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Tropical Pacific upper ocean heat content variations and ENSO predictability during the period from 1881-2000

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In this study, we performed breeding vector (BV) analysis for the 120 years from 1881-2000 using a realistic ENSO (El Niño and the Southern Oscillation) model that assimilate the historic dataset of sea surface temperature (SST). Correspondingly the retrospective ENSO forecasts of the same period was also employed. The BVs of SST and upper ocean heat content (HC) were analyzed. It was found that breeding vectors share many of the properties already seen in other models, and are similar to final patterns of the singular vector analysis. The average structure of BVs over purturbations is not sensitive to seaon and ENSO cycle but inidivdial BV pattern diverges. The BV growth rate varies seasonaly with the maximum value appearing at the start time of winter. It is also sensitive to the strength of ENSO signal, and the stronger ENSO the smaller the BV rate.

By examining the breeding vectors and actual forecast skills, we have explored several important issues of ENSO predictability using BV analysis. Emphasis was placed on the relationship between BV, which is able to characterize potential predictability without the evaluation of observations, and the actual prediction skills, which makes use of real observations. The results show that the BV growth rate and the prediction utility defined using breeding vectors are both good measures of potential predictability and there are a good relationship between them withy actual prediction skills. These findings offer a practical mean of estimating the confidence that we can place in future predictions using the same climate model.