Phase transitions for different El Niño types and periods

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The most significant contribution to the interannual variability of the global surface air temperature is associated with the El Niño/Southern Oscillation (ENSO) effects. Here, changes in phase transitions for different El Nino types and periods are estimated. Various phase transitions for different ENSO types were characterized by the Niño3, Niño3.4 and Niño4 indices for different periods during 1891-2015.

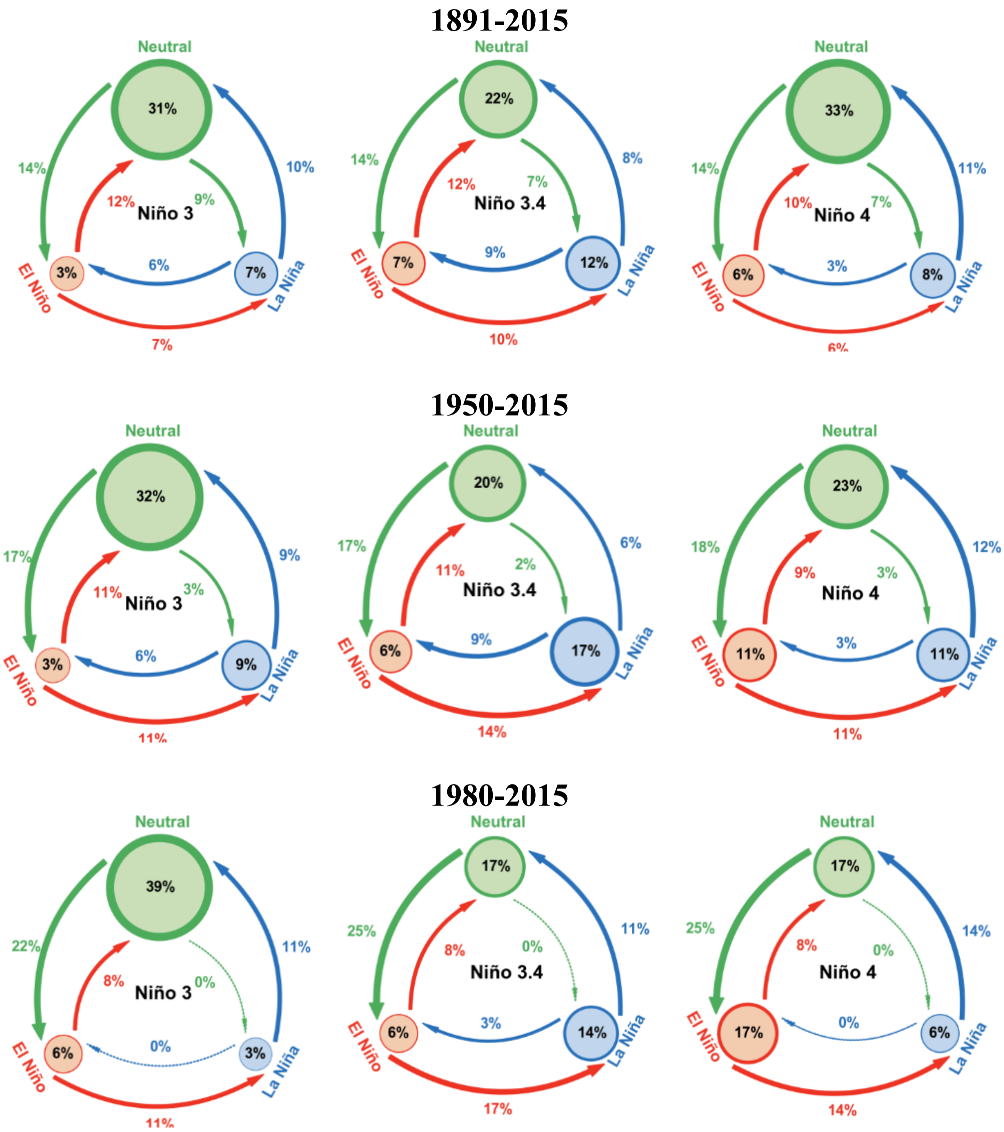

Fig. 1. Estimates of probability for different ENSO phase transitions characterized by various ENSO indices (Niño3, Niño3.4, Niño4) for different periods during 1891-2015.

For estimation of the El Niño/La Niña effects, we used their indices characterized by the sea surface temperature (SST) in the Niño3 (150–90W, 4N–4S), Niño3.4 (170–120°W, 4N–4S) and Niño4 (160E–150W, 4N–4S) regions in the equatorial latitudes of the Pacific Ocean (ftp://www.coaps.fsu.edu/). The El Niño (*E*) and La Niña (*L*) phases were distinguished using 5-month moving averaging of the SST anomaly in the Niño3 region (JMA index). El Niño (warm) and La Niña (cold) phases were defined by the index values of at least 0.5K and at most –0.5K, respectively, over six consecutive months (including October–December). All the other cases were characterized as neutral phases (*N*).

Nine possible phases of transitions for ENSO are analyzed, including $N \rightarrow E$ as a transition from the neutral phase in the beginning of the year (winter in the Northern Hemisphere) to the El Niño phase at the beginning of the next year, $N \rightarrow L$ as a transition from neutral to La Niña phase, and $N \rightarrow N$ as a prolongation of the neutral phase [1-5]. The number of years (n) starting from the neutral phase is about half the total number of the analyzed years (n=125). The number of years started from the El Niño and La Niña phases is about a quarter of the total number of the analyzed years.

Figure 1 presents the probability estimates for various ENSO phase transitions characterized by the Niño3, Niño3.4 and Niño4 indices for different periods during 1891-2015: 1891-2015, 1950-2015 and 1980-2015. According to Fig. 1 the phase transition statistics for ENSO differs significantly when using various indices and for different periods. If indices Niño3 and Niño4 are used to classify the transitions, then the number of years beginning from phase *N* for the period 1891–2015 (n_Σ=125) is equal to n_N=68, whereas in the case of using the Niño3.4 index, this number is equal to n_N=53. The number of years beginning in phases *E* and *L* is less than a quarter of all years (n_Σ=125): $n_{E(L)}$=28 or $n_{E(L)}$=29, depending on the index used (Niño3 or Niño4). In the case of using the Niño3.4 index, the number of years beginning with phases *E* and *L* ($n_{E(L)}$=36) is noticeably more - about a third of all years.

The most frequent are the $N \rightarrow N$ transitions. For ENSO processes detected using the Niño3 index, which characterizes the canonical El Niño with anomalously high SST in the equatorial latitudes of the eastern Pacific Ocean, the $E \rightarrow E$ transitions are most rare. At the same time, they manifest themselves twice as often in the case of using the Niño 4 index, which characterizes the El Niño regime in the equatorial latitudes of the central part of the Pacific Ocean. When ENSO processes are detected by the Niño4 index, the $L \rightarrow E$ transitions are the most rare, which are almost twice as often with the Niño3 index.

There are significant differences in phase transitions for different El-Niño types with a significant changes for different time intervals.

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