Venus Surface Platform Study Group

Rationale for Study

The recent 2017 report "Getting Ready for the Next Planetary Science Decadal Survey" by the Committee on Astrobiology and Planetary Science (CAPS); Space Studies Board of the National Academies identifies (in Table 2) priority studies that should be undertaken in preparation for the next decadal survey. For Venus the study recommendation is for *"Additional concepts beyond the Venera-D orbiter and lander".* In the conclusion of the report, it goes on to say *"CAPS concludes that the missions outlined in Table 2 represent broad areas ripe for further development in preparation for the next planetary science decadal survey."*

In addition to the clear recommendation by CAPS for additional Venus mission concept studies beyond Venera-D, another basis for the study is to complement and "complete" other current Venus studies. For example, the Keck Institute for Space Studies (KISS) is currently supporting a study focused aerial platforms in the Venus atmosphere. That study explores science impacts and technology needs for various aerial platform concepts. The study explicitly excludes surface elements. However, recent technology developments (such as high temperature electronics) and innovative concepts for long lived surface assets that have been proposed (for example the PSDS^3 funded SAEVe concept) suggest that a similar study for Venus lander would be very relevant and also would closely complement the work being put into the aerial platform study. With the technology progress being made long lived landers at Venus are much more a possibility than previous decadal reports may have anticipated and therefore additional surface concepts need to be studied.

This study would also complement the current aerial platform study with complimentary assessment of deployment options. Aerial platforms can potentially be used to deploy small long-lived landers and this work will add additional data on other distinguishing contributions some aerial platforms may offer.

1. Study Goals

The purpose of this study is to assess the state of the technology for exploring Venus' surface with lander and probes, and to lay out a roadmap for the future exploration of the planet by this means. This study will serve to merge knowledge gained from recent developments in mission studies (PSDS3 and Venus Bridge) and technology. We are planning a 12-15 month study effort, including two face-to-face meetings of study team participants, additional telecoms, and extensive on-line interaction. The product of this effort is a report for use by the Venus science community and NASA's Planetary Science Division. It is the intent that this work will be used to help inform future scientific and technical development applicable to Venus surface exploration. Potential mission infusion opportunities include Russia's Venera-D mission, a future Venus Flagship Mission study, and future Discovery, New Frontiers, or Venus Bridge (if such a mission class where to be initiated).

2. Approach

The organizers (NASA GRC and NASA GSFC) will bring together experts on the science that can be performed from landed platforms, the environments that they experience, the technologies for tolerating those environments, the technologies for the platforms themselves, and mission architects who must integrate all those factors into a viable exploration concept. This work will include two mutli-day meetings of invited experts be held in within the next 12-15 months at the NASA Glenn Research Center. The study team meetings are in the format of a working meetings, are invitation only, and involve not expected to involve more than 25-30 participants.

3. Initial Contact and Telecon

This phase will be initiated with identification of the appropriate subject matter experts and a kick-off telecon to introduce the discussion objective, approach, and to address questions. We will disseminate the study plan and bibliography of relevant papers and reports. We plan to use online collaboration tools to facilitate team member communication.

4. In-Person Meetings

This portion of the study will serve to connect technologists and scientists to address the question of how lander science expectations and priorities are affected by recent and ongoing technological developments. Rather than break-out sessions, plenary discussion will be facilitated as a real-time trade study for specific topics: 1) near-surface atmosphere, 2) surface-atmosphere interaction, 3) weather and climate, 4) geophysics. Each topic will be examined in the context of short-life surface probes, long-lived landers, and long-lived mobile explorers.

5. Reporting

Following the second workshop, the team and subgroup leaders will work together on a report documenting the findings of the study. The report will include proposed technology investments and a recommended roadmap for surface platform missions. In addition to the report, the study leaders will brief the Venus science community at a VEXAG meeting and other potential venues. A briefing to NASA HQ will also be prepared. The final report will be complete around December, 2018.

Updates to HQ will be provided as requested or needed via telecom email during the preparation and implementation of the effort.

6. Cost

NASA GRC and GSFC plan to organize the meetings at the Ohio Aerospace Institute to facilitate easy access by team members and to save on expenses. No new resources will be needed to cover use of the facility. Some travel expenses are anticipated to be needed by some of the invited experts. In addition some labor support (civil servant and contractor) will be required to provide analysis, report writing, and implementation of the study and study events. Current activities and support at GRC and GSFC will be

leveraged to the degree possible. It is estimated that the total cost of the study will be approximately $200K. The split between NASA GRC and GSFC will be determined once the study is approved and more details are defined.