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Supporting Information for

M2-SCREAM: A Stratospheric Composition Reanalysis of Aura MLS data with MERRA-2 transport

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Contents of this file

Figures S1 to S18

Additional Supporting Information (Files uploaded separately)

Captions for Movies S1 to S3

Introduction

This file contains supplementary figures and movie captions for “M2-SCREAM: A Stratospheric Composition Reanalysis of Aura MLS data with MERRA-2 transport”. Figure S1 shows observation minus forecast statistics for water vapor, HCl, HNO₃, and N₂O, analogous to Figure 3a and b in the main text. Figure S2 plots global zonal mean comparisons between M2-SCREAM and BRAM2. Figures S3–S16 show comparisons of M2-SCREAM HNO₃, H₂O, and ozone with GLORIA data from individual flights during the joint Polar Stratosphere in a Changing Climate, Gravity Wave Life Cycle Experiment, and Seasonality of Air mass transport and origin in the Lowermost Stratosphere using the HALO Aircraft campaigns. These are analogous to Figure 6 in the main text. Figures S17 and S18 show statistical comparisons of M2-SCREAM with ACE-FTS as in Figure 10 but limited to 30°N–60°N and for December–January 2005–2020. Animations S1–S3 show all available frost point hygrometer water vapor profile observations between 2005 and 2021 and collocated M2-SCREAM profiles. These are discussed in Section 6.1 of the main text. Figure 7 shows statistical comparisons calculated using the data displayed in the animations.

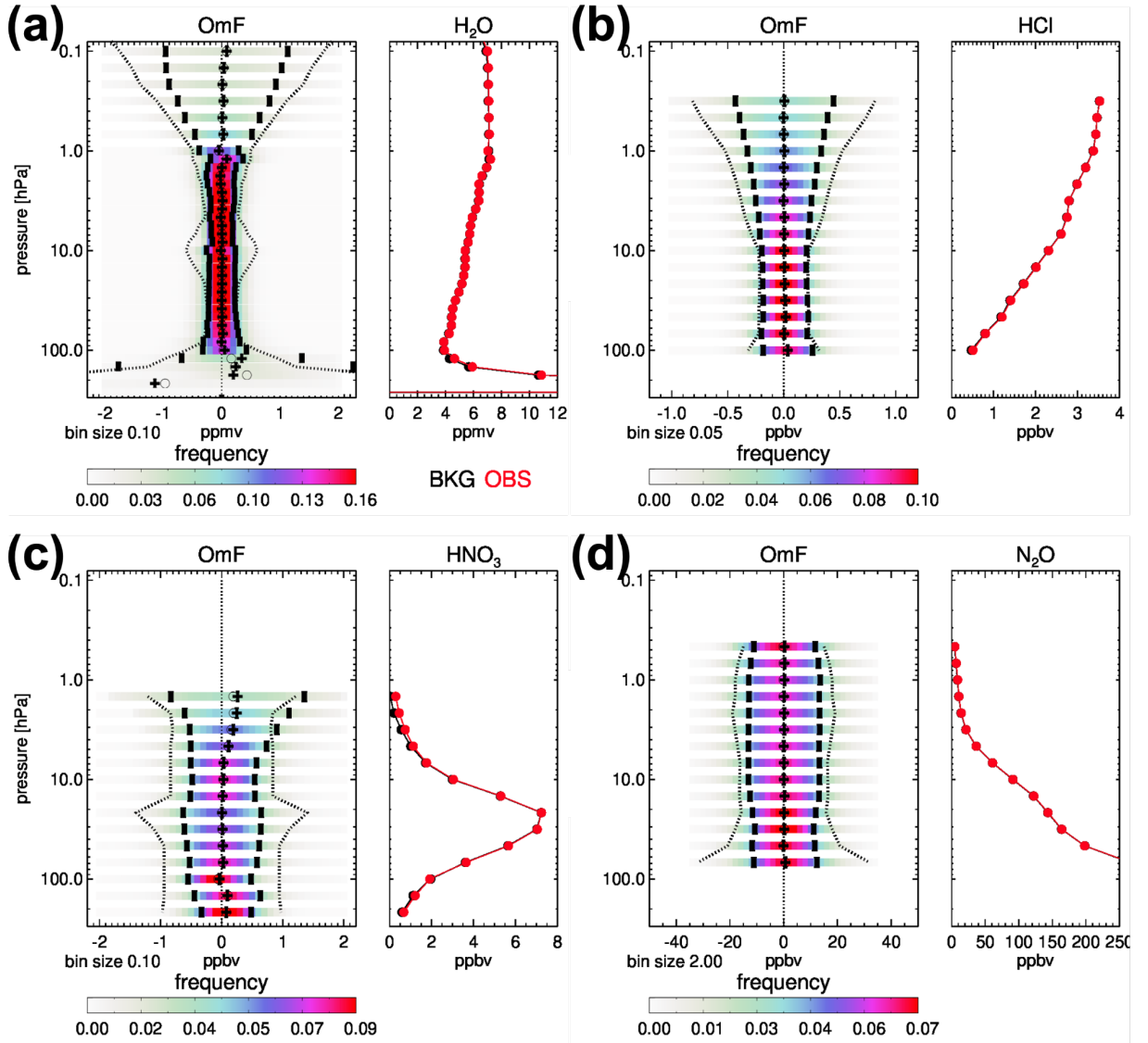


Figure S1: Internal global SCREAM statistics for H_2O (a), HCl (b), HNO_3 ©, and N_2O (d). The right-hand side panels show the mean background and MLS profiles. Observation minus forecast (O-F) statistics are plotted in the left-hand side panels. Shown are the O-F mean (plus signs), median (open circles), standard deviations around the mean (short vertical bars), probability density functions (colors) at prescribed pressure levels. The dotted lines are plus/minus MLS uncertainty estimates. Valid for January 2005.

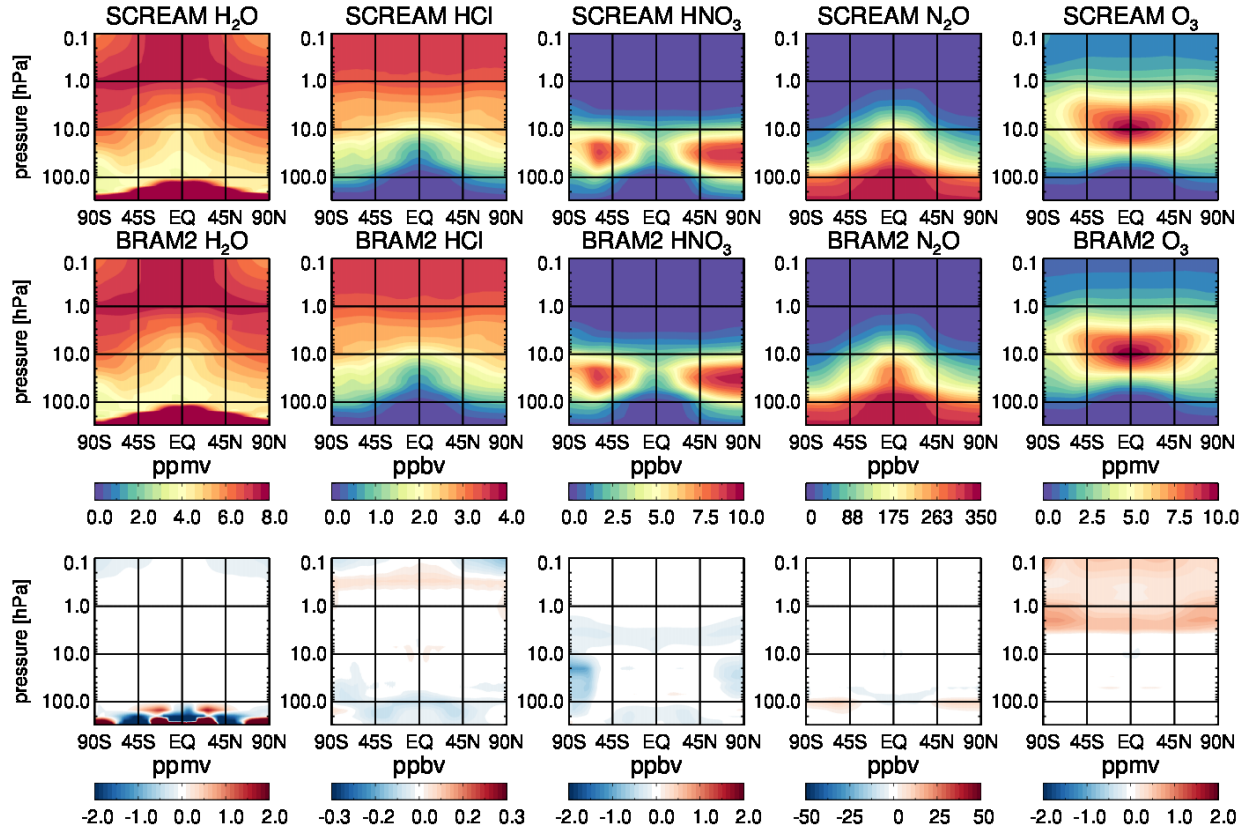


Figure S2: Zonal mean mixing ratios of the assimilated constituents from the BRAM2 reanalysis (a) and SCREAM (b). The SCREAM minus BRAM2 differences are shown in (c).

