The Venus Climate Database S. Lebonnois[1], E. Millour[1], A. Martinez[1], T. Pierron[1], F. Forget[1], A. Spiga[1], J.-Y. Chaufray[2], F. Montmessin[2], F. Cipriani[3]. [1]Laboratoire de Météorologie Dynamique, LMD/IPSL, Paris, France (sebastien.lebonnois@lmd.ipsl.fr), [2]Laboratoire Atmosphères, Milieux, Observations Spatiales, LATMOS/IPSL, Paris, France (jean-yves.chaufray@latmos.ipsl.fr), [3]European Space Research and Technology Center (ESTEC), ESA, Noordwijk, The Netherlands (Fabrice.Cipriani@esa.int).

Overview: The Venus Climate Database (VCD) is based on the outputs of our state-of-the-art Venus Global Climate Model (GCM) [1-3]. This tool, in the footsteps and spirit of its Martian equivalent, the Mars Climate Database (MCD) [4], is intended to be useful for engineers and scientists wanting to compare with their models, analyze observations or plan future missions. This project is funded by the European Space Agency, in the frame of preliminary studies for the EnVision mission to Venus. The VCD provides mean values and statistics of the main meteorological variables (atmospheric temperature, density, pressure and winds) as well as atmospheric composition and related physical fields. It extends from the surface up to and including the thermosphere (~250km). The database contains high resolution temporal outputs (using 24 hourly bins) enabling a good representation of the diurnal evolution of quantities over a climatological Venusian day.

VCD features: As the goal of the VCD is to provide information about the state of the Venusian atmosphere, various realistic settings have been used to run a series of baseline GCM simulations, namely:

- Simulations using various Extreme UltraViolet (EUV) input from the Sun, as this forcing influences significantly the thermosphere (~120km and above). In practice three cases (solar minimum, average and maximum) using fixed E10.7 forcings are provided. The user also has the possibility to obtain outputs corresponding to a chosen E10.7, which may either be specified as a set value or that corresponding to an actual Earth date. In these cases interpolation from the encompassing EUV scenarios is used to estimate the state of the system.
- To realistically bracket the state of the atmosphere below the thermosphere, which may vary with long-term changes (over time scales of many Venusian days) of the UV cloud albedo [5], along with the baseline case, two supplementary scenarios where that albedo is under and over-estimated are also provided.

The following features are also available:

- A "high resolution mode" using some post-processing and a high resolution topography map (at 23 pixels/degree) to adjust the local pressure (and density). The GCM simulations have been run at the resolution of a few degrees in longitude and latitude (3.75° x 1.875°).
- Access to the Venusian intra-hour variability (RMS) of main meteorological variables, as well as the Venusian day-to-day variability thereof, as estimated from the multiple Venus days of GCM simulations.
- The possibility to add perturbations to the climatological fields as:
  - Small-scale perturbations, representative of gravity waves (which are unresolved in the GCM, but accounted for via adequate parametrizations [3]).
  - Large-scale perturbations, representative of actual weather systems present in the GCM simulations.

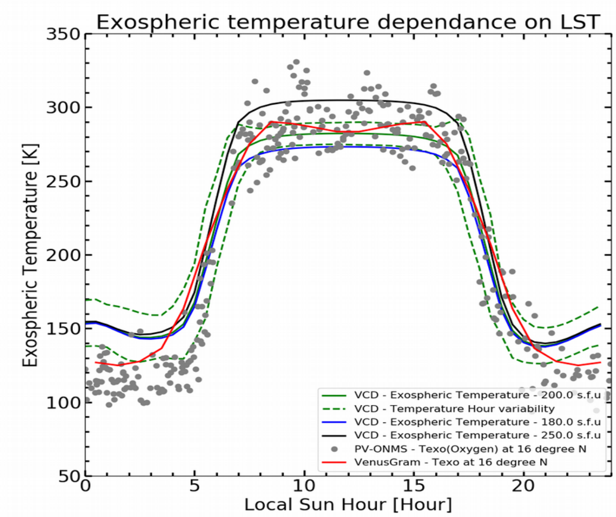

Figure 1: Illustrative example of diurnal variations of the exospheric temperature retrieved from the VCD, compared to PV-ONMS temperature retrievals.

VCD access modes and availability: A first public version of the VCD should be released around mid-October 2021. Based on our experience with the MCD, the VCD will be distributed as (1) a main Fortran subroutine that users can interface and directly call from their own software (interfaces to call this gateway routine using other programming languages will also be available); (2) A web interface, based on the MCD one (at http://www-mars.lmd.jussieu.fr), for quick looks will be set up and maintained on http://www-venus.lmd.jussieu.fr.

References: [1] S. Lebonnois et al., Icarus, 278:38-51, 2016.
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[3] I. Garate-Lopez and S. Lebonnois, Icarus, 314:1-11, 2018.
[4] The Mars Climate Database http://www-mars.lmd.jussieu.fr
[5] Y. J. Lee et al., Astron. J., 158:126, 2019.