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Venus Express – Status and major results

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Abstract

Venus Express has now been circling Venus for more than five years and has continuously provided high quality data of the Earth's twin planet with its six scientific instruments. The spacecraft is in a very good condition and is expected to last at least until the end of 2014 when the present funding of its operation runs out. The 24 hour polar orbit has allowed extended global studies of the southern hemisphere and in particular of the southern polar vortex structure and dynamics, studies of chemical composition and processes throughout the atmosphere, and dedicated observations of the structure and dynamics of the cloud layers. Radio occultation measurements have provided the most comprehensive data set to date of the atmospheric density and temperature, and of the electron density in the ionosphere. Stellar and solar occultations have allowed very high spatial resolution vertical profiles of the abundance of many chemical species. Wind velocities have been measured by cloud tracking at several altitudes and the super-rotating atmosphere has been confirmed and further characterized. The interaction of the upper atmosphere with the solar wind has been studied and escape rates for the major escaping ions (Hydrogen, Oxygen and Helium) have been estimated. These results have led to new ideas about how an intrinsic magnetic field protects a planetary atmosphere. The conventional theory is that an atmosphere without a magnetic field would erode faster than one with a magnetic field but as measurements show that the Earth is losing more matter to space than Venus does, this cannot be true.

Studies of the surface in the near infrared have shown several areas of recent geologic activity. These areas correspond well to the suspected 'hot spots' previously identified in the Magellan radar and gravity field maps.

Recently the atmospheric density has been probed *in situ* by reducing the pericentre altitude such that the drag force on the spacecraft has become significant and thus measureable. In this way the altitude range 165-200 km, which is not possible to address with remote measurements, has been characterized. For the first time a new technique has been applied whereby the solar panels are set in an asymmetric position with respect to each other such that a torque is acting on the spacecraft during the atmospheric pass. Since the spacecraft attitude is maintained automatically be the reaction wheels the rotation rate changes of the wheels provide a very sensitive measure of the atmospheric density.

During the last year a study has been carried out by Astrium, Toulouse, in order to assess the feasibility of modifying the orbital period by means of aerobraking. The technique was first successfully applied by the Magellan mission in 1992. The results show that Venus Express will be compatible with a soft aerobraking, at a dynamic pressure of 0.3 to 0.4 N/m^2, and that a change from the present 24 hour orbit to an 18 hour orbit can be achieved within a reasonable time. A shorter orbital period will provide opportunity for new scientific measurements and may allow a longer lifetime as a lower apocentre will need less fuel for orbit maintenance.

Continued measurements the coming years will provide new insights to the importance of the solar activity for the different processes already studied at low solar activity. This is particularly important for the study of atmospheric loss.

Joint measurement campaigns with complementary ground based observations of various kinds will continue. These are mostly focused at times of Venus maximum elongations due to the limited opportunities for good observations at other times.