



*Supplement of*

## **Combined UV and IR ozone profile retrieval from TROPOMI and CrIS measurements**

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**S1 Validation with tropospheric lidar**

**S2 Validation with ozonesondes**

**S3 Comparison with MLS ozone profiles**

**S4 Data: Ozonesonde and lidar measurements**

The location, station name, and number of profiles of ozonesondes and lidars used for validation in this study are given in Table S1.

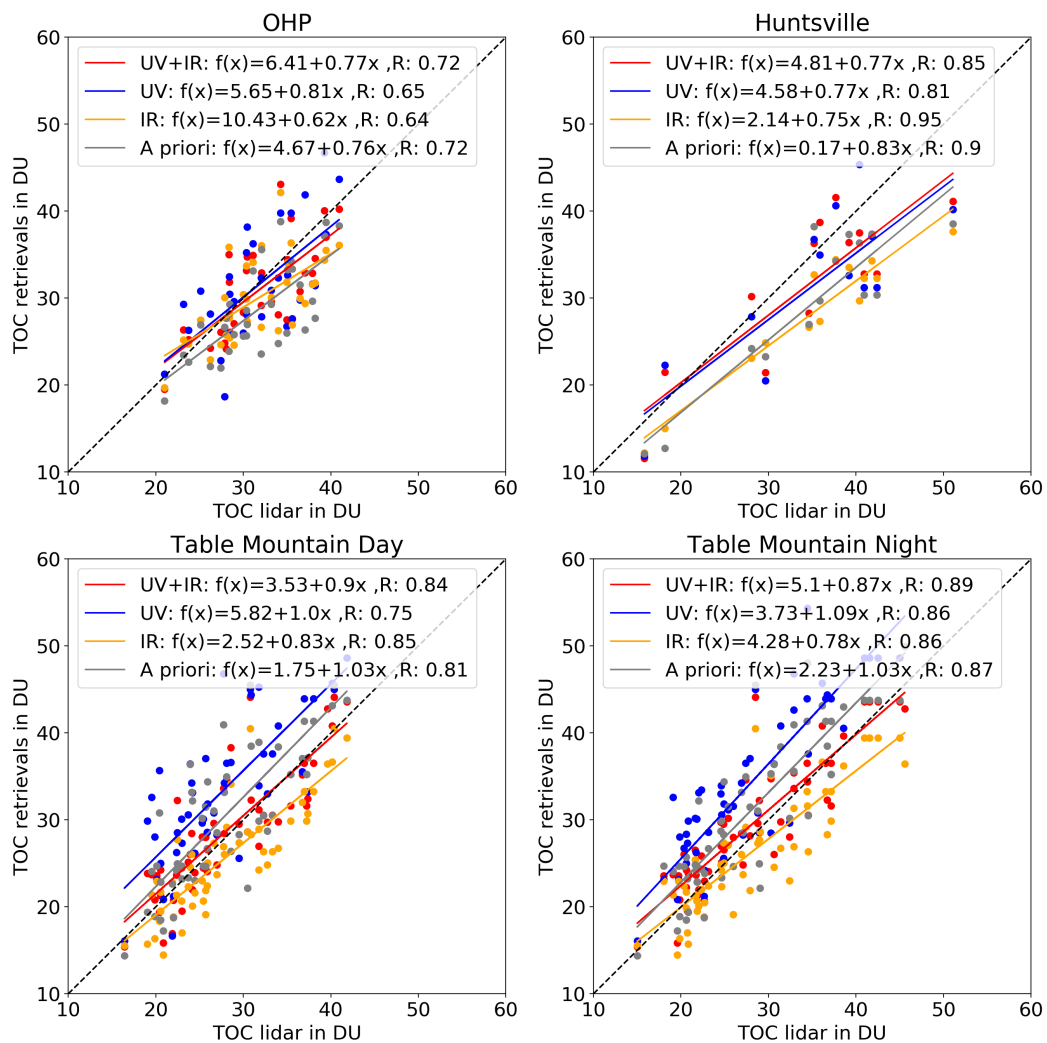


Figure S1: TOC scatter plot of TOPAS retrievals with respect to lidar data from OHP, Huntsville and Table Mountain. The one-to-one line is given by the black dashed line. The linear regression curves are plotted with different colours and their equations are given in the legend.

