Incorporating the convection-SST sensitivity to understand ENSO and its diversity

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The relationship between sea surface temperature (SST) and convection indicates that convection has nonlinear sensitivity to El Niño-Southern Oscillation (ENSO) SST anomalies (SSTA), depending on the background SST. Existing SSTA-based ENSO indices failed to imply the nonlinearity in the convection response. This study demonstrates that the convection-SST sensitivity must be considered to understand ENSO and its diversity. The convection-SST sensitivity is quasi-linear to SST so that it helps to identify the high-impact SSTs in the range of 25.25–30.25˚C, in which SSTA induces large changes in convection. By incorporating the convection-SST sensitivity, the traditional focus on SSTA is shifted to on the changes in the convection induced by the changes of the high-impact SSTs, which are defined as the *fluctuations of the accumulated convection strength* (FACT). FACT reflects the simultaneous changes of SST and convection sensitivity, and carries the nonlinearity in the Bjerknes feedback that positive (negative) SSTA enhances (weakens) the convection sensitivity and induce larger (smaller) convection response. New ENSO indices defined from FACT (InFACT) show that ENSO diversity manifests more as differences in the intensity. However, an intensity-pattern interdependence is noticed in El Niño, with strong (moderate and weak) events having maximal SSTA in the equatorial eastern (central) Pacific. This interdependence arises from the different extensions of high-impact SST over 27˚C into the eastern Pacific. Due to weak nonlinearity in FACT caused by the negative SSTA and low convection-SST sensitivity, La Niña events show weak pattern diversity. Our approach and InFACT provide another way to look at ENSO and its diversity in a convection perspective.

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