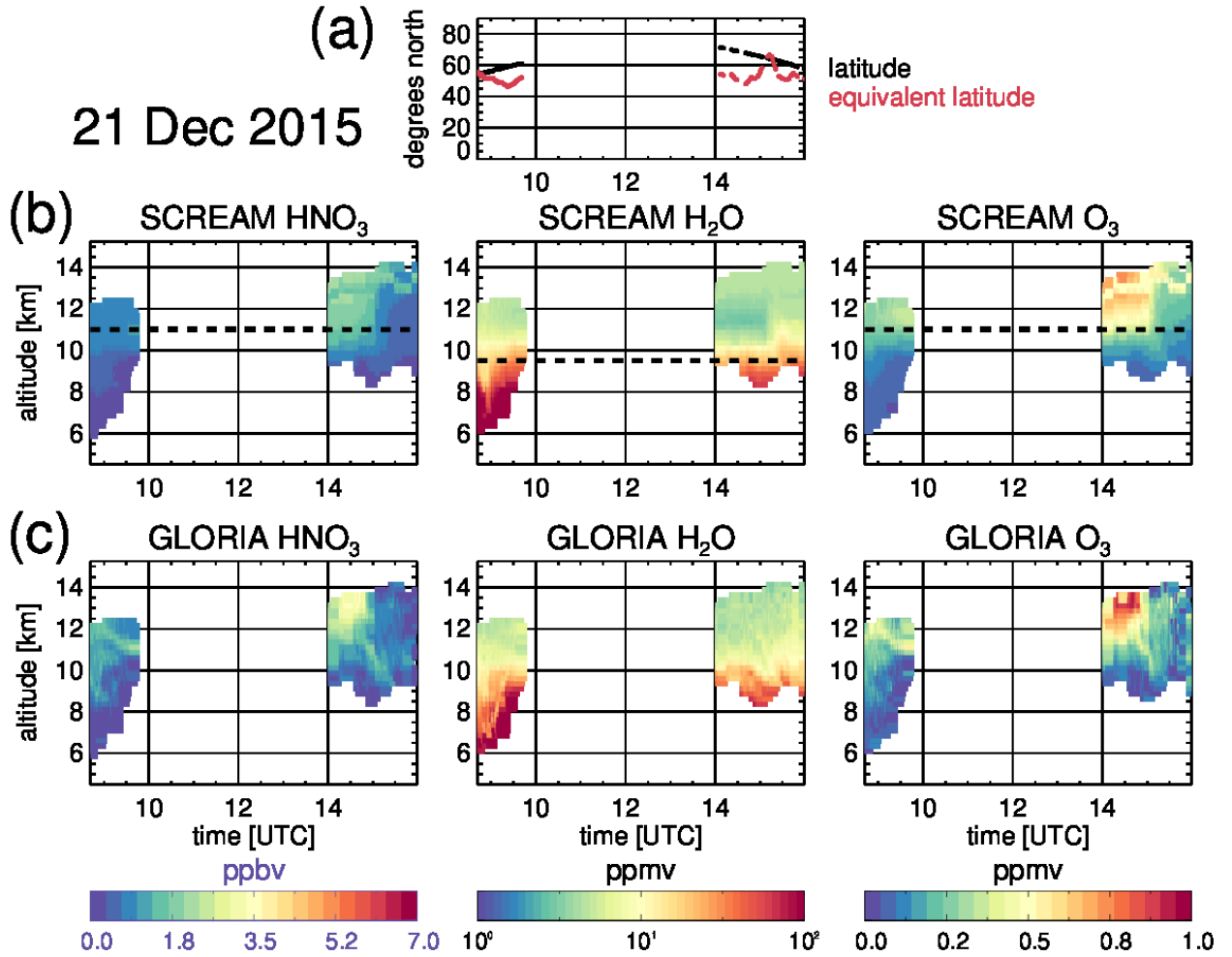


Figure S3: (a) Latitudes and equivalent latitudes of the GLORIA measurements at 10 km. (b) M2-SCREAM HNO₃, water vapor, and ozone collocated with GLORIA measurements during a single flight on 21 December 2015. The dashed lines mark the lowest altitudes of MLS observations assimilated in M2-SCREAM. (c) GLORIA observations.

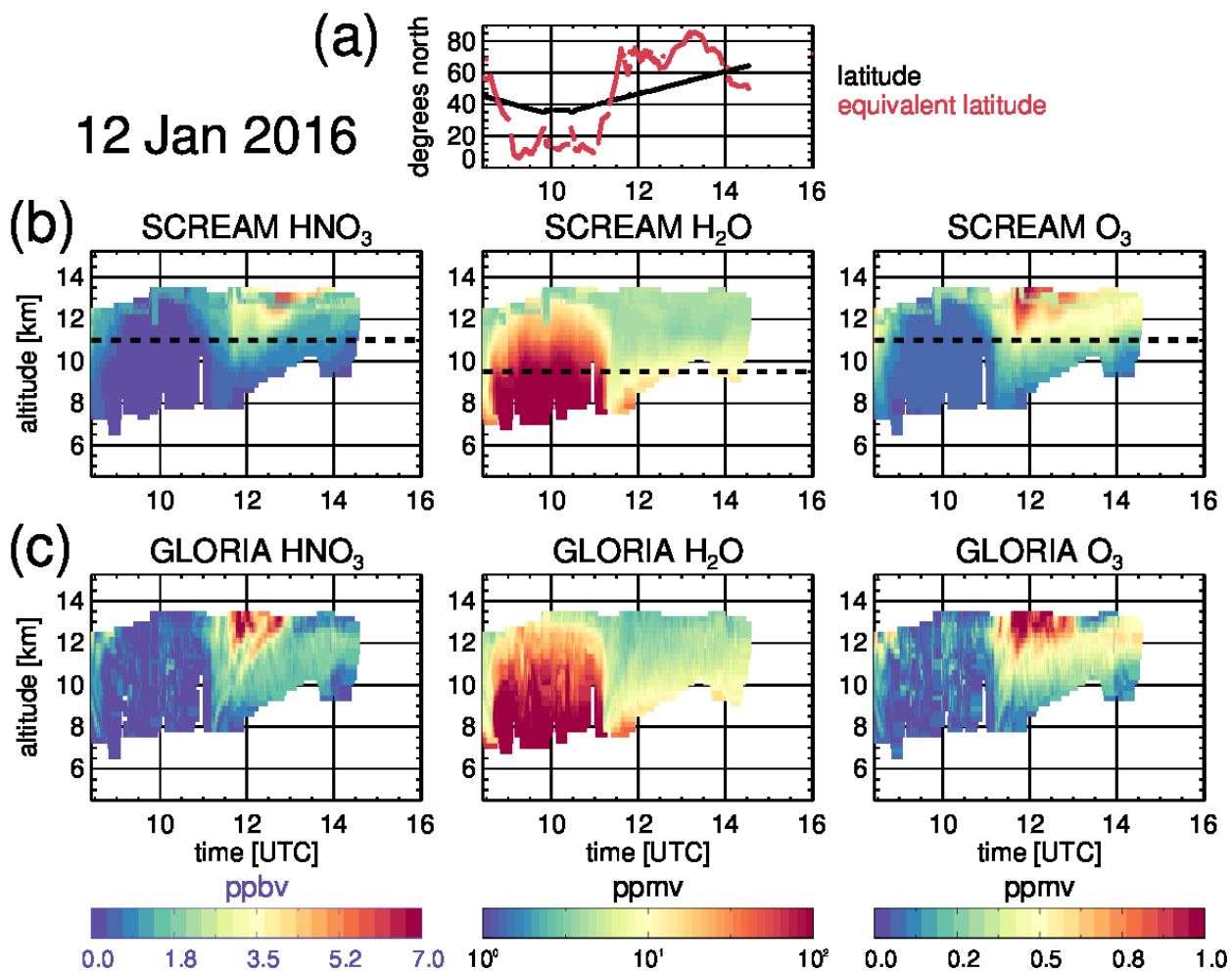


Figure S4: As in Fig. S3 but for 12 January 2016.

