N2O update

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Analysis at Thule.

- ❑ Linelist (HIT08 vs HIT20 vs ATM20)
- ❑ WACCM v6 vs V7
- ❑ Sa (OE & Tik)

Retrieval code: sfit4 v1.0.18
Years (Thule): 2017-2018

Overview

Version	Description	Some retrieval parameters
HIT08	HIT08	mw1: 2481.30 - 2482.60 cm^{-1} mw2: 2526.40 - 2528.20 cm^{-1} mw3: 2537.85 - 2538.80 cm^{-1} mw4: 2540.10 - 2540.70 cm^{-1} OPD: 257 cm Profiles: N2O H2O Columns: HDO CO2 CH4 FLT: 3 and 4 OE Sa: 7% weighted as (Sa/sqrt(thickness)
HIT20	All HIT20	
ATM20	All ATM20	
WACCM V6	WACCM V6 and OCS from ACE-FTS/HIPPO (Hannigan et al., 2022)	
WACCM V7	WACCM V7 and OCS from ACE-FTS/HIPPO	

- Start from current NDACC retrieval strategy.
- Change retrieval method one aspect at a time.
- Analyze effect on RMS, DOFS, total column and profile
- Validation against other instruments is missing.

Summary

- From Hashemi et al., (2021): *Careful comparisons of broadening parameters using the Voigt and speed-dependent Voigt line-shape profiles were performed.* HIT20 shows an improvement of 1% in RMS (not that much difference).
- HIT20 and HIT08 (and ATM20) show similar columns (<0.1% differences).
- WACCM V6 vs V7 show similar results. V7 shows an improvement in RMS of 1%.
- Similarly, Tikhonov regularization shows good results. With an alpha of 1e4 DOFs improve by 1 DOF.

Improvement of the spectroscopic parameters of the air- and self-broadened N_2O and CO lines for the HITRAN2020 database applications

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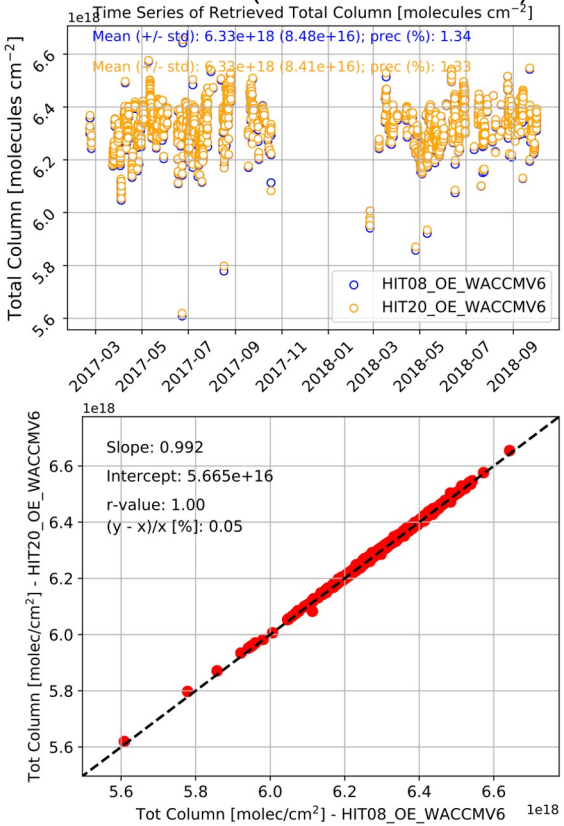
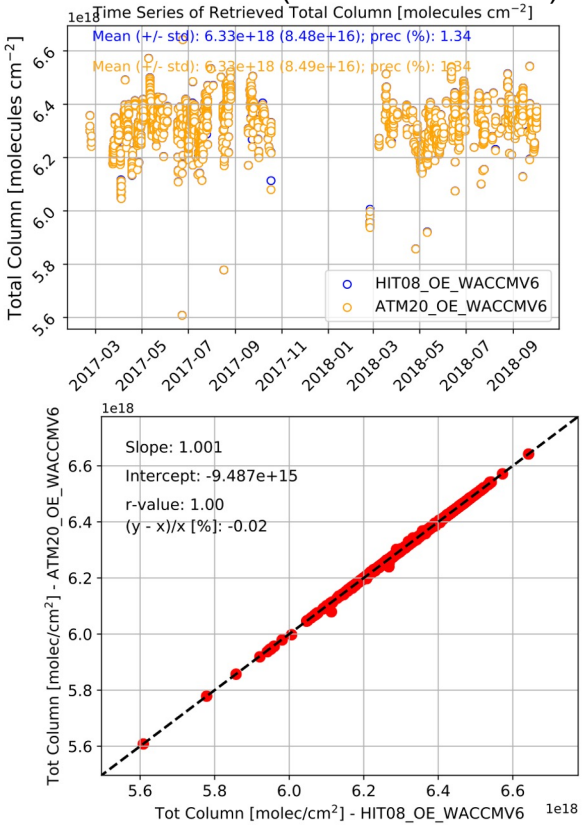
Time Series: total Columns

HIT08 vs HIT20 (OE & WACCM V6)

