

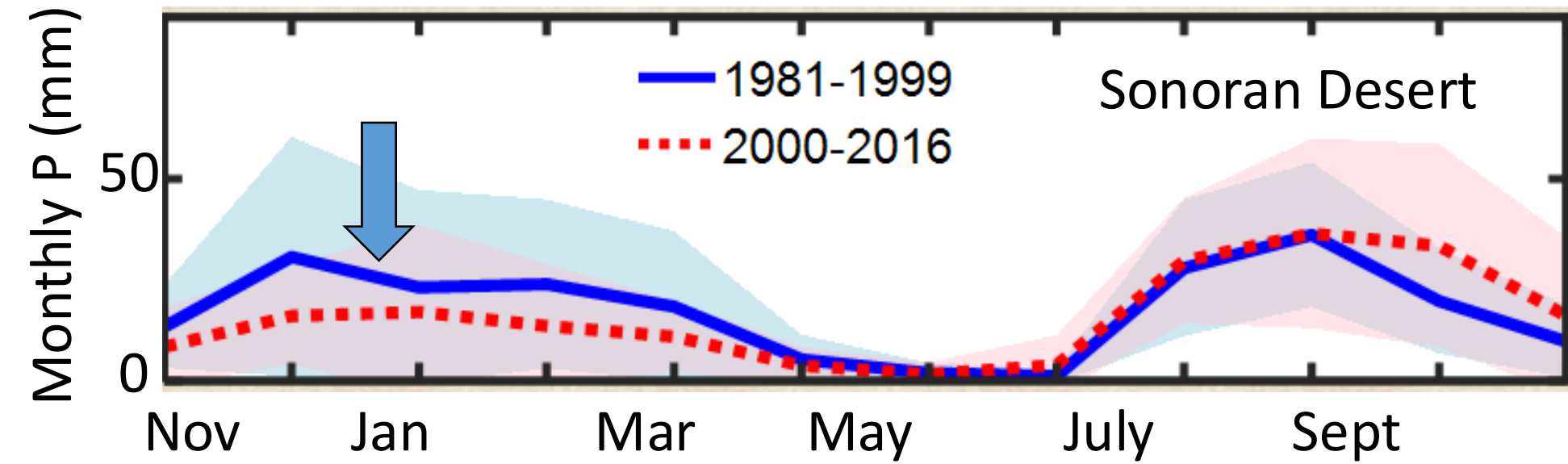
RainManSR: An experimental facility to assess how rainfall amount and timing affect desert grasslands



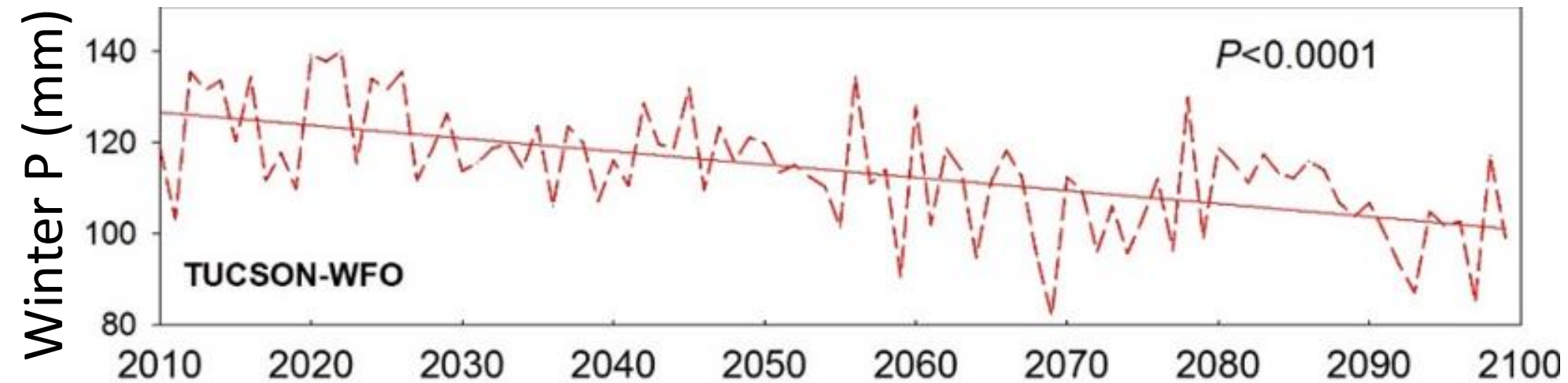
Joel Biederman, Bill Smith, Nathan Pierce, Fangyue Zhang, Matt Roby, Mostafa Javadian, Dan Potts, Harrison Friedman, Tianyi Hu, Charlie Devine, Jacob Blais, Russ Scott and many others.



