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An Exploration of $(SO)_2$ as a Source for Polysulfur within a Simulated Venus Atmosphere with an Overabundance of Oxygen

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Venus at ultraviolet (UV) wavelengths exhibits distinct light and dark markings (Rossow et al., 1980). The discovery of sulfur dioxide (SO_2) using a ground-based high resolution spectrometer explained Venus' albedo at wavelengths < 320 nm but not these dark markings at 320-500 nm (Esposito et al., 1979; Pollack et al., 1980, Pérez-Hoyos et al., 2018). So at least one other absorber must be important at these wavelengths.

Radiative balance simulations suggest this unidentified absorber is responsible for about half of the solar energy absorbed by Venus' atmosphere (Titov et al., 2018). Polysulfur species (S_x) have been suggested but the pathway to how these polysulfur species are formed hasn't been fully agreed on (Mills et al., 2007). Pinto et al. [2021] proposed the production rate of S_x could be enhanced via production of disulfur, S_2 , from photodissociation of SO dimer, $(SO)_2$. However, Francés-Monerris et al. [2022] found a much lower yield for S_2 from photodissociation of $(SO)_2$ in their ab initio simulations and proposed that S_2 production could be enhanced instead via disulfur oxide (S_2O) reacting with sulfur oxide, SO . The atmospheric model used by Francés-Monerris [2022] did not include all important feedback processes. This present work evaluates both the Pinto et al. [2021] and Francés-Monerris et al. [2022] pathways in a comprehensive 1-d photochemical model. This study demonstrates that elevated oxygen abundances suppress polysulfur formation in both the Pinto et al. [2021] and Francés-Monerris et al. [2022] pathways, resulting in optical depths for polysulfur that are too low to explain Venus' "missing" UV absorber.

Author: KATRIVESIS BROWN, Griffin (Australian National University)

Co-authors: Prof. CROKE, Barry (Australian National University); MILLS, Franklin (Australian National University); Prof. PINTO, Joseph (University of North Carolina at Chapel Hill); Dr WILLACY, Karen (NASA Jet Propulsion Laboratory); Prof. YUNG, Yuk (California Institute of Technology)

Presenter: KATRIVESIS BROWN, Griffin (Australian National University)

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