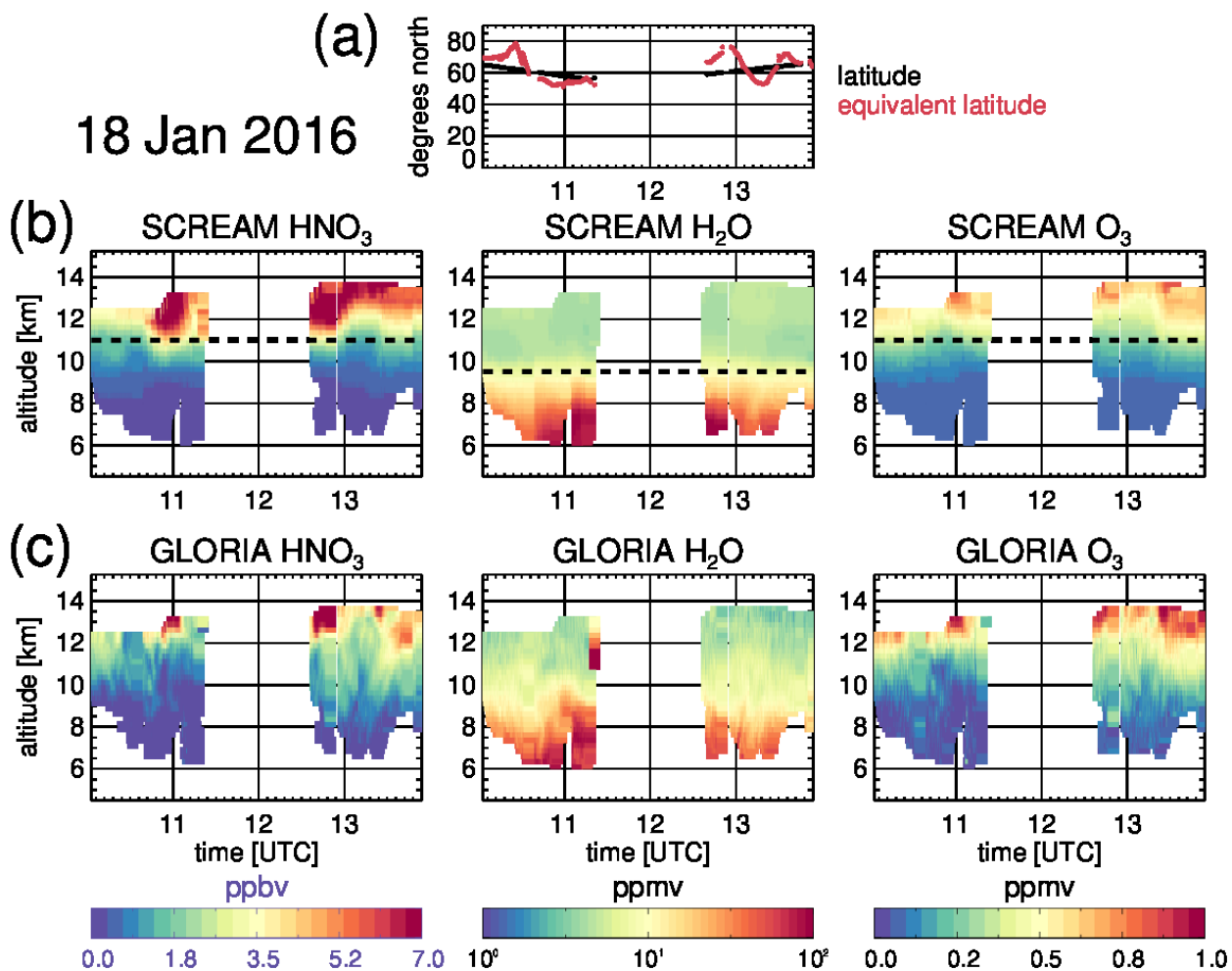


Figure S5: As in Fig. S3 but for 18 January 2016.

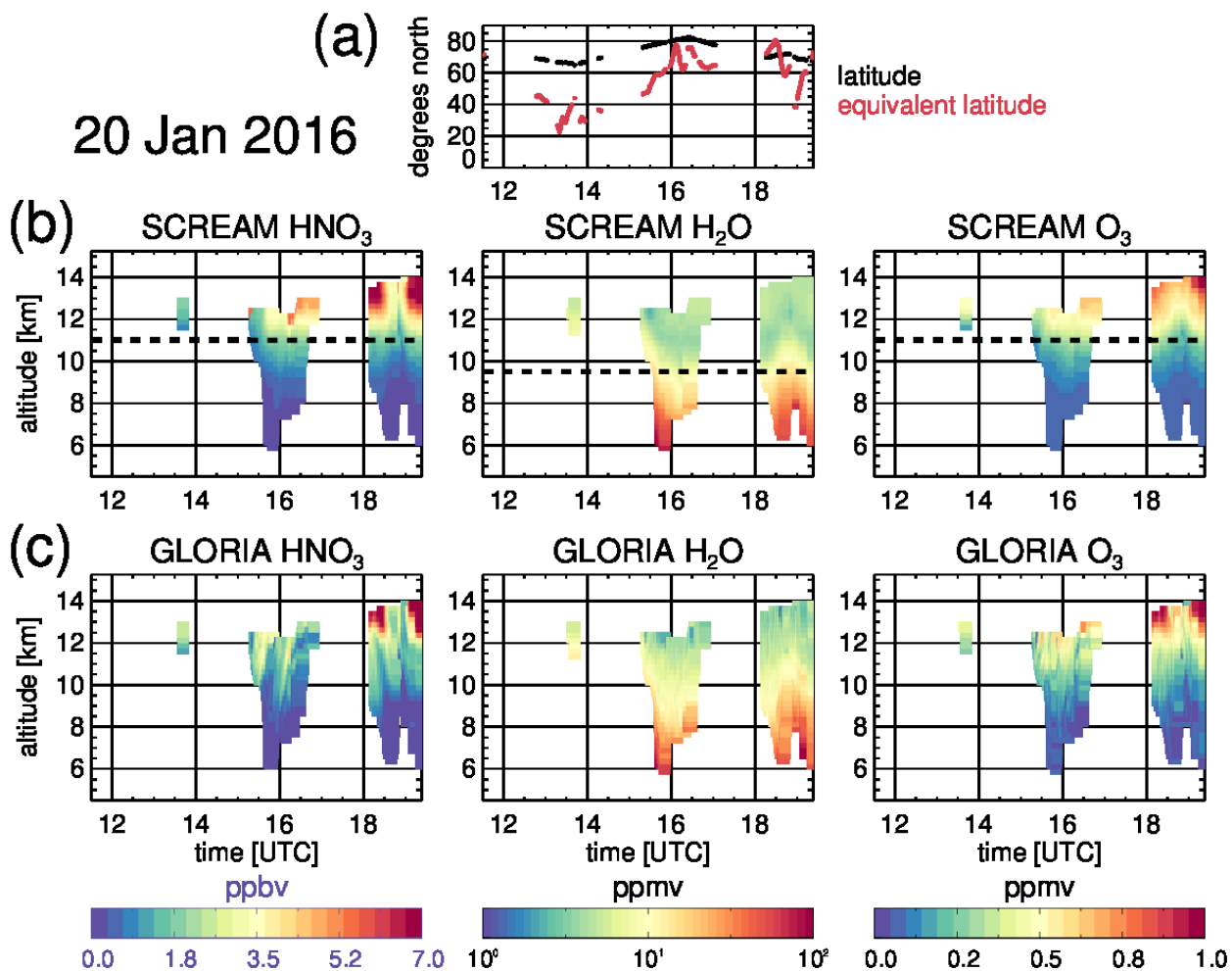


Figure S6: As in Fig. S3 but for 20 January 2016.

