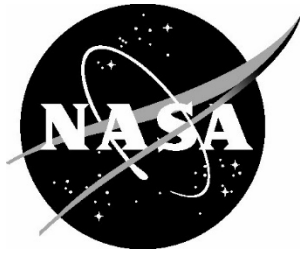


NASA/TP-20230016524



NASA Ames Mars GCM Reference Simulation Description

Melinda A. Kahre, R. John Wilson
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November 2023

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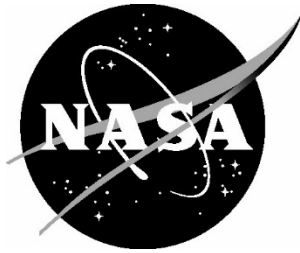
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National Aeronautics and
Space Administration

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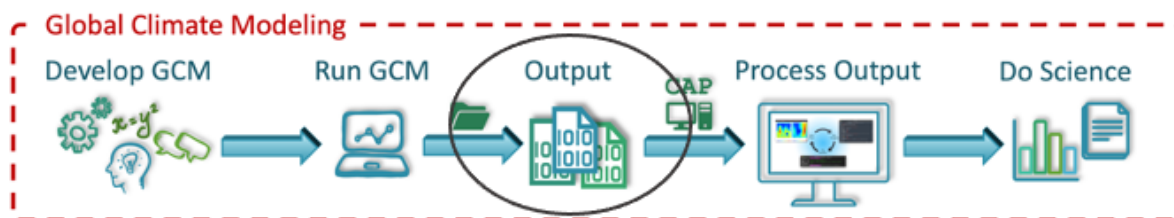
November 2023

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NASA Langley Research Center
Hampton, VA 23681-2199

NASA Ames Mars GCM



The NASA Ames Mars GCM is based on the *NOAA/GFDL Finite Volume Cubed-Sphere Dynamical Core*, with Mars-appropriate physics developed at Ames.

Reference Simulation Description

Goal of the Reference Simulation

- Provide a beta model output dataset for students, scientists and engineers that captures the representative diurnal and seasonal variation of Mars' climate.
 - Reproducible with the publicly available version of the MGCM (Version 3.0).

Overview

- Horizontal Grid: c48 (interpolated to a 2x2 lat/lon grid)
- Vertical Grid: 56 vertical layers
 - Lowest layer midpoint is at ~5 m above the surface
 - Layer thickness is ~4 km at ~0.05 Pa (~80 km)
 - Recommended model science domain extends to 0.05 Pa (~80 km), with a sponge layer above that extends to ~0.0001 Pa
- *No Water Cycle, No Rayleigh Drag, No Parameterized Gravity Wave Drag*
- 6 Year Simulation, 6th Year is available on the NAS Data Portal (With Year 6 RESTART files):
 - <https://data.nas.nasa.gov/mcmcref/fv3betaout1/data.php>
 - Starts on Sol 3340 (5*668)

Output Files and Structures

- The fields outputted to each type of output file are chosen based on expected scientific/engineering applications
- We anticipate modifying these choices in the future, and we welcome feedback

