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Sensitivity of El Niño intensity and timing to the magnitude of the subsurface heat buildup

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The subsurface heat buildup in the western tropical Pacific and the recharge phase in equatorial heat content are intrinsic elements of El Niño-Southern Oscillation (ENSO) variability, leading to those changes in zonal wind stress, sea surface temperature and thermocline tilt that characterize the growing and mature phases of El Niño (EN). Here we use 11 simulation ensembles of the Community Earth System Model (CESM) v1.2 to describe the sensitivity of EN in terms of intensity and timing to leading subsurface heat buildup conditions in the western and central tropical Pacific. Results show that the larger the initial subsurface heat buildup, the larger the tropical heat content during the recharge phase. This dependency is found to be strong and linear (correlation = 0.98), but the recharge process is faster when the heat content is initially reduced or suppressed (regression = 0.74 J / J). After the recharge phase, the warming of the ocean subsurface starts to differ among simulation ensembles, which in turn affects the timing of the onset of EN. In simulations with reduced initial subsurface warming, the weaker the initial tropical heat content, the larger the delay of the peak of EN (correlation = -0.72). This dependency is found to be stepwise given the seasonal locking of ENSO, so that the experiments with the largest reduction in initial subsurface warming peak in the following winter. Instead, the timing of the EN maximum remains unchanged in the simulations with enhanced initial subsurface warming, although a weak EN event is already observed a year earlier in those experiments with doubled initial subsurface warming.