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Response of the SMOOTHED Hybrid sigma-pressure (SMH) coordinate to higher-resolution topographic data in Korean Integrated Model (KIM)

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Korea Institute of Atmospheric Prediction Systems (KIAPS) has developed a global forecasting system, Korean Integrated Model (KIM) and the model now operates with 12-km horizontal resolution. With plans to develop the numerical model in horizontally and vertically higher resolution, smoothed hybrid sigma-pressure (SMH) coordinate has applied to KIM to cover the influence of the terrain structure. The SMH is proposed to alleviate artificial circulations that horizontal pressure gradients and advection can be appeared along complex surfaces by reducing small-scale components more rapidly with height (Choi and Klemp, 2021).

In this research, we focus on the prediction with higher-resolution topography in the SMH coordinate and it is revealed that more realistic data can be utilized than the previous topography adapted in hybrid sigma coordinate. The SMH coordinate could well reflect the steepness and roughness of complex region such as terrains near mountains without stability issue. To investigate the sensitivity to the detailed topographic data, case studies such as heatwave, cold surge and rainfall are dealt with especially in the Korean peninsula consisted of complex terrain. By considering more complex topography, the SMH coordinate performs better in capturing precipitation peak and temperature bias. In addition, it will be discussed that vertical propagation to the upper atmosphere is appropriately controlled due to the SMH coordinate. This study can contribute to the future work on adjusting diffusion coefficient by optimizing the SMH coordinate in much higher resolution.