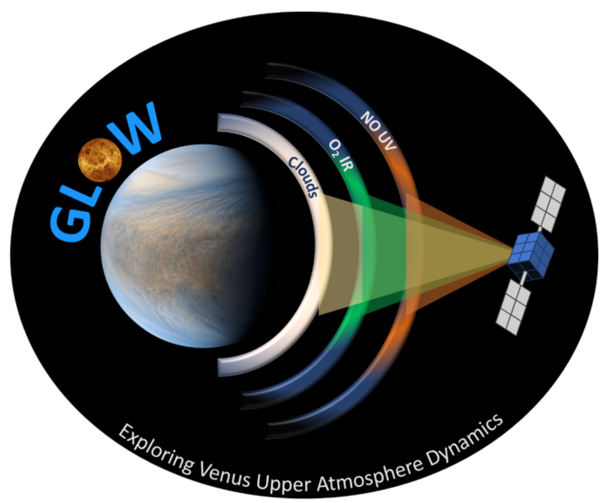
Glow: A Mission Concept to Explore Venus' Upper Atmospheric Dynamics by Monitoring Nightglows and Cloud Motion.

E. Sciamma-O'Brien[1], A. Brecht[1], K. McGouldrick[2], K. Ennico-Smith[1], H. Ray[1], J. Homan[1], A. Colaprete[1], G. Holsclaw[2], D. Hoffman[1], E. Noe-Dobrea[1,3], M. Courtney[4], [1]NASA ARC, Moffett Field, CA (ella.m.sciammaobrien@nasa.gov), [2]LASP, University of Colorado, Boulder, CO, [3]PSI, Tucson, AZ, [4]NASA JSC, Houston, TX.

Introduction: We present the Glow mission concept, currently being developed as a Small Innovative Mission for Planetary Exploration (SIMPLEx) mission concept. Glow's science goal is to "Understand the dynamical connection between Venus' lower atmosphere and upper atmosphere circulation." To accomplish this goal, Glow will quasi-simultaneously map and monitor the spatial and temporal evolution of three features that occur at three different altitudes on Venus' nightside: **the nitric oxide (NO) UV nightglow** emission (190-280 nm) occurring at ~115-120 km[1], **the molecular oxygen (O_2) IR nightglow** emission (1.27 µm) occurring at ~90-100 km[1], and **the motion of clouds** present at 55 km[2] measured through brightness variations, due to cloud opacity, of the 1.74 µm thermal emission from the deep atmosphere. These unprecedented observations conducted quasi-simultaneously will enable an assessment of the vertical structure of Venus global atmospheric dynamics from the clouds to the upper atmosphere and allow investigating the coupling among these three altitude regions.

Knowledge gap in Venus upper atmosphere: The Venus atmospheric circulation is unique in our Solar System. Previous observations have shown that two distinct zonal flow types are present in Venus atmosphere: a Super-Rotating Zonal (SRZ) flow, where zonal winds advect the atmosphere at speeds much greater than the rotation velocity of the solid body (in an East-to-West direction, i.e., retrograde); and a SubSolar to AntiSolar (SSAS) flow caused by inhomogeneous insolation that drives a day-to-night pressure gradient, (from East to West at the evening terminator and from West to East at the morning terminator)[1,2]. A steady SRZ flow has been observed over decadal timescales in the lower atmosphere (< 75 km altitude) and a strong SSAS flow has been observed at altitudes above 75 km. An SRZ flow that appears to be more variable has also been observed above ~120 km[1]. While the maintenance of the lower atmosphere SRZ flow can be explained by means of solar tides[3,4], the fundamental drivers and maintainers of the super rotation in Venus' upper atmosphere remain unknown. Being able to explain the SRZ in the upper atmosphere of Venus and in what manner it might interact with the SSAS flow is needed to better understand the vertical distribution of energy and momentum in Venus' atmosphere.

The Glow Mission concept: By characterizing the spatial and temporal evolution of the NO and O_2 nightglows and the cloud motion, the Glow mission aims to assess potential correlations among these three features to determine the magnitude of energy and momentum transfer from the lower atmosphere to the upper atmosphere. The three features are proxies for the different zonal flow regions: the cloud motion for the lower atmosphere steady SRZ flow, the O_2 IR nightglow emission for the upper atmosphere circulation that does not appear to include an SRZ flow, and the NO UV nightglow emission for the upper atmosphere circulation that includes the variable SRZ flow. With these observations we will be able to determine how the different regions of the super-rotating flow are connected. This will impact our understanding of the general behavior and the variability of the dynamics of Venus' upper atmosphere.



Acknowledgments: The authors acknowledge internal support from NASA ARC and LASP.

References:[1] J.-C. Gérard et al. (2017) *Space Sci. Rev.*, *212(A5)*, 1–67. [2] Sanchez-Lavega et al. (2017) *Space Sci. Rev.*, *212(4)*, 1–76. [3] Horinouchi et al., 2017. [4] P. J. Gierasch (1975) *J. Atmos. Sci., 32*,1038–1044.