

**Table S1:** Cloud mask thresholds on the digital numbers (DNs) for ASTER L1T scenes.

ASTER file	Thresholds
AST L1T 00308022019031333 20190803141911 14051	26
AST L1T 00308022019031342 20190803141600 9757	26
AST L1T 00308112019030349 20190812105135 28843	32
AST L1T 00308112019030357 20190812104954 23382	34
AST L1T 00308112019030406 20190812105004 23706	34
AST L1T 00308112019030610 20190812105215 31501	31
AST L1T 00308112019030619 20190812140508 25723	31
AST L1T 00308112019030628 20190812140438 25011	28
AST L1T 00308112019030637 20190812140448 25276	28
AST L1T 00308122019020838 20190813144916 10612	26
AST L1T 00308122019021024 20190813144316 1211	18
AST L1T 00308122019021033 20190813144326 1313	18
AST L1T 00308122019021236 20190813143955 28514	14
AST L1T 00308122019021245 20190813144026 29126	14
AST L1T 00308122019021254 20190813144107 30191	14
AST L1T 00308122019021303 20190813144055 29900	13
AST L1T 00308122019021312 20190813144035 29334	15
AST L1T 00308122019021321 20190813143858 26750	13
AST L1T 00308122019021330 20190813144005 28815	12
AST L1T 00308122019021338 20190813144246 429	11
AST L1T 00308132019025228 20190814180250 22041	33
AST L1T 00308132019025313 20190814180400 23562	34
AST L1T 00308132019025330 20190814180310 22641	35
AST L1T 00308132019025339 20190814180130 19897	31
AST L1T 00308132019025348 20190814180040 19019	32
AST L1T 00308132019025357 20190814180050 19143	31
AST L1T 00308132019025406 20190814175940 17219	32
AST L1T 00308132019025415 20190814175920 16589	32
AST L1T 00308132019025423 20190814180140 19989	32
AST L1T 00308132019025432 20190814175950 17450	32
AST L1T 00308172019023134 20190818134456 19678	16
AST L1T 00308202019030015 20190821155036 29366	31
AST L1T 00308202019030032 20190821155046 29781	31
AST L1T 00308202019030041 20190821154846 22696	31
AST L1T 00308202019030050 20190821155146 1590	33
AST L1T 00308212019020752 20190822141412 5251	22
AST L1T 00308222019024819 20190823133642 1034	19

AST L1T 00308272019030344 20190828175532 6328	20
AST L1T 00308272019030353 20190828175322 31437	18
AST L1T 00308272019030504 20190828171148 6847	16
AST L1T 00308282019020833 20190829143226 23340	23
AST L1T 00308282019021258 20190829114004 875	17
AST L1T 00308282019021307 20190829142706 15382	18
AST L1T 00308302019020045 20190831144610 18880	17
AST L1T 00308302019020054 20190831144510 17404	17
AST L1T 00308302019020129 20190831123924 32147	19
AST L1T 00309012019014313 20190902143906 21600	21
AST L1T 00309012019014322 20190902111738 24363	22
AST L1T 00309012019014805 20190902143455 16342	25
AST L1T 00309012019014831 20190902143335 13632	23
AST L1T 00309012019014840 20190902143155 9009	27
AST L1T 00309052019030035 20190906141152 13873	21
AST L1T 00309052019030129 20190906141012 11012	22
AST L1T 00309052019030146 20190906141232 14661	23
AST L1T 00309072019024813 20190908115737 24063	19
AST L1T 00309082019015506 20190909142930 19243	35
AST L1T 00309092019023608 20190910135924 4989	19
AST L1T 00309152019015707 20190916195250 23380	19
AST L1T 00309152019015911 20190916195020 20537	23
AST L1T 00309152019015919 20190916194930 19585	21
AST L1T 00309152019015946 20190916195000 20172	24
AST L1T 00309152019020004 20190916194900 18585	21
AST L1T 00309152019020012 20190916194910 18729	23
AST L1T 00309152019020030 20190916194920 19261	22
AST L1T 00309152019020039 20190916194810 17568	21
AST L1T 00309152019020048 20190916194820 17760	19
AST L1T 00309152019020057 20190916194830 18017	18
AST L1T 00309152019020106 20190916195030 20719	19
AST L1T 00309152019020123 20190916194840 18212	21
AST L1T 00309152019020132 20190916194730 16235	17
AST L1T 00309222019020743 20190923141633 1061	23
AST L1T 00309272019022354 20190928105112 26106	15
AST L1T 00309272019022514 20190928130515 8611	16
AST L1T 00309282019030320 20190929140637 3771	27
AST L1T 00309282019030329 20190929140535 1343	30
AST L1T 00309302019025346 20191001124626 3545	14
AST L1T 00309302019025431 20191001123335 11846	15