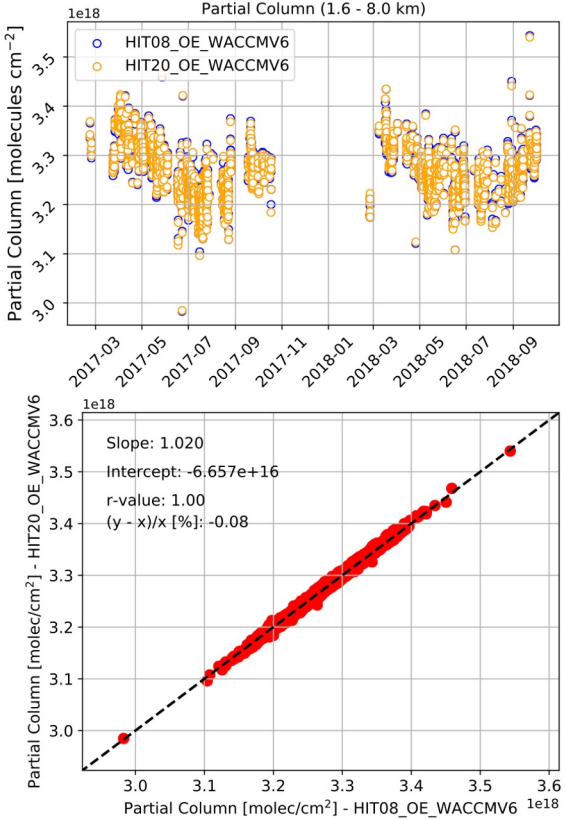


HIT08 vs ATM20 (OE & WACCM V6)

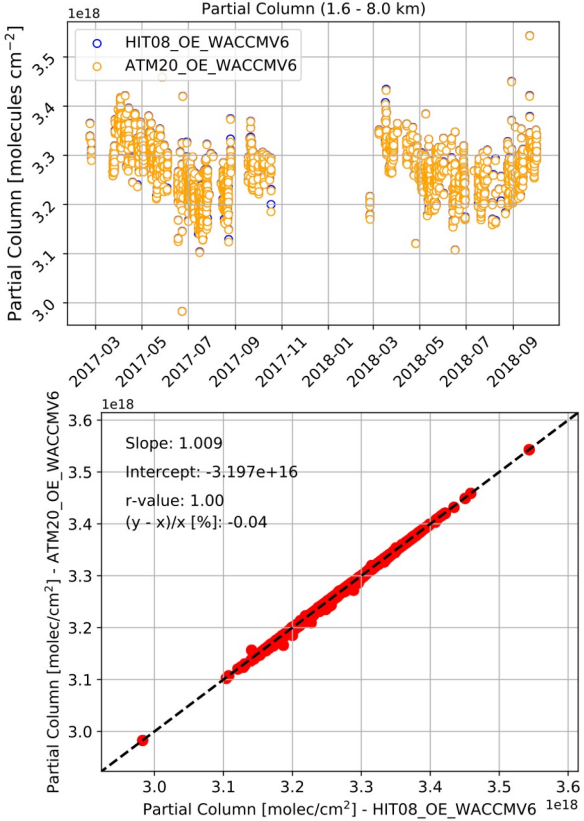


Time Series: Tropospheric Columns

HIT08 vs HIT20 (OE & WACCM V6)

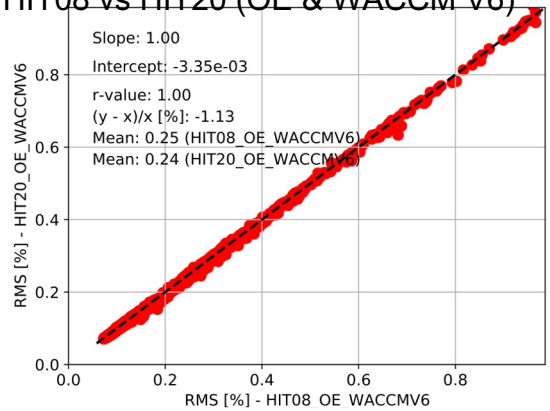


HIT08 vs ATM20 (OE & WACCM V6)

