Photochemical depletion of heavy CO isotopes in the Martian atmosphere: Supplementary Information

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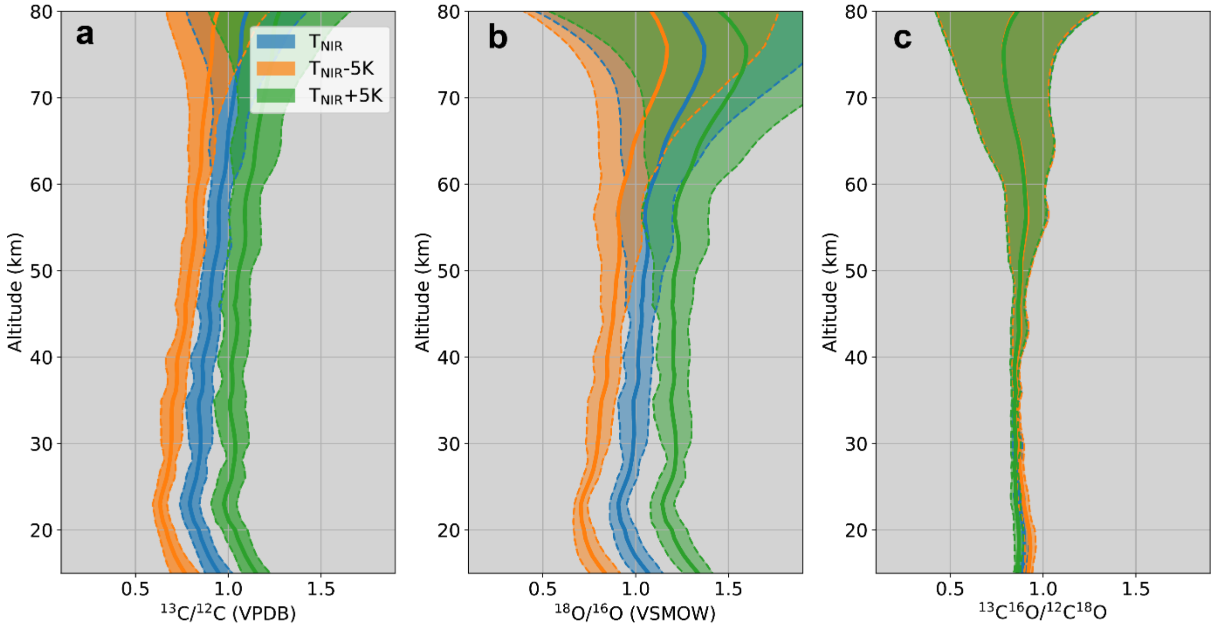
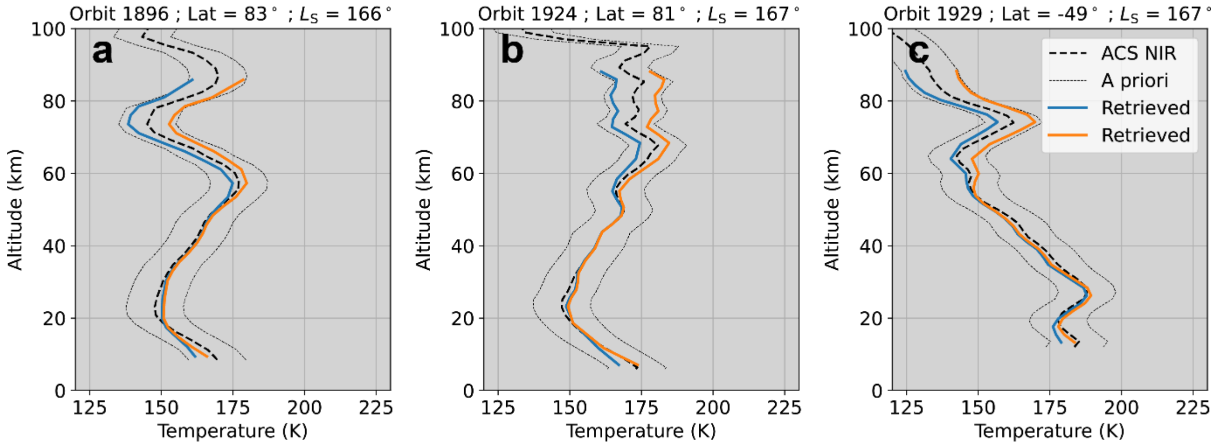
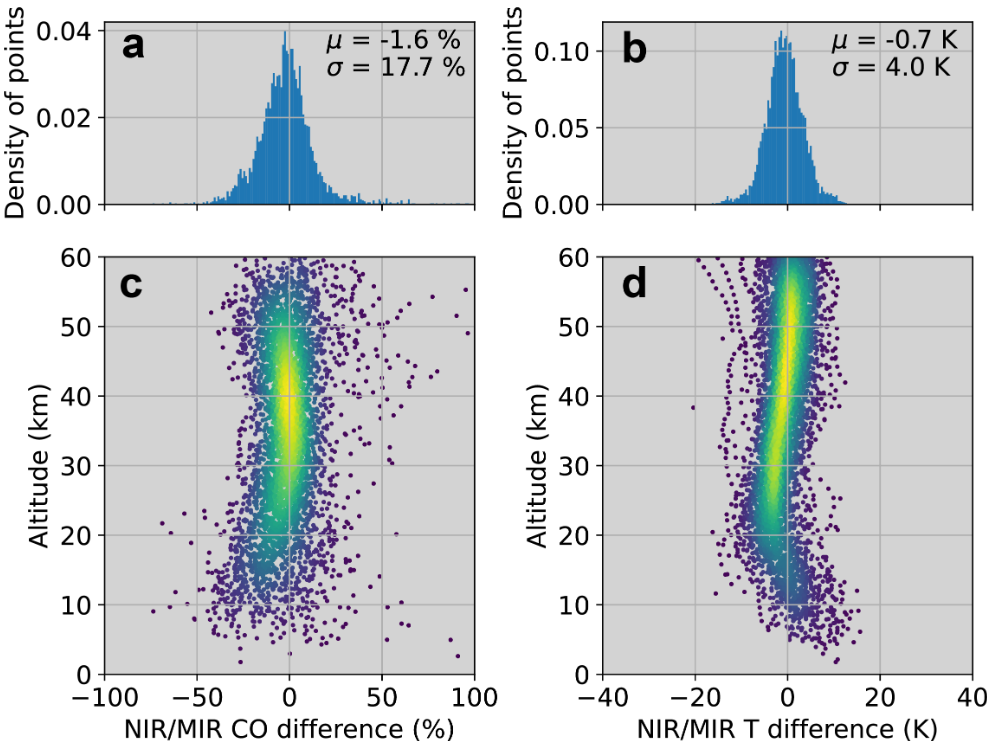
1. Supplementary Figures