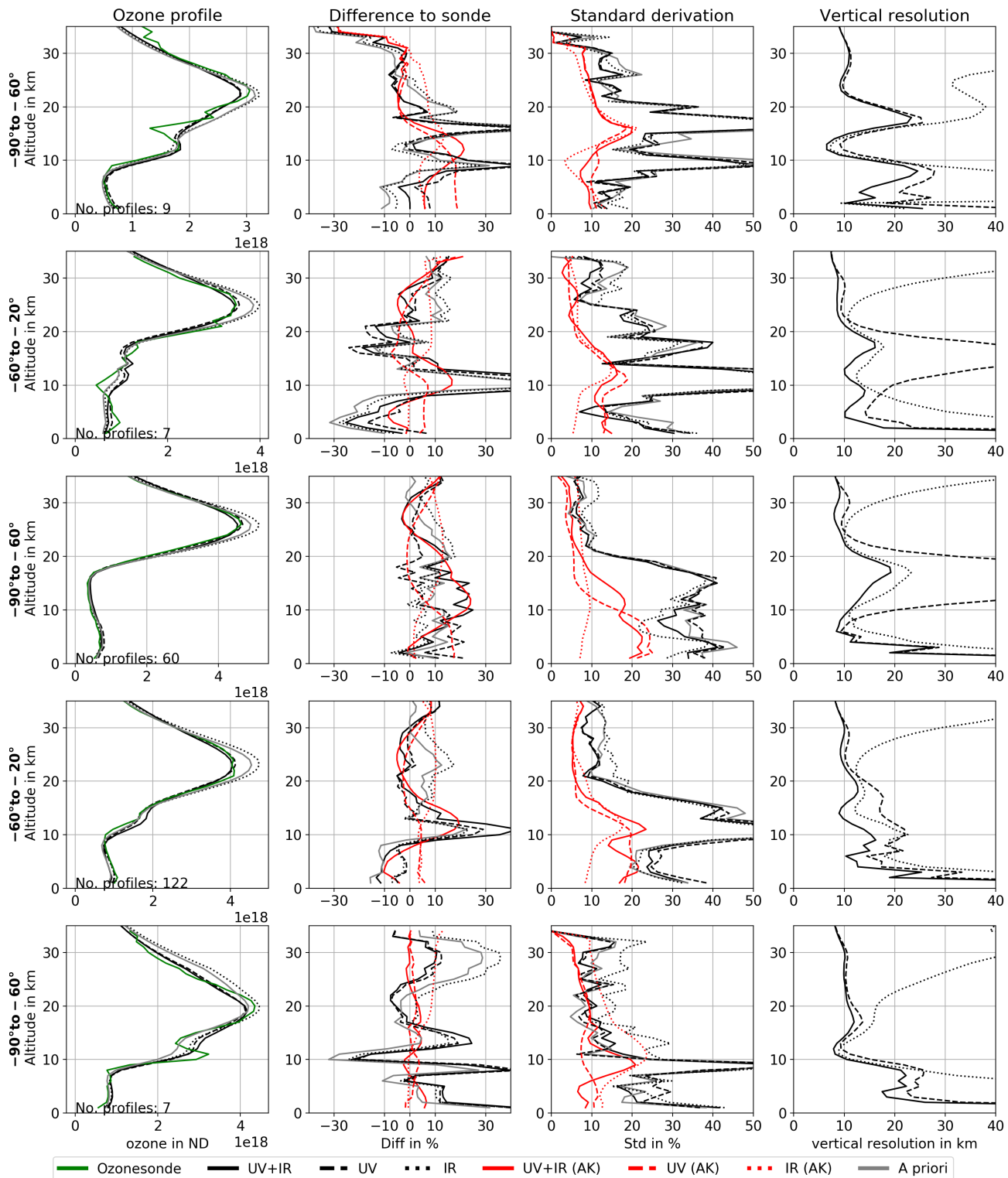


Figure S2: Ozone profile comparisons between UV+IR, UV-only and IR-only retrievals and ozonesonde measurements for all latitude regions.

