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NEWS

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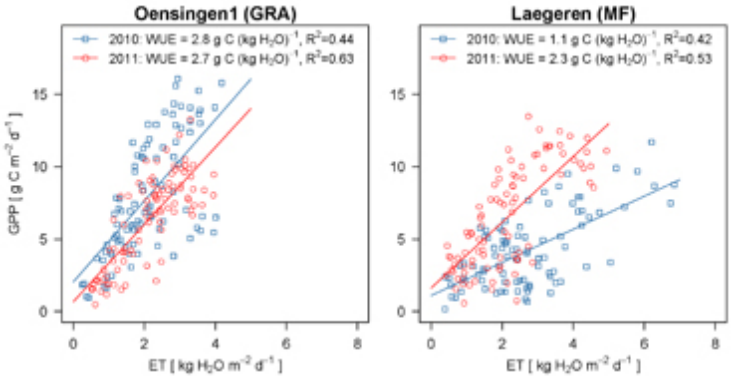
Insight: forests use water more efficiently during spring drought

Droughts are predicted to become more and more frequent in the future, but how will different ecosystems react to these dry periods? A recent study published in Environmental Research Letters (http://iopscience.iop.org/1748-9326/8/3/035007/article) has revealed that grasslands and forests in Switzerland respond very differently to spring drought. While forests appear to adapt by increasing water-use efficiency (the ratio of ecosystem gross primary production to evapotranspiration), grasslands do not.



(http://images.iop.org/objects/erw/news/8/8/110/WUE.jpg)

Water-use efficiency (WUE) of grassland (GRA) versus mixed forest (MF) during spring drought. (http://images.iop.org/objects/erw/news/8/8/110/WUE.jpg)

Spring 2011 was the warmest and one of the driest springs in Switzerland since meteorological measurements began. Temperatures were on average 3.4°C higher than normal and there was around 47% less rainfall. The season also followed an exceptionally dry winter.

This combination of dry winter and spring resulted in a pronounced spring drought that affected farming and water supplies. Reservoir levels reached record lows, and extra irrigation was required to maintain agricultural production in parts of Switzerland.

Drought not only affects plant productivity, and so carbon assimilation, but also changes how much water is lost from plants and soil. How ecosystems respond to droughts and the impacts of these responses on the atmosphere are hence strongly controlled by water-use efficiency. While we are beginning to understand how ecosystems respond to summer drought much better, the responses to spring drought are still largely unknown.

Our research team analysed Swiss FluxNet (http://www.swissfluxnet.ch) data from three grassland and two forest ecosystems to investigate the effects of the 2011 spring drought. Across all the sites studied, spring phenological development started 11 days earlier in 2011 compared to the mean start date for 2000–2011.

Forests also adapted to the spring drought by reducing water loss (via stomatal regulation of transpiration) and thus substantially increased their water-use efficiency. In contrast, the grasslands did not increase their water-use efficiency during the drought, and the low soil moisture limited regrowth after the grass was cut.

Our results clearly show that grasslands and forests respond differently to drought thanks to different adaptive strategies. They also suggest that understanding the responses of different land-use types to drought will be important when it comes to predicting the impacts of climate change on biosphere-atmosphere fluxes in terrestrial ecosystems.

The scientists reported their work in **Environmental Research Letters (ERL)** (http://iopscience.iop.org/1748-9326/8/3/035007/article) as part of the *ERL Focus on Extreme Events and the Carbon Cycle* (http://iopscience.iop.org/1748-9326/focus/Extreme%20Events%20and%20the%20Carbon%20Cycle).

Related links

- Grassland Sciences Group, ETH Zurich (http://www.gl.ethz.ch/)
- Swiss FluxNet (http://www.swissfluxnet.ch/)
- Contrasting response of grassland versus forest carbon and water fluxes to spring drought in Switzerland, Sebastian Wolf *et al* 2013 **Environ. Res. Lett. 8** 035007 (http://iopscience.iop.org/1748-9326/8/3/035007/article)
- *ERL Focus on Extreme Events and the Carbon Cycle* (http://iopscience.iop.org/1748-9326/focus/Extreme%20Events%20and%20the%20Carbon%20Cycle)

About the author

Sebastian Wolf (http://nature.berkeley.edu/~sewolf) is a postdoctoral fellow in the Biometeorology Lab (http://nature.berkeley.edu/biometlab) at the University of California, Berkeley. His research focuses on the biosphere-atmosphere exchange of carbon and water in terrestrial ecosystems using the eddy covariance technique (http://www.ipw.agrl.ethz.ch/~sewolf/PICS/EC-Method_S.Wolf.png). He is particularly interested in the effects of extreme events (for example, drought) and land use change on ecosystem processes such as photosynthesis and transpiration.