Table 2. Overview of the retrieval performance for 35 test scenarios based on SCIATRAN 3.0 simulations with a modified US-standard atmosphere. For all scenarios, we assume a Lambertian surface with an albedo which is spectrally constant 0.2 except for the "spectral albedo" scenarios. The table shows the average signal to noise (SNR) and the residuals relative root mean square (RMS) in both fit windows as well as the main retrieval errors of XCO_2, scattering parameters (CWP, CTH, APS), and surface pressure. All errors are given with systematic error (bias) ±stochastic error. The scenarios are based on the "dry run" scenario (♣), the "met. 1σ" scenario (♦), and the "no cloud" scenario (♥). Some scenarios are intended to quantify the retrievals capability of reproducing modifications of state vector elements (❍). The other scenarios are intended to additionally quantify the retrievals sensitivity to parameter vector elements (❑) (i.e. to a imperfect forward model).

Scenario	SNR		RMS [‰]		SZA 40°					SZA 20°	SZA 60°
	O_2	CO_2	O_2	CO_2	p_s [hPa]	CWP [g/m^2]	CTH [km]	APS	XCO_2 [ppm]	XCO_2 [ppm]	XCO_2 [ppm]
dry run ♣,❍	1560	1116	0.00	0.00	0±7	−0.1±1.1	0.0±0.4	0.0±0.7	0.1±3.2	0.1±3.1	0.0±3.3
met. 1σ ♣,❍	1645	1078	0.04	0.06	4±6	0.6±0.7	−0.3±0.4	−0.6±0.7	−2.4±3.4	−3.2±3.4	−1.2±4.0
calibration ♣,❑	1659	1190	0.04	0.01	−5±6	0.9±1.0	0.2±0.4	−0.1±0.6	0.8±3.1	0.8±3.1	0.9±3.1
CO_2 profile											
plus 1σ ♣,❍	1560	1114	0.03	0.05	0±7	0.1±1.1	−0.0±0.4	−0.0±0.7	−1.5±3.5	−1.4±3.5	−1.6±3.5
plus 3σ ♣,❍	1560	1110	0.08	0.14	5±7	0.8±1.1	−0.2±0.4	−0.4±0.6	−5.7±4.4	−5.6±4.4	−5.1±3.9
art. profile ♣,❍	1560	1115	0.03	0.04	0±7	−0.0±1.1	0.0±0.4	0.0±0.7	−1.2±3.4	−1.1±3.4	−1.3±3.4
Spectral albedo											
sand ♣,❍	1966	1950	0.02	0.05	0±5	−0.2±1.0	0.1±0.4	0.1±0.7	−0.2±3.0	−0.1±3.0	−0.5±2.6
soil ♣,❍	1264	1531	0.01	0.01	0±8	−0.1±1.0	0.0±0.4	0.0±0.6	0.1±3.9	0.2±3.9	−0.2±3.5
deciduous ♣,❍	1891	808	0.02	0.01	−1±5	−0.2±1.0	0.1±0.4	0.1±0.7	−0.2±3.5	−0.1±3.3	−0.8±4.8
conifers ♣,❍	1557	694	0.02	0.01	−1±7	−0.2±1.1	0.1±0.4	0.1±0.7	−0.2±4.1	−0.1±3.7	−0.5±5.6
rangeland ♣,❍	1542	1182	0.01	0.00	0±7	−0.1±1.1	0.0±0.4	0.0±0.7	0.1±3.2	0.2±3.2	0.1±3.2
snow ♣,❍	3622	348	0.00	0.18	0±3	−0.0±0.4	0.0±0.3	0.0±0.3	0.5±7.9	−0.7±7.1	−0.3±10.4
ocean ♣,❍	640	279	0.01	0.00	0±21	−0.0±0.7	0.0±0.3	0.0±0.5	0.0±10.3	0.0±9.4	0.6±12.3
Macro physical cloud properties											
no cloud ♣,❍	1492	1195	0.03	0.01	−1±4	0.0±0.8	10.0±5.0	−0.0±0.6	−0.4±3.3	−0.5±3.6	−0.4±3.0
CWP 0.3 ♣,❍	1493	1193	0.03	0.01	0±4	0.1±0.9	−0.0±4.7	−0.0±0.7	−0.5±3.3	−0.5±3.5	−0.4±3.1
CWP 3.0 ♣,❍	1508	1170	0.02	0.00	0±6	0.0±1.3	0.0±1.5	0.0±0.7	−0.2±3.4	−0.2±3.4	−0.2±3.1