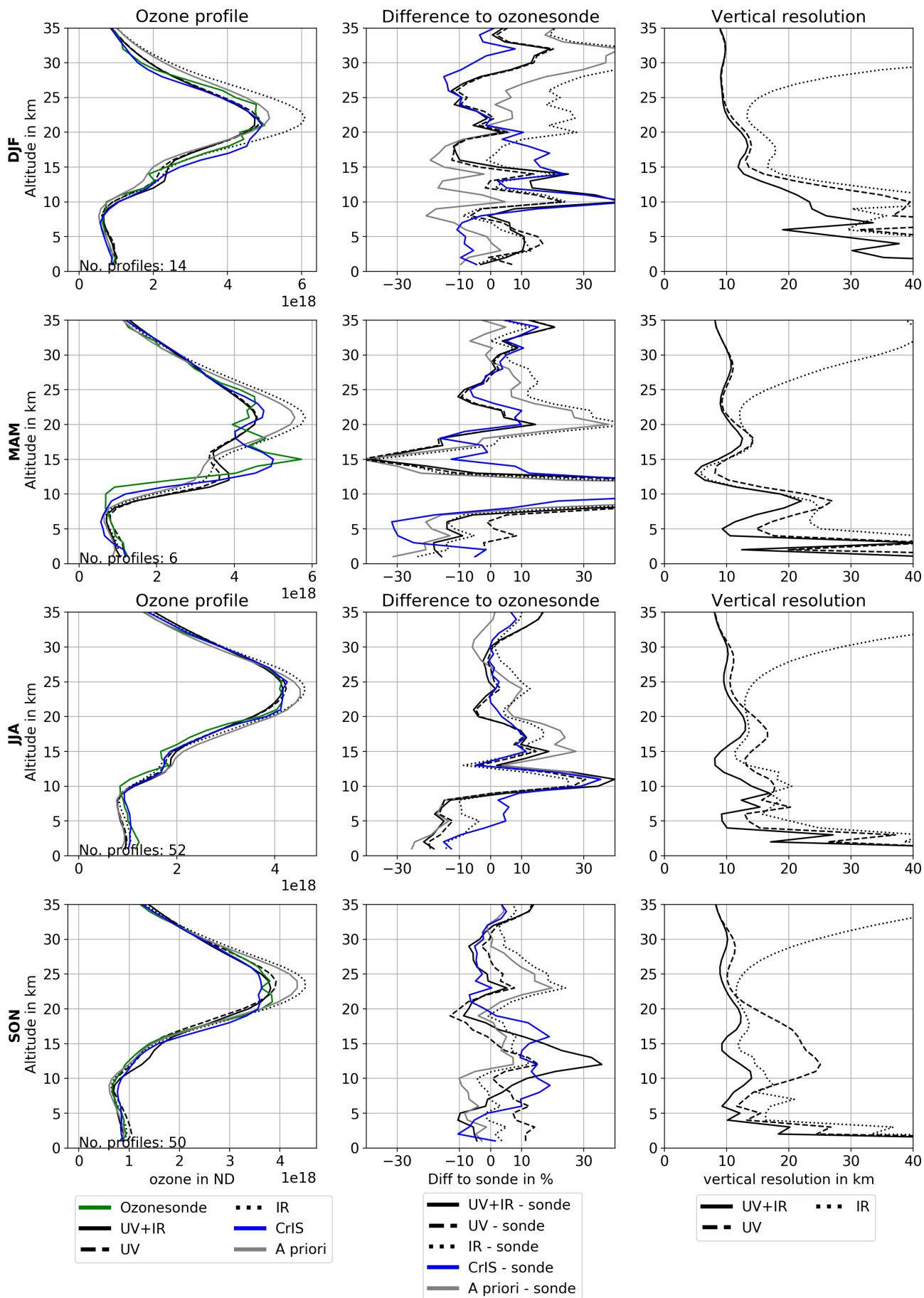


Figure S3: Ozone profile comparisons using ozonesondes and NASA operational CrIS profiles at northern latitudes (20°N – 60°N) separated into seasons. The differences to MLS and CrIS data are given only for the UV+IR (solid line) and UV-only retrievals (dashed line)

