Structure of polar upper atmosphere of Venus as measured by the Venus Express Atmospheric Drag Experiment (VExADE)

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Around 30 years ago the thermosphere of Venus was extensively observed in-situ by the Pioneer Venus Orbiter, measurements which concentrated near 16^{o}N latitude. Additional in-situ information was provided above 100 km altitude by the Pioneer Venus Entry Probes which entered the atmosphere at low and mid-latitudes. Until recently, no in-situ measurements of the polar upper atmosphere of Venus had ever been carried out. Empirical atmosphere models such as VTS3 and VIRA relied on solar zenith angle trends inferred at low latitudes in order to extrapolate to polar latitudes.

The Venus Express Atmospheric Drag Experiment (VExADE) consists in accurate orbital tracking in order to infer the effects of atmospheric drag on the spacecraft, and thereby obtain in-situ measurements of the total mass density at periapsis. The highly eccentric polar orbit of Venus Express implies that this experiment provides us with the first ever density measurements in Venus polar thermosphere near 180 km altitude at solar minimum.

To-date, we have carried out measurements during 3 tracking campaigns. The varying degrees of success of these campaigns have shown us the limits of detectability of this technique. We successfully obtained a number of density measurements that allow us to compare actual densities in those regions with those predicted by the reference atmosphere models. The drag measurements have allowed us to construct a hydrostatic diffusive equilibrium atmosphere model that interpolates between the Venus Express remote sensing measurements in the upper mesosphere and lower thermosphere region and the in-situ drag measurements by VExADE. The experiment, thus, has extended the range of possible (and previously unplanned) measurements by this mission, setting a precedent also for future missions to Venus and elsewhere.