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Origins of the extremely warm European fall of 2006

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The fall of 2006 is the warmest fall on record in Europe and very likely the warmest since 1500, with a temperature anomaly on continental areas reaching +2.6°C (corresponding to 3.5 standard deviations of the 1948-2007 temperature distribution). This episode is comparable in amplitude to the devastating heat-wave of the summer of 2003 and caused heavy impacts on the ecosystem phenology and terrestrial carbon fluxes. The understanding of such climatic extremes is crucial since the climate change may increase their frequency and amplitude, which is more hazardous for societal and natural environmental systems than an increase of the mean global temperature. However, the origins of the extreme anomaly of the fall 2006 have not been elucidated so far.
The aim of this presentation is to quantify the contribution of the atmospheric flow anomaly for this exceptional event and to determine the impact of the extremely warm Eastern Atlantic sea-surface temperature (SST) anomaly on the continental surface temperatures. In order to estimate these responses we used a combination of statistical methods and sensitivity experiments with a regional climate model (MM5). We find that the North-Atlantic atmospheric circulation, which mostly governs the European fall climate, is insufficient to explain the +2.6°C anomaly. Even if the fall 2006 presents an exceptional persistence of northward flow bringing mild air from tropical Atlantic and Sahara regions, it only explains +1.3°C of the anomaly according to both statistical and dynamical models. About +0.8°C of the remaining is attributed to the SST warm anomaly contribution. Overall, 80% of the continental warmth can be explained by the combined effect of atmospheric flow and SST, while the remaining 20% may be due to other processes, nonlinearity, or to an anomaly of the global background man-induced warming trend. Assuming such decomposition, the contribution of trend components should explain about 20 to 40% of the anomaly, a proportion that should increase under enhanced radiative forcing as expected in the 21st century.