



Venus Global Reference Atmospheric Model (Venus-GRAM) Updates

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Introduction

- The Venus Global Reference Atmospheric Model (Venus-GRAM) is an engineering-oriented atmospheric model that estimates mean values and statistical variations of the atmospheric properties of Venus
- Venus-GRAM inputs include local solar time, latitude, longitude, and solar longitude
- Venus-GRAM outputs include atmospheric density, temperature, pressure, winds, and chemical composition along a user-defined path
- NASA Science Mission Directorate (SMD) has provided funding support to upgrade the GRAMs since 2018
- Full presentation will provide details regarding Venus-GRAM updates, as well as the ongoing objectives, tasks, and milestones related to the Venus-GRAM upgrades funded by NASA SMD

Objectives

- Modernize the code
- Upgrade atmosphere models
- Socialize plans and status to improve communication between users, modelers, and developers

Status

- Developed the GRAM Suite, a common C++ framework that simplifies model updates, integration, testing and maintenance
- GRAM ephemeris has been upgraded to NASA Navigation and Ancillary Information Facility (NAIF) Spacecraft Planet Instrument C-matrix Events (SPICE) toolkit
- Speed of sound calculations have been improved
- The GRAM team distributed funding for two projects that will improve the atmospheric model data in Venus-GRAM:
 - Sanjay Limaye and Patrick Fry (University of Wisconsin) – Reanalysis of the Venus Express radio occultation observations resulting in number density, temperature, and pressure profiles for the 40-90 km altitude range
 - Kunio Sayanagi (Hampton University) - Developing an empirical global model for Venus incorporating the latest data available
- Rearchitected Neptune and Titan-GRAM have been released in the GRAM Suite
- Rearchitected Venus-GRAM will be released in a future version of the GRAM Suite
- GRAM Suite is available through NASA Software Catalog <https://software.nasa.gov/>