



Satellite-based drought response characterization and vegetation- atmosphere coupling for model evaluation at the global scale

Jakob Zscheischler, Nadine Nicolai-Shaw, Lukas Gudmundsson, Martin Hirschi, Rene Orth, Sebastian Sippel, and Sonia Seneviratne

Institute for Atmospheric and Climate Science

ETH zürich



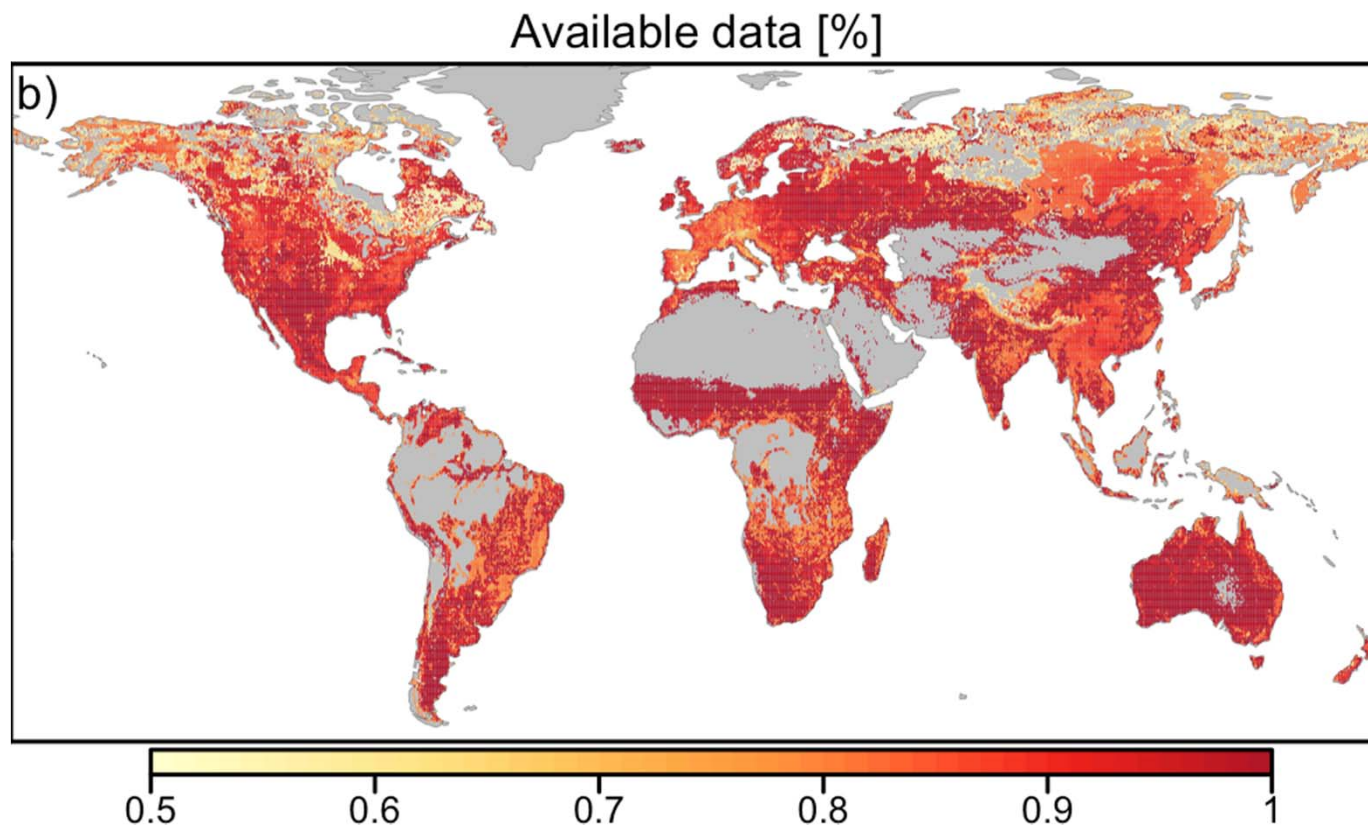
Outline

- 1) Satellite-based drought response characterization
- 2) Vegetation-atmosphere coupling and model evaluation

Data

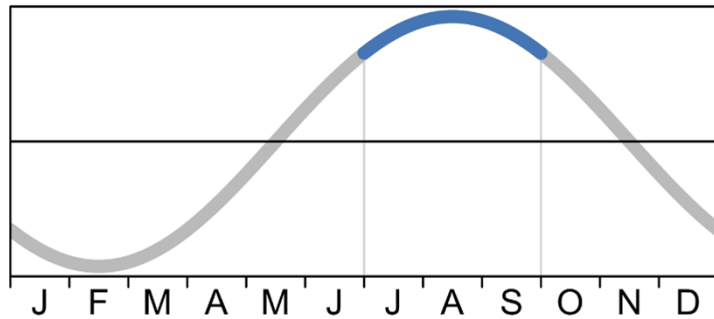
Variable	Dataset
Soil moisture	ESA CCI v03.2
Evapotranspiration	GLEAM
Maximum temperature, precipitation	ERA Interim
NDVI	NDVI3g
LAI, FAPAR	MODIS
Landcover	ESA CCI
Soil moisture	ERA Interim/Land