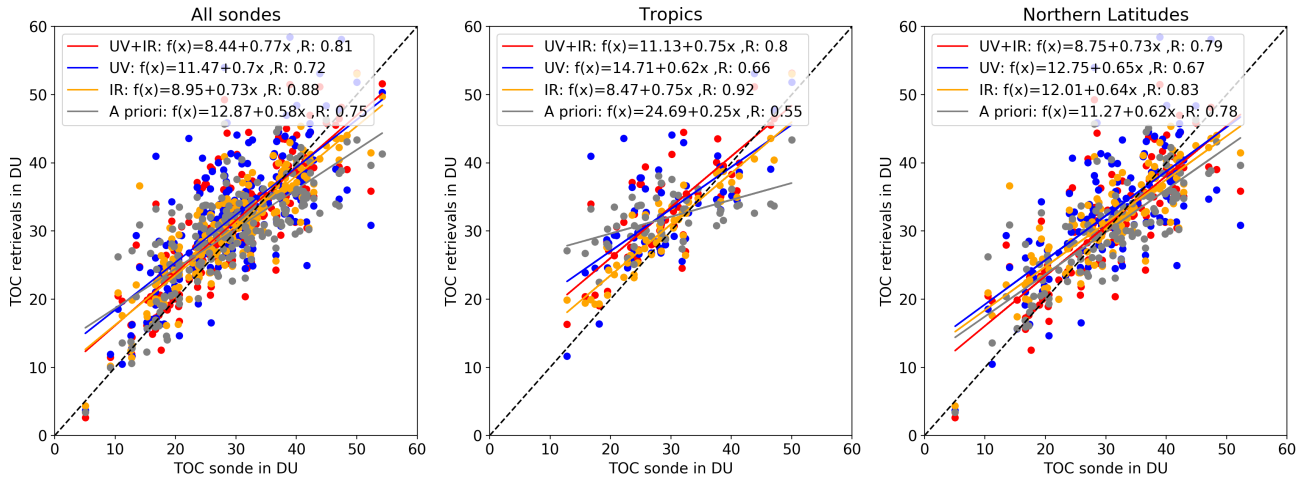


Figure S4: Scatter plot of TOCs from TOPAS retrievals with respect to ozonesonde data. The comparison is separated into data from all ozonesonde sites, the tropical region and the mid-northern latitudes. The one-to-one line is given as a black dashed line. The linear regression curves are plotted with different colours and their equations are given in the legend.