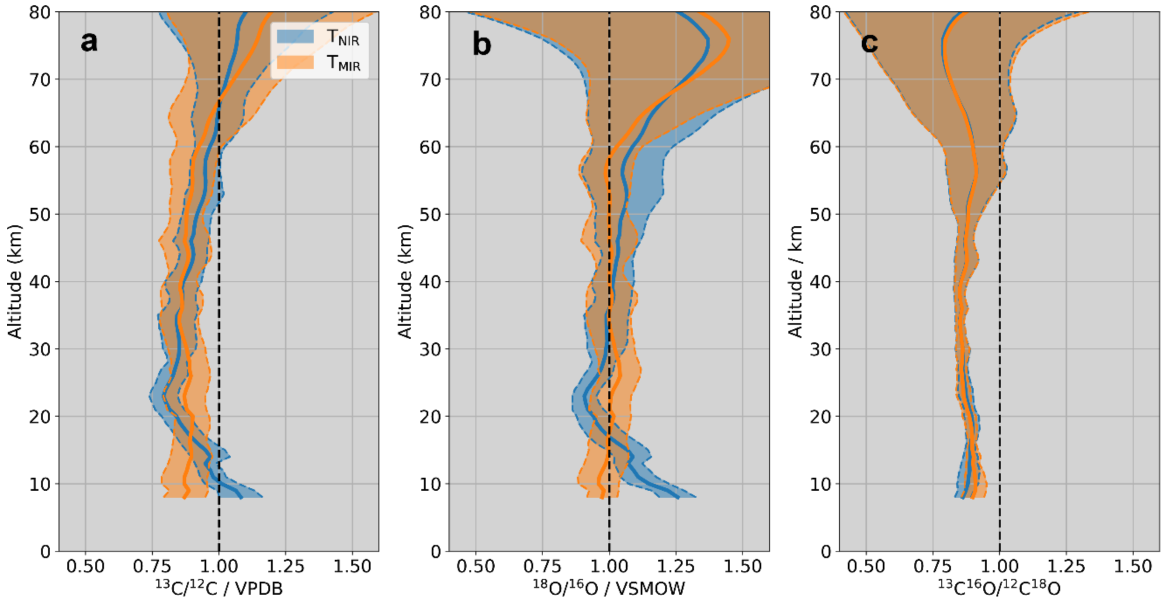
Supplementary Figure 1: Sensitivity of the retrieved isotopic ratios to the assumed temperature distribution. *The panels show the weighted average isotopic ratios derived from the first 20 ACS MIR measurements with secondary grating position 6, assuming different temperature distributions, while the shaded areas represent the standard deviation of the derived profiles. The results show that while $^{13}C/^{12}C$ (a) and $^{18}O/^{16}O$ (b) are highly sensitive to the temperature field, the ratio between the two (c) is insensitive to inaccuracies in the assumed temperature distribution.*



