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A statistical and dynamical analysis of some Winter and Summer temperature extremes in Europe

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Over the last decades Europe has been facing strong extreme events, particularly temperature extremes, with foremost influence on economy, agriculture, water management and society in general. The study of the large-scale atmospheric mechanisms linked to their occurrence is thus significant and is going to be discussed for the winter and summer seasons in this region for 50 years (1961-2010). Additionally, a canonical correlation analysis, coupled with a principal component analysis (BPCCA), is applied between the monthly mean sea level pressure fields and the monthly occurrences of four temperature extreme indices (TN10p - cold nights, TN90p – warm nights, and TX90p - warm days, TX10p – cold days) within a large Euro-Atlantic sector. Each co-variability mode represents a large-scale forcing on the occurrence of those extremes. North Atlantic Oscillation-like patterns and strong anomalies in the atmospheric flow westwards of the British Isles are leading couplings between large-scale atmospheric circulation and wintertime occurrences of both cold (warm) nights and warm (cold) days in Europe. Although summer couplings show lower coherence between warm and cold events, their key driving mechanisms are significant to explain their atmospheric anomalies. In order to get a better insight for both seasons of these extremes, the main features of the statistical distributions of the minima (TNn and TXn) and maxima (TXx and TNx) are also analyzed. Moreover, statistically significant downward (upward) trends are detected in the cold nights and days (warm nights and days) occurrences over the period 1961-2010 throughout Europe for the winters. These tendencies can also be found in summer for the cold nights and warm days, which is in clear agreement with the overall warming. For the summer warm nights and cold days these tendencies are weaker and its signal is geographically dependent.
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