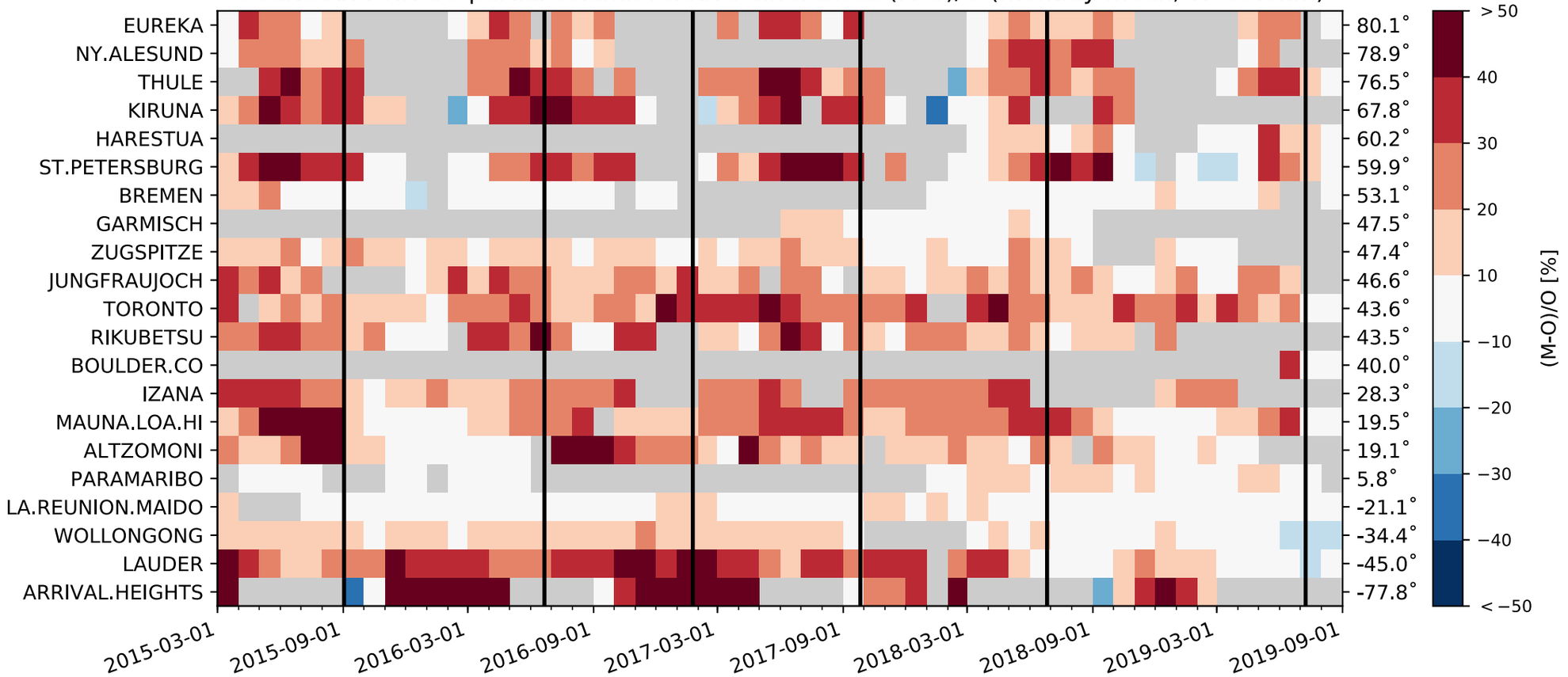
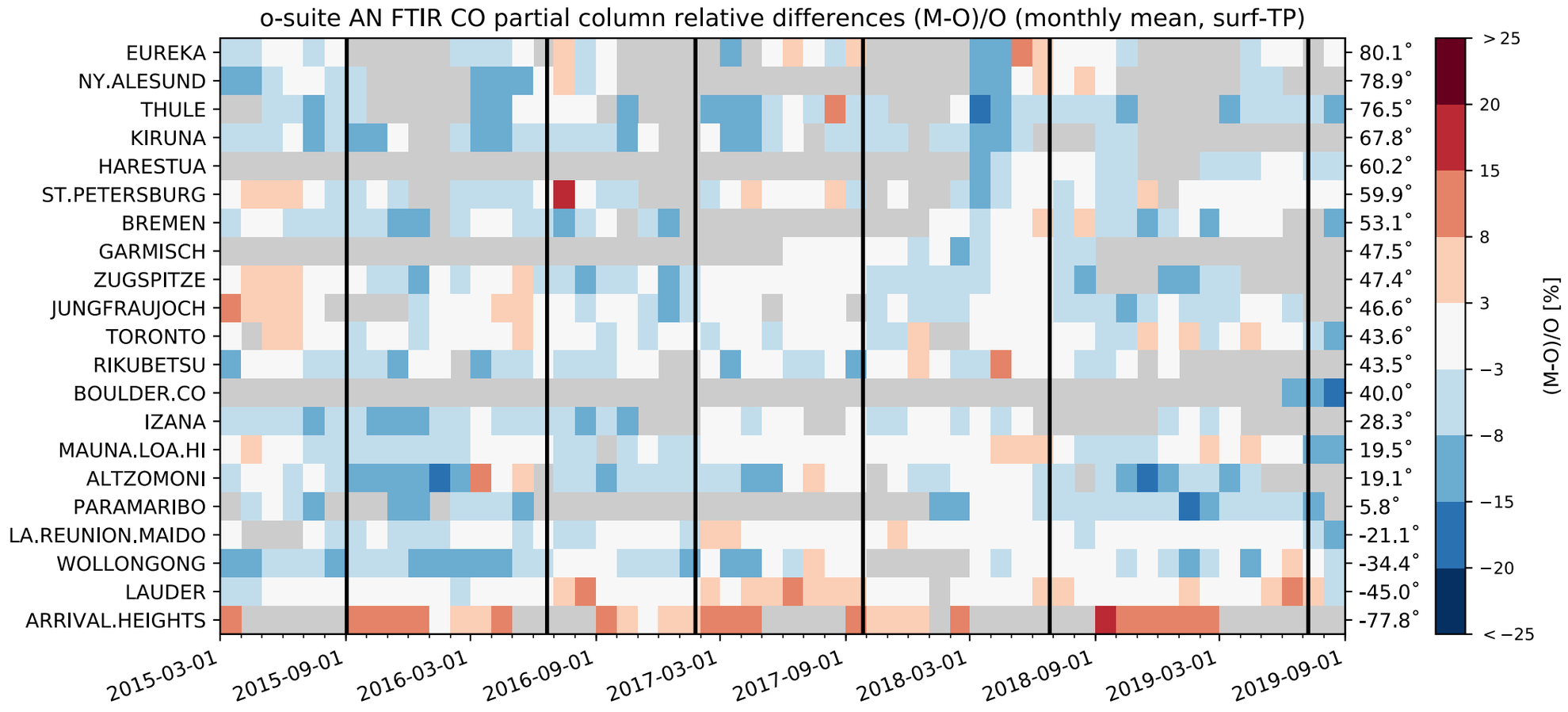