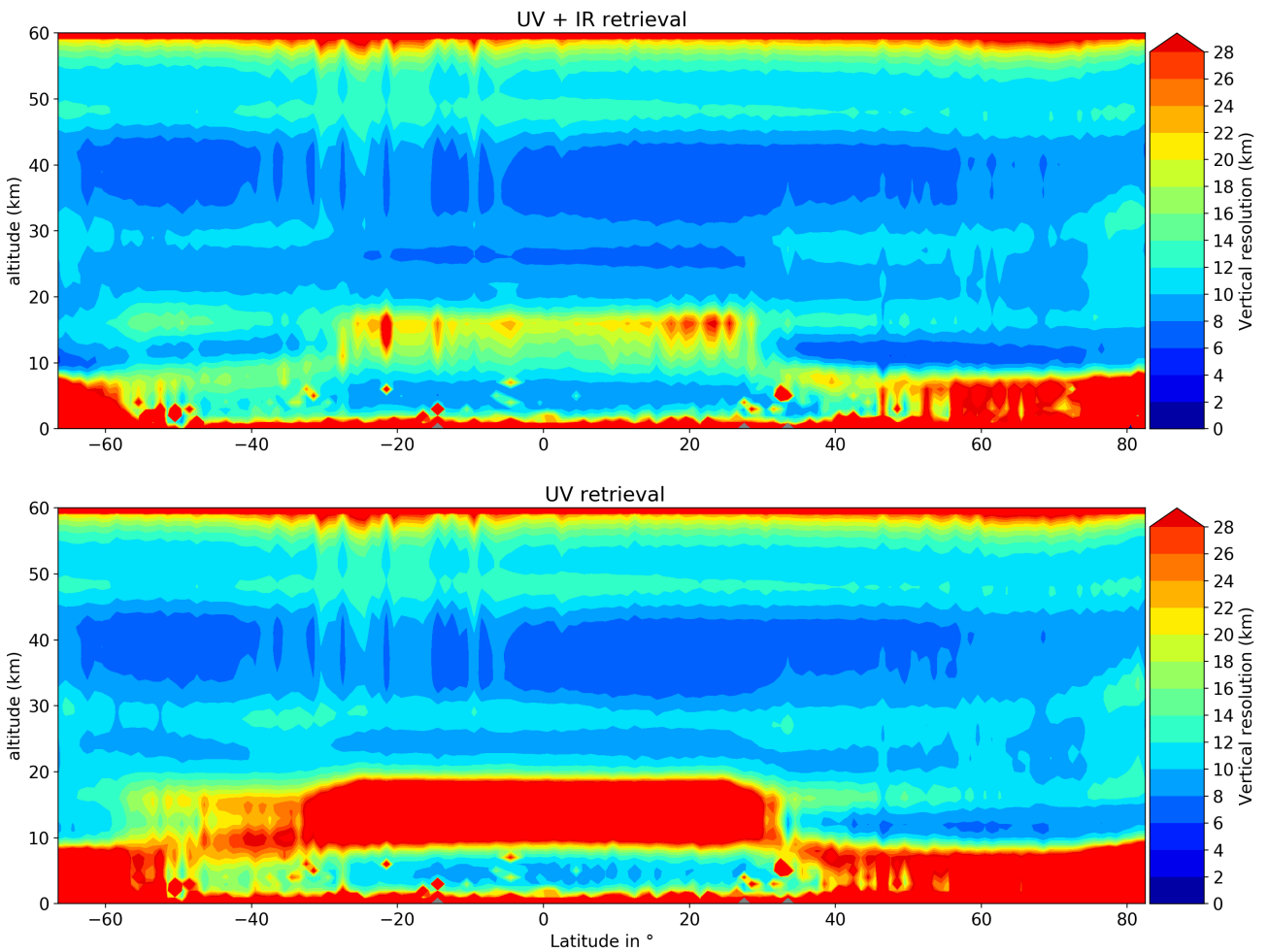


Figure S5: Zonally averaged vertical resolution for one day of TOPAS retrieval data (26 March 2019). The vertical resolution is given by the inverse main diagonal of the AK matrix. Upper panel (A): vertical resolution for the combined retrieval. Lower panel (B): vertical resolution from the UV-only retrieval.