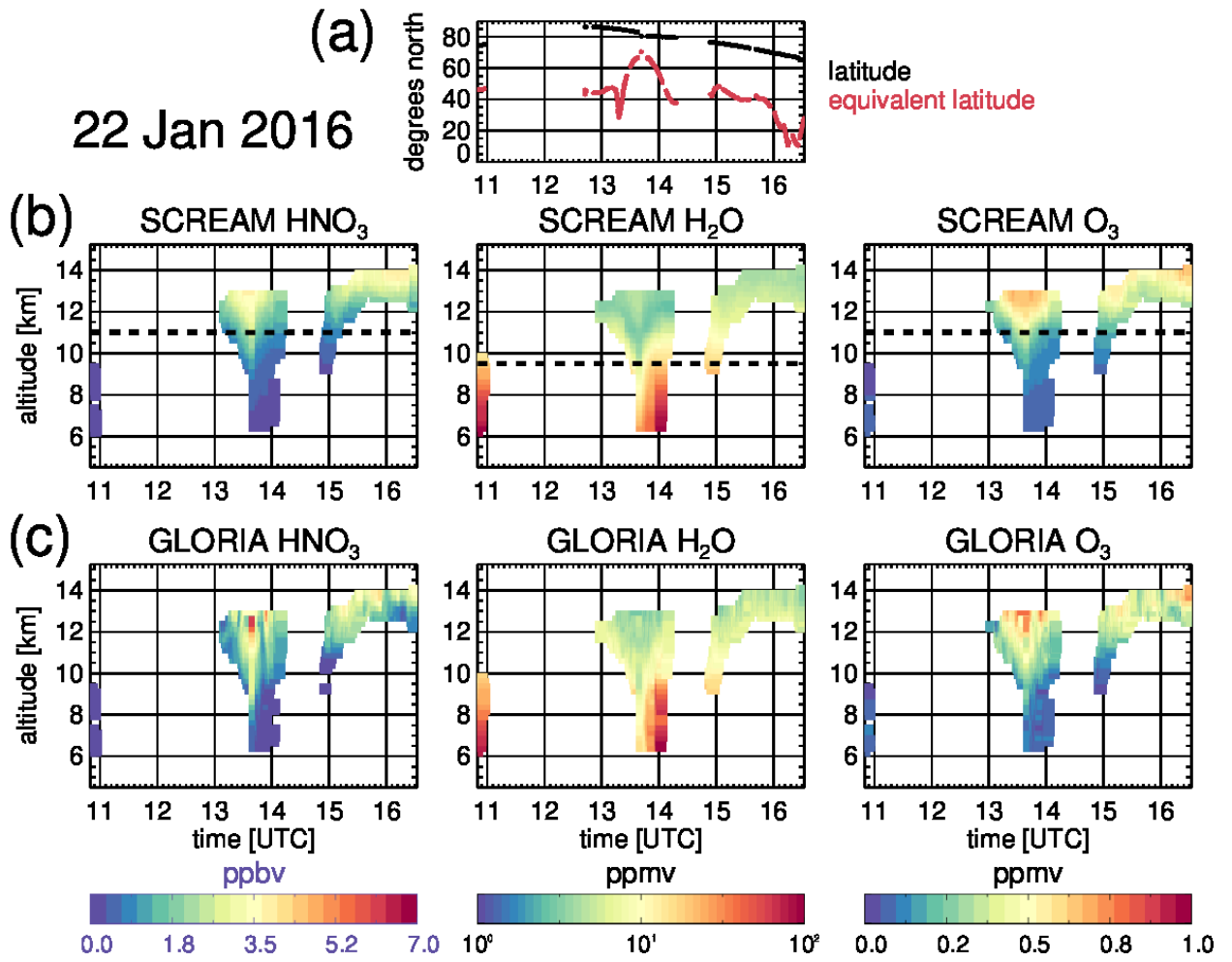


Figure S7: As in Fig. S3 but for 22 January 2016.

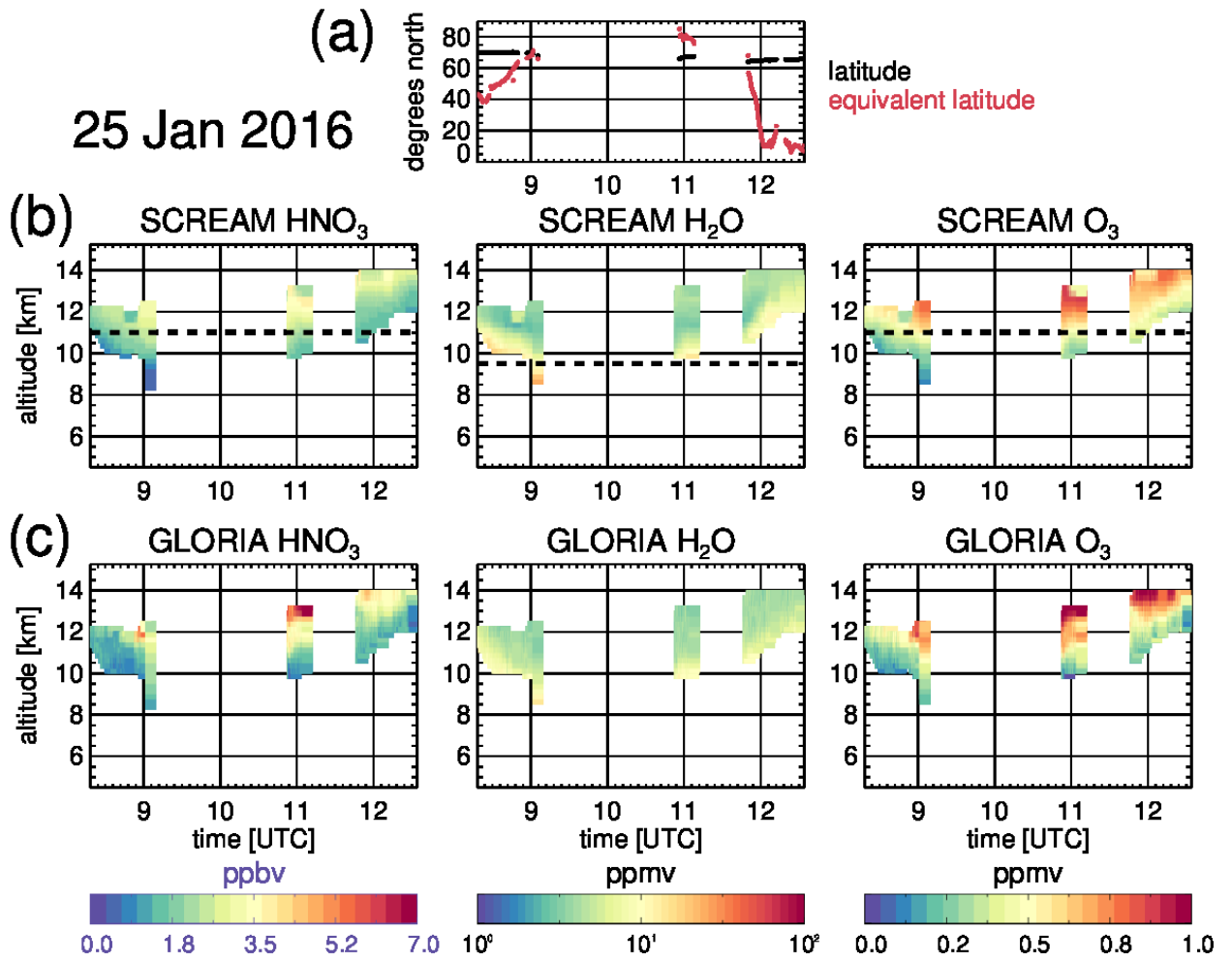


Figure S8: As in Fig. S3 but for 25 January 2016.

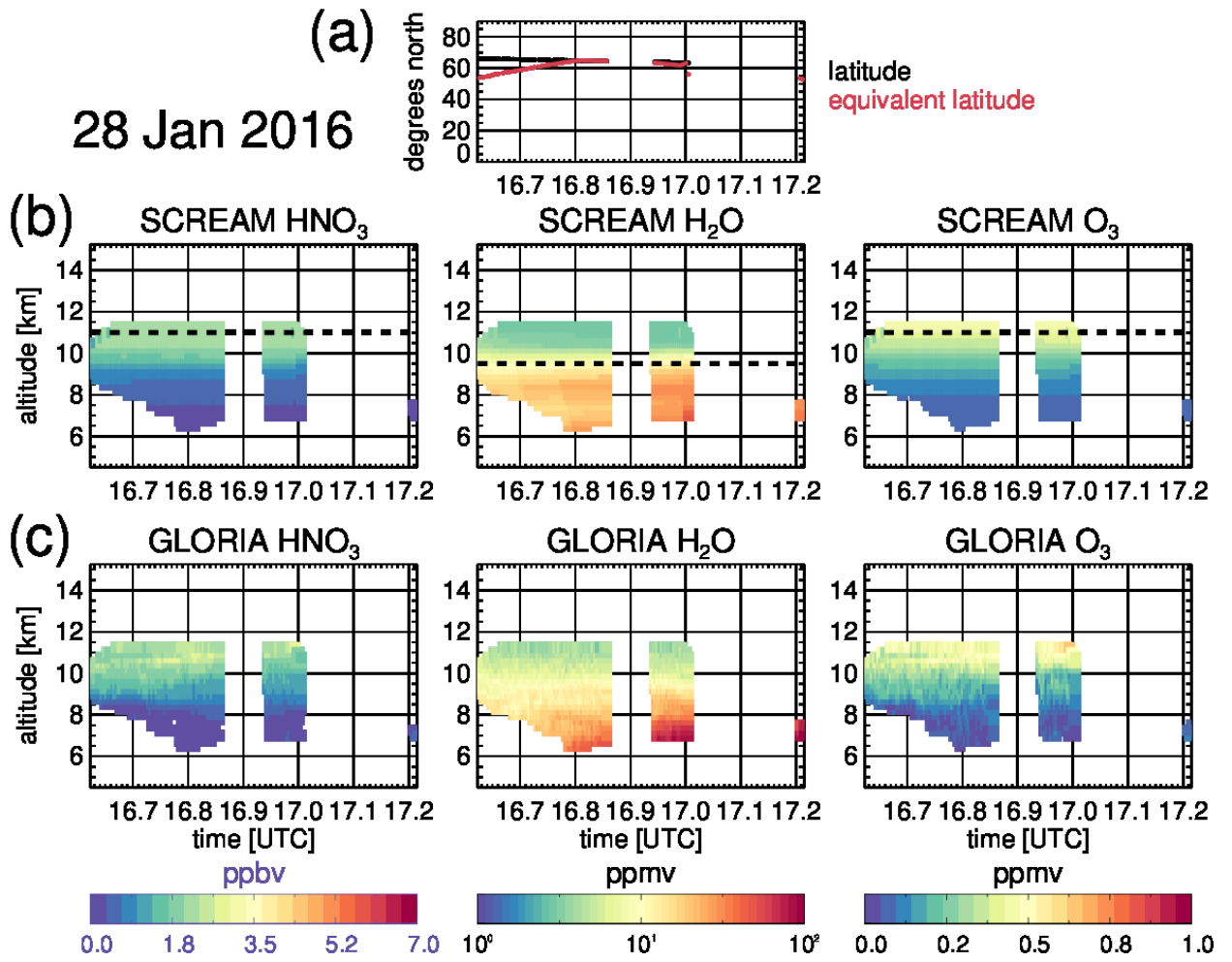


Figure S9: As in Fig. S3 but for 28 January 2016.

