



The "spring predictability barrier" for ENSO predictions and its possible mechanism: results from a fully coupled model

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Using predictions for the sea surface temperature (SST) generated by the FGOALS-g model, the season-dependent predictability of SST anomalies for El Niño/La Niña events was investigated by analyzing the forecast error growth in imperfect model scenario. The results showed that, for the predictions through the spring season in the growth phase of El Niño events, the prediction errors induced by both initial errors and model errors tended to have a prominent season-dependent evolution. The largest error growth occurred in the spring season, which indicates that a prominent spring predictability barrier (SPB) occurs in the growth-phase predictions for El Niño events. Despite this, the prediction uncertainties associated with the growth-phase predictions were often smaller than those in the decay-phase predictions, which yielded a less prominent season-dependent evolution of prediction errors. For the growth- and decay-phase predictions of La Niña events, the prediction errors did not exhibit a significant season-dependent evolution and yield a less prominent SPB phenomenon. These results indicate that the SPB phenomenon depends remarkably on the ENSO events themselves, in particular, the phases of El Niño/La Niña events. We also showed that the initial SST errors that correspond to a significant SPB for El Niño events tend to have the dominant modes as a large-scale dipolar pattern with negative anomalies in the equatorial central-western Pacific and positive anomalies in eastern Pacific, or vice versa. We further demonstrated that the error growth related to a significant SPB for El Niño prediction generated by the FGOALS-g model can be resulted from two dynamical mechanisms: in one case, the prediction errors grow in a manner similar to El Niño; in the other, the prediction errors develop with a tendency opposite to El Niño.