

Supporting Information for “GEOS Constituent Data Assimilation Beyond Aura MLS: Assimilating NASA SAGE III/ISS profiles of stratospheric water vapor for continued climate record”

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Introduction

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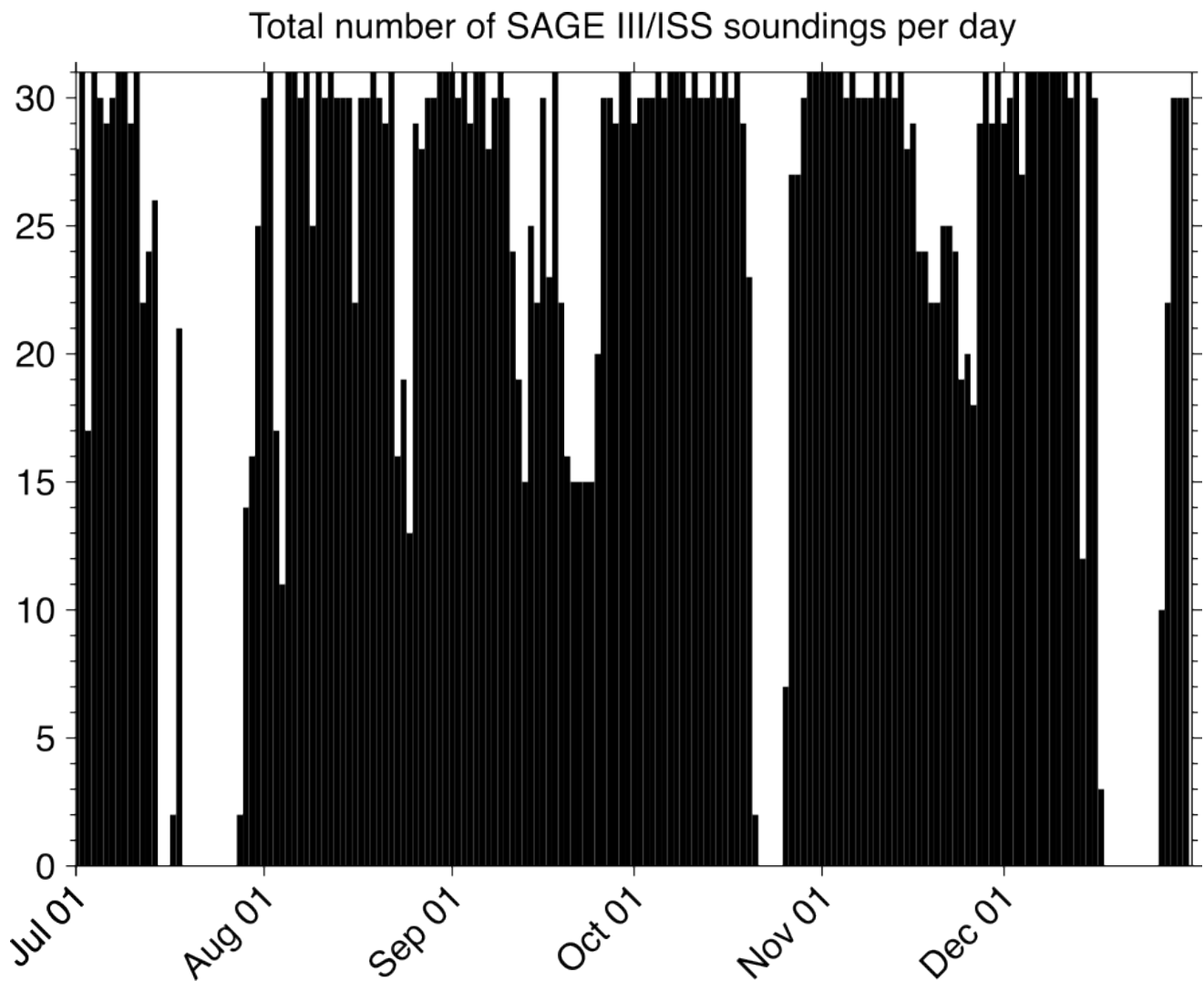


Figure S1. Total number of SAGE III/ISS profiles available for the assimilation globally from July 1, 2017 through December 31, 2017.

