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A new 24-variable low-order coupled ocean-atmosphere model as a tool for predictability analysis

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A new low-order coupled ocean-atmosphere model for mid-latittudes is derived. It is based on Quasi-geostrophic equations for both the ocean and the atmosphere, coupled through momentum transfer at the interface. The systematic reduction of the number of modes describing the dynamics leads to an atmospheric low-order component of 20 ordinary differential equations, and an oceanic low-order component of 4 ordinary differential equations.

Its dynamics is briefly explored, through the analysis of its mean field, its variability and its instability properties. The wind-driven ocean displays a decadal variability induced by the atmospheric chaotic wind forcing. The chaotic behavior of the coupled system is highly sensitive to the ocean-atmosphere coupling, for low values of the thermal forcing affecting the atmosphere (corresponding to a weakly chaotic coupled system). But it is less sensitive for large values of the thermal forcing (corresponding to a highly chaotic coupled system). In all the cases explored, the number of positive exponents is increasing with the coupling. Limitations and potential extensions of this model will be discussed.