BIMODAL DISTRIBUTION OF H_2SO_4 AEROSOLS IN THE UPPER ATMOSPHERE OF VENUS. P. Gao[1], X. Zhang[1], D. Crisp[2], C. G. Bardeen[3], and Y. L. Yung[1], [1]California Institute of Technology, Pasadena, CA, United States (pgao@caltech.edu), [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, United States (David.Crisp@jpl.nasa.gov), [3]National Center for Atmospheric Research, Boulder, CO, United States (bardeenc@ucar.edu).

Introduction: The vertical and size distributions of Venus' atmospheric aerosols – major factors in determining their effects on the planet's climate – were measured *in situ* by the Pioneer Venus atmospheric probes [1], revealing multi-modal structure in the sizes of aerosols. The probes also detected separate layers in the cloud system: the main cloud deck is separated into three vertical layers sandwiched between thinner haze layers. These clouds have been studied using 1D atmospheric models (e.g. [2], [3], and [4]). For example, Imamura and Hashimoto [3] simulated the effects of winds on the microphysical properties governing aerosol formation and evolution; their results showed good agreement with Pioneer Venus data.

Most recently, the Venus Express spacecraft used its SPICAV/SOIR instruments to study the upper haze via solar occultation experiments. From the data, Wilquet et al. [5] was able to retrieve a bi-modal size distribution in the haze aerosols with sizes of 0.1-0.3 μm for mode 1 and 0.4-1.0 μm for mode 2. We propose that the larger mode results from vertical diffusion of cloud aerosols from the upper cloud layer, while the smaller mode is generated from the nucleation of infalling meteoric dust.

Model: We use a modified CARMA 3.0 (Community Aerosol and Radiation Model for Atmospheres) code to simulate our model Venus atmosphere and test our upper haze hypothesis. CARMA was developed by Turco et al. [6] and version 3.0 is the work of Bardeen et al. [7]. Our modifications include the addition of eddy diffusion into the vertical transport routines, as well as a partial treatment of sulfuric acid including the saturation vapor pressure curve derived by Kulmala and Laaksonen [8]. In order to test the validity of CARMA 3.0 for Venus' atmosphere, we attempt to reproduce the results of the nominal model of Imamura and Hashimoto [3], as well as the analytical solutions of Zhang et al. [9]. We then apply CARMA 3.0 to the upper haze region (~70–100 km) and use an incoming meteoric dust flux similar to that of Earth, as calculated by Hunten et al. [10], assuming 10 nm dust particles, the largest [10] considered in their paper.

Preliminary Results: Figure 1 (see next page) shows a preliminary simulation of the upper haze of Venus involving just infalling meteoric dust and no eddy diffusion. We see that particles with sizes corresponding to both modes are generated, though their spatial distributions do not match what Wilquet et al. [5] discovered and varies greatly with assumed initial conditions and meteoric dust flux. The particle size distribution (not included here) also does not show two distinct modes, but rather a broad "shoulder" that span the range of both modes. The addition of an extra source of aerosols from the cloud deck below and the effects of eddy diffusion may help in alleviating the disagreement. It is clear, however, that CARMA 3.0's microphysics can be adapted to the atmosphere of Venus, as particles of the correct size are indeed generated through the model's nucleation, condensation, and coagulation routines.

Future Prospects: In future work we hope to complete our validation of CARMA 3.0 and apply the model to a simulated column of Venus' atmosphere that covers both the cloud deck and the upper haze.

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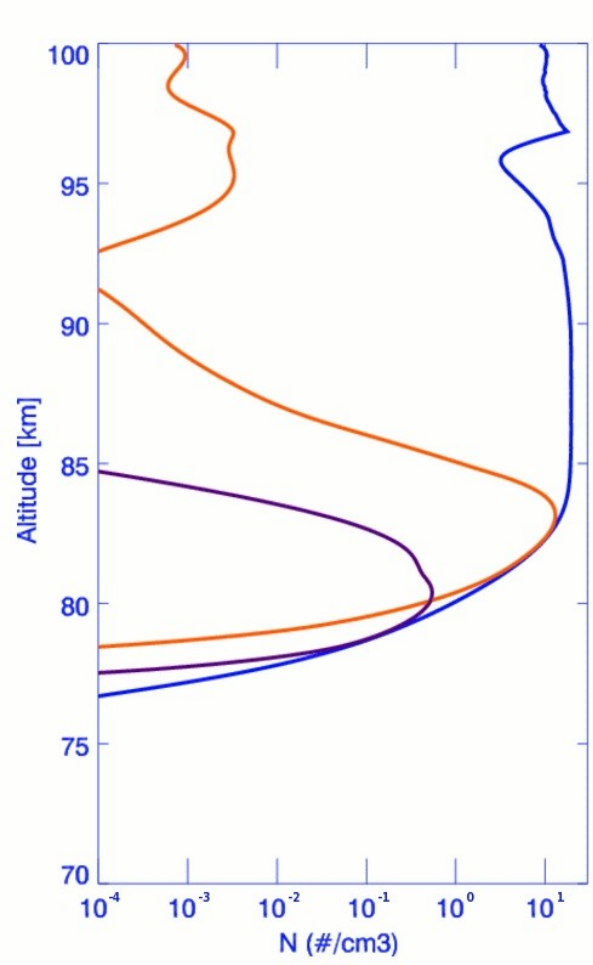

Figure 1. Preliminary simulation of the upper haze of Venus using CARMA 3.0. N is the aerosol number density (AND) (the number density of meteoric dust is ignored). The blue curve is total AND; the orange curve is the mode 1 AND; and the purple curve is the mode 2 AND.