

## Ivan Ortega, James Hannigan

Analysis at Thule.

- Linelist (JGR22 vs HIT20 vs ATM20)
- WACCM v6 vs V7 (HIPPO+ACE-FTS) VS v7
- Sa (OE & Tik)

Retrieval code: sfit4 v1.0.18

Years (Thule): 2017-2021

# Overview

Version	Description	Some retrieval parameters
JGR22	HIT 2012 (OCS and O <sub>3</sub> ) ATM 2012 (H <sub>2</sub> O, CO, and CO <sub>2</sub> ) (Hannigan et al., 2022)	mw1: 2047.85 - 2048.24 cm <sup>-1</sup> mw2: 2049.77 - 2050.18 cm <sup>-1</sup> mw3: 2051.18 - 2051.46 cm <sup>-1</sup> mw4: 2054.33 - 2054.67 cm <sup>-1</sup>
HIT20	All HIT20	
ATM20	All ATM20	OPD: 180 cm
WACCM V6	WACCM V6 and OCS from ACE-FTS/HIPPO (Hannigan et al., 2022)	Profile: OCS O3 CO Columns: CO2 H218O H2O
WACCM V7	WACCM V7 and OCS from ACE-FTS/HIPPO	OE: Sa as described in Hannigan et al. (2022)
WACCM V7_M	WACCM V7 (including OCS)	

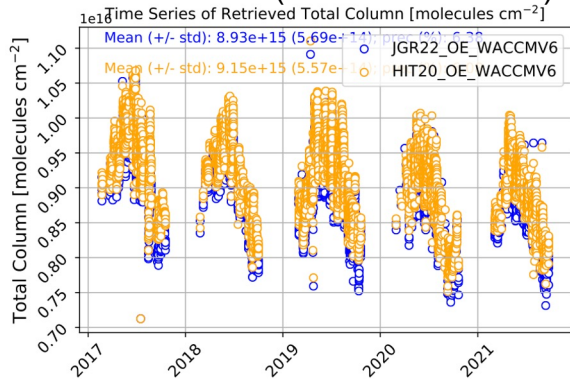
- Start from current NDACC retrieval strategy. Change retrieval method one aspect at a time.
- Analyze effect on RMS, DOFS, total column and profile
- Validation against other instruments is missing.

# Summary

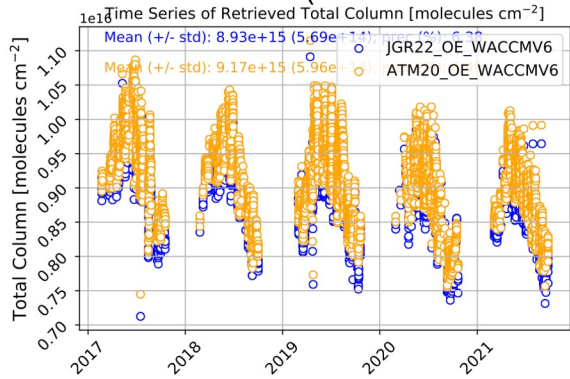
- ❑ JGR22 shows better RMS than HIT20/ATM20 (~10%) but only for low OCS columns. Unfortunately, I did not test HIT20 (OCS) with ATM20 (H<sub>2</sub>O) but that may improve the residuals.
- ❑ HIT20 and ATM20 show larger columns (~3%). The main increase is in the troposphere and profiles show a significant difference. **To conclude which one is better we may need to compare with surface/aircraft/other observations.**
- ❑ WACCM V7 (including OCS) shows improvements in RMS. Columns are similar within 1%. Same as above, comparisons with surface would be good to check profiles.
- ❑ Either OE or Tikhonov would be ok.

# Time Series: total Columns

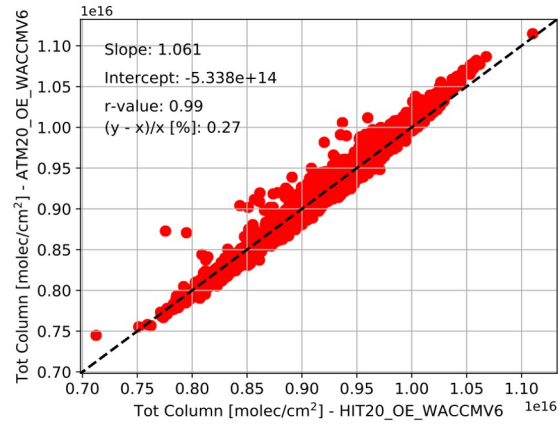
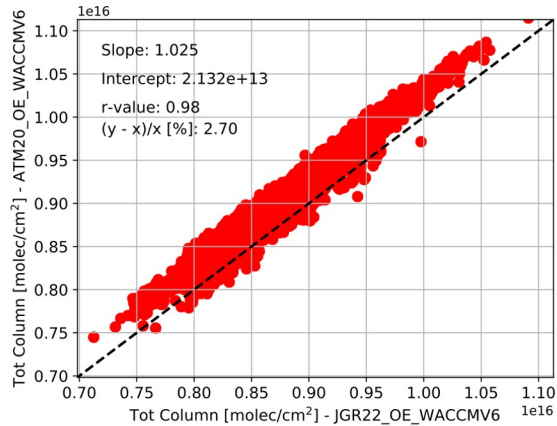
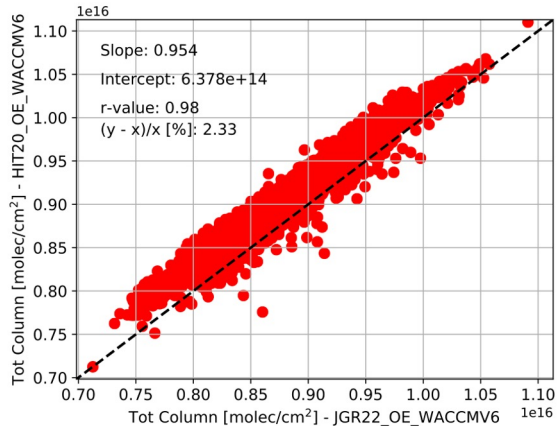
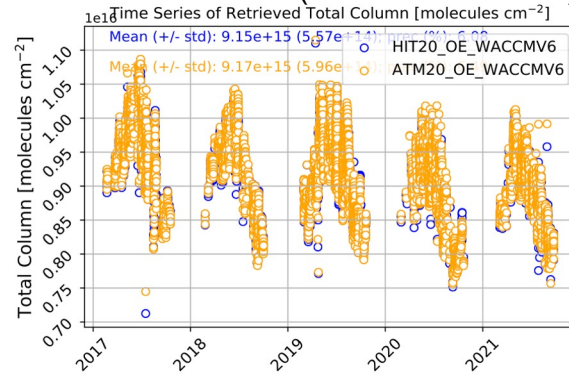
## JGR22 vs HIT20 (OE & WACCM V6)



