

1 **Table 1.** Spectral Regions used in Joint TES and OMI Ozone Retrievals.

Data Source	Optical Filter	Start Frequency	End Frequency	Point Spacing ¹	Atmospheric Species
TES	1B2	990.02 cm ⁻¹	1031.12 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, CO ₂
TES	1B2	1044.08 cm ⁻¹	1049.06 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, CO ₂
TES	1B2	1068.98 cm ⁻¹	1071.38 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, CO ₂
TES	2A1	1172.56 cm ⁻¹	1176.22 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1184.62 cm ⁻¹	1189.36 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1195.12 cm ⁻¹	1201.30 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1209.52 cm ⁻¹	1214.26 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1224.10 cm ⁻¹	1227.88 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1259.38 cm ⁻¹	1261.42 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1265.92 cm ⁻¹	1267.06 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1269.46 cm ⁻¹	1270.54 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1277.86 cm ⁻¹	1279.24 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1311.70 cm ⁻¹	1315.36 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
TES	2A1	1315.72 cm ⁻¹	1317.82 cm ⁻¹	0.06 cm ⁻¹	O ₃ , H ₂ O, HDO, CO ₂ , CH ₄ , N ₂ O
OMI	UV-1	270 nm	308 nm	0.32 nm	O ₃
OMI	UV-2	312 nm	330 nm	0.15 nm	O ₃

2 1. TES has a uniform spectral grid. The spectral point spacing of OMI is not constant and the mean value in the spectral region is listed.

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1 **Table 2.** Coincident Measurements among TES, OMI, and Ozonesonde.

Profile Index	Date	TES Ground Pixel		Cloud	Delta Time ¹	Distance	Measurement ²	Ozonesonde Site
		Latitude	Longitude	Optical Depth	Minute	Km	TES	
1	2005-07-18	19.86°N	154.82°W	0.10	-12.6	24.29	Global Survey	Hilo
2	2005-08-25	37.94°N	76.21°W	0.05	40.1	19.81	Global Survey	Wallops Island
3	2006-01-10	19.89°N	154.81°W	0.03	-12.1	23.31	Global Survey	Hilo
4	2006-01-12	21.32°S	55.09°E	0.03	-3.7	36.35	Global Survey	Reunion Island
5	2006-01-25	0.85°S	90.09°W	0.02	-24.9	19.92	Transect	San Cristobal
6	2006-04-06	37.88°N	76.27°W	0.03	38.9	27.45	Global Survey	Wallops Island
7	2006-05-04	21.29°S	54.85°E	0.03	-3.8	35.61	Global Survey	Reunion Island
8	2006-08-28	37.91°S	76.30°W	0.06	40.2	28.28	Global Survey	Wallops Island
9	2006-09-29	37.94°N	76.29°W	0.01	22.4	26.24	Global Survey	Wallops Island
10	2006-10-25	19.85°N	154.98°W	0.03	-18.7	16.38	Global Survey	Hilo
11	2006-12-18	37.90°N	76.09°W	0.03	39.0	14.18	Global Survey	Wallops Island
12	2007-01-03	37.91°N	76.08°W	0.03	-3.0	12.16	Global Survey	Wallops Island
13	2007-05-21	19.88°N	154.95°W	0.03	-18.3	14.13	Global Survey	Hilo
14	2007-06-06	19.89°N	154.92°W	0.02	-18.6	14.41	Global Survey	Hilo
15	2007-08-01	26.28°N	127.79°E	0.00	-33.5	37.61	Global Survey	Naha
16	2007-08-31	37.91°N	76.28°W	0.06	34.0	26.44	Global Survey	Wallops Island
17	2007-10-02	37.94°N	76.30°W	0.04	27.2	26.94	Global Survey	Wallops Island
18	2008-07-09	26.34°N	128.19°E	0.02	-34.4	42.49	Global Survey	Naha
19	2008-07-23	38.35°N	76.00°W	0.02	42.5	38.77	Step & Stare	Wallops Island
20	2008-08-08	37.95°N	75.92°W	0.03	39.7	8.99	Step & Stare	Wallops Island
21	2008-08-16	35.13°N	87.47°W	0.01	15.9	45.18	Step & Stare	Huntsville
22	2008-10-29	25.63°N	128.24°E	0.02	-32.7	47.92	Global Survey	Naha

- 2 1. TES measurement time – Ozonesonde measurement time
3 2. All of OMI measurements used here were taken from global measurement mode.

1 **Table 3.** List of fitting variables, *a priori* values and *a priori* errors.

Case Selection ¹	Fitting Parameters	Number of Parameters	<i>A Priori</i>	<i>A Priori</i> Uncertainty
TES+OMI, TES, OMI	O ₃ at each level	25	MOZART-3	MOZART-3
TES+OMI, TES	H ₂ O at each level	16	GEOS4	NCEP ~30%
TES+OMI, TES	Surface temperature ²	1	GEOS4	0.5K
TES+OMI, TES	Surface emissivity ²	32	ASTER and land use map	~0.006
TES+OMI, TES	Cloud extinction	10	Initial BT difference	300%
TES+OMI, TES	Cloud top pressure	1	500 mbar	100%
TES+OMI, OMI	UV-1 Surface Albedo	1	OMI climatology	0.05
TES+OMI, OMI	UV-2 Surface Albedo (zero order term)	1	OMI climatology	0.05
TES+OMI, OMI	First-order wavelength-dependent term for UV-2	1	0.0	0.01
TES+OMI, OMI	Ring scaling parameters	2	1.9	1.00
TES+OMI, OMI	Radiance/irradiance wavelength shifts	2	0.0	0.02 nm
TES+OMI, OMI	Radiance/O ₃ cross section wavelength shifts (zero order)	2	0.0	0.02 nm
TES+OMI, OMI	Radiance/O ₃ cross section wavelength shifts (first order)	2	0.0	0.004
TES+OMI, OMI	Cloud Fraction	1	Derived from 347 nm	0.05

2 1. The parameters are included in the retrievals for different cases (TES only, OMI only, and TES and OMI)

3 2. Retrievals over land, spectral surface emissivity and surface temperature are included.

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