Types of History Files

1. Fixed File: 03340.fixed.nc

- Time-independent surface fields

2. Average file: 03340.atmos_average.nc

- 5-sol time average

3. Composite diurnal file: 03340.atmos_diurn.nc

- Hourly-resolved (and averaged) diurnal cycle
- Composited from 5-sol segments

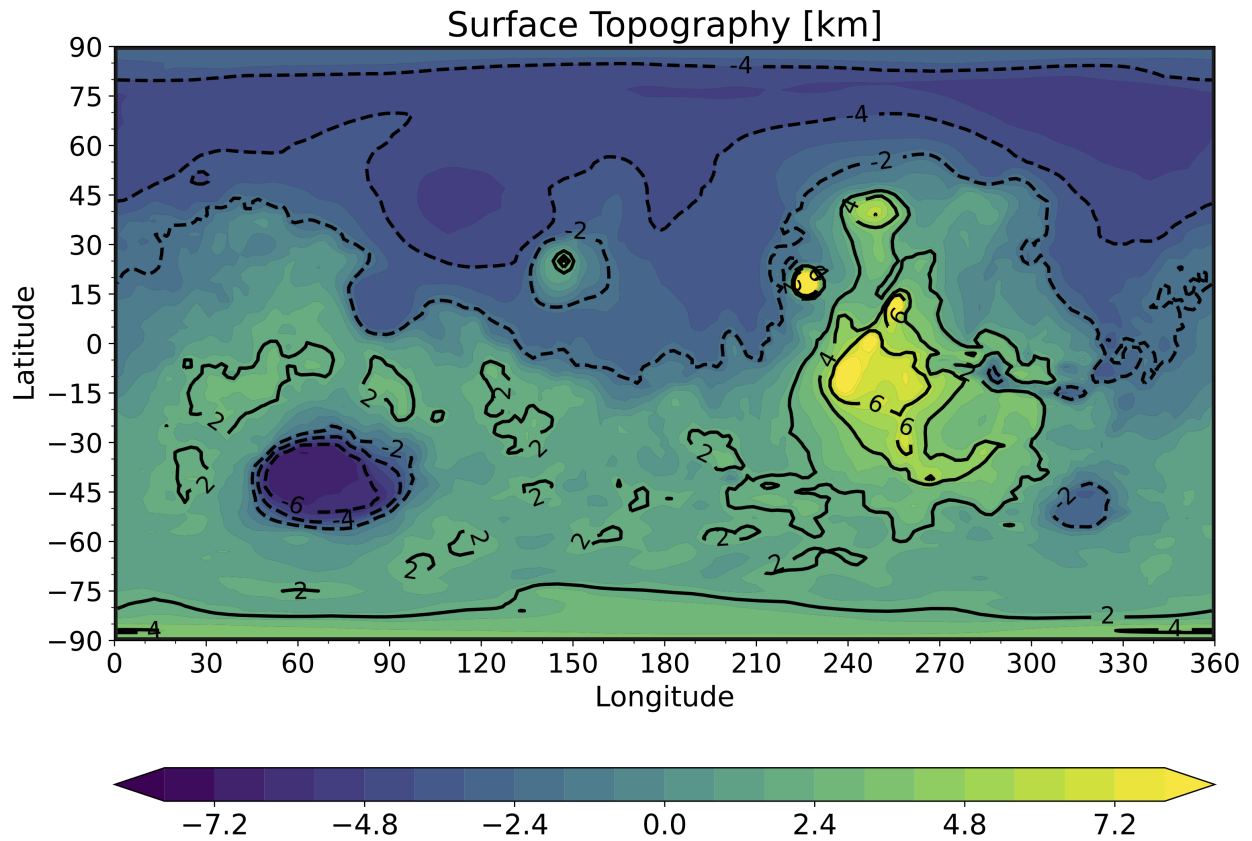
4. Instantaneous file: 03340.atmos_daily.nc

- 24 outputs per sol (hourly output)
- No time averaging (instantaneous output)

