





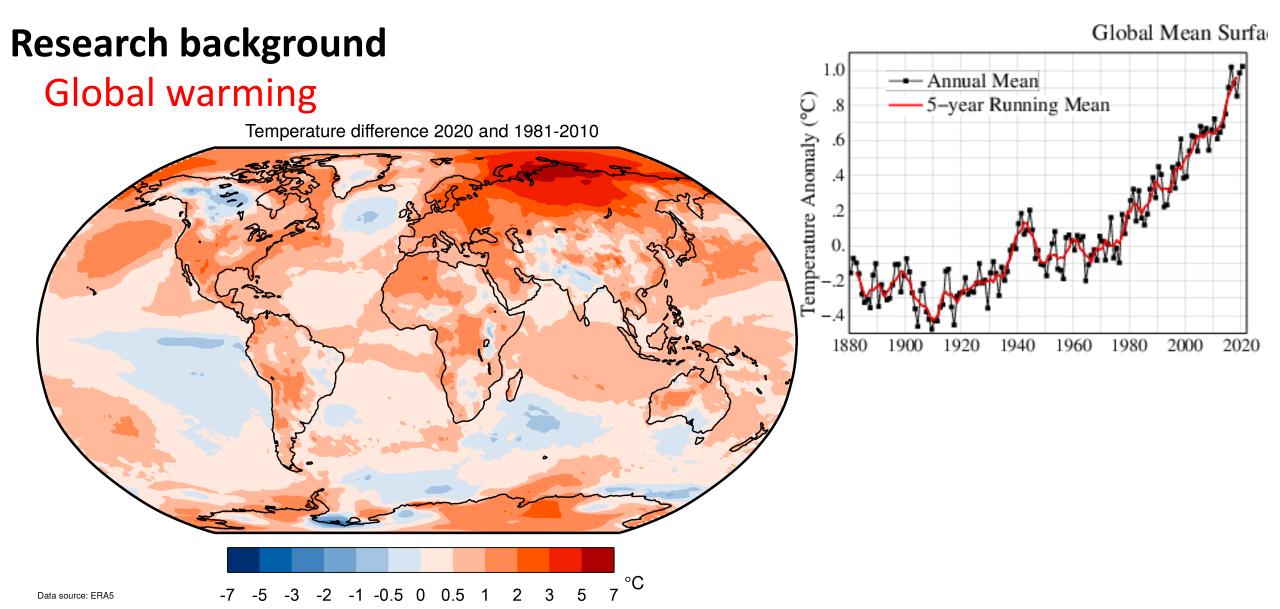
Effects of climate experiments and nitrogen addition on the sensitivity of shrubland communities

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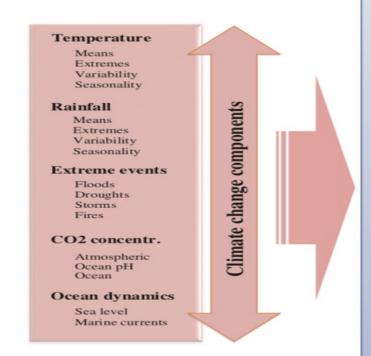






http://www.columbia.edu/~mhs119/Temperature/

Climate and ecosystem response



More strong responses in the future

Genetics

Natural selection Allelic diversity Mutation rates Heterozygosis richness

Physiology

Fecundity Activity rates and rhythms Tsd species sex ratios Disease susceptibility Survival

Organisms

Populations

Species

Communities

Ecosytems

Biomes

Phenology

Migration departure/arrival Budding/flowering Growing season length Hatchling/fledging/dispersal Hibernation/diapause

Dynamics

Recruitment Age structure Sex ratio Abundance

Distribution

Biodiversity component

Habitat quantity and quality Ecological niche/microniche Range size Range localization

Interspecific relationships

Disynchronisation Disequilibrium Uncoupling New interactions

Community productivity

Biomass quantity Energy flux Disruptions frequency Matter flux Erosion

Ecosystem services

Composition Function Production

Biome integrity

Catastrophes frequency Resilience Ecotypes characteristics Distribution shifts Desertification

Flow-on effects of climate changes at different spatial scales



molecular

(genetics, metabolomics, chemical ecology-VOCs)



individual (phenology, growth)



population

(adaptation, migration, extinction)



community

(species interactions, species composition



ecosystem (productivity, biogeochemistry)