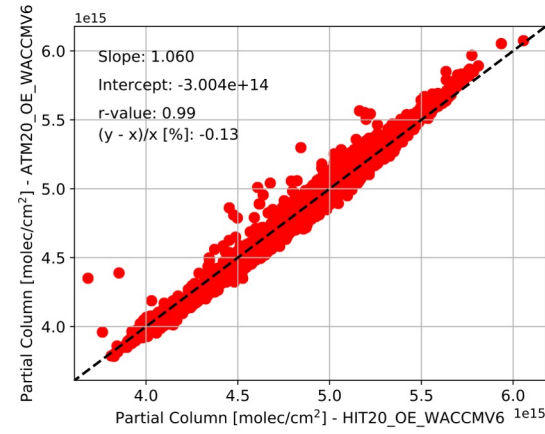
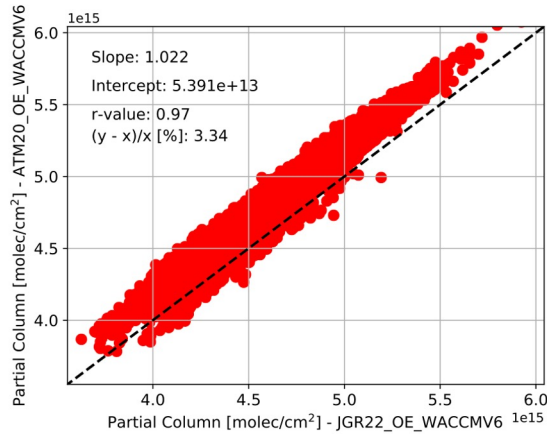
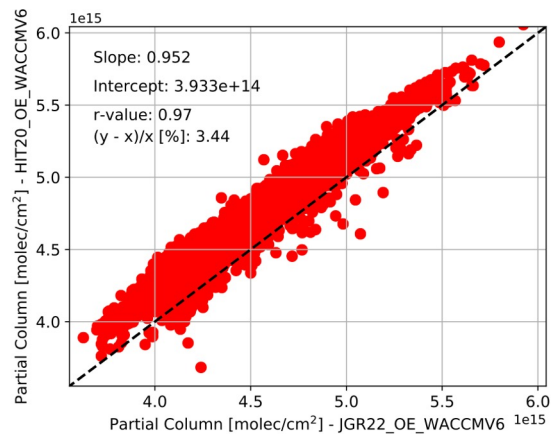
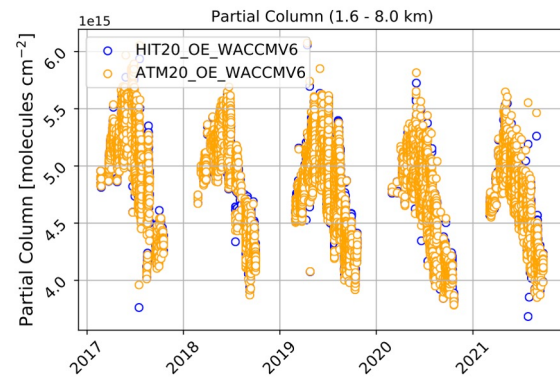
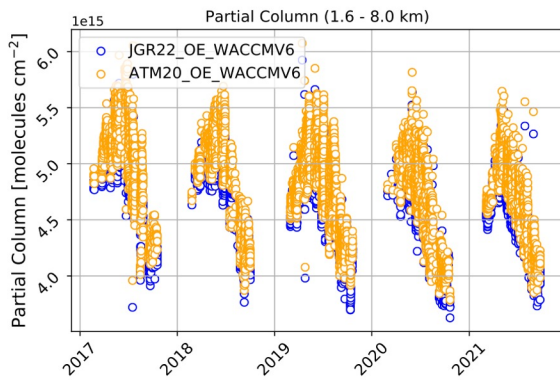
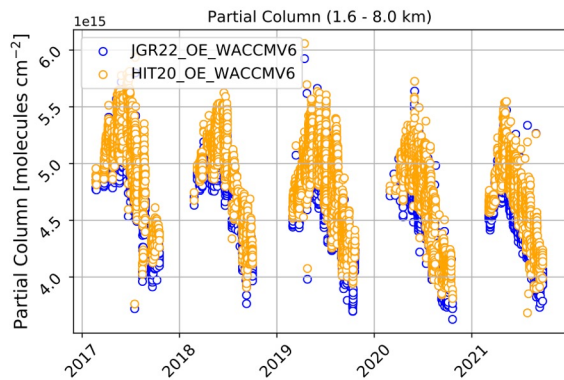
## JGR22 vs ATM20 (OE & WACCM V6)