CWP 30.0 ♣,❍	1756	997	0.03	0.02	−5±6	−0.3±0.7	0.0±0.1	0.2±0.7	−0.3±3.4	0.3±3.2	0.0±4.2
CTH 3 ♣,❍	1543	1116	0.17	0.02	0±5	−8.0±1.9	2.2±2.9	−0.0±0.9	−0.5±3.7	−1.0±3.7	0.3±3.3
CTH 6 ♣,❍	1550	1116	0.05	0.00	−2±6	−0.6±2.1	0.1±0.7	0.0±0.8	0.3±3.3	0.2±3.3	0.4±3.5
CTH 12 ♣,❍	1564	1116	0.01	0.00	0±6	−0.0±0.8	−0.0±0.5	0.0±0.7	0.1±3.1	0.1±3.1	−0.2±3.3
CTH 21 ♣,❍	1575	1116	0.07	0.00	0±3	0.1±0.3	−0.6±1.1	−0.0±0.4	−0.1±2.9	−0.1±2.8	−0.1±3.4
CFC 50 ♦,❑	1577	1134	0.09	0.04	0±6	−5.8±0.8	−0.6±0.8	−1.2±0.6	−5.1±3.5	−6.0±3.5	−0.3±3.4
CGT ♦,❑	1641	1078	0.05	0.06	3±6	0.6±0.7	−1.6±0.3	−0.6±0.7	−2.9±3.3	−3.3±3.4	−1.6±4.0
multilayer ♦,❑	1626	1078	0.13	0.06	0±5	−1.4±1.0	0.2±0.3	−0.3±0.8	−2.1±3.3	−2.8±3.3	−1.6±4.2
Micro physical cloud properties											
ice frac. 100 ♦,❑	1575	1126	0.06	0.05	5±6	−5.8±0.8	−0.8±0.7	−0.9±0.7	−1.5±3.4	−3.4±3.4	6.1±3.6
ice frac. 300 ♦,❑	1528	1166	0.08	0.05	6±6	−10.9±1.0	−2.1±1.3	−1.0±0.7	−3.2±3.6	−4.3±3.6	2.2±3.3
ice hex. 25 ♦,❑	1614	1137	0.06	0.06	5±6	5.0±0.7	−0.3±0.5	−0.7±0.7	−0.3±3.4	−3.2±3.5	3.9±3.7
ice hex. 50 ♦,❑	1575	1122	0.06	0.07	3±6	1.5±0.8	−0.7±0.7	−1.0±0.7	0.8±3.5	−0.9±3.6	8.3±3.6
water 6 ♦,❑	1613	1281	0.18	0.06	−1±6	−0.6±1.6	5.9±1.9	−1.2±0.8	−5.3±4.0	−7.6±3.8	−5.0±3.3
water 12 ♦,❑	1559	1236	0.28	0.05	1±5	−1.1±1.7	5.1±2.4	−1.0±0.8	−4.5±4.1	−3.4±4.0	−0.5±3.4
water 18 ♦,❑	1541	1220	0.12	0.05	2±5	−0.9±1.6	5.1±2.3	−1.1±0.8	−5.4±4.0	−3.5±4.0	−0.3±3.4
Aerosol											
OPAC background ♥,❑	1492	1197	0.02	0.01	−1±4	0.0±0.7	10.0±5.0	−0.2±0.6	−0.3±3.3	−0.1±3.6	−0.6±3.0
OPAC urban ♥,❑	1452	1177	0.08	0.01	0±4	0.1±0.6	10.1±5.0	−0.3±0.6	−0.3±3.2	−0.2±3.5	−0.0±3.1
OPAC desert ♥,❑	1491	1200	0.04	0.00	2±4	−0.1±0.8	10.0±5.0	0.1±0.7	0.2±3.4	0.2±3.7	0.3±3.0
extreme in BL ♥,❑	1609	1139	0.16	0.05	−11±5	0.6±1.5	7.1±4.0	0.3±0.8	6.5±3.8	2.9±3.8	13.9±3.4

Table 3. Detailed retrieval results of the "met. 1σ" scenario for each state vector element and for the resulting XCO_2. The meaning of the columns from left to right is: 1) name of the state vector element, 2+3) weighting function with non-zero elements in the O_2 and CO_2 fit window, respectively, 4) true state $\boldsymbol{x}_t$, 5) first guess state $\boldsymbol{x}_0$, 6) a priori state $\boldsymbol{x}_a$ ±uncertainty, 7) retrieved state $\hat{\boldsymbol{x}}$ ±stochastic error, 8) information content H, 9) degree of freedom for signal d_s, 10) uncertainty reduction $\boldsymbol{r}_\sigma$ Note: $\boldsymbol{x}_t$, $\boldsymbol{x}_0$, $\boldsymbol{x}_a$, $\hat{\boldsymbol{x}}$, and the corresponding errors are rounded to the same number of digits within each line.