Available Data

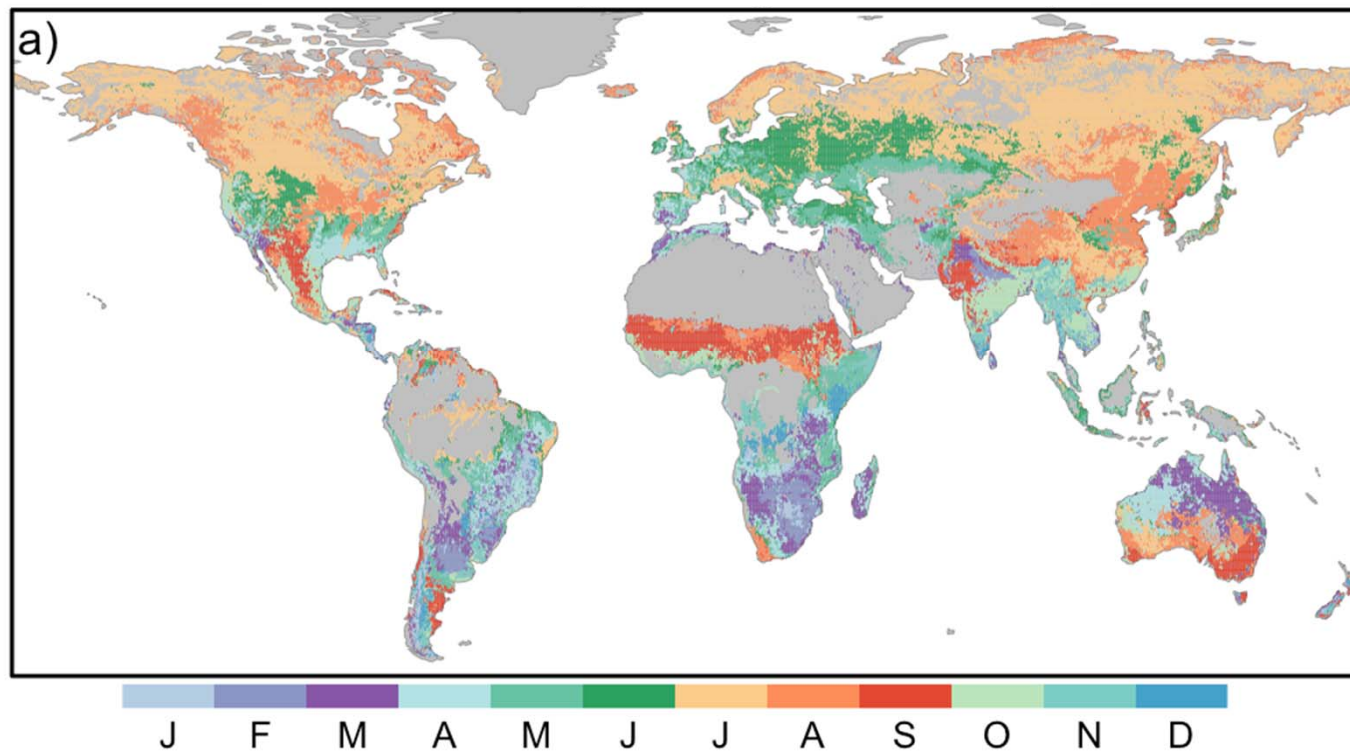


Methodology

Define the peak of the growing season

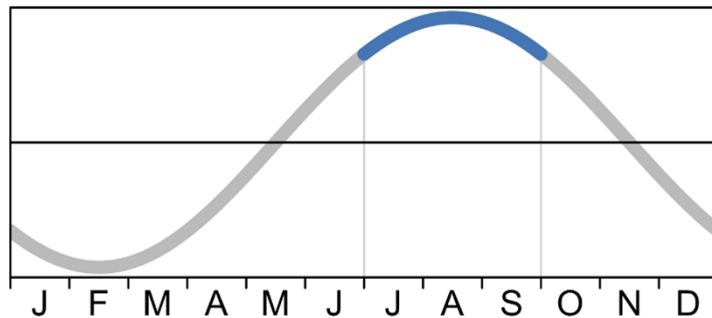


Month with highest vegetation activity

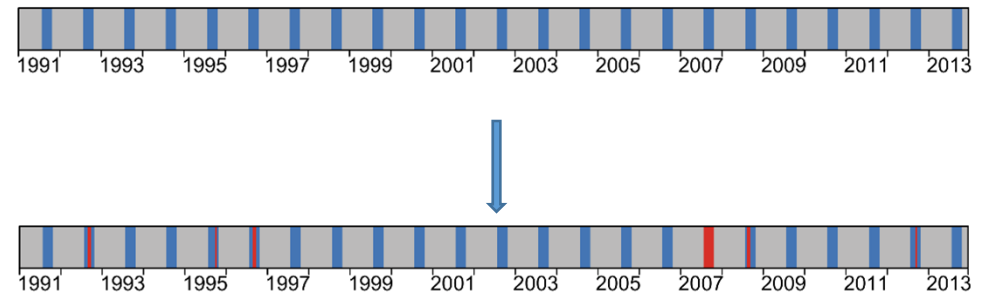


Methodology

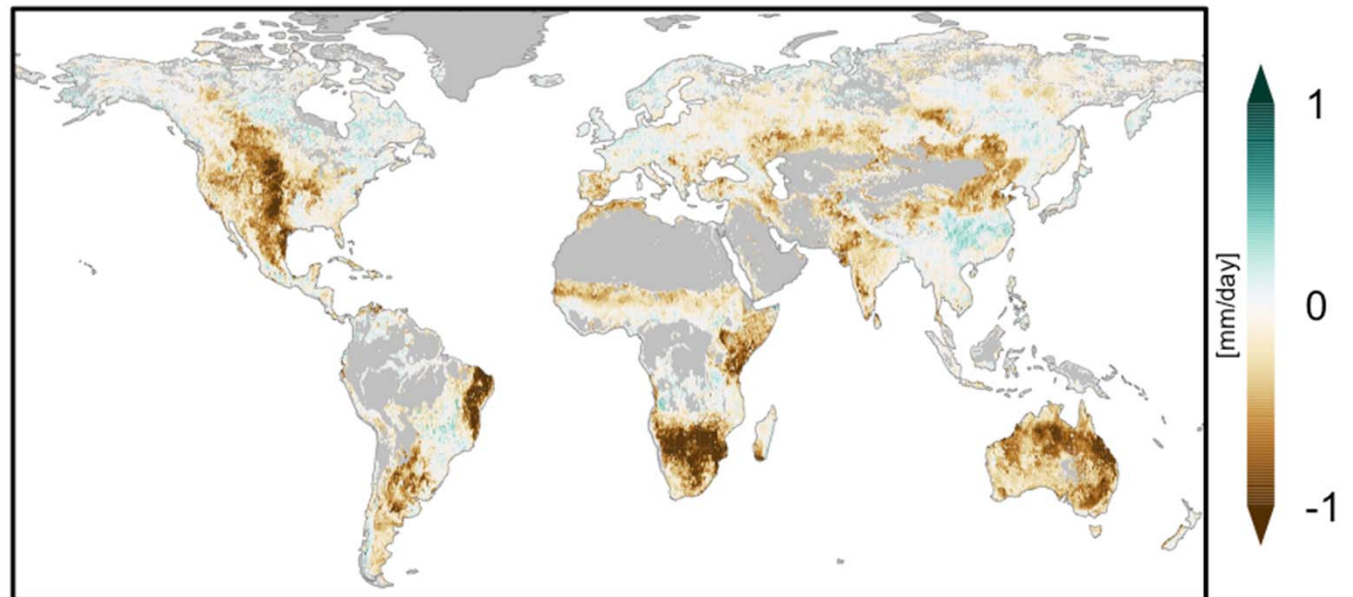
Define the peak of the growing season



Periods of extremely dry soil moisture conditions



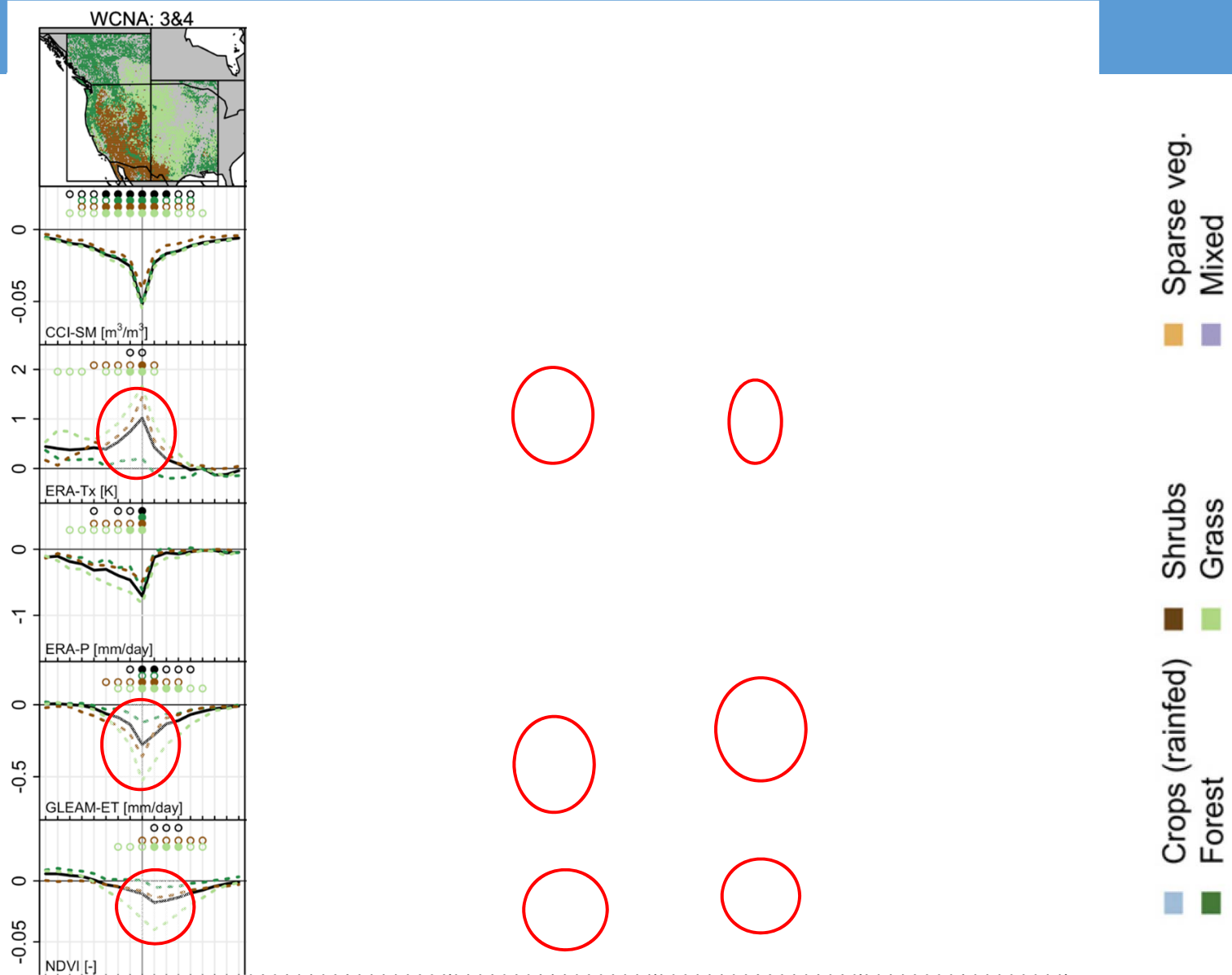
Drought composite anomaly: here for ET



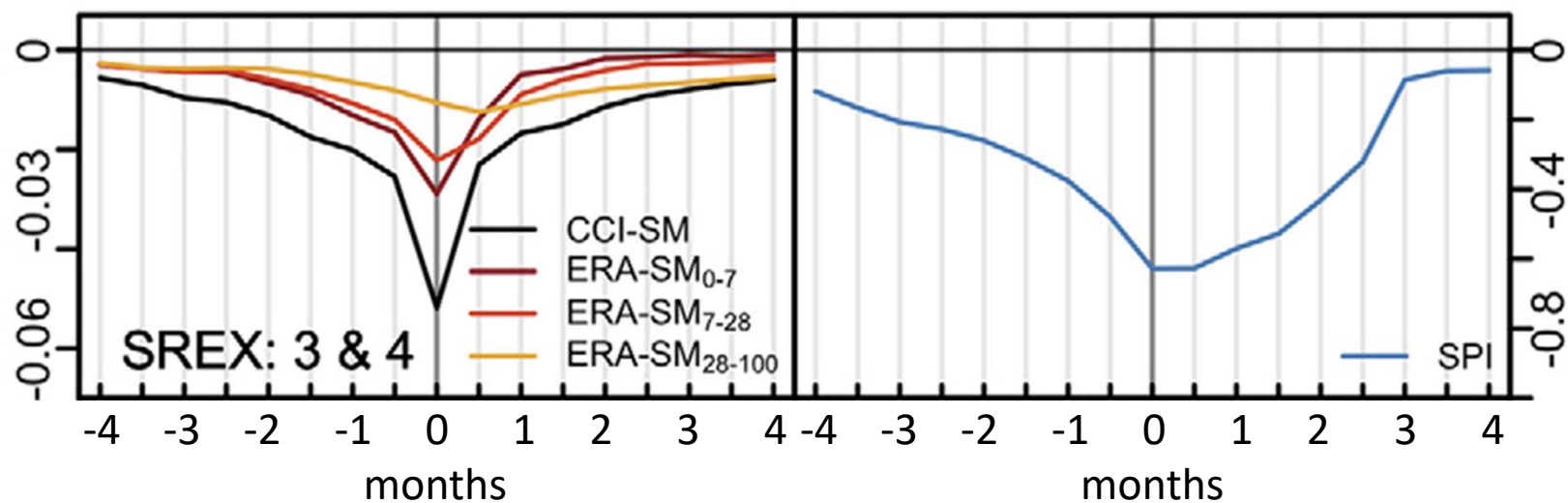
Drought responses



Drought responses



Remotely-sensed SM droughts in comparison with modeled SM and SPI