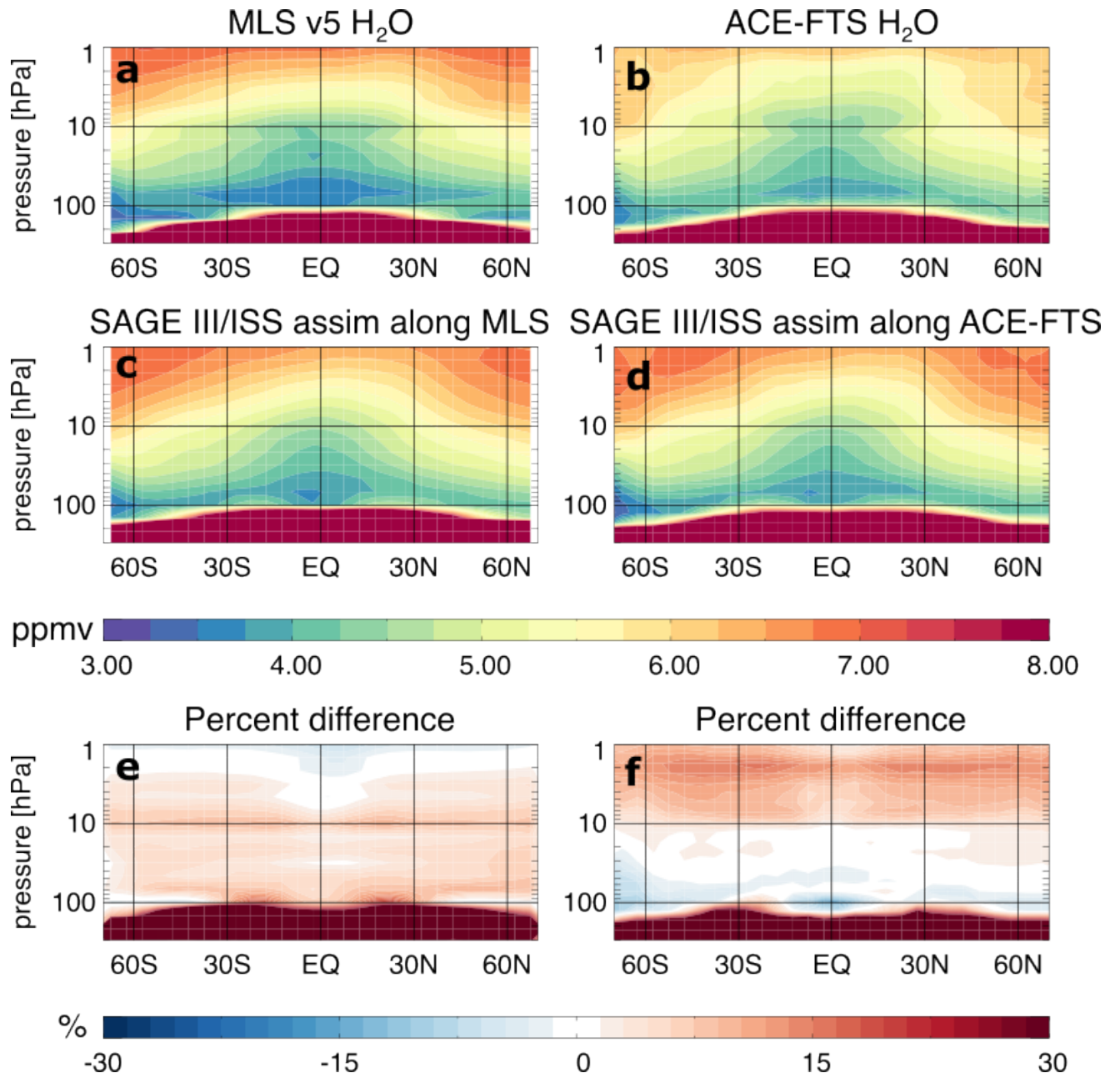


Figure S2. Zonal mean water vapor for 2018-2021 for MLS v5 (a) and ACE-FTS (b) compared to co-located CoDAS SAGE III/ISS v5.2 analyzed water vapor (c and d, respectively) and the difference of the SAGE assimilation minus the observation (e and f, respectively).

