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## Summer Northern Hemisphere annular mode revealed from observation and AGCM simulation

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The seasonal variations of the Northern Hemisphere annular mode (NAM) are investigated through empirical orthogonal function analysis of the zonally averaged geopotential height fields for each individual calendar month. Patterns of the winter and summer NAMs differ not only in the geopotential height fields but also in the mean meridional circulation and eddy structure. The summer NAM has a smaller meridional scale, and is displaced poleward as compared to the winter NAM. The antinode on the lower-latitude side in the summer NAM is at the nodal latitude of the winter NAM. The summer NAM is more strongly related to surface air temperatures over Eurasia than the original Arctic Oscillation. The summer NAM is a wave-driven internal atmospheric mode that is maintained by both stationary and transient waves. The summer NAM is associated with the Arctic front, polar jet, and storm track around the Arctic Ocean. The CCSR/NIES/FRCGC AGCM (T106L56) is also able to exhibit the summer NAM. In addition, the summer NAM enables the realization of anomalous summers, such as the hot Europe/cool Japan occurrences in 2003. Anomalous geopotential and temperature polarity of the summer NAM are substantially identical to the summer patterns in 2003.