AST L1T 00309302019025439 20191001124746 4588	15
AST L1T 00309302019025448 20191001113628 387	14
AST L1T 00310022019023921 20191004192931 3008	14
AST L1T 00310022019023930 20191004192941 3111	12
AST L1T 00310022019023938 20191004192951 3288	12
AST L1T 00310032019014308 20191006205637 8955	12
AST L1T 00310032019014317 20191006205647 9353	13
AST L1T 00310032019014326 20191006205657 10244	12
AST L1T 00310032019014334 20191006205707 10376	10
AST L1T 00310032019014343 20191006205717 10569	14
AST L1T 00310032019014352 20191006212957 504	10
AST L1T 00310032019014419 20191006215109 28937	15
AST L1T 00310032019014428 20191006205927 13434	13
AST L1T 00310032019014436 20191006213208 3659	11
AST L1T 00310032019014445 20191006213058 1921	9
AST L1T 00310032019014454 20191006205937 13645	9
AST L1T 00310032019014503 20191006205947 13957	9
AST L1T 00310032019014512 20191006205957 14222	9
AST L1T 00310032019014521 20191006213017 964	10
AST L1T 00310032019014529 20191006213218 3755	10
AST L1T 00310032019014556 20191006210017 14502	17
AST L1T 00310032019014649 20191006213118 2475	15
AST L1T 00310032019014658 20191006205116 1886	13
AST L1T 00310032019014707 20191006205126 2020	14
AST L1T 00310032019014716 20191006210057 15184	13
AST L1T 00310032019014751 20191006183329 10396	11
AST L1T 00310032019014800 20191006213258 4391	11
AST L1T 00310032019014809 20191006210247 17090	11
AST L1T 00310032019014844 20191006210327 17596	17
AST L1T 00310032019032312 20191006213938 13622	28
AST L1T 00310052019013649 20191008164511 17430	24
AST L1T 00310052019030957 20191008172554 30976	14
AST L1T 00310062019021903 20191008201952 23551	10
AST L1T 00310072019025709 20191008125458 7851	34
AST L1T 00310072019025717 20191008125508 8051	37
AST L1T 00310082019020047 20191009165612 21339	17
AST L1T 00310112019023242 20191012101601 28187	16
AST L1T 00310122019031607 20191013113537 32386	16
AST L1T 00310122019031616 20191013113547 32416	14
AST L1T 00310122019031642 20191013113717 2122	17

AST L1T 00310122019031651 20191013113727 2363	14
AST L1T 00310122019031700 20191013113737 2490	16
AST L1T 00310122019031718 20191013112726 17034	21
AST L1T 00310122019031735 20191013113857 4112	20
AST L1T 00310132019022455 20191014112704 2987	11
AST L1T 00310132019022504 20191014112814 7265	10
AST L1T 00310162019025114 20191017122645 14731	22
AST L1T 00310162019025158 20191017122856 16981	26
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AST L1T 00310162019025225 20191017121833 28199	28
AST L1T 00310162019025242 20191017121853 29737	22
AST L1T 00310162019025251 20191017122906 17062	18
AST L1T 00310162019025353 20191017123006 18095	17
AST L1T 00310162019025402 20191017123106 19287	18
AST L1T 00310162019025411 20191017121503 16598	15
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AST L1T 00310182019023927 20191019114900 31751	17
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AST L1T 00310182019024012 20191019114210 19170	16
AST L1T 00310182019024020 20191019114941 32094	16
AST L1T 00310192019014306 20191020115007 17245	9
AST L1T 00310192019014315 20191020102851 2972	9
AST L1T 00310192019014323 20191020102451 20227	9
AST L1T 00310192019014416 20191020102921 5435	13
AST L1T 00310192019014603 20191020115407 21440	10
AST L1T 00310192019014612 20191020115417 21515	11
AST L1T 00310192019014620 20191020115427 21571	12
AST L1T 00310192019014629 20191020114836 14570	11
AST L1T 00310192019014638 20191020114846 14602	12
AST L1T 00310192019014647 20191020114856 15845	12
AST L1T 00310192019014656 20191020115437 21606	13
AST L1T 00310192019014705 20191020115447 21683	12
AST L1T 00310212019013501 20191022122338 4054	11
AST L1T 00310212019013510 20191022121418 14059	11
AST L1T 00310212019013518 20191022121528 18288	12
AST L1T 00310212019013527 20191022122348 4169	11
AST L1T 00310212019030955 20191022104419 32705	19
AST L1T 00310212019031004 20191022105019 21200	15