Conclusions I

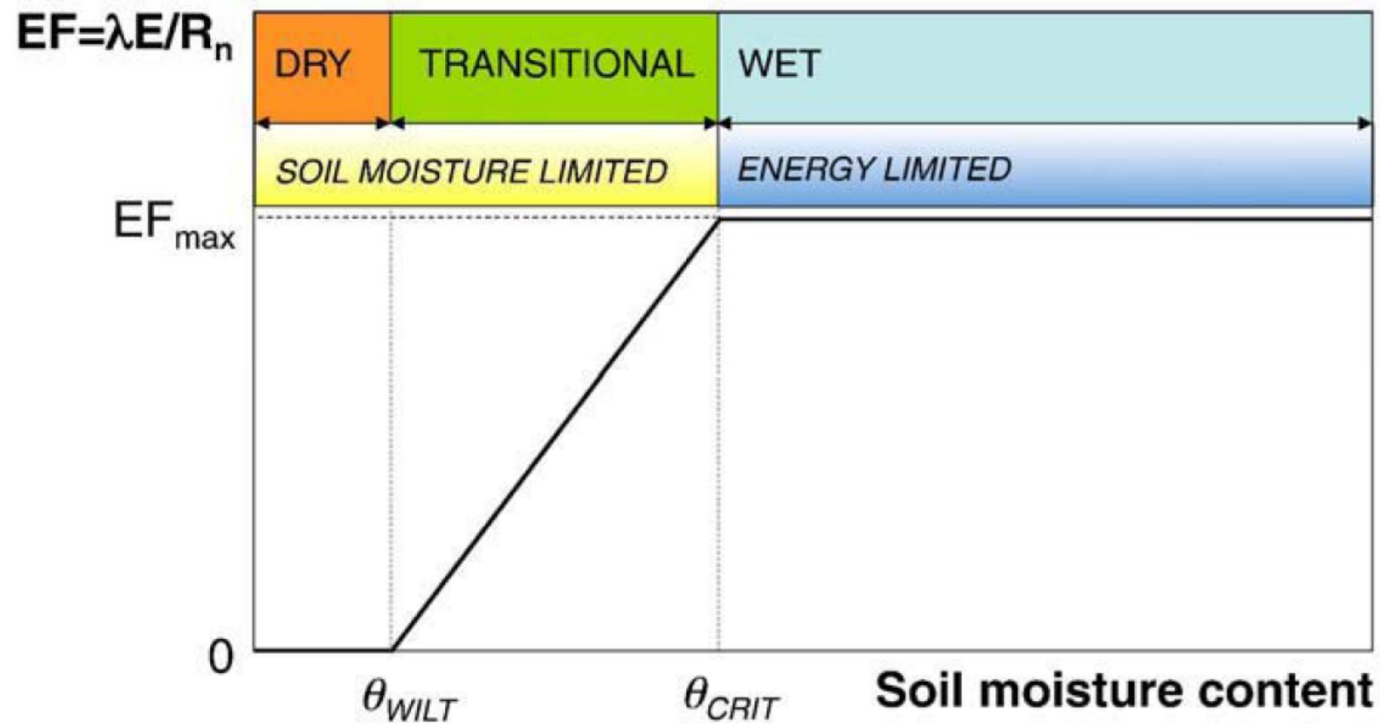
- Remotely sensed soil moisture drought behavior corresponds well to modeled shallow layer soil moisture
- Grasslands respond much more strongly to remotely sensed soil moisture drought than forests
- The ESA CCI SM dataset is well suited for drought monitoring in crop regions/grasslands
- It may complement/replace commonly used soil moisture proxies to study land-atmosphere dynamics at the global scale



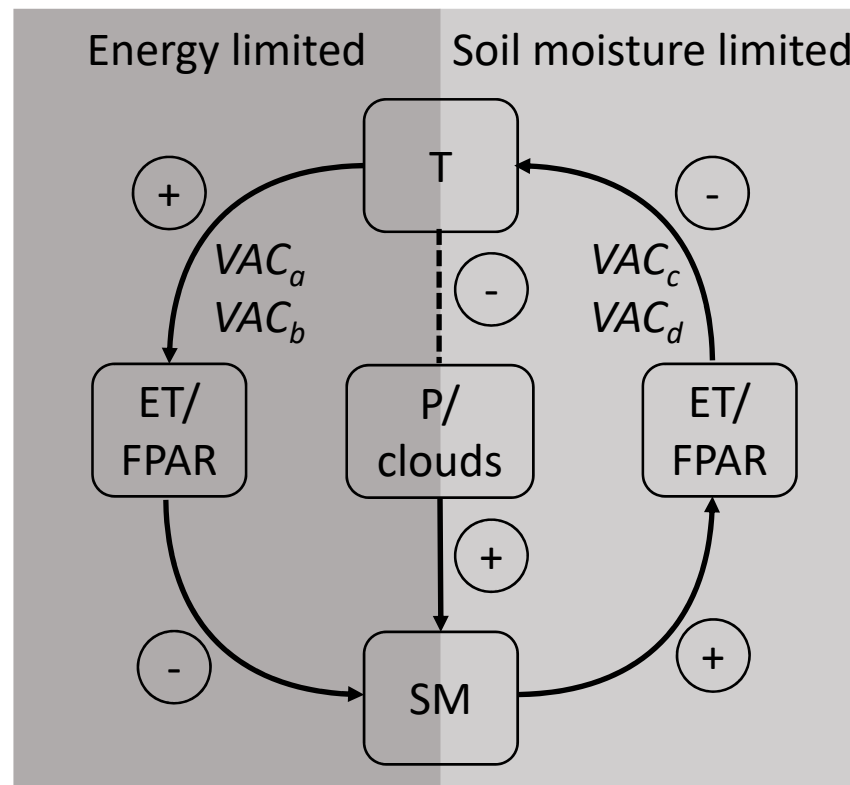
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The different climate regimes