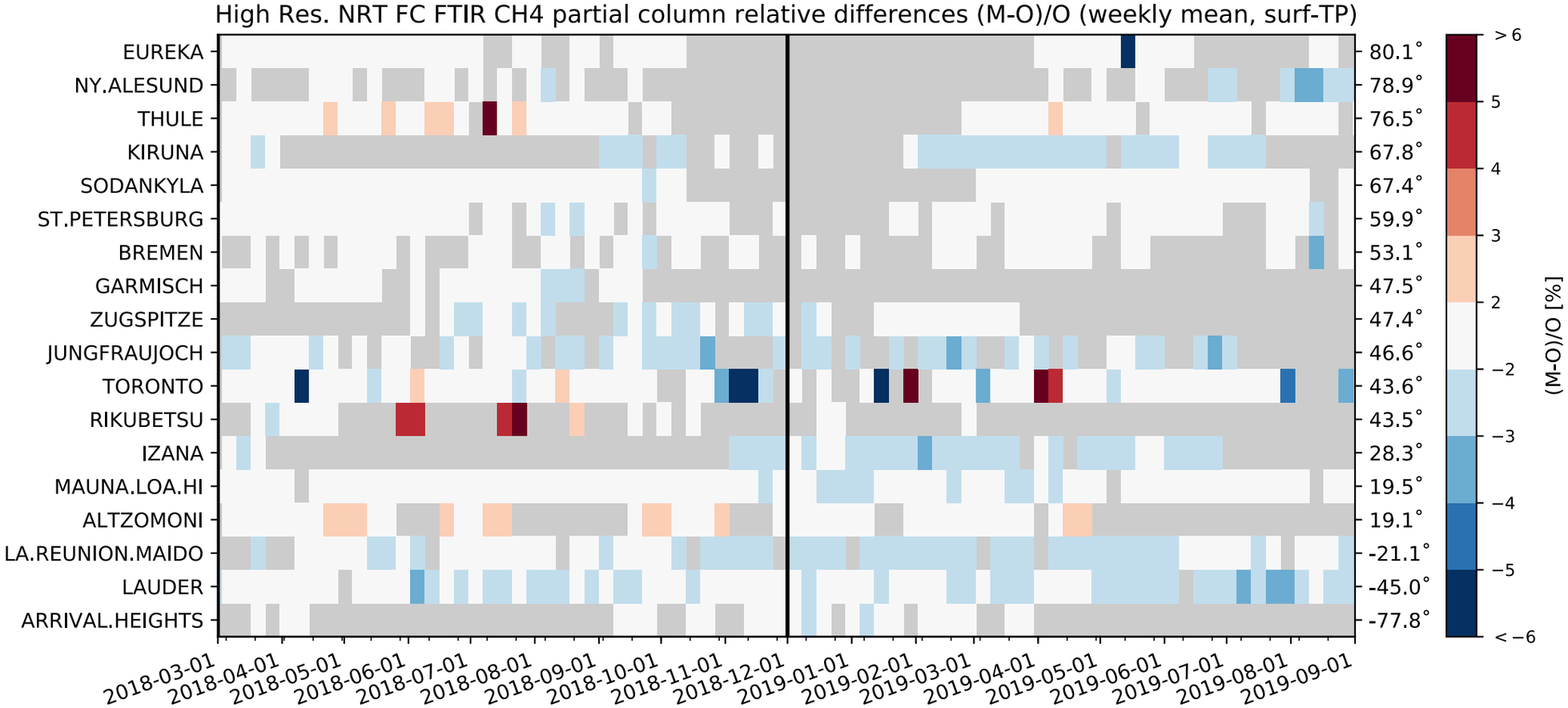