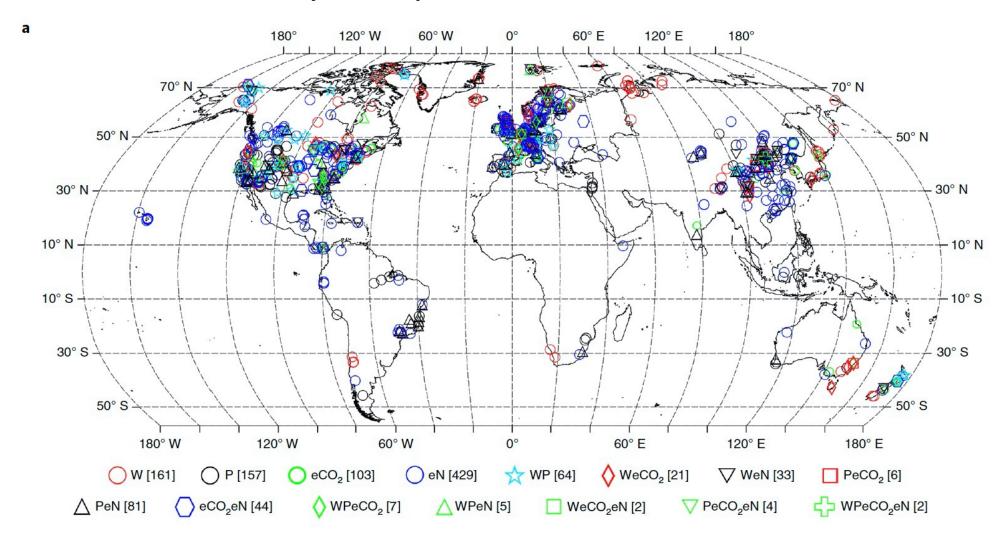


Regional and global

(gas and energy fluxes)

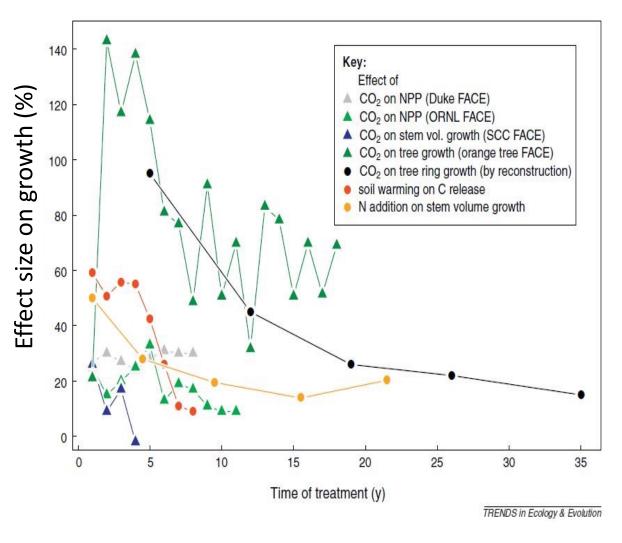
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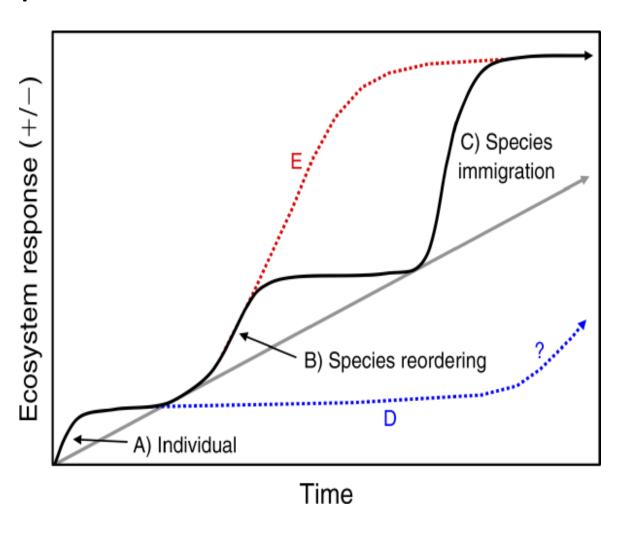
Field experiments to simulate the ecosystem responses in future



Carbon - related ecosystem function responses, but less reports on structure and composition?

