

Eric Hillebrand
Aarhus University

Abstract

Title:

Phase Changes and Seasonal Warming in Early Instrumental Temperature Records

Phase analyses of the annual cycle of monthly temperature time series that date back to the 18th century show trending behavior that has been difficult to interpret. Negative trends in the estimated phase have been identified with precession, but the implied later onset of seasons is at odds with recent comprehensive satellite measurements and with the phenological record. Positive trends in the phase and the occurrence of trends of both signs in temperature time series from geographically nearby locations have remained mysterious. In this paper, we show that there is a mathematical equivalence between trends in phases and seasonally differing warming trends, in particular more intense warming in winters than in summers. Using temperature time series from 16 northern hemispheric locations reaching back to the 18th century and a statistical model that can estimate the seasonal warming trends, we can reject the hypothesis that the timing of the seasons in these locations is jointly driven by precession.