AST L1T_00310212019031013_20191022104029_18179	14
AST L1T_00310212019031021_20191022104039_19212	15
AST L1T_00310222019021307_20191023170118_13156	13
AST L1T_00310222019021316_20191023170128_13212	13
AST L1T_00310252019024614_20191029053654_17681	24
AST L1T_00310252019024640_20191029052554_11316	20
AST L1T_00310252019024658_20191029055125_583	22
AST L1T_00310252019024707_20191029065622_1217	24
AST L1T_00310252019024716_20191029065632_1452	22
AST L1T_00310252019024724_20191029065642_1874	23
AST L1T_00310252019024751_20191029065232_19089	28
AST L1T_00310252019024800_20191029065312_21734	29
AST L1T_00310252019024809_20191029055135_1005	31

**Table S2:** Pooled standard deviation and median coefficient of variation of the scene averaged meteorological variables.

Meteorological Variable	Level	Pooled Standard Deviation	Median Coefficient of Variation
u-wind component	1000 hPa	0.512	-0.003
u-wind component	975 hPa	0.539	0.013
u-wind component	950 hPa	0.565	-0.018
u-wind component	925 hPa	0.609	-0.025
u-wind component	900 hPa	0.622	-0.020
u-wind component	875 hPa	0.546	-0.014
u-wind component	850 hPa	0.503	-0.001
u-wind component	600 hPa	0.388	-0.041
v-wind component	1000 hPa	0.509	0.022
v-wind component	975 hPa	0.527	0.026
v-wind component	950 hPa	0.502	0.026
v-wind component	925 hPa	0.480	0.028
v-wind component	900 hPa	0.451	0.037
v-wind component	875 hPa	0.429	0.042
v-wind component	850 hPa	0.391	0.045
v-wind component	600 hPa	0.393	-0.042
Vertical velocity	1000 hPa	0.020	-0.579
Vertical velocity	975 hPa	0.032	-0.371
Vertical velocity	950 hPa	0.042	0.272
Vertical velocity	925 hPa	0.048	0.282
Vertical velocity	900 hPa	0.049	0.311
Vertical velocity	875 hPa	0.049	0.159

Vertical velocity	850 hPa	0.047	0.164
Relative humidity	1000 hPa	1.552	0.013
Relative humidity	975 hPa	1.737	0.013
Relative humidity	950 hPa	3.013	0.018
Relative humidity	925 hPa	4.330	0.038
Relative humidity	900 hPa	4.190	0.036
Relative humidity	875 hPa	3.565	0.034
Relative humidity	850 hPa	3.588	0.034
Sea surface temperature (SST)		0.121	0.000
Total column water vapor (TCWV)		1.138	0.016
Wind speed	10 m	0.504	0.060
Wind speed	1000 hPa	0.585	0.064
Wind speed	975 hPa	0.619	0.067
Wind speed	950 hPa	0.635	0.066
Wind speed	925 hPa	0.671	0.065
Wind speed	900 hPa	0.647	0.064
Wind speed	875 hPa	0.554	0.062
Wind speed	850 hPa	0.501	0.058
Wind speed	600 hPa	0.386	0.057
Wind direction	10 m	11.668	0.025
Wind direction	1000 hPa	11.701	0.024
Wind direction	975 hPa	11.917	0.024
Wind direction	950 hPa	17.310	0.023
Wind direction	925 hPa	12.770	0.025
Wind direction	900 hPa	18.503	0.024
Wind direction	875 hPa	18.688	0.023
Wind direction	850 hPa	10.184	0.022
Wind direction	600 hPa	24.196	0.033
Lower tropospheric stability (LTS)	1000-700 hPa	0.193	0.011
Lower tropospheric stability (LTS)	1000-850 hPa	0.198	-0.017
Lower tropospheric stability (LTS)	1000-875 hPa	0.213	0.038
Lower tropospheric stability (LTS)	1000-900 hPa	0.236	0.056
Lower tropospheric stability (LTS)	1000-925 hPa	0.257	0.114
Lower tropospheric stability (LTS)	1000-950 hPa	0.193	0.379
Lower tropospheric stability (LTS)	1000-975 hPa	0.041	-0.586
Estimated inversion strength (EIS)	1000-700 hPa	0.204	-0.092
Equivalent potential temperature	1000 hPa	0.709	0.001
Equivalent potential temperature	975 hPa	0.708	0.001
Equivalent potential temperature	950 hPa	0.721	0.001
Equivalent potential temperature	925 hPa	0.787	0.002