Why RainMan? Drier winters

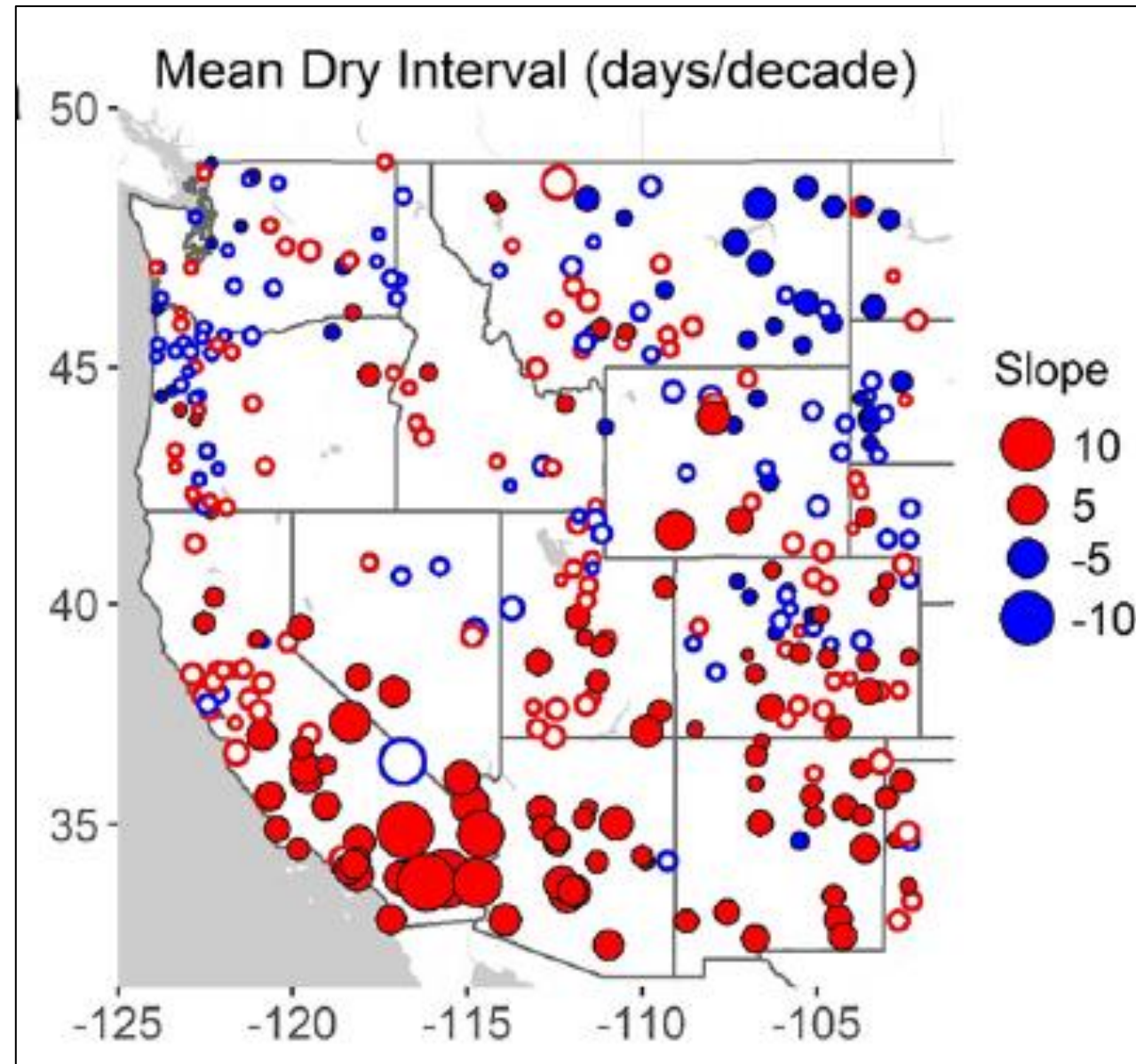


Data



Models

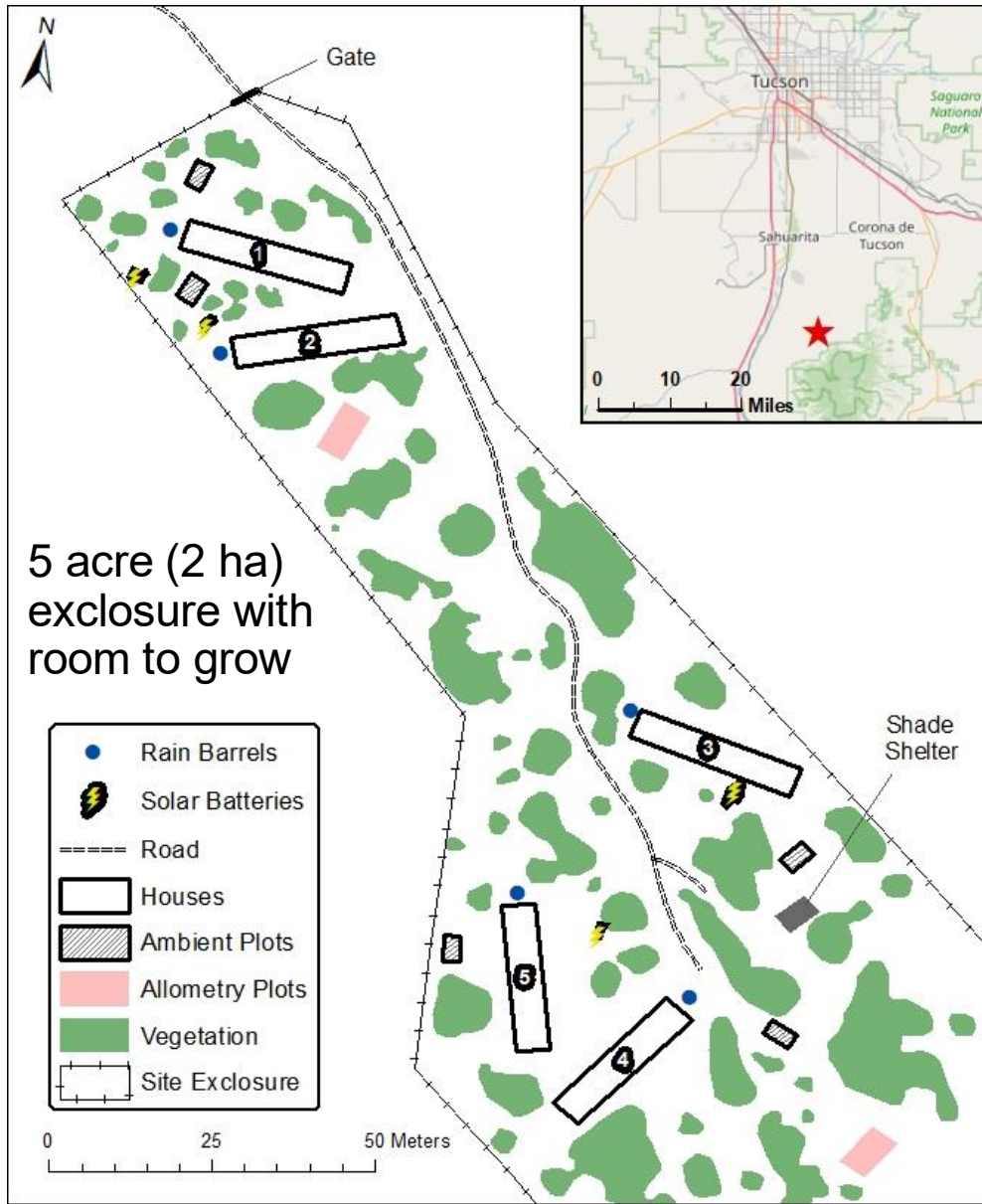
Why RainMan? Fewer/larger summer rainfalls



Zhang et al., 2021 GRL

RainMan-SR Built 2019

Rainfall Manipulation in the Santa Rita Experimental Range



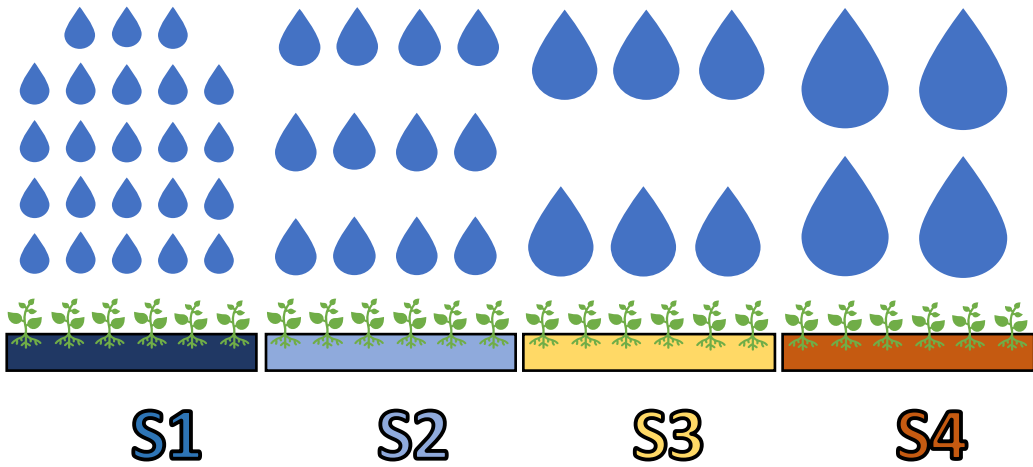
Direct and proximal remote sensing measurements



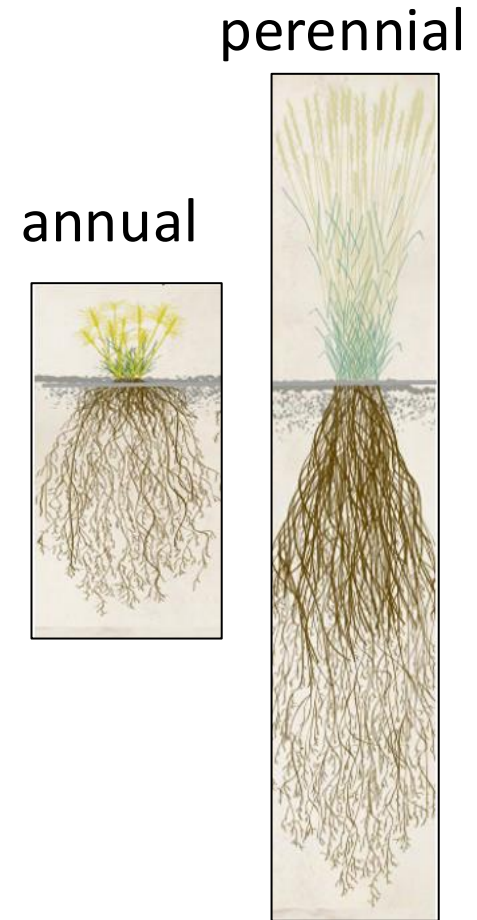
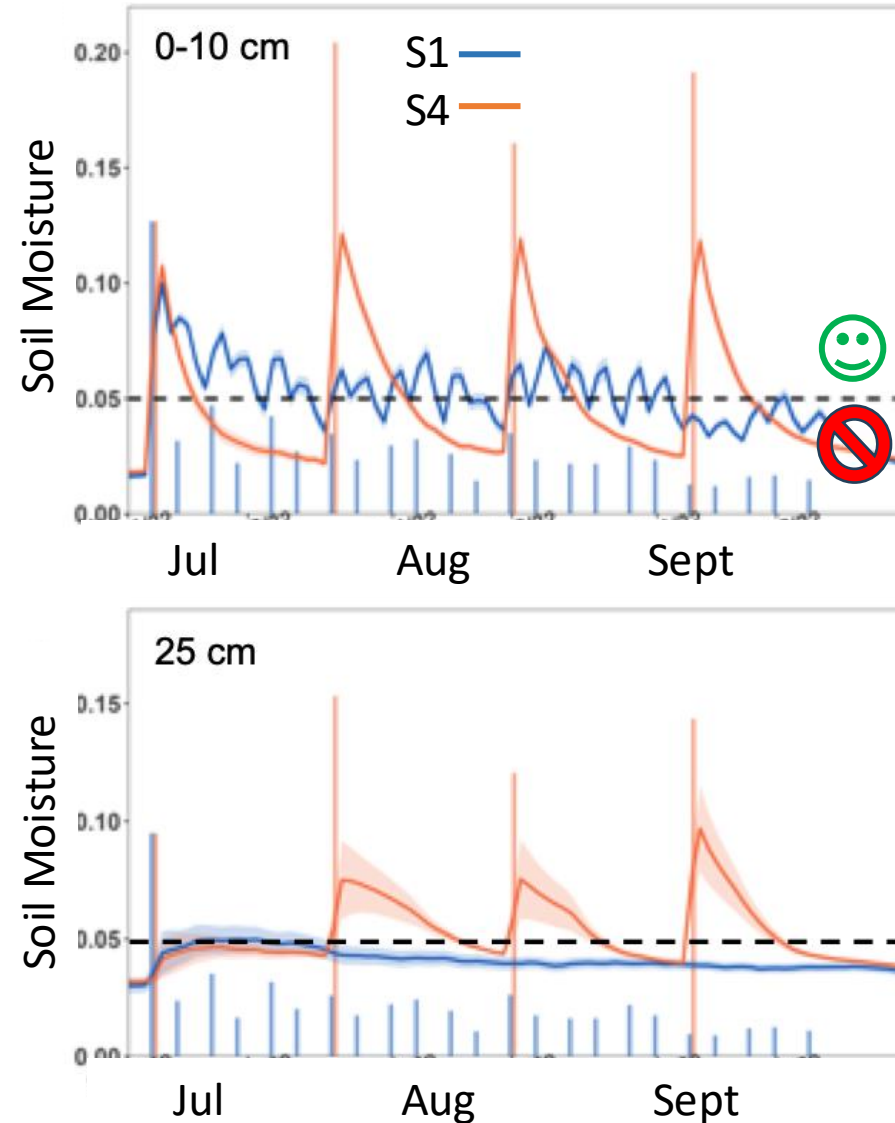
- **Automated:** soil water content, water potential, temperature, soil CO₂ flux, RGB imagery,
- **Weekly:** ecosystem gas exchange, hyperspectral, thermal
- **Biweekly:** LAI, root area vs. depth
- **Monthly:** plant community & cover