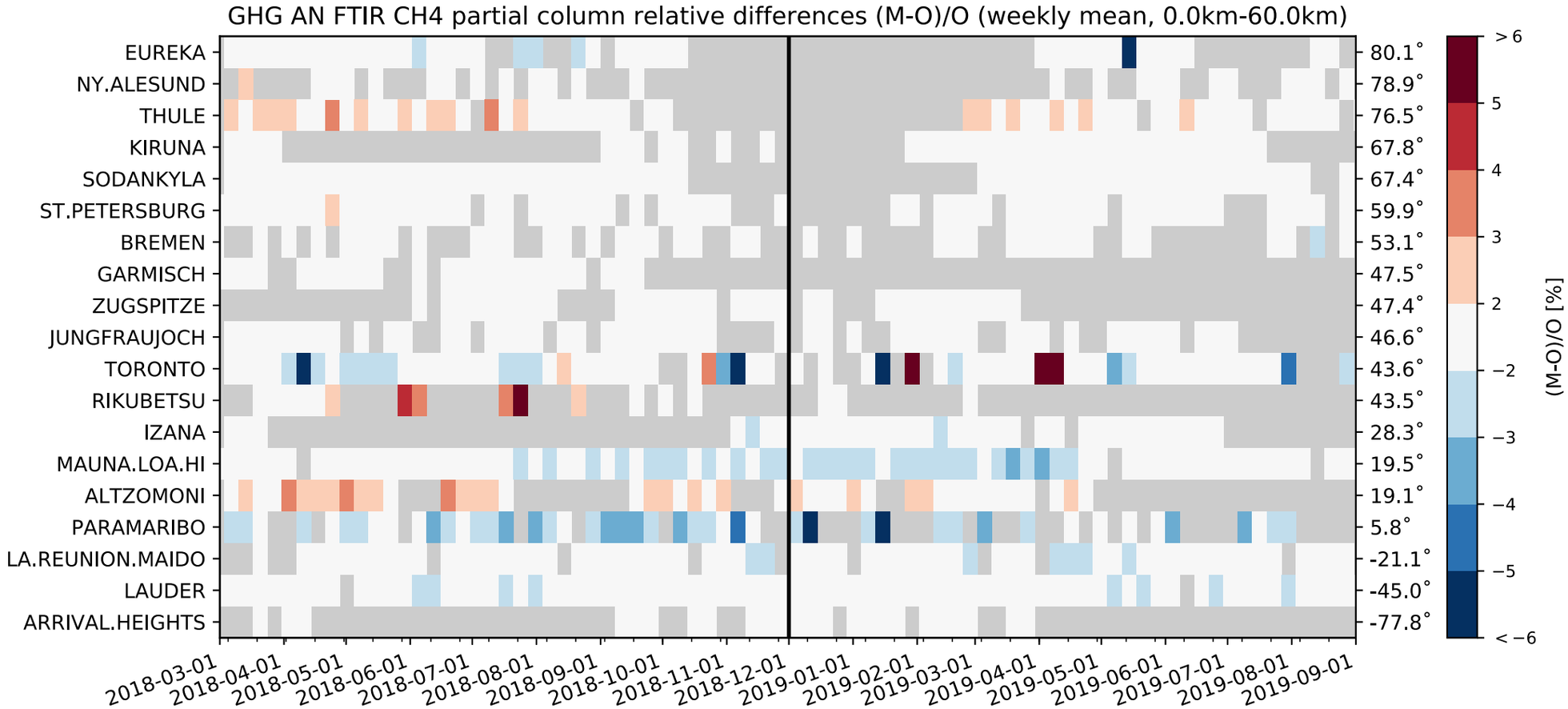
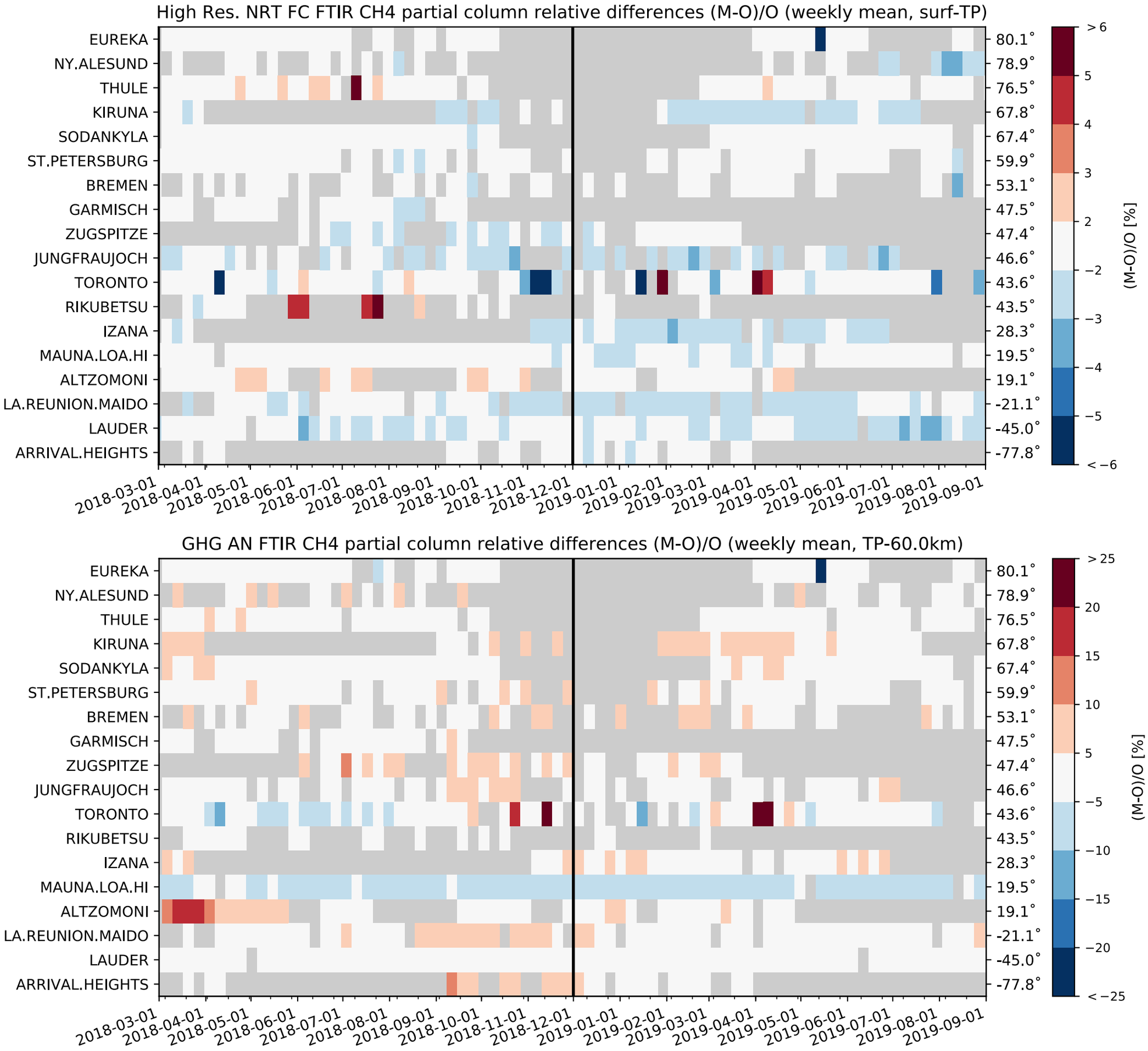

