

Centennial to millennial scale variability of the Aleutian Low and Westerly Jet during the Holocene

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The Aleutian Low (AL), the semi-permanent low-pressure system located over the Gulf of Alaska, is critically linked to environmental change in the North Pacific and surrounding continental areas. At timescales that exceed the recent instrumental record of the last 100 years, the AL intensity has been reported to vary on centennial to millennial scales from various proxy records (e.g., Anderson et al., 2005, 2016; Fisher et al., 2008; Jones et al., 2014). However, the ultimate trigger of these intensity changes has not been systematically studied.

Recent meteorological records showed that the Westerly Jet (WJ) over East Asia and the North Pacific links strongly to the AL intensity and position through changes in cyclogenesis, monsoon, and storm track activity (e.g. Lau, 1998; Nakamura et al., 2002; Nakamura and Shimpō, 2004). According to Lau (1988), southward displacement of the WJ axis and associated storm track path over the North Pacific results in a southeastward shift and intensification of the AL. At longer timescales, however, the interactions between the AL and the WJ are virtually unknown. This study examines millennial- and centennial-scale linkages between the AL and WJ during the Holocene to better understand the long-term nature of their interaction. We also introduce WJ records from the Southern Hemisphere, because the WJ path in both the Northern and Southern Hemispheres trace the expansion and shrinkage of the Hadley Cell circulation, which helps to understand changes in North Pacific atmospheric circulation.

The proxy records of the AL and WJ revealed millennial-scale coupling of the AL-WJ path with weakened AL and poleward WJ shifts in both hemispheres during 7–5.2 and 2.8–1.2 ka, and an intensified AL and equatorward shift of the WJ path during 5.2–2.8 ka and 1.2 ka onward (Nagashima et al., submitted to Quaternary Research). Centennial scale AL intensification and equatorward shifts of the WJ path in both hemispheres also appeared in the proxy records. Periods of centennial and millennial-scale AL maxima and equatorward shifts of the WJ correlate well with periods of solar activity minima, suggesting solar activity has played a primary role in the generation of the atmospheric circulation changes, possibly through dynamic Hadley cell changes (Nagashima et al., submitted to Quaternary Research).

Keywords: Holocene, Aleutian Low, Westerly Jet, Solar activity