Variations in links of key modes of interdecadal climate variability with El Niño phenomena

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The strongest interannual variations of the global climate are associated with El Niño phenomena. Significant interdecadal global-scale climate variations are associated with oscillations like Atlantic Multidecadal Oscillation (AMO), Pacific Decadal (PDO) and Interdecadal Pacific (IPO) Oscillations. Different mechanisms are responsible for generation of various key interannual and interdecadal climate oscillations and their variations and links. Here we study variations in links with El Niño phenomena of key modes of interdecadal climate variability since the beginning of the 20th century with the use of the cross-wavelet analysis of data from (https://climexp.knmi.nl/). This analysis is performed with different El Niño indices characterizing different El Niño types.

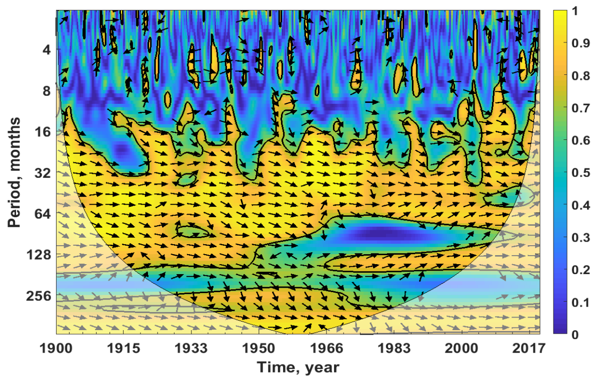

Figure 1. Local coherence between Nino3 and Nino4 indices of El Niño phenomena by monthly-mean data for the period 1900-2019. The arrows signify the correlation phase direction.

Figure 1 shows the coherence between El Niño phenomena characterized by Nino 3 and Nino 4 indices from monthly-mean satellite data for the period 1900-2019. Significant coherence between Nino3 and Nino4 is noted for intra-decadal variations with a period about 5 years, characteristic for El Niño phenomena, and for long-term variations with a period larger than two decades. The coherence for decadal variations is less significant as a whole.

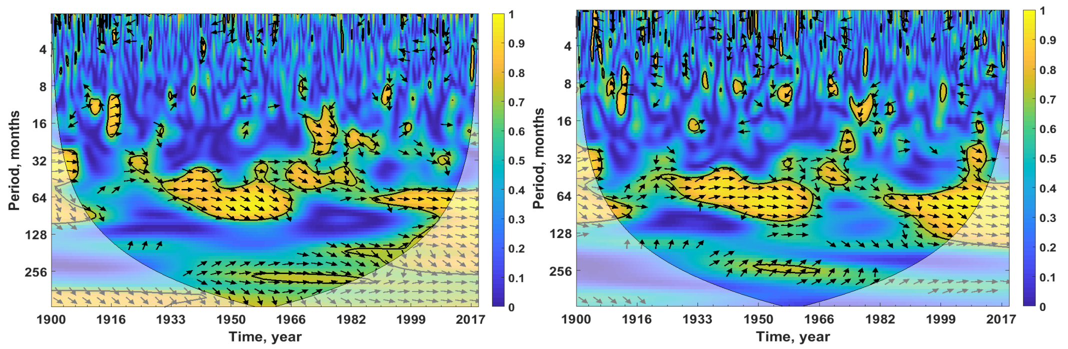

Figure 2. Local coherence of Nino3 (left) and Nino4 (right) indices of El Niño phenomena and PDO by monthly-mean data for the period 1900-2018. The arrows signify the correlation phase direction.

Figure 2 shows local coherence between El Niño phenomena (Nino 3 and Nino 4 indices) and PDO by monthly-mean data for the period 1900-2018. The most significant coherence between El Niño (Nino3 and Nino4) and PDO is observed for variations with periods of about 5 years, characteristic for El Niño phenomena. The coherence of PDO and El Niño phenomena for decadal and interdecadal variations is more significant in the case when El Niño phenomena are characterized by Nino3 index.

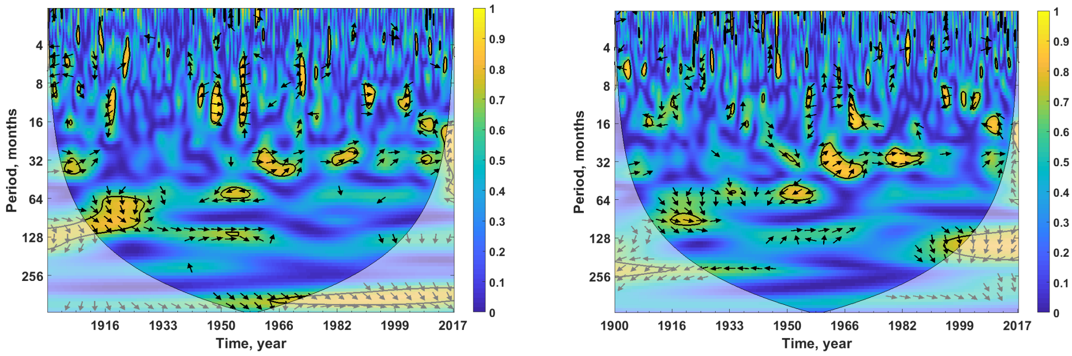

Figure 3. Local coherence of Nino3 (left) and Nino4 (right) indices of El Niño phenomena and IPO by monthly-mean data for the period 1900-2016. The arrows signify the correlation phase direction.

Figure 3 shows the coherence between Nino3 and Nino4 indices and IPO for the period 1900-2016 by monthly mean data. Along with interannual local coherence, 5 years local coherence can be spotted, and, at the same time, 10 years coherence with Nino4 is noted in recent years.

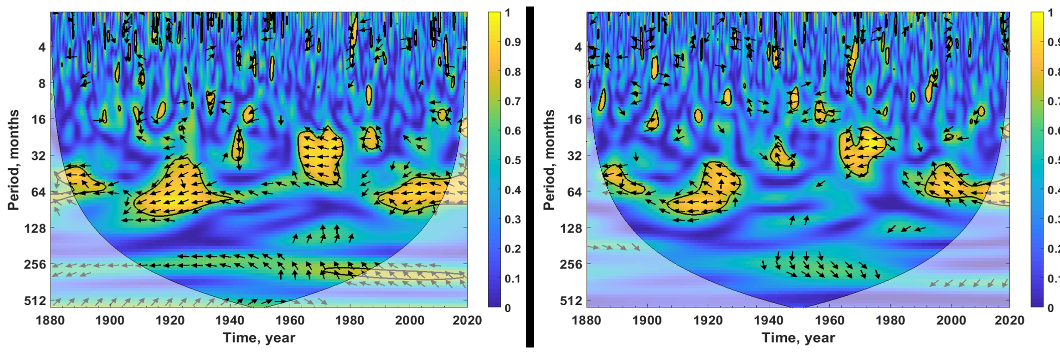

Fig. 4. Local coherence of the indices Nino3 (left) and Nino4 (right) of El Niño phenomena with AMO by monthly-mean data for the period 1880-2019. The arrows signify the correlation phase direction.

Figure 4 displays local coherence of El Niño phenomena (Nino3 and Nino4 monthly-mean indices) with AMO for the period 1880-2019. Time intervals with significant anticorrelation are exhibited for the typical for El Niño phenomena 5-year period. Significant anticorrelation is displayed also between El Niño phenomena (characterized by Nino3 index) and AMO for variations with a period about two decades since 1970s.

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