

Central-Pacific El Niño: Dynamics, Climate Impacts, and the Cause of Its Recent Emergence

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The recent identification of two distinct types (or flavors) of El Niño offers a new way to reconsider how El Niño and its global impacts may change as the climate changes. These two El Niño types are the Eastern-Pacific (EP) type that produces sea surface temperature (SST) anomalies near the South American coast and the Central-Pacific (CP) type that produces anomalies near the international dateline. While the EP El Niño used to be the most frequently occurring type of El Niño it has come to people's attention that the CP El Niño has gradually increased in occurrence over the past two decades. The intensity of El Niño in the CP region has doubled in the past decades. Three of the four El Niño events in the 21st century (the 2002/03, 2004/05, and 2009/10 events) have been of the CP type. CMIP3 models project that the CP type may become the prevailing type of El Niño in a future warmer world. These studies indicate that the CP El Niño is an emerging mode of climate variability.

More importantly, recent studies suggested that the generation mechanism of the CP El Niño is different from that of the EP El Niño. The CP El Niño was argued to result not from basin-wide interactions between the tropical Pacific Ocean and the Walker circulation, which is the generation mechanism for the EP El Niño. Rather, the CP El Niño was suggested to grow via interactions between the tropical Pacific and the Hadley circulation. CP El Niño events are excited by extratropical atmospheric forcing (via the lower returning branch of the Hadley circulation) and then intensify in the central equatorial Pacific via local air-sea interactions. The connection with the Hadley circulation implies that the CP El Niño may produce a stronger impact on higher-latitude climate than the EP El Niño. A record warming in the South Central Pacific and western Antarctica were observed during the strong CP El Niño in 2009. Several recent studies have also indicated that the CP El Niño can affect global climate differently from the EP El Niño. These studies suggest that we cannot use our existing understanding of the conventional EP El Niño to anticipate the climate impacts and teleconnections associated with the CP El Niño. A better understanding of the emerging CP El Niño is important to climate change studies.

In this talk, statistical analyses, forced and coupled model experiments, and case studies will be presented to discuss the (1) the role of extratropical forcing in the generation of the CP El Niño; (2) the changing impact of the El Niño on US winter climate after the El Niño shifts from the EP type to the CP type, and (3) the possible cause of the increased occurrence of the CP El Niño after 1990.