Photochemical Distribution of Venusian Sulfur and Halogen Species

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The photochemistry of Venus' atmosphere from 40 to 100 km has been modeled using an updated/expanded chemical scheme, with the view to improving our understanding of the vertical distributions of sulfur and halogen species. We mainly follow Yung and DeMore (1982), Mills (1998), and Pernice et al. (2004) in our choice of chemical reactions, chemical rate constants, and boundary conditions for 38 species. We examine two models, with HCl mixing ratios of 10^{-7} and 4 x 10^{-7}, respectively. The former corresponds to Venus Express observations made at high northern latitudes and the latter to the mid- to low-latitude value Young (1972) determined based on infrared measurements by Connes et al (1967). Both models agree satisfactorily with stratospheric observations of key species such as CO, O_2 and SO_2, but we hope to better quantify the implications of the different HCl mixing ratios observed. Additionally, we perform sensitivity tests where water is set to ~31 ppm at 40 km, but vary the SO_2 mixing ratio at the lower boundary about a nominal value of ~25 ppm. We also consider a range of eddy diffusion profiles and other sensitivity studies. For most cases, $K = K_o\ (n(z)/n\_ref)^{-a}$, where K_o is the eddy diffusion coefficient at some reference altitude, n is the number density, z is altitude, and a is the variable parameter (<1). Our modeling suggests lower HCl abundances result in greater abundances of SO_2, SO, and SO_3 generally lower O_2 abundances, and greater ClO abundances. Also, the effects on sulfur compounds seems more evident/pronounced for lower mixing ratios of SO_2 at the lower boundary as well as higher up in the atmosphere i.e. above ~58 km. We will use some of this 1-D chemistry in the Venus Thermospheric General Circulation Model (VTGCM) (Bougher et al, 1997) for comparison to VEX datasets.