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Effects of the Convective Gravity-Wave Drag Parameterization in the Global Forecast System of the Met Office Unified Model in Korea

Hye-Yeong Chun and Young-Ha Kim

Yonsei University, Atmospheric Sciences, Seoul, Democratic People's Republic Of Korea (chunhy@yonsei.ac.kr)

The spectral convective gravity-wave drag (CGWD) parameterization proposed by Song and Chun (2005) is implemented into the operational version of UK Met Office Unified Model (UM) 6.6 in Korea to investigate the effects of CGWD in the medium-range global weather forecasting. We performed one-month experiments of the five-day forecasts at every 00/12 UTC for the January 2010 and July 2009 initialized from 6-hr 4DVAR data assimilation cycle with (GWDC experiment) and without (CTL experiment) the CGWD parameterization. The parameterization represents well the spatial and temporal variability of the cloud-top gravity-wave momentum flux: the maximum eastward momentum flux occurs in the Tropics, whereas the maximum westward flux exists in the oceans of midlatitudes winter hemisphere along the storm tracks. CGWD modulates the equatorial zonal winds and decelerates winds in mid- to high-latitudes of the winter hemisphere in the stratosphere. The addition of CGWD forcing modulates the resolved planetary wave and other parameterized gravity wave (e.g., orogrphic gravity waves) forcing terms as well as the mean zonal and meridional circulations. The tropical stratospheric wind biases in the CTL experiment are reduced by 10 – 20% in the GWDC experiment: the excessive easterly in the mid-stratosphere is weakened and the positive and negative biases of the near-zero winds in the upper and lower stratosphere, respectively, are reduced. The cold pole bias and westerly biases in midlatitudes of the winter stratosphere are also alleviated by $\sim$10%. In the troposphere, the tropical circulation is significantly modified and the precipitation error in the January 2010 is reduced. The skill scores of the 5-day forecasts for the mid-tropospheric geopotential heights and lower tropospheric temperatures in the tropics are better in the GWDC experiments. The root-mean-square errors of the 500-hPa geopotential heights are reduced by 5 – 10% for the both months, and those of the 850-hPa temperatures by $\sim$5% for the July 2009.