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The Distinct Contributions of the Seasonal Footprinting and Charged-Discharged Mechanisms to ENSO Complexity

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ABSTRACT

Not all El Niño-Southern Oscillation (ENSO) events are the same. A significant component of ENSO complexity is manifested in the way one ENSO event transits to another. Some events are followed by events of the opposite phase (*i.e.*, El Niño to La Niña or La Niña to El Niño) to give rise to ENSO cycles, others are followed by neutral years to become episodic events, and still others are followed by events of the same phase to become multi-year El Niño or La Niña events. This study finds the seasonal footprinting (SF) mechanism to be a key source of ENSO complexity whereas the charged-discharged (CD) mechanism acts to reduce complexity. The CD mechanism forces El Niño and La Niña to follow each other resulting in a more cyclic and less complex ENSO evolution, while the SF mechanism involves subtropical forcing and results in an ENSO evolution that is more episodic and irregular (Fig. 1). The SF mechanism also contributes to El Niño-La Niña asymmetries by producing multi-year La Niña events but not multi-year El Niño events. It is found that the strength of CD mechanism has been steady over the past 60 years but SF mechanism has intensified during the past two decades making ENSO more complicated. For model simulations, most CMIP5 models overestimate the strength of the CD mechanism but underestimate the strength of the SF mechanism, causing their simulated ENSOs to be too regular and symmetric.

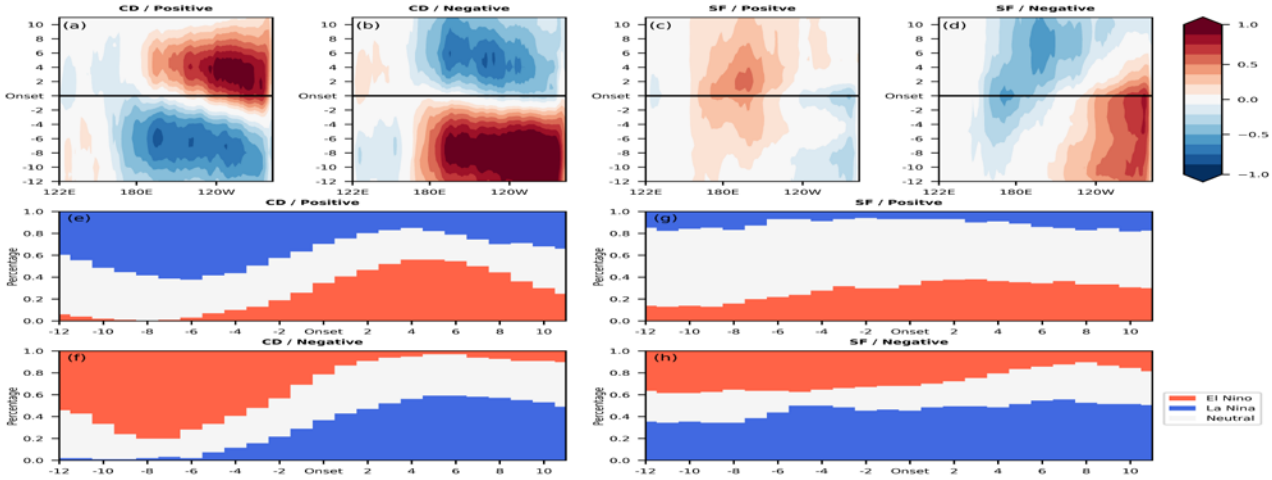

Fig. 1 (a)-(d) The evolution of equatorial Pacific (5°S-5°N) SST anomalies composited for (a) the positive CD mechanism, (b) the negative CD mechanism, (c) the positive SF mechanism, and (d) the negative SF mechanism. (e)-(h) The percentages of the composited months that are in an El Niño (red), La Niña (blue), or neutral (white) state during the period 12 months before to 12 months after the positive and negative phases of the CD mode (e and f) and the SF mode (g and h) reach their peak (at lag 0).

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Reference

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