

The effect of 18.6-year period lunar nodal cycle on Pacific Decadal Oscillation (PDO)

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Pacific Decadal Oscillation (PDO) is the most dominant decadal-inter-decadal ocean-climate variability over the North Pacific; however, the periodicity and cause have not been fully understood. Previous studies suggested that 18.6-year period lunar tidal cycle ($T_{18.6}$) regulate bi-decadal PDO variability through changes in the strength of diapycnal mixing of ocean around the Kuril Islands to result in ocean variability, together with air-sea interactions in the mid-latitude North Pacific and/or equatorial Pacific. In the present study, 297yr-long reconstructed PDO timeseries was re-examined, and 27.9yr (3/2 times 18.6-yr, henceforth, $T_{27.9}$) period variability was significantly detected, and the zero-crossing from minus to plus was found to occur simultaneously with $T_{18.6}$ variability in the interval of 55.4 years (3 times $T_{18.6}$). In the PDO spectrum, a broad multi-decadal 50-80-yr peak (corresponding to 3-5 times $T_{18.6}$, henceforth T_M) was also detected with the zero-crossing synchronized with $T_{18.6}$; this is the extension of previous studies during 1900-2000 back to 1700s on the synchronous changes of bi-decadal and penta-decadal variabilities. These $T_{18.6}$, $T_{27.9}$ and T_M explain 71% of the 10-year low-passed PDO variability. These imply that the 27.9-yr and the multi-decadal variabilities could be related to $T_{18.6}$ tide-induced variability, and may be excited by $T_{18.6}$ tidal forcing, considering that external periodic forcing for delayed oscillator models could excite 3 times period of the external forcing and some non-linear processes may make the half-period variability.

Keywords: 18.6-year period lunar nodal cycle, Pacific Decadal Oscillation