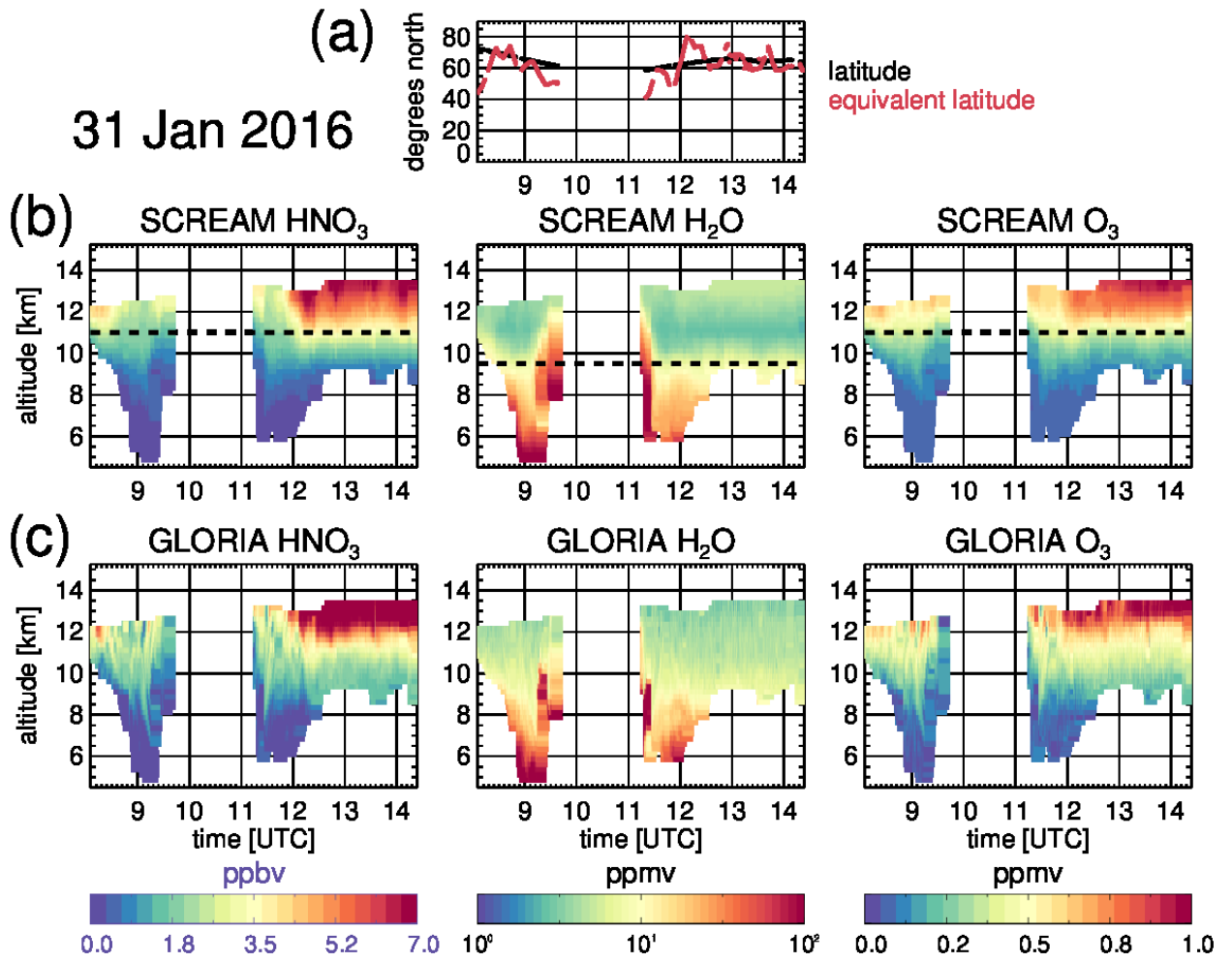


Figure S10: As in Fig. S3 but for 31 January 2016.

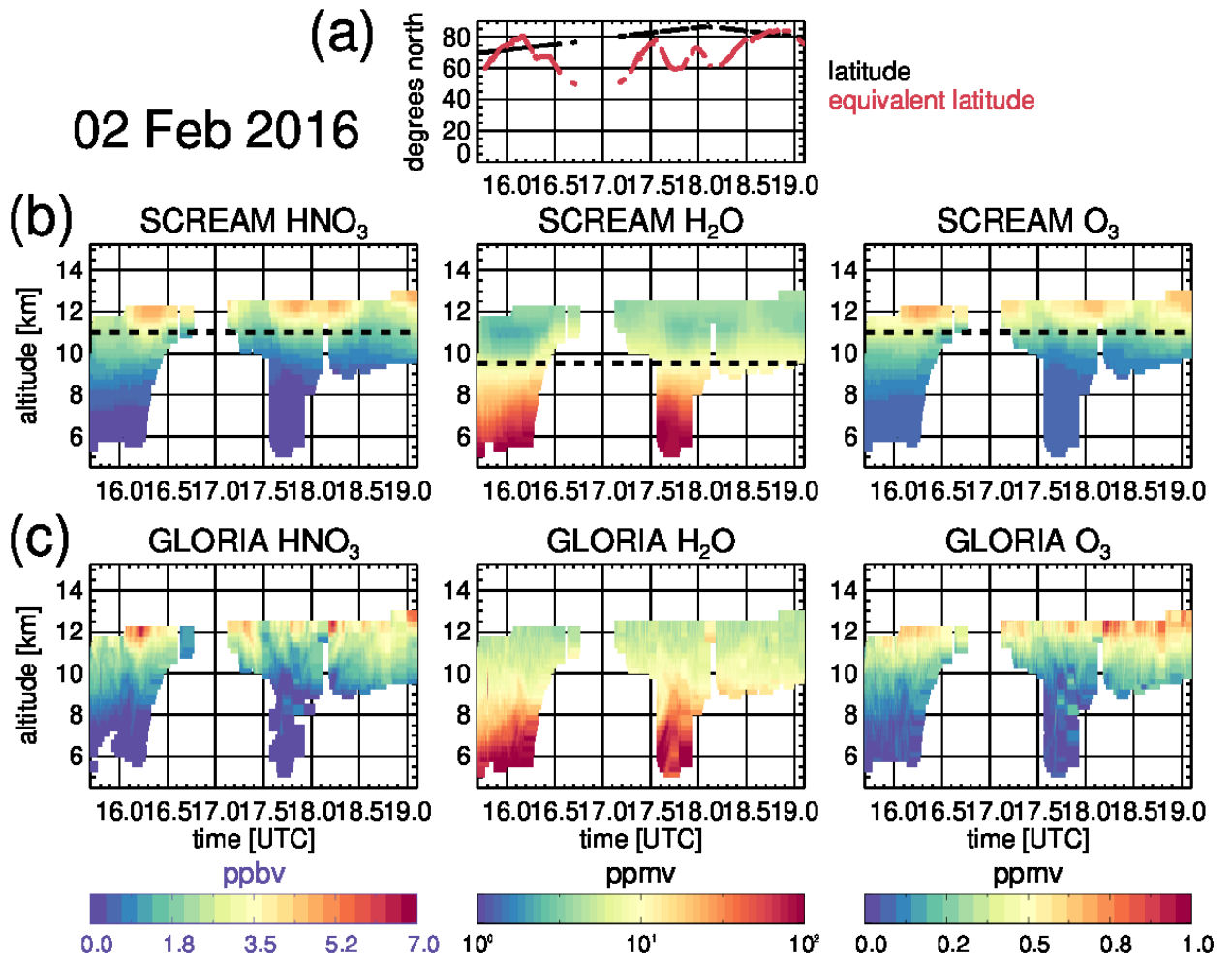


Figure S11: As in Fig. S3 but for 2 February 2016.

