A model based Mars Climate Database for Mission design:

LMD-CNRS
AOPP
CNES
ESA
Why a model based climate database?

- The Martian environment is highly variable
- Observations coverage is far from complete:
  - mostly temperature profiles up to 60 km, many with coarse vertical resolution (TES)
  - limited local time coverage
  - a few in situ observations
- GCMs (Mars General Circulation Models = Global Climate Models) can predict main aspects of the observations

Models can be used to extrapolate the observations
Mars Climate Database v3.1
Who uses it? (~60 users!)

Data analysis:
- Mars Express: PFS data inversion (IFSI), Spicam (SA), Omega (LESIA, LPG)
- Mars Odyssey GRS (LPL), Infrared Space Observatory (LESIA, IKI), Phobos 2 ISM (IAS, LESIA), MGS Mars Odyssey accelerometer (NASA Langley), ISO (LESIA-IKI), Anglo-australian Observatory

Mission design:
- MSL (JPL), Study for Aurora program (Astrium UK, CEA, Graz University of Technology, Alenia)
- Beagle 2 (Open University, Martin Baker Aircraft Ltd, DLR), Mars Express (Astrium, ESTEC), Netlander (CNES, Alcatel, CEA, Babakin, Astrium, OHB-System, Institut fuer Planetologie, Muenster), Entry study (Surrey Space Centre, Canadian Space Agency, Mars Horizon project)

Instrument design:
- PFS Mars Express (IFSI, Observatory of Capodimonte), Neige-Netlander, Mars Atmosphere Microwave sounder

Science studies:
- Isotope cycle (NCP, Canada), Mesoscale model (University of Helsinki), Geodesy (JPL, Royal Observatory of Belgium), Wave analysis (University of Boulder), Photochemistry (Centro de astrobiologia)

New release MCD v4.0
The new Mars Climate database
MCD v4.0
Extension to the thermosphere: up to 250 km

Above 100 km database v4.0 will also include 3 scenarios to describe solar cycle (Extreme UV input): “solar mean”, “solar maximum”, “solar minimum”

Use of hybrid coordinates

LS=30

LS=130
MCD v4.0: what’s new ? 2/3

New dust scenario to represent the dust variability

- "Best" dust scenario (Scenario « MY24 » based on assimilation) topped by 3 solar EUV conditions: solar min, solar mean, solar max
MCD v4.0: what’s new ? 2/3

New dust scenario to represent the dust variability

- "Best" dust scenario (Scenario « MY24 » based on assimilation) topped by 3 solar EUV conditions: solar min, solar mean, solar max

- One dust storm scenario (Constant visible optical depth = 3) for 6 seasons from Ls=180 to Ls=360 (season 7 to 12) topped with 3 solar EUV conditions: solar min, solar mean, solar max

- Warm scenario: our traditional "Viking Lander dust scenario" + topped with a solar max thermosphere

- Cold scenario: our traditional "Low dust scenario" topped by a solar minimum scenario
Content: stored Variables

- **mean variables** (12 local times per season – 12 seasons)
  - temperature, surface pressure, winds, atmospheric density
  - atmosphere turbulent kinetic energy, CO2 ice cover
  - thermal and solar radiative fluxes
  - below 120km: Dust mixing ratio
  - below 120km: [H2O] volume mixing ratio, H2O ice
  - above 100km: [O], [O2], [CO], [H], in volume mixing ratio
  - above 100km: Vertical wind

- add RMS variables
  - surface temperature, surface pressure, CO2 ice cover
  - temperature, winds, atmospheric density
Simulation of Water ice clouds

Montmessin et al., LMD GCM

Figure 5.19: Figure du haut: Variation temporelle et géographique de l'épaisseur optique des nuages de glace d'eau telle que déduite des mesures TES au nadir. Figure du bas: Distribution spatiale et saisonnière de la glace d'eau atmosphérique prédite par le modèle.
Simulation of Water ice cycle

Montmessin et al., LMD GCM
A new tool for surface pressure prediction

The best possible guess of surface pressure on Mars.
It combines:

- reference pressure measure of Viking lander 1 site at a given seasonal date.

- large scale spatial variation due to meteorology (including thermal tides at a given local time) from the GCM climate database.

- small scale variations due to topography, using 1/32 degree MOLA data
Diurnal Min Pressure (Pa) 22/09/2008, Ls=130.9 (LMD model)
Access to the database MCD 4.0
How to access the database?

- For intensive use (Fortran subroutines designed for Monte-Carlo re-entry studies):
  - MCD v3.1 on 2 CDroms provided with datafile (NetCDF) and softwares. ⇒ 60 copies currently used !!
  - MCD v4.0 on 1 DVDrom

  Ask the LMD forget@lmd.jussieu.fr for copies of the database

- For moderate use: interactive web site:
  *same address for MCDv4.0*
New web access

Live Access Server v6.2.1

- access to all new variables, with all possible scenarios, up to 250km

- Vertical coordinate: altitude above areoid, pressure level, altitude above surface

- allow output comparisons

- averages, min, max, sum, variances

- numerous output formats (gif, ps, text, netcdf, arcview gridded, ferret script, fortran formatted text...)

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