Arrays in History Files

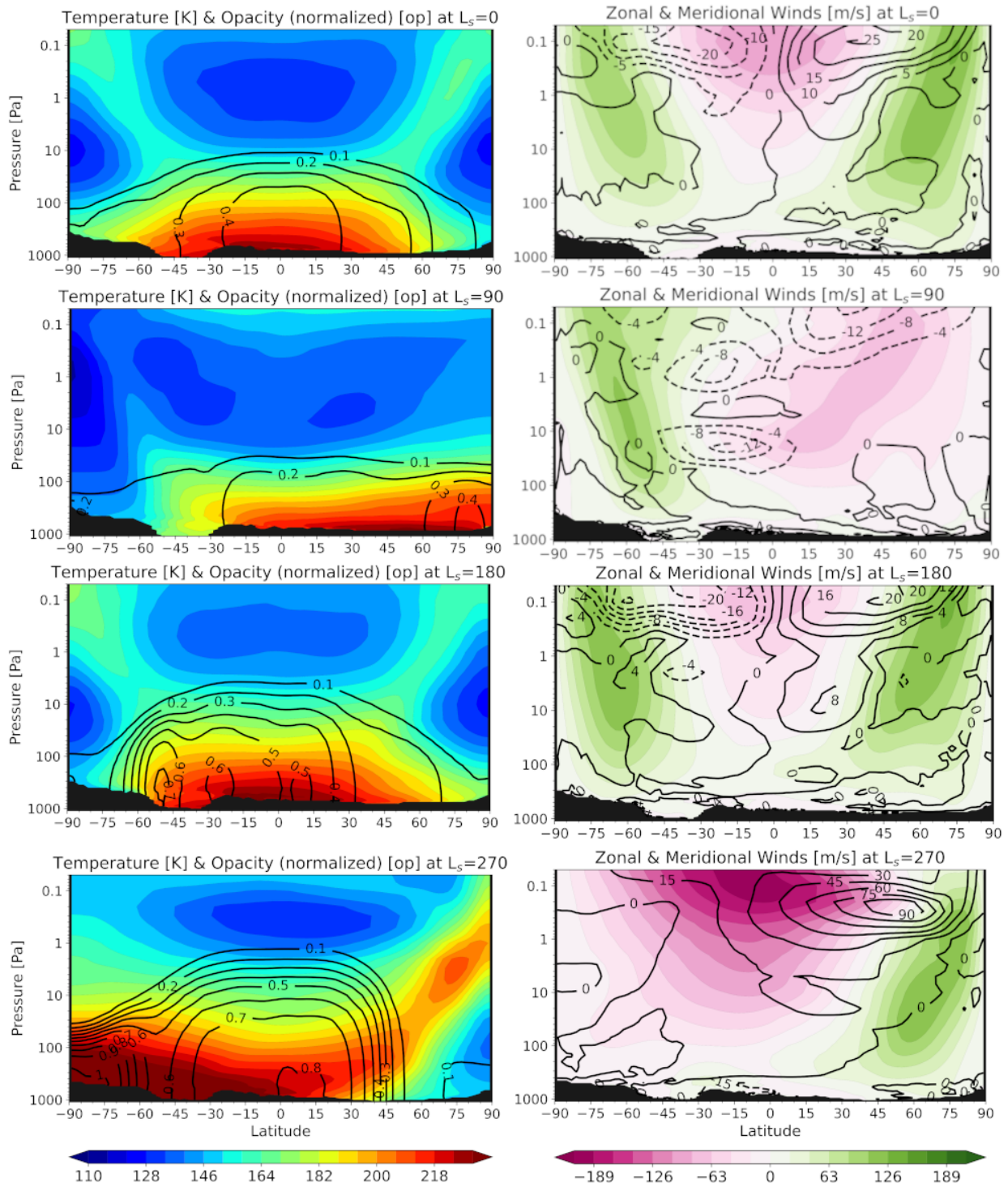
1. fixed

Variable	Description
ak	Pressure Component of the Hybrid Coordinate (Layer Boundaries)
bk	Sigma Component of the Hybrid Coordinate (Layer Boundaries)
zsurf	Surface Topography
thin	Inputted Surface Thermal Inertia
alb	Inputted Surface Albedo
emis	Inputted Surface Emissivity
gice	Inputted Subsurface Water Ice Distribution



