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Forests: a CO2 Sink that Could Dry up

European researchers have analysed the impact of the extreme heat and drought experienced in the summer of 2003 in Europe. They found that such extreme conditions resulted in 30% decrease in primary productivity over the continent which reversed European forests and prairies from CO2 sinks to CO2 sources.

The question of how ecosystems will respond to predicted consequences of climate change in Europe - temperature rise, occurrence of more intense and frequent heat-waves and droughts, water shortage – is widely investigated by the scientific community and is of great importance for European environment policy.

A large body of scientific research addresses the issue of climate effects on terrestrial ecosystems, namely forests that are known to play a major role in reducing global warming by sequestering a substantial amount of the CO2 released in the atmosphere by human activities. The results of various manipulative experiments suggest that global warming in the 21st century could have a positive effect on primary productivity in Europe and temperate latitudes, namely due to carbon sequestration and the extension of the growth period during the spring.

But a recent study on the impact of the extreme heat-wave and drought that occurred in Europe during the summer of 2003 shows the contrary. The observed climate conditions - rainfall dropping 50% below the long-term norm and temperature exceeding the average by more than 6℃ - had a negative effect on the biomass producti on and the capacity of forests to sequester the CO2 from the atmosphere.

The study was carried out by a group of European researchers involved in the EU CarboEurope project that uses an atmospheric modelling system coupled with a unique monitoring network measuring carbon, water, and energy fluxes in a representative set of forests and prairies in Europe during 2002 and 2003.

For the year 2003, researchers have observed that the extreme temperatures and especially the deficit in precipitation during the summer accelerated the drying of soils and produced altered photosynthesis, with effects lasting until fall. Consequently ecosystem photosynthesis declined by a total of 195 g C/m^2yr which lead to an exceptional 30% reduction in gross primary productivity. This decline resulted in strong anomalous net loss of CO2 to the atmosphere (0.5 Pg C/yr) and reversed the effect of about four years of net ecosystem carbon sequestration across the continent.

Though study quantifies the short-term effects of extreme climate conditions on productivity, the authors argue that the long-term consequences are likely to be significant as well. They suggest that the predicted increase in the frequency and the intensity of events such as the 2003 European drought has the potential of eroding the productivity of ecosystems, reversing sinks into sources, and contributing to positive carbon-climate feedbacks. This raises important questions on ecosystems adaptation to climate changes and on the measures to be taken to manage this adaptation.

Source: Ciais, Ph et al (2005) “Europe-wide reduction in primary productivity caused by the heat and drought in 2003”, Nature 437, 529-533.
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