SOLAR CYCLE AND SEASONAL VARIATION OF PLASMA MASS DENSITY INFERRED FROM ULF AND VLF OBSERVATIONS AT LOW LATITUDES

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ULF and VLF diagnosis of the magnetosphere plasma are both well established techniques that went through a great progress in the last decades. While the VLF diagnostic method was developed and applied even before the IGY, ground-based and satellite magnetometer records have been used to monitor the geomagnetic field line resonance (FLR) frequencies and hereby the plasma mass density (PMD) in the magnetosphere since the early 1990's. Now we have sufficiently long FLR observations to study its solar cycle dependence.
FLR observations using the gradient-method started in Hungary (at L~1.9) in 1996, and have been more regular since 2000. The plasmaspheric equatorial electron density data were obtained by using whistler data recorded at Tihany (Hungary, L=1.8) since early 2002. The whistlers were analysed by a new whistler inversion method using a recent experimental filed aligned density distribution.
The variation of noontime equatorial PMD shows clear solar cycle dependence with higher densities for higher sunspot numbers. In addition, a clear seasonal variation with a winter peak can also be observed, which is stronger during years near sunspot maximum. Similar solar cycle dependence of plasmaspheric equatorial electron densities were identified earlier from mid-latitude (L=2.5) whistler as well as from plasmaspheric altitude (~ 2000 km) satellite (e.g. Akebono) measurements. This behaviour was built in the plasmasphere models (e.g. IRI, FLIP). The seasonal variation, however, seems to be dependent on latitude and maybe even on longitude. While at L=2.5 (~110°W) Park (1978) reported an annual and a semiannual variation, the latter cannot be identified in our plasma mass density observations at L=1.9 (~18°E).
Our PMD estimations were compared to F2 layer electron density (Juliusruh) and a strong correlation was found. This correlation is thought to be maintained by the ambipolar diffusion of plasma along the field lines. The solar cycle and seasonal variation of the F2 layer density, including the "winter anomaly" is a well-described and partially understood phenomenon (e.g Zou et al, 2000). Our results support that FLR frequencies at low (and mid) latitudes are highly influenced by F2 region dynamics.
An interhemispheric comparison (ULF data from HER, South Africa at L~1.8) of the FLR based PMD monitoring was also carried out. The inferred values and general trends were similar as expected, since in both cases the equatorial density of the same L-shell was estimated.
During the investigated interval the F2 region was, however, highly asymmetric, the equatorial PMD correlates with the F2 electron density at the northern footpoint, but not with that at the southern footpoint.

remote sensing of the plasmasphere; ULF waves; field line resonance

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