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On the relative role of meridional convergence and downwelling motion during the heat buildup leading to El Niño events

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Despite steady progress in the understanding of El Niño-Southern Oscillation (ENSO) in the past decades, questions remain on the exact mechanisms leading to the onset of El Niño (EN) events. Several authors have highlighted how the subsurface heat buildup in the western tropical Pacific and the recharged phase in equatorial heat content are intrinsic elements of ENSO variability, leading to those changes in zonal wind stress, sea surface temperature and thermocline tilt that characterize the growing and mature phases of EN. Here we use an ensemble of ocean and atmosphere assimilation products to identify the mechanisms contributing to the heat buildup that precedes EN events by about 18-24 months on average. Anomalous equatorward subsurface mass convergence due to meridional Sverdrup transport is found to be an important mechanism of thermocline deepening near and to the east of the dateline. In the warm pool, instead, surface horizontal convergence and downwelling motion have a leading role in subsurface warming, since equatorward mass convergence is weaker and counterbalanced by subsurface zonal divergence. The picture emerging from our results highlights the complexity of the three dimensional dynamic and thermodynamic structure of the tropical Pacific during the heat buildup leading to EN events.