Geophysical Research Abstracts
Vol. 16, EGU2014-8720-6, 2014
EGU General Assembly 2014

Sampling the Cloudtop Region on Venus

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The details of the cloud structure on Venus continue to be elusive. One of the main questions is the nature and identity of the ultraviolet absorber(s). Remote sensing observations from Venus Express have provided much more information about the ubiquitous cloud cover on Venus from both reflected and emitted radiation from Venus Monitoring Camera (VMC) and Visible InfraRed Imaging Spectrometer (VIRTIS) observations. Previously, only the Pioneer Venus Large Probe has measured the size distribution of the cloud particles, and other probes have measured the bulk optical properties of the cloud cover. However, the direct sampling of the clouds has been possible only below about 62 km, whereas the recent Venus Express observations indicate that the cloud tops extend from about 75 km in equatorial region to about 67 km in polar regions.

To sample the cloud top region of Venus, other platforms are required. An unmanned aerial vehicle (UAV) has been proposed previously (Landis et al., 2002). Another that is being looked into, is a semi-buoyant aerial vehicle that can be powered using solar cells and equipped with instruments to not only sample the cloud particles, but also to make key atmospheric measurements – e.g. atmospheric composition including isotopic abundances of noble and other gases, winds and turbulence, deposition of solar and infrared radiation, electrical activity. The conceptual design of such a vehicle can carry a much more massive payload than any other platform, and can be controlled to sample different altitudes and day and night hemispheres. Thus, detailed observations of the surface using a miniature Synthetic Aperture Radar are possible. Data relay to Earth will need an orbiter, preferably in a low inclination orbit, depending on the latitude region selected for emphasis. Since the vehicle has a large surface area, thermal loads on entry are low, enabling deployment without the use of an aeroshell. Flight characteristics of such a vehicle have been studied (Alam et al., 2014; Kumar et al., 2014)

Acknowledgements
Mr. Ashish Kumar and Mr. Mofeez Alam were supported by the Indo US Forum for Science and Technology (IUSSTF) as S.N. Bose Scholars at the University of Wisconsin, Madison as Summer interns. We are grateful for the guidance support provided by Dr. Kristen Griffin and Dr. Daniel Sokol, Northrop Grumman Aerospace Corporation.

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