0.4	1.2	0.7	0.4	0.4	1.6	0.5	0.2	0.2	1.6	0.6	0.4	0.4
B_i, P, Ws, Wd	10	1.7	0.4	0.3	0.2	1.5	0.6	0.3	0.3	1.1	0.6	0.4	0.3	1.5	0.5	0.2	0.2	1.4	0.5	0.3	0.3
B_i, T, Ws, Wd	11	1.7	0.4	0.3	0.2	1.5	0.6	0.3	0.3	1.1	0.6	0.4	0.3	1.5	0.5	0.2	0.2	1.4	0.5	0.3	0.3
B_i, LC, P, T	12	2	0.9	0.6	0.3	1.6	0.7	0.5	0.4	1.4	1	0.6	0.5	1.6	0.5	0.4	0.3	1.8	0.8	0.5	0.5
B_i, LC, P, Ws, Wd	13	1.8	0.5	0.4	0.3	1.6	0.7	0.4	0.4	1.2	0.7	0.5	0.4	1.6	0.5	0.2	0.2	1.6	0.6	0.4	0.4
B_i, LC, T, Ws, Wd	14	1.8	0.5	0.4	0.3	1.6	0.7	0.4	0.4	1.2	0.7	0.5	0.4	1.6	0.5	0.2	0.2	1.6	0.6	0.4	0.4
B_i, P, T, Ws, Wd	15	1.8	0.5	0.4	0.3	1.6	0.7	0.4	0.4	1.2	0.7	0.4	0.4	1.6	0.5	0.2	0.2	1.6	0.6	0.4	0.4
B_i, LC, P, T, Ws, Wd	16	2	0.9	0.6	0.3	1.6	0.7	0.4	0.4	1.4	1	0.6	0.5	1.6	0.5	0.4	0.3	1.8	0.8	0.5	0.5
RMSE × 10^{-2}																					
B_i	1	5.2	5.8	4.6	2.4	4.3	3.1	2.9	2.5	4.3	4	4	3.2	5.1	2.8	2.5	2.6	5.3	3.1	3.1	3.1
B_i, LC	2	5.2	5.7	4.6	2.4	4.3	3.1	2.9	2.5	4.5	4	3.5	3.1	5.1	2.8	2.5	2.6	5.3	3.1	3.1	3.1
B_i, P	3	4.8	3.2	2.2	2.2	4.3	3.1	2.3	2.3	3.8	2	2.2	2.8	1.2	5.1	3.1	2.2	4.7	2.4	2.3	2.9
B_i, T	4	4.6	2.9	2.3	1.9	4.1	2.8	2	1.7	3.6	2	2	2.5	4.7	2.8	1.8	2.5	4.3	2.2	1.6	2.4
B_i, Ws, Wd	5	4.6	2.6	2.3	1.2	4	2.5	1.9	1	3.6	2	1.6	1.7	4.7	2.4	1.8	1.7	42	2.1	1.5	1.5
B_i, LC, P	6	5.2	5.7	4.6	2.4	4.3	3.1	2.9	2.5	4.4	3.9	3.6	3.1	5.1	2.9	2.5	2.6	5.3	3.1	3.1	3.1
B_i, LC, T	7	4.9	3.1	3.1	2.2	4.4	3.1	2.5	2.4	4	2.4	2.4	2.8	5	2.9	2	2.5	4.8	2.4	2.4	3
B_i, LC, Ws, Wd	8	4.6	2.8	2.3	1.9	4.1	2.8	2.1	1.8	3.6	2	2	2.6	4.7	2.7	1.8	2.6	4.3	2.2	1.6	2.3

$\boldsymbol{B_i}$, P, T	9	4.8	3.2	3.1	2.2	4.3	3	2.3	2.3	3.8	2.3	2.2	2.8	4.9	2.8	2	2.4	4.7	2.4	2.3	2.9
$\boldsymbol{B_i}$, P, Ws, Wd	10	4.7	2.8	2.3	1.8	4.1	2.7	2.1	1.7	3.6	2	2	2.6	4.7	2.9	1.8	2.4	4.2	2.2	1.6	2.4
$\boldsymbol{B_i}$, T, Ws, Wd	11	4.7	2.9	2.3	1.9	4.1	2.8	2	1.7	3.6	2	2	2.5	4.7	2.8	1.8	2.5	4.3	2.2	1.6	2.4
$\boldsymbol{B_i}$, LC, P, T	12	5.2	5.7	4.6	2.4	4.3	3.1	2.9	2.5	4.4	3.9	3.6	3.1	5.1	2.9	2.5	2.6	5.3	3.1	3.1	3.1
$\boldsymbol{B_i}$, LC, P, Ws, Wd	13	5	3.1	3.1	2.2	4.4	3.1	2.5	2.3	4	2.4	2.5	2.9	4.9	2.9	2	2.4	4.8	2.5	2.4	2.9
