

**Venus: The Nearby Exoplanetary Laboratory.** Stephen R. Kane<sup>1</sup>, Giada Arney<sup>2</sup>, David Crisp<sup>3</sup>, Shawn Domagal-Goldman<sup>2</sup>, Lori S. Glaze<sup>2</sup>, Colin Goldblatt<sup>4</sup>, David Grinspoon<sup>5</sup>, James W. Head<sup>6</sup>, Adrian Lenardic<sup>7</sup>, Cayman Unterborn<sup>8</sup>, Michael J. Way<sup>9</sup>

<sup>1</sup>University of California, Riverside, CA, 92521, <sup>2</sup>NASA GSFC, <sup>3</sup>JPL, Pasadena, CA, <sup>4</sup>University of Victoria, Canada, <sup>5</sup>Planetary Science Institute, Tucson, AZ, <sup>6</sup>Brown University, Providence, RI, <sup>7</sup>Rice University, <sup>8</sup>Arizona State University, <sup>9</sup>NASA GISS

**Abstract:** A fundamental aspect of understanding the limits of habitable environments and detectable signatures is the study of where the boundaries of such environments can occur, and the conditions under which a planet is rendered into a hostile environment. In our solar system, Venus is the most Earth-like planet, yet at some point in planetary history there was a bifurcation between the two: Earth has been continually habitable since the end-Hadean, whereas Venus became uninhabitable. Indeed, Venus is the type-planet for a world that has transitioned from habitable and Earth-like conditions, through the inner edge of the Habitable Zone (HZ); thus it provides a natural laboratory to study the evolution of habitability. Whilst ever we struggle to understand the fundamental properties of the Earth-sized planet directly next door, the task of characterizing the surface environments of Earth-sized planets around other stars will remain proportionally inaccessible.

In this talk I will describe the gaps in our knowledge regarding Venus within the context of how these gaps are impacting our ability to model exoplanet atmospheres and interiors. I will outline the premise behind the “Venus Zone” and how testing the conditions of runaway greenhouse is an essential component of understanding the development of habitable conditions. I will present several detected potential Venus analogs including detailed climate simulations that constrain their surface environments. I will further present the expected yield of Venus analogs from the Transiting Exoplanet Survey Satellite (TESS) and the potential for atmospheric characterization with the James Webb Space Telescope (JWST). Finally, I will summarize the primary exoplanet science questions that would be addressed by a return surface mission to Venus.