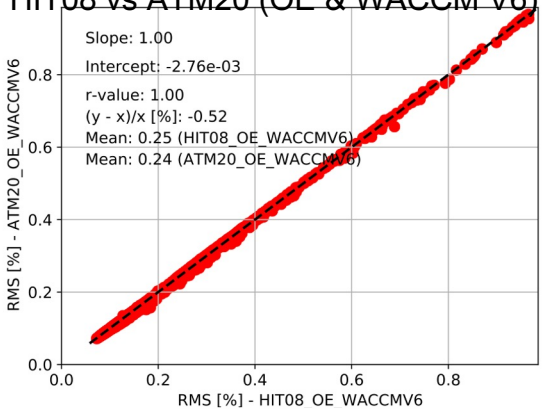


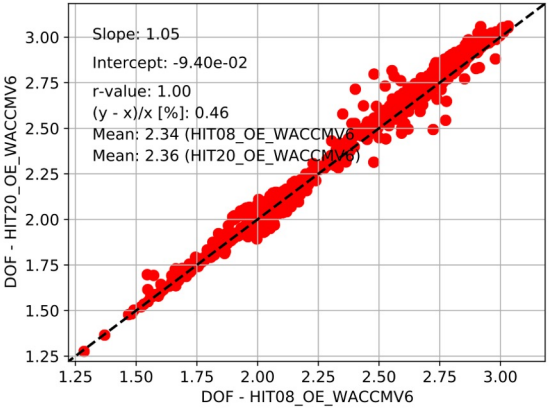
RMS and DOF

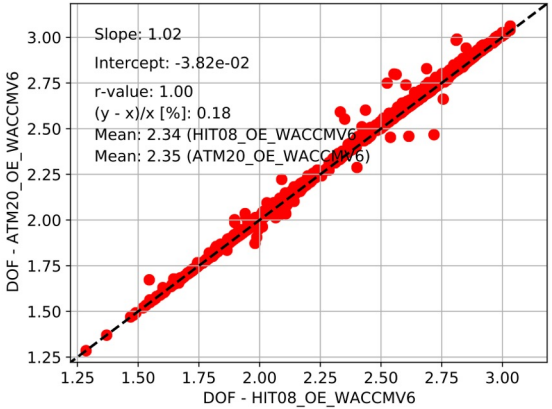
HIT08 vs HIT20 (OE & WACCM V6)



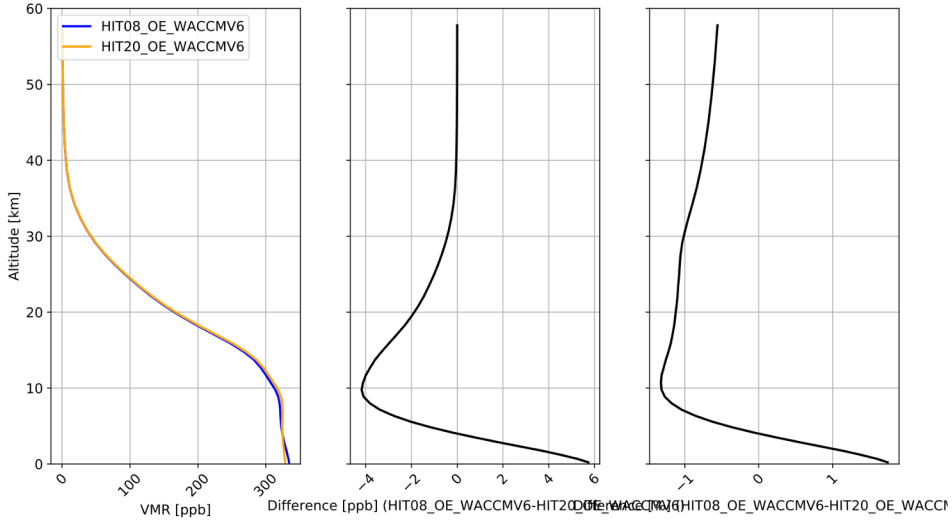
HIT08 vs ATM20 (OE & WACCM V6)