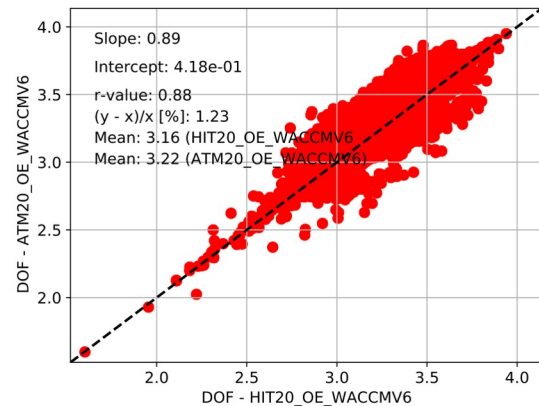
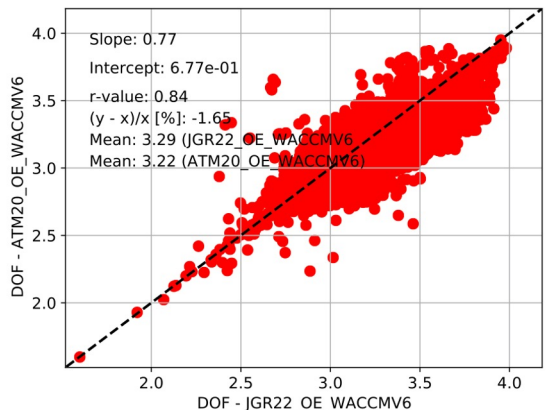
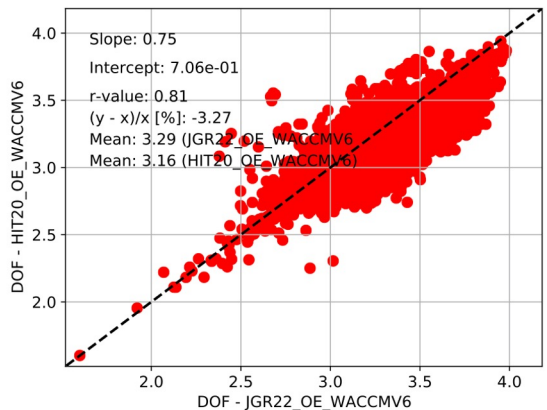
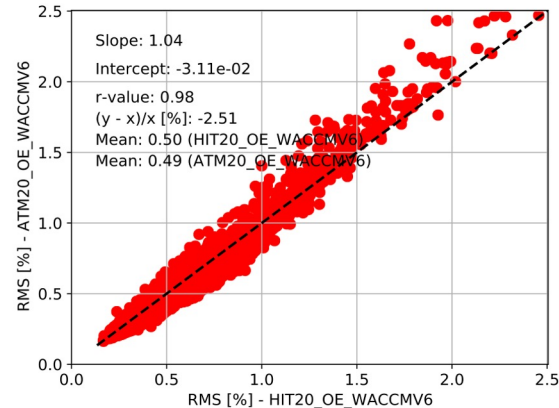
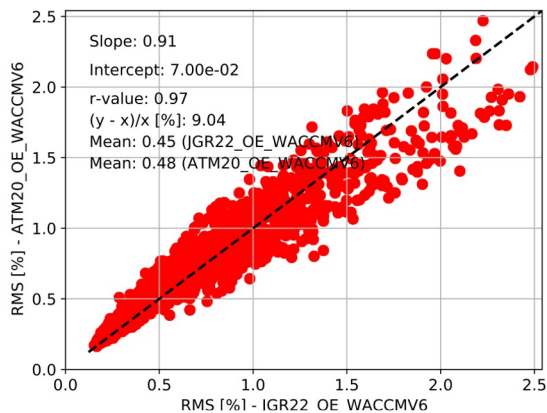
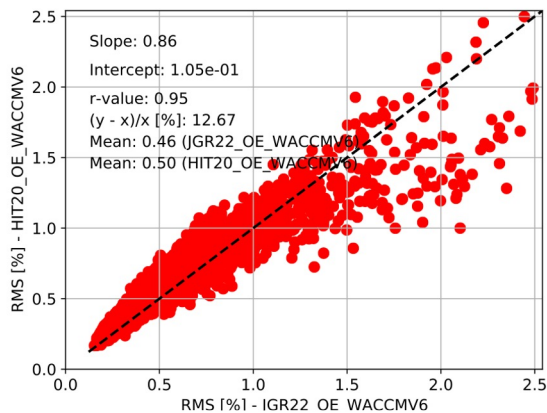
## HIT20 vs ATM20 (OE & WACCM V6)



# Time Series: Tropospheric Columns

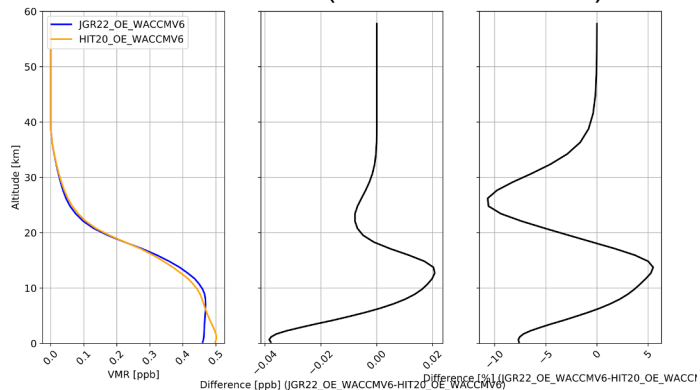


# RMS and DOF

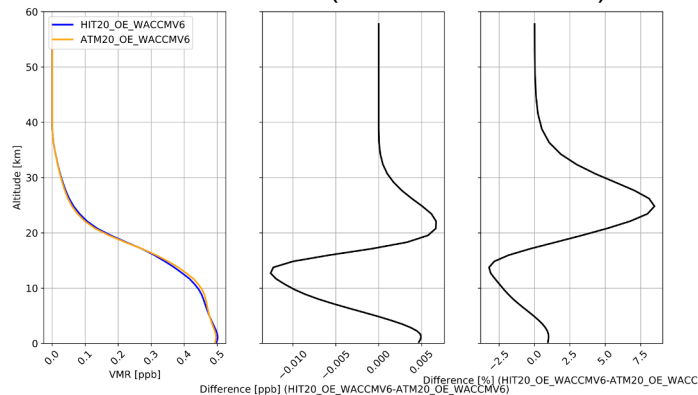


# Profiles

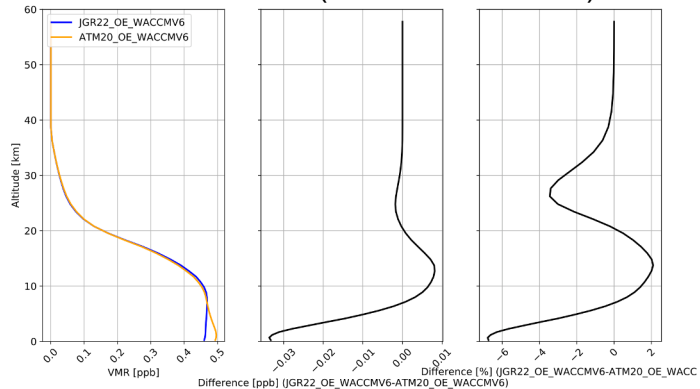
## JGR22 vs HIT20 (OE & WACCM V6)



