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Baroclinic Adjustment of the Eddy-Driven Jet

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The prediction of poleward shift in the midlatitude eddy-driven jets due to anthropogenic climate change is now a robust feature of climate models, but the magnitude of this shift or the processes responsible for it are less certain. This uncertainty comes from the complex response in storm tracks to large-scale forcing and their nonlinear modulation of the jet. This study uses global circulation models to reveal a relationship between eddy growth rate (referred to as baroclinicity) and eddy activity, whereby baroclinicity responds most rapidly to an eddy-dissipating forcing whereas eddy activity responds most rapidly to a baroclinicity-replenishing forcing. This nonlinearity can be generally explained using a two-dimensional dynamical system essentially describing the baroclinic adjustment as a predator-prey relationship. Despite this nonlinearity, the barotropic changes in the eddy-driven jet appear to be of a comparable magnitude for the ranges of both types of forcing tested in this study. It is implied that while changes in eddy activity or baroclinicity may indicate the sign of latitudinal jet shifting, the precise magnitude of this shifting is a result of a balance between these two quantities.