Field experiment and vegetation responses





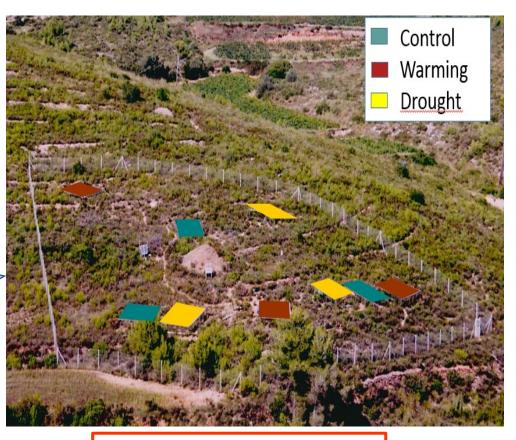
(Leuzinger et al., 2011. Trends in Ecology and Evolution)

(Smith et al., 2009. Ecolog)

Long-term climatic experiments (since 1999)



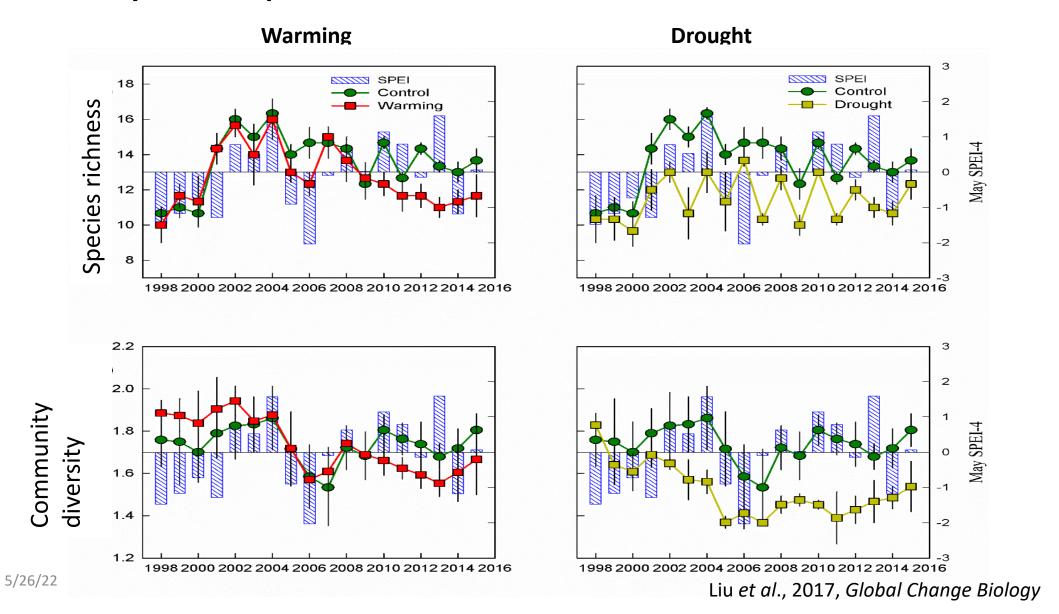
Mediterranean shrubland



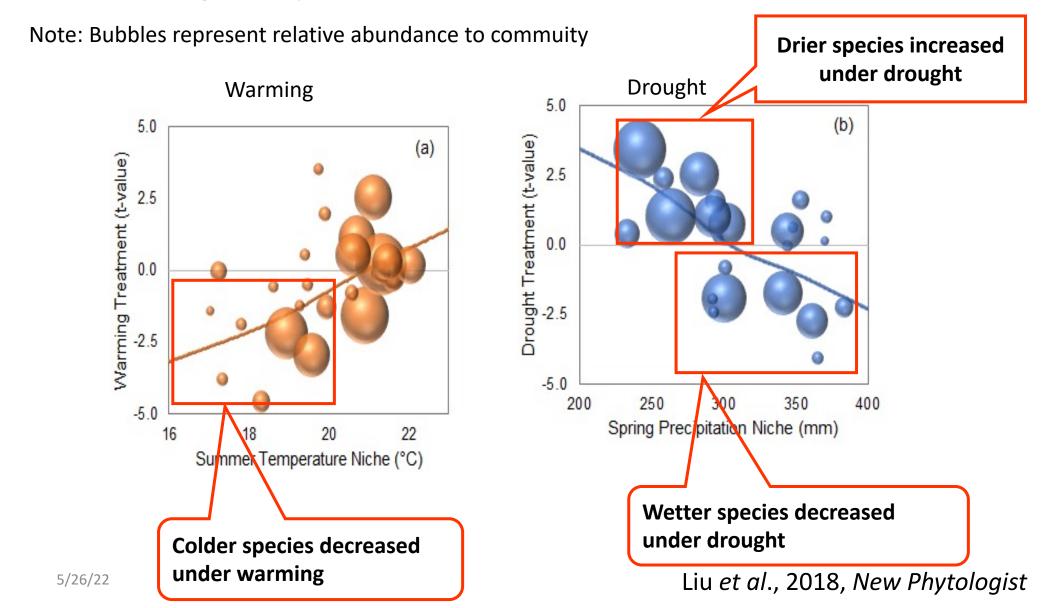
Warming: + 0.6°C

Drought: **-17%**

Species diversity and composition



Abundance changes at species level



Hypothesis and Methods

Shrubland:

-Plant communities are dominated by shrub species.