## HIT20 vs ATM20 (OE & WACCM V6)



## JGR22 vs ATM20 (OE & WACCM V6)

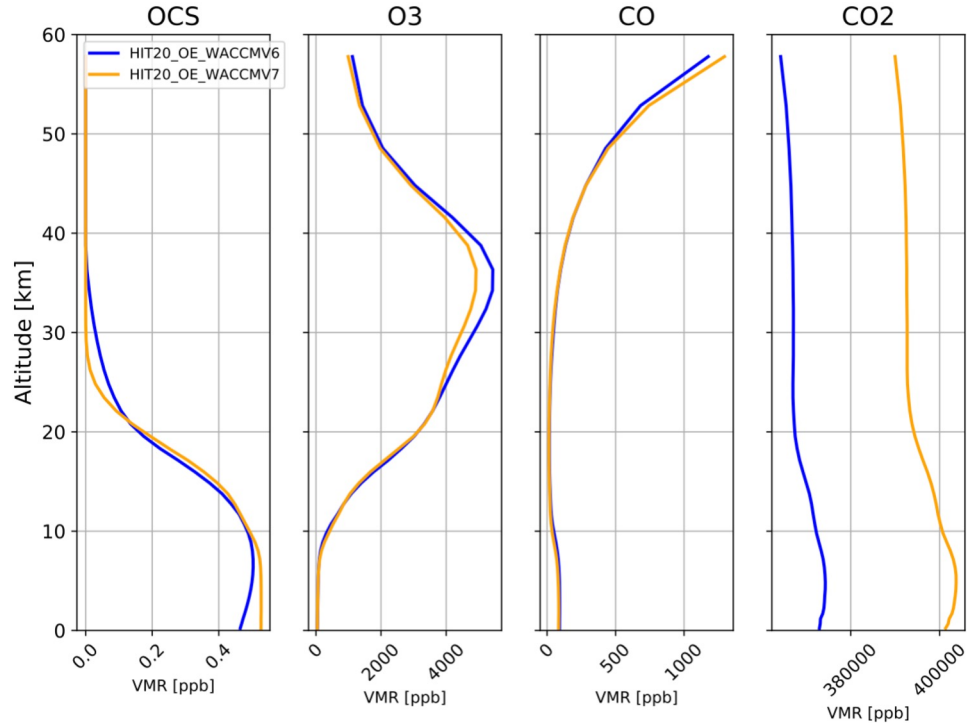


- HIT20 and ATM20 show 3% larger columns than JGR22.
- Profiles in the lower trop are significantly different, which warrants further investigation with surface observations.

# Investigation of a priori profiles

## A priori profiles

WACCM V6 (w ACE/FTS and HIPPO) vs WACCM V7 (OCS from model)

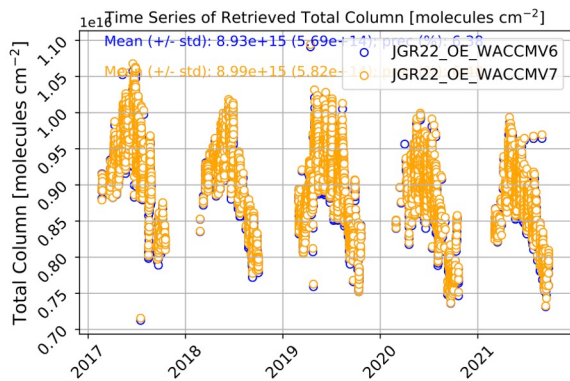


OCS a priori from WACCM V7

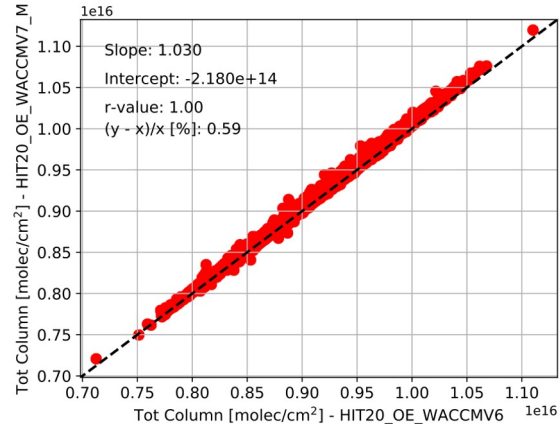
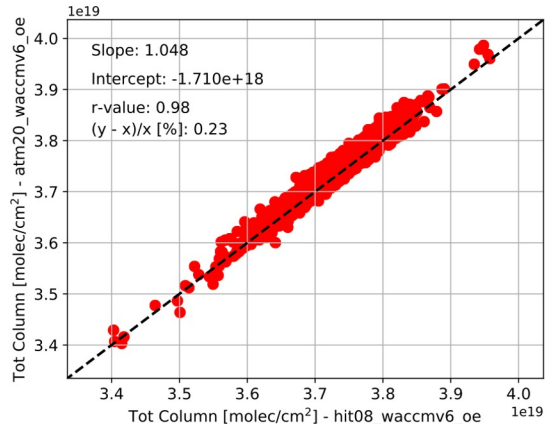
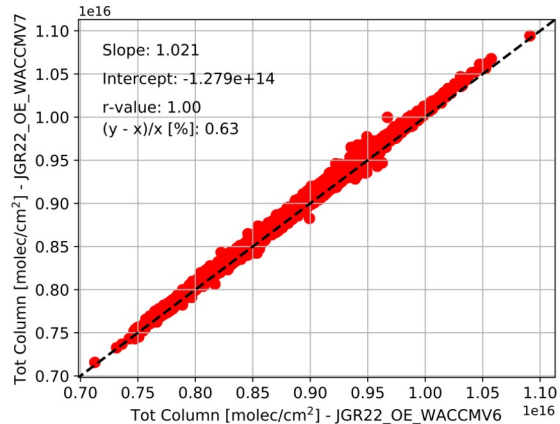
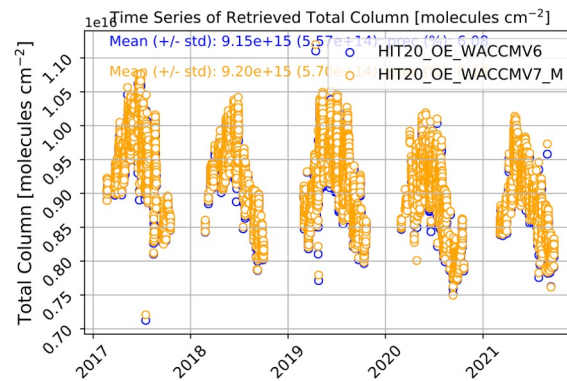
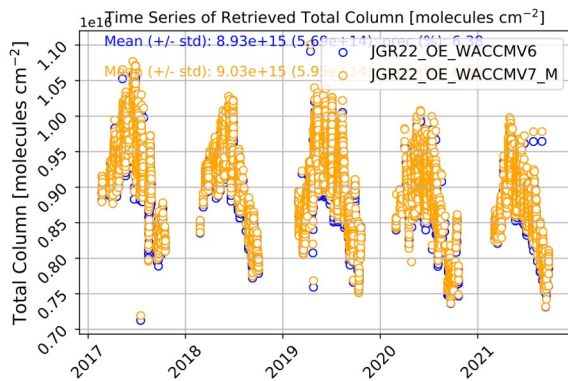


