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Analysis of occurrence characteristics of sporadic E layers using GAIA

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Sporadic E (Es) is a high-density ion layer formed in a narrow-altitude region between about 90 km and 120 km. Since Es has significant influences on radio communications and broadcast, it is one of the most important phenomena in space weather forecast. Although it is generally accepted that Es is formed by combination of neutral wind shear and metallic ions originated from meteor ionization in the lower thermosphere and in the upper mesosphere, the mechanisms of formation and variation of Es have not been quantitatively understood. Previous observations have indicated that Es has clear seasonal and local time variations and geographic location dependences. One of the most prominent features of Es is that Es appears most frequently in the mid-latitude east Asian region in the northern hemispheric summer, and in the mid-latitude South American region in the southern hemispheric summer. This phenomenon has been recognized for a long time, but no theoretical explanation has been given until now. Our group has been developing GAIA (Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy), which self-consistently includes the whole atmosphere and the ionosphere with meteorological reanalysis data introduced in the lower atmosphere. Although the resolution of GAIA is still not enough to directly reproduce Es, it is expected that the model can give at least a clue to estimating occurrence conditions of Es. Using the GAIA simulation data, we analyzed neutral wind shear in the E region. We found that the wind shear is larger in the east Asian region the northern hemispheric summer, and in the South American region in the southern hemispheric summer, which is consistent with the previous observations. We will discuss the mechanism of dependence of the Es occurrence on geographical locations.

Keywords: sporadic E layer, atmosphere, ionosphere, model, neutral wind shear, occurrence