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A model study of the Gulf Stream Extension intrinsic low-frequency variability

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A process-oriented model study aimed at understanding aspects of the intrinsic low-frequency variability of the Gulf Stream Extension is presented. Reduced-gravity and two-layer shallow water eddy-permitting models are implemented in a domain spanning the latitudes from 10°S to 60°N, with schematic coastlines representing correctly the large-scale shape of the continental boundaries. The forcing, provided by a time-independent climatological wind stress field, is obtained from 41 years (1961-2001) of ECMWF Re-Analysis data. In the two-layer model a Deep Western Boundary Current is introduced through boundary forcing. The dissipative mechanisms are the lateral eddy viscosity (with coefficient A) and the interfacial friction (with coefficient F) and, in the two-layer model, also the bottom friction. Sensitivity experiments are carried out by varying A and F, and the results are interpreted also in terms of dynamical systems theory. For sufficiently high dissipation a steady western boundary current and corresponding extension jet are obtained: their comparison with AVISO altimeter data provides experimental validation of the model setup. Decreasing A and F leads to a first Hopf bifurcation and to the successive transition to chaotic fluctuations characterized by interannual time scales. A thorough analysis is carried out also by considering previous work on more idealized double-gyre flows.