# Time Series: total Columns

Same OCS apriori (ACE and HIPPO)

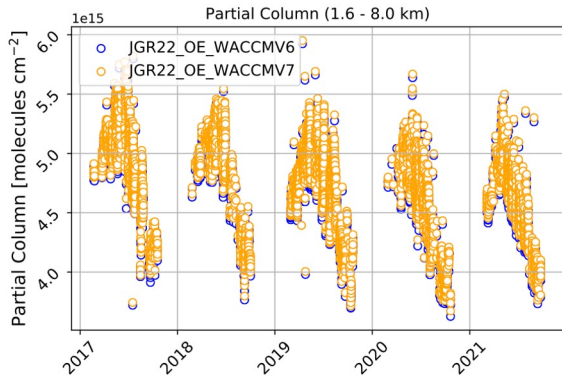


\_M = OCS apriori from WACCM V7

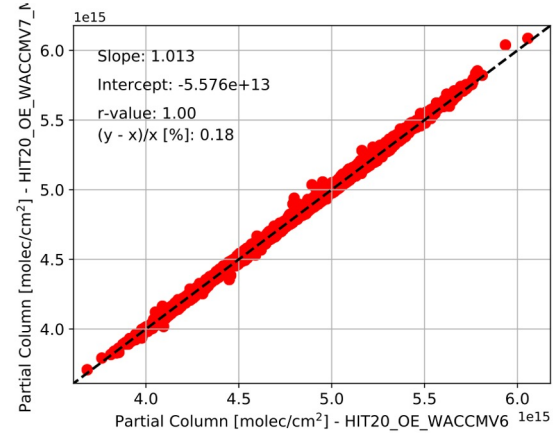
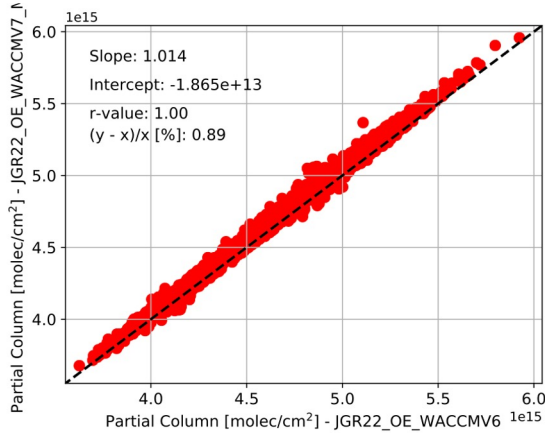
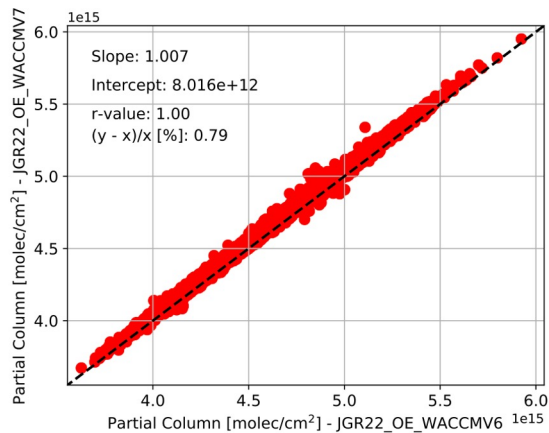
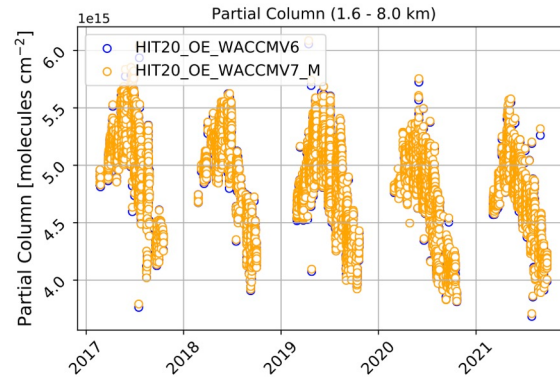
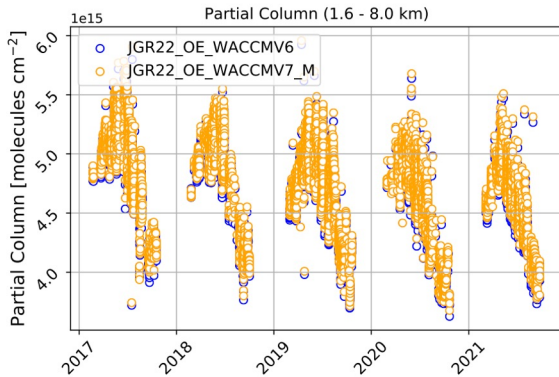


