



A combined eddy-covariance, remote-sensing and modeling analysis of carbon and water fluxes during the European 2003 heat wave

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The European CARBOEUROPE ecosystem sites, spatial remote sensing observations via the MODIS sensor and ecosystem modelling provide independent and/or synergistic views on the effect of the 2003 heat wave on the European biosphere's productivity and carbon balance. We show results from an analysis that consistently demonstrate a strong negative anomaly of primary productivity during the summer of 2003. The fraction of absorbed photosynthetically active radiation (fPAR) detected via remote sensing was below minus five standard deviations from the mean fPAR of the previous years during summer. Analysis of the CARBOEUROFLUX eddy covariance data indicates that the drop in productivity was not primarily caused by high temperatures ('heat stress') but rather by limitation of water (drought stress). A joint analysis of carbon and water fluxes suggests that canopies did not increase their intrinsic water-use efficiency during the drought period. For understanding the effect on the annual net carbon balance one has to consider the synoptic weather patterns during the whole year and effects on respiration that was also strongly depressed in 2003. Hence, a number of Mediterranean sites were in fact stronger carbon sources in 2003 than in previous years. A model inter-comparison along a gradient from data-oriented models to process-oriented models indicates that all approaches are similarly describing the spatial patterns of ecosystem sensitivity to the climatic 2003 event. For Western Europe an anomalous source of carbon between 0.4 and 0.6 Pg C is conceived by the models. A more extended analysis including more sites, with more participating models and integration of results from the top-down perspective (atmospheric signal)

is being pursued in the CARBOEUROPE integration component.