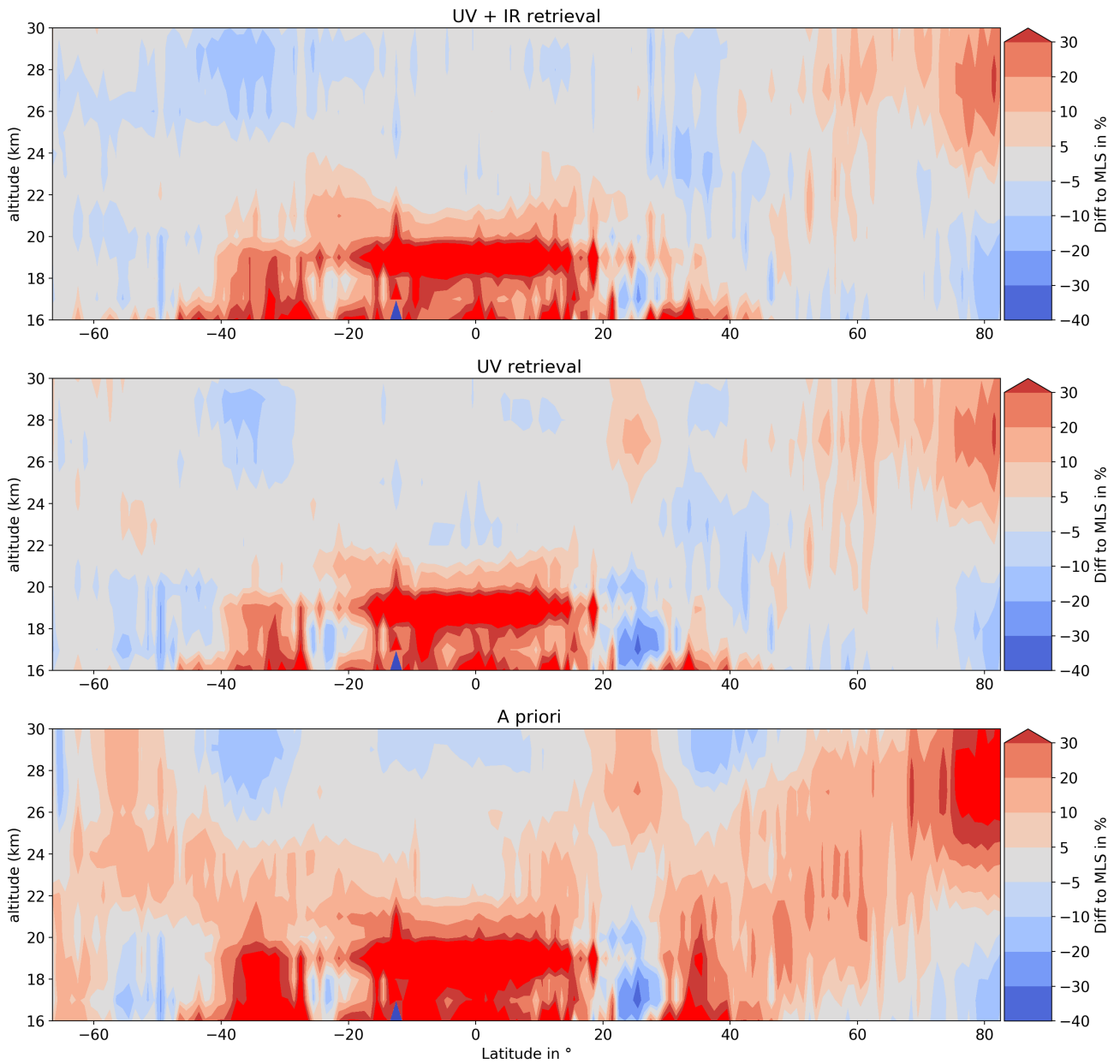


Figure S6: Zonal mean differences in percent between combined TOPAS ozone profiles (A), UV-only TOPAS profiles (B) as well as the climatological (a priori) (C) and MLS data on 23 March 2018.