# Time Series: Tropospheric Columns

Same OCS apriori (ACE and HIPPO)

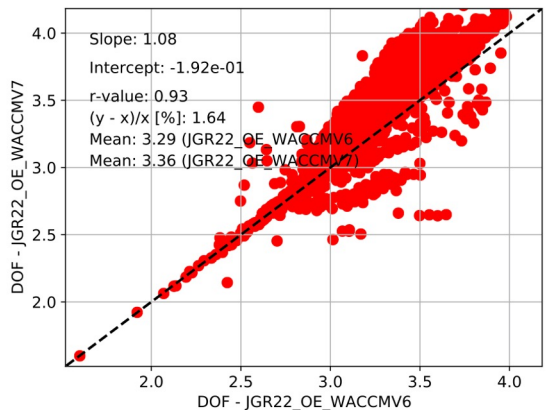
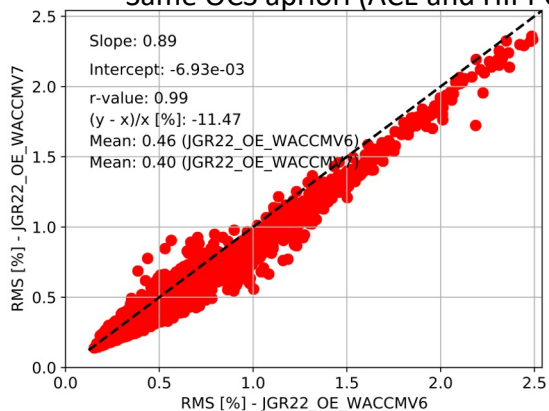


\_M = OCS apriori from WACCM V7

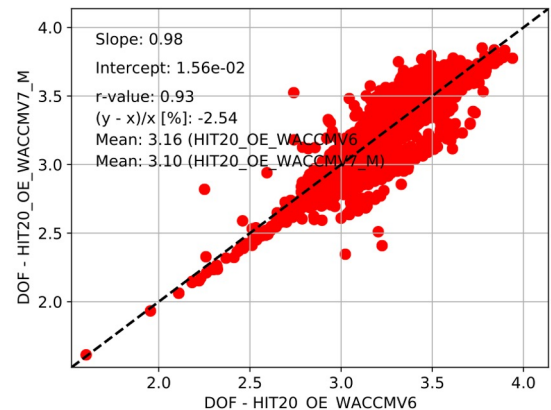
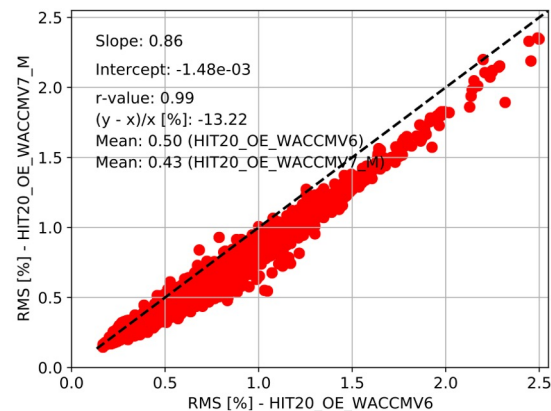
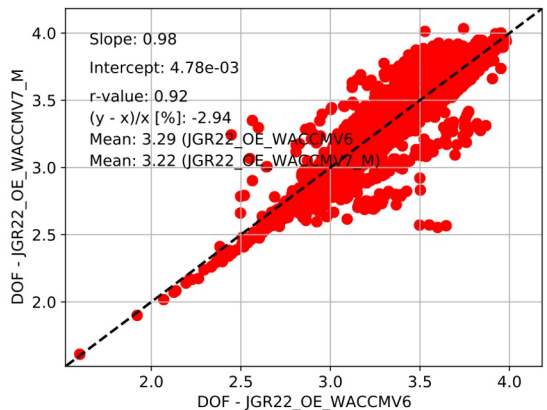
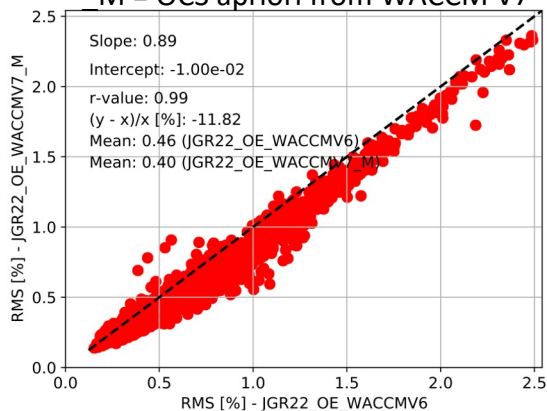


# RMS and DOF

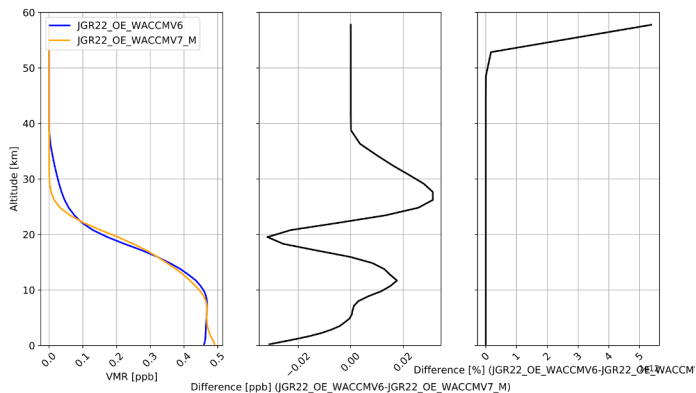
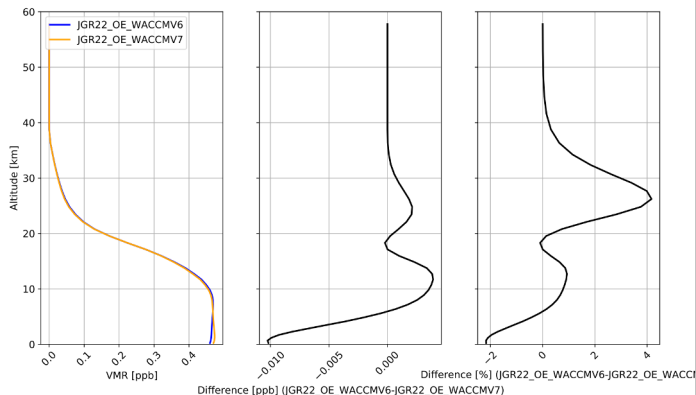
## Same OCS apriori (ACE and HIPPO)



