The status of activity on the study group 1.11 on Comparative Climatology (Sept 2017)

1. Composition of planetary atmosphere

Status: A preliminary write up has been made.

2. Energy budget of Planets

Status: This has been initiated and initial write-up has been generated based on the literature survey.

3. Current Understanding of the thermal state of the planetary bodies

Status: A report on this is under progress.

4. Atmospheric boundary layer over terrestrial planets

Status: The Mars Climate Database (MCD) is a database of atmospheric statistics compiled from state-of-the art Global Climate Model (GCM) simulations of the Martian atmosphere. The GCM computes in 3D the atmospheric circulation and climate taking into account radiative transfer through the gaseous atmospheres and the dust and ice aerosols, includes a representation of the CO2 ice condensation and sublimation on the ground and in the atmosphere, simulates the water cycle (with modelling of cloud microphysics), the dust multi size particle transport, the atmospheric composition controlled by the photochemistry and the local non-condensable gas enrichment and depletion induced by CO2 condensation and sublimation, and has been extended into the thermosphere and to model ionospheric processes (due to chemistry). The models used to compile the statistics have been extensively validated using available observational data and represent the current best knowledge of the state of the Martian atmosphere given the observations and the physical laws which govern the atmospheric circulation and surface conditions on the planet.

With regard to the evolving scenario of the Large Eddy Simulations (LES), the Space Physics Laboratory of Vikram Sarabhai Space Centre (SPL, VSSC) has ventured into the utilization of Parallized Large-Eddy Simulation Model (PALM) for investigation of turbulent flows in different scenario. For addressing different features of the fluid characteristics within the Martian atmosphere, we intend to make use of the PALM model in conjunction with the Martian Climate database by fine-tuning the PALM model to incorporate essential components of the Martian atmosphere. The study is likely to be focused on the simulation of Martian atmosphere for a regional domain with fine-resolution grid size of about few tens of metres.

5. Review of the RT modeling for different planets in solar system

Status: A detailed literature survey on the existing model for planetary radiative transfer simulation for planetary atmosphere and the terrestrial surface has been carried out. Based on this, ARTS (Atmospheric Radiative Transfer Simulator) model has been used to simulate the radiative transfer and thermal emission at microwave, millimeter and sub mm frequencies for Earth and Mars atmosphere.

A numerical method has been developed to retrieve the atmospheric constituents based on the RT model simulation at sub mm using ARTS. The numerical method is further tested for Earth's atmosphere and verified the results.

6. Geology and composition of the terrestrial planets

Status

Study completed on the surface and subsurface properties of the Mercury and Venus. The write-up on geology of Venus and Mercury has been initiated.

A study has been initiated to understand the thermal evolution of sub-surface temperature variation of Mars under different geological conditions such as regolith alone, two layer of regolith with mixed water ice by coupling the heat transfer model with proper boundary conditions. These models are coupled to radiation transfer computation of thermal emission at microwave frequencies. These studies are in progress to develop inversion method for probing shallow Martian properties from multi-frequency microwave observations. The simulation is being extended for lunar evolution also.

The literature survey is going on for the following topics and an initial write-up has been generated

- Evolutionary theory of terrestrial planets and giant planets and exoplanets
- Timeline for evolution of terrestrial planets
- Solar Variability and its effect on climate
- Magnetism on planets in the solar system

CCTP-3 Conference

Planning started for organizing the next conference on comparative climatology for terrestrial planets 'CCTP3' in year 2018 at Boston University.

It is planned to form a standing working group on comparative climatology as well.
