



Spacecraft potential vs electron density correlation: electron temperature and Lyman alpha effects

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The spacecraft potential (V_s), measured with a double probe antenna, is well correlated with the ambient electron density (N_e), which thus provides a simple tool to determine the density in tenuous plasma regions from the solar wind into the magnetosphere. We investigate the validity of this technique and aim to identify possible caveats and limitations in the usage of spacecraft potential as a density proxy. We perform a large parametric study of spacecraft potential and density measurements from the Cluster spacecraft for a full solar cycle (years 2001-2012) by binning the data according to the solar UV flux, electron density and electron temperature (T_e) in various plasma regions. The density measurements between 0.1-80/cc are taken primarily from the Whisper wave experiment that is operated both in active and natural mode. In tenuous regions, with density less than 1/cc, density is also determined from ion and electron instruments. In all cases the electron temperature is measured by the electron experiment (PEACE). The V_s - N_e relationship has a clear linear dependence on solar UV photon flux, as expected. Instead, T_e affects the V_s - N_e relationship in a more complicated way due to a strong non-linear dependence.