Volcanic Impacts on Planetary Atmospheres: Research and Reconnaissance Strategies (VIPARRS). S.D. Guzewich[1,2], J. Richardson[1,3], P. Whelley[1,2], J. B. Abshire[1], G. Arney[1], J. Bleacher[1], P. Colarco[1], B. Garry[1], S. Gassó[1,3], L. Glaze[1], T. Hurford[1], E. Mazarico[1], L. Oman[1], X. Sun[1], N. Whelley[1,2], [1]NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA (scott.d.guzewich@nasa.gov), [2]CRESST/University of Maryland, College Park, MD 20742, USA, [3]Morgan State University, Baltimore, MD, 21251, USA, Universities Space Research Association, Columbia, MD 21046.

Introduction: The Volcanic Impacts on Planetary Atmospheres: Research and Reconnaissnace Strategies (VIPARRS) group at NASA's Goddard Space Flight Center was chartered for FY2018 to study the role that volcanoes have had and continue to have in creating, modifying, and altering planetary climates both within and beyond the Solar System. The VIPARRS group is seeking broad collaboration on these scientific questions with the aim of creating a sustainable research group.

VIPARRS is an explicitly interdisciplinary research group and leverages both volcanology and atmospheric science expertise within GSFC. It is additionally cross-divisional (as NASA defines science divisions) with representation from both planetary and Earth science divisions.

Scientific Goals: Volcanism is a fundamental building block in the evolution of planets that creates and modifies atmospheres, both habitable and hostile, and provides a natural factory for delivering life-supporting chemicals to the surface. Volcanic outgassing likely created the secondary atmospheres that exist today on Venus, Earth, and Mars [1], may have created a transient atmosphere on the Moon [2], and possibly has a role in the atmospheres of Titan, Triton, and Pluto [3]. The rate of volcanism and the composition of the volcanic products appears to be an important controlling mechanism on planetary habitability, at times making a planet more conducive (e.g., as on early Mars [4]) or more hostile to life (e.g., as during mass extinctions on Earth (e.g., [5]).

Leveraging expertise in observation and theoretical volcanology and atmospheric science, VIPARRS aims to study the volcanic histories of Earth, Venus, Mars and Titan and understand how their volcanic activity over time has modified their atmospheres and climates. This involves using and adapting existing tools to study volcanic eruptions and plumes, as well as model the dispersion of gas and ash from eruptions in an atmosphere and the resulting climactic impacts. Similar related work has been done by our group members in the past studying optical properties of volcanic ash [6] and volcanic effects on both Earth (e.g., [7, 8]) and other Solar System worlds [9].

Additionally, VIPARRS aims to develop instrumentation to detect volcanogenic species in planetary atmospheres or geomorphologic features on planetary surfaces indiciative of volcanic processes. For example, several studies have made detections of SO_2 above the Venusian cloudtops [10] and volcanic-like features have been identified on Titan and Pluto [11, 3]. Dedicated instruments to study these features could resolve outstanding questions about these exciting, but tentative detections.

Ongoing and Future Plans: In an effort to foster broader collaboration on volcanic-atmosphere interactions, VIPARRS will be hosting a regional workshop on volcanic processes in February 2018. The 2018 DC Volcano Workshop will bring together volcanologists and atmospheric scientists from around the Mid-Atlantic to develop new research paths and collaborations studying volcanic-atmosphere interactions on Earth and other Solar System Worlds.

The VIPARRS team is using internal GSFC funding to begin instrument and proposal development. Specifically, we are looking to modify and mature instruments with strong GSFC heritage in atmospheric and surface remote sensing to detect volcanogenic gas species and ash in planetary atmospheres and study volcanic geomorphologies on planetary surfaces.

An additional objective is to link observed volcanic landforms on terrestrial planets to their potential contribution to ancient atmospheres. Recently identified paterae on Mars might have been the sites of supereruptions that would have played a major role in developing the Noachian atmosphere [8]. VIPARRS seeks to study the cadence and volumetric output of large volcanoes in the past to better constrain habitability on our closest neighbors.

Lastly, the VIPARRS team is evaluating existing GSFC-based climate and atmospheric models (e.g., GEOS-5 and ROCKE3D) for adaptation and use in planetary atmospheres. For example, ROCKE3D has already been used for studying early Venus [12] and has heritage as a terrestrial climate model that incorporates volcanic eruptions. Similarly, GEOS-5 has been frequently employed to study terrestrial eruptions such as Pinatubo and the ongoing eruption of Mt. Agung [8].

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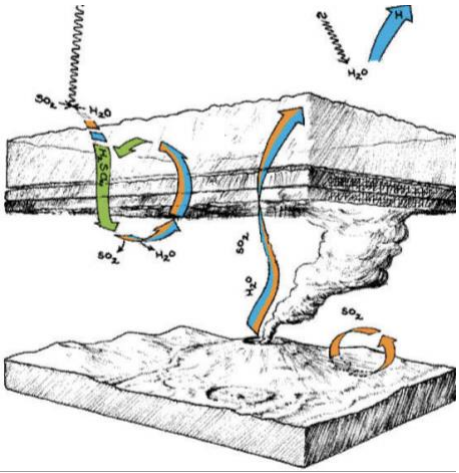

Figure 1. Cartoon (NRC, 2013; provided by David Grinspoon and Carter Emmart) showing how the climate of Venus is controlled in part by volcanic processes.