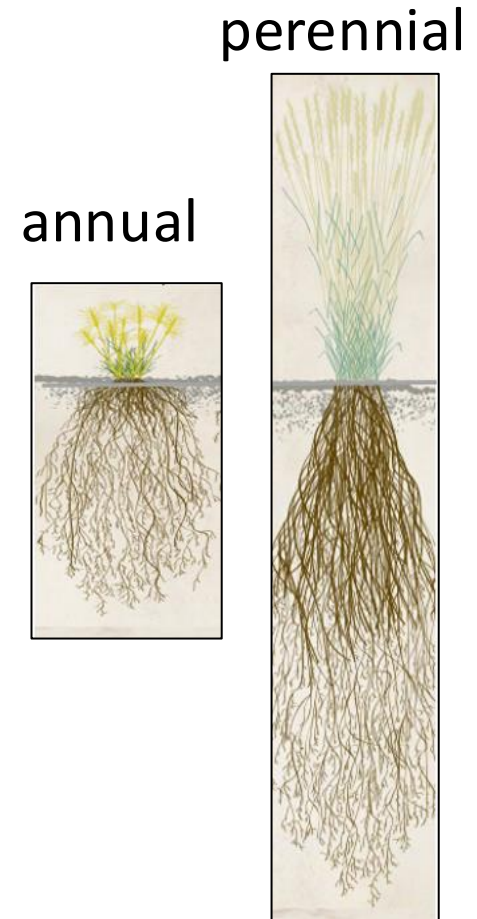
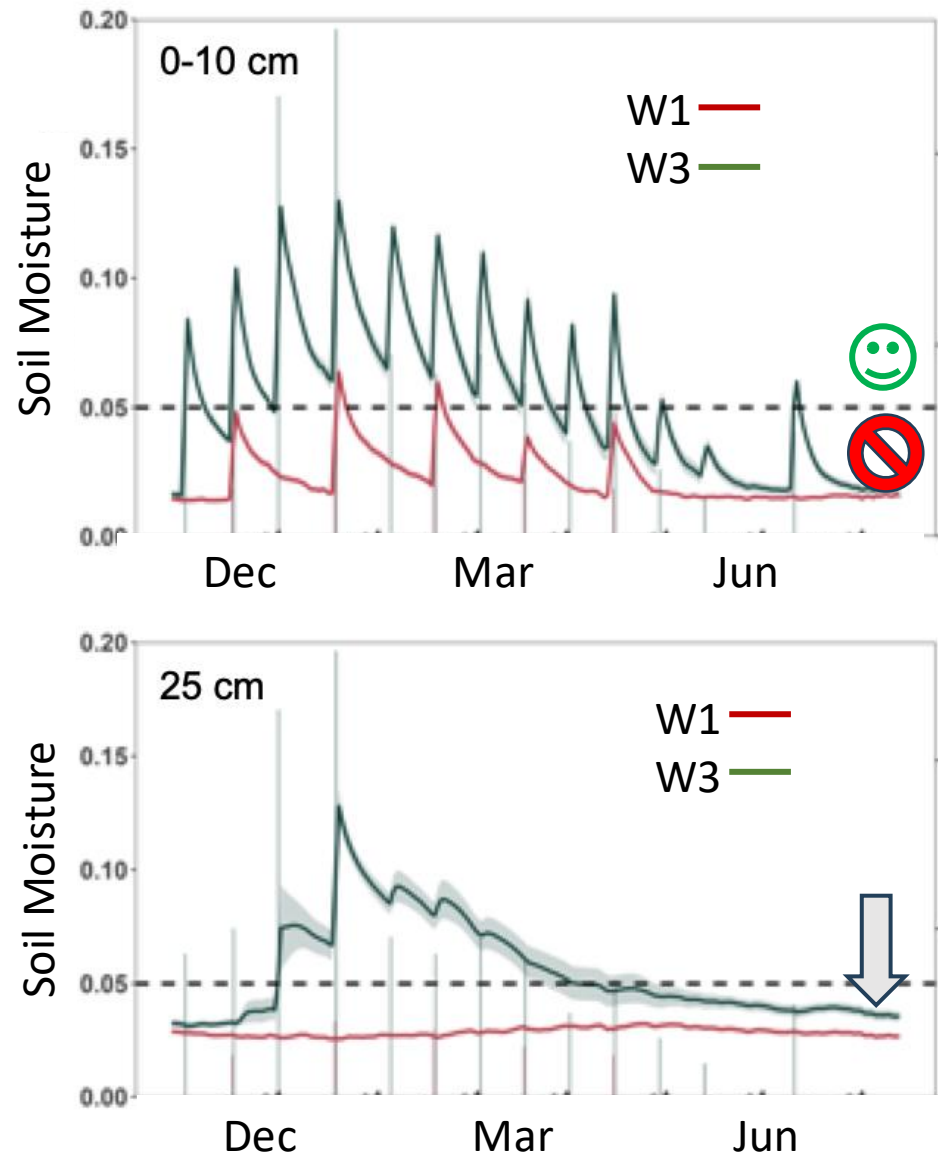
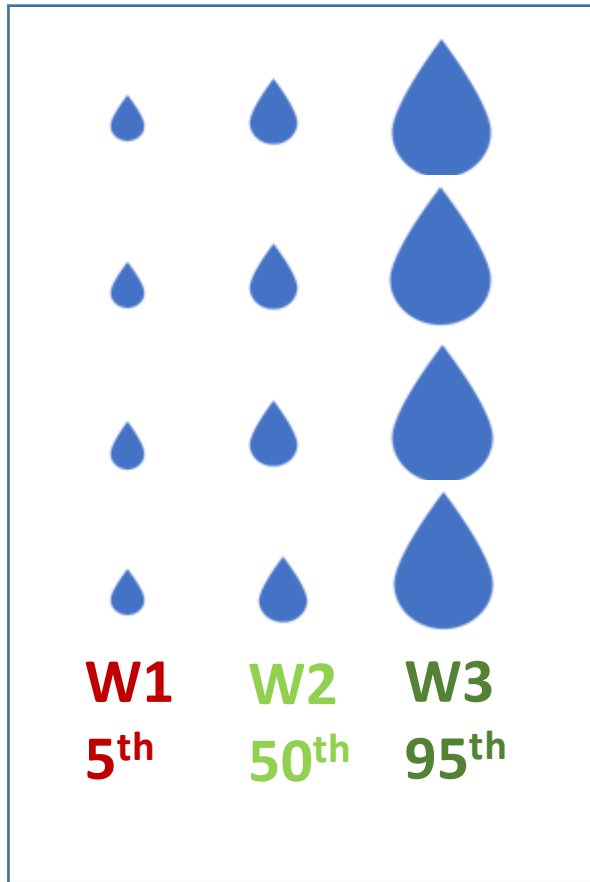
Temporal repackaging of summer rain: Fewer/larger storms, longer drought