$\boldsymbol{B_i}$, LC, T, Ws, Wd	14	4.9	3	3.1	2.2	4.4	3	2.5	2.4	4	2.4	2.4	2.8	5	2.9	2	2.5	4.8	2.4	2.4	3
$\boldsymbol{B_i}$, P, T, Ws, Wd	15	4.8	3.2	3.1	2.2	4.3	2.9	2.3	2.3	3.8	2.3	2.2	2.8	4.9	2.9	2	2.4	4.7	2.4	2.3	2.8
$\boldsymbol{B_i}$, LC, P, T, Ws, Wd	16	5.2	5.7	4.6	2.4	4.3	2.9	2.3	2.3	4.4	3.9	3.6	3.1	5.1	2.9	2.5	2.6	5.3	3.1	3.1	3.1
$\mathbf{R \times 10^{-2}}$																					
$\boldsymbol{B_i}$	1	99	59	53	37	99	97	93	64	99	88	74	51	98	92	91	75	99	95	82	56
$\boldsymbol{B_i}$, LC	2	99	61	53	41	99	97	93	63	99	88	73	48	98	92	91	75	99	95	82	56
$\boldsymbol{B_i}$, P	3	99	95	90	55	99	97	96	71	99	98	93	68	77	59	81	91	99	98	93	68
$\boldsymbol{B_i}$, T	4	99	96	97	75	99	98	98	87	99	99	95	79	99	92	97	86	99	98	98	83
$\boldsymbol{B_i}$, Ws, Wd	5	99	98	96	94	99	99	98	98	99	99	97	94	99	96	97	97	99	99	98	95
$\boldsymbol{B_i}$, LC, P	6	99	61	53	41	99	97	93	63	99	88	73	52	98	92	91	75	99	95	82	56
$\boldsymbol{B_i}$, LC, T	7	99	96	90	56	99	97	96	64	99	98	91	66	99	91	96	83	99	98	92	64
$\boldsymbol{B_i}$, LC, Ws, Wd	8	99	96	96	76	99	98	98	85	99	98	95	76	99	93	97	80	99	98	98	83
$\boldsymbol{B_i}$, P, T	9	99	95	90	55	99	97	96	71	99	98	93	68	99	92	96	86	99	98	93	68
$\boldsymbol{B_i}$, P, Ws, Wd	10	99	96	96	77	99	98	97	87	99	98	95	75	99	91	97	86	99	98	98	82
$\boldsymbol{B_i}$, T, Ws, Wd	11	99	96	97	75	99	98	98	87	99	99	95	79	99	92	97	86	99	98	98	83
$\boldsymbol{B_i}$, LC, P, T	12	99	61	53	41	99	97	93	63	99	88	73	52	98	92	91	75	99	95	82	56
$\boldsymbol{B_i}$, LC, P, Ws, Wd	13	99	96	89	60	99	97	96	74	99	98	90	65	99	92	96	83	99	98	92	65
$\boldsymbol{B_i}$, LC, T, Ws, Wd	14	99	96	90	56	99	97	96	64	99	98	91	66	99	91	96	83	99	98	92	64
$\boldsymbol{B_i}$, P, T, Ws, Wd	15	99	95	90	55	99	97	96	71	99	98	93	68	99	92	96	86	99	98	93	68
$\boldsymbol{B_i}$, LC, P, T, Ws, Wd	16	99	61	53	41	99	97	96	71	99	88	73	52	98	92	91	75	99	95	82	56
$\boldsymbol{R^2 \times 10^{-2}}$																					
$\boldsymbol{B_i}$	1	91	31	27	14	92	86	75	37	88	65	47	21	90	78	71	48	89	80	59	27
$\boldsymbol{B_i}$, LC	2	91	33	38	17	92	86	76	36	88	66	49	22	90	78	71	48	89	80	59	27