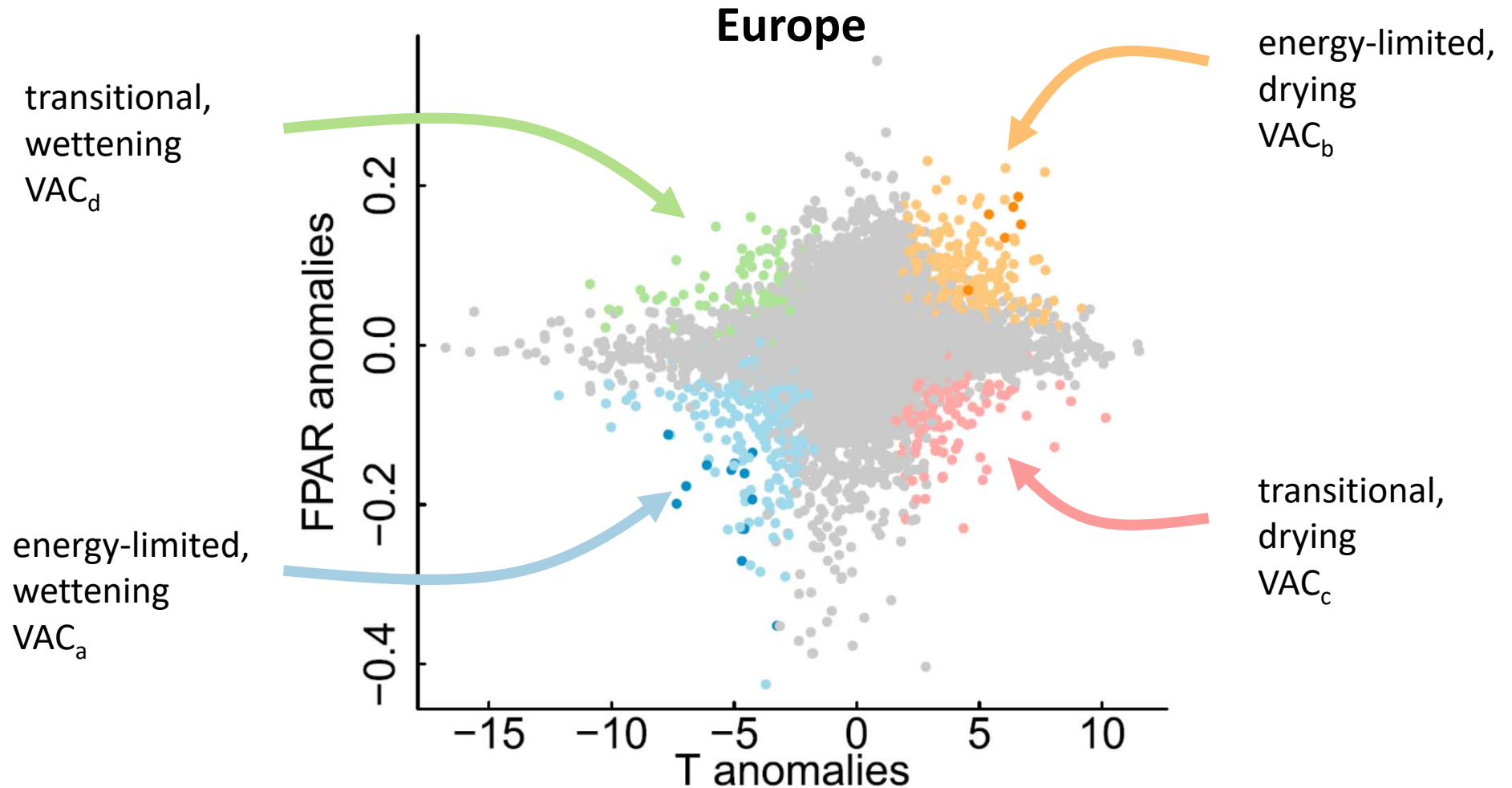
Vegetation-atmosphere coupling



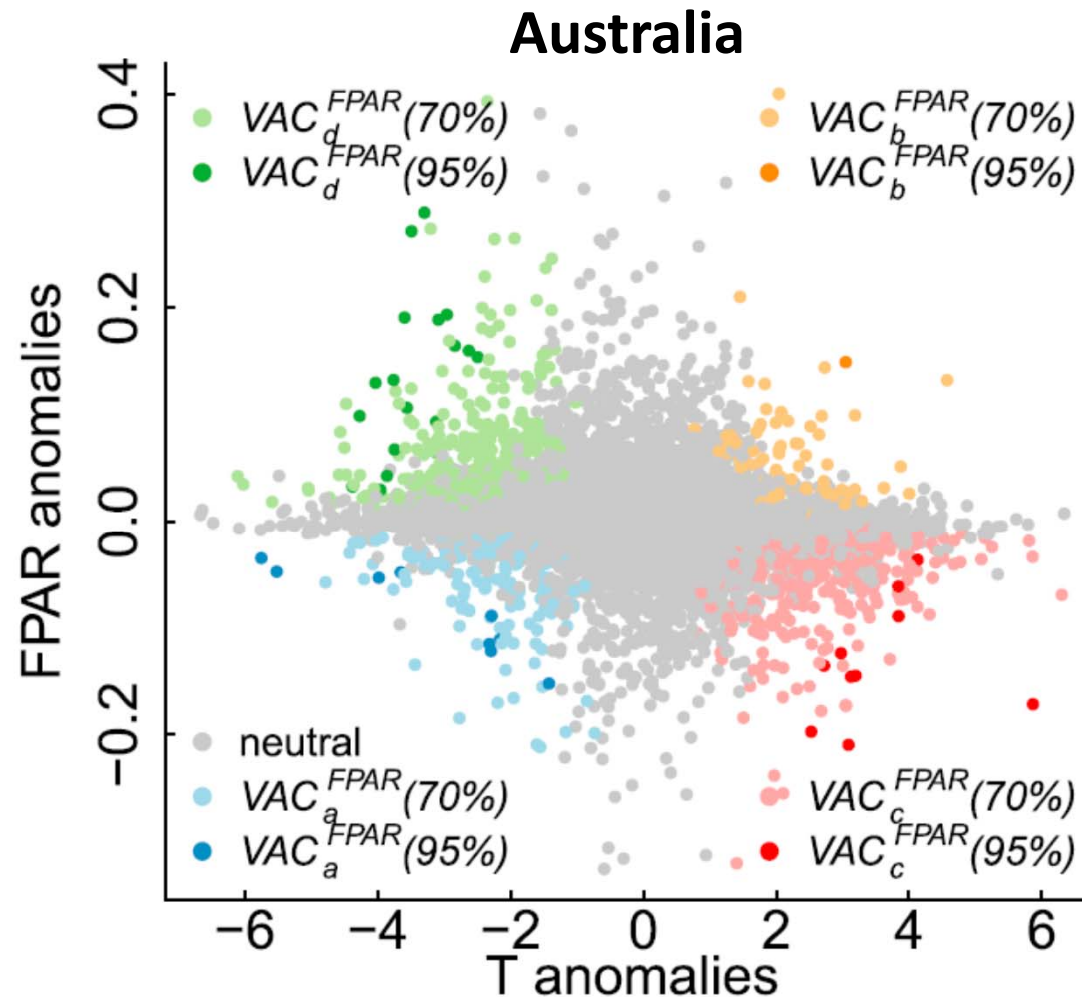
Data

Variable	Dataset
FAPAR	FAPAR3g
Temperature	ERA Interim
Evapotranspiration	earthH2Observe
(Soil moisture	Orth & Seneviratne, 2015, ERL)
(Net radiation	NASA GEWEX SRB/CERES)

