Geophysical Research Abstracts
Vol. 12, EGU2010-14874, 2010
EGU General Assembly 2010

Energy budget of the extreme Autumn 2006 in Europe

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Autumn 2006 was extraordinarily mild in many parts of Europe. Near-surface temperatures were more than three standard deviations above the 1961-90 climatology. Even accounting for global warming, this event was far outside the probability density function (PDF) of previous observations or climate model simulations. To investigate the mechanisms behind this event, the energy-budget for Autumn 2006 in Europe is estimated. Atmospheric energy-transport convergence over Europe is calculated and compared with the net energy flux at the top of the atmosphere (TOA) as well as at the earth's surface.

The central North-Atlantic Ocean constituted the major source of energy. Here, the release of both sensible and latent heat was anomalously high. Atmospheric circulation played a crucial role by transporting the excess energy into Europe. Of this energy excess, dry-static energy was larger than the latent part, partly due to an additional contribution derived from a conversion of latent energy to sensible heat, which occurred upstream of the study area in the eastern Atlantic. In Europe, surface turbulent-energy fluxes into the atmosphere respond to atmospheric energy-transport convergence and are accordingly suppressed due to the anomalously high temperature and humidity content of the overlying air. The net outflow of radiational energy to space is anomalously high but not sufficient to offset the large positive anomaly of energy found over Europe.

Even though the relative humidity was near its normal values in Europe, the specific humidity was considerably higher than usual. The high water-vapour content induced a local radiative positive feedback, increasing the opacity of the atmosphere to long-wave radiation. This appears to have significantly contributed to the extreme event. Atmospheric circulation played a crucial role in sustaining this feedback loop.