$\boldsymbol{B_i}$, P	3	93	79	67	30	92	87	84	45	91	88	80	39	49	29	56	63	91	88	77	36

B_i, T	4	93	83	82	47	93	89	88	68	92	91	86	52	92	79	85	52	93	90	90	57
B_i, Ws, Wd	5	93	86	82	78	93	91	89	89	92	92	89	78	92	84	85	79	93	91	90	82
B_i, LC, P	6	91	33	28	17	92	86	76	36	88	66	48	26	90	78	71	48	89	80	59	27
B_i, LC, T	7	92	80	66	29	91	86	82	38	90	87	77	37	91	77	82	50	91	88	76	32
B_i, LC, Ws, Wd	8	93	84	81	50	93	88	87	65	92	91	86	47	92	79	84	47	93	90	89	58
B_i, P, T	9	93	79	67	30	92	87	84	45	91	88	80	39	91	78	82	56	91	88	77	36
B_i, P, Ws, Wd	10	93	84	81	52	93	89	87	69	92	91	86	48	92	77	85	54	93	90	90	57
B_i, T, Ws, Wd	11	93	83	82	47	93	89	88	64	92	91	86	52	92	79	85	52	93	90	90	57
B_i, LC, P, T	12	91	33	28	17	92	86	76	36	88	66	48	26	90	78	71	48	89	80	59	27
B_i, LC, P, Ws, Wd	13	92	80	67	32	92	86	82	47	9	87	75	37	91	77	82	56	91	87	76	34
B_i, LC, T, Ws, Wd	14	92	80	67	29	91	86	82	38	90	87	77	37	91	77	82	50	91	88	76	32
B_i, P, T, Ws, Wd	15	93	79	67	30	92	87	84	45	91	88	80	39	91	78	82	54	91	88	78	36
B_i, LC, P, T, Ws, Wd	16	91	33	28	17	92	87	84	45	88	66	48	26	90	78	71	48	89	80	59	27

Table S2. Statistical Metrics for 16 Cases Using Various Combinations of Meteorological and Land Cover Features with *Bi* as Input Features for the RF Model.

RF		**MAE × 10^{-2}**																			
		winter				spring				summer				autumn				annual			
Features	ID	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}	$AOD_{1.5}$	AOD_3	AOD_5	AOD_{10}
B_i	1	1.3	1.2	0.8	0.4	0.7	0.4	0.5	0.6	0.5	1.4	1.2	0.8	0.5	0.3	0.4	0.4	0.7	1.1	0.8	0.6
B_i, LC	2	1.3	1.2	0.8	0.4	0.7	0.4	0.5	0.6	0.5	1.4	1.2	0.8	0.5	0.3	0.4	0.4	0.7	1.1	0.8	0.6
B_i, P	3	1.2	0.2	0.4	0.4	0.6	0.4	0.5	0.6	0.5	0.6	0.5	0.7	0.5	0.3	0.1	0.4	0.6	0.5	0.5	0.6
B_i, T	4	0.7	0.2	0.1	0.3	0.6	0.4	0.2	0.4	0.5	0.5	0.3	0.5	0.5	0.3	0.1	0.4	0.6	0.4	0.2	0.4
B_i, Ws, Wd	5	0.6	0.2	0.1	0.03	0.6	0.4	0.2	0.04	0.5	0.5	0.3	0.07	0.5	0.3	0.1	0.03	0.6	0.4	0.2	0.00
B_i, LC, P	6	1.3	1.2	0.8	0.4	0.7	0.4	0.5	0.6	0.5	1.4	1.2	0.8	0.5	0.3	0.4	0.4	0.7	1.1	0.8	0.6
B_i, LC, T	7	0.8	0.2	0.4	0.4	0.6	0.4	0.5	0.6	0.5	0.6	0.5	0.7	0.6	0.3	0.1	0.4	0.6	0.5	0.4	0.6
