



## **Spatiotemporal Variations in Cloud-Top Momentum Flux of Convective Gravity Waves Including Nonlinear Forcing Effects**

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Cloud-top momentum flux (CTMF) of a convective gravity wave (CGW) parameterization by Choi and Chun is calculated using the NCEP Climate Forecast System Reanalysis (CFSR) data during 7 years (2003-2009) with a horizontal resolution of  $1^\circ$  latitude  $\times$   $1^\circ$  longitude and an hourly temporal resolution. CGWs are generated by both diabatic forcing and nonlinear forcing, and in this study, two sets of CTMF are calculated considering CGW generated exclusively by diabatic forcing (DF) and by both forcing mechanisms (CTL). In DF, CTMF shows strong peak near the equator and winter extratropics in association with storm-track region, while in CTL, the total amount of CTMF is reduced compared with DF due to the cancellation between the diabatic forcing and nonlinear forcing. Nonlinear forcing effect is included in the CTMF calculation based on the nonlinearity factor (NF) of thermally induced internal gravity waves, which is determined by diabatic heating rate, wind, and stability in the convective region. NF is relatively large near the equator where major convection exists, and this can be one of factors to lead unexpected small values of GWMF near the equator, which has been revealed in recent reports of the satellite observations. For comparison with satellite observation, GWMF estimated from the HIRDLS observation is used during 2005-2007. In Asian Monsoon region, HIRDLS GWMF at  $z = 25$  km shows clearly small values in 2006, while convective sources and CTMF are generally similar to the three years. To understand this result, CGW momentum flux at 25 km (CGWMF25) is estimated from CTMF, considering exclusively the critical-level filtering by the background wind from the cloud top to  $z = 25$  km. CGWMF25 in 2006 is smaller than other two years in JJA equatorward of  $10^\circ$ , associated with different QBO phase that can filter out a large portion of the positive momentum flux of CTMF in the stratosphere. The QBO filtering effect is not evident poleward of  $10^\circ$ , and thus interannual variation in CGWMF25 in the Asian Monsoon region, which is clearly evident in HIRDLS, is not clearly shown. Potential sources of this discrepancy will be presented in the conference.