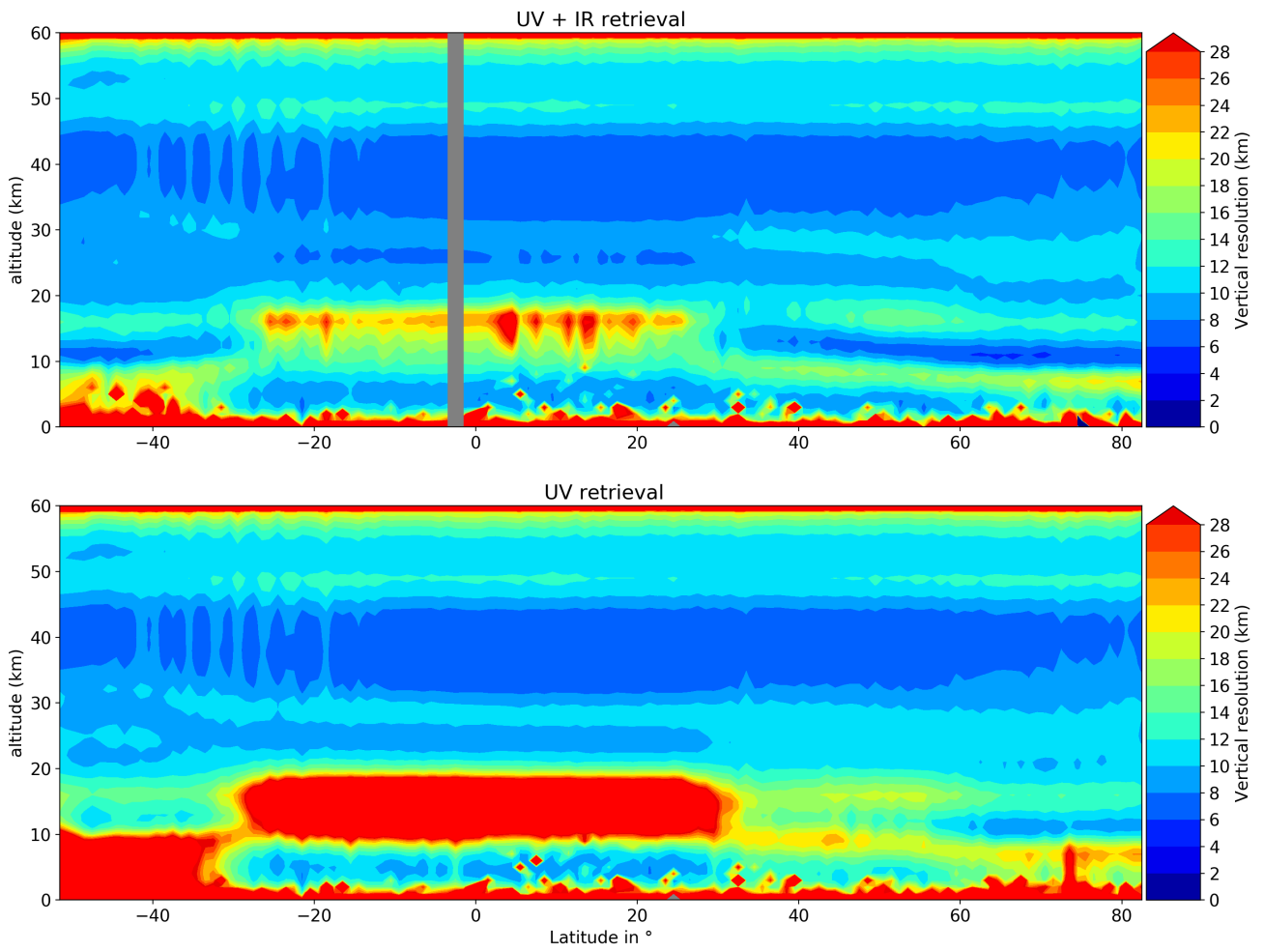


Figure S7: Same as Figure S5 but for 31 July 2019.



