The Interactive Effects of Multifactor Global Change Were Evaluated for a Range of Ecosystems

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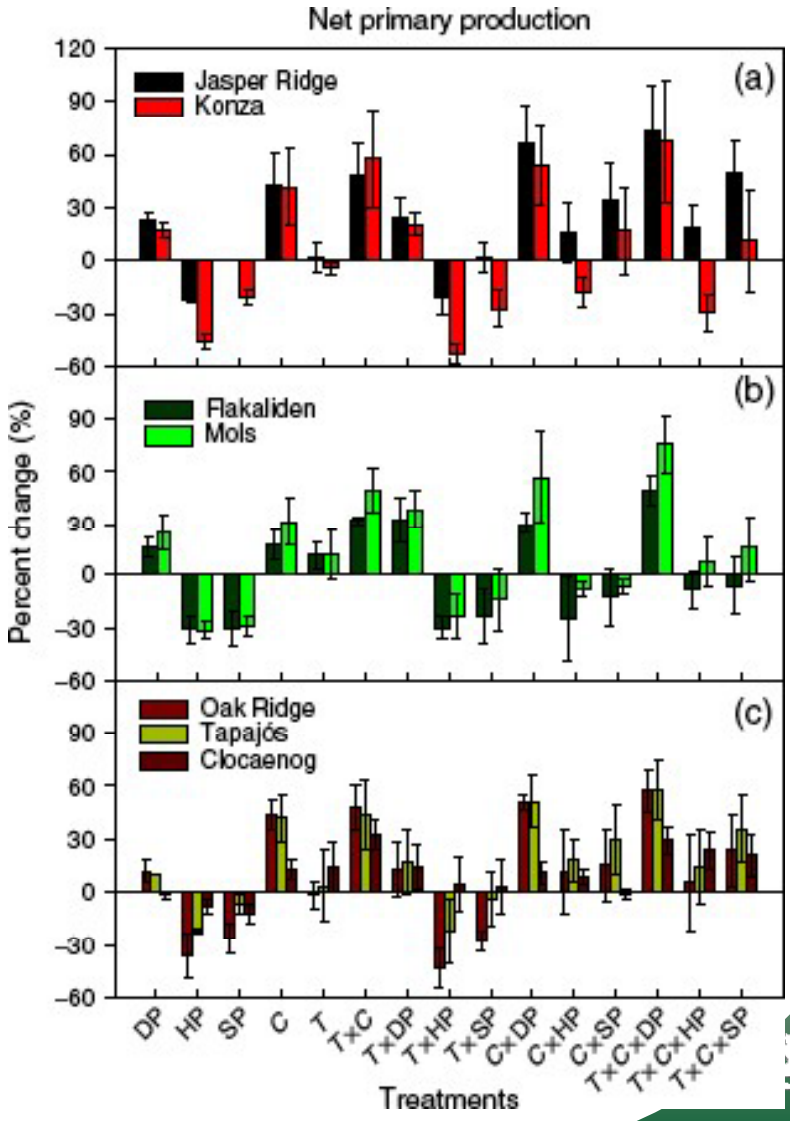
- Four independent models were used to quantify interactive effects of temperature (T), altered precipitation amounts (doubled - DP; halved HP) and seasonality (SP), and elevated [CO_2] (C) in various combinations.
- Seven distinct ecosystems used for climate change manipulation studies were evaluated including the upland oak forest in Tennessee.
- Three-way interactions were not common, but two way interactions between T-and-C and between T-and-DP lead to an amplification of the response of one variable by another.
- A negative reaction between T-and-HP demonstrating the deleterious effect of warming and drought was predicted by all models.
- Areas of disagreement between models illustrated by large error bars point to the need for the inclusion of new experimental results into ecosystem models.



OAK RIDGE National Laboratory

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Interactive effects of multiple global change factors on ecosystem processes are complex. It is relatively expensive to explore those interactions in manipulative experiments. We conducted a modeling analysis to identify potentially important interactions and to stimulate hypothesis formulation for experimental research. Four models were used to quantify interactive effects of climate warming (T), altered precipitation amounts [doubled (DP) and halved (HP)] and seasonality (SP, moving precipitation in July and August to January and February to create summer drought), and elevated [CO2] (C) on net primary production (NPP), heterotrophic respiration (Rh), net ecosystem production (NEP), transpiration, and runoff. We examined those responses in seven ecosystems, including forests, grasslands, and heathlands in different climate zones. The modeling analysis showed that none of the threeway interactions among T, C, and altered precipitation was substantial for either carbon or water processes, nor consistent among the seven ecosystems. However, two-way interactive effects on NPP, Rh, and NEP were generally positive (i.e. amplification of one factor's effect by the other factor) between T and C or between T and DP. A negative interaction (i.e. depression of one factor's effect by the other factor) occurred for simulated NPP between T and HP. The interactive effects on runoff were positive between T and HP. Four pairs of two-way interactive effects on plant transpiration were positive and two pairs negative. In addition, wet sites generally had smaller relative changes in NPP, Rh, runoff, and transpiration but larger absolute changes in NEP than dry sites in response to the treatments. Th modeling results suggest new hypotheses to be tested in multifactor global change experiments. Likewise, more experimental evidence is needed for the further improvement of ecosystem models in order to adequately simulate complex interactive processes.

Luo Y, Gerten D, Le Marie G, Parton WJ, Weng E, Zhou X, Keough C, Beier C, Ciais P, Cramer W, Dukes JS, Emmett B, Hanson PJ, Knapp A, Linder S, Nepstad D, Rustad L (2008) Modeled interactive effects of precipitation, temperature, and [CO_2] on ecosystem carbon and water dynamics in different climatic zones. *Global Change Biology* 14:1986-1999 [doi: 10.1111/j.1365-2486.2008.01629.x]