o-suite AN FTIR CO partial column relative differences (M-O)/O (monthly mean, TP-60.0km)
EUREKA
NY.ALESUND
THULE
KIRUNA
HARESTUA
ST.PETERSBURG
BREMEN
GARMISCH
ZUGSPITZE
JUNGFRAUJOCH
TORONTO
RIKUBETSU
BOULDER.CO
IZANA
MAUNA.LOA.HI
ALTZOMONI
PARAMARIBO
LA.REUNION.MAIDO
WOLLONGONG
LAUDER
ARRIVAL.HEIGHTS
80.1°
78.9°
76.5°
67.8°
60.2°
59.9°
53.1°
47.5°
47.4°
46.6°
43.6°
43.5°
40.0°
28.3°
19.5°
19.1°
5.8°
-21.1°
-34.4°
-45.0°
-77.8°
2015-03-01
2015-09-01
2016-03-01
2016-09-01
2017-03-01
2017-09-01
2018-03-01
2018-09-01
2019-03-01
2019-09-01
> 50
40
30
20
10
−10
−20
−30
−40
< −50
(M-O)/O [%]


o-suite AN FTIR CO partial column relative differences (M-O)/O (monthly mean, surf-TP)
EUREKA
NY.ALESUND
THULE
KIRUNA
HARESTUA
ST.PETERSBURG
BREMEN
GARMISCH
ZUGSPITZE
JUNGFRAUJOCH
TORONTO
RIKUBETSU
BOULDER.CO
IZANA
MAUNA.LOA.HI
ALTZOMONI
PARAMARIBO
LA.REUNION.MAIDO
WOLLONGONG
LAUDER
ARRIVAL.HEIGHTS
80.1°
78.9°
76.5°
67.8°
60.2°
59.9°
53.1°
47.5°
47.4°
46.6°
43.6°
43.5°
40.0°
28.3°
19.5°
19.1°
5.8°
-21.1°
-34.4°
-45.0°
-77.8°
2015-03-01
2015-09-01
2016-03-01
2016-09-01
2017-03-01
2017-09-01
2018-03-01
2018-09-01
2019-03-01
2019-09-01
> 25
20
15
8
3
−3
−8
−15
−20
< −25
(M-O)/O [%]


