

El Niño Multiplicity and Sensitivity

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Decades of observational and theoretical studies have portrayed the El Niño phenomenon as one phase of a natural oscillatory mode sprang from the instability of the tropical Pacific climate background state owing to unstable ocean-atmosphere interactions. The basic dynamics of the mode is largely understood by invoking either one of the two thought to be parallel but different paradigms: the delayed-oscillator and recharge-oscillator models. However, major issues still remain to be resolved. For example, there are evidences pointing to significant different behaviors of ENSO, such as the so-called warm-pool and cold-tongue types of ENSO. Then, what is the dynamic base for this kind of ENSO multiplicity? How the two ENSO paradigms can be reconciled to explain the different behaviors of ENSO? To address these questions, a brief review of research of the past two-decades on the basic dynamics of ENSO is given. New theoretical results are present to support a new picture for El Niño: its variations in the modern time, such as its different patterns and frequencies, are linked to not one but two similar but distinct leading oscillatory modes from the same instability. The dichotomy of delayed-oscillator and recharge-oscillator paradigms for El Niño thus is united with the two oscillators capturing the different physical mechanisms of these two modes. ENSO multiplicity may thus be intrinsic, which makes ENSO sensitive to tropical climate state changes of either natural or anthropogenic causes.