Analyzing regimes of mid-latitude atmosphere circulation by novel nonlinear data decomposition method

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We present a new method for identifying dominant dynamical regimes underlying the observed mid-latitude atmospheric circulation. The method combines the partitioning of recurrence networks and kernel principal component analysis. It enables the detection of significant regimes of variability in addition to obtaining dynamical variables which can be used for regimes embedding. The method is applied to the analysis of geopotential height anomalies of the mid-latitude atmosphere in the Northern hemisphere for the 1981-present winter season. The identified regimes as well as the set of dynamical variables explain large-scale weather patterns, which are associated, e.g., with severe winters over Eurasia and North America. Pronounced interannual signatures are also found in the long-term dynamics of the regimes’ frequencies, which are shown to be closely related to the quasi-biennial oscillation of the tropical stratosphere. The method is presented, and prospects for empirical modeling of the atmosphere circulation regimes, and long-term climate predictability are discussed. The work is supported by the Russian Science Foundation (grant 19-42-04121).