Alleviating low cloud problem in climate and weather forecast models by adaptive vertical grid enhancement

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Abstract

Low cloud bias in atmospheric models for climate and weather remains as an unsolved problem. Considering decades of community effort for developing and advancing boundary layer and microphysics parameterizations, one realizes how persistence the low cloud problem is. In this presentation, the first focus is impact of vertical resolution on representation of low clouds for these large scale models. For these models, sensitivity of vertical resolution on simulated boundary layer is a relatively less explored aspect due to limitation of computational resources. We will discuss how low cloud representation is improved by simply increasing vertical resolution for the Energy Exascale Earth System Model (E3SM) (Fig. 1) and its single column model. Second, we will introduce a new computational method, Framework for Improvement by Vertical Enhancement (FIVE; Yamaguchi et al. 2017) coupled with Adaptive Vertical Grid (AVG). This method will offer better representation of atmospheric boundary layer clouds while limiting additional increase of computational cost due to increased number of levels. Last, we will discuss a path to E3SM coupled with FIVE-AVG and challenges for developing a computationally efficient FIVE-AVG and current progress of the development.

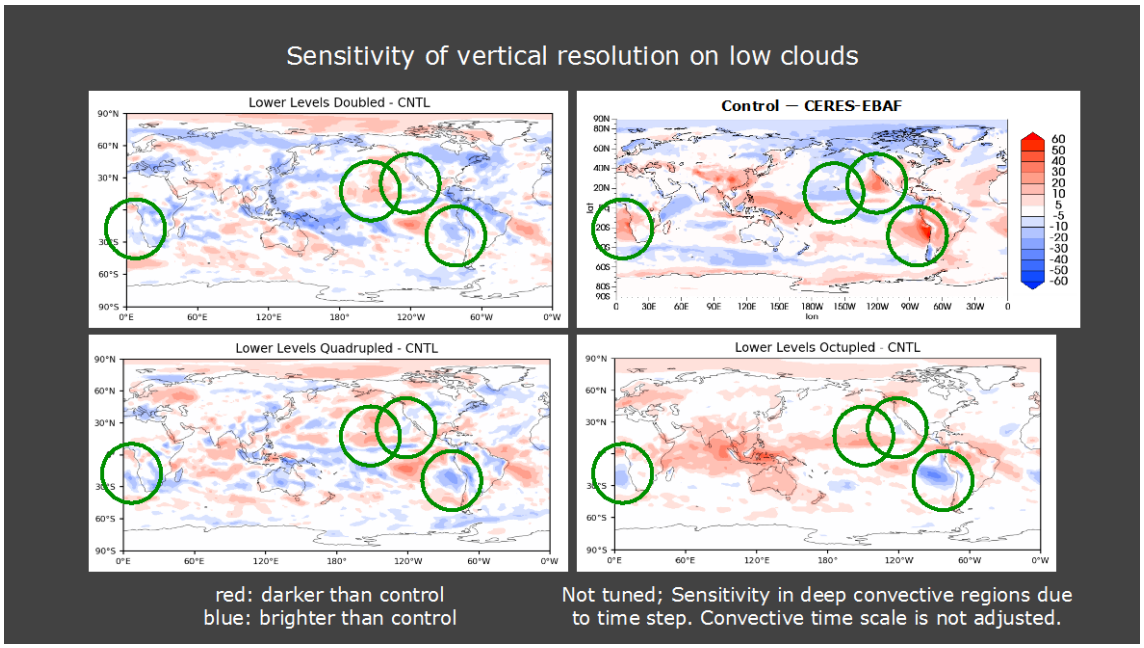

Fig. 1: Sensitivity of vertical resolution for E3SM.

References:

Yamaguchi, T., G. Feingold, and V. E. Larson: Framework for improvement by vertical enhancement: A simple approach to improve representation of low and high-level clouds in large-scale models, *J. Adv. Model. Earth Syst.* 2017, **9**(1), 627-646. doi: 10.1002/2016MS000815