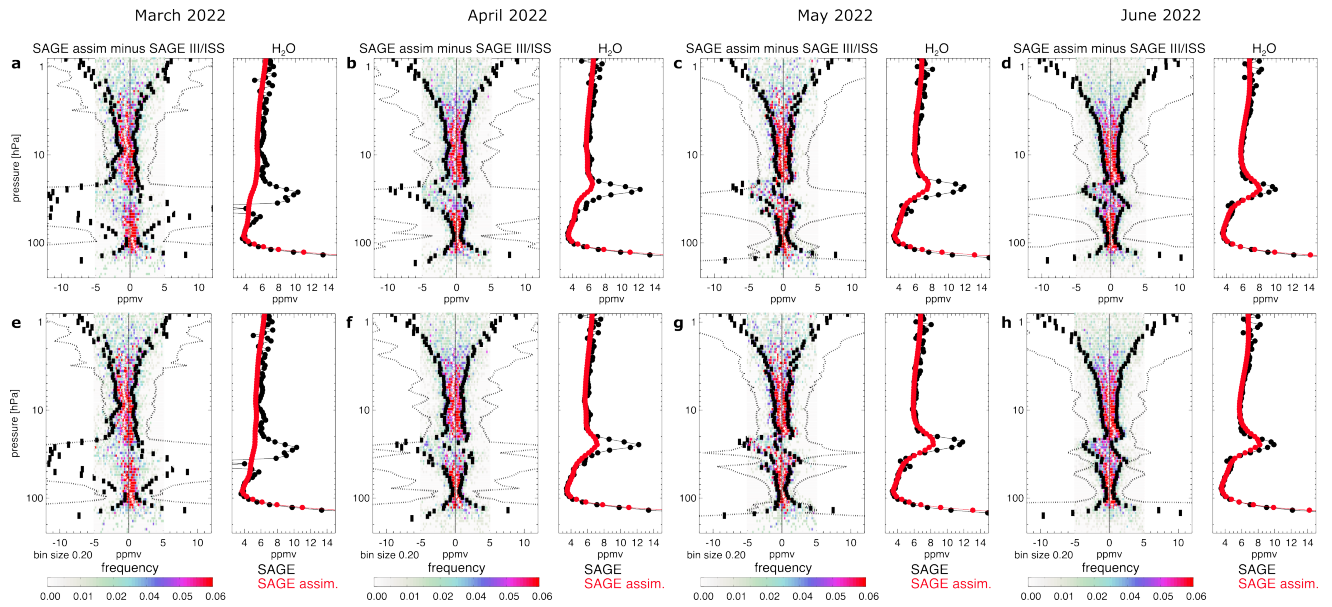


Figure S3. Similar to Figure 5, except here monthly statistics for March (a,e), April (b,f), May (c,g) and June (d,h) 2022 for SAGE observations compared to the SAGE assimilation (a-d) and the SAGE assimilation with reduced uncertainty (e-h). Note, panel d is the same as Figure 5a,b.

