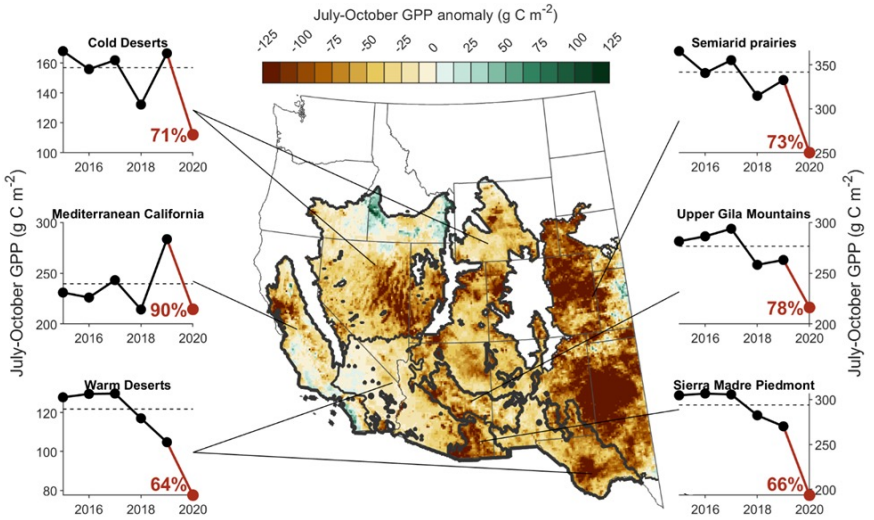
SMAP reveals widespread dryland productivity losses from the 2020 Southwest US hot drought

Motivation: Dryland ecosystems are drought adapted, but drought intensification in a warming climate will have uncertain impacts on ecosystem productivity. An intense "hot drought" occurred over the southwest US in 2020 due to high temperatures and extreme moisture deficits; providing a natural experiment to understand productivity in a warmer future.

Method: Gross primary production (GPP) from the SMAP Level 4 Carbon (L4C) product used to quantify productivity impacts from drought in major southwest (SW) ecosystems. The drought occurred from Jul-Oct, 2020 and annual Jul-Oct GPP anomalies were computed relative to the SMAP baseline (2015-2019) record. GPP anomalies verified from local tower CO_2 flux data. Statistical modeling used to clarify impacts from different climate drivers on GPP.

Findings: The 2020 hot drought reduced GPP by >25% (120 Tg C) below a baseline already depleted by extended 21st century drought. Low soil moisture and excessive Atm. VPD caused ~50% and 40% of the respective GPP reduction.



Map of GPP anomalies over SW drylands during the Jul-Oct 2020 hot drought relative to baseline (2015-2019 mean); time-series plots show annual Jul-Oct GPP for major SW ecoregions. Dashed horizontal lines denote the 2015-19 Jul-Oct GPP mean for each region, and red values show the 2020 GPP as a percent of the 2015-19 mean in each region.

Impact: Better monitoring and understanding of ecological drought from SMAP.

Dannenberg et al., 2022: Exceptional heat and atmospheric dryness amplified losses of primary production during the 2020 U.S. southwest hot drought *Geophys. Res. Lett.*