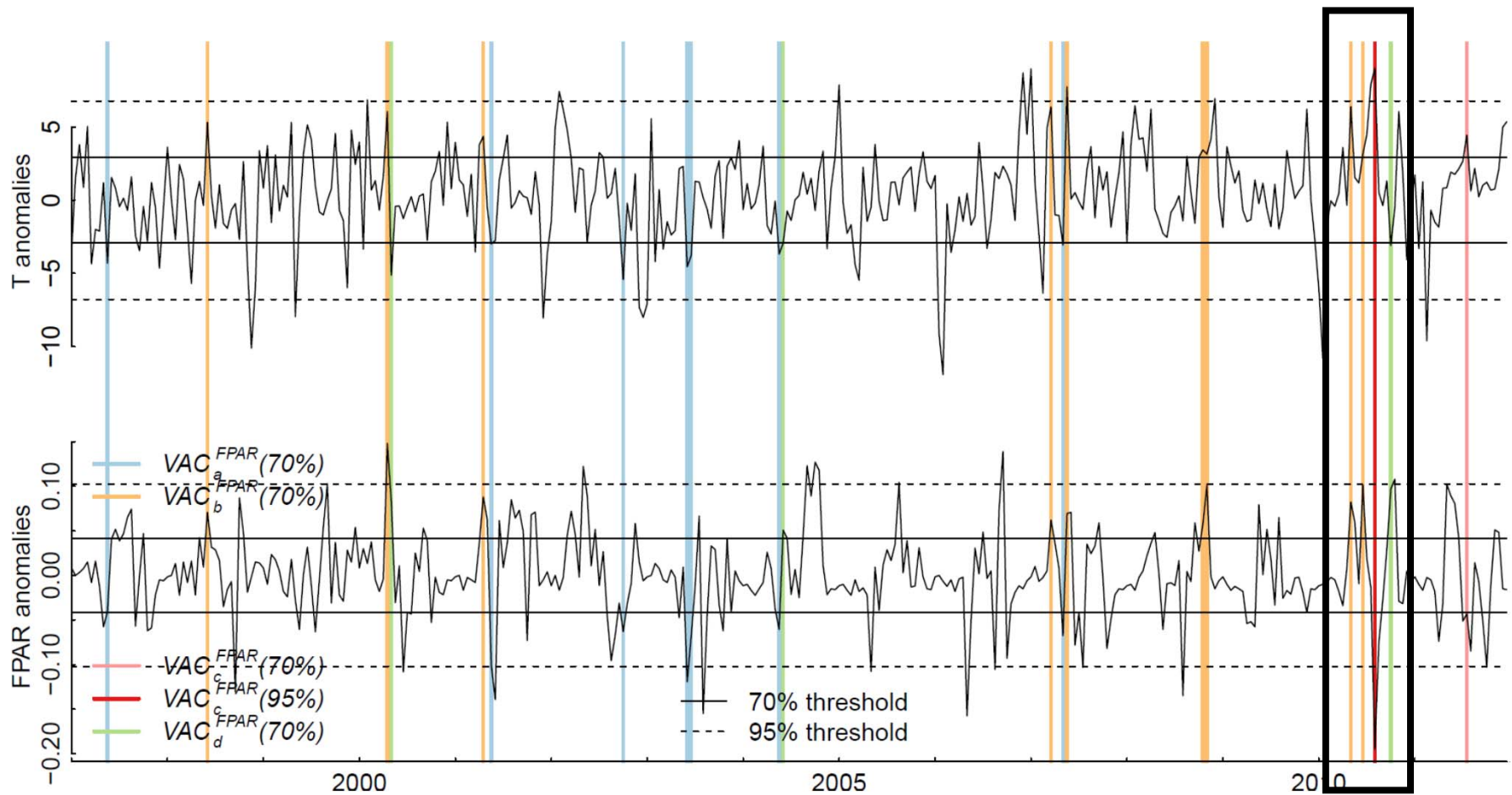
Climate regimes are related to different regions in the T-FPAR space



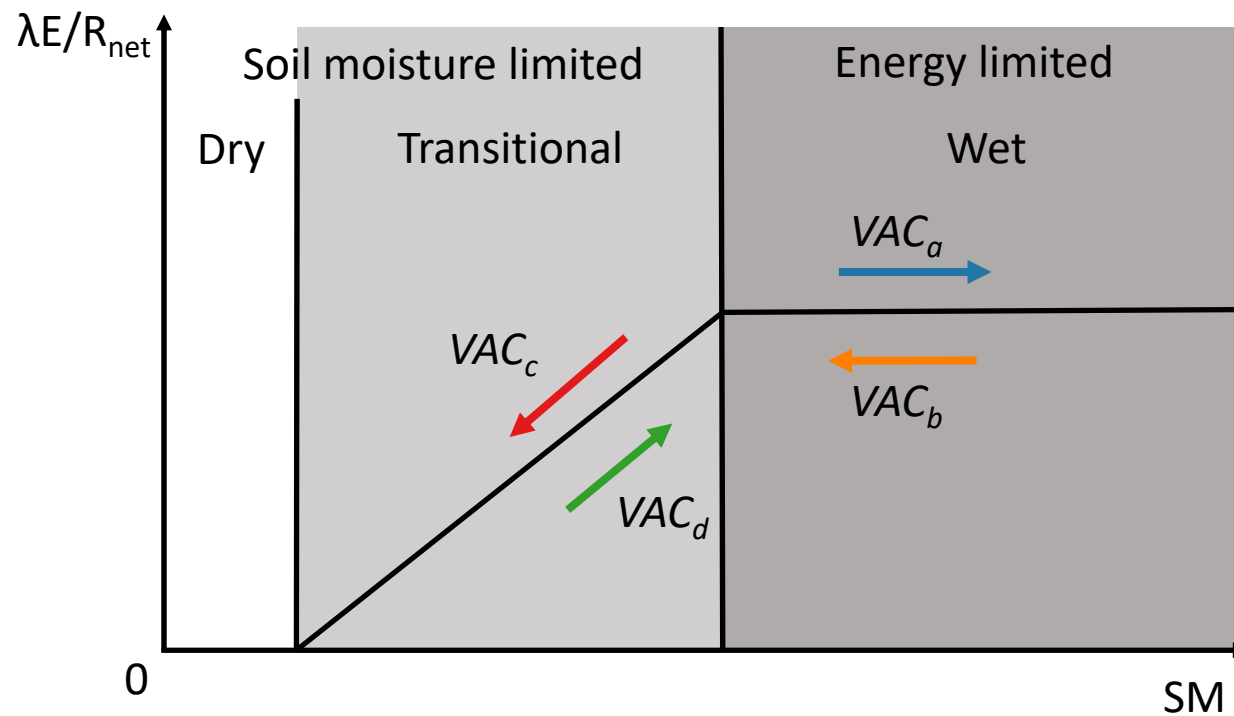
Climate regimes are related to different regions in the T-FPAR space



