Occurrence probability of plasma bubbles deduced from GAIA simulation data

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In the forecast of ionospheric disturbances, it is important to predict mesoscale ionospheric phenomena such as plasma bubbles, sporadic E layers (Es), and Storm Enhanced Density (SED), which have significant influences on radio communication and broadcast systems as well as global positioning systems. Prediction of those phenomena requires real-time observation and a high-resolution numerical model of the ionosphere and atmosphere. We have been developing a whole atmosphere-ionosphere coupled model, GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy), which self-consistently solves the entire region from the lower atmosphere to the ionosphere. Although present version of GAIA does not have enough spatial resolution to reproduce individual plasma bubbles, it is possible to deduce the occurrence probabilities by estimating the linear growth rate of the ionospheric Rayleigh-Taylor instability in the GAIA simulation data. We have performed a long-term simulation using GAIA covering a period from 1996 to the present. Using the database we calculated the linear growth rate, and compared the result with plasma bubble observations. We found that a period in which large linear growth rates appeared in the simulation data tends to correspond to a period of plasma bubbles occurrence, suggesting a possibility of prediction of plasma bubble occurrence using GAIA simulation.

Keywords: plasma bubble, GAIA, linear growth rate, Rayleigh-Taylor instability, ionospheric disturbance

