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Cluster analysis of Northern Hemisphere wintertime 500-hPa flow regimes during 1920–2014

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Clusters in the Northern Hemisphere wintertime, 10-day low-pass-filtered 500-hPa height field are identified using the method of self-organizing maps (SOMs). Results are based on 1) a 57-winter record of ERA and 2) a 93-winter record of the NOAA Twentieth-Century Reanalysis (20CR). The clusters derived from SOMs appear to be more robust and more linearly independent than their counterparts derived from Ward's method, and clusters with comparable numbers of member days are more distinctive in terms of the standardized Euclidean distances of their centroids from the centroid of the dataset. The reproducible SOM clusters in the hemispheric domain are 1) the negative polarity of the North Atlantic Oscillation (NAO), 2) a pattern suggestive of Alaska blocking with a downstream wave train extending over North America and the North Atlantic, 3) an enhancement of the climatological-mean stationary wave pattern in theWestern Hemisphere that projects positively upon the Pacific–North America (PNA) pattern, and 4) a pattern that projects upon the negative polarity of the PNA pattern. The first three patterns have important impacts on the wintertime climate in North America and Europe. In particular, they are helpful in interpreting prevailing flow patterns during the exceptional winters of 1930–31, 2009–10, and 2013–14.