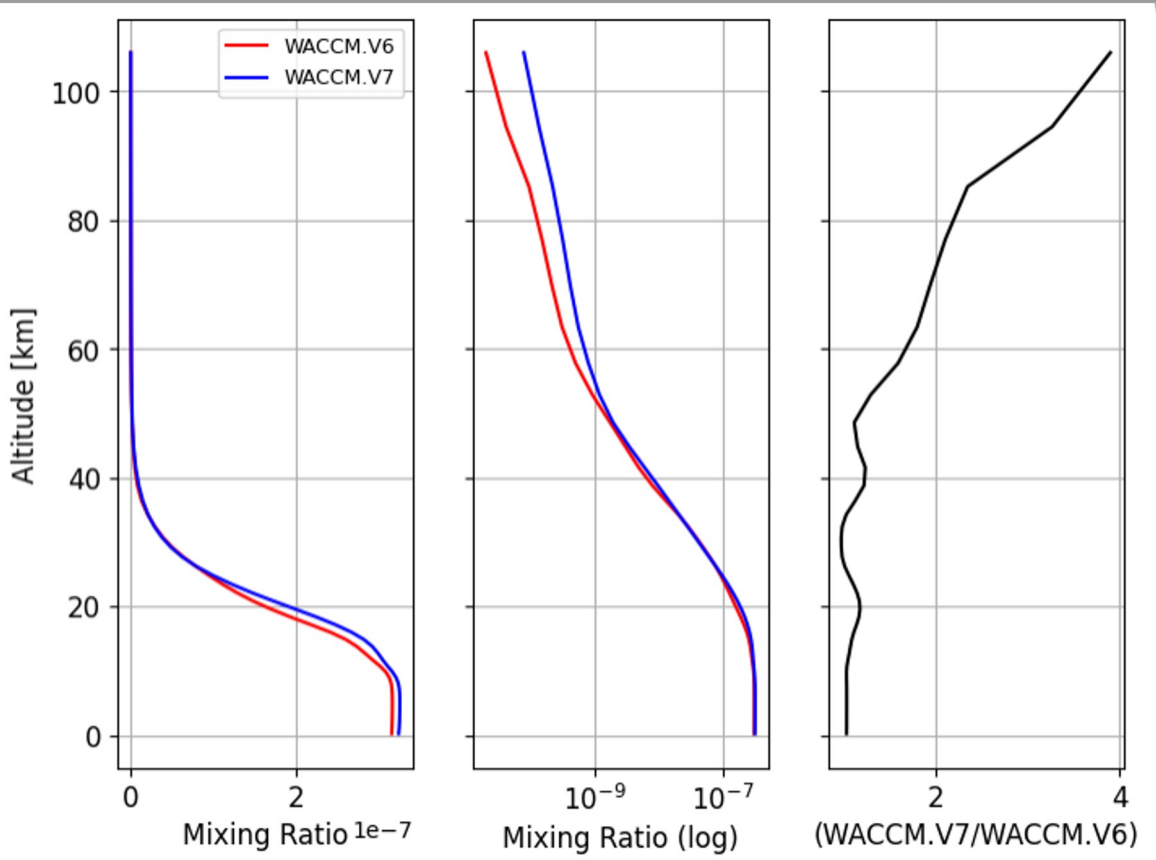


Profiles

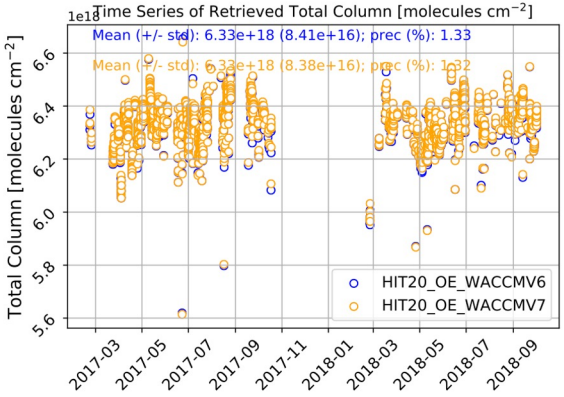


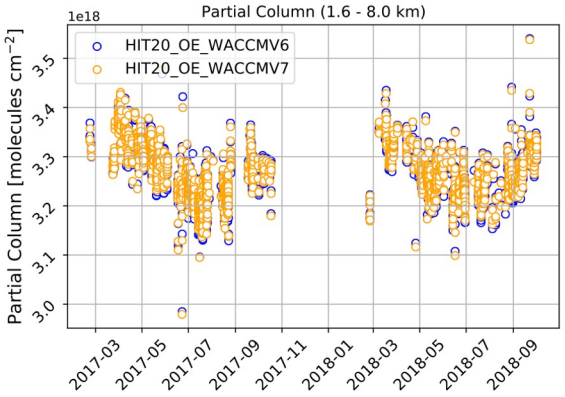
- HIT20 does not show significantly different columns (<0.1% differences).
- Very similar RMS/DOF (1% improvement with HIT20 in rms)