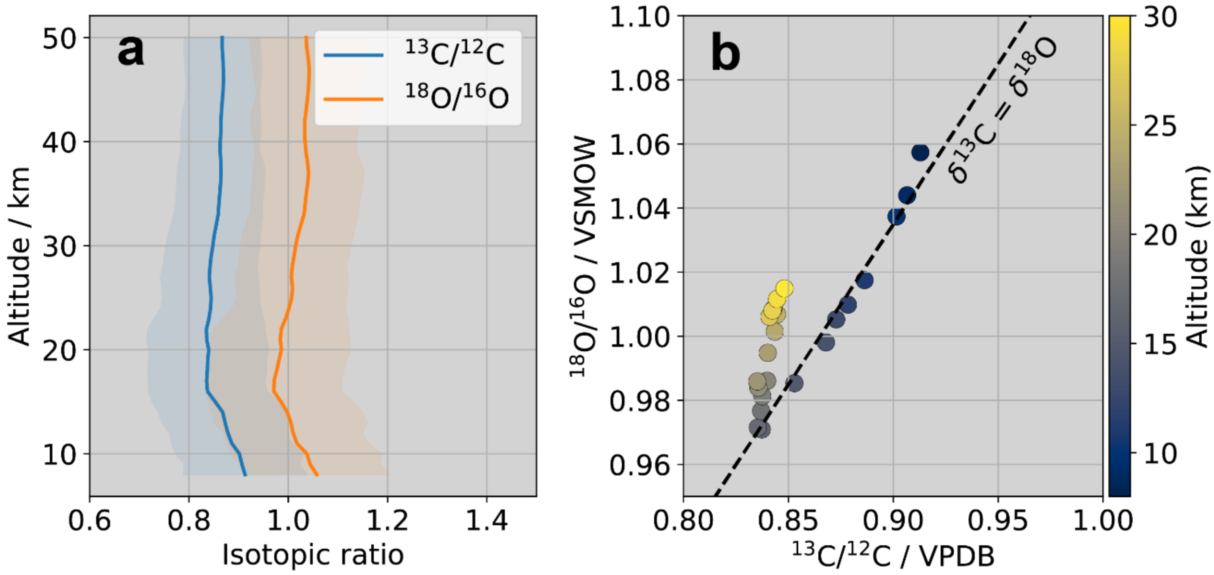
Supplementary Figure 2: Validation of the retrieved temperature profiles against simultaneous ACS NIR observations. *The thick dashed line shows the retrieved profiles from the ACS NIR channel, while the thin dashed lines show these same profiles shifted with an offset of ±10 K, which are used as the a priori for these retrieval tests. The solid blue and orange lines represent the retrieved ACS MIR temperature profiles using the two different a priori cases.*



