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Eddy Saturation and Latitudinal Storm Track Shift in a Reduced Two-level Model of the Atmosphere

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We introduce a minimal dynamical system derived from the classical Phillips two-level model with the goal of elucidating the essential mechanisms responsible for the interaction between eddies and mean flow. The choice of a two-level model as starting points allows for appreciating the relative role of barotropic and baroclinic processes. Specifically, we wish to explore the eddy saturation mechanism, whereby, when average conditions are considered, direct forcing of the zonal flow increases the eddy kinetic energy, while the energy associated with the zonal flow does not increase. The eddy-driven jet stream and storm tracks in the mid-latitude atmosphere are known to shift in latitude on various timescales, but the physical processes that cause these shifts are still unclear. Using our low-order model, we aim to understand the link between the structure of the eddies and the shift of the latitudinal maximum of the zonal flow in the mid-latitude atmosphere. Our findings elucidate the basic mechanisms behind baroclinic adjustment and provide insights into the properties of the storm track change between the jet entrance and jet exit regions of the North Atlantic.