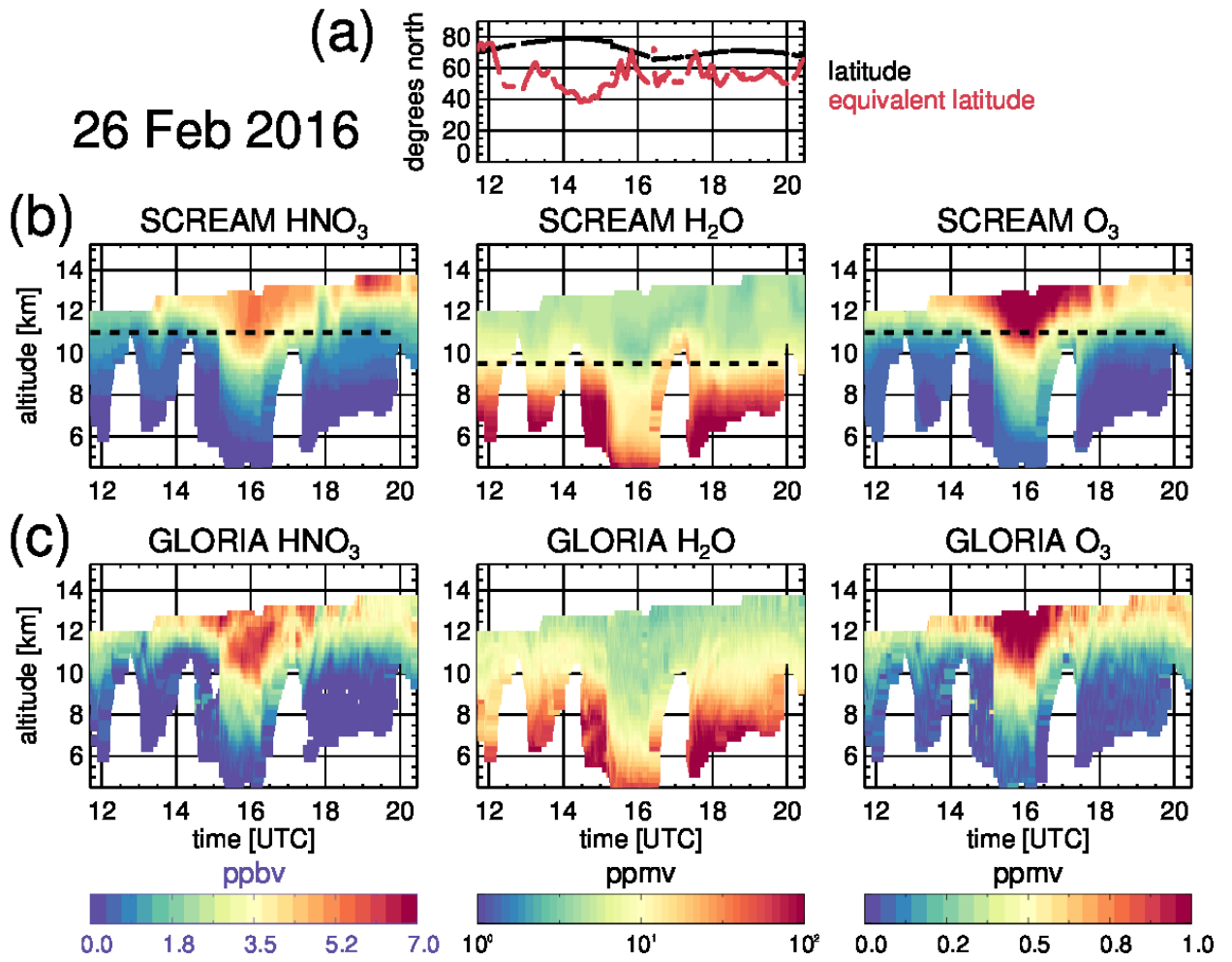


Figure S12: As in Fig. S3 but for 26 February 2016.

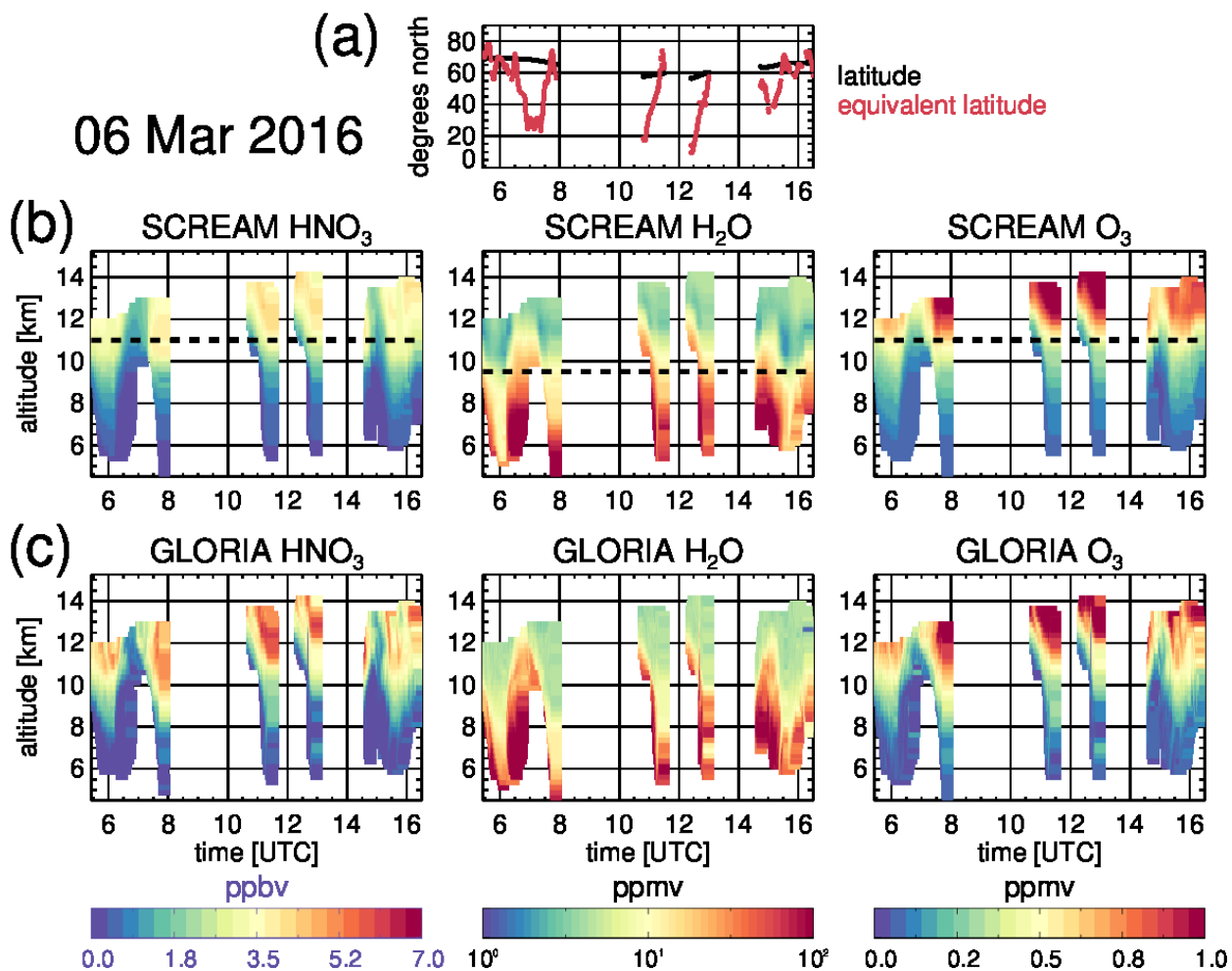


Figure S13: As in Fig. S3 but for 6 March 2016.

