Geophysical Research Abstracts
Vol. 16, EGU2014-11055, 2014
EGU General Assembly 2014

6i7H8JSg

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Atmospheric CO_2 concentration (Ca) is rising at an unprecedented rate, nowadays nearing 400 ppm. Rising levels of Ca directly affect plant functioning and these effects cascade into all the rest of the ecosystem. A major mechanism for this is through stomatal closure in response to elevated Ca , which should result into increased soil moisture availability. The water savings lead to increased soil water storage in the deeper soil layers and ultimately increase surface runoff. The hypothesised water savings phenomenon is hotly debated, since the reduction in transpiration per unit of foliar area could be counterbalance by an increase in leaf area index (LAI) or increased understorey transpiration. To address these hypotheses, we conducted a large-scale CO_2 enrichment experiment (FACE) in a water-limited ecosystem in Australia.

We quantified the impact of elevated Ca on ecosystem water use and storage within the EucFACE experiment. The EucFACE experiment (Eucalyptus Free Air CO_2 Enrichment) is the first of its kind established on a native old growth woodland, a remnant patch of native Cumberland plain woodland west of Sydney (Australia). The experiment consists of six 25 m diameter cylindrical arrays ('rings'). The vegetation within three of the rings is exposed to a Ca of 150 ppm above ambient. To assess the impact of elevated Ca on the different ecosystem components we monitor: soil moisture availability (from 25 to 450 cm depth), canopy transpiration (on the one major canopy forming species: Eucalyptus tereticornis), LAI, ground water oscillations, canopy interception, stemflow and understorey transpiration. We ask here whether canopy transpiration is altered by elevated Ca, and whether soil moisture dynamics have changed during the early stages of the experiment.

We found reduced stomatal conductance to water vapour under elevated Ca, though this depended on soil water availability and prevailing temperature. Stomatal closure resulted in a small seasonal reduction of transpiration at the whole canopy level, only under moist conditions. Vegetation water savings under elevated Ca translated into greater moisture availability in the shallow soil during relatively moist periods whereas this effect disappeared after a sustained period without precipitation. Finally we found that during a dry period, in the deeper soil layers (200-350 cm), soil moisture gradually decreased more under ambient than under elevated Ca.

Overall, these results suggest that elevated C¬a will not produce water savings during drought, but will under high and medium water availability. According to our preliminary analyses, we propose that these water savings will translate into increased soil water storage at the deeper layers.