PLANNED IMPROVEMENTS TO THE VENUS GLOBAL REFERENCE ATMOSPHERIC MODEL. H. L. Justh[1] and A. M. Dwyer Cianciolo[2], [1]NASA Marshall Space Flight Center, EV44, Huntsville, AL 35812 hilary.l.justh@nasa.gov, [2]NASA Langley Research Center, MS 489, Hampton VA 23681 alicia.m.dwyercianciolo@nasa.gov.

Introduction: The Venus Global Reference Atmospheric Model (Venus-GRAM) is an engineering-level atmospheric model applicable for engineering design analyses, mission planning, and operational decision making. Missions to Venus have generated a wealth of atmospheric data, however, Venus-GRAM has not been updated since its development and release in 2005. GRAM upgrades and maintenance have depended on inconsistent and waning project-specific support. The NASA Science Mission Directorate (SMD) has agreed to provide funding support in Fiscal Year 2018 and 2019 to upgrade the GRAMs. This presentation will provide an overview of Venus-GRAM and the objectives, tasks, and milestones related to the GRAM upgrades.

Venus-GRAM: Venus-GRAM provides density, temperature, pressure, and wind components from 0 to 1000 km. It also allows simulation of random perturbations about the mean. Venus-GRAM has been widely used by the engineering community because of its ability to create realistic dispersions; GRAMs can be integrated into high fidelity flight dynamic simulations of launch, entry, descent and landing (EDL), aerobraking and aerocapture.

The lower atmosphere model in Venus-GRAM (up to 250 km) is based on the Venus International Reference Atmosphere (VIRA) [1]. The Venus-GRAM thermosphere (250 to 1000 km) is based on a MSFC-developed model [2] which assumes an isothermal temperature profile initialized using VIRA conditions at 250 km [3]. The VIRA version included in Venus-GRAM includes Pioneer Venus Orbiter and Probe data as well as Venera probe data, but it does not include a solid planet model or a high resolution gravity model [4].

GRAM Upgrade Objectives, Tasks, and Milestones:

Objectives. The GRAM upgrade effort focuses on three primary objectives: upgrade atmosphere models within the GRAMs, modernize the GRAM code, and socialize plans and status to improve communication between GRAM users, modelers and GRAM developers.

Model Upgrade Task. The focus of this task is to update the atmosphere models in the existing GRAMs and to establish a foundation for developing GRAMs for additional destinations. For Venus, the Venus General Circulation Model (VGCM), Venus Thermospheric General Circulation Model (VTGCM), Venus analytic wind models [5], updated VIRA model and development of the Venus Global Ionosphere-Thermosphere Model (V-GITM) will be of interest. Earth observation data of Venus, Akatsuki and Venus Express data will be used as the basis for Venus-GRAM verification and validation. Adding the highest resolution topography available/reasonable to Venus-GRAM will also be addressed.

Code Upgrade Task. Another key element is modernizing the GRAM code. A new common GRAM framework is being developed in C++.

Model Socialization Task. Socializing the status of the GRAM upgrades and advocating and promoting its continued use in proposals and projects is being conducted by the GRAM upgrade team.

Milestones. Project milestones for fiscal year 2018/2019 and beyond include: meeting with key modeling groups, identifying, obtaining and implementing atmosphere model upgrades for GRAMs, acquiring observational and mission data sets for GRAM comparisons, upgrading the GRAM code framework, and releasing updated and new GRAMs that include programming and user guides.

Conclusions: Venus-GRAM is a critical tool set that influences mission selection and decisions. The funding provided by the NASA SMD is vital to address current limitations and accomplish Venus-GRAM developmental goals.

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