A New Method for Turbulence Generation in Large Eddy Simulations Using Horizontal Momentum Perturbations.

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Abstract

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Atmospheric phenomena are characterized by a wide range of scales. Multi-scale atmospheric modelling allows us to represent these flows accurately. One such method is coupled mesoscale and microscale simulations. A recurring issue for the transition between mesoscale and microscale models is the generation of turbulence in the microscale simulations. When grid-nesting between these two regimes, large fetches are necessary for turbulence to develop in the nested LES domain. The highly resolved, long distance for turbulence generation significantly increases computational costs. Turbulence generation methods have been explored to trigger turbulent motions and reduce this distance. One widely studied technique is the cell perturbation method [Muñoz-Esparza et al., 2015], which adds random potential temperature perturbations to the nested domain's inflow boundaries. Although the cell perturbation method can significantly reduce the fetch, in many cases long turbulence generation distances are still needed, and can be significant enough to incur constraining computational expenses. Further improvements to these techniques are still needed.

Previous studies have suggested the use of a combination of temperature, and velocity perturbations to further accelerate the generation of turbulence [Mirocha et al., 2013]. In this study we implement a new perturbation method, by adding fluctuations to the modelled horizontal momentum. The method has been implemented in the Weather Research and Forecasting Model (WRF), which has mesoscale-to-microscale grid-nesting capabilities. We evaluate the performance of this technique on its own, and the advantages of combining it with the potential temperature perturbations.

References (Times New Roman 9 pt font**)**

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