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COnstraining ORographic Drag Effects (COORDE): A model intercomparison of resolved and parametrized orographic drag

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Mountains are know to impact the atmospheric circulation on a variety of spatial scales and through a number of different processes. They exert a drag force on the atmosphere both locally through deflection of the flow and remotely through the generation of atmospheric gravity waves. The degree to which orographic drag parametrizations are able to capture the complex impacts on the circulation from realistic orography in high resolution simulations is examined here. We present results from COnstraing ORographic Drag Effects (COORDE), a project joint with the Working Group on Numerical Experimentation (WGNE) and Global Atmospheric System Studies (GASS). The aim of COORDE is to validate parametrized orographic drag in several operational models in order to determine both systematic and model dependent errors over complex terrain. To do this, we compare the effects of parametrized orographic drag on the circulation with those of the resolved orographic drag, deduced from km-scale resolution simulations which are able to resolve orographic low-level blocking and gravity-wave effects. We show that there is a large spread in the impact from parametrized orographic drag between the models but that the impact from resolved orography is much more robust. This is encouraging as it means that the km-scale simulations can be used to evaluate the caveats of the existing orographic drag parametrizations. Analysis of the parametrized drag tendencies and stresses shows that much of the spread in the parametrized orographic drag comes from differences in the partitioning of the drag into turbulent and flow blocking drag near the surface. What is more, much of the model error over complex terrain can be attributed to deficiencies in the parametrized orographic drag, particularly coming from the orographic gravity wave drag.