Field treatments:

-Warming, increase precipitation, nitrogen addition and drought, as well as their interactions

Literature review:

-90 publications representing 78 study sites

Vegetation metrics to W, P, N and D:

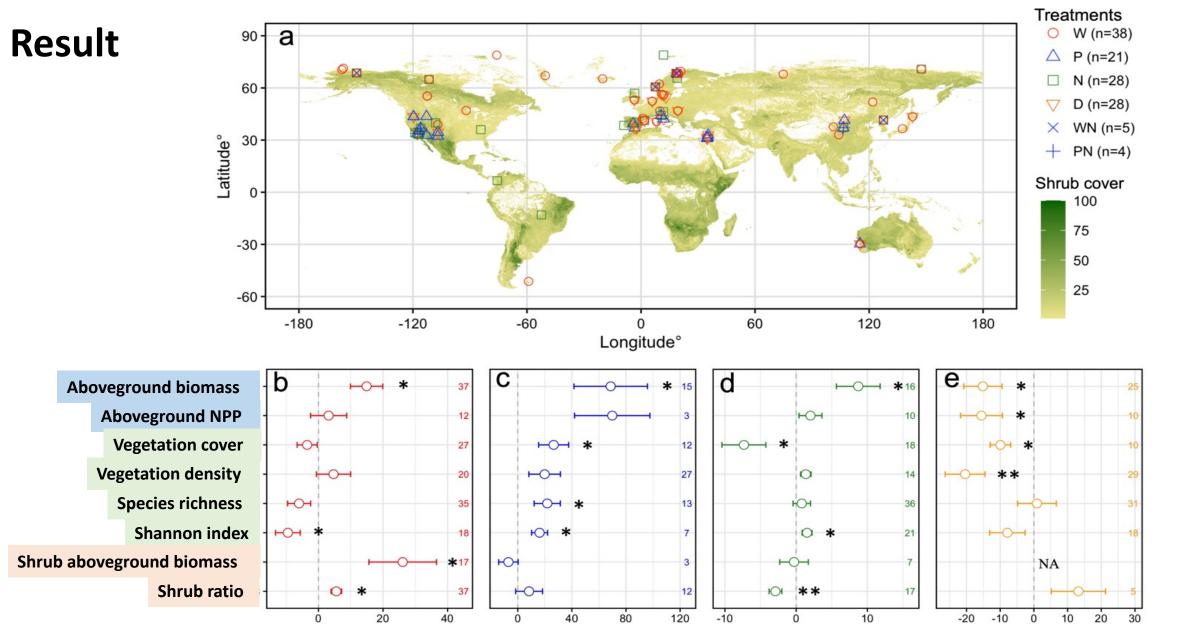
- -Functioning: aboveground biomass (AGB), aboveground net primary production (ANPP).
- -Structure: vegetation cover (COV), density (DEN), species richness (SP), Shannon diversity index (H).
- -Shrub encroachment: shrub ratios (Ratio_S), shrub aboveground biomass (AGB_S).

Calculation of sensitivity: Sensitivity to treatment (%) =
$$\frac{(X_t - X_c)/X_c}{T_t - T_c}$$
 x 100

Hypothesis and Methods

Hypothesis:

- All vegetation metrics relating to structure and functioning are response to climate and nitrogen addition.
- Test the sensitivity difference to 0.
- The responses can be different for experimental duration and for the successional status
- Test the differences between short-term (1-4 year) vs long-term (>5 years) and differences between stable vs disturbed communities.
- The responsiveness will be strongly associated with habitat climate of the study sites.
- Test the correlations with AI, MAT, meantT_Q, meanP_Q



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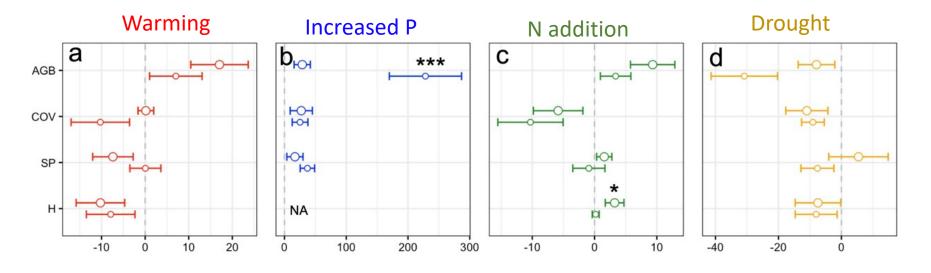
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All the vegetation metrics are responsive to climate and nitrogen addition. $\frac{5/26/22}{}$

W

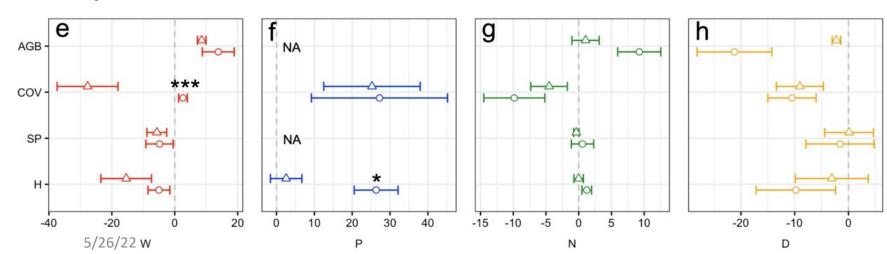
Result

Sensitivity between short-term vs Long-term



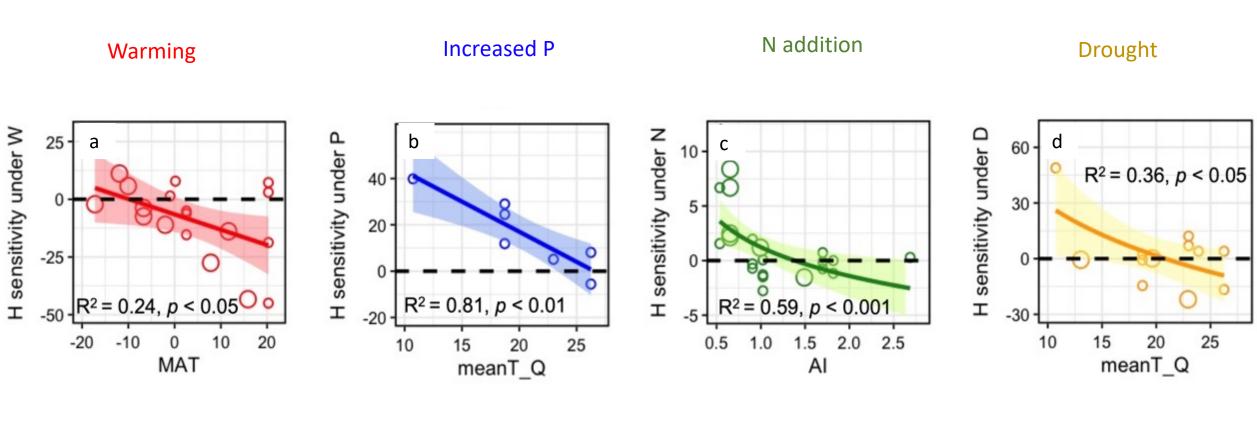
No differences between short-term (small circle) and long-term (large circle)

Sensitivity between disturbed vs stable status



No differences between disturbed (triangle) and stable Status (circle)

Result – Sensitivity and background climate of the sites



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in high MAT sites

More negative to warming

More positive to P in the sites with low mean temperature of warmest quarter.

More positive under N in more arid sites.

More negative to D in high mean temperature of warmest quarter.

Take home message

• 1) Shrubland structure and functioning were responsive to climate experiments and nitrogen addition globally.

2) Few temporal and successional differences for the sensitivity.

• 3) The magnitudes of the sensitivity were associated with background climate of the study site.

Any questions?

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