June 2022

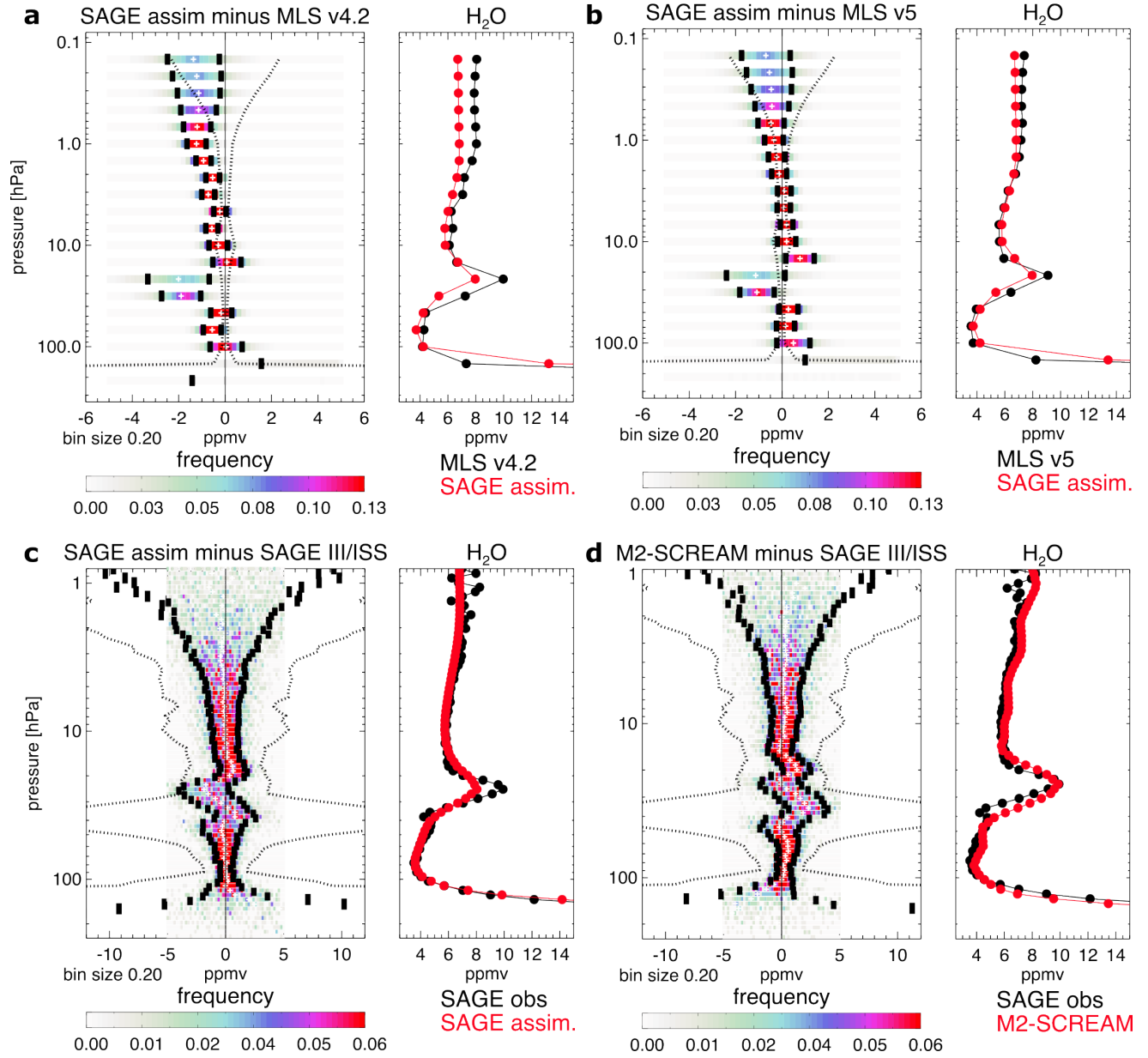


Figure S4. Similar to Figure 5 with monthly statistics for June 2022, except here (a) MLS v4.2 and (b) MLS v5 observations compared to the SAGE assimilation, with dotted lines indicating the MLS instrument uncertainty estimates. For comparison, Figure 5 reproduced here as panels c and d.

Table S1. Comparison of GEOS model and DA products compared to co-located ACE-FTS measurements of water vapor between 70° S to 70° N in 2018. Pearson correlation (r) ≥ 0.9 are in bold.

	Theta level (K)	Pearson Correlation	absolute mean bias (ppmv)	absolute std. dev. (ppmv)	mean bias active ACE (%)	std. dev rel- to to ACE (%)
<i>Control</i>						
	1500	0.76	0.78	0.28	13.37	4.69
	1000	0.88	0.50	0.30	8.75	5.30
	800	0.90	0.24	0.30	4.35	5.38
	500	0.39	0.22	0.60	4.74	12.97
	400	0.28	1.52	1.51	38.15	37.97
<i>CoDAS SAGE III/ISS v5.2</i>						
	1500	0.78	0.83	0.26	14.14	4.44
	1000	0.90	0.50	0.27	8.83	4.71
	800	0.93	0.10	0.26	1.75	4.63
	500	0.64	-0.09	0.45	-1.99	9.70
	400	0.48	-0.12	1.03	-3.04	25.72
<i>CoDAS MLS v5.0</i>						
	1500	0.60	0.68	0.47	11.60	7.96
	1000	0.88	0.20	0.31	3.58	5.38
	800	0.92	-0.21	0.27	-3.72	4.89
	500	0.70	-0.28	0.38	-6.07	8.21
	400	0.54	-0.23	0.95	-5.70	23.80
<i>M2 – SCREAM</i>						
	1500	0.82	1.14	0.27	19.51	4.59
	1000	0.92	0.80	0.27	14.08	4.75
	800	0.94	0.35	0.29	6.28	5.22
	500	0.76	0.22	0.33	4.85	7.24
	400	0.55	0.34	0.95	8.64	23.82