## M = OCS apriori from WACCM V7



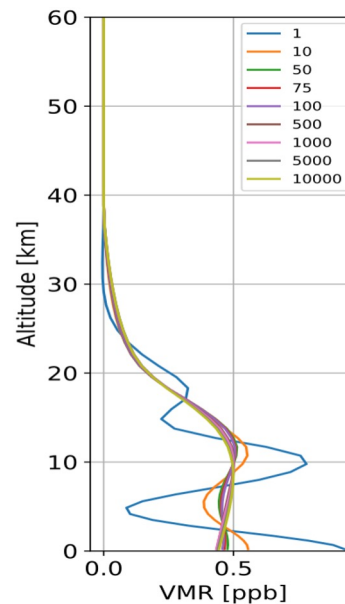
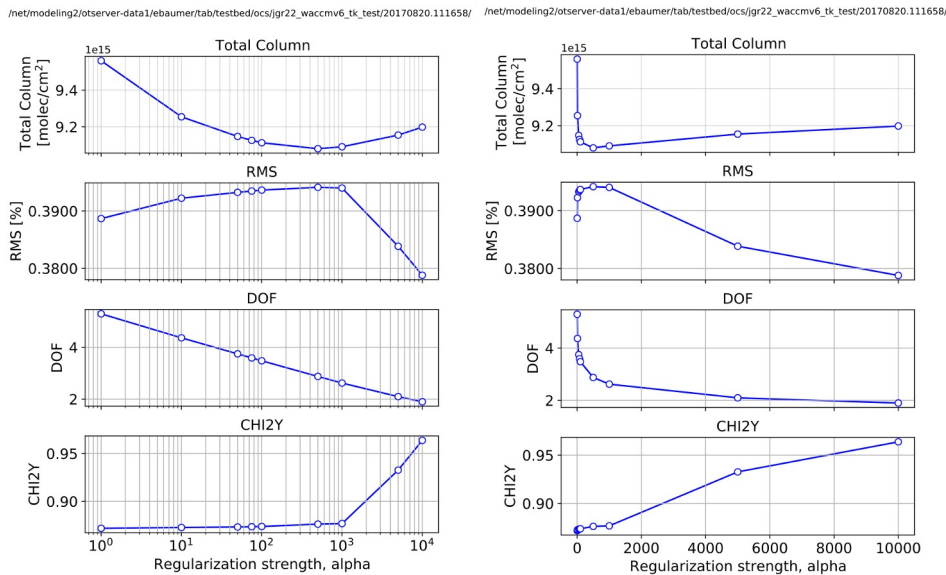
# Profiles



- Total/Partial columns agree within 1% using WACCM V6 (OCS from ACE/HIPPO) and WACCM V7 (including OCS).
- RMS improves by  $\sim 12\%$  if using WACCM V7 (including OCS).
- Profiles in the lower trop are a bit different, which warrants further investigation with surface observations.

# Tik Optimization

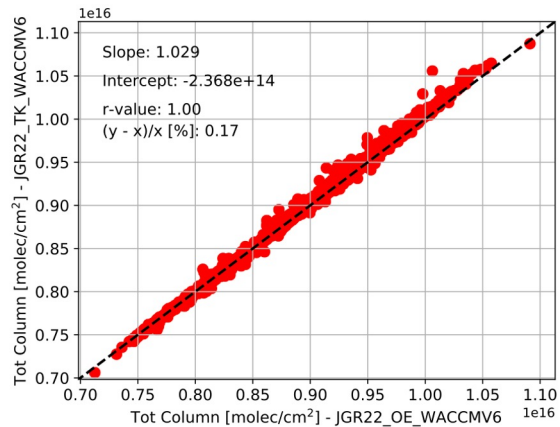
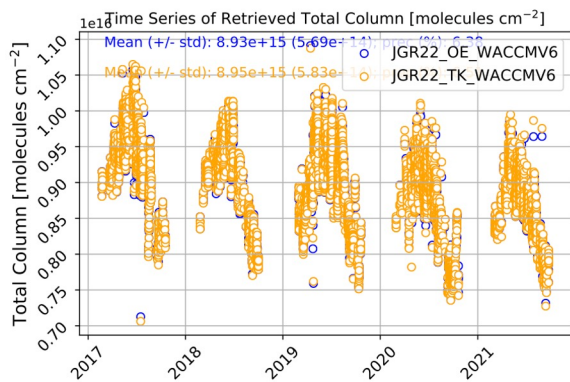
## Tikhonov optimization using JGR22 and WACCM V6



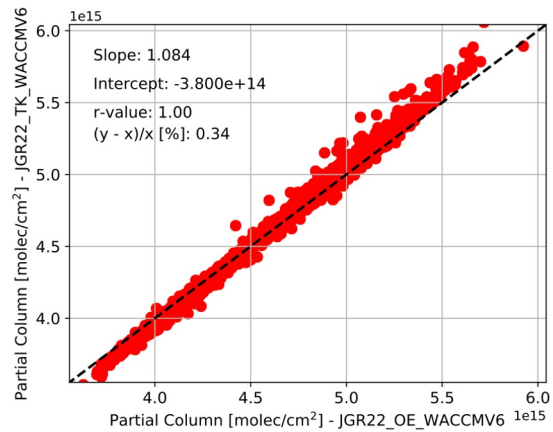
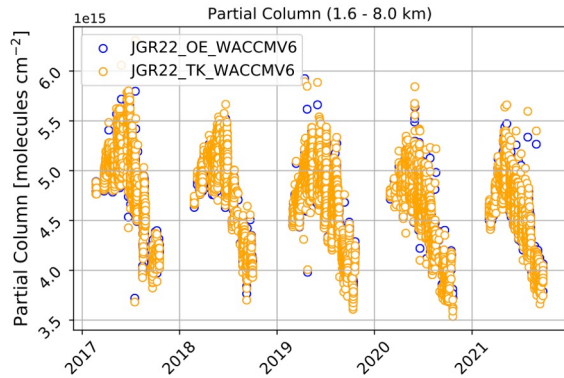
OE  
RMS: 0.466  
DOF: 3.05  
CI\_2\_Y: 0.83

