Mechanisms of Future Summer Drying over Central Europe

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Global circulations models (GCMs) consistently predict that one of the effects of enhanced atmospheric concentrations of greenhouse gases may be to cause a reduction in summertime precipitation over much of southern and central Europe. If this becomes a reality, significant stress on water resources and agriculture is likely to result, and thus it is important to assess the reliability of such projections. One way of achieving this is through a better understanding of the simulated mechanisms of these climate changes, alongside an understanding of the GCM's strengths and weaknesses. This would then contribute to the process of judging the level of uncertainty to be attached to these climate predictions.

The prime source of data employed in this study is an ensemble of 'time-slice' experiments using a high resolution atmospheric GCM, HadAM3H. Three integrations simulate the 1961-1990 period using observed SST forcing, and a further three integrations simulate possible realisations of the 2071-2100 period using forcing from the SRES A2 scenario and forcing from SSTs produced by an ensemble of coupled model runs using the A2 scenario.

Over central Europe (42-58ºN) this scenario of future climate predicts that precipitation will be enhanced from December to March, but substantially reduced from May to October. Over southern Europe (land points south of 42ºN) precipitation is reduced throughout the year. Furthermore, substantial reductions in the availability of soil moisture are also modelled. The mechanism for the decrease in rainfall totals may be separated into two basic processes: reduced atmospheric supply of moisture to the region, and/or a reduced moisture supply by evaporation from the land surface. Over central Europe, the former process (caused by circulation changes) dominates in May, June and October, whereas the evaporative process may also play a major (possibly dominant) role in July to September. Further details of these mechanisms will also be described, enabling a preliminary assessment to be made of the reliability of the HadAM3H European summer rainfall projections.