Name	O_2	CO_2	$\boldsymbol{x}_t$	$\boldsymbol{x}_0$	$\boldsymbol{x}_a$	$\hat{\boldsymbol{x}}$	H [bit]	d_s	$\boldsymbol{r}_\sigma$
Albedo P_0	•		0.200	0.224	0.224 ± 0.050	0.202 ± 0.002	4.65	1.00	0.96
Albedo P_1	•		0.0000	0.0000	0.0000 ± 0.0100	0.0000 ± 0.0001	6.73	1.00	0.99
Albedo P_2	•		0.0000	0.0000	0.0000 ± 0.0010	0.0000 ± 0.0001	3.09	0.99	0.88
Albedo P_0		•	0.200	0.168	0.168 ± 0.050	0.201 ± 0.001	5.62	1.00	0.98
Albedo P_1		•	0.0000	0.0000	0.0000 ± 0.0100	0.0000 ± 0.0002	5.63	1.00	0.98
Albedo P_2		•	0.0000	0.0000	0.0000 ± 0.0010	0.0001 ± 0.0003	1.92	0.93	0.74
$\Delta\lambda$ [nm]	•		0.000	0.000	0.000 ± 0.100	0.000 ± 0.000	9.14	1.00	1.00
$\Delta\lambda$ [nm]		•	0.000	0.000	0.000 ± 0.100	0.001 ± 0.007	3.77	0.99	0.93
FWHM [nm]	•		0.450	0.450	0.450 ± 0.050	0.450 ± 0.000	6.76	1.00	0.99
FWHM [nm]		•	1.400	1.400	1.400 ± 0.100	1.397 ± 0.031	1.68	0.90	0.69
ΔT [K]	•	•	-0.6	0.0	0.0 ± 1.1	-0.8 ± 0.4	1.62	0.89	0.67
H_2O [‰]	•	•	2.70	2.22	2.22 ± 0.86	2.65 ± 0.18	2.26	0.96	0.79
APS	•	•	2.0	1.0	1.0 ± 1.0	1.4 ± 0.7	0.56	0.54	0.32
CWP [g/m^2]	•	•	15.0	10.0	5.0 ± 10.0	15.6 ± 0.7	3.85	1.00	0.93
CTH [km]	•	•	15.0	10.0	10.0 ± 5.0	14.7 ± 0.4	3.59	0.99	0.92
p_s [hPa]	•	•	981	1013	1013 ± 30	985 ± 6	2.33	0.96	0.80
CO_2 L_9 [ppm]		•	380.9	373.0	372.9 ± 8.0	375.4 ± 7.5	0.01	0.01	0.06
CO_2 L_8 [ppm]		•	384.5	375.6	375.7 ± 9.0	378.3 ± 8.5	0.02	0.02	0.06
CO_2 L_7 [ppm]		•	385.1	376.4	376.4 ± 8.6	380.9 ± 7.3	0.03	0.04	0.16
CO_2 L_6 [ppm]		•	386.6	376.8	376.8 ± 10.0	383.0 ± 7.9	0.03	0.04	0.21
CO_2 L_5 [ppm]		•	387.9	377.0	377.0 ± 11.1	384.0 ± 8.7	0.03	0.05	0.22
CO_2 L_4 [ppm]		•	388.9	377.0	377.0 ± 12.0	384.7 ± 9.4	0.04	0.05	0.22
CO_2 L_3 [ppm]		•	390.0	377.1	377.1 ± 13.1	385.7 ± 10.2	0.04	0.05	0.22
CO_2 L_2 [ppm]		•	394.7	377.3	377.3 ± 18.8	394.7 ± 9.8	0.08	0.10	0.48
CO_2 L_1 [ppm]		•	409.3	377.6	377.6 ± 36.4	411.5 ± 18.5	0.17	0.21	0.49
CO_2 L_0 [ppm]		•	448.0	380.2	380.2 ± 81.8	453.6 ± 42.0	0.50	0.50	0.49
XCO_2 [ppm]			395.6	376.8	376.8 ± 15.6	393.2 ± 3.4	2.46	1.07	0.78

Table A1. As Table 2 but with an spectrally constant albedo of 0.1.