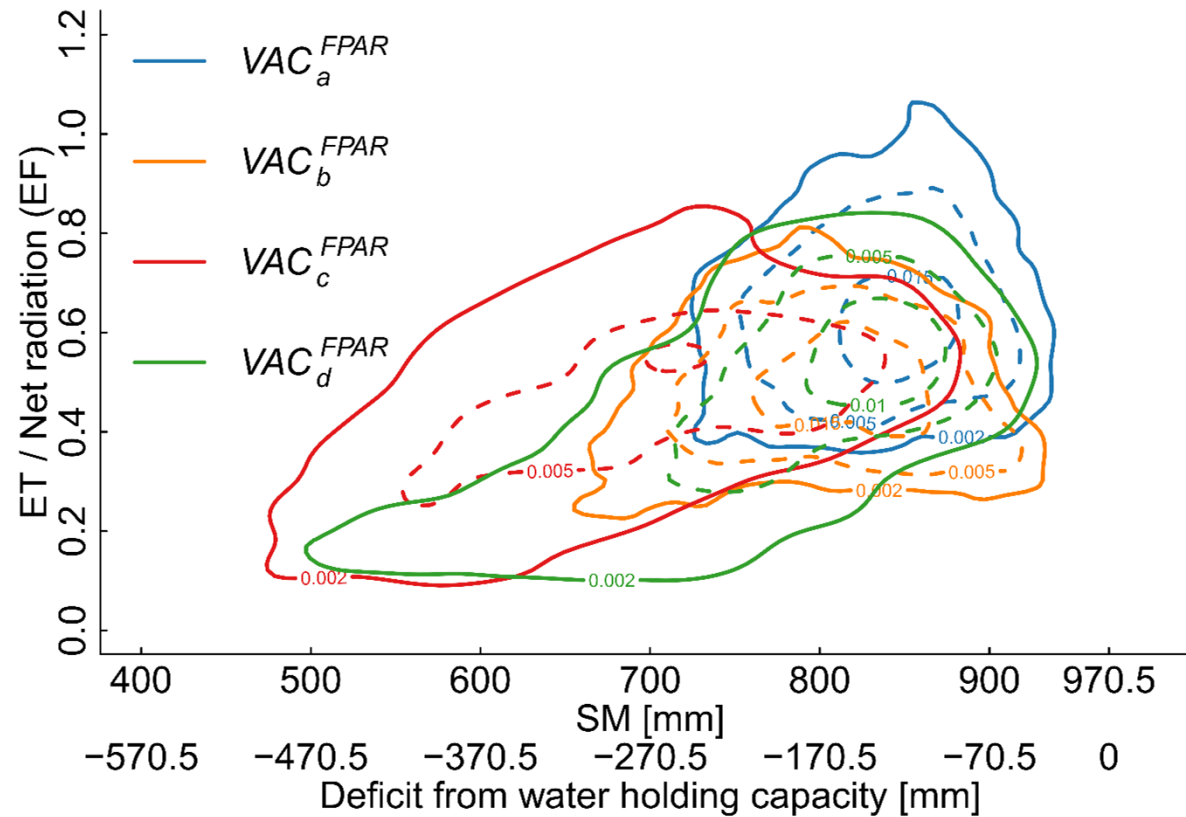
Moscow



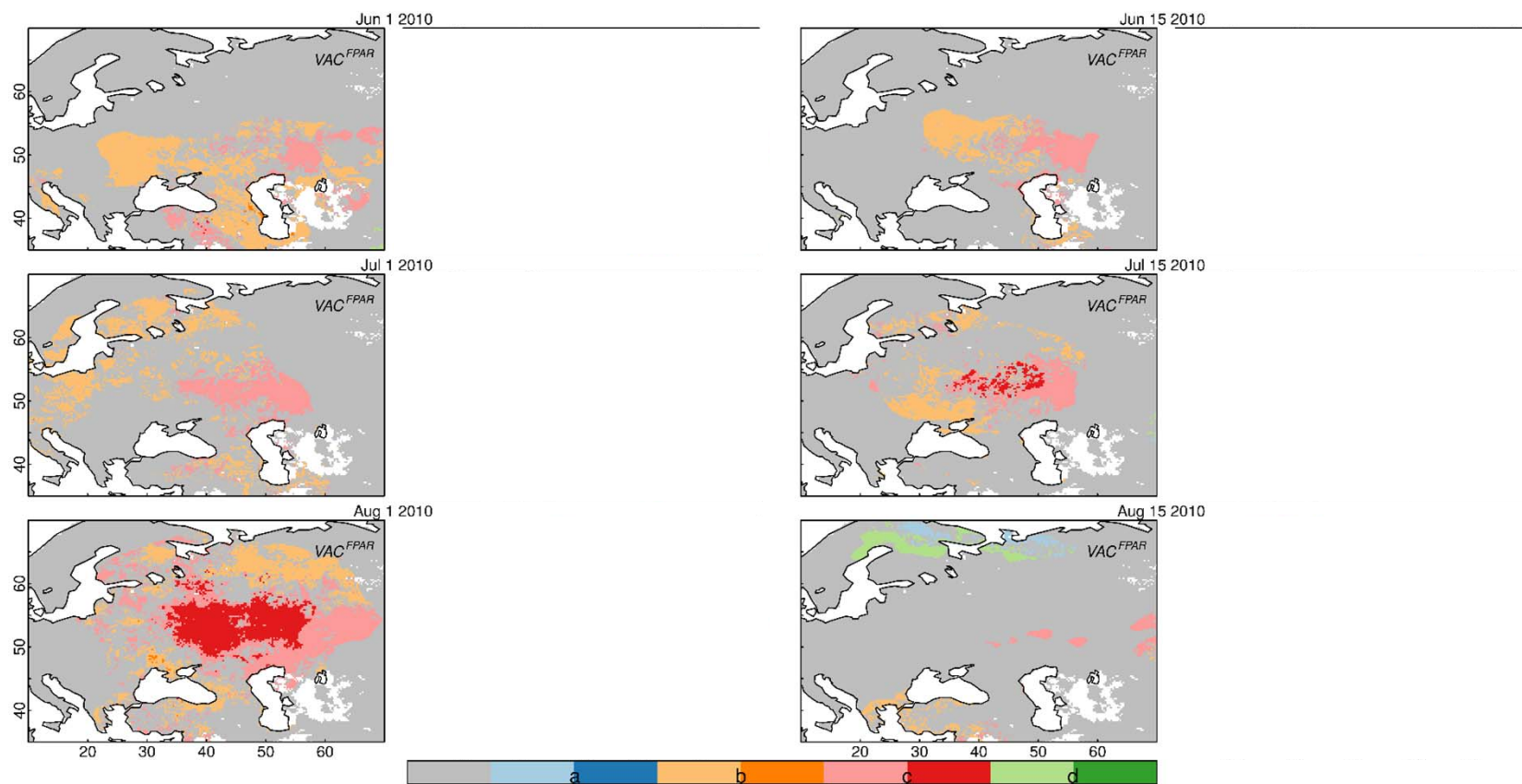
Relating the VAC index to climate regimes



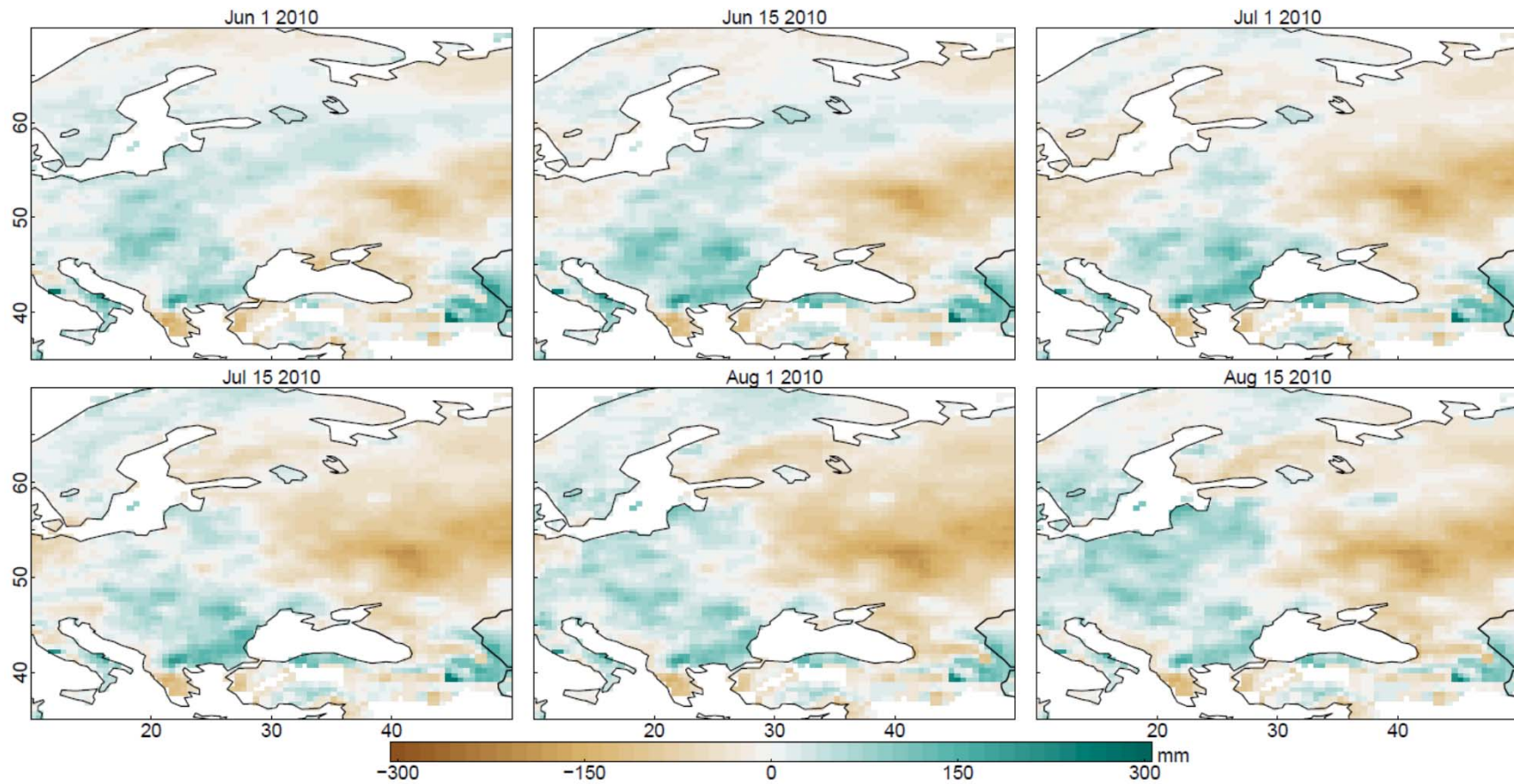
Relating the VAC index to climate regimes



