Geophysical Research Abstracts
Vol. 14, EGU2012-3684, 2012
EGU General Assembly 2012

The use of vertical electron density profiles to determine key parameters of the Chapman function for ionosphere modeling

M. Limberger (1), U. Hugentobler (1), M. Schmidt (2), D. Dettmering (2), W. Liang (2), N. Jakowski (3), and M. Hoque (3)

(1) Institut für Astronomische und Physikalische Geodäsie (IAPG), Technische Universität München, Germany, (2) Deutsches Geodätisches Forschungsinstitut (DGFI), München, Germany, (3) Institut für Kommunikation und Navigation, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Neustrelitz, Germany

Empirical models consider the physical meaning behind complex phenomena only indirectly by introducing adapted mathematical functions. In order to achieve a deeper geophysical understanding of the ionosphere the physics-motivated Chapman function can be applied to describe the electron density (Ne) structure vertically in a proper way. The combination of this function with a vertical plasmasphere representation yields a profile defined by altogether five key parameters.

The Chapman function accounts for the F2-peak electron density (N0F2), the related peak height (hmF2) and the F2 scale height (HF2) regarding the ionosphere F2-layer. The plasmasphere basis density (N0P) and the plasmasphere scale height (HP) describe the plasmasphere layer. For the determination of these parameters we separate each of them into an initial (background) part that implies given prior information plus an unknown correction term, composed as a series expansion in terms of endpoint-interpolating polynomial B-spline base functions with respect to longitude, latitude and time as well as the unknown series coefficients. Our objective is the determination of all series coefficients for each key parameter. The number of coefficients to be estimated depends on the B-spline level deduced from the observation density and distribution.

In this contribution we estimate the coefficients directly from Ne input data. Ne data can be derived, e.g. from occultation measurements onboard of Low-Earth Orbiting (LEO) satellites such as Champ, GRACE or the six COSMIC satellites by applying the Abel transform. The major issue of our study is the estimation of the series coefficients related to the three key parameters N0F2, HF2 and hmF2 from scenarios of simulated Ne input data. Caused by the nonlinear character of the observation equation, linearization and an iterative estimation procedure are required. Examples with respect to a varying spatial and temporal observation density and different sampling point resolution are analysed. The International Reference Ionosphere (IRI) constitutes the fundamental background model providing initial data.