CHARACTERISATION OF DROUGHT FROM GLOBAL TO LOCAL SCALE: REMOTE SENSING APPROACH

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Data and Methods

Moderate Resolution Imaging Spectroradiometer (MODIS)

- Surface reflectance 500 m
- Land Surface Temperature 1 km
- Evapotranspiration (ET) 500 m

Landsat based time series at 30m resolution

- Normalized difference vegetation index (NDVI),
- Normalized difference Moisture index (NDMI)
- Land Surface Temperature (LST)

Cropland masks

Methods:

- Comparison of remote sensing-based drought indices from local to global scales
- Derivation of anomalies of time series
- Calculation of correlation with crop yield anomalies
- Use of Satellite-based time series derivation for model and AI-based yield estimation

Global Analysis

The condition of croplands was observed using the Evaporative Stress Index (ESI). We classified all pixels with an ESI anomaly < -1 as affected (Figure 1).

Frequently affected areas can be delineated, such as the U.S., Australia, Ethiopia.