Equivalent potential temperature	900 hPa	0.668	0.001
Equivalent potential temperature	875 hPa	0.523	0.001
Equivalent potential temperature	850 hPa	0.466	0.001

**Table S3:** Statistics of the meteorological variables among all scenes used for multiple linear regression analysis.

Cloud Macrophysical Property	Mean	Standard Deviation	Median	25th Percentile	75th Percentile
Line-Fit	2.346	0.225	2.320	2.214	2.492
Direct Power-Law Fit	2.124	0.169	2.103	2.007	2.212
Fractal Dimension	1.246	0.035	1.245	1.232	1.266
Mean Cloud Top Height	967.181	245.645	941.414	815.095	1115.253
Cloud Fraction	0.115	0.091	0.092	0.057	0.155

**Table S4:** Statistics of the cloud macrophysical properties among all scenes used for multiple linear regression analysis.

Meteorological Variable	Level	Mean	Standard Deviation	Median	25th Percentile	75th Percentile
u-wind component	1000 hPa	-0.308	5.215	-0.004	-3.737	3.020
u-wind component	975 hPa	-0.224	5.648	0.022	-3.821	3.113
u-wind component	950 hPa	-0.034	6.252	-0.211	-3.838	2.907
u-wind component	925 hPa	0.247	6.720	-0.411	-3.601	3.265
u-wind component	900 hPa	0.375	6.880	-0.172	-3.823	4.168
u-wind component	875 hPa	0.500	6.777	-0.227	-4.055	4.029
u-wind component	850 hPa	0.646	6.659	-0.043	-4.348	4.845
u-wind component	600 hPa	-1.381	5.007	-2.336	-4.866	1.306
v-wind component	1000 hPa	1.709	4.883	1.016	-1.440	6.145
v-wind component	975 hPa	1.858	5.163	1.016	-1.490	6.604
v-wind component	950 hPa	2.015	5.236	1.146	-1.475	6.832
v-wind component	925 hPa	1.962	4.847	1.280	-1.336	5.955
v-wind component	900 hPa	1.745	4.400	1.370	-1.396	5.616
v-wind component	875 hPa	1.476	3.918	1.248	-1.260	4.423
v-wind component	850 hPa	1.197	3.461	1.124	-0.935	3.703
v-wind component	600 hPa	0.006	3.353	-0.297	-1.894	1.208
Vertical velocity	1000 hPa	-0.010	0.015	-0.010	-0.018	-0.001
Vertical velocity	975 hPa	-0.002	0.033	-0.001	-0.024	0.016
Vertical velocity	950 hPa	0.005	0.051	0.007	-0.028	0.032
Vertical velocity	925 hPa	0.009	0.062	0.006	-0.031	0.052
Vertical velocity	900 hPa	0.008	0.067	0.010	-0.035	0.053