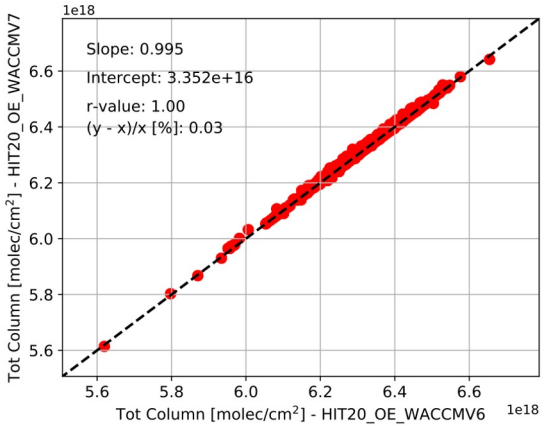
Apriori Profiles

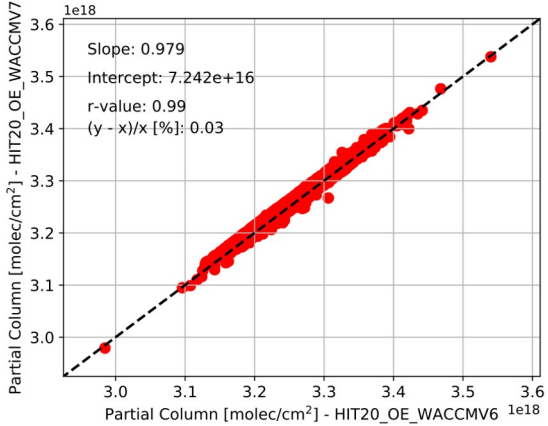


Time Series: total/partial Columns

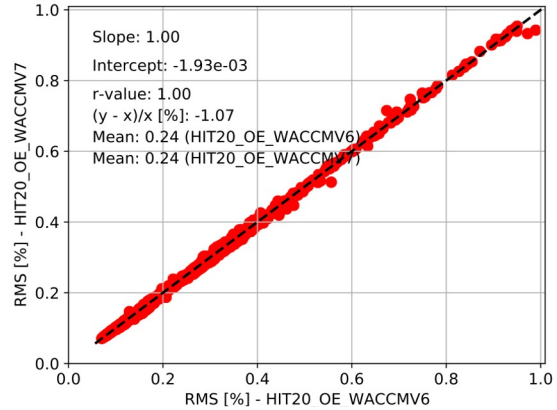


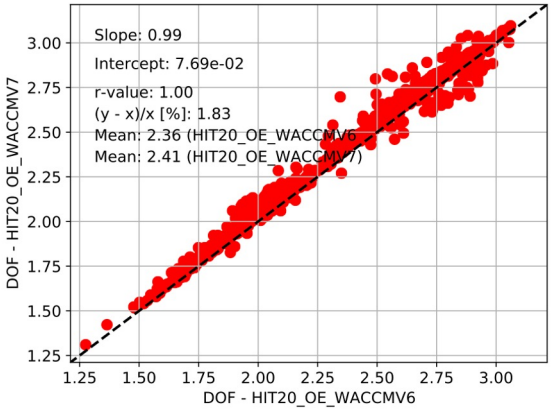


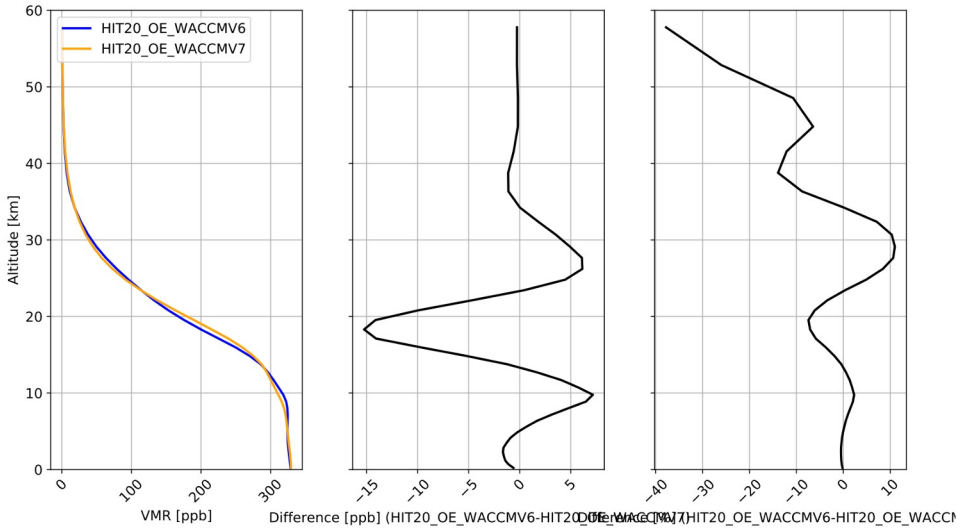




RMS, DOF and profiles

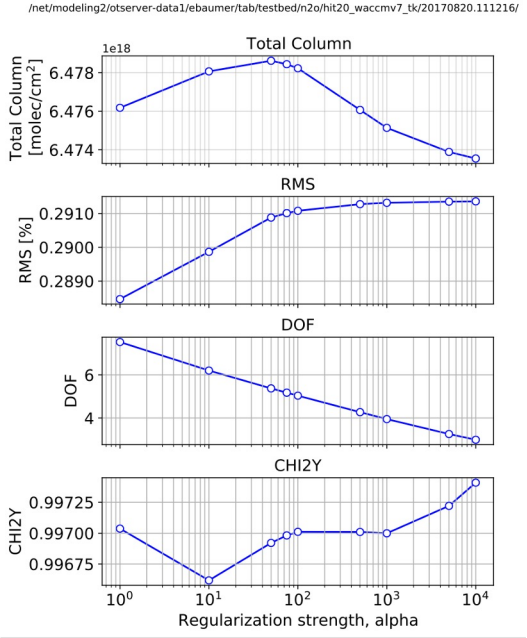


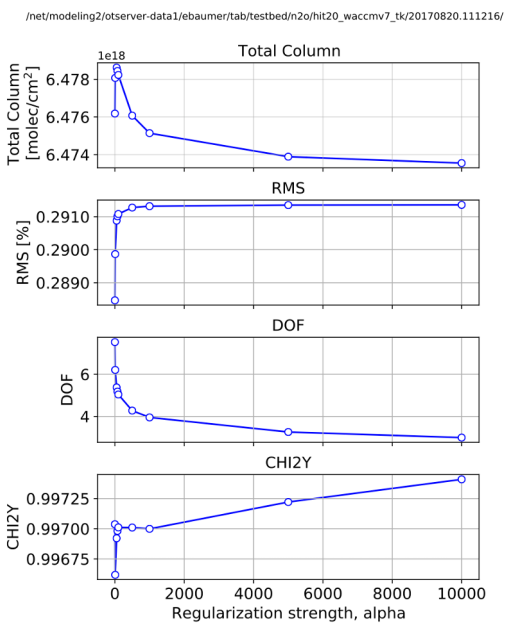


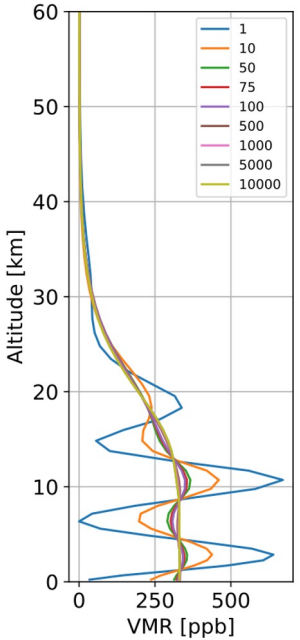