All treatments sum to 205 mm per summer



Dry, Average, or Wet Winter Rainfall Totals



Research Questions

With fewer/larger summer rainfall events but the same total amount:

With varying total amounts of winter rainfall:

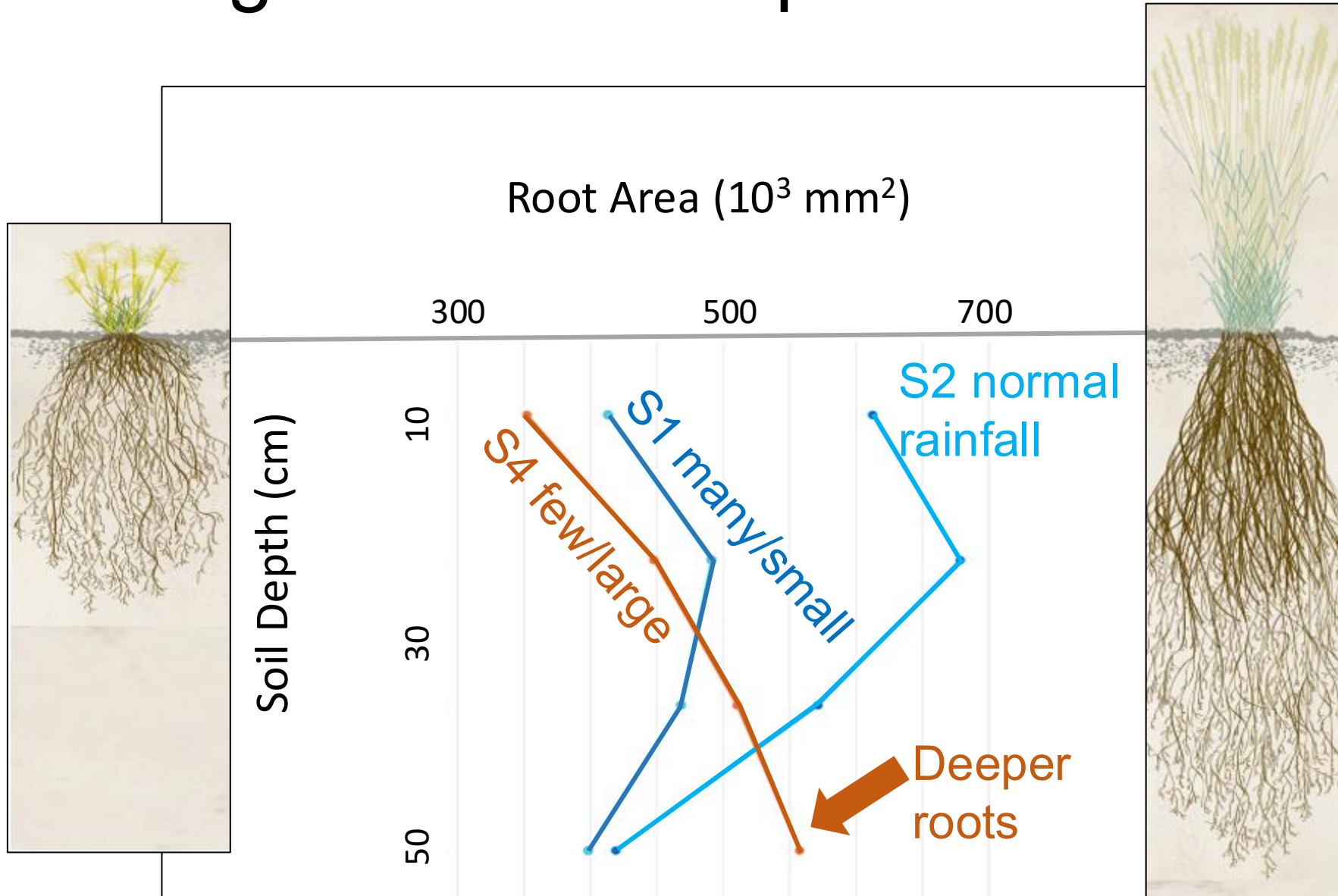
Q1: What plants will be successful? Deep vs. shallow rooting.

Q2: What are the consequences for rangeland productivity?

Q3: Are there seasonal legacy effects between winter and summer?

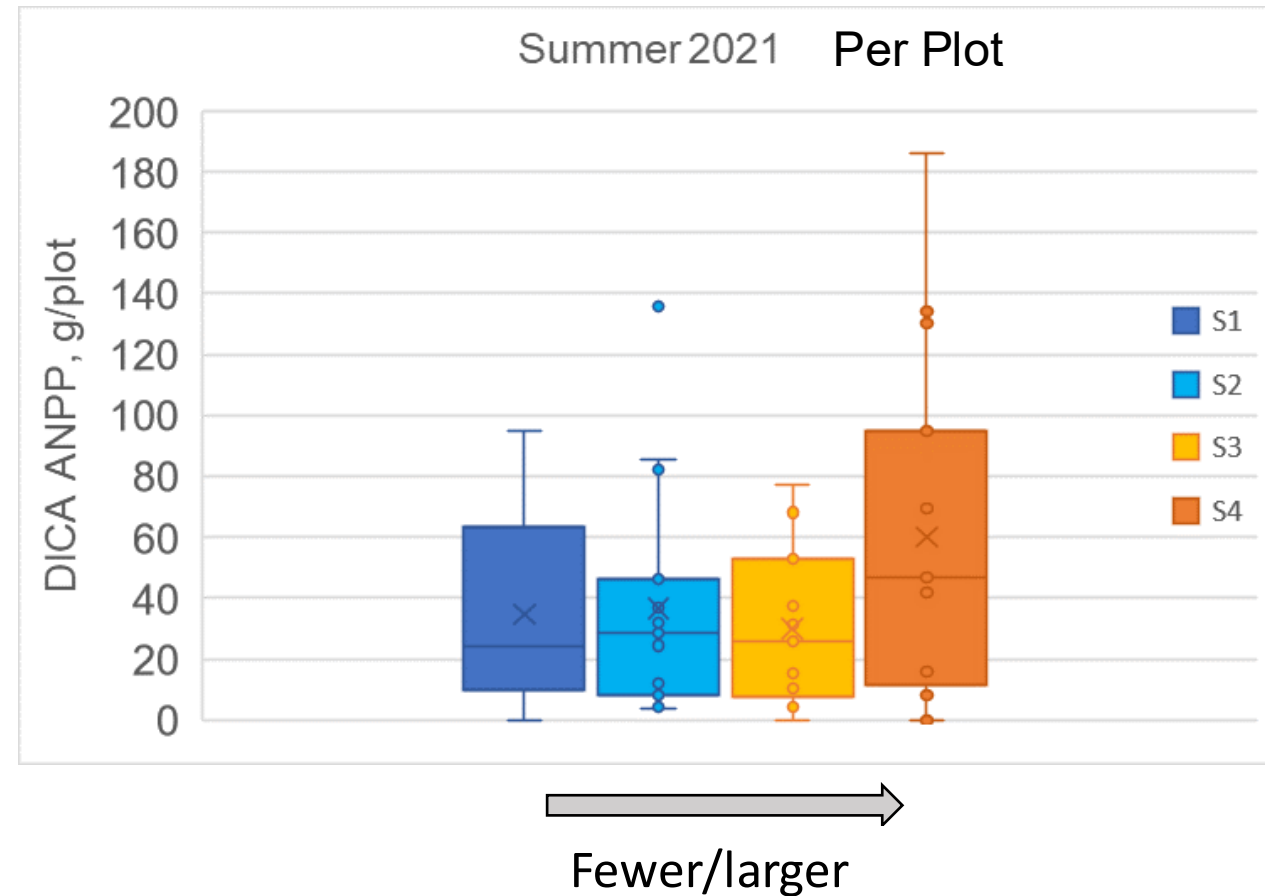
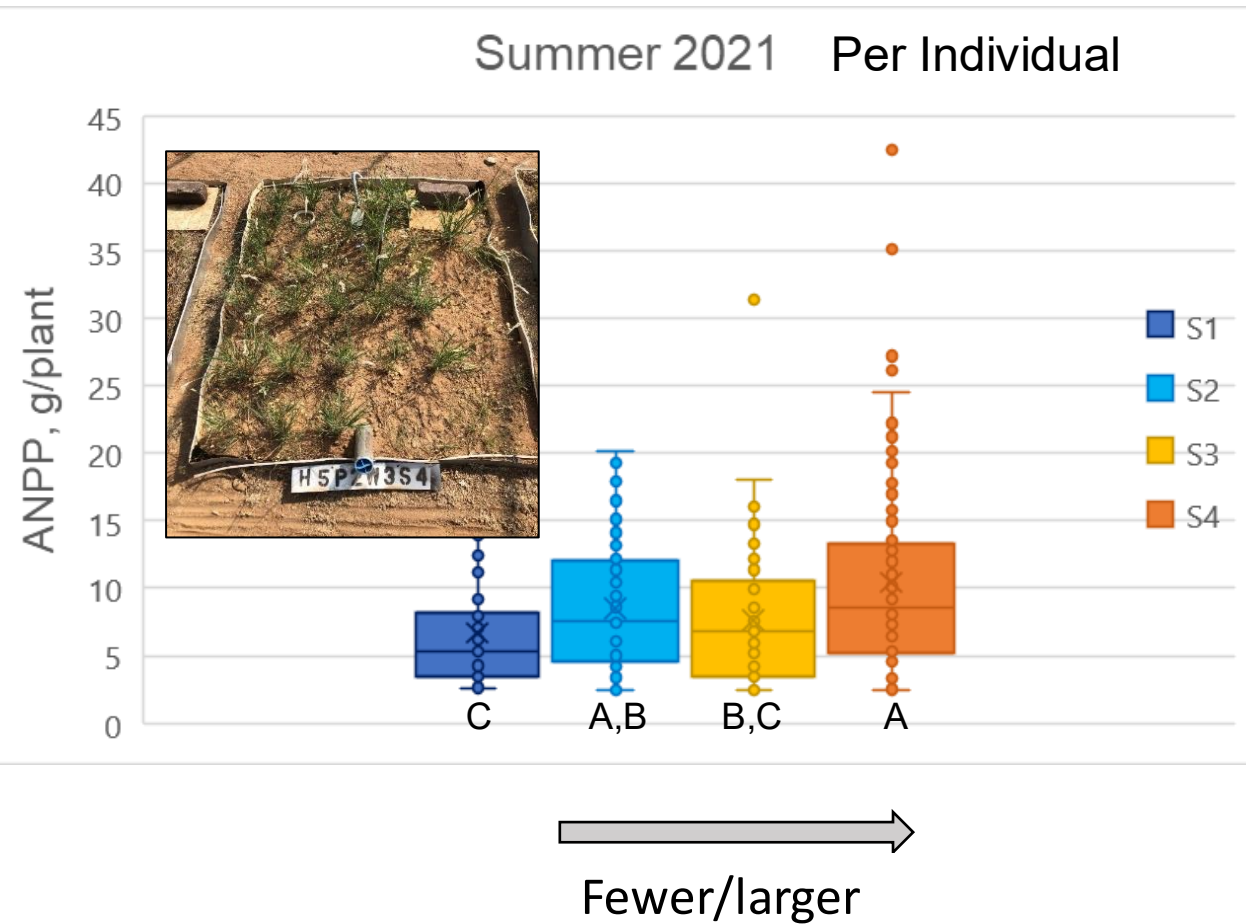
Q4: What automated remote sensing tools accurately capture plant productivity and water use?

