Impact of a non-orographic gravity wave drag parameterization on the middle atmosphere in the Global Spectral Model of Japan Meteorological Agency.

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In the middle atmosphere, gravity waves play key roles as a driving force of meridional circulations and long-term oscillations like QBO and SAO (Fritts and Alexander 2003). Although some global models for weather forecast and climate prediction have reasonable horizontal resolutions compared with gravity wave scales (from 10 to 100 km), typical vertical resolutions in the stratosphere are not sufficient to represent vertical propagations of small scale gravity waves explicitly. Therefore, gravity wave effects should be parameterized in those models. Gravity wave effects in global models have been usually divided in two types of parameterizations : orographically excited gravity wave drag and non-orographic gravity wave drag. For many years, to represent the non-orographic gravity wave drag effect, the Rayleigh friction has been used in the operational Global Spectral Model (GSM) at the Japan Meteorological Agency (JMA). Now, JMA has a plan to raise the topmost level of GSM from 0.1hPa to 0.01hPa, which makes GSM to include whole stratosphere and place model lid on the mesopause. The number of total model layers will be increased from 60 to 100. In the stratosphere and mesosphere, an amplitudes of gravity waves are increasing according to upward propagation because the density of air decreases exponentially due to height. These waves deposit momentum on the background fields and give both effects of acceleration and deceleration of wind when they break or meet critical levels. The Rayleigh friction cannot treat these process since it is expressed in a friction term. So a non-orographic gravity wave drag scheme (NON-ORO GWD), based on Scinocca (2003), is tested in order to replace the Rayleigh friction. Preliminary experimental results of three years integrations with NON-ORO GWD using low-resolution version of GSM showed QBO-like periodic zonal wind oscillation in the tropical lower stratosphere, although westerly phase is too weak and not clear. Without NON-ORO GWD, the result did not show a periodic oscillation in this region. We will present the results of further experiments using low-top (60 layers) and high-top (100 layers) GSM. This work was conducted under the framework of the"Projection of the change in future weather extremes using super-high-resolution atmospheric models" supported by the KAKUSHIN Program of the Ministry of Education, Culture, Sports, Science, and Technology (MEXT)of Japan.