- Little differences between WACCM V6 and V7

Tik Optimization





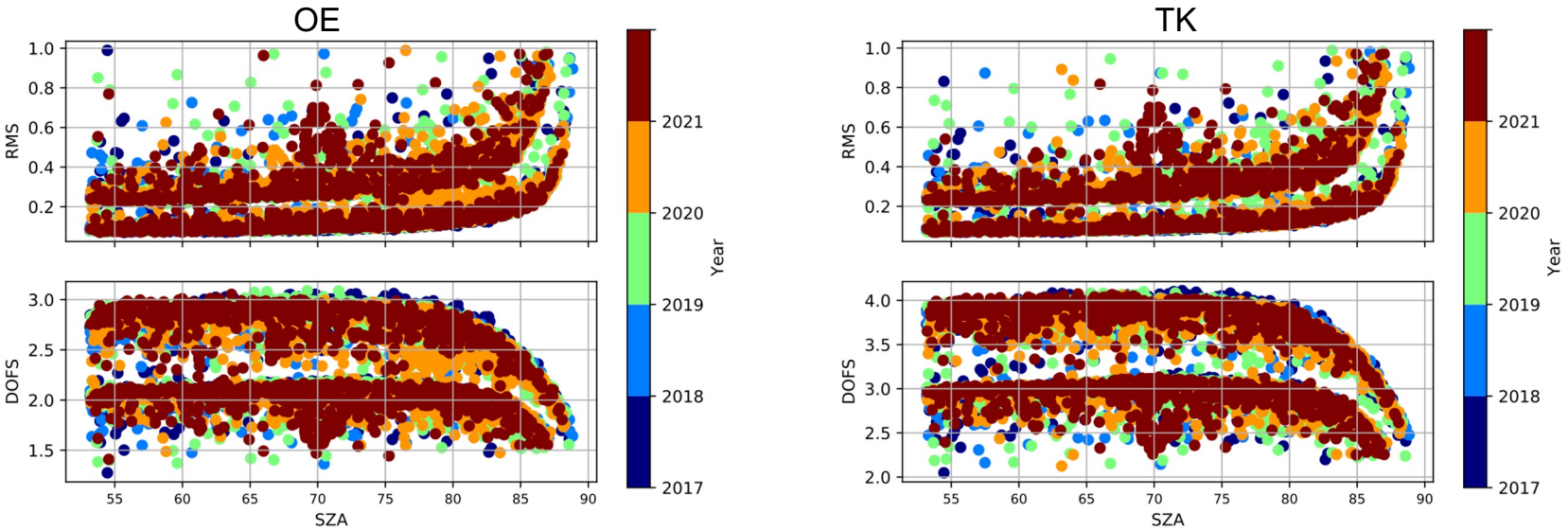


OE
RMS: 0.292
DOF: 2.125
CI_2_Y: 0.93
TC:6.471E18

With an alpha of 10000 we get about 2.9 DOF for the same retrieval testcase.

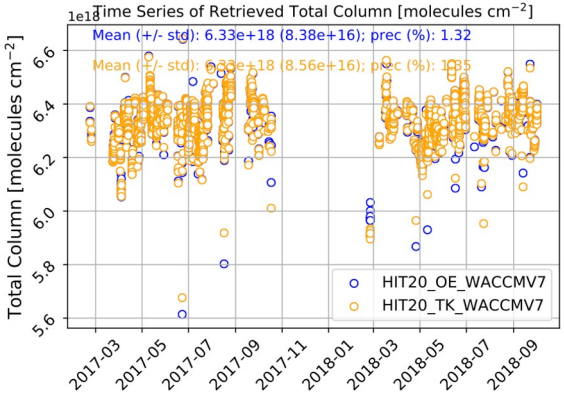
RMS and DOF

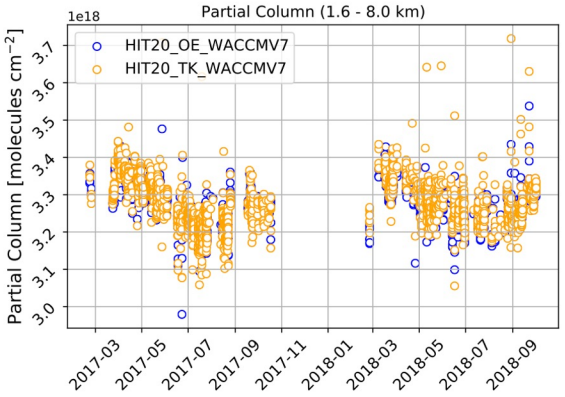
- Filters 3 and 4 are used. Typically, FLT4 yields better RMS/DOF due to larger SNR.

