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Space Studies of the Upper Atmospheres of the Earth and Planets including Reference Atmospheres (C)
Venus Express: Two Years of Observations (C33)

# FUTURE DRAG MEASUREMENTS FROM VENUS EXPRESS

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Beginning in July 2008 during the Venus Express Extended Mission, the European Space Agency will dramatically drop orbital periapsis from near 250km to near 180km above the Venus North Polar Region. This will allow orbital decay measurements of atmospheric densities to be made near the Venus North Pole by the VExADE (Venus Express Atmospheric Drag Experiment) whose team leader is Ingo Mueller-Wodarg. VExADE consists of two parts VExADE-ODA (Orbital Drag Analysis from radio tracking data) and VExADE-ACC (Accelerometer in situ atmospheric density measurements). Previous orbital decay measurements of the Venus thermosphere were obtained by Pioneer Venus from the 1970's into the 1990's and from Magellan in the 1990's. The major difference is that the Venus Express will provide measurements in the North Polar Region on the day and night sides, while the earlier measurements were obtained primarily near the equator. The periapsis will drift upwards in altitude similar to the earlier spacecraft and then be commanded down to its lower original values. This cycle in altitude will allow estimates of vertical structure and thus thermospheric temperatures in addition to atmospheric densities. The periapsis may eventually be lowered even further so that accelerometers can more accurately obtain density measurements of the polar atmosphere as a function of altitude, latitude, longitude, local solar time, pressure, Ls, solar activity, and

solar wind on each pass. Bias in accelerometer measurements will be determined and corrected for by accelerometer measurements obtained above the discernable atmosphere on each pass. The second experiment, VExADE-ACC, is similar to the accelerometer experiments aboard Mars Global Surveyor, Mars Odyssey, and Mars Reconnaissance Orbiter that carried similar accelerometers in orbit around Mars. The risk involved in the orbital decay and accelerometer measurements is minimal. We have not lost any spacecraft orbiting Venus or Mars due to unexpected thermospheric drag effects over the last 30 years. The Venus Express drag experiments will allow a global empirical model of the thermosphere to emerge. This new model will be a substantial improvement over the Venus International Reference Atmosphere, which was based principally on near equatorial measurements. General Circulation Models (GCM's) and other models will be generated that are in fair accord with the empirical models. The experiment may help us understand, on a global scale, tides, winds, gravity waves, planetary waves and the damping of waves. Comparisons will be made between low and high latitude results; between the middle and upper atmosphere; and with other instruments that provide information from current and previous measurements. The character of the sharp temperature gradient near the day/night terminator needs to be studied at all latitudes. The cryosphere we discovered on the nightside needs to be studied at high latitudes. The vortex dipole over the North Pole surrounded by a colder "collar" needs to be analyzed to identify how wave activity extends into the polar thermosphere. We have already discovered super-rotation in the equatorial thermosphere, but we need to study 4-day super-rotation at higher latitudes to obtain a global picture of the thermosphere. The observed global cooling from radiative effects of 15 micron excitation of CO2 by atomic oxygen should improve our understanding of global thermospheric cooling on Earth and Mars as well.