The electron content in the low- and mid-latitude ionosphere is closely related to the electron content in the plasmasphere. The vertical electron density profiles, in particular, are of considerable importance.

In situ measurements of plasmaspheric density by the Cluster multi-spacecraft mission offer new prospects for determining the field-aligned density distribution. We discuss a new technique to infer field-aligned density profiles from the densities sampled by the individual spacecraft as they traverse the plasmasphere. In a first step the density gradient at the centre of the spacecraft constellation is computed from the 4-spacecraft measurements. In a second step the field-aligned gradient information is extracted from these data and used to empirically determine the field-aligned density profile.

The method is applied to a few Cluster data sets to show its potential. These results constitute a valuable in situ confirmation of field-aligned density profiles obtained from ground- or space-based remote sensing. Of course, because of its orbital characteristics, the Cluster results are obtained only in a limited latitudinal range.

Such empirical field-aligned density profiles are of considerable theoretical interest, since they tell us something about plasma refilling. They are also of practical importance, as they allow plasmaspheric density observations to be mapped onto a common reference, e.g. the equatorial plane, so that it becomes possible to properly interpret structure transverse to the magnetic field. One obvious application is the improved multi-point sampling of plasmaspheric plumes with Cluster.