April 2017

Dear Editors,

Please consider our paper, entitled “**How do climate change experiments actually change climate?**” for publication as a “Perspective” in *Nature Climate Change.*

Our paper offers an important step forward in understanding the biological impacts of climate change. These impacts have been widely observed around the world, from shifting species’ distributions to altered timing of important life events1-3. Ecologists are now challenged to not only document such impacts, but also to make quantitative, robust predictions of the ecological effects of climate change.

Field experiments that alter temperature and precipitation are critical tools that scientists have used for over three decades to understand and forecast these effects4, 5. They offer the ability to create “no-analog" climate scenarios forecasted for the future, to isolate effects of temperature and precipitation from other environmental changes, and to examine non-linear responses to climatic changes. Because of experiments’ crucial role in understanding biological impacts of climate change, it is essential that we interpret and apply their results accurately. Yet to date, a rigorous assessment of how active warming experiments alter the climate conditions experienced by organisms has not been conducted.

In this paper, we offer the first meta-analysis of high-resolution climate data from field-based climate change experiments. We find that results from these experiments may be interpreted in misleading ways, because the common practice of summarizing and analyzing only the mean changes across treatments hides variation in treatment effects over space and time. In addition, we identify secondary, unintended treatment effects that are rarely described or interpreted (e.g. soil drying with warming treatments). Based on our findings, we believe there is a need to rethink the design and interpretation of climate change experiments. We make specific recommendations for future experimental design, analysis, and data sharing that will improve the ability of climate change experiments to accurately identify and forecast species' responses to changes in climate.

This paper brings together an international and interdisciplinary team of researchers that bridges perspectives from ecology, climatology, and land surface modeling. Importantly it is comprised of many of the scientists who executed the major warming experiments6-10 and those who have raised concerns over the findings of such experiments11.

In addition to the results and ideas presented in the paper, we present a new, publicly accessible database. We expect future analyses of this database will lead to improved mechanistic understanding of climatic drivers of biological responses, and inspire innovative experimental design and analysis.

We suggest Josep Peñuelas (CREAF-CSIC**,** [josep.penuelas@uab.cat](mailto:josep.penuelas@uab.cat)) and Osvaldo Sala (Arizona State University, [Osvaldo.Sala@ASU.edu](mailto:Osvaldo.Sala@ASU.edu)) as potential reviewers. Thank you for your time and consideration of our paper.

Sincerely,



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