2. atmos_average

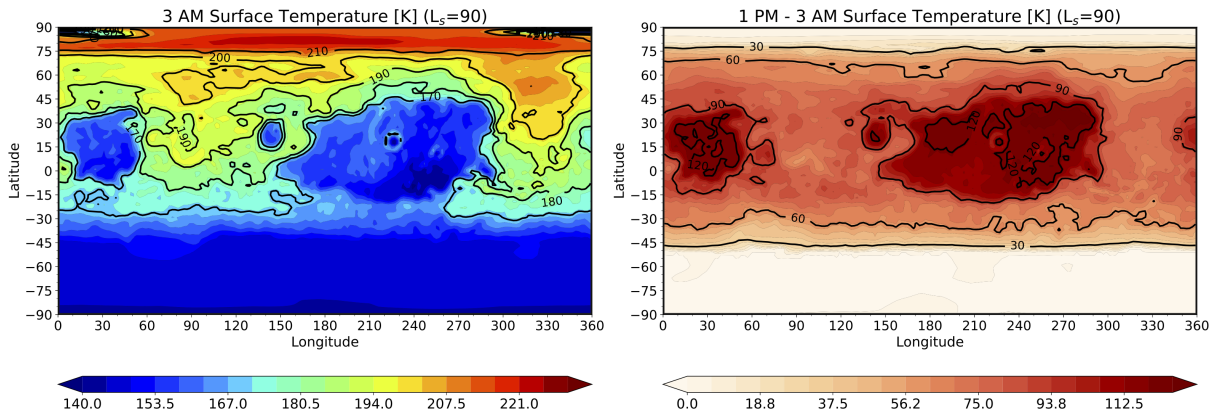
Variable	Description
ak	Pressure Component of the Hybrid Coordinate (Layer Boundaries)
bk	Sigma Component of the Hybrid Coordinate (Layer Boundaries)
pfull	Reference Pressure Grid (Layer Boundaries)
areo	Aerocentric Longitude (L_s)
ps	Surface Pressure
ucomp	Zonal Wind
vcomp	Meridional Wind
omega	Vertical Velocity in Pressure Coordinates
temp	Air Temperature
ucomp_bot	Lowest Layer Zonal Wind
vcomp_bot	Lowest Layer Meridional Wind
temp_bot	Lowest Layer Air Temperature
stress	Surface Wind Stress
cosz	Cosine of the Zenith Angle
ts	Surface Temperature
temp50pa	50 Pa Air Temperature
taudust_VIS	Column Visible Dust Optical Depth
taudust_IR	Column Infrared Dust Optical Depth
dustref	Visible Dust Optical Depth Per Layer
opac	Visible Dust Optical Depth Per Pa
delP	Layer Depth in Pa
delZ	Layer Depth in m
alb_sfc	Surface Albedo
swdnflx_sfc	Downward Visible Flux at Surface
swupflx_sfc	Upward Visible Flux at Surface
irdnflx_sfc	Downward Infrared Flux at Surface
irupflx_sfc	Upward Infrared Flux at Surface
irupflx_top	Upward Infrared Flux at Top of Atmosphere
swupflx_top	Upward Visible Flux at Top of Atmosphere
irdnflx_top	Downward Infrared Flux at Top of Atmosphere
swdnflx_top	Downward Visible Flux at Top of Atmosphere



Time and zonal mean temperature and dust opacity (left panels) zonal and meridional wind (right panels) for L_s 0, 90, 180, and 270.