B_i, LC, Ws, Wd	8	0.7	0.2	0.1	0.3	0.6	0.4	0.2	0.4	0.5	0.5	0.3	0.5	0.6	0.3	0.1	0.4	0.6	0.4	0.2	0.4
B_i, P, T	9	1.2	0.2	0.4	0.4	0.6	0.4	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.3	0.1	0.4	0.6	0.5	0.5	0.6
B_i, P, Ws, Wd	10	0.6	0.2	0.1	0.3	0.6	0.4	0.2	0.4	0.5	0.5	0.3	0.5	0.5	0.3	0.1	0.4	0.6	0.4	0.2	0.4

B_i, T, Ws, Wd	11	0.7	0.2	0.1	0.3	0.6	0.4	0.2	0.4	0.5	0.5	0.3	0.5	0.5	0.3	0.1	0.4	0.6	0.4	0.2	0.4
B_i, LC, P, T	12	1.3	1.2	0.8	0.4	0.7	0.4	0.5	0.6	0.5	1.4	1.2	0.7	0.5	0.3	0.4	0.4	0.6	1.1	0.8	0.6
B_i, LC, P, Ws, Wd	13	0.7	0.2	0.4	0.4	0.6	0.4	0.6	0.6	0.5	0.6	0.5	0.6	0.6	0.3	0.1	0.4	0.6	0.4	0.4	0.6
B_i, LC, T, Ws, Wd	14	0.8	0.2	0.4	0.4	0.6	0.4	0.5	0.6	0.5	0.6	0.5	0.7	0.6	0.3	0.1	0.4	0.6	0.5	0.4	0.6
B_i, P, T, Ws, Wd	15	1.2	0.2	0.4	0.4	0.6	0.4	0.5	0.6	0.5	0.6	0.5	0.7	0.5	0.3	0.1	0.4	0.6	0.5	0.5	0.6
B_i, LC, P, T, Ws, Wd	16	1.3	1.2	0.8	0.4	0.7	0.4	0.5	0.6	0.5	1.4	1.2	0.8	0.5	0.3	0.4	0.4	0.6	1	0.8	0.6
RMSE × 10^{-2}																					
B_i	1	2.4	6.3	5.2	2.6	1.7	1.3	2.4	2.8	1.4	4.9	4.7	3.4	1.2	1	2.2	2.7	1.9	3.7	4	3.5
B_i, LC	2	2.4	6.3	5.2	2.6	1.7	1.3	2.4	2.8	1.4	4.9	4.7	3.4	1.2	1	2.2	2.7	1.9	3.7	4	3.5
B_i, P	3	2.2	1.4	2.9	2.4	1.7	1.2	2.8	2.6	1.1	1.7	2	3.2	1.2	1	0.7	3	1.5	1.5	2.3	3.5
B_i, T	4	1.4	0.9	0.8	2.2	1.7	1.2	0.9	2.1	1.1	1.5	1.2	2.8	1.2	1	0.7	2.9	1.5	1.2	0.8	2.9
B_i, Ws, Wd	5	1.3	0.9	0.6	0.4	1.7	1.2	0.7	0.3	1.1	1.5	1	0.4	1.2	0.9	0.7	0.6	1.5	1.2	0.6	0.2
B_i, LC, P	6	2.4	6.3	5.2	2	1.7	1.3	2.4	2.8	1.4	4.9	4.7	3.4	1.2	1	2.2	2.7	1.9	3.7	4	3.5
B_i, LC, T	7	1.6	1.2	2.7	2.1	1.7	1.2	3	2.7	1.1	1.7	2.1	3.2	1.3	1	0.7	2.9	1.5	1.5	2.3	3.5
B_i, LC, Ws, Wd	8	1.4	0.9	0.8	2.5	1.7	1.2	0.9	2.1	1.1	1.5	1.2	2.6	1.2	1	0.7	2.7	1.5	1.2	0.8	3
B_i, P, T	9	2.2	1.4	2.9	2.4	1.7	1.2	2.8	2.6	1.1	1.7	2	3.2	1.2	1	0.7	3	1.5	1.5	2.3	3.5
B_i, P, Ws, Wd	10	1.3	0.9	0.8	2.3	1.7	1.2	0.9	2.1	1.1	1.5	1.2	2.7	1.2	1	0.7	2.7	1.5	1.2	0.8	2.9
B_i, T, Ws, Wd	11	1.4	0.9	0.8	2.2	1.7	1.2	0.9	2.1	1.1	1.5	1.2	2.8	1.2	1	0.7	3	1.5	1.2	0.8	2.9
B_i, LC, P, T	12	2.4	6.3	5.2	2.6	1.7	1.3	2.4	2.8	1.4	4.9	4.7	3.4	1.2	1	2.2	2.7	1.9	3.7	4	3.5
