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Multidecadal changes in ENSO properties in the recharge oscillator conceptual model

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We use a simple conceptual recharge oscillator model for the tropical Pacific to identify multidecadal changes in El Niño-Southern Oscillation (ENSO) statistics and dynamics during the observational record. The model, defined by only two variables, sea surface temperature (SST) and warm water volume (WWV), is fitted to the observations for the period 1901-2010. The variability of ENSO has increased during the 20th century. The model simulates similar changes in variance of SST and WWV. The cross-correlation between SST and WWV also shows significant changes during the observational record. From the 1970s onwards, both observations and model output show that the SST drives WWV anomalies with a lead-time of 10 months and the WWV feedbacks onto the SST with a lead-time of about 8 months. The latter is reminiscent of a recharge-discharge mechanism of the upper ocean heat content. Before the 1970s only the impact of SST on WWV, through implied wind changes, is observed and is reproduced by the model. The periodicity of ENSO has also changed; ENSO has become more frequent changing from a 7-yr periodicity in the beginning of 20th century to a 5-yr periodicity in the recent decades. We find that the full recharge-discharge mechanism of the equatorial upper ocean heat content that characterizes the dynamics of the ReOsc model is only observed from the 1970s onwards and is likely to be a consequence of a stronger observed coupling between WWV and SST and of the leading role of the thermocline feedback. The degrading quality in the observations for earlier periods can also partly explain the decadal changes in the ENSO interactions. We find that the Atlantic Multidecadal Variability and global warming can partly explain the observed and simulated multidecadal changes in ENSO properties.