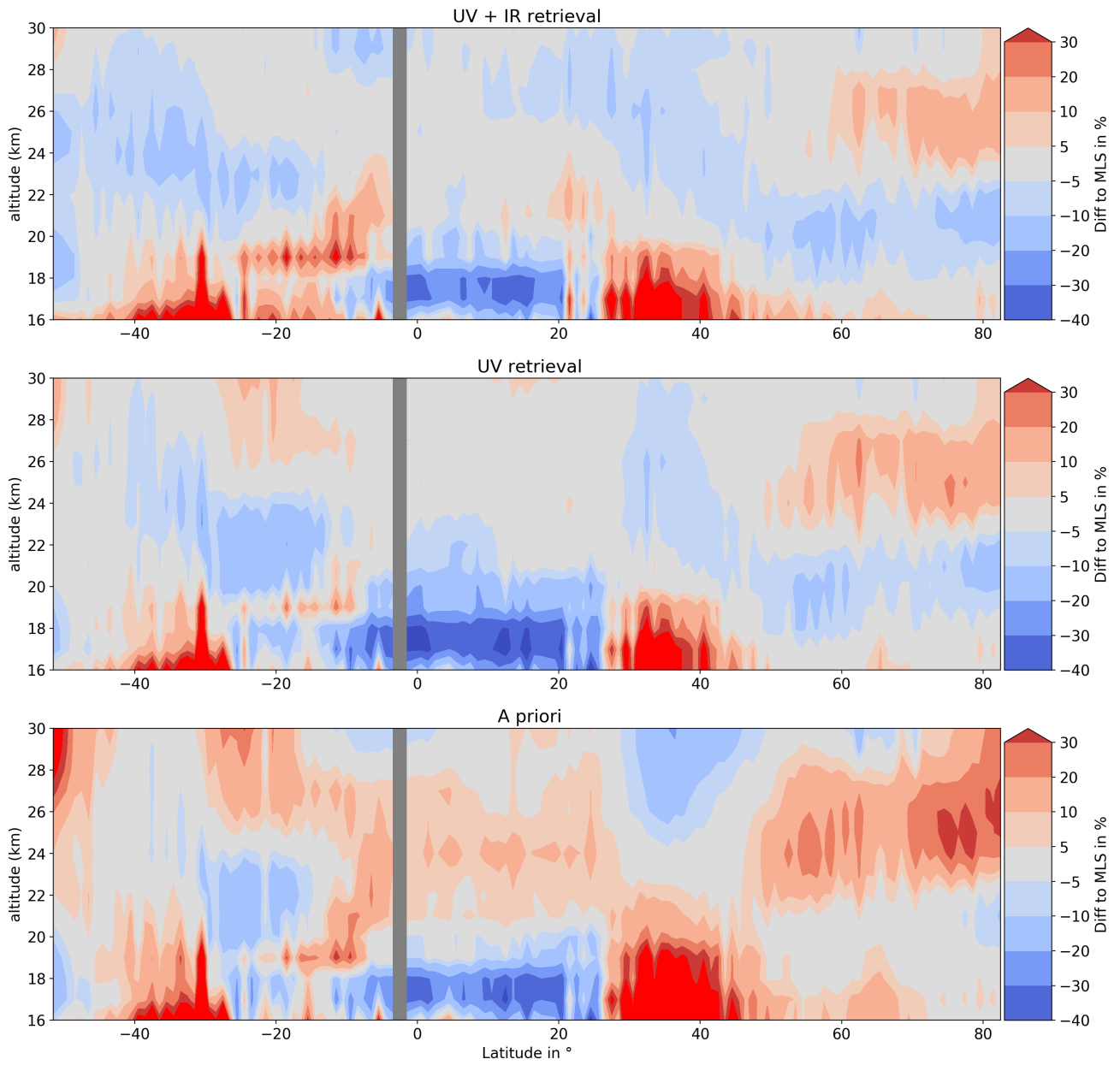


Figure S8: Same as Figure S6 but for 31 July 2019.

Table S1: Ozonesonde and Lidar Stations

Ozonesonde station	Latitude	Longitude	nr. of profiles
Alert	82.49	-62.34	2
Ascension Is., U.K.	-7.56	-14.22	10
Churchill	58.74	-94.07	1
Costa Rica (sites around San Jose)	9.96	-84.12	6
Davis	-68.58	77.97	1
De Bilt	52.1	5.18	18
Easter Island	-27.17	-109.42	3
Edmonton	53.54	-114.1	2
Eureka	79.98	-85.94	4
Goose Bay	53.31	-60.36	4
Hilo, HI	19.4	-155.4	14
Hohenpeissenberg	47.8	11.0	29
Irene, South Africa	-25.9	28.2	1
La Reunion Is., France	-21.1	55.5	4
Legionowo	52.41	20.96	14
MARAMBIO	-64.23	-56.62	4
Madrid	40.47	-3.58	13
Nairobi, Kenya	-1.3	36.8	12
Natal, Brazil	-5.4	-35.4	9
Paramaribo	5.81	-55.21	5
Paramaribo, Surinam	5.81	-55.21	13
Payerne	46.49	6.57	35
Port Hardy	50.68	-127.38	3
Praha	50.0	14.44	3
Resolute	74.7	-94.96	3
Syowa	-69.01	39.58	4
UCCLE	50.8	4.35	15
Ushuaia	-54.85	-68.31	3
Valentia	51.93	-10.25	2
Yarmouth	43.87	-66.11	5
Ozone lidar station	Latitude	Longitude	Nr. of profiles
Huntsville	34.73	-86.65	14
OHP	43.94	5.71	33
Table Mountain day	34.4	-117.7	52
Table Mountain night	34.4	-117.7	55