



Applications of nonlinear optimization method to quantifying ENSO predictability

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Abstract Within a simple coupled El Niño-Southern Oscillation (ENSO) model, three problems related to the quantifying ENSO predictability are investigated by nonlinear optimization methods. First, for a given allowable prediction error, we establish a lower bound of the maximum predictable time. Second, for a given prediction time, an upper bound of maximum prediction error is established. Thirdly, with the given allowed prediction error and the prediction time, a lower bound on the maximum allowable initial error is also obtained. These results demonstrate the phenomenon of a “spring predictability barrier” for ENSO events, which supports the view of some previous works. Additionally, the prediction errors of ENSO events estimated by nonlinear model and tangent linear model were also explored, which shows the limitation of linear estimation of prediction error. The results suggest that nonlinear optimization method is one of the useful tools of quantifying ENSO predictability.