Scenario	SNR		RMS [‰]		SZA 40°					SZA 20°	SZA 60°
	O_2	CO_2	O_2	CO_2	p_s [hPa]	CWP [g/m^2]	CTH [km]	APS	XCO_2 [ppm]	XCO_2 [ppm]	XCO_2 [ppm]
dry run ❍	1108	717	0.01	0.00	0 ± 10	-0.1 ± 1.0	0.0 ± 0.4	0.0 ± 0.6	0.1 ± 4.2	0.1 ± 4.0	-0.0 ± 5.2
met. 1σ ❍	1247	718	0.06	0.13	5 ± 8	0.6 ± 0.7	-0.3 ± 0.4	-0.6 ± 0.6	-2.5 ± 4.6	-3.2 ± 4.4	-1.9 ± 6.7
calibration ♣,❑	1185	770	0.02	0.01	-4 ± 10	1.1 ± 1.0	0.0 ± 0.4	-0.0 ± 0.6	1.2 ± 4.1	1.2 ± 3.9	1.1 ± 4.9
CO_2 profile											
plus 1σ ♣,❍	1108	716	0.03	0.09	1 ± 10	0.1 ± 1.0	-0.0 ± 0.4	-0.0 ± 0.6	-2.3 ± 4.5	-2.1 ± 4.4	-2.8 ± 5.5
plus 3σ ♣,❍	1108	714	0.09	0.28	8 ± 10	0.8 ± 1.0	-0.3 ± 0.4	-0.4 ± 0.6	-7.5 ± 5.4	-7.4 ± 5.4	-9.9 ± 6.1
art. profile ♣,❍	1108	716	0.02	0.07	0 ± 10	0.0 ± 1.0	-0.0 ± 0.4	0.0 ± 0.6	-1.7 ± 4.4	-1.6 ± 4.3	-2.1 ± 5.4
Spectral albedo											
no cloud ♣,❍	981	736	0.03	0.01	-1 ± 3	0.0 ± 0.8	10.0 ± 5.0	-0.0 ± 0.7	-0.3 ± 3.9	-0.4 ± 3.8	-0.2 ± 4.4
CWP 0.3 ♣,❍	984	735	0.02	0.01	0 ± 4	0.1 ± 0.9	-0.1 ± 4.7	-0.0 ± 0.7	-0.3 ± 3.9	-0.4 ± 3.8	-0.1 ± 4.5
CWP 3.0 ♣,❍	1015	728	0.02	0.00	0 ± 8	0.0 ± 1.3	-0.0 ± 1.4	-0.0 ± 0.7	-0.2 ± 4.1	-0.2 ± 3.9	-0.1 ± 4.8
CWP 30.0 ♣,❍	1409	715	0.02	0.02	-5 ± 10	-0.2 ± 0.7	0.0 ± 0.1	0.1 ± 0.6	-0.3 ± 5.2	0.6 ± 4.7	0.5 ± 6.7
CTH 3 ♣,❍	1086	716	0.24	0.02	-9 ± 7	-7.9 ± 1.9	1.8 ± 2.8	0.0 ± 0.9	0.0 ± 4.1	-0.4 ± 4.0	0.4 ± 4.5
CTH 6 ♣,❍	1095	717	0.05	0.00	-2 ± 12	-0.4 ± 2.1	0.1 ± 0.6	-0.0 ± 0.8	0.4 ± 4.4	0.5 ± 4.1	0.7 ± 5.7
CTH 12 ♣,❍	1113	717	0.01	0.00	0 ± 9	-0.0 ± 0.8	-0.0 ± 0.5	0.0 ± 0.6	0.1 ± 4.1	0.1 ± 3.9	-0.0 ± 5.3
CTH 21 ♣,❍	1126	718	0.08	0.00	1 ± 3	0.1 ± 0.3	-0.5 ± 1.1	-0.0 ± 0.4	-0.2 ± 4.1	-0.4 ± 3.8	0.1 ± 5.2