High Res. NRT FC FTIR CH4 partial column relative differences (M-O)/O (weekly mean, surf-TP)
EUREKA
NY.ALESUND
THULE
KIRUNA
SODANKYLA
ST.PETERSBURG
BREMEN
GARMISCH
ZUGSPITZE
JUNGFRAUJOCH
TORONTO
RIKUBETSU
IZANA
MAUNA.LOA.HI
ALTZOMONI
LA.REUNION.MAIDO
LAUDER
ARRIVAL.HEIGHTS
80.1°
78.9°
76.5°
67.8°
67.4°
59.9°
53.1°
47.5°
47.4°
46.6°
43.6°
43.5°
28.3°
19.5°
19.1°
-21.1°
-45.0°
-77.8°
2018-03-01
2018-04-01
2018-05-01
2018-06-01
2018-07-01
2018-08-01
2018-09-01
2018-10-01
2018-11-01
2018-12-01
2019-01-01
2019-02-01
2019-03-01
2019-04-01
2019-05-01
2019-06-01
2019-07-01
2019-08-01
2019-09-01
> 6
5
4
3
2
−2
−3
−4
−5
< −6
(M-O)/O [%]


GHG AN FTIR CH4 partial column relative differences (M-O)/O (weekly mean, 0.0km-60.0km)
EUREKA
NY.ALESUND
THULE
KIRUNA
SODANKYLA
ST.PETERSBURG
BREMEN
GARMISCH
ZUGSPITZE
JUNGFRAUJOCH
TORONTO
RIKUBETSU
IZANA
MAUNA.LOA.HI
ALTZOMONI
PARAMARIBO
LA.REUNION.MAIDO
LAUDER
ARRIVAL.HEIGHTS
80.1°
78.9°
76.5°
67.8°
67.4°
59.9°
53.1°
47.5°
47.4°
46.6°
43.6°
43.5°
28.3°
19.5°
19.1°
5.8°
-21.1°
-45.0°
-77.8°
2018-03-01
2018-04-01
2018-05-01
2018-06-01
2018-07-01
2018-08-01
2018-09-01
2018-10-01
2018-11-01
2018-12-01
2019-01-01
2019-02-01
2019-03-01
2019-04-01
2019-05-01
2019-06-01
2019-07-01
2019-08-01
2019-09-01
> 6
5
4
3
2
−2
−3
−4
−5
< −6
[%] O/(O-M)


High Res. NRT FC FTIR CH4 partial column relative differences (M-O)/O (weekly mean, surf-TP)
EUREKA
NY.ALESUND
THULE
KIRUNA
SODANKYLA
ST.PETERSBURG
BREMEN
GARMISCH
ZUGSPITZE
JUNGFRAUJOCH
TORONTO
RIKUBETSU
IZANA
MAUNA.LOA.HI
ALTZOMONI
LA.REUNION.MAIDO
LAUDER
ARRIVAL.HEIGHTS
80.1°
78.9°
76.5°
67.8°
67.4°
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47.4°
46.6°
43.6°
43.5°
28.3°
19.5°
19.1°
-21.1°
-45.0°
-77.8°
2018-03-01
2018-04-01
2018-05-01
2018-06-01
2018-07-01
2018-08-01
2018-09-01
2018-10-01
2018-11-01
2018-12-01
2019-01-01
2019-02-01
2019-03-01
2019-04-01
2019-05-01
2019-06-01
2019-07-01
2019-08-01
2019-09-01
> 6
5
4
3
2
−2
−3
−4
−5
< −6
(M-O)/O [%]
GHG AN FTIR CH4 partial column relative differences (M-O)/O (weekly mean, TP-60.0km)
> 25
20
15
10
5
−5
−10
−15
−20
< −25
(M-O)/O [%]

CAMS 27: QA/QC

- **<u>Consistency of reported variables</u>**:
  conversions of VMR profile -> partial column profile
  profiles -> integrated data
  uncertainty covariances -> standard deviations on integrated data
  AVK's acting on profile -> column AVK's
  conversions and reported ancillary data (eg partial column of air and pressure/temperature)

- **<u>Uncertainties:</u>**
  covariances should be symmetric and semi-positive definite
  std's should be strictly positive
  std's should be within expected values (to be defined)
  random and systematic uncertainty variables must contain physical data (no fill values!)

- **Location:**
  consistency between solar position variables and reported measurement time
  consistency between altitude grid and instrument's height
  no fill values in any lat/lon/time variable

- **Averaging kernels**:
  sensitivity curve for 2D AVK should not go wild (0<:<1.5)
  DOF should be within expected thresholds (DOF > 0.8)
  1D column AVK data should not go wild (0<:<1.5)
  availability of apriori profiles (not only fill values!)

properties of the AVK are used to check the quality of the retrieval!

