Modeling the Impacts of Droughts and Climate Change on U.S. Forests with the WaSSI Model

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INTRODUCTION

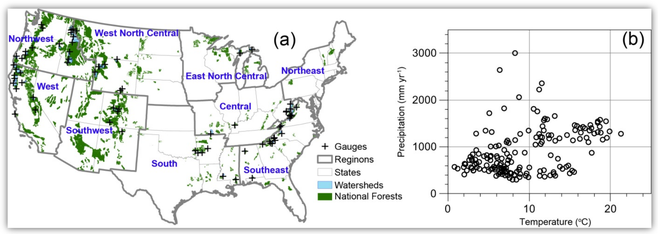
- ✓ Drought is one of the most common and costly disasters, and poses a serious threat to the National Forests and Grasslands system (NFs).
- ✓ Due to the dynamic nature of droughts and the complex mechanisms of ecohydrologic response to droughts in forest ecosystems, a comprehensive quantitative assessment of drought impacts on the large scale NF ecosystem services is needed.

OBJECTIVES

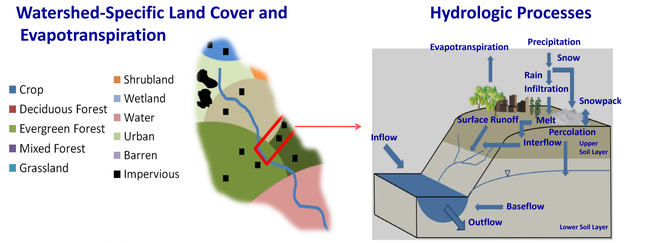
- To evaluate performance of the Water Supply and Stress Index (WaSSI) model using observed watershed water yield (Q) and other estimates of evapotranspiration (ET) and gross primary productivity (GPP) for 170 NFs
- To explore the impacts of historic droughts on Q and GPP in the 170 NFs during 1961-2012
- To provide some useful information for USDA-FS managers to mitigate the negative drought impacts on the NFs ecosystem services

METHODOLOGY

Study area:
- 170 NFs
- Southeastern (Loblolly pine)



Model: WaSSI Monthly Water Balance Model (Sun et al. 2008, 2011; Caldwell et al. 2012; 2015 a, b)



Datasets: PRISM precipitation and air temperature (1961-2012); 72 USGS gauges streamflow (1990-2009) and MACA future climate data.

Evaluated top-five drought years that had the lowest Standardized Precipitation Index (3-month scale SPI3) during 1961-2012.

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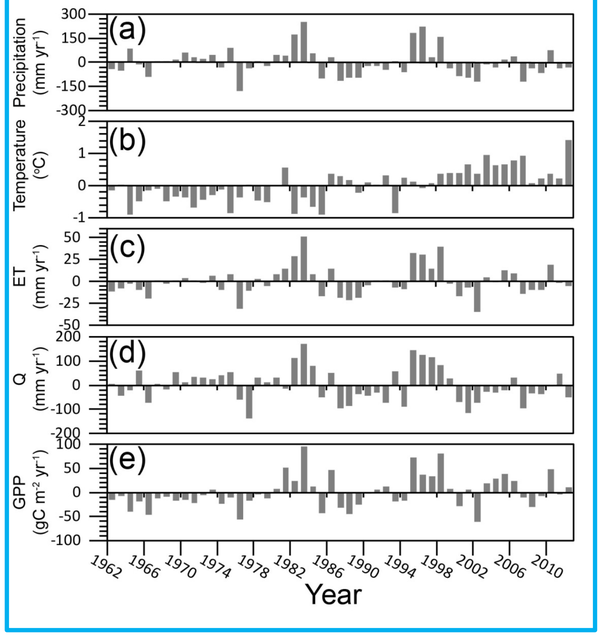
Anomaly of Climate, Water Yield, and Productivity (1962-2012)



CONCLUSIONS

- Extent of extreme droughts across the NFs increased during the last decade resulting in adverse impacts on the NFs hydrology and productivity;
- This study provides a comprehensive benchmark assessment of likely drought impacts on hydrology and productivity using a consistent method and datasets across the CONUS.
- Water is a major determinant of future forest productivity in the southeastern U.S.

References

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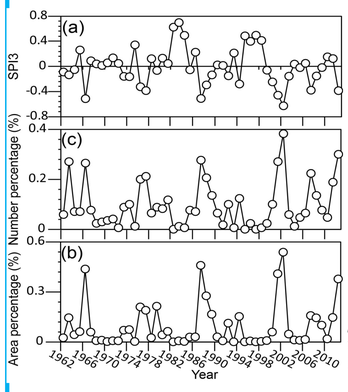
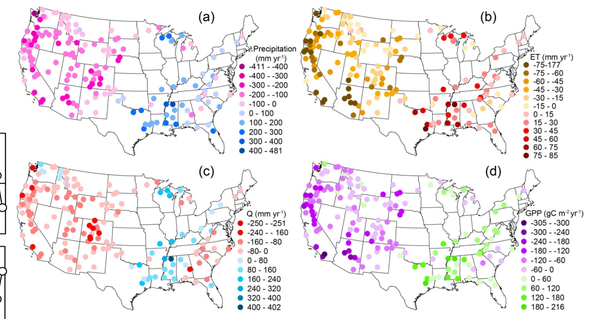
www.forestthreats.org/research/tools/WaSSI

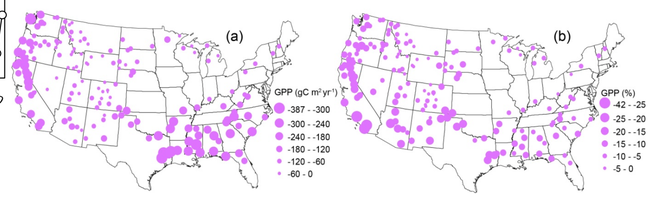
Extent of National Forests under Droughts over Time



Anomalies of 2002



Impacts of extreme droughts (Top-5)



Impacts of Climate Change on Loblolly Pine Forests by 2030 with MACA Data (CCM4 Climate Change Model)