B_i, LC, P, Ws, Wd	13	1.4	1.2	2.6	2.4	1.7	1.3	3.1	2.6	1.1	1.7	2	3.3	1.2	1	0.7	2.5	1.5	1.5	2.3	3.5
B_i, LC, T, Ws, Wd	14	1.6	1.2	2.7	2.4	1.7	1.2	3	2.7	1.1	1.7	2	3.2	1.3	1	0.7	2.9	1.5	1.5	2.3	3.5
B_i, P, T, Ws, Wd	15	2.2	1.4	2.9	2.4	1.7	1.2	2.8	2.6	1.1	1.7	2	3.2	1.2	1	0.7	3	1.5	1.5	2.3	3.5
B_i, LC, P, T, Ws, Wd	16	2.4	6.3	5.2	2.6	1.7	1.3	2.4	2.8	1.4	4.9	4.7	3.4	1.2	1	2.2	2.7	1.9	3.7	4	3.5
R × 10^{-2}																					
B_i	1	99	44	28	15	99	99	91	43	99	69	30	31	99	98	89	70	99	84	57	24
B_i, LC	2	99	44	28	15	99	99	91	43	99	69	30	31	99	98	89	70	99	84	57	24
B_i, P	3	99	98	85	40	99	99	87	58	99	97	92	51	99	99	99	65	99	98	88	30
B_i, T	4	99	99	99	53	99	99	99	74	99	97	97	68	99	99	99	70	99	99	99	58
B_i, Ws, Wd	5	99	99	99	99	99	99	99	99	99	97	98	99	99	99	99	99	99	99	99	99

$\boldsymbol{B_i}$, LC, P	6	99	44	28	15	99	99	91	43	99	69	30	31	99	98	89	70	99	84	57	24
$\boldsymbol{B_i}$, LC, T	7	99	98	87	37	99	99	86	48	99	97	91	45	99	99	99	72	99	98	88	26
$\boldsymbol{B_i}$, LC, Ws, Wd	8	99	99	99	42	99	99	99	74	99	97	97	75	99	99	99	74	99	99	99	27
$\boldsymbol{B_i}$, P, T	9	99	98	95	40	99	99	87	58	99	97	92	51	99	99	99	65	99	98	88	30
$\boldsymbol{B_i}$, P, Ws, Wd	10	99	99	99	51	99	99	99	73	99	97	97	71	99	99	99	776	99	99	99	59
$\boldsymbol{B_i}$, T, Ws, Wd	11	99	99	99	53	99	99	99	74	99	97	97	68	99	99	99	70	99	99	99	58
$\boldsymbol{B_i}$, LC, P, T	12	99	44	28	15	99	99	91	43	99	69	30	31	99	98	89	70	99	84	57	24
$\boldsymbol{B_i}$, LC, P, Ws, Wd	13	99	99	88	43	99	99	84	56	99	97	91	41	99	99	99	80	99	98	88	27
$\boldsymbol{B_i}$, LC, T, Ws, Wd	14	99	98	87	37	99	99	86	48	99	97	91	45	99	99	99	72	99	98	88	26
$\boldsymbol{B_i}$, P, T, Ws, Wd	15	99	98	85	40	99	99	87	58	99	97	92	51	99	99	99	65	99	98	88	30
$\boldsymbol{B_i}$, LC, P, T, Ws, Wd	16	99	44	28	15	99	99	91	43	99	69	30	31	99	98	89	70	99	84	57	24
									$\boldsymbol{R^2 \times 10^{-2}}$												
$\boldsymbol{B_i}$	1	91	31	27	14	92	86	75	37	88	65	47	21	90	78	71	48	89	80	59	27
$\boldsymbol{B_i}$, LC	2	91	33	38	17	92	86	76	36	88	66	49	22	90	78	71	48	89	80	59	27