CFC 50 ♦,❑	1137	728	0.07	0.11	0 ± 8	-5.7 ± 0.8	-0.8 ± 0.7	-1.1 ± 0.6	-2.6 ± 4.4	-4.2 ± 4.3	3.5 ± 5.7
CGT ♦,❑	1242	718	0.07	0.13	5 ± 8	0.5 ± 0.7	-1.7 ± 0.3	-0.5 ± 0.7	-2.8 ± 4.6	-3.4 ± 4.3	-2.9 ± 6.7
multilayer ♦,❑	1226	718	0.14	0.13	-3 ± 8	-1.4 ± 1.0	0.2 ± 0.3	-0.2 ± 0.7	-2.2 ± 4.6	-3.0 ± 4.3	-4.1 ± 6.8
Micro physical cloud properties											
ice frac. 100 ♦,❑	1138	718	0.09	0.16	7 ± 8	-5.8 ± 0.8	-0.8 ± 0.7	-0.8 ± 0.7	3.2 ± 4.4	0.2 ± 4.3	13.6 ± 6.6
ice frac. 300 ♦,❑	1057	728	0.11	0.13	7 ± 7	-10.8 ± 1.0	-2.3 ± 1.3	-1.0 ± 0.7	-0.3 ± 4.3	-2.1 ± 4.2	7.0 ± 5.5
ice hex. 25 ♦,❑	1202	744	0.08	0.12	6 ± 8	4.9 ± 0.7	-0.3 ± 0.5	-0.7 ± 0.6	1.7 ± 4.5	-1.3 ± 4.6	6.8 ± 6.5
ice hex. 50 ♦,❑	1140	716	0.09	0.19	2 ± 8	1.5 ± 0.8	-0.6 ± 0.7	-0.9 ± 0.6	6.9 ± 4.5	6.5 ± 4.7	16.4 ± 6.6
water 6 ♦,❑	1196	912	0.19	0.09	-8 ± 9	2.2 ± 2.1	3.5 ± 1.1	-1.5 ± 0.8	-11.9 ± 4.2	-13.0 ± 4.0	-9.4 ± 4.3
water 12 ♦,❑	1102	822	0.47	0.09	-5 ± 6	-1.8 ± 1.1	8.6 ± 3.1	-1.3 ± 0.7	-6.5 ± 4.1	-4.8 ± 4.3	-1.5 ± 4.9
water 18 ♦,❑	1073	793	0.19	0.08	0 ± 8	-0.8 ± 1.6	5.3 ± 2.2	-1.2 ± 0.8	-7.2 ± 4.3	-3.8 ± 4.2	0.1 ± 4.9
Aerosol											
OPAC background ♥,❑	974	737	0.04	0.01	-1 ± 3	0.0 ± 0.7	10.0 ± 5.0	-0.2 ± 0.7	-0.4 ± 3.9	-0.2 ± 3.9	-0.7 ± 4.4
OPAC urban ♥,❑	962	727	0.06	0.00	0 ± 3	-0.0 ± 0.7	10.0 ± 5.0	-0.2 ± 0.7	-0.3 ± 3.9	-0.2 ± 3.8	-0.2 ± 4.4
OPAC desert ♥,❑	1003	757	0.11	0.01	3 ± 4	-0.2 ± 1.0	9.9 ± 5.0	0.2 ± 0.8	0.5 ± 3.9	0.6 ± 3.9	0.2 ± 4.2
extreme in BL ♥,❑	1402	808	0.17	0.05	-20 ± 5	1.3 ± 1.8	5.7 ± 3.4	0.1 ± 0.9	7.7 ± 3.9	4.2 ± 3.9	13.7 ± 3.8

Table A2. As Table 2 but with an spectrally constant albedo of 0.3.