Few/Large rainfalls deepened roots

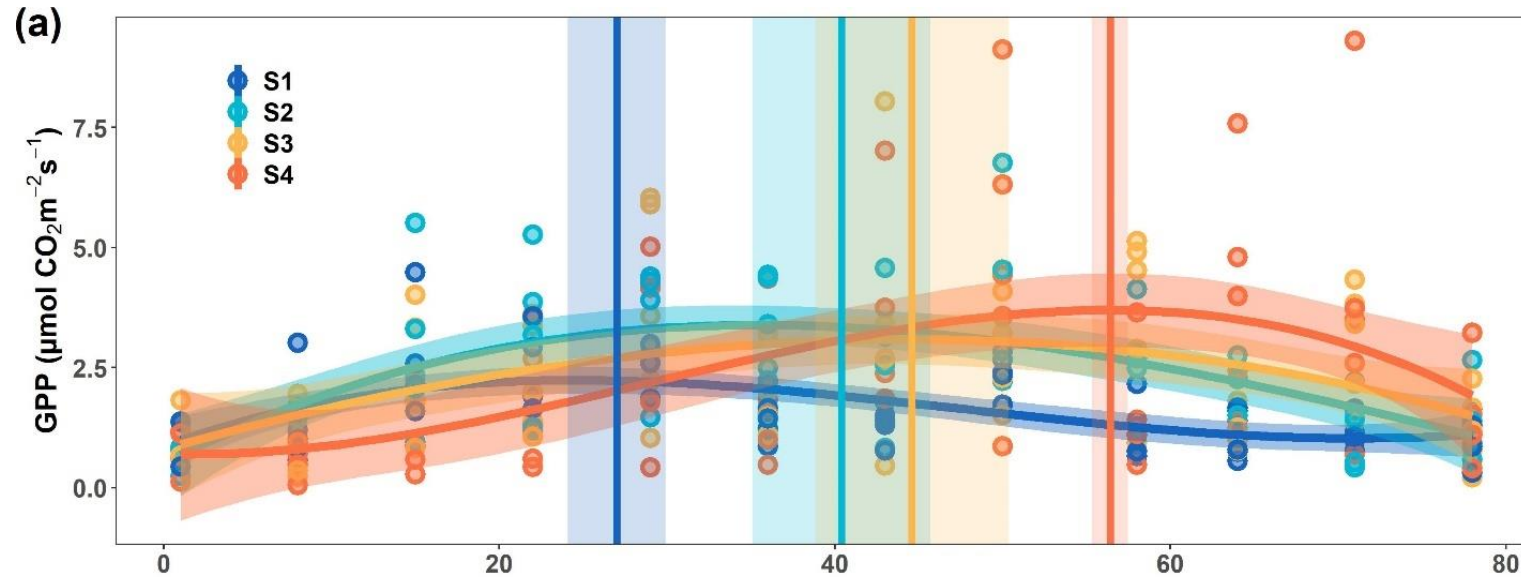


A. Huerta

Few/Large rainfalls made few/large bunch grasses



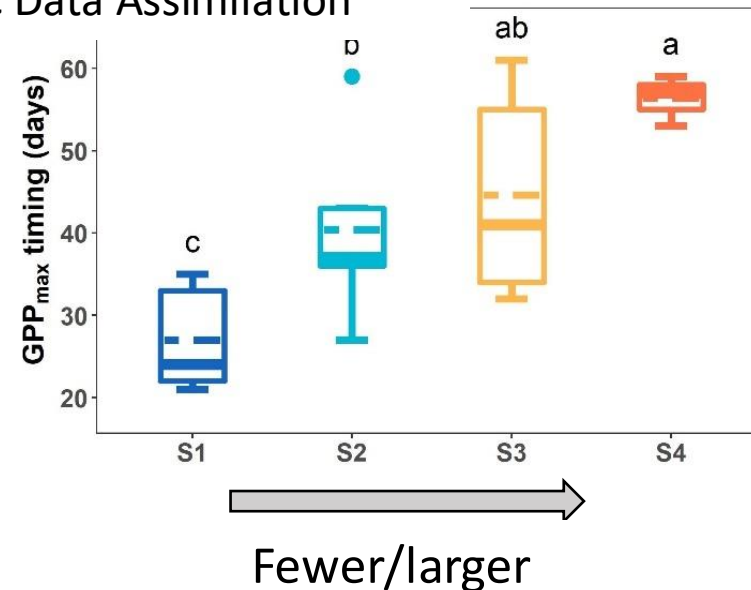
Few/large rains *delayed* but didn't change GPP magnitude