$\boldsymbol{B_i}$, P	3	93	79	67	30	92	87	84	45	91	88	80	39	49	29	56	63	91	88	77	36
$\boldsymbol{B_i}$, T	4	93	83	82	47	93	89	88	68	92	91	86	52	92	79	85	52	93	90	90	57
$\boldsymbol{B_i}$, Ws, Wd	5	99	98	99	98	99	98	98	99	99	95	96	99	99	98	98	97	99	97	98	99
$\boldsymbol{B_i}$, LC, P	6	91	33	28	17	92	86	76	36	88	66	48	26	90	78	71	48	89	80	59	27
$\boldsymbol{B_i}$, LC, T	7	92	80	66	29	91	86	82	38	90	87	77	37	91	77	82	50	91	88	76	32
$\boldsymbol{B_i}$, LC, Ws, Wd	8	93	84	81	50	93	88	87	65	92	91	86	47	92	79	84	47	93	90	89	58
$\boldsymbol{B_i}$, P, T	9	93	79	67	30	92	87	84	45	91	88	80	39	91	78	82	56	91	88	77	36
$\boldsymbol{B_i}$, P, Ws, Wd	10	93	84	81	52	93	89	87	69	92	91	86	48	92	77	85	54	93	90	90	57
$\boldsymbol{B_i}$, T, Ws, Wd	11	93	83	82	47	93	89	88	64	92	91	86	52	92	79	85	52	93	90	90	57
$\boldsymbol{B_i}$, LC, P, T	12	91	33	28	17	92	86	76	36	88	66	48	26	90	78	71	48	89	80	59	27
$\boldsymbol{B_i}$, LC, P, Ws, Wd	13	92	80	67	32	92	86	82	47	9	87	75	37	91	77	82	56	91	87	76	34
$\boldsymbol{B_i}$, LC, T, Ws, Wd	14	92	80	67	29	91	86	82	38	90	87	77	37	91	77	82	50	91	88	76	32
$\boldsymbol{B_i}$, P, T, Ws, Wd	15	93	79	67	30	92	87	84	45	91	88	80	39	91	78	82	54	91	88	78	36
$\boldsymbol{B_i}$, LC, P, T, Ws, Wd	16	91	33	28	17	92	87	84	45	88	66	48	26	90	78	71	48	89	80	59	27

Table. S3. Seasonal performance of proposed AOD profiling ML models.

	Targets	Metrics	Annually	Winter	Spring	Summer	Autumn
XGB	$AOD_{1.5}$	R	0.994	0.995	0.994	0.993	0.99
		MAE	0.0144	0.0171	0.0149	0.0115	0.0154
	AOD_3	R	0.988	0.976	0.988	0.99	0.962
		MAE	0.0052	0.0039	0.0064	0.0061	0.0045
	AOD_5	R	0.982	0.962	0.981	0.967	0.97
		MAE	0.0026	0.0024	0.0029	0.0034	0.0023
	AOD_{10}	R	0.951	0.944	0.98	0.941	0.973
		MAE	0.0017	0.0013	0.0016	0.0022	0.0013
RF	$AOD_{1.5}$	R	0.995	0.997	0.994	0.996	0.997
		MAE	0.0057	0.0062	0.0062	0.0052	0.0054
	AOD_3	R	0.986	0.991	0.99	0.975	0.988
		MAE	0.0037	0.0018	0.0044	0.0051	0.0027
	AOD_5	R	0.991	0.993	0.991	0.979	0.989
		MAE	0.0016	0.001	0.0017	0.0026	0.0014
	AOD_{10}	R	0.998	0.989	0.994	0.994	0.99
		MAE	0.0003	0.0003	0.0004	0.0007	0.0003