Supplemental materials for: How do climate change experiments actually change climate?

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Climate from Climate Change Experiments Database

We developed a new, publicly available database for our analyses: the Climate from Climate Change Experiments (C3E) database, which is available at KNB. These database of daily climate data allow us to explore, for the first time, the complex ways that climate is altered by active warming treatments, both directly and indirectly, across multiple studies.The data in this database were collected between 1991 and 2014 from North American and European climate change experiments (Table1, Figure 1 in the main text).

We carried out a full literature review to identify potential active field warming experiments to include in the database. To find these studies, we followed the methods and search terms of (Wolkovich *et al.*, 2012) for their Synthesis of Timings Observed in iNcrease Experiments (STONE) database (also available on KNB). We searched the Web of Science (ISI) for Topic=(warm* OR temperature*) AND Topic=(plant* AND phenolog*) AND Topic=(experiment* OR manip*). We restricted dates to the time period after their database (i.e. January 2011 through March 2015). This yielded 277 new studies.

We wanted to focus on active warming studies only, so we removed all passive warming studies from this list. In addition, a secondary goal of this database was to test hypotheses about mechanisms for the mismatch in sensitivities between observational and experimental phenological studies. Because of this secondary goal, studies included in the database had to either 1) include more than one level of warming, or 2) manipulate both temperature and precipitation. (Some studies met both of these criteria.) These additional restrictions constrained the list to 11 new studies, as well as 6 of the 37 studies in the STONE database. We contacted authors to obtain daily (or sub-daily) climate data and the most accurate phenological data for these 17 sites, as well as one additional site that we knew about through personal connections (BACE). We recieved data from authors of 12 of these 18 studies or 67%. STONE received 16.7% of data directly.

Supplemental Analyses

Effects on local climate vary over time and space

To test how treatment effects vary spatially (i.e. among blocks within a study) and temporally (i.e. among years within a study), we used data from the four studies in the C3E database that used blocked designs. We fit linear mixed effect models with soil and air temperature as reponse variables (Figure 3 in the main text). For spatial models, we included fixed effects of temperature treatment, block, and their interaction; random effects were site and year nested within site (intercept-only structure,). For temporal models, we included

fixed effects of temperature treatment, year, and their interaction; random effects were site and block nested within site (intercept-only structure,).

References

Wolkovich, E. M. *et al.* Warming experiments underpredict plant phenological responses to climate change. *Nature* **485**, 494–497 (2012). PT: J; UT: WOS:000304344500041.

Tables

Table 1: Study sites in C3E database, and methods.

study	location	warming_type	data_years	warming_c	precip_perc	soiltemp_depth_cm	soilmois_depth_cm
exp01	Waltham, MA	infrared	2010-2014	1,2.7,4	150,50	2,10	30
exp02	Montpelier, France	infrared	2002-2005	1.5,3	70		15,30
exp03	Duke Forest, NC	forecd air & soil warming	2009-2012	3,5		10	
exp04	Harvard Forest, MA	forecd air & soil warming	2009-2012	3,5		10	
exp05	Jasper Ridge, CA	infrared	2000-2002	1.5	150	15	15
exp06	RMBL, CO	infrared	1995-1998	1.5		12,25	12,25
exp07	Harvard Forest, MA	forecd air	2009-2010	1.5-5.5		2,6	
exp08	Harvard Forest, MA	soil warming	1993-1993	5		5	
exp09	Stone Valley Forest, PA	infrared	2009-2010	2	120	3	8
exp10	Duke Forest, NC	forecd air	2010-2012	1.5-5.5		2,6	
exp11	RMBL, CO	infrared	1991-1994	1		12	
exp12	Kessler Farm, OK	infrared	2003-2003	4	200	7.5,22.5	15