Zhang et al,
Functional
Ecology 2022

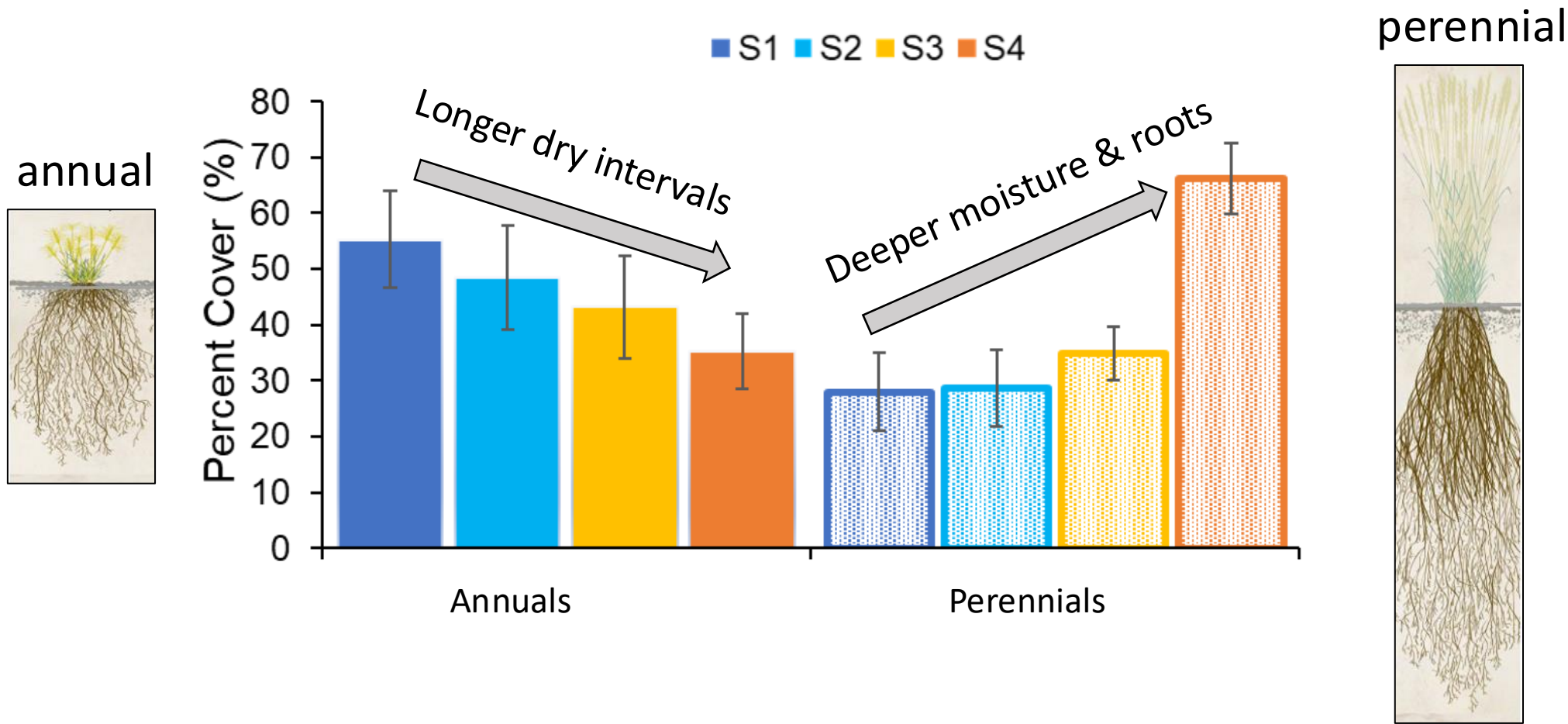


CLM Model with SWC Data Assimilation

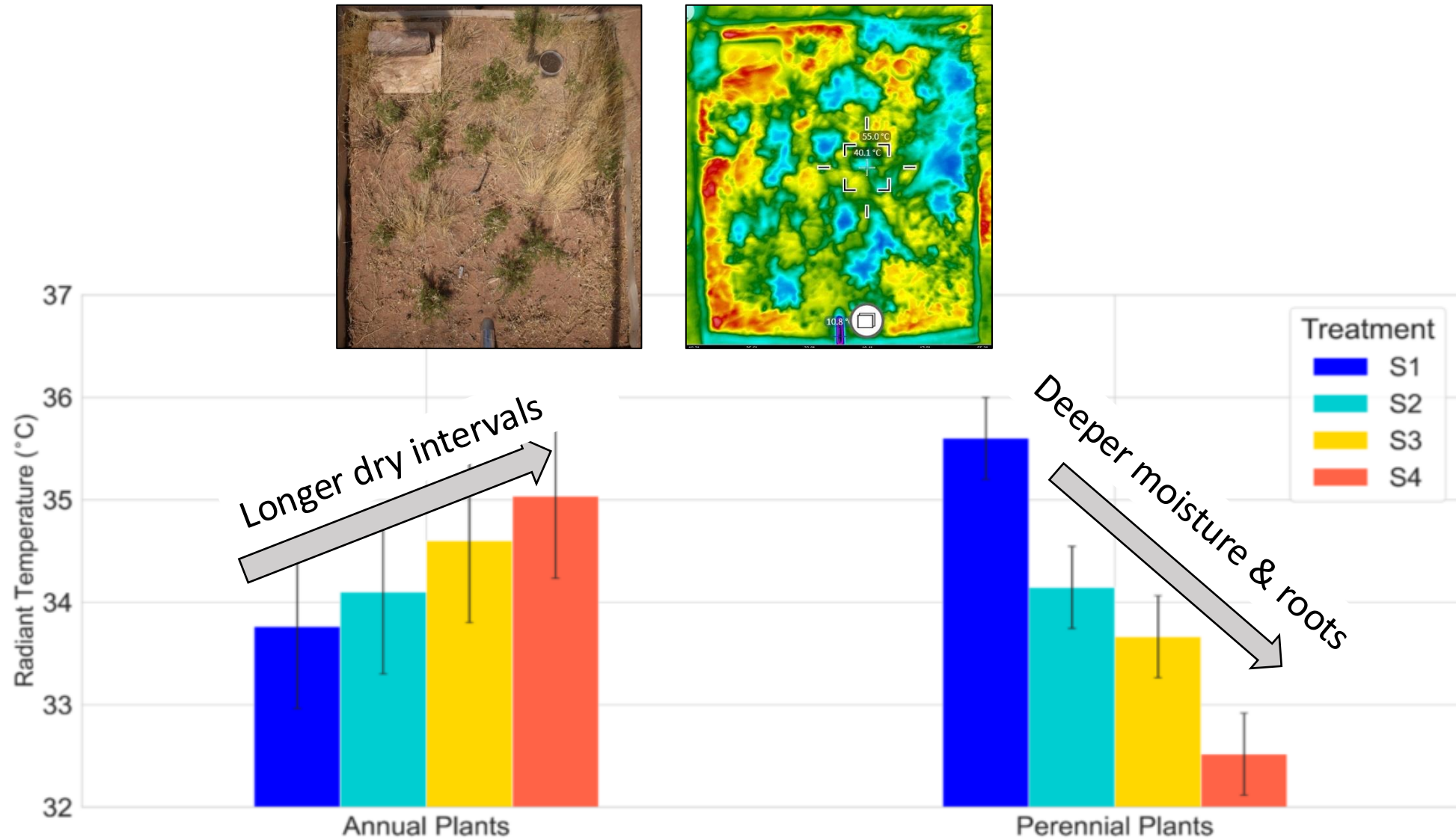


Hu, Song et
al., in prep.

