Trees adapt to poor levels of sunlight to effectively process carbon, study shows

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In Europe forests appear evergreen even in the cloudiest conditions, while the lush interiors of Asian jungles are typically overshadowed by a dense canopy. The ability of trees to adapt to light conditions, and even increase their intake of carbon for photosynthesis in poor light, has been explored by Czech researchers and published in the British Ecological Society's *Functional Ecology*.

The research centers around the impact of cloud cover on photosynthesis, the process through which plants and trees take in carbon and utilise the solar energy to produce oxygen, a process which is dependent on sunlight. The sun's energy reaches the earth's surface directly, or it can be diffused through the atmosphere by factors including cloud cover.

"Cloud cover has a direct impact on ecosystems by influencing temperature and light, so the conditions of the sky are just as important to photosynthesis as sunlight itself," said lead author Dr Otmar Urban, from the Global Change Research Centre in Brno, Czech Republic. "Surprisingly however studies show that an increase in cloud cover and the resulting diffusion of light can actually enhance the photosynthesis of forest canopies, but the mechanism behind this has remained unknown."

The idea that greater cloud cover can increase an ecosystem's exchange of carbon through photosynthesis may appear counterintuitive, but Dr Urban's team believe the process is due to the even distribution of light among leaves throughout the many levels of a forest canopy.

To test the theory the team analysed the net carbon intake of a spruce forest in the Beskydy Mountains of the Czech Republic under both cloudy and sunny skies. This was coupled with a study of the leaf chlorophyll within different sections of the canopy to gauge the resulting levels of photosynthesis.

The results showed that the higher diffusion of sunlight during cloudy days did result in a higher uptake of carbon across the ecosystem when compared to the same levels of light on sunny days.

Analysis of tree shoots also revealed that shoots from deep within the canopy contributed substantially to the overall carbon balance of the forest during cloudy days. However the contribution of middle or shaded parts of the canopy was marginal, or even negative, on sunny days. Shoots at the top of the canopy contributed 78% of the total carbon intake during a sunny day, but only 43% during a cloudy day when light was more evenly distributed.

"This research shows that diffuse light, caused by cloud cover, has an important impact on the productivity of vegetation," concluded Urban. "The ability of forests to not only adapt to the levels of light they regularly receive, but make effective use of those conditions, helps us to understand how individual trees can maintain such a high intake of carbon despite being overshadowed by the tops of the canopy."

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