

VEXAG FINDINGS 2020

1. NASA is currently considering support of U.S. scientists and instruments for international missions, including Venera-D, EnVision, and the ISRO Venus mission. While these strategic partnerships are important for developing a robust international Venus community, VEXAG is concerned that such financial support may come at the cost of compromising or detracting from U.S.-led technology development, research, and/or mission selection. VEXAG urges NASA to carefully evaluate U.S. funding commitments to international missions, and to prioritize U.S.-led missions and technology development. VEXAG and the entire Venus community ask to be kept informed as commitments to international partners are considered and selected. Solely participating in international missions is insufficient to maintain an active and impactful US workforce. **VEXAG advocates that U.S. participation in active international missions be maintained without compromising the high priority given to U.S.-led missions.**
2. In light of the recently selected missions that will or may use a Venus gravity assist (e.g., Lucy and one of the proposed Dragonfly trajectories), VEXAG requests that ride-along opportunities for competed small Venus spacecraft and flybys opportunities be encouraged. The NASA mission directorate should adopt the lessons learned from the joint ESA–JAXA opportunity at Venus and provide resources for U.S.-based researchers to better assess and take advantage of the possible combined efforts between teams having spacecraft flying by the same target. **Thus, VEXAG urges NASA to encourage any mission that plans to fly by Venus to assess and consider the possibilities of adding Venus science data acquisition during the encounter.** We further suggest that mission teams should have a dedicated flyby coordinator either as an existing team member or via a solicitation similar to a Participating Scientist.
3. The HOTTech high-temperature technology program has been both cohesively organized and highly successful, but is reaching the end of its three-year duration. Although HOTTech-2 is included in ROSES-21, it is unfortunate that the program is noted as “contingent upon available funding.” This program deserves ample funding with emphasis on integration so that its technologies can be infused into missions. Support from the instrument-focused MATISSE and PICASSO programs also provides essential pathways for bringing the next generation of instruments and technologies on line for Venus exploration. **VEXAG strongly encourages NASA to make funding available for HOTTech 2, and provide additional funding to increase the selection rates for MATISSE and PICASSO.**
4. NASA is currently developing a small long-duration Venus surface lander currently on track to reach TRL 6 by early 2027: Long-Lived In-situ Solar System Explorer (LLISSE). LLISSE is a significant investment, enables timely infusion into current and future mission development, and is highly relevant to requested feedback for new capability and technologies toward the next New Frontiers Announcement of Opportunity. **Thus, VEXAG encourages NASA to leverage the LLISSE development by offering LLISSE as a capability in the New Frontiers 5 Announcement of Opportunity.**

5. The problem of providing long-term power to Venus surface assets has been studied extensively, including the Venus Surface Platform Study. However, there is still no clear long-term solution (other than radioisotope/nuclear power) for providing months or more of power for mobility and/or temperature control. This long-term capability is needed to answer key science questions (see the VEXAG GOI.). Given that the development of such capability is expected to take a decade at a minimum, **VEXAG encourages NASA STMD to restart the assessment and development of long-duration power systems for Venus (and other) surface applications.**
6. Because of the small size of the active (funded) Venus community, there is concern that not enough R&A review panelists will have relevant expertise to evaluate Venus-related proposals. To address key science questions related not just to Venus but evolution of terrestrial planets as well as exoplanets, it is critical that fundamental and underlying Venus science be supported and developed to enable mission development. **VEXAG requests detailed statistics on proposal submission and selection rates in all ROSES programs that include: 1) how many Venus proposals were submitted to each program, 2) what percentage of those proposals was selected, and 3) success rates for non-Venus proposals in those same programs.**
7. Fundamental questions about its surface and atmosphere can be effectively addressed by ground-based and suborbital observing campaigns. However, NASA has only a single program to fund Solar System observations (SSO), and none to support suborbital observations. **VEXAG encourages NASA to augment the SSO program to support dedicated Venus observations, and expand technology advancement programs to include proposals to develop new capabilities for suborbital and ground-based observatories.** This has especially become critical since the loss of Arecibo.
8. Laboratory measurements are critical for calibrating instruments and interpreting data from current, historical, and future Venus missions. Yet Venus-related laboratory work involves high initial outlay given the thermochemical environment of the deep Venus atmosphere and surface. There is currently no clear mechanism for securing funding for establishing new laboratory capabilities that are needed to advance fundamental Venus science. **VEXAG advocates that NASA establish a "seed" program, similar to the STMD low-TRL awards, to support high-expense/high-reward experimental proposals.**
9. Venus is a compelling cross-disciplinary research target, essential for answering fundamental astrobiological and climate evolution questions, and for its ability to help us understand habitability on terrestrial planets and the exoplanets that we continue to discover. A deeper understanding of the conditions in the Venus atmosphere will help us better understand where the inner edge of the habitable zone is in our own, and other, planetary systems. The Venus cloud layer warrants further investigation in order to better understand the different planetary processes occurring on a global scale (e.g. the unknown UV absorber, recent interest in the possibility of phosphine in the clouds, etc.), and their possible impacts on habitability. If Venus was Earth-like at some point, it offers us an amazing opportunity to understand how habitable conditions are lost. **VEXAG**

requests that Venus-related and comparative planetology proposals remain on the list of solicited research on calls for the Habitable Worlds and Exobiology Programs in R&A, with specific language on which Venus-related science questions are sought for that program.

- 10.** Cloud-level aerial platforms uniquely enable a wide range of important Venus science investigations from atmospheric chemistry and dynamics, to geophysics and astrobiology. However, there is at present little NASA support for technology development funding to achieve high TRL before mission proposals for key technologies such as balloon envelope and inflation systems, attitude determination, power and communications systems, thermal control and sulfuric acid resistance approaches. **We strongly suggest that NASA funds a broad solicitation for cloud-level technologies,** e.g., a “CLOUDTECH” program similar to the HOTTECH and COLDTECH programs already established.