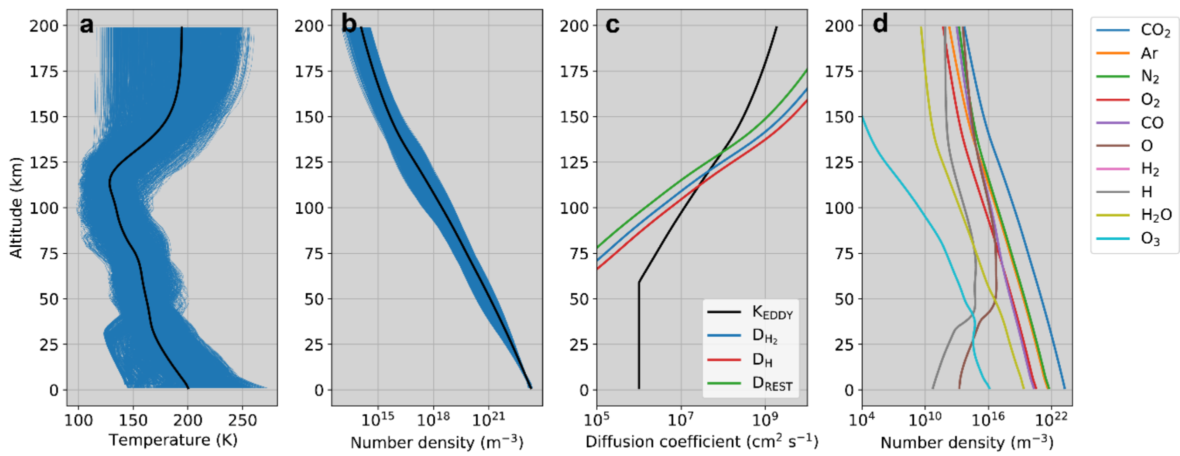
Supplementary Figure 3: Overview of the comparison between the retrieved datasets from the ACS NIR and MIR channels. *Panels a and c show the difference between the retrieved $^{12}C^{16}O$ abundances between both channels for all of the observations included in this study, filtering for the points where the uncertainties in both datasets are lower than 50%. Panels b and d show the difference between the retrieved temperatures in both datasets, filtering the points where the retrieved uncertainties are lower than 20 K.*



Supplementary Figure 4: Retrieved isotopic ratios using retrieved temperatures from ACS MIR or ACS NIR. *The panels show the retrieved isotopic ratios for the first 20 ACS MIR measurements with secondary grating position 6 using the temperature profiles from both the ACS NIR and ACS MIR channels. The solid lines represent the weighted average isotopic ratios in these orbits, while the shaded areas represent the standard deviation of the measurements.*



Supplementary Figure 5: Analysis of the increase in the isotopic ratios of CO below 15 km. *Although smaller than the reported uncertainties (shaded areas in panel a), the averaged profiles from the whole ACS MIR dataset (solid lines in panel a) suggest a systematic increase in the isotopic ratios below 15 km. The relationship between these two ratios (b) below 15 km closely follows a slope of* $\delta^{13}C = \delta^{18}O$, suggesting it is most likely due to a systematic bias in the retrieval of the $^{12}C^{16}O$ abundance at the lowest altitudes.



***Supplementary Figure 6: Overview of the main inputs for the photochemical model.** The initial profiles for the temperature, total number density and partial number density (black lines in a-b and coloured lines in d) are calculated by averaging profiles from the Mars Climate Database throughout different seasons, locations and local time (blue lines in a-b). The Eddy and molecular diffusion coefficients (c) are calculated from previous studies[43,50].*

2. References

43. Krasnopolsky, V. A. Photochemistry of the Martian Atmosphere (Mean Conditions). *Icarus* **101**, 313–332 (1993).
50. Hunten, D. M. The Escape of Light Gases from Planetary Atmospheres. *J. Atmos. Sci.* **30**, 1481–1494 (1973)