Periodicity of atmospheric teleconnection patterns and its temporal variations as revealed by wavelet analysis

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The wavelet analysis is a powerful tool for detecting an oscillatory behaviour of various phenomena and localizing their periodicity in time. The necessary assumption of its application is an equal temporal distribution of datapoints. In an attempt to apply the wavelet transform to the modes of low-frequency atmospheric circulation variability (teleconnection patterns), we must first define these modes in a monthly resolution throughout the year. The solution to this task is not self-evident as the majority of the modes are active in a part of year only. Of several potentially applicable methodological configurations, rotated principal component analysis (PCA) based on a covariance matrix of monthly mean anomalies appears to be the most convenient tool. The analysis is conducted on two datasets: (i) 500 hPa heights, covering whole Northern Hemisphere north of 20°N and extending from 1950 to 2003, and (ii) sea level pressure, which extends from 1899 to 2000, but with gaps mainly over the former U.S.S.R. and some other parts of Asia in early years. 12 modes are detected, most of which are active in winter. Morlet wavelet is selected as a base for the wavelet transform. The basic feature of wavelet spectra of the variability modes is their intermittency: generally, no period (within the range between 1 and 15 years) appears as dominant throughout the whole analyzed time domain. There are only a few exceptions, which have undergone stationary oscillations; e.g., 9-years for the North Atlantic Oscillation and 14 years for the Tropical / Northern Hemisphere pattern. The wavelet spectra considerably differ between corresponding modes based on 500 hPa heights and SLP. The effects of the sampling interval (monthly or 10 day means) and of the way of compensation for the annual cycle of variability are marginal. This study is supported by the Grant Agency of the Czech Academy of Sciences, project A300420506, and by the Czech Science Foundation, project 205/05/2282.