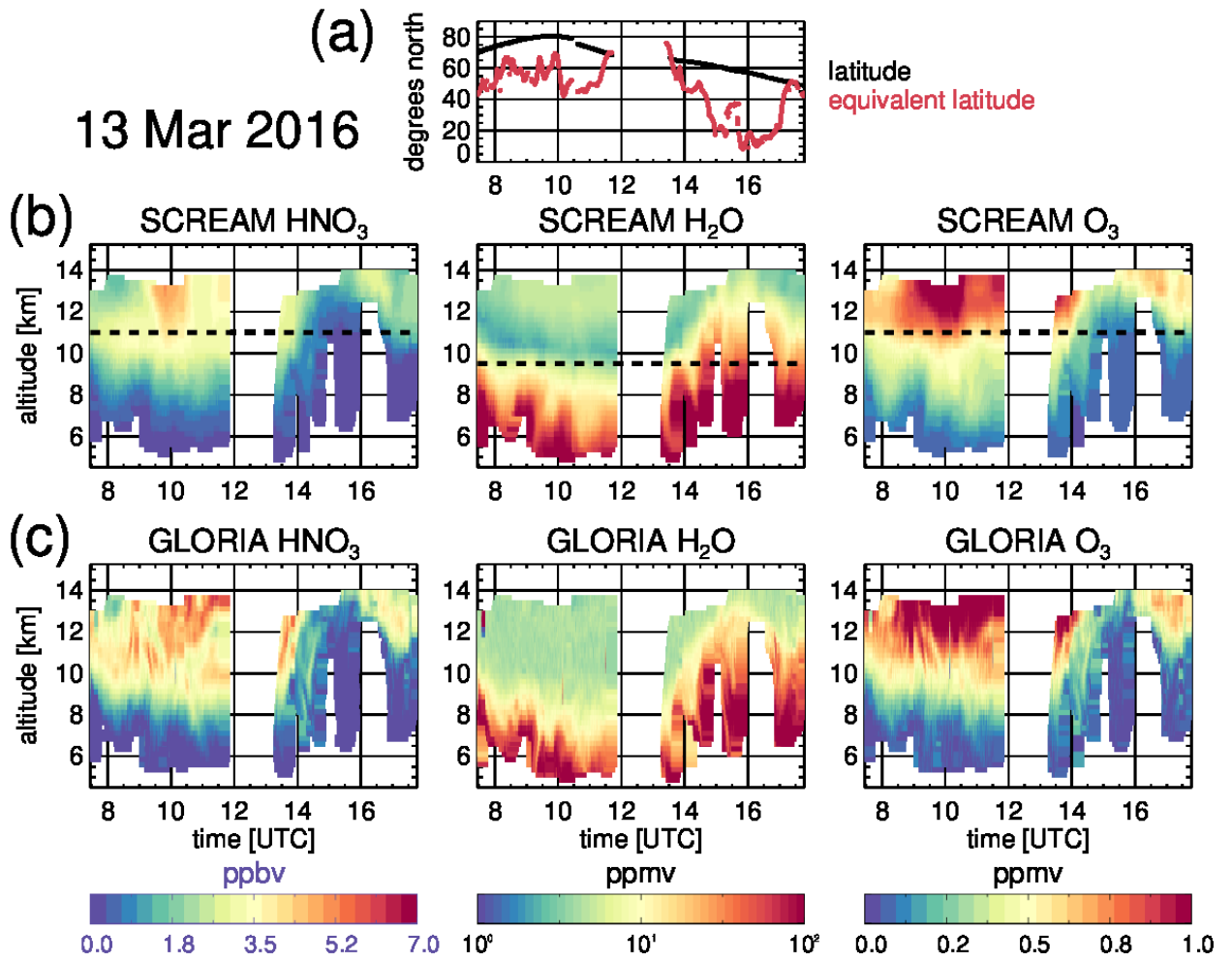


Figure S14: As in Fig. S3 but for 13 March 2016.

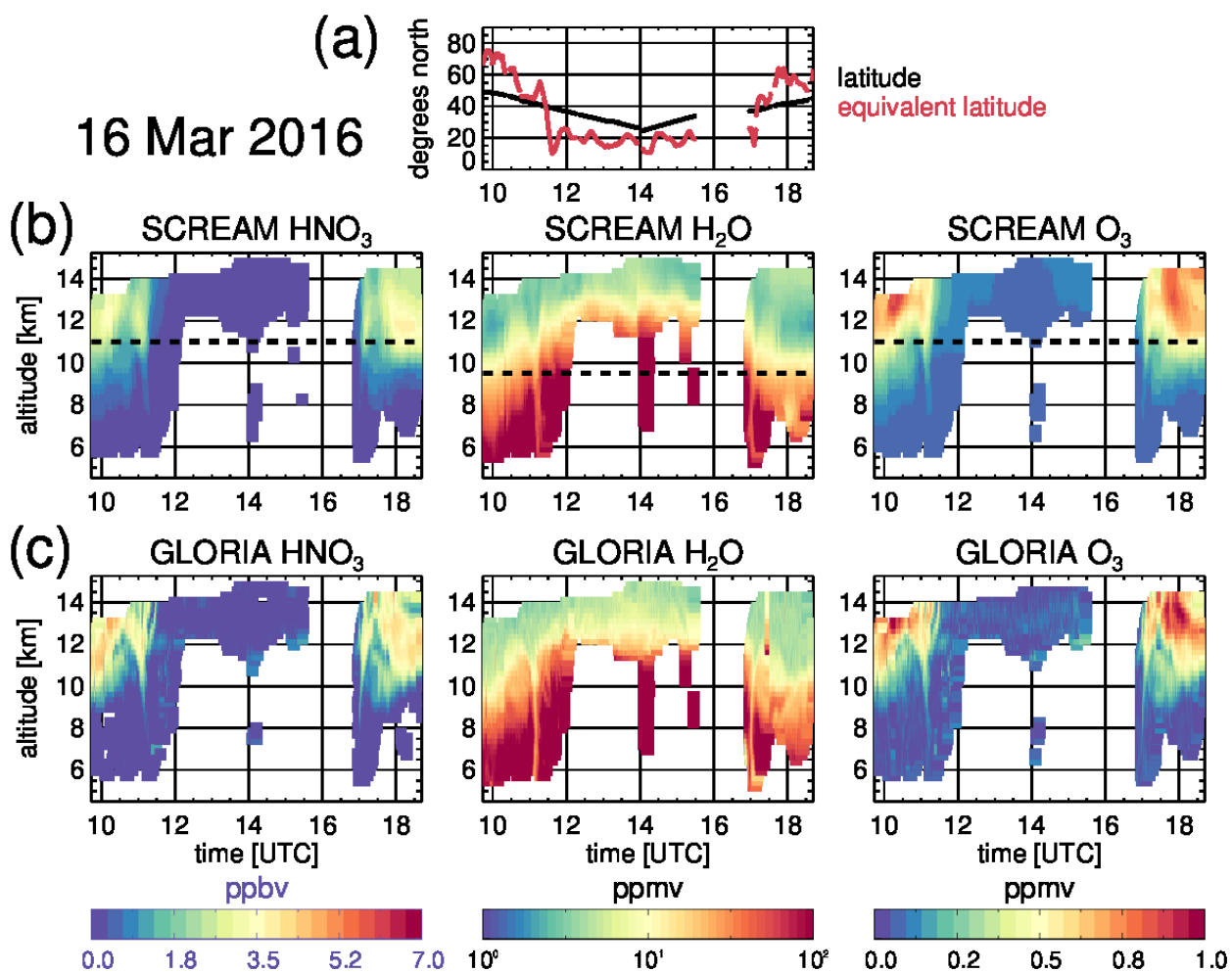


Figure S15: As in Fig. S3 but for 16 March 2016.

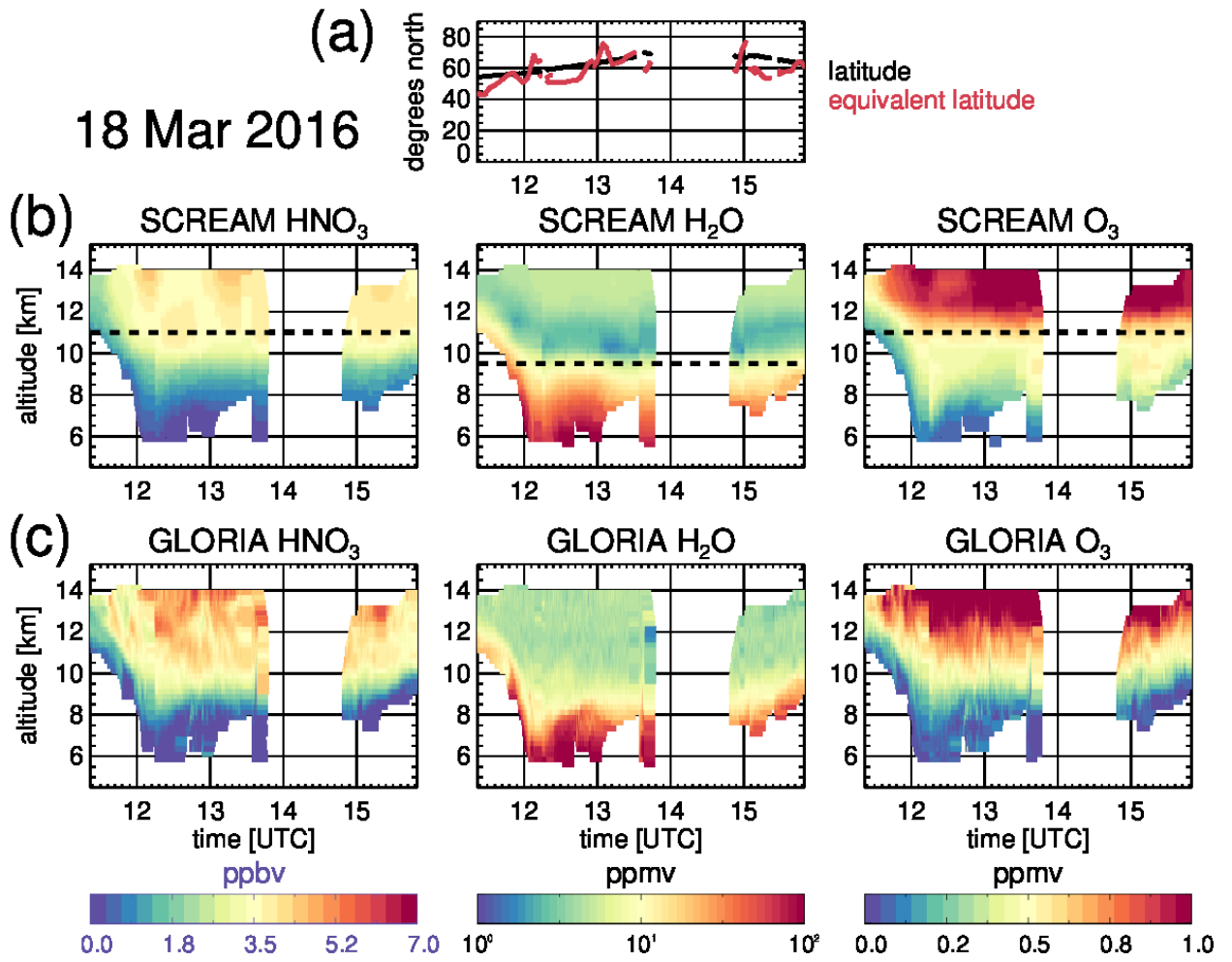


Figure S16: As in Fig. S3 but for 18 March 2016.