3. atmos_diurn

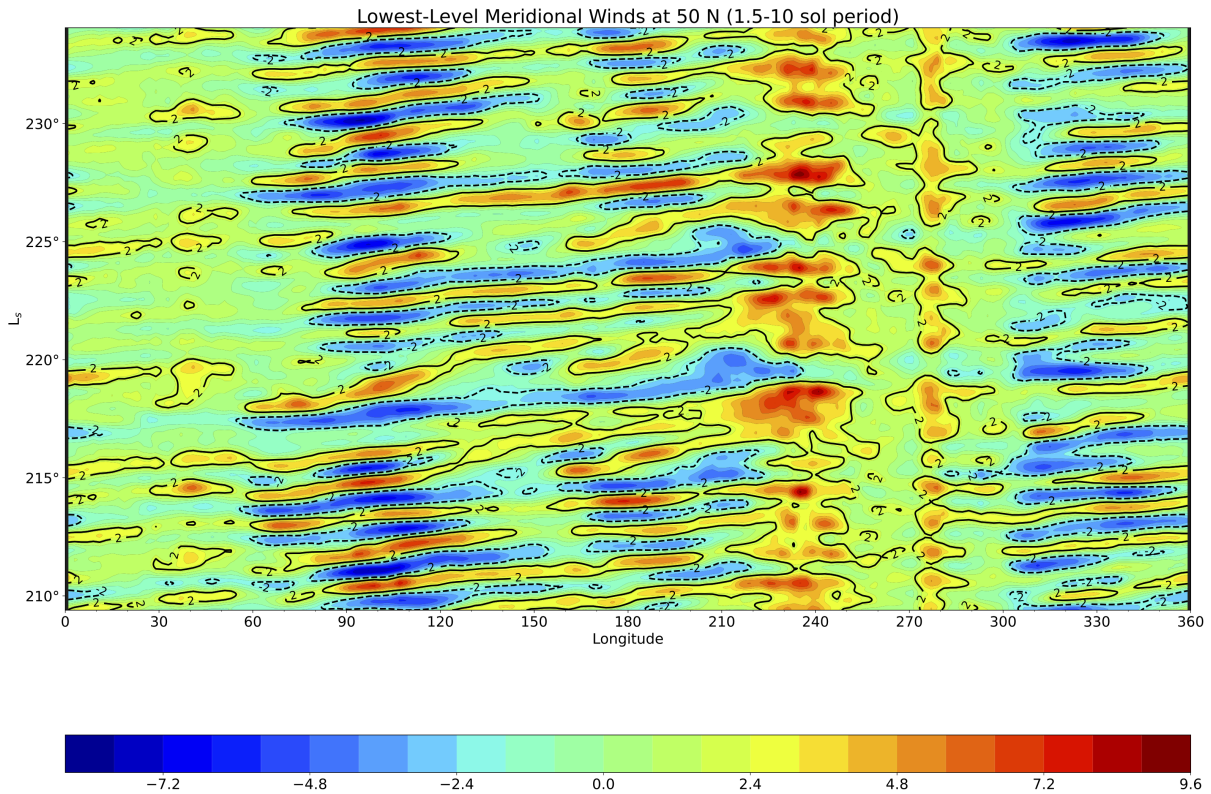
Variable	Description
ak	Pressure Component of the Hybrid Coordinate (Layer Boundaries)
bk	Sigma Component of the Hybrid Coordinate (Layer Boundaries)
pfull	Reference Pressure Grid (Layer Boundaries)
areo	Aerocentric Longitude (L_s)
ps	Surface Pressure
ts	Surface Temperature
temp	Air Temperature
ucomp	Zonal Wind
vcomp	Meridional Wind
omega	Vertical Velocity in Pressure Coordinates
swdnflx_sfc	Downward Visible Flux at Surface
swupflx_sfc	Upward Visible Flux at Surface
irdnflx_sfc	Downward Infrared Flux at Surface
irupflx_sfc	Upward Infrared Flux at Surface



3 AM local time surface temperature (left panel) and (1 PM - 3 AM local time) surface temperature difference (right panel). At L_s 90.

4. atmos_daily

Variable	Description
ak	Pressure Component of the Hybrid Coordinate (Layer Boundaries)
ak	Pressure Component of the Hybrid Coordinate (Layer Boundaries)
bk	Sigma Component of the Hybrid Coordinate (Layer Boundaries)
pfull	Reference Pressure Grid (Layer Boundaries)
areo	Aerocentric Longitude (L_s)
ps	Surface Pressure
ts	Surface Temperature
temp_bot	Lowest Layer Air Temperature
ucomp_bot	Lowest Layer Zonal Wind
vcomp_bot	Lowest Layer Meridional Wind



1.5-10 sol filtered meridional wind at 50 N from L_s 209 to 234.

List of Restart Files: 03340.restart.tar

atmos_model.res
fv_core.res.nc
fv_core.res.tileX.nc
fv_srf_wnd.res.tileX.nc
fv_tracer.res.tileX.nc
physics.res.tileX.nc
radiation.res.tileX.nc
soil_accum2.res.nc
soil_accum2.res.tileX.nc
soil_temp.res.nc
soil_temp.res.tileX.nc