CHARGED HAZE LAYERS IN VENUS' LOWER ATMOSPHERE. B. McGinness[1], K.A. Nicoll[1], M.W. Airey[1],
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Introduction: The Venera 13 and 14 landers carried corona discharge sensors as part of their "Groza-2" instruments. These sensors operated during the final stages of the lander descents, and were intended to measure any electrical discharges from the lander to the atmosphere. The corona sensors were included to ensure that the LF emissions detected by other instruments were not being caused by electrical effects from the lander itself. These sensors detected corona currents of the order of magnitude of 10s of nA. For both landers, the detected currents increased linearly as the lander descended, until around 25 km. Below this, the discharge current profiles showed more complicated changes with height, evading simple explanation. One proposed explanation for the unusual measurements was a charged haze layer in the lower atmosphere [1].

Investigating the plausibility of this charged haze layer is of interest, as it could help to explain the electrical environment of Venus' atmosphere. Currently this is poorly understood – e.g., the existence of lightning has still not been proven or disproven. In addition, it is believed that there may be other processes important to cloud/particle formation, such as ion-induced nucleation, that could occur under certain conditions on Venus, while they are unable to occur on Earth [2]. These processes would be strongly affected by, but also would affect, the electrical environment. This investigation may also help to identify the effects of charge on the cloud microphysics on Venus. Previous studies on water droplets have suggested that charge can affect the lifetime of cloud droplets [3] e.g. through "Rayleigh explosions", which cause droplets to explode, thus reducing their mass, if they exceed a critical amount of charge for a given droplet size. It is unknown how significant the effect of these processes would be on Venus.

Typically, the lower atmosphere of Venus is considered clear, however there is some evidence for the existence of haze layers beneath the main cloud deck. Ragent and Blamont [4] found that on two out of the four Pioneer Venus probes, the nephelometer experiment showed a sharp increase in backscatter at around 6km. This increase in backscatter would be consistent with a region of increased aerosol population. In addition, Grieger [5] showed that the extinction profiles calculated from the Venera 13 and 14 spectrophotometer experiments showed a large spike at around 2km. The cause of these features is currently unexplained.

The aim of this work is to investigate the plausibility of charged haze layers in the lower atmosphere, in particular as an explanation for the Venera 13 and 14 discharge current measurements. In order to investigate this, an electrical model of Venus' environment will be used along with the data collected by the Venera landers. The input parameters of the model will be altered to allow the effects of a haze layer to be studied.

Electrical Models: Previously, an electrical model of Venus' atmosphere was constructed by Borucki et al. [6] to calculate the concentration of ions, and the electrical conductivity of the lower 80km of the atmosphere. This model determined the ion concentration by numerically solving a set of ion balance equations to find the steady state concentration. As an alternate approach, here we have constructed a model to calculate the analytical steady state solution to a similar set of ion balance equations. As this method uses an analytical solution, a simplified set of ion balance equations was used. Despite using simplified equations, a good agreement was found between the two models; Across the operational range of Borucki's model (0-80km) the results found from the two models typically agreed within a factor of 2. Here we investigate the effect of altering the model input parameters, to include various types of low altitude haze layers (including charged and uncharged droplets) to investigate effects on the ion concentration and conductivity. The results from this model are then compared with the data recorded by the corona discharge sensors on Venera 13 and 14 to investigate more fully whether or not low altitude haze layers are likely to be responsible for the unexpected corona current profiles. In addition, the discharge currents are compared with the extinction profiles calculated by Grieger [5], to look for features occurring at the same altitudes.

References:
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