# NASA Ames Legacy Mars GCM Software Requirements Document

# 1. Introduction

## 1.1 Purpose

This Software Requirements Document (SRD) establishes the requirements for the NASA Ames Legacy Mars Global Climate Model; hereinafter referred to as the “GCM.”

## 1.2 System Description

The GCM is software which simulates the climate of the planet Mars using the primitive equations to predict the global atmosphere given various planetary parameters and physical parameters.

# 2. Requirements Specification

## 2.1 External Library Requirements

- Fortran Compiler. GNU Fortran and Intel Fortran are supported
- IDL access for included analysis routines

## 2.2 Input Data Requirements

- The GCM shall include the files Dust_ir_wolff2010_JD_12bands.dat, and Dust_vis_wolff2010_JD_12bands.dat for dust optical properties
- The GCM shall include the file topog37x60.mola_intel for the Mars topography
- The GCM shall include the files waterCoated_ir_JD_12bands.dat, and waterCoated_vis_JD_12bands.dat for the water ice cloud optical properties
- The GCM shall include the files CO2H2O_IR_12_95_INTEL, and CO2H2O_V_12_95_INTEL for the CO2 and H2O gas correlated-k optical properties
- The GCM shall include the file npcflag_osu_550_intel for the north polar residual cap map
- The GCM shall include the file osu_albedo_5x6_2011 for the surface albedo
- The GCM shall include the file osu_ti_5x6_2011 for the surface thermal inertia
- The GCM shall include the file TES_my24_dustscenario_zvary_37x60_6ls_intel for the annual dust cycle

## 2.3 Namelist Requirements

- The GCM shall include a namelist file at execution time
- The GCM shall use runnumx to identify the model version
- The GCM shall use dlat to define the step size of the latitude dimension
- The GCM shall use jm to define the number of latitude points
- The GCM shall use im to define the number of longitude points
- The GCM shall use nlay to define the number of vertical sigma layers
- The GCM shall use psf to define the average surface pressure in millibars
- The GCM shall use ptrop to define the pressure at the top of the model in millibars
- The GCM shall use dtm to define the dynamical time step in minutes
- The GCM shall use nc3 to define the number of dynamical time steps per physics time step
- The GCM shall use tautot to define the global average dust opacity if varying dust is off
- The GCM shall use rptau to define the reference pressure where tautot is defined
- The GCM shall use conrnu to define the conrath nu parameter for the vertical distribution of dust when active_dust is false
- The GCM shall use taue to define the length of the simulation in model hours
- The GCM shall use tauh to define the frequency of history output
- The GCM shall use tauid to define the starting day of the model run
- The GCM shall use tauih to define the starting hour of the model run
- The GCM shall use rsetsw to define if the simulation will cold start or warm start
    - If warm start, the GCM shall require fort.11, fort.51, and fort.91 files for input
- The GCM shall use cloudon to define the radiatively active state of water ice clouds
- The GCM shall use active_dust to define the radiatively active state of advected dust
- The GCM shall use active_water to define the radiatively active state of gaseous H2O
- The GCM shall use microphysics to define the state of dust and ice microphysics
- The GCM shall use co2scav to define if atmospheric co2 condensation removes aerosols
- The GCM shall use timesplit to define if the microphysics will have a shorter time step than the physics
- The GCM shall use albfeed to define if surface water ice will affect the surface albedo
- The GCM shall use latent_heat to define if atmospheric water phase transitions will contribute to the heat
- The GCM shall use vdust to define if a varying dust map will be used for dust lifting
- The GCM shall use icealb to define the water ice albedo no the surface
- The GCM shall use icethresh_depth to define the minimum water ice depth for albedo feedback
- The GCM shall use dtsplit to define the microphysics time step when timesplit is on

## 2.4 Software Quality Requirements

- The data produced by the GCM shall match the results published in the article: Haberle, R. M., Kahre, M. A., Hollingsworth, J. L., Montmessin, F., Wilson, R. J., Urata, R. A., Brecht, A. S., Wolff, M. J., Kling, A. M., & Schaeffer, J. R. (2019). Documentation of the NASA/Ames Legacy Mars Global Climate Model: Simulations of the present seasonal water cycle. *Icarus*, *333*. https://doi.org/10.1016/j.icarus.2019.03.026
- The GCM has reached End-of-Life and will no longer be receiving version updates