Predicting hot days in Europe

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(Phys.org) -- 'Red sky at night, shepherd's delight, red sky in morning, fisherman's warning.' This saying is one of Europe's earliest rhymes that were used to predict weather for the following day. With advances in modern technology, from radar to satellite imagery, we can now predict weather well beyond the following day. European scientists have gone one step further, however, by predicting weather, not just days and weeks in advance, but a whole season ahead. Seasonal prediction can help us prepare against adverse weather conditions in the areas of agriculture, health and other industries. The findings were published in the journal Nature Climate Change.

Seasonal predictions are the next hurdle faced by meteorologists but they remain a significant scientific challenge due to flow instability and nonlinearity, which occurs mostly in the mid-latitudes. In this latest study, researchers focused on whether preceding seasons rainfall allow scientists to predict the frequency of forthcoming summer hot days and physical causes of such a predictability.

Led by the Laboratoire des Sciences du Climat et de l'Environnement (LSCE) and the Swiss Federal Institute of Technology Zurich (ETH Zurich), researchers in France and Switzerland observed that summer heat in Europe rarely develops after rainy winter and spring seasons over southern Europe. But they discovered that dry seasons are either followed by hot or cold summers. What this means is that the predictability of summer heat is asymmetric and that climate projections indicate a drying of southern Europe. The results suggest that the asymmetry that exists should create a favourable situation for the

development of more summer heat waves with a modified seasonal predictability from winter and spring rainfall.

The researchers noted that over the past decade Europe saw a number of exceptional summer heat waves with important impacts on society. The 2003 heat wave was the hottest summer on record since 1540 and led to a major health crisis and crop shortfall. Meteorologists were stunned when the record was shattered by the 2010 heat wave just a few years later. Maximum temperature measurements averaged over 7 days exceeding the average for this figure from 1871-2010 by 13.3 degrees Celsius. According to the researchers, extreme summers such as these could be considered as prototypes of summers of future warmer climate. But our ability to anticipate such events one or several months in advance, thereby giving us the chance to prepare ourselves, remains poor.

The team analysed precipitation and temperature observations made in 200 European meteorological stations over a period of time stretching more than 60 years. From this they made some generalisations for the region of southeastern Europe, including that rainy winters and springs inhibit the development of hot summer days for the following summer season, while dry or normal rainfalls allow either a large or a weak number of hot temperature days.

After dry months, a strong solar energy, associated with anticyclonic conditions, is transferred to the atmosphere through heat fluxes, amplifying drought and heat with a positive feedback. After rainy months, solar energy is largely used for evapo-transpiration instead, limiting the amplification of heat. Even after very dry winter and spring seasons, early summer heavy precipitations can annihilate the potential to develop extreme temperatures, which may have been the case during the 2011 summer, which followed an exceptional spring drought.

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