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Eddy-driven coupled variability in a mid-latitude climate model

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Multi-layer, atmospheric and oceanic quasi-geostrophic models are studied. The models are placed in a parameter regime in which the former exhibits tendency for the simulated jet stream to alternate irregularly between two distinct anomalously persistent states (regimes) characterized by the jet's displacement poleward and equatorward of its time-mean position, respectively. This low-frequency behavior occurs in the background, but dynamically largely independent of a vigorous synoptic variability. The ocean model's climatology is also characterized by the narrow and intense eastward jet formed at the confluence of two western boundary currents, as well as by energetic eddy field; the eddies play a significant role in maintaining the eastward jet via a nonlinear rectification mechanism. Coupling of the two models via a simple oceanic mixed layer results in the occurrence of an interdecadal mode, whose essential dynamics lie in delayed adjustment of the oceanic eastward jet to changes in the occupation frequency of atmospheric regimes. The time scale of adjustment, and hence that of the coupled mode, is set by the oceanic eddy processes; these processes also act to maintain sea-surface temperature anomalies (and ocean-atmosphere heat fluxes), which favor the atmospheric transition from the current regime to its alternative. The action of this feedbacks is illustrated and summarized in a simple mechanistic stochastic model.