Geophysical Research Abstracts, Vol. 7, 07192, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07192

Physical processes during the 2003 European summer heatwave

E Fischer (1), D Lüthi (1), PL Vidale (2), SI Seneviratne (1) and C Schär (1)

(1) Institute for Atmospheric and Climate Science, ETH Zürich,
(2) NCAS Centre for Global Atmospheric Modelling, University of Reading
(erich.fischer@env.ethz.ch)

A record-breaking heatwave affected the European continent in summer 2003, causing between 20,000 and 35,000 deaths and large financial loss due to crop shortfall and forest fires. The physical processes and the sequence of feedbacks during the formation of heatwaves involve substantial uncertainties.

Here we use the regional climate model CHRM to simulate the summer 2003 over Europe in order to identify the key processes in an evolving heatwave. We investigate the role of the synoptic-scale circulation, soil hydrology and evapotranspiration, as well as their interactions and the related feedback processes. Sensitivity experiments are performed by perturbing spring soil moisture in order to determine its influence on the formation of the heatwave. The simulations are driven by lateral boundary conditions and sea-surface temperatures from the ECMWF operational analysis. A multi-year regional climate simulation for 1960–2000 as well as independent observational and ERA-40 reanalysis data are used for validation.

The exceptionally high temperatures in summer 2003 were initiated by anticyclonic atmospheric circulation enabling a dominance of the local heat balance over Europe. The extremely strong radiative anomalies resulted in a first temperature maximum in June 2003. This surface temperature anomaly is revealed to have contributed to a rapid loss of soil water, which is found to exceed the long-year average by far. The lack of moisture resulted in negative latent and positive sensible heat flux anomalies culminating in the maximum heatwave in August 2003. The evaluation

of the experiments with perturbed spring soil water reveals a significant non-linear response of surface heat fluxes and summer temperature. These findings offer new evidence for the important role of soil water in the formation of the 2003 summer heatwave.