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On the role of the Atlantic SST in enhancing the recent and future European seasonal land temperatures

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Over the past five years Europe witnessed a spate of extremely warm seasons which broke all the previous temperature records. The most spectacular example is the dramatic heat-wave of the summer 2003 that had severe impacts on human health, especially in France. More recently the consecutive fall 2006, winter 2006/2007 and spring 2007 presented three unprecedented warm seasonal anomalies and also induced strong socio-economic and environmental damages. Since the temperature conditions observed during these seasons may occur with an increased frequency in the 21st century, they can roughly be considered as “previews” of the future standards. Using recent observations as prototypes of the future is helpful in considering adaptation or mitigation strategies to reduce the impacts of a warmer climate.
This presentation shows that even if the European climate is mostly governed by the North-Atlantic atmospheric dynamics, the warming trend observed in Europe since the 1990s is incompatible with circulation changes only. Using a linear regression model and computing regional simulations with the MM5 NCAR/PSU model for each record-breaking season, we highlight the role of the East-Atlantic SST in shifting the continental temperatures towards warmer values. The statistical and the dynamical models show a good agreement concerning the quantification of the SST contribution.
The linear regression model is also used to analyse the links between North-Atlantic atmospheric dynamics, Atlantic SST and European land temperatures in the outputs of the IPSL global model under different IPCC emission scenarios for the 21st century. We find that the atmospheric flow remains significantly correlated with the land temperatures but is insufficient to explain the strong 2000-2100 warming. This trend is mainly explained by the Atlantic SST that keeps enhancing the land temperatures, so that the future European climate could roughly be reconstructed from a linear combination of atmospheric dynamics and SST. However this simplistic model fails to reproduce some local processes and nonlinear aspects that amplify the warming, especially concerning summer and fall seasons.