

The Aleutian-Icelandic low seesaw: its seasonality, formation, mechanism and impacts on surface climate

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During winter, the weather over and around the North Atlantic and North Pacific is strongly influenced by interannual and intra-seasonal variability of the Icelandic low (IL) and Aleutian low (AL), respectively. A seesaw-like oscillation between intensities of the two lows has been apparent for recent decades. The AL-IL seesaw primarily exhibits an equivalent barotropic structure within the troposphere. The seesaw formation is initiated by the amplification of the AL anomalies with wave-activity accumulation in early through midwinter. In midwinter, part of the wave activity thus accumulated disperses downstream across North America in the form of a stationary Rossby wave train, which appears to trigger the formation of stationary anomalies over the North Atlantic. The IL anomalies thus initiated amplify and then become matured by late winter through the persistent feedback forcing from migratory eddies around the Atlantic storm track. It is suggested that the interannual variability in the late-winter IL intensity tends to be strongly influenced by the AL anomalies that develop over the North Pacific by midwinter.

It is argued that what is called the Arctic Oscillation in some recent literature, defined as the leading mode of the sea-level pressure variability for the entire cold season, may be interpreted as a superposition of the AL-IL seesaw upon a dominant signal of the Arctic-midlatitude dipole. The corresponding leading mode for the upper troposphere primarily represents the variability associated with the seesaw.

Further, we show that the AL-IL seesaw exerts a significant influence on the Northern Hemisphere surface climate, especially in the latter half of winter. The strong IL and weak AL cause warmer condition in Europe and Far East associated with the anomalous southerlies. In contrast, the anomalous northerlies bring about colder conditions along the west coast and in the northeastern part of North America. Our analysis suggests that the variability of the AL not only affects wintertime surface climate in and around the North Pacific, but it also has a potential to influence surface climate in and around the North Atlantic a month later.

The seesaw relationship between the AL and IL intensities was not always robust throughout the 20th century. We show some evidence for multidecadal modulations in the seesaw relationship between two lows.