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The warm water volume, a better predictor of La Niña than of El Niño

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El Niño – Southern Oscillation (ENSO) is the dominant mode of interannual climate variability, with large environmental impacts at the global scale. With sea surface temperature anomalies (SSTA) reaching up to 4°C in the eastern equatorial Pacific, extreme El Niño events, such as in late 1982, 1997 and 2015, involve a complete re-organization of tropical convection with outsized societal impacts (e.g., tropical cyclones, floods, drought,...) relative to moderate El Niño events. Despite an improved understanding of ENSO dynamics over the past decades, predicting the amplitude of ENSO events remains a challenge, especially at lead-times longer than 2-3 seasons. The “recharge-discharge oscillator” theory, used to describe ENSO dynamics, highlighted the role of the oceanic heat content averaged over the western equatorial Pacific as a robust long-lead precursor of ENSO. This theory is however essentially linear and does not account for the potential asymmetries existing between El Niño and La Niña events. Yet, observations suggest that the ocean preconditioning is a more efficient predictor for La Niña than for El Niño events. The observational record is short and therefore uncertainties on this asymmetry are large. Here we analyse the link between the oceanic preconditioning and ENSO in pre-industrial control experiments, and focusing on a set of eleven models that can reasonably reproduce ENSO variability. As suggested by observations, the discharge one year before ENSO peak in these models is a significantly better precursor of La Niña occurrence and amplitude than the recharge for El Niño. This asymmetry likely arises from (1) the asymmetry of the ocean preconditioning that promotes a larger influence on La Niña (larger discharge) than on El Niño (weaker recharge) and from (2) a nonlinear Bjerknes feedback that promotes the growth of El Niño rather than La Niña. We further build sensitivity experiments to understand these differences in predictability with the CNRM-CM5 coupled general circulation model. Large ensembles starting from contrasted sets of recharge level and ENSO states are run. Experiments with a discharged state generally stand out in terms of predictability, with very systematic transitions to La Niñas. We examine the factors that promote an increased predictability in those experiments, including (1) and (2) above, but also the role of Westerly Wind Events.