Scenario	SNR		RMS [‰]		SZA 40°					SZA 20°	SZA 60°
	O_2	CO_2	O_2	CO_2	p_s [hPa]	CWP [g/m^2]	CTH [km]	APS	XCO_2 [ppm]	XCO_2 [ppm]	XCO_2 [ppm]
dry run ❍	1935	1437	0.00	0.00	0 ± 5	-0.1 ± 1.0	0.0 ± 0.4	0.0 ± 0.7	0.1 ± 2.9	0.1 ± 2.9	0.0 ± 2.7
met. 1σ ❍	1987	1375	0.05	0.04	3 ± 5	0.5 ± 0.7	-0.3 ± 0.4	-0.6 ± 0.7	-2.4 ± 3.0	-2.7 ± 3.0	-1.4 ± 3.0
calibration ♣,❑	2052	1527	0.07	0.01	-6 ± 5	0.5 ± 0.9	0.4 ± 0.4	-0.1 ± 0.6	0.8 ± 2.8	0.9 ± 2.8	0.8 ± 2.7
CO_2 profile											
plus 1σ ♣,❍	1935	1435	0.03	0.03	0 ± 5	0.0 ± 1.0	0.0 ± 0.4	-0.0 ± 0.6	-1.3 ± 3.2	-1.2 ± 3.2	-1.3 ± 2.9
plus 3σ ♣,❍	1935	1430	0.08	0.10	3 ± 5	0.6 ± 1.0	-0.1 ± 0.4	-0.4 ± 0.6	-5.0 ± 4.0	-4.8 ± 3.9	-4.4 ± 3.4
art. profile ♣,❍	1935	1435	0.03	0.03	0 ± 5	-0.0 ± 1.0	0.0 ± 0.4	0.0 ± 0.7	-1.0 ± 3.1	-0.9 ± 3.1	-1.1 ± 2.8
Spectral albedo											
no cloud ♣,❍	1900	1553	0.03	0.01	-1 ± 4	0.0 ± 0.8	10.0 ± 5.0	-0.0 ± 0.6	-0.4 ± 3.4	-0.0 ± 3.9	-0.4 ± 2.8
CWP 0.3 ♣,❍	1900	1550	0.03	0.01	0 ± 4	0.1 ± 0.9	0.0 ± 4.6	-0.0 ± 0.6	-0.5 ± 3.4	-0.5 ± 3.7	-0.4 ± 2.9
CWP 3.0 ♣,❍	1907	1518	0.03	0.00	0 ± 5	-0.0 ± 1.2	0.1 ± 1.4	0.0 ± 0.7	-0.1 ± 3.3	-0.2 ± 3.4	-0.2 ± 2.9
CWP 30.0 ♣,❍	2064	1240	0.02	0.01	-1 ± 5	-0.2 ± 0.7	0.0 ± 0.1	0.2 ± 0.6	0.2 ± 2.8	0.2 ± 2.7	-0.0 ± 3.2
CTH 3 ♣,❍	1922	1437	0.15	0.02	4 ± 5	-7.9 ± 1.8	2.8 ± 3.3	-0.1 ± 0.8	-1.1 ± 3.7	-1.3 ± 3.7	-0.1 ± 3.1
CTH 6 ♣,❍	1926	1437	0.05	0.00	-1 ± 5	-0.7 ± 2.0	0.2 ± 0.8	0.0 ± 0.8	0.2 ± 3.0	0.1 ± 3.1	0.2 ± 2.8
CTH 12 ♣,❍	1939	1437	0.01	0.00	0 ± 5	-0.0 ± 0.8	0.0 ± 0.4	0.0 ± 0.6	0.1 ± 2.8	0.1 ± 2.9	-0.2 ± 2.7
CTH 21 ♣,❍	1949	1437	0.07	0.00	0 ± 3	0.1 ± 0.3	-0.7 ± 1.2	-0.0 ± 0.4	-0.1 ± 2.5	-0.0 ± 2.5	-0.1 ± 2.7