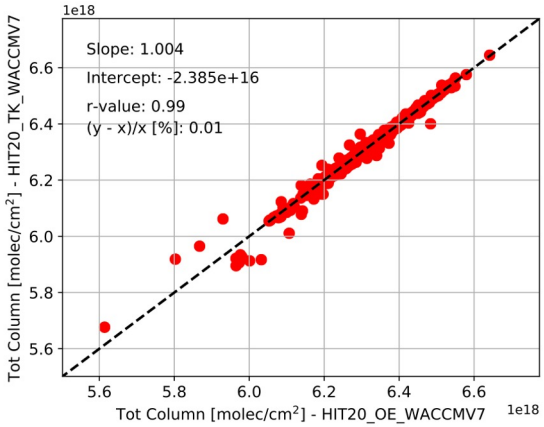


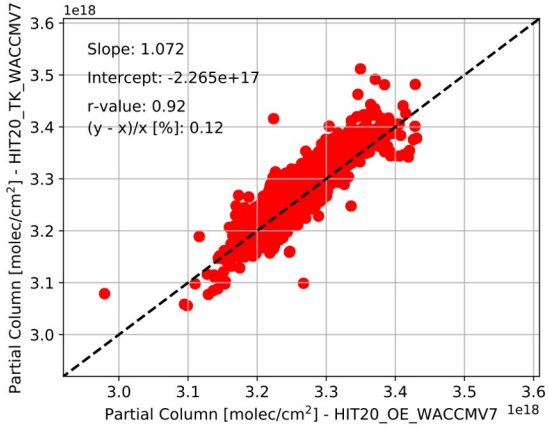
2007-2021

Time Series: total/partial Columns

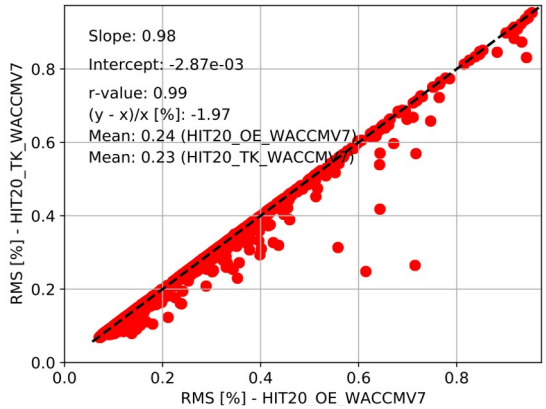


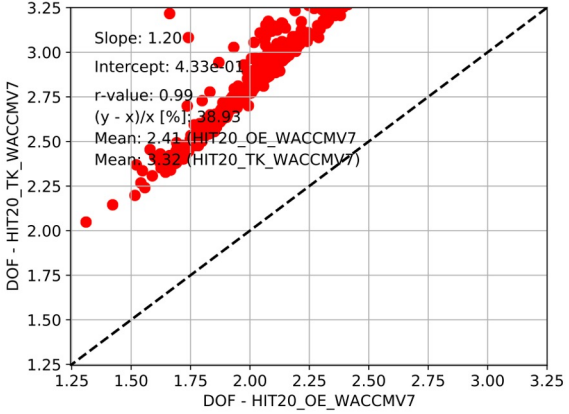


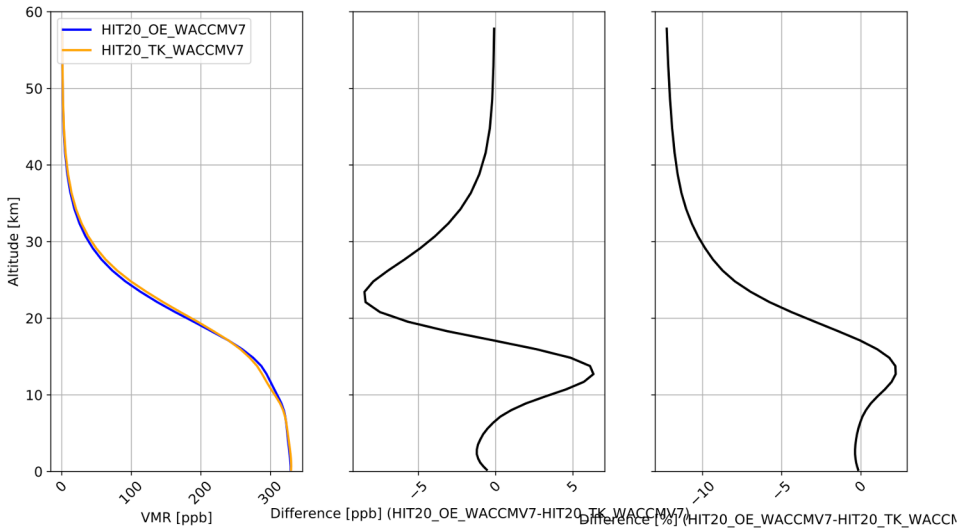




RMS, DOF and profiles



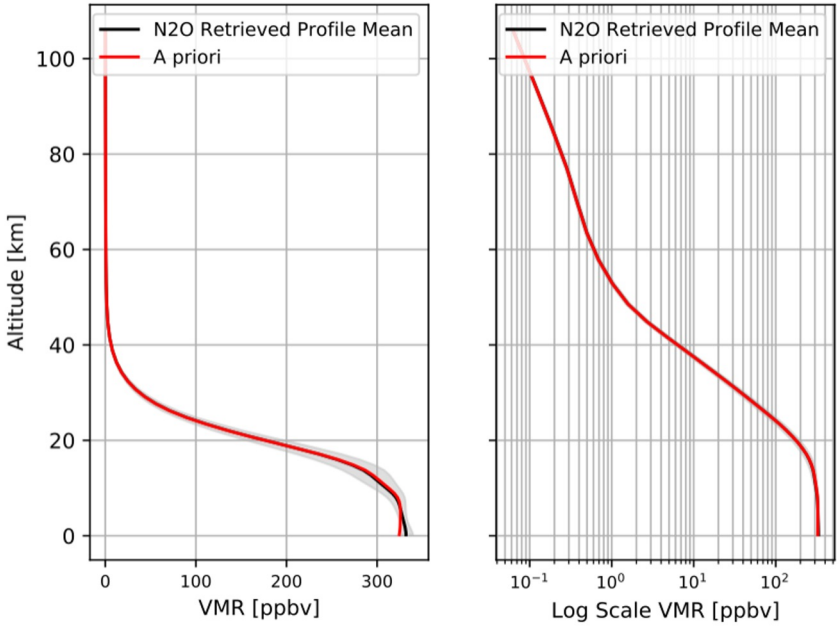




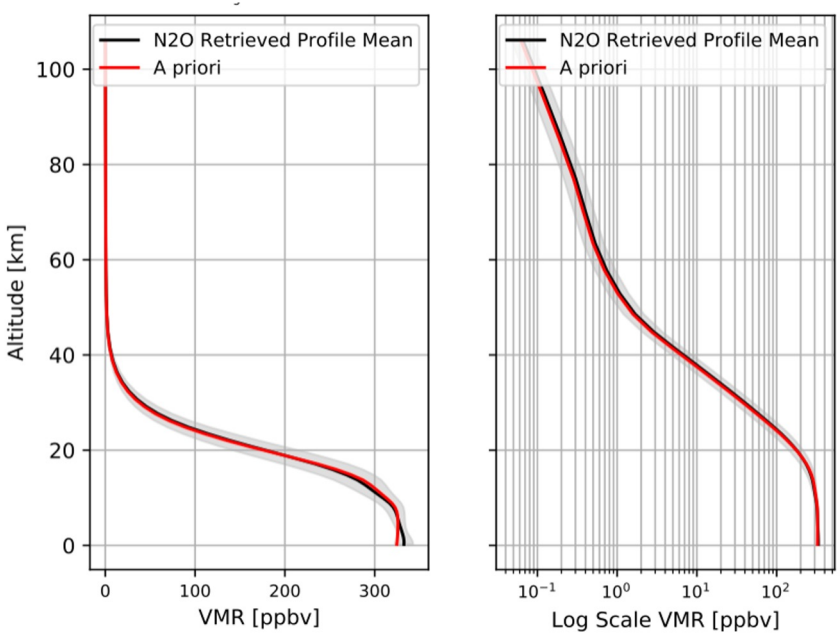
