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Venus Atmospheric Circulation

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After a long interval, Venus atmosphere is about to be explored by at least two, and perhaps three spacecraft missions in the near future, at long last exploiting the near infrared windows that allow us to peer into the deep Venus atmosphere on the nightside. The MESSENGER mission on its journey towards Mercury will have three fly-bys of Venus, much like Mariner 10 fly-by of Venus in February 1974. In November 2005, Venus Express will be launched by ESA to make an extensive survey of the Venus atmosphere from a polar orbit with far more capable instruments than carried to Venus by any previous spacecraft.

The Venus Monitoring Camera, the Visible and InfraRed Thermal Imaging Spectrometer and the Venus Radio Experiment (VeRA) are expected to provide us with more comprehensive set of observations over three and perhaps more Venus days. These observations are expected to provide clues to the processes that maintain the rapid retrograde circulation of the bulk of Venus atmosphere. Much of what we know about the circulation has come from tracking of entry probes, cloud tracking from orbiter and fly-by spacecraft imagery, radio occultations and even ground based Doppler spectroscopy. Due to inadequate temporal and spatial coverage, these observations have not been sufficient to understand the circulation mechanisms that control it.

Despite its proximity to the Earth, Venus is a difficult target to observe from ground based or biting telescopes due to its high brightness and proximity to the Sun. Recent advances in infrared imaging at 2-4 microns has enabled us to observe the night side emissions from Venus with greater spatial resolution than before, but the temporal coverage is still difficult to achieve such as that which would be obtained from Venus Express from its polar orbit.

What we lack are systematic, global observations of the Venus atmosphere over an extended time to enable us to resolve the solar thermal tides, the large scale planetary waves and other gravity waves perhaps triggered by the surface topography in the near neutral atmosphere of Venus below ~ 40 km. These can then help us understand how the Venus atmosphere super rotates at the equatorial latitudes and has a peak angular momentum density approximately 15-20 km above the surface. We are looking forward to the new observations of Venus from the new probes.