CFC 50 ♦,❑	1946	1461	0.14	0.04	-1 ± 5	-6.2 ± 0.8	-0.2 ± 0.9	-1.1 ± 0.6	-6.0 ± 3.2	-6.1 ± 3.2	-2.2 ± 3.0
CGT ♦,❑	1983	1374	0.04	0.04	4 ± 5	0.5 ± 0.7	-1.7 ± 0.3	-0.6 ± 0.7	-2.5 ± 3.0	-2.8 ± 3.0	-1.5 ± 3.0
multilayer ♦,❑	1970	1374	0.13	0.04	2 ± 4	-1.4 ± 0.9	0.3 ± 0.3	-0.3 ± 0.7	-2.2 ± 2.9	-2.5 ± 3.0	-1.4 ± 3.1
Micro physical cloud properties											
ice frac. 100 ♦,❑	1942	1452	0.05	0.03	5 ± 5	-5.9 ± 0.8	-0.6 ± 0.7	-0.8 ± 0.7	-3.4 ± 3.1	-4.4 ± 3.2	2.6 ± 2.8
ice frac. 300 ♦,❑	1914	1511	0.07	0.03	6 ± 5	-11.0 ± 1.0	-1.9 ± 1.3	-0.9 ± 0.7	-4.4 ± 3.4	-5.2 ± 3.5	-0.2 ± 3.0
ice hex. 25 ♦,❑	1965	1455	0.06	0.04	5 ± 5	5.0 ± 0.7	-0.4 ± 0.5	-0.7 ± 0.7	-1.2 ± 3.1	-2.8 ± 3.0	2.5 ± 2.9
ice hex. 50 ♦,❑	1940	1448	0.05	0.04	3 ± 5	1.5 ± 0.8	-0.6 ± 0.7	-1.0 ± 0.7	-1.7 ± 3.2	-2.4 ± 3.1	4.4 ± 2.9
water 6 ♦,❑	1968	1591	0.21	0.11	2 ± 5	-0.5 ± 1.8	4.6 ± 1.8	-0.6 ± 0.8	-0.9 ± 4.0	-3.1 ± 3.9	-2.9 ± 3.2
water 12 ♦,❑	1936	1571	0.13	0.04	5 ± 5	-1.0 ± 1.6	5.5 ± 2.0	-1.0 ± 0.8	-3.8 ± 4.1	-2.4 ± 4.0	-0.7 ± 3.3
water 18 ♦,❑	1924	1561	0.11	0.04	6 ± 5	-0.9 ± 1.7	5.1 ± 1.9	-1.0 ± 0.8	-4.6 ± 4.1	-3.2 ± 4.0	-1.1 ± 3.3
Aerosol											
OPAC background ♥,❑	1903	1557	0.02	0.01	-1 ± 4	0.0 ± 0.8	10.1 ± 5.0	-0.2 ± 0.6	-0.1 ± 3.4	0.9 ± 3.9	-0.5 ± 2.7
OPAC urban ♥,❑	962	727	0.06	0.00	0 ± 3	-0.0 ± 0.7	10.0 ± 5.0	-0.2 ± 0.7	-0.3 ± 3.9	-0.2 ± 3.8	-0.2 ± 4.4
OPAC desert ♥,❑	1883	1557	0.05	0.01	2 ± 4	-0.2 ± 0.8	10.0 ± 5.0	0.1 ± 0.6	2.1 ± 3.5	2.1 ± 3.9	2.1 ± 2.9
extreme in BL ♥,❑	1807	1420	0.17	0.04	-5 ± 4	0.0 ± 1.1	9.3 ± 4.8	0.5 ± 0.8	5.8 ± 3.7	2.0 ± 3.7	13.0 ± 3.5