In order to have a similar retrieval we have used an alpha of 200, using a correlation type of 6 in sfit4.ctf

# Time Series: total Columns

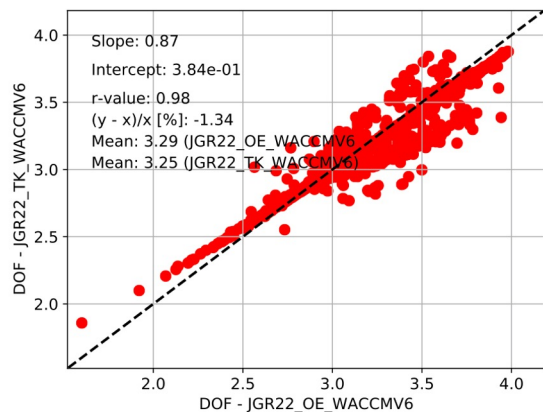
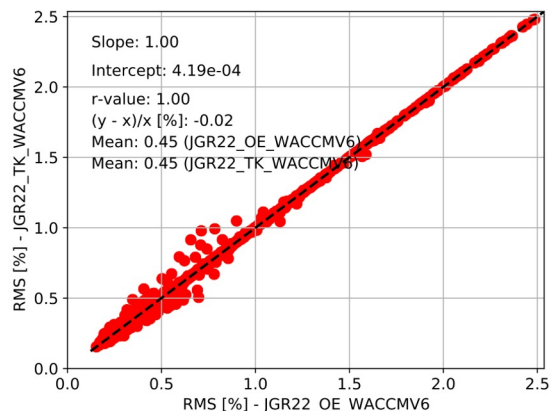


# Time Series: Tropospheric Columns



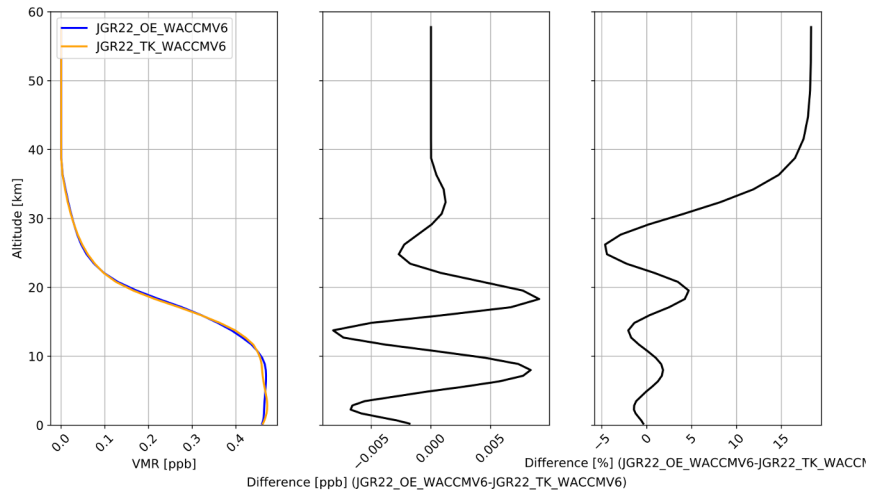


# RMS and DOF



- Total/Partial columns agree within 1% using WACCM V6 (OCS from ACE/HIPPO) and WACCM V7 (including OCS).
- RMS improves by  $\sim 12\%$  if using WACCM V7 (including OCS).
- Profiles in the lower trop are a bit different, which warrants further investigation with surface observations.



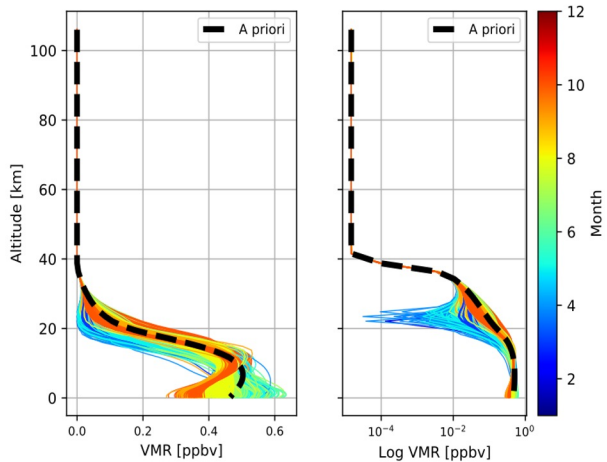


- Tik and OE agree quite well.

# Profiles

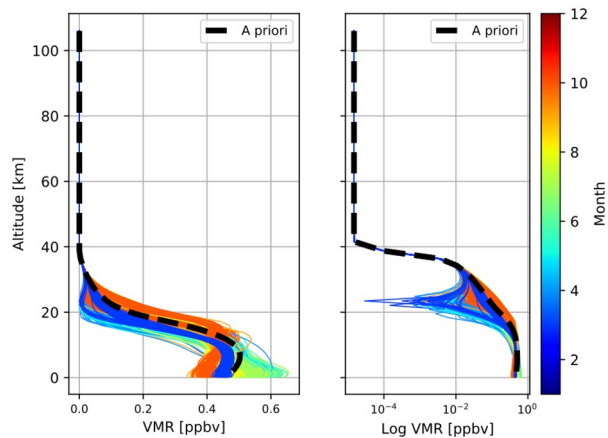
JGR22\_WACCMv6\_OE

OCS



hit2020\_WACCMv7\_OE

OCS



hit2020\_WACCMv7\_TK

OCS

