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Decadal variability in Europe's seasons

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Although the analysis of long-term climate variability is often performed on "anomalies", observations for which the seasonal cycle has been removed, the seasonal pattern can be of interest in itself, and can provide further information on climate variability. Climate change is expected to involve not only changes in the mean of climate parameters (what is examined using deseasoned data) but also changes in the characteristics of the corresponding seasonal cycle (what is often neglected). One reason hindering the proliferation of studies on the seasonality of climate parameters is the difficulty in discriminating between long-term changes in the mean and long-term changes in the seasonal pattern itself. This is a challenging task, requiring the use of appropriate statistical approaches in order to be able to distinguish between overall trends in the mean and trends in the seasons.

In the present study, a method based on the dynamic linear model representation of an autoregressive process is applied to temperature records from the ECA (European Climate Assessment) project in order to analyse the seasonality of Europe's air temperature. The derived seasonal pattern is characterised by an annual cycle with a stable phase but considerable decadal variability in amplitude. The decadal pattern corresponds to high amplitudes in the 1940's and lower annual amplitudes in the early and last part of the 20th century. Although there is a broad tendency for decades with higher amplitudes to be associated with periods of predominantly negative values of the NAO index, the correlation is moderate (correlation coefficient = -0.46) and the most extreme amplitudes (e.g. the sharp minima in the mid 70's and early 90's) are not associated with corresponding changes in the state of the North Atlantic Oscillation. The distinct minimum in the annual air temperature amplitude around 1995 is coincident with the climatic regime shift of the mid-1970's, while the other sharp peak in the early 90's is coincident with the Pinatubo eruption.

In summary, the seasonal cycle of air temperature over Europe is not constant, exhibiting considerable decadal fluctuations in amplitude; these are associated with the state of the NAO and to hemispheric-global scale events, such as the eruption of the Pinatubo.