QC trhesholds

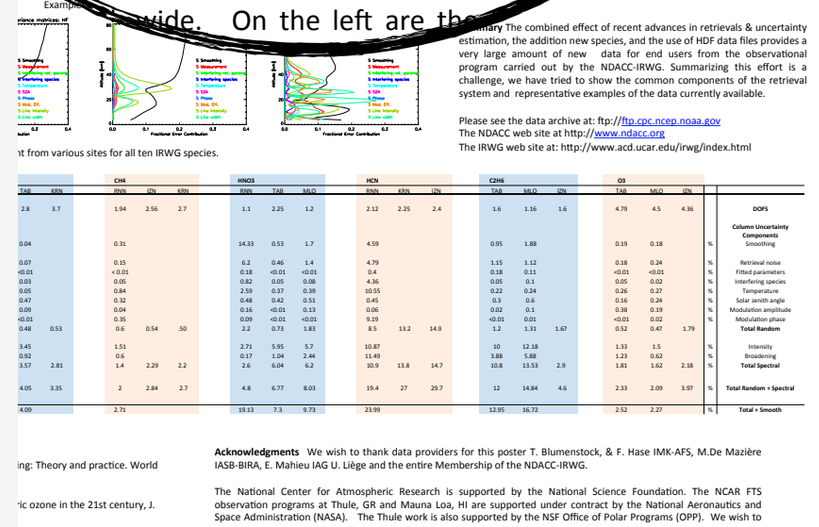
```
[DEFAULTS]
#tolerance how many outliers allowed (relative to total in file)
TOL_AVK_CAVK=0.5
TOL_AVK_SENS=0.2
TOL_AVK_DOF=0.2

TOL_EIG_COV=-0.1 #eigenvalues should not be smaller than -10% of max eig
TOL_REL_STD = 0.5 #generate error if 50% or relative errors is too large

[FTIR.CO]
CO.COLUMN_ABSORPTION.SOLAR_UNCERTAINTY.SYSTEMATIC.STANDARD = [1,4]
CO.COLUMN_ABSORPTION.SOLAR_UNCERTAINTY.RANDOM.STANDARD = [0.3,4.8]
#sensitivity height limit for AVK
CO.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.SENSITIVITY.HEIGHT = [-n
CO.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.SENSITIVITY = [0,1.5]
CO.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.DOFS.HEIGHT = [-np.inf,3
CO.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.DOFS = [1.5,3.5]
CO.COLUMN_ABSORPTION.SOLAR_AVK.HEIGHT=[-np.inf,60e3]


[FTIR.CH4]
CH4.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.SENSITIVITY.HEIGHT = [-np.inf,
CH4.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.SENSITIVITY = [0,1.5]
CH4.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.DOFS.HEIGHT = [-np.inf,55e3]
CH4.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.DOFS = [1.5,3.5]
CH4.COLUMN_ABSORPTION.SOLAR_AVK.HEIGHT=[-np.inf,60e3]
CH4.COLUMN_ABSORPTION.SOLAR_UNCERTAINTY.SYSTEMATIC.STANDARD = [2,6]
CH4.COLUMN_ABSORPTION.SOLAR_UNCERTAINTY.RANDOM.STANDARD = [0.3,6]

[FTIR.O3]
O3.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.SENSITIVITY.HEIGHT = [-np.inf,60e3]
O3.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.SENSITIVITY = [0,1.5]
O3.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.DOFS.HEIGHT = [-np.inf,55e3]
O3.MIXING.RATIO.VOLUME_ABSORPTION.SOLAR_AVK.DOFS = [2.5,5.8]
O3.COLUMN_ABSORPTION.SOLAR_UNCERTAINTY.SYSTEMATIC.STANDARD = [1.8,6]
O3.COLUMN_ABSORPTION.SOLAR_UNCERTAINTY.RANDOM.STANDARD = [0.2,6]
O3.COLUMN_ABSORPTION.SOLAR_AVK.HEIGHT=[-np.inf,80e3]

```

Characterization of in vertical profile retrievals from the Fourier-transform infrared spectrometers in the NDACC IRWG & strategies to make a more homogeneous global Dataset

James Hannigan, Martine de Mazière and the members of the NDACC IRWG
Contact: jamesw@ucar.edu

Abstract
Over the now more than 20 year time frame of the Network for the Detection of Atmospheric Composition Change (NDACC) both instrumentation and data analysis techniques have improved. Adapting to such changes has been an important effort within the Infrared Working Group (IRWG). During the last decade the data produced by an IRWG group has increased many fold. The number of required archival gases has doubled, initially these were O_3, HCl, HF, $ClONO_2$, and HNO_3, and recently has been increased to include N_2O, CH_4, CO, C_2H_6 and HCN. The information about each gas has increased where initially only the daily average total column and its uncertainty were delivered now profiles and their associated uncertainty covariences as well as averaging kernels are available at the archive for data users. This is done for each measurement which may be several per day. The higher vertical resolution data product places a more stringent demand on instrumentation and processing. It requires ... wide, requires more homogeneous sets of ... to obtain the desired quality of global data products.

	4000.86-4001.10		>180	H2O, O3	
	4109.77-4110.07			H2O, HDO, CH4	
	780.35		>50	H2O	WAC
		780.0-781.3		CO2, O3	
		779.0-780.0		H2O	
	867.05-870.00				WACCMV5
		872.25-874.00			
O	2481.30-2482.60		250		WACCMV5
	2526.40-2528.20				
	2537.85-2538.80				
	2540.10-2540.70				
CH4	2613.70-2615.40		250	HDO, CO2	WACCMV5
	2650.60-2651.30	*Optimal*		HDO, CO2	
	2835.50-2835.80	*CH4*			
	2903.60-2904.03	*Retrieval*		NO2	
	2921.00-2921.60	*TBD*		HDO, NO2, H2O	
	2611.60-2613.35	*At this*		HDO, CO2	
	2613.70-2615.40	*Time*		CH4, CO2, HDO	
	2914.70-2915.15			CH4, NO2,H2O,HDO	
	2941.23-2942.23			CH4,H2O,O3	
CO	2057.70-2058.00		250	O3, CO2, OCS	WACCMV5
	2069.56-2069.76			O3, CO2,OCS	
	2157.50-2159.15			O3, CO2, OCS, N2O, H2O	
C2H6	2976.66-2976.95		250	H2O, O3, CH4	WACCMV5*
	2983.20-2983.55			H2O, O3, CH	
HCN	3268.05 - 3268.40		250	H2O, C2H2	WACCMV5*
	3287.10 - 3287.35			H2O, CO2, C2H2	
	3299.40 - 3299.60			H2O, H218O	
		3277.775 – 3277.950		H2O	
		3286.168 – 3288.482		H2O	
		3301.030 – 3301.300		H217O	
		3304.825 – 3305.60		H2O, H218O, H217O, C2H2	



...tity accounted for in most ...t for several gases as examples ... component can be created and the ...se shown are for a single observation. ...ty is counter to the other components since ...easurement has the most information and the ...ate.

