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Development of a high-resolution atmosphere-ionosphere model for analyzing acoustic-gravity wave phenomena

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In the lower atmosphere of the earth, acoustic-gravity waves are generated by various kinds of natural and artificial sources, such as cumulus clouds, typhoons, earthquakes, tsunamis, volcanic eruptions, meteor impacts, nuclear explosions, rocket launches, etc. Previous theoretical and observational studies have suggested that acoustic-gravity waves induced by such sources can propagate up to the upper atmosphere, producing temporal and spatial variations in the thermosphere and in the ionosphere. However, specific mechanisms of upper atmospheric variations caused by the acoustic-gravity waves have not yet been fully understood because the upper atmosphere is an extremely complicated system and is easily disturbed by many other sources in the atmosphere and in space. In order to quantitatively study the ionospheric variations caused by tsunami-driven acoustic-gravity waves, we developed a nonhydrostatic compressible atmosphere-ionosphere model. The model successfully reproduced atmospheric waves and large-scale electron density variations associated with the tsunamis of the 2004 Sumatra earthquake and of the 2011 Tohoku-oki earthquakes. We are now developing a high-resolution global atmosphere-ionosphere model including more physical processes. We expect that the model is able to reproduce atmospheric-ionospheric phenomena associated with acoustic-gravity waves produced by various kinds of phenomena. We will review previous results of the present model and present a plan for developing a new model.

Keywords: acoustic wave, gravity wave, atmosphere, ionosphere, coupling, model