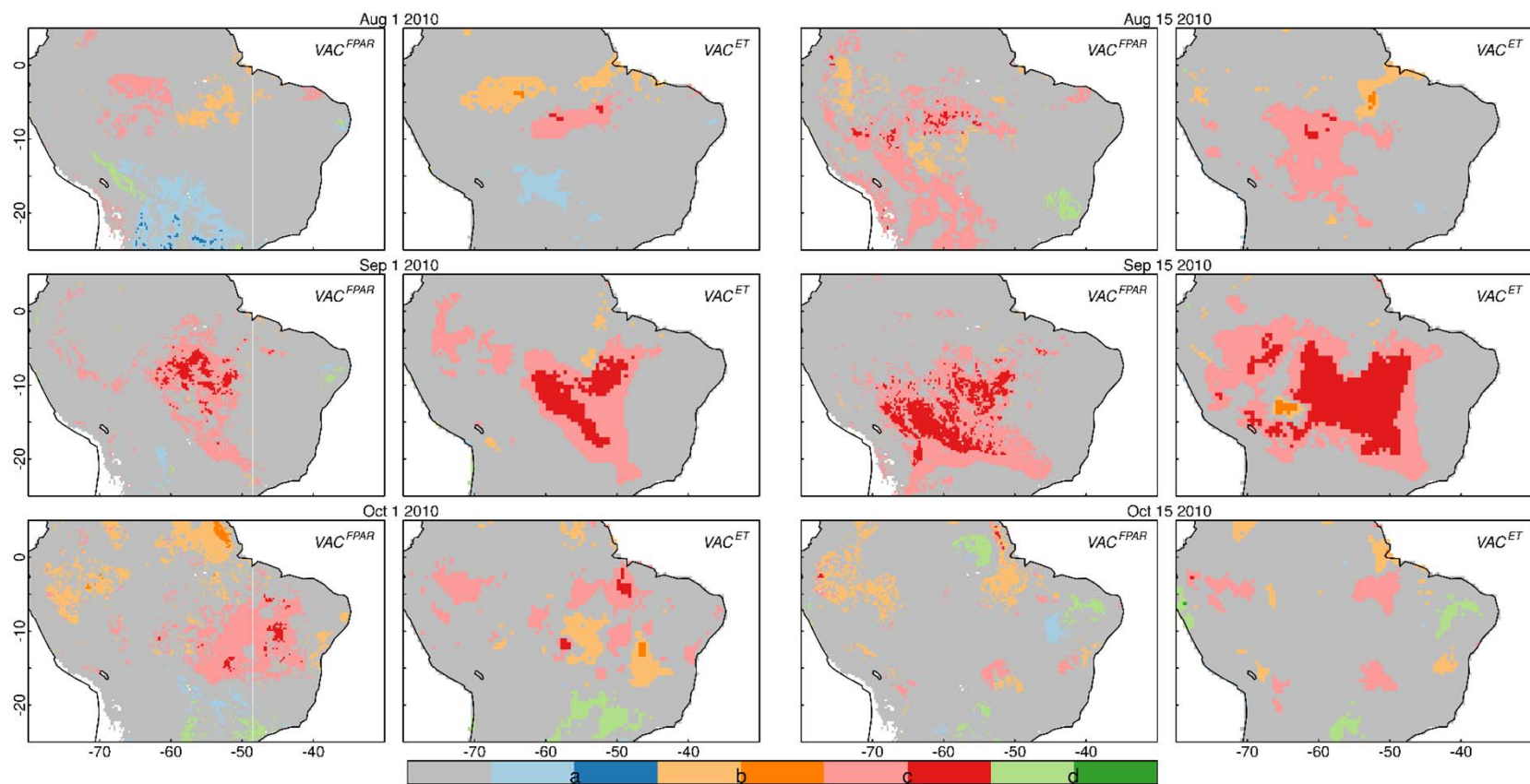
Temporal revolution: Russian heatwave 2010



