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From the low past to the high future: Plant growth across CO_2 levels

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In today's atmosphere fossil fuel emissions and land use change since the industrial revolution have increased atmospheric CO_2 concentration from 280 ppm to nearly 400 ppm, a value not experienced by plants for over 10 million years. In contrast, over the same period atmospheric CO_2 levels have been much lower than preindustrial levels. Plants' recent evolutionary history has thus been under carbon starvation while over the next 90 years atmospheric CO_2 is expected to rise to a bountiful $\sim$800 ppm. Plants' response to this rapid increase is likely influenced by their long evolution in low CO_2, but this has been hardly studied at all. Very little is known about how plant traits drove carbon cycling in the past and how these relationships may shift going from past to future CO_2. In a climate chamber experiment we germinated and grew seedlings of 30 species (C_3, C_4, woody, herbaceous) at past low CO_2 (150ppm), ambient CO_2, and future high CO_2(750ppm). Our aim was to understand how plant traits are affected by CO_2 and if and why winners and losers in terms of growth performance shift going from past to future CO_2 concentrations. Results show a great effect of low and high CO_2 on specific leaf area, biomass and allocation shifts above and belowground but mixed results in patterns between species and plant types. Ongoing work focuses on leaf level chemistry and photosynthesis and the interaction between CO_2 and drought stress with promising initial results.