

Synchronized interdecadal periodic variations behind regime shifts in Pacific Decadal Oscillation

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Interdecadal climate variability over the North Pacific is examined using a 298-yr (1700-1997) Pacific Decadal Oscillation (PDO) index reconstructed from tree-ring records. Three statistically significant variations including the bi-decadal (~20yr), the tri-decadal (~30yr), and the multi-decadal (>50yr) variations are identified. The latter two variations exhibit 'phase-lock' features respectively with the bi-decadal variation: zero-crossings of the tri-decadal (multi-decadal) variation and the bi-decadal variation take place within significantly short duration. Above-mentioned characteristics imply that the two variations with longer timescale receive notable influence from the bi-decadal variation. These three variations together explain phase reversals identified using an instrumental 119-yr PDO index (1900-2018) including the period after 1997, where only the observed PDO index covers. Besides, these variations provide a viewpoint which integrates two contrary perspectives on the climatic regime shifts presented by previous studies. We further discuss possible linkages between these variations and the 18.6-yr lunar nodal cycle, as well as a phenomenon known as subharmonic resonances, which involves excitements of longer variations in nonlinear systems.

Keywords: regime shift, Pacific Decadal Oscillation, phase-lock, 18.6-yr lunar nodal cycle