MOTIVATIONS FOR A DETAILED IN-SITU INVESTIGATION OF VENUS' UV ABSORBER.

K-L. Jessup[1], R. W. Carlson[2], S. Perez-Hoyos[3], Y-J. Lee[4], F. P., Mills[5], S. Limaye[6], N. Ignatiev[7], L. Zasova[7]
[1]*Southwest Research Institute, Boulder CO, USA*; [2]*Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California USA* [3]*Universidad del Pais Vasco, UPV/EHUS, Spain*; [4]*Institute of Space and Astronautical Science, Japan Aerospace Agency, Japan*; [5]*Australian National University, Australia;* [6]*University of Wisconsin, Madison, Wisconsin, USA*; 7[;]*Space Research Institute for Russian Academy of Sciences, Moscow, Russia*.

Photos of Venus' distinctive near-UV contrasting cloud features provided the first evidence of Venus' infamous UV absorber [1]. Barker et al. [2] was the first to show the spectral signature of the absorber and assert that broad its absorption at 0.33-0.39 μm occurs ubiquitously at the cloud tops in UV bright and dark regions. Detailed studies of radiative properties of the atmosphere indicate that the UV absorber is responsible for 50% of the solar energy deposited in Venus' atmosphere [3]. Consequently, the UV absorber plays a key role in planetary energy budget and is expected to be a key factor in the dynamics of the atmosphere including the superrotation of the clouds. For this reason, studying the nature of the UV absorber has been assigned a high priority science target for both in-situ and remote sensing Venus observing programs proposed and executed throughout the decades.

Currently, a unique identification of the absorbing species has yet to be accomplished; and on-going research on the topic continues to reveal the complexity of the absorber. For example, long-term image monitoring of the cloud tops at NUV (~0.34-0.39 μm) wavelengths completed by multiple missions to Venus indicates that the morphology of the NUV markings is highly variable. Analysis of Venus Express data indicates that the NUV contrast boundaries are linked to important changes/boundaries in the cloud top altitude and temperature [4]. This result implies a link to dynamics and may in fact motivate a link to microphysical [5] if not chemical changes at the cloud tops—i.e., the composition and/or nature of the absorber itself may be highly variant. Additionally, the first spectrally resolved NUV spectrum of the cloud tops revealed absorption that onset at ~ 0.5 μm, increased in strength at shorter wavelengths following a positive gentle gradient between 0.5 and 0.39 μm and then ended in a broad (nearly flat) absorption band between 0.33 and 0.39 μm [2]; however, these initial spectra were disk-integrated. Spatially resolved spectral observations obtained with VIRTIS [6], HST [7] and MESSENGER [8] during the Venus Express era indicate that while the spectral signatures of Venus' NUV bright, dark and minimal contrast regions all have significant absorption between 0.33 and 0.39 μm, the shape of their absorption spectra from 0.3 to 0.6 μm is variant. Only the relatively NUV bright regions have an 0.3-0.7 μm absorption structure that can be well replicated by the species fit to the disk-integrated Barker et al. data. Additionally, contrary to the earliest spectral measurements of the UV absorber, the VIRTIS data implies that the onset of the UV absorption commonly occurs at wavelengths longward of 0.5 μm. Preliminary analysis of these data implies that the variance in NUV brightness may correspond to an actual change in the nature (rather than the abundance) of the absorber; these changes may correspond to variances in the particle size, age and/or composition of the primary absorber. Additionally, the observed range of NUV brightness levels may be an indication that a variety of absorbers with different lifetimes (or responses to UV exposure) contribute to the observed spectral signatures-perhaps even some of organic origin [9].

Thus, we assert that the high variability of the spectral signature of the absorber strongly motivates a need to consistently map the spectrum of the absorber over multiple altitudes at all possible local times for the full duration of a cloud rotation cycle if not a full Venus day (i.e., 117, 24hr periods of time). The 60-70 km altitude range is most critical because it is directly below the cloud top altitude where the NUV absorber has been repeatedly detected—and it has never before been successfully sampled by an in-situ mission element. Additionally, to identify how the changes in the observable cloud contrasts relates to changes in the nature of the UV absorber, the size of the aerosol particles, the atmospheric thermal emission, and both the horizontal and vertical wind shears at the altitudes where the absorber is observed must be simultaneously obtained. In summary, with the proper payload, an airborne in-situ investigation that is able to access an altitude of 60 km or higher would provide the first opportunity in over 20 years to obtain the required observational data without any temporal disparity using state of the art instrumentation in UV spectroscopy, nephelometry, microimaging, and anemometry. It could also provide the first opportunity to definitively confirm or refute the organic or inorganic nature of the absorber in Venus' atmosphere.

REFERENCES: [1] Ross, F. E.. (1928), *Astrophys. J.*, ***68***, 57-92.; [2] Barker, E. S., et al. (1975). *J.Atmos. Sci*, ***32***, 1205-1211.; [3] Crisp, D. (1986). *Icarus*, ***67*****,** 484-514.; [4] Ignatiev, et al. (2009). *J. Geophys. Res.* ***114.*** E00B43.; [5] Lee et al. (2012), *Icarus*, ***217***, 599-609; [6] Carlson, et al. (2016) *International Venus Conference*, Oxford, UK; [7] Jessup. et al. (2017) Moscow Solar System Symposium, Moscow, Russia.; [8] Perez-Hoyos et al., (2017) *JGR-Planets*, ***submitted***. [9] Limaye, S. S. et al. (2017). *Venus Modeling Workshop*. Cleveland, OH, USA.