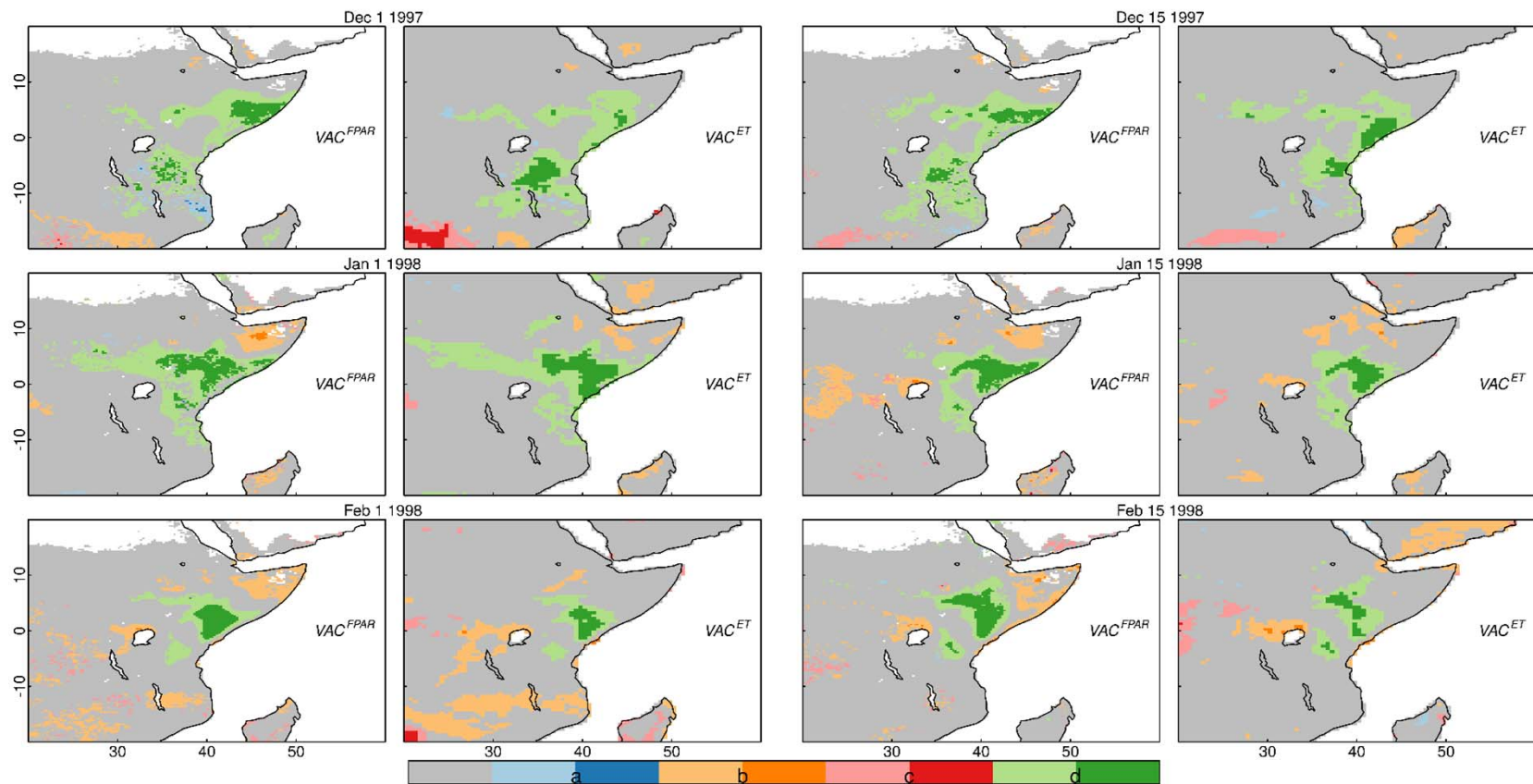
Soil moisture reconstruction



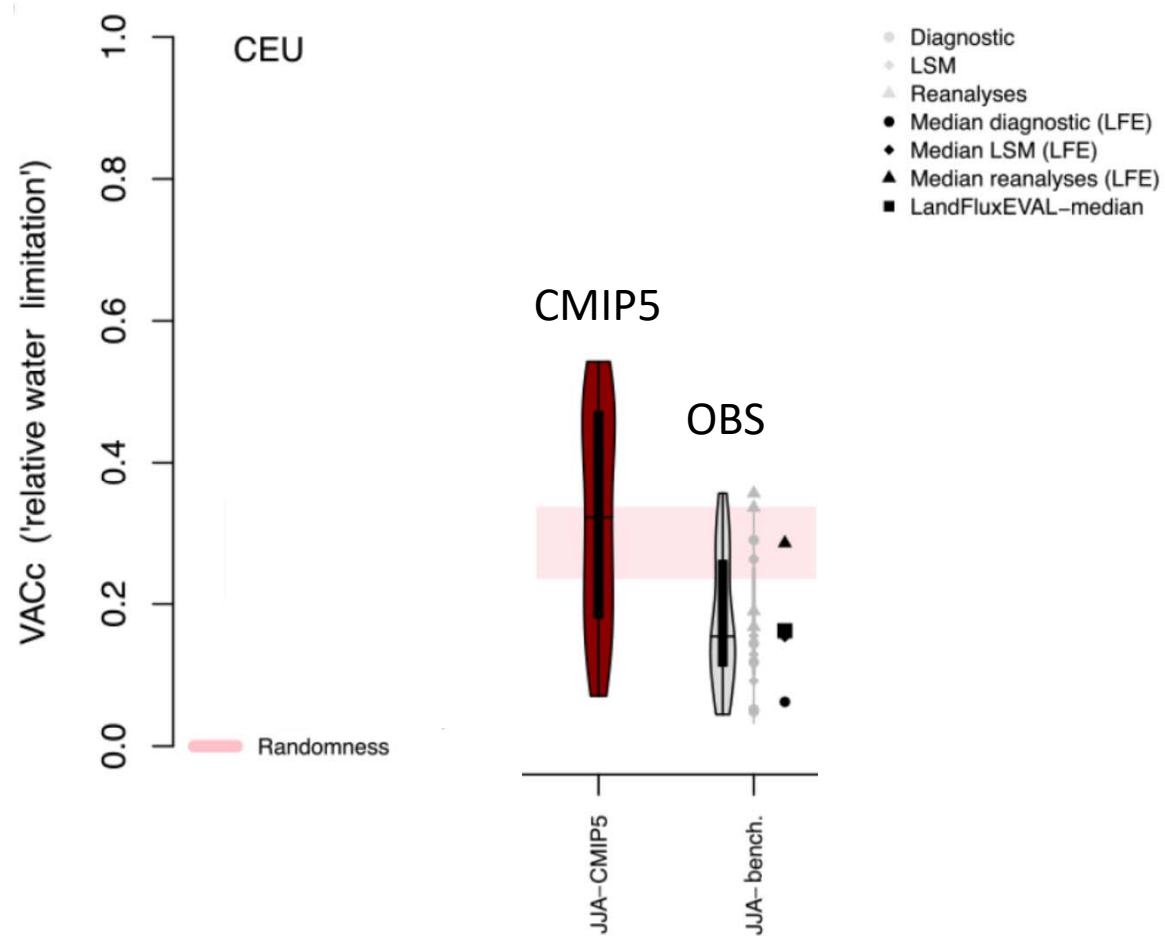
Temporal evolution: Amazon drought 2010



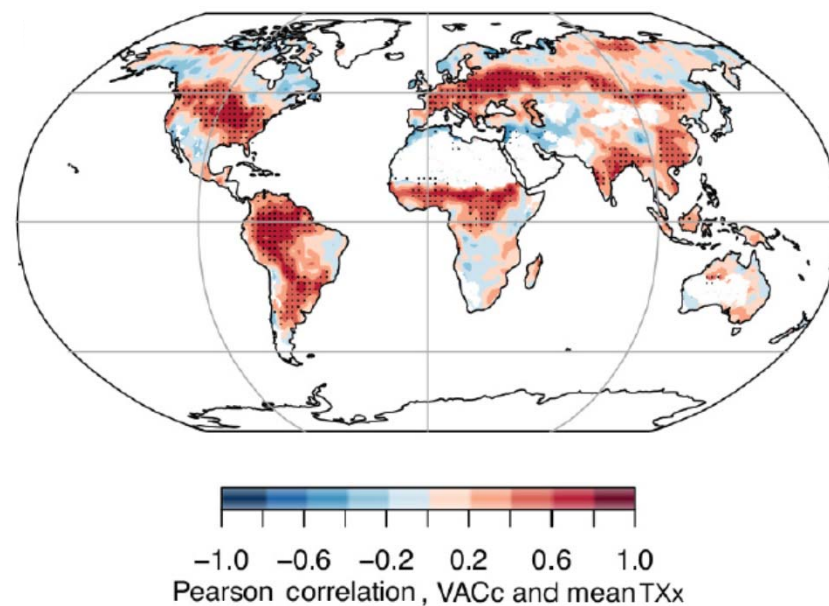
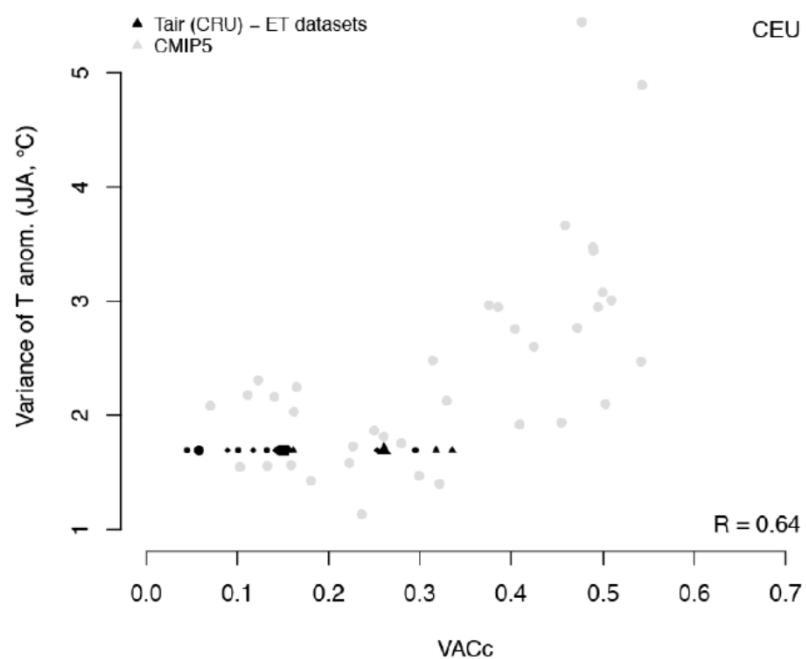
Temporal evolution: East Africa, response to El Niño 2011



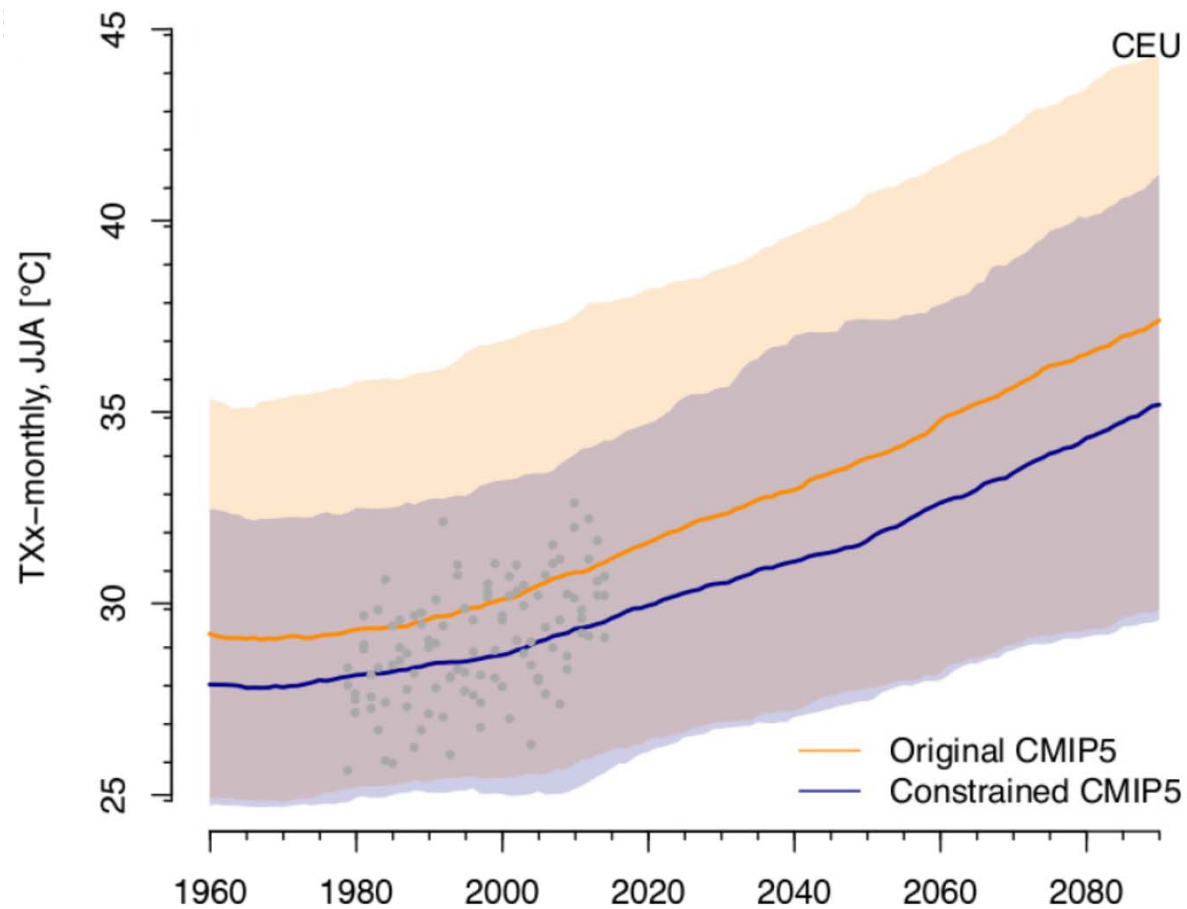
Many models overestimate occurrence of soil moisture limited regime



Occurrence of SM limited regime is correlated with temperature extremes



Use VAC index to constrain model ensembles



Conclusions II

- The VAC index based on FAPAR/ET and temperature can diagnose climate regimes at high temporal and spatial resolution
- Many climate models overestimate the occurrence of water limited regimes
- This overestimation leads to positive biases in daily temperature extremes

Thank you!