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Large-eddy simulation study of turbulent flow over a complex topography using the terrain-following coordinate transformation method: application to aeolian dunes. JIANZHI YANG, WILLIAM ANDERSON, UT Dallas — Modeling of turbulent flow over complex topography is of great interest in many engineering applications. However, accurate modeling of turbulent flow over complex topography still presents major technical challenges. The immersed boundary method (IBM) has been widely used to deal with the arbitrary domain geometry, due to its advantage of keeping the computation grid and, thus, preservation of the original numerical formulation. But IBM can introduce wall-modeling errors since the terrain and computational mesh points are not collocated. Terrain-following coordinate transformation, however, obviates wall-modeling errors. In this study, an existing large-eddy simulation (LES) code has been generalized for coordination transformation in the wall-normal direction, and applied to flow over a series of topographic configurations (flat surface, as a baseline for comparison, spanwise ridge, and an aeolian dune digital elevation map). Validation of simulation data has, firstly, been performed via comparison with first- and second-order data experimental data. Secondly, for the three-dimensional hill and dune cases, an LES simulation with IBM will be also performed. The implications of these results for physics-based, aeolian morphodynamic modeling will be discussed.

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