

Aeolus - a mission to study the thermal and wind environment of Mars

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Aeolus is a small satellite mission to observe surface and atmospheric forcing and general circulation of Mars, by measuring surface energy balance, atmospheric temperatures, aerosols and clouds, and winds. Critically, Aeolus will make these measurements at all local times of day, providing information on both seasonal and diurnal variability. To date, direct measurements of Martian wind speeds have only been possible at the surface, only during daylight hours, and over small areas limited by rover traverse capabilities. From orbit, thermal measurements (e.g., estimates from assumed geostrophic balance) as well as images of dust storms and dune migration have provided inputs to derive current data sets on Martian winds. However, Mars General Circulation models demonstrate that wind speeds derived from these indirect measurements may be in error by 50 to 100%. For this reason, direct wind velocity measurements have been deemed “High Priority” by MEPAG (Mars Exploration Program Analysis Group); measuring wind speeds and corresponding thermal data is vital to understanding the climate of Mars.

Aeolus will carry four Spatial Heterodyne Spectrometers (SHS), coupled to two orthogonal viewing telescopes. These high-resolution near-infrared spectrometers will measure CO₂ (daytime absorption) and O₂ (day and night emission) lines in the Martian atmosphere. Doppler shifts in these lines can be measured during Martian day and night, resolving wind speeds down to ~5 m/s. Orthogonal views allow the spectrometers to capture wind vectors over all observation locations. Aeolus will also carry the atmospheric limb-viewing Thermal Limb Sounder (TLS) to measure atmospheric temperatures, water ice clouds, and dust abundances across all altitudes where winds are measured. Finally, the Surface Radiometric Sensor Package (SuRSeP), a nadir viewing radiometer, will measure the total reflected solar and emitted thermal radiance, surface temperature, and water cloud and dust total column abundances. The combined spectral and thermal measurements will provide a new understanding of the global energy balance, dust transport processes, and climate cycles in the Martian atmosphere. Aeolus will consist of a single satellite in a near-polar orbit, allowing it to pass over all local times, with the baseline mission observing all seasons of an entire Martian year (two Earth years).

Aeolus was one of two Martian smallsat concepts selected for study through the *Planetary Science Deep Space SmallSat Studies* program. This talk will provide an overview of the mission, including science rationale, instruments, spacecraft, and mission operations concept.