Variations of atmospheric teleconnections in response to solar activity

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It is already known that the geographical extent of the North Atlantic Oscillation is considerably larger in years with a high solar activity. We extend the investigation to other modes of low-frequency circulation variability (i.e., teleconnections) in the Northern Hemisphere in winter by comparing the area influenced by the modes between the years (months) with a high and low solar activity. Analyzed is the period 1950-2003, atmospheric circulation is characterized by 500 hPa geopotential heights, and solar activity by the Wolf number. Rotated principal component analysis is used to define the modes separately in each class of solar activity (low, moderate, high). Nine modes are detected in all classes. Solar activity affects all the modes, namely their intensity (i.e., the variance they explain), the position of action centres, and their geographical extent. In particular, there are hints of splitting the North Atlantic Oscillation into two modes under high solar activity, weakening and even vanishing of the Tropical / Northern Hemisphere (East Pacific) pattern under high (low) solar activity, and weakening of the North Asian pattern under moderate solar activity. Two mechanisms cooperate in the response of the teleconnection patterns to solar forcing: the change in correlation structurues, and change in the intensity with which they operate. The general impression is that under high solar activity, the modes become more zonal and zonal modes more intense. However, the effect of the solar cycle on the modes is far from linear, as is manifested by insignificant correlations between their intensity and the solar activity. The work is supported by the Grant Agency of the Czech Academy of Sciences, project A3042401.