...rameters Above in Table 2 is a summa... wide. On the left are the...

Examp...

...t from various sites for all ten IRWG species.

...ing: Theory and practice. World

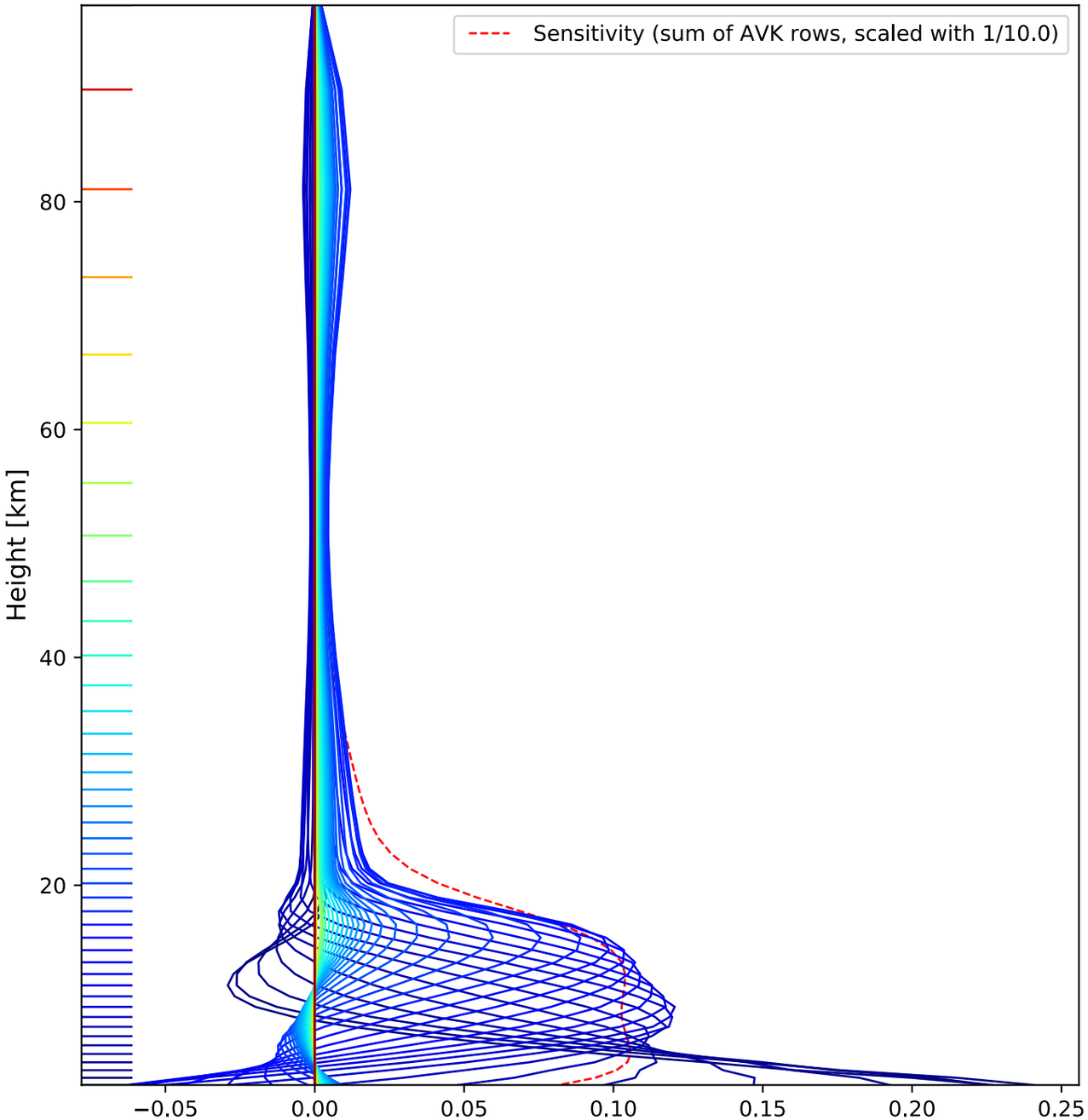
...ic ozone in the 21st century, J.

