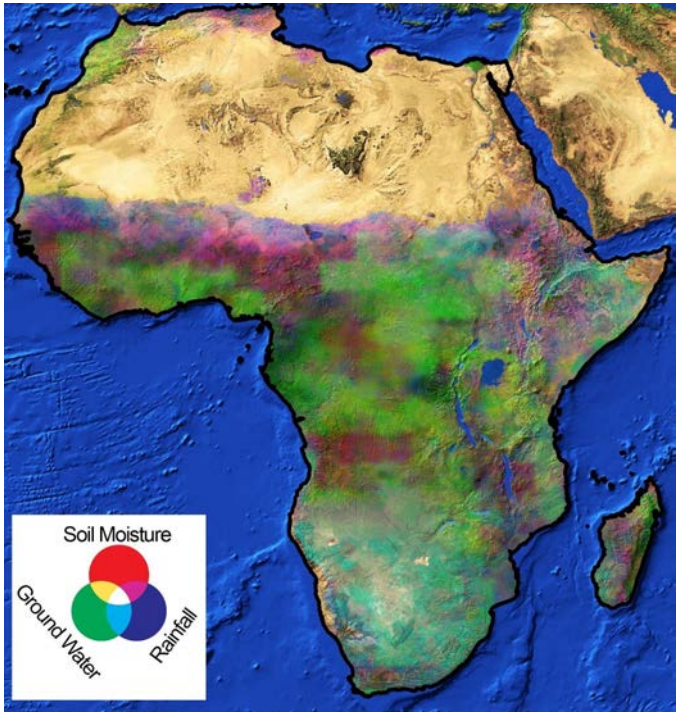
SMAP clarifies below-surface water controls on ecosystem productivity in Africa

Problem: Terrestrial ecosystem gross primary productivity (GPP) is the largest land-Atm. annual carbon flux & primary mechanism for photosynthetic fixation of CO_2 into plant biomass. Semi-arid lands strongly impact the global carbon sink, but less is known regarding African ecosystems where monitoring networks are lacking.

Finding: Africa contributes ~20% (25 PgC) of global annual terrestrial GPP, but with large variability. Rainfall explains majority of GPP spatial & seasonal trends, but with stronger soil moisture & groundwater influence in savanna & forest ecosystems.

Impact: Better understanding of moisture related controls on productivity in climate-sensitive African ecosystems, & their impact on the global carbon sink.

Dominant water supply controls on annual productivity



Estimated control of different water resources on annual productivity (L4C GPP) in Africa indicated from satellite soil moisture (L4SM), groundwater (GRACE) & rainfall (CHIRPS) records.

Madani, Kimball, Parazoo, Ballantyne, Tagesson, Jones, Reichle, Palmer, Velicogna, Bloom, Saatchi, Liu, 2020: Below-surface water mediates the response of African forests to reduced rainfall, *Environmental Research Letters*.

SMAP reveals seasonal variation in water supply sources and restrictions to grassland productivity

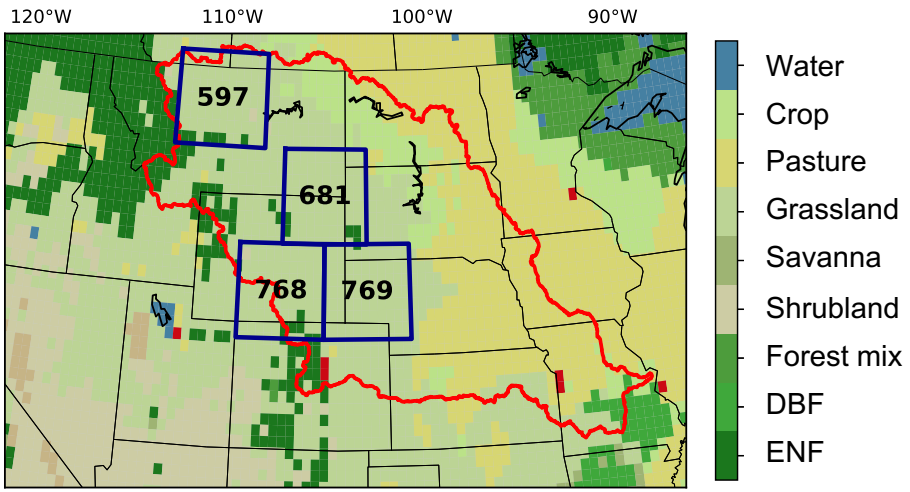
Problem: Grasslands occupy 20-40% of global lands, Incl. rangeland & agriculture, but climate impacts on productivity are uncertain due to lack of clarity on water supply sources & restrictions for growth.

Methods: Diagnosis of water supply sources & controls on grassland productivity in Missouri basin using SMAP soil moisture (L3SM); deeper groundwater storage (GRACE TWS); EVI (MODIS) & SIF (GOME-2) productivity.

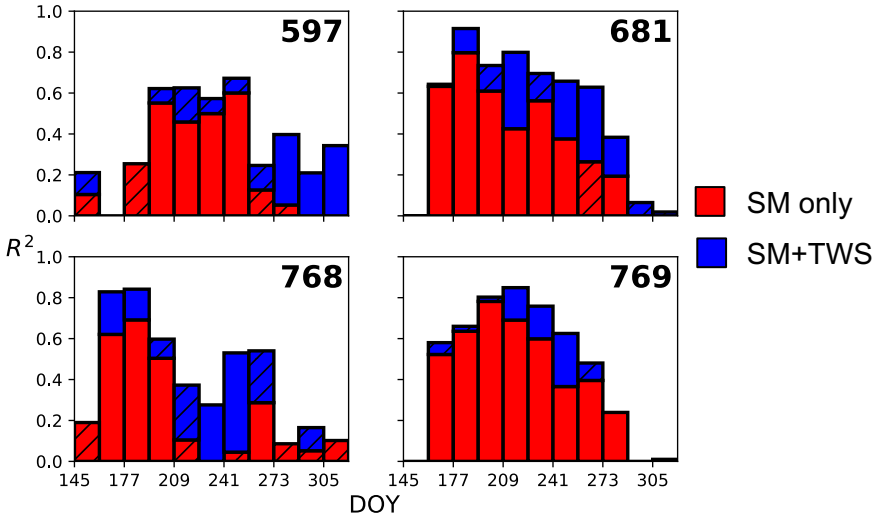
Finding: SM is dominant control on productivity during mid-growing season, but with increasing late season groundwater influence; 2-9 wk lag between water supply change & productivity response; SM & TWS together explain more productivity variation than either variable alone.

Impact: New understanding of water supply sources & restrictions for regional grassland productivity.

Missouri Basin, USA



Growing season EVI variance explained



A, Velicogna, Zhao, Colliander, Kimball, 2020. *RSE* 239, 111623, https://doi.org/10.1016/j.rse.2019.111623 .