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Elongation and contraction of the western boundary current extension in a shallow-water model: a bifurcation analysis

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We present a numerical bifurcation analysis of a shallow water equation model of the double-gyre ocean circulation. The analysis is performed in a two parameter space where one parameter controls the viscosity of the model and a second parameter controls the symmetry of the wind forcing. The two parameter analysis is used to find 'isolated' steady-state solution branches that were not and could not have been found in previous one-parameter continuation studies. The new branches come into existence at lower viscosity, have a jet extension that penetrates further eastward and are more stable than steady-state solution branches found in previous primitive equation model studies. The intrinsic low-frequency variability at lower viscosity is shown to be associated with a sequence of bifurcations originating from the new steady-state solution branch. As in previous studies however, the origin of the low-frequency variability is due to a gyre mode arising from the merger of two stationary modes.