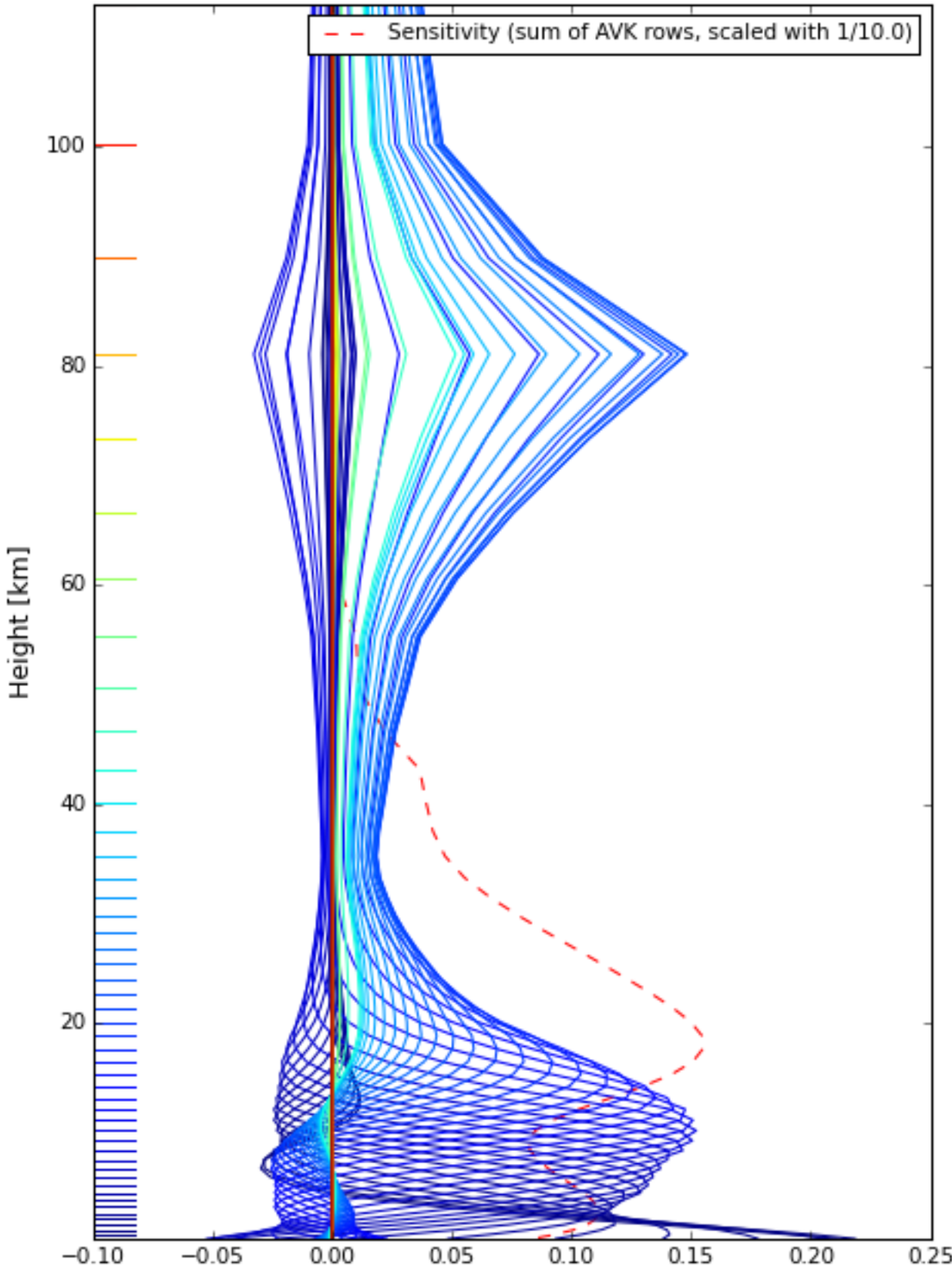
Acknowledgments We wish to thank data providers for this poster T. Blumenstock, & F. Hase IMK-AFS, M.De Mazière IASB-BIRA, E. Mahieu IAG U. Liège and the entire Membership of the NDACC-IRWG.

The National Center for Atmospheric Research is supported by the National Science Foundation. The NCAR FTS observation programs at Thule, GR and Mauna Loa, HI are supported under contract by the National Aeronautics and Space Administration (NASA). The Thule work is also supported by the NSF Office of Polar Programs (OPP). We wish to thank the Danish Meteorological Institute for support at the Thule site and NOAA for support of the MLO site.

Summary The combined effect of recent advances in retrievals & uncertainty estimation, the addition new species, and the use of HDF data files provides a very large amount of new data for end users from the observational program carried out by the NDACC-IRWG. Summarizing this effort is a challenge, we have tried to show the common components of the retrieval system and representative examples of the data currently available.

Please see the data archive at: ftp://ftp.cpc.ncep.noaa.gov
The NDACC web site at http://www.ndacc.org
The IRWG web site at: http://www.acd.ucar.edu/irwg/index.html


Sensitivity (sum of AVK rows, scaled with 1/10.0)
Height [km]
80
60
40
20
−0.05
0.00
0.05
0.10
0.15
0.20
0.25


Sensitivity (sum of AVK rows, scaled with 1/10.0)
Height [km]
100
80
60
40
20
−0.10
−0.05
0.00
0.05
0.10
0.15
0.20
0.25

19-11-02 11:19:16 ftir.OPER.cams27_filelist_20191102T0900Z.txt.check_GEOMS ERROR Found a significant number 10/10 of extreme (0<:<1.5, -inf[km]<:<80.0[km]) col AVK values for O3.COLUMN_ABSORPTION.SOLAR_AVK: eg measurement 10

1.89004[113.0km]
0.558618[100.25km]
0.67463[89.85km]
0.844829[81.1km]
1.06932[73.385km]
1.45264[66.585km]
1.81896[60.59km]
1.92652[55.315km]
1.88051[50.7km]
1.7824[46.68km]