



## **Relationships between circulation modes and surface climatic variables in winter and summer: a comparison of reanalyses**

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The circulation modes from five atmospheric reanalyses (20CR, ERA-20C, ERA-40, JRA-55, and NCEP/NCAR) are identified over the Northern Hemisphere extratropics between 1957 and 2002 separately for winter (December-February) and summer (June-August). To obtain circulation modes, rotated principal component analysis (RPCA) based on correlation matrix is applied to monthly mean 500h Pa heights for both seasons. RPCA is an appropriate method for the identification of circulation modes; each mode calculated from RPCA is described by its score and loading, the former standing for circulation index and the latter for the spatial representation of that circulation mode. The number of identified circulation modes is 9 in winter and 13 in summer. The (dis)similarity of the modes between the reanalyses is evaluated and the statistical significance of differences is assessed using the Fisher transform of loadings. In general, spatial differences of circulation modes between reanalyses are much higher in summer, especially between NCEP/NCAR and 20CR reanalyses. The spatial representation of circulation modes in winter is more uniform with exception of Eurasian pattern 1 and Eurasian pattern 2, which differs in 20CR reanalysis from other reanalyses considerably more than how the other four reanalyses differ from each other. Relationships between circulation modes of all five reanalyses and monthly temperature and precipitation are described by Pearson correlation for nearly 650 stations in all continents of the Northern Hemisphere. Generally, substantial spatial differences in circulation mode between reanalyses also imply high differences in correlations between circulation mode and temperature or precipitation.