



## **Impacts of an Updated Subgrid Orographic Parameterization Scheme in a Global Spectral Atmospheric Forecast Model**

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The subgrid orographic parameterization scheme implemented in Global/Regional Integrated Model system (GRIMs), which is used as the reference in developing physics schemes of KIAPS Integrated Model, is updated by including effects of flow blocking and orographic anisotropy in addition to existing orographic gravity wave (GW) drag parameterization. The formula of the additional flow-blocking stress follows bulk aerodynamic drag form based in part on scale analysis, and the height of blocked layer is determined according to the dividing streamline theory. The formula of the GW stress is modified by including the effect of orographic anisotropy. To investigate impacts of the updated orographic parameterization scheme, short- and medium-range forecasts for heavy rainfall case over Korea (12 UTC 25 July-12 UTC 4 August 2011) and seasonal simulations (December-February 1996/97) are performed using the GRIMs with the updated scheme. The updated orographic parameterization scheme contributes to alleviate 10m wind speed overestimated over the land in the short- and medium-range forecasts due to the additional flow-blocking drag. In addition, the alleviated wind speed reduces surface fluxes by decreasing exchange coefficients which in turn affects surface temperature and precipitation. The wind forecasts are improved throughout the entire atmosphere from the troposphere to the stratosphere as well as near the surface, which is directly due to the modified GW drag and indirectly due to the interaction of the GW drag with the flow-blocking drag. In particular, the stratospheric winter polar night jet is simulated more realistically in the seasonal forecasts.