- Little differences between OE and Tik. DOF are larger with Tik even though a quite large alpha is used.

Profiles

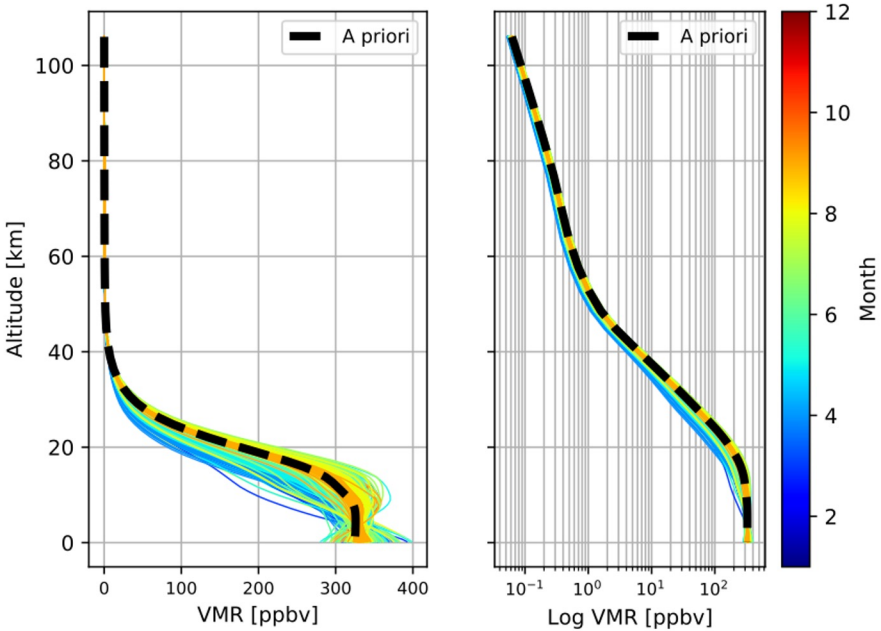
2017_2021_hit20_waccmv7_oe



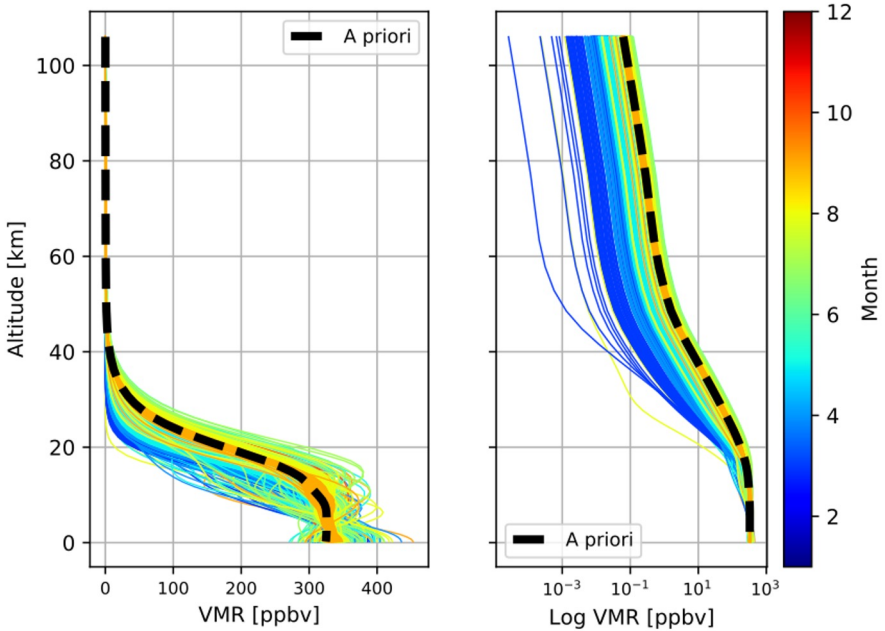
2017_2021_hit20_waccmv7_tk



2017_2021_hit20_waccmv7_oe



2017_2021_hit20_waccmv7_tk



Maybe the alpha value needs to be greater to constrained more the profiles?