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GCPM と GPS-TEC を利用したプラズマ圏電子密度分布モデルの構築
A model of the plasmaspheric density profile combined with the GCPM and its error-correction model using GPS-TEC

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The earth's plasmasphere is filled with relatively dense core plasmas which are predominantly provided from the ionosphere. A realistic plasmaspheric density model is useful for applications not only in plasma physics but also in engineering. The plasmasphere is, however, too vast to be probed by a single spacecraft. In order to construct the realistic model, an integration of observational knowledge is indispensable. Formerly, diffusive equilibrium models were generally used to represent plasmaspheric density profiles but the models were insufficient to deal with a variety of solar and geomagnetic activities. In recent years, several new density models, such as the global core plasma model (GCPM), the global plasmasphere ionosphere density (GPID) and the standard plasmasphere ionosphere model (SIM), were developed theoretically, semi-empirically or fully-empirically. These models are more reliable than the traditional diffusive equilibrium model but each model still has weaknesses. Among these models, the GCPM has an advantage in supporting continued improvements.

The final purpose of our study is to develop a realistic plasmaspheric density model by incorporating large data sets of VLF whistler dispersions obtained by the Akebono satellite and GPS-derived TECs provided by the International GNSS Service (IGS) into the GCPM. In the present study, we adopt a new representation for the density profile. That is, the profile is constructed by a combination of the GCPM and an additional model which represents GCPM errors. The combination model makes it possible to reflect the characteristics of the long-term observations to the profile without varying the parameters in the physical base model and it always provides spatially and temporally continuous distribution. By assuming smoothness prior to the errors in multi-dimensional parameter space of the GCPM, we first estimated equatorial error distribution in order that model-derived TECs agree with the observed ones. The equatorial density is the most important factor to reconstruct the whole plasmaspheric density profile in the GCPM. By using the GPS-TECs obtained from LEO (low earth orbit) satellites, we confirmed that the developed error-reduced GCPM accurately reconstructs plasmaspheric density profiles. The model profiles show larger seasonal variations and local-time dependences than the original GCPM.

キーワード: 電子密度モデル, GCPM, GPS-TEC
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