Abstract View

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Linear versus Self-Sustained Interdecadal Thermohaline Varia Coupled Box Model

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ABSTRACT

Recent studies of decadal/interdecadal climate variability suggested two main classes of mechanisms: self-sustained (supercritical) oscillations due to the internal nonlinearity of the ocean and linear (subcritical) thermohaline oscillations driven by stochastic atmospheric forcing. The authors use a coupled ocean–atmosphere meridional box model to carefully examine these two alternatives. It is shown that a weakly nonlinear relation between the north–south density gradient in the ocean and the meridional ocean transport can lead to self-sustained oscillations. A nonlinear relation between the SST and the air–sea heat flux can also lead to self-sustained oscillations, although indications are given that the air–sea heat flux depends linearly on the SST for a wide range of SST perturbations. It is thus concluded that, if interdecadal climate variability is due to self-sustained oscillations, the necessary nonlinearity must be related to internal ocean dynamics rather than to the air–sea interaction or to nonlinear atmospheric dynamics. The box model results are used to discuss a simple criterion, based on the probability distribution function of the meridional circulation time series, for differentiating between self-sustained and linear variability. This criterion could not rule out either the linear or nonlinear hypotheses for the thermoha the GFDL coupled general circulation model run of Delworth, Manabe, and Stouffer. This may indi variability in the coupled general circulation model is near critical.