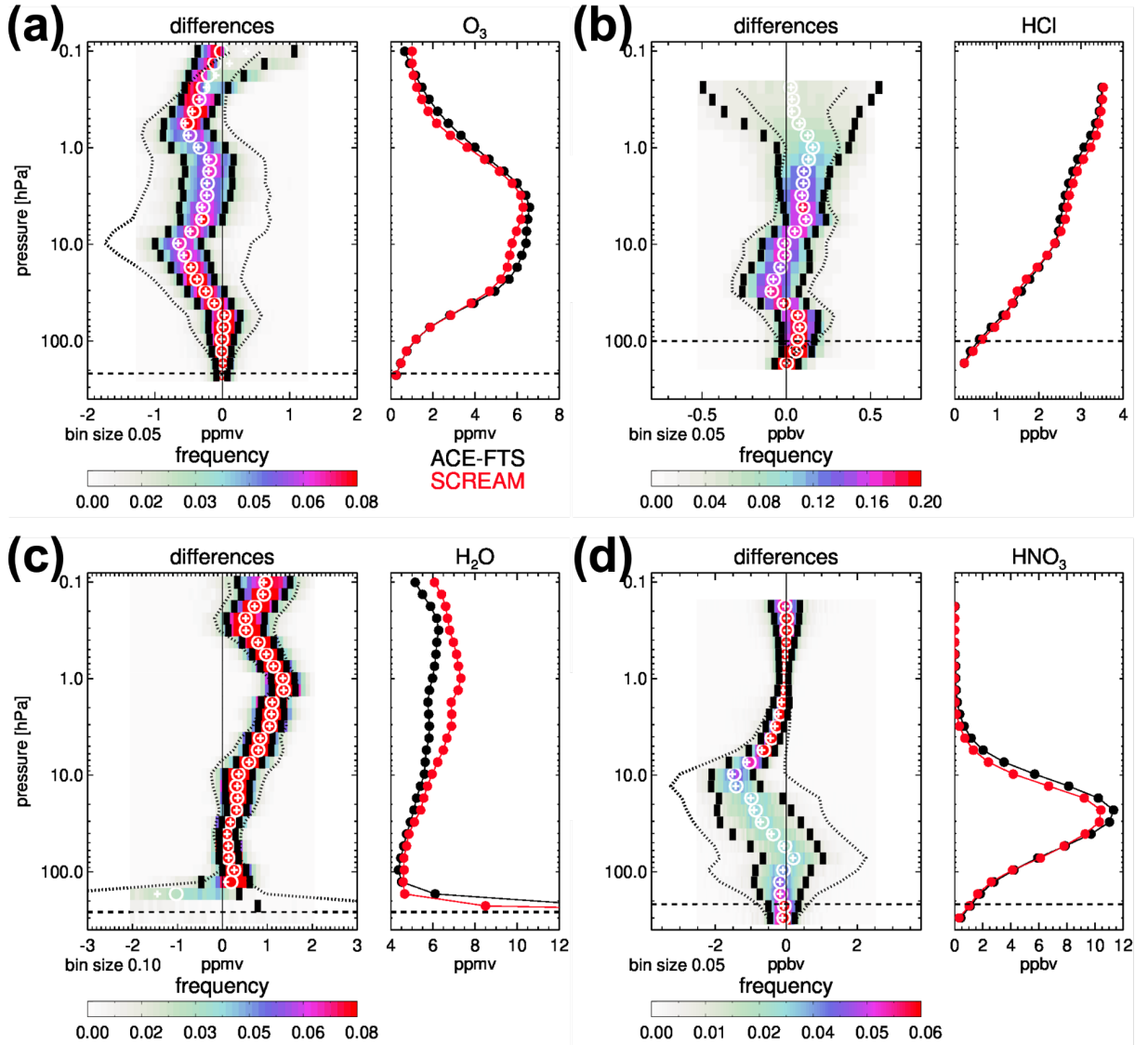


Figure S17: Statistical comparisons of the SCREAM ozone (a) and HCl (b), H₂O (c), and HNO₃ (d). with ACE-FTS observations for December–January, 30°N–60°N. The right- and left-hand side panels show mean profiles and difference statistics, respectively. Shown are the difference mean (plus signs), median (open circles), standard deviations around the mean (short vertical bars), probability density functions (colors) at prescribed pressure levels. The dotted lines are the mean difference plus/minus standard deviation of the ACE-FTS observations. All available December–January 2005–2020 ACE-FTS data are used.

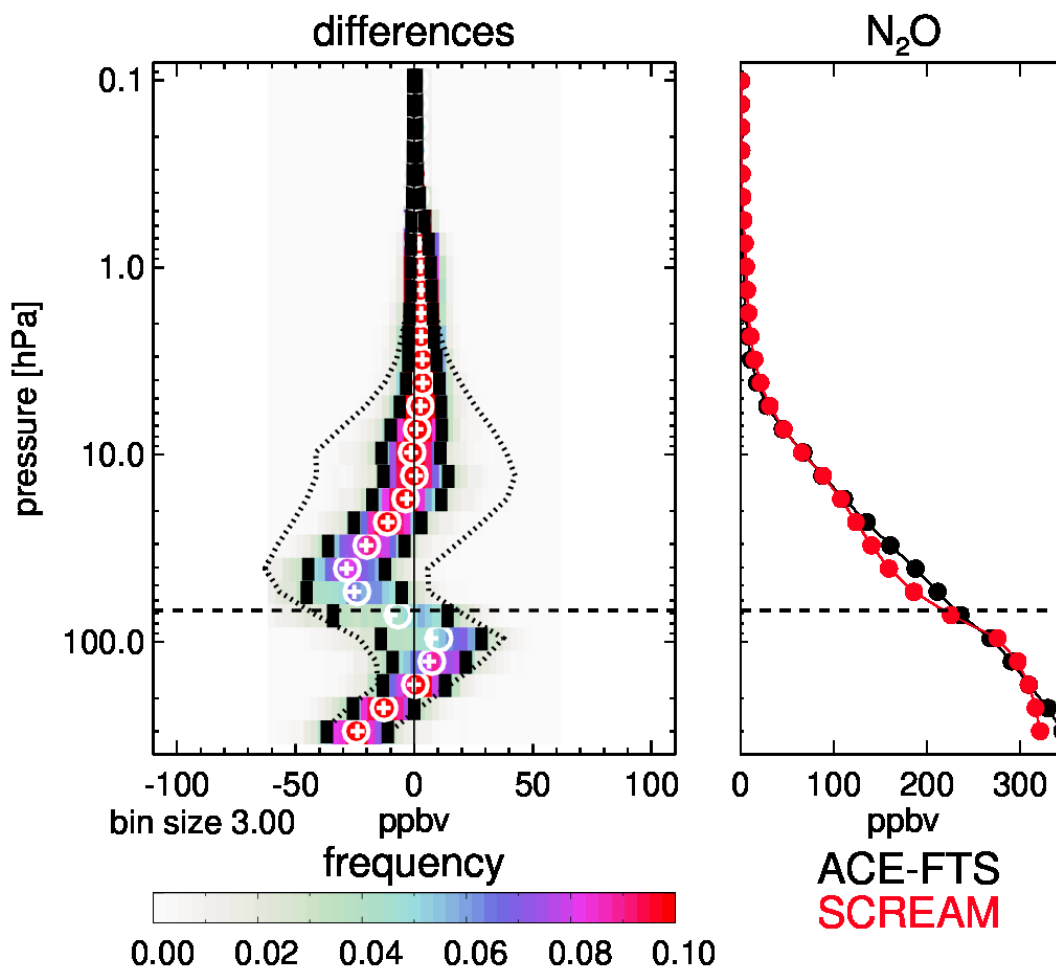


Figure S18: As in Fig. S17 but for N₂O.

Movie S1. File name: M1-Lauder-FPH-SCREAM.mp4. Animation showing all available frost point hygrometer water vapor profiles at Lauder, New Zealand (169.68°E, 45.04°S) between 2005 and 2021 (black) and collocated M2-SCREAM profiles (blue).

Movie S2. File name: M2-Hilo-FPH-SCREAM.mp4. As in Movie S1 but for Hilo, Hawaii (155.05°W, 19.72°N).

Movie S3. File name: M3-Boulder-FPH-SCREAM.mp4. As in Movie S1 but for Boulder, CO, USA (105.2°W, 39.95°N).