Vertical velocity	875 hPa	0.006	0.072	0.004	-0.043	0.055
Vertical velocity	850 hPa	0.006	0.076	0.003	-0.048	0.064
Relative humidity	1000 hPa	77.994	3.974	78.127	75.979	80.209
Relative humidity	975 hPa	85.767	4.220	85.979	83.628	88.366
Relative humidity	950 hPa	87.330	5.229	88.388	85.321	90.645
Relative humidity	925 hPa	78.270	9.295	79.850	73.407	86.087
Relative humidity	900 hPa	72.230	10.356	74.443	66.046	79.749
Relative humidity	875 hPa	69.238	11.714	71.990	63.723	78.051
Relative humidity	850 hPa	67.078	12.670	69.589	61.642	76.441
Sea surface temperature (SST)		302.053	0.811	302.186	301.687	302.572
Total column water vapor (TCWV)		45.362	6.877	46.261	41.860	50.358
Wind speed	10 m	5.758	3.049	5.748	3.008	8.268
Wind speed	1000 hPa	6.411	3.594	6.315	3.153	9.202
Wind speed	975 hPa	6.801	3.967	6.535	3.205	10.051
Wind speed	950 hPa	7.145	4.405	6.811	3.103	11.012
Wind speed	925 hPa	7.178	4.573	6.754	3.413	10.953
Wind speed	900 hPa	7.037	4.500	6.711	3.324	9.796
Wind speed	875 hPa	6.733	4.278	6.582	3.049	9.770
Wind speed	850 hPa	6.497	3.983	5.768	3.301	9.067
Wind speed	600 hPa	5.440	2.935	4.683	3.204	7.187
Wind direction	10 m	160.086	83.233	178.961	69.362	224.789
Wind direction	1000 hPa	160.141	83.149	179.210	69.456	224.459
Wind direction	975 hPa	160.087	82.987	179.865	69.603	224.862
Wind direction	950 hPa	159.547	81.535	172.946	71.410	226.405
Wind direction	925 hPa	158.675	81.945	170.572	76.025	231.309
Wind direction	900 hPa	161.615	81.366	176.881	80.344	234.184
Wind direction	875 hPa	162.954	81.712	171.580	80.021	238.564
Wind direction	850 hPa	166.249	84.611	176.105	80.659	245.307
Wind direction	600 hPa	145.683	92.380	103.396	78.216	237.452
Wind shear	1000-975 hPa	0.406	0.487	0.228	0.078	0.611
Wind shear	1000-950 hPa	1.023	1.091	0.616	0.254	1.302
Wind shear	1000-925 hPa	1.786	1.631	1.215	0.682	2.322
Wind shear	1000-900 hPa	2.420	1.935	1.797	1.043	3.097
Wind shear	1000-875 hPa	2.910	2.175	2.376	1.213	4.093
Wind shear	1000-850 hPa	3.372	2.485	2.621	1.434	5.452
Wind shear	950-925 hPa	1.053	0.785	0.886	0.453	1.435
Wind shear	950-900 hPa	1.880	1.353	1.495	0.799	2.887
Wind shear	950-875 hPa	2.555	1.889	1.965	0.989	3.906
Wind shear	950-850 hPa	3.210	2.372	2.567	1.257	4.753
Wind shear	850-600 hPa	5.371	3.547	4.957	2.523	7.200



Lower tropospheric stability (LTS)	1000-700 hPa	13.876	1.029	13.839	13.060	14.489
Lower tropospheric stability (LTS)	1000-850 hPa	-8.456	0.713	-8.512	-8.906	-8.158
Lower tropospheric stability (LTS)	1000-875 hPa	4.226	0.696	4.138	3.788	4.599
Lower tropospheric stability (LTS)	1000-900 hPa	3.034	0.654	2.934	2.618	3.429
Lower tropospheric stability (LTS)	1000-925 hPa	1.697	0.613	1.723	1.316	2.122
Lower tropospheric stability (LTS)	1000-950 hPa	0.430	0.400	0.355	0.082	0.641
Lower tropospheric stability (LTS)	1000-975 hPa	-0.003	0.039	-0.010	-0.021	0.001
Estimated inversion strength (EIS)	1000-700 hPa	-1.201	1.058	-1.250	-2.052	-0.578
Equivalent potential temperature	1000 hPa	352.621	5.045	353.115	349.639	355.706
Equivalent potential temperature	975 hPa	352.167	4.962	352.830	349.182	355.271
Equivalent potential temperature	950 hPa	349.378	4.553	350.306	347.020	352.250
Equivalent potential temperature	925 hPa	344.111	5.157	344.204	340.413	348.034
Equivalent potential temperature	900 hPa	341.117	5.943	341.940	338.019	345.423
Equivalent potential temperature	875 hPa	339.282	6.430	340.784	336.359	343.504
Equivalent potential temperature	850 hPa	337.881	6.686	339.519	334.777	342.079
Equivalent potential temperature difference	1000-975 hPa	0.454	0.266	0.379	0.285	0.555
Equivalent potential temperature difference	1000-950 hPa	3.243	2.707	2.445	1.131	4.562
Equivalent potential temperature difference	1000-925 hPa	8.510	4.189	7.805	5.136	11.024
Equivalent potential temperature difference	1000-900 hPa	11.504	4.305	11.266	8.117	14.434
Equivalent potential temperature difference	1000-875 hPa	13.339	4.625	12.513	9.895	16.352
Equivalent potential temperature difference	1000-850 hPa	14.740	4.827	13.932	11.129	17.949
Equivalent potential temperature difference	950-925 hPa	5.267	3.163	4.421	3.166	6.414
Equivalent potential temperature difference	950-900 hPa	8.261	3.793	7.482	5.560	10.166
Equivalent potential temperature difference	950-875 hPa	10.095	4.267	9.391	7.193	11.731
Equivalent potential temperature difference	950-850 hPa	11.497	4.625	10.797	8.377	13.885
Convective available potential energy (CAPE)	850 hPa	0.759	1.618	0.000	0.000	0.556
Convective inhibition (CIN)	850 hPa	-6.328	8.577	0.000	-12.745	0.000