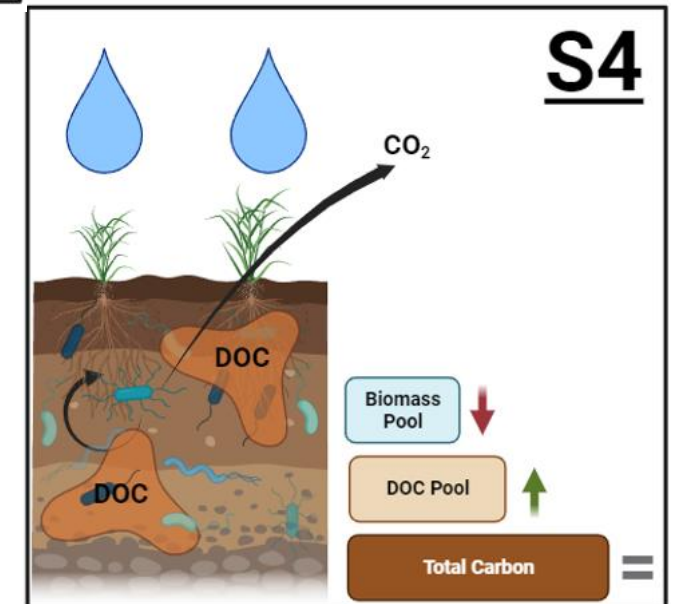
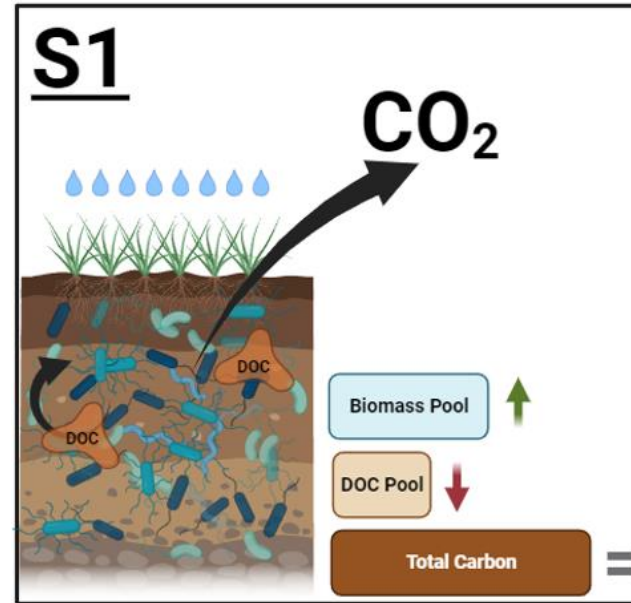
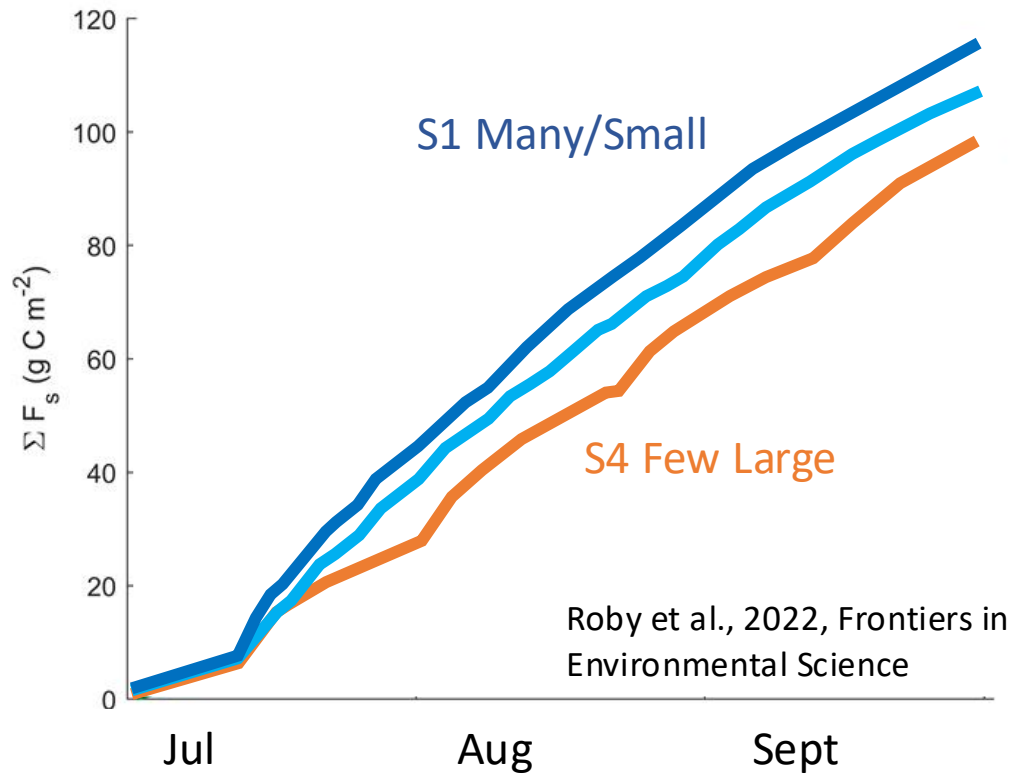
Fewer/Large summer rainfalls increased perennials & decreased annuals



Few/Large rainfalls warmed annuals, cooled perennials



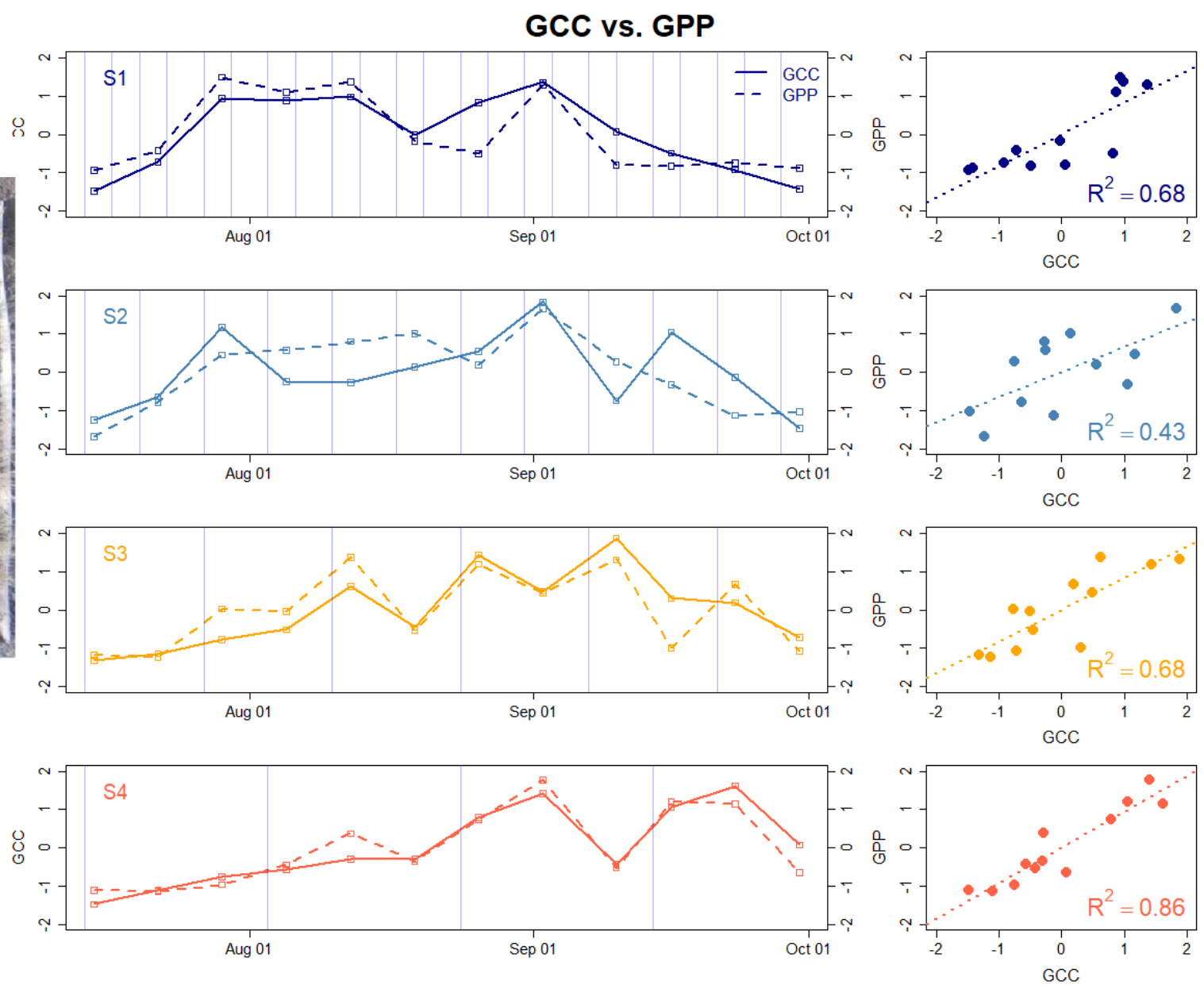
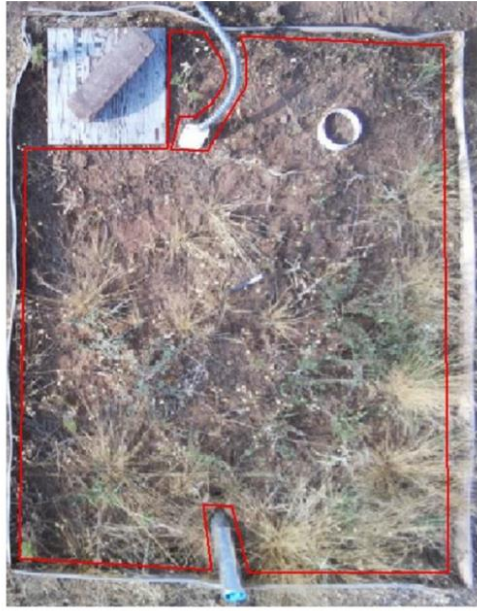
Few/Large rainfalls reduced soil respiration and increased soil microbes



Friedman, in prep

H. Friedman & Gallery in prep.

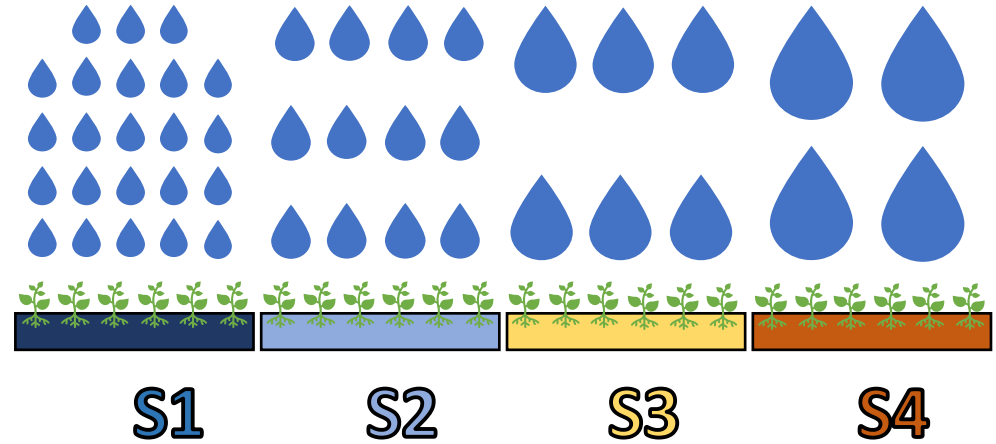
PiCam GCC vs. GPP



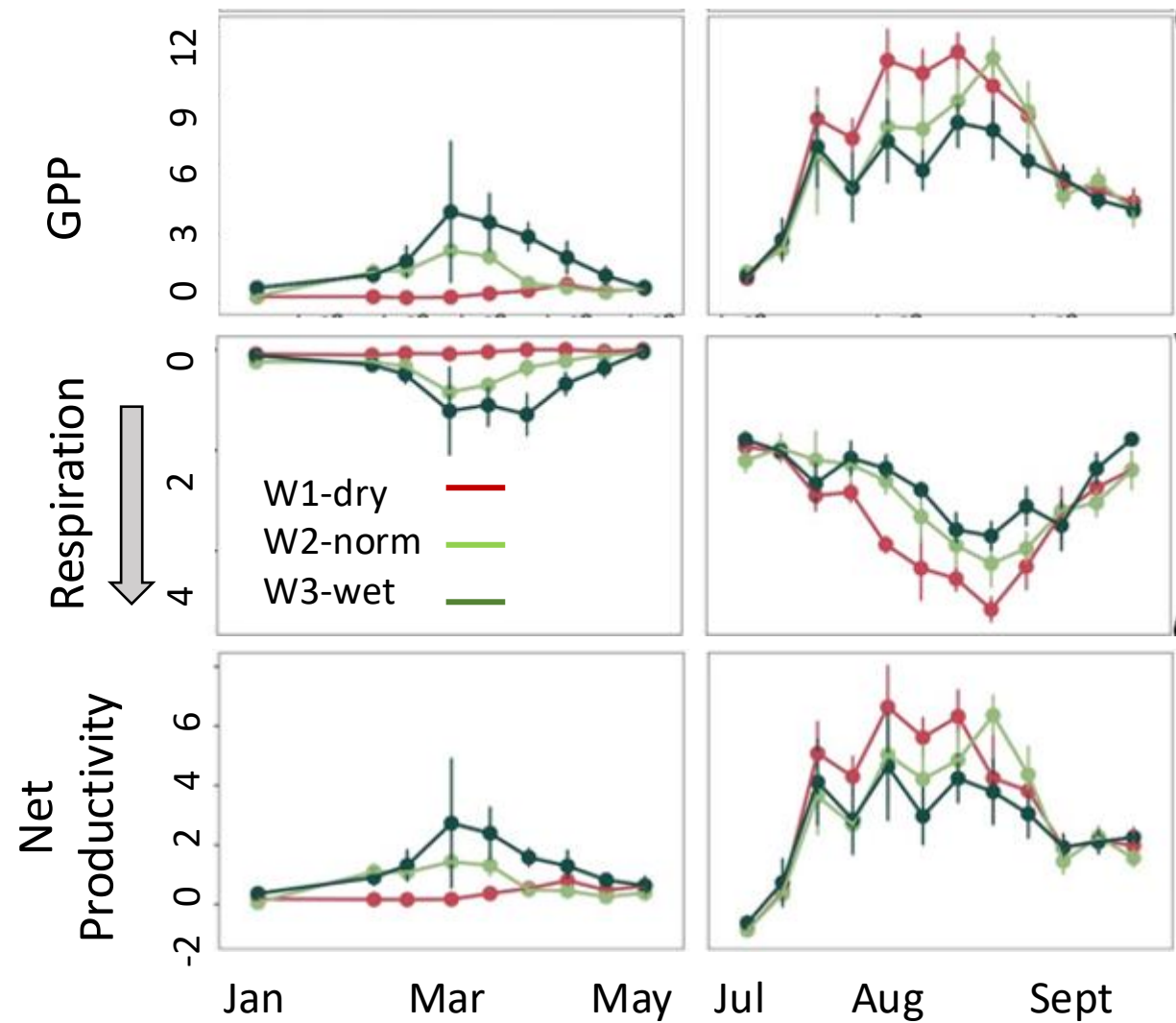
C. Devine

Fewer/Larger Summer Rainfalls:

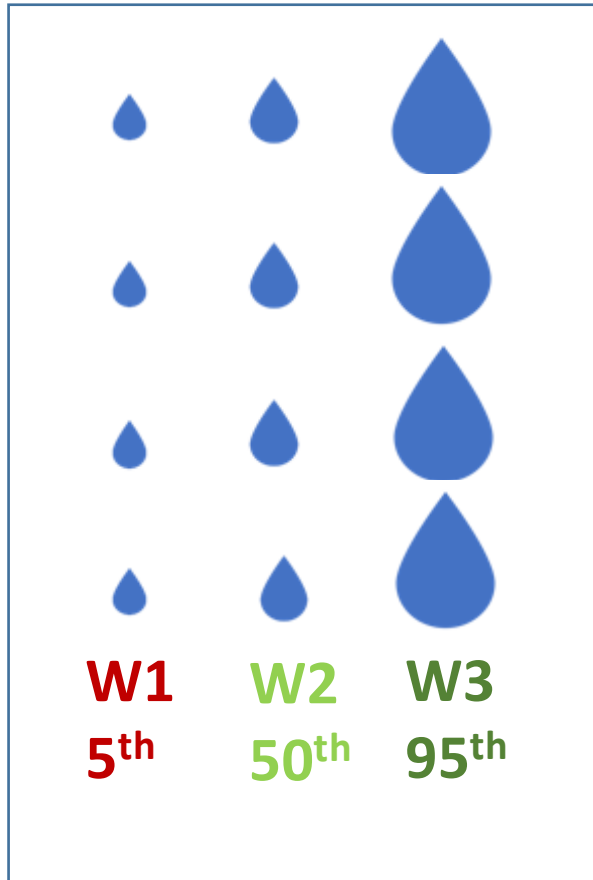
- Wet the soil more deeply
- Deepened root production
- Led to fewer but larger perennial bunchgrasses
- Delayed peak productivity but didn't change magnitude
- Promoted perennials, suppressed annuals
- Reduced cumulative soil respiration but increased soil DOC



Winter Precipitation Amount



Extreme Winter Drought:



- Suppressed productivity in spring
- Accumulated more litter in spring
- Produced flush of summer annual cover
- Increased productivity the following summer

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PI's, project leads and major collaborators

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ARS: Nate Pierce, Russ Scott, Andrew Corrales, Wyatt Philabaum, Nick Tennes, Robin Bradley, Aaron Peretz, Madelynne Masterson, Ben McDonald

SUNY Buffalo State: Dan Potts

UA Students and Postdocs

Mostafa Javadian, Matt Roby, Jacob Blais, Charlie Devine, Harrison Friedman, Tianyi Hu, Emilio Cubilla, Wen Zhang, Hannah Runyon, Julia Olson