

Super El Niño: Mechanisms, Impacts, and Climatic Consequences

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Super El Niño represents an exceptionally intense phase of the El Niño-Southern Oscillation (ENSO), characterized by anomalously high sea surface temperature deviations in the eastern and central tropical Pacific Ocean - typically exceeding 2°C above the long-term average. Historically, the most powerful Super El Niño events were recorded in 1982-1983, 1997-1998, and 2015-2016, each triggering widespread climatic anomalies on a global scale. During Super El Niño episodes, global mean air temperatures rise significantly, atmospheric circulation patterns are disrupted, and the frequency of extreme weather events intensifies - including wildfires, droughts, floods, and tropical cyclones. Current research indicates that, against the backdrop of global climate change, the frequency and intensity of Super El Niño events may increase in the coming decades. This study examines the physical mechanisms underlying Super El Niño, its influence on regional climate variability, and its impacts on the disruption of the hydrological cycle. Particular attention is given to the interaction between the atmosphere and the ocean - specifically, the weakening of the Walker Circulation and the transformation of the Hadley Cell. The research draws on instrumental records from the twentieth and twenty-first centuries alongside projections from coupled climate models, contributing to the development of evidence-based adaptation strategies in response to Super El Niño-driven climate hazards.