**README**

Data from: Links across ecological scales: Plant biomass responses to elevated CO2 (Global Change Biology, 2022). Maschler, Julia; Bialic-Murphy, Lalasia; Wan, Joe; Andresen, Louise C.; Zohner, Constantin M.; Reich, Peter B; Lüscher, Andreas; Schneider, Manuel K.; Müller, Christoph; Moser, Gerald; Dukes, Jeffrey S.; Kappel Schmidt, Inger; Bilton, Mark C.; Zhu, Kai; Crowther, Thomas W.

**Abstract**

Despite the wide agreement that increased plant biomass accumulation under elevated CO2 concentrations (e[CO2]) might play a key role in climate change, the effect of e[CO2] on plant biomass levels remains a major uncertainty in climate models. In the review associated with this dataset, we discuss the evidence for increased biomass levels under e[CO2] across multiple levels of ecological organization, scaling from physiological responses to changes in population-, community-, ecosystem-, and global-scale dynamics. We find that evidence for a sustained biomass response to e[CO2] varies across ecological scales, leading to diverging conclusions about the responses of individuals, populations, communities, and ecosystems. We identify key research gaps in our understanding of the effect of e[CO2] on plant biomass and highlight the need to integrate knowledge across scales of ecological organization so that large-scale modeling can represent the finer-scale mechanisms needed to constrain our understanding of future terrestrial C storage.

**Data details & usage in our review**

The data used for our analyses were collated by L. C. Andresen and M. C. Bilton for a meta-analysis(Andresen et al., 2016). For our analyses, we used a subset of this original dataset with observations of plant biomass under ambient and elevated CO2 concentrations (a[CO2] and e[CO2]) at Free-Air CO2 Enrichment (FACE) studies, including cases where other treatments had been applied to both CO2 levels (e.g. a[CO2]-warming vs e[CO2]-warming). In total, our subset has 331 observations from nine different experimental sites. More detailed site information and original data citations are reported in Andresen et al. (2016).

The associated dataset (Plant\_biomass\_under\_eCO2) was used for two analyses in the community–ecology section of the review (Maschler et al., 2022). In the first analysis, we evaluated how the nitrogen status of non-tree functional types affects plant biomass responses to e[CO2] across time, and we found that the response of plant biomass to e[CO2] was only sustained across 18 years in plants under nitrogen addition but not in absence of additional nitrogen. In the second analysis, we evaluated if the plant biomass response to e[CO2] differed over the years between trees and non-trees, and we found that the plant biomass response to e[CO2] tended to be higher in trees compared to non-trees. For more information on the modeling, we refer to our review paper (captions of Figures 3 and 4, supplements).

For our analyses, we did not carry out corrections for pre-treatment differences because we only had pre-treatment values (‘yearnumber’ < 1) from five of the nine experimental sites. Like in Andresen et al. (2016), the response variable for our modeling was ln(aboveground biomass under e[CO2]) – ln(aboveground biomass under a[CO2]), where biomass can mean both aboveground standing biomass (for non-trees) as well as a measure of annual aboveground biomass increment (for trees).

To characterize the effects of nitrogen on plant biomass responses to e[CO2] over time, we assigned all observations to one of two nitrogen treatments (low N, high N), depending on if nitrogen fertilizer had been added or not. The only exception to this was ETH Swiss FACE, where not only the high N treatments had been fertilized but also the low N treatments had received small amounts of nitrogen fertilizer, and we assigned these low N treatments to our low N group. In our data analysis of the effect of nitrogen on the e[CO2] response, we only used observations with non-tree functional types because there were no high N observations for trees in the dataset.

To enable the analysis of differences in e[CO2]-induced plant biomass responses between functional types, we assigned each observation to the dominant plant functional type (tree, non-tree). We excluded the high N treatment observations from this analysis because this treatment had not been done for trees. While aboveground standing biomass was measured for non-trees and annual increment in aboveground biomass was measured for trees, we considered these values to be comparable because aboveground tree biomass is a cumulative measure, and we were primarily interested in characterizing how the annual rate of plant biomass production changed over time.

Original data citations and detailed site information are reported in Andresen et al. (2016). The column names in the attaced CSV (Plant\_biomass\_under\_eCO2) are defined in Table 1 below.

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| **Variable name** | **Description** |
| experiment | Name of experimental site |
| year | Calendar year |
| yearnumber | Years since start of experimental treatment (yearnumber < 1 ≙ pre-treatment) |
| meanCtrl | Aboveground biomass under ambient CO2 concentrations  (non-trees: mean aboveground standing biomass;  trees: mean annual aboveground biomass increment) |
| meanTreat | Aboveground biomass under elevated CO2 concentrations  (non-trees: mean aboveground standing biomass;  trees: mean annual aboveground biomass increment) |
| effectLOG | ln(meanTreat) – ln(meanCtrl) |
| nitrogen | Nitrogen addition (0 = no, 1 = yes; see data description for exceptions) |
| temperature | Temperature treatment (high, ambient) |
| water | Water treatment (wet, dry, ambient) |
| species | Identifier for species or community |
| addTreat | Additional treatment = non-CO2 and non-N treatment at the same experimental site (temperature, water, species) |
| functType | Functional type (tree, non-tree) |
| unit | Unit of aboveground biomass measure (see data description for details) |

*Table 1: CSV column data discriptions*

References:

Andresen, L. C., Müller, C., de Dato, G., Dukes, J. S., Emmett, B. A., Estiarte, M., et al. (2016). “Shifting Impacts of Climate Change: Long-Term Patterns of Plant Response to Elevated CO2, Drought, and Warming Across Ecosystems,” in *Advances in Ecological Research* doi:10.1016/bs.aecr.2016.07.001.

Maschler, J., Bialic-Murphy, L., Wan, J., Andresen, L. C., Zohner, C. M., Reich, P. B., et al. (2022). Links across ecological scales: Plant biomass responses to elevated CO2. *Glob. Chang. Biol.*