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Machine Learning for Nonorographic Gravity Waves in a Climate Model

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Use of machine learning algorithms in climate simulations requires such algorithms to replicate certain aspects of the physics in general circulation models. In this study, a neural network is used to mimic the behavior of one of the subgrid parameterization schemes used in global climate models, the nonorographic gravity wave scheme. Use of a one-dimensional mechanistic model is advocated, allowing neural network hyperparameters to be chosen based on emergent features of the coupled system with minimal computational cost, and providing a testbed prior to coupling to a climate model. A climate model simulation, using the neural network in place of the existing parameterization scheme, is found to accurately generate a quasi-biennial oscillation of the tropical stratospheric winds, and correctly simulate the nonorographic gravity wave variability associated with the El Niño–Southern Oscillation and stratospheric polar vortex variability. These internal sources of variability are essential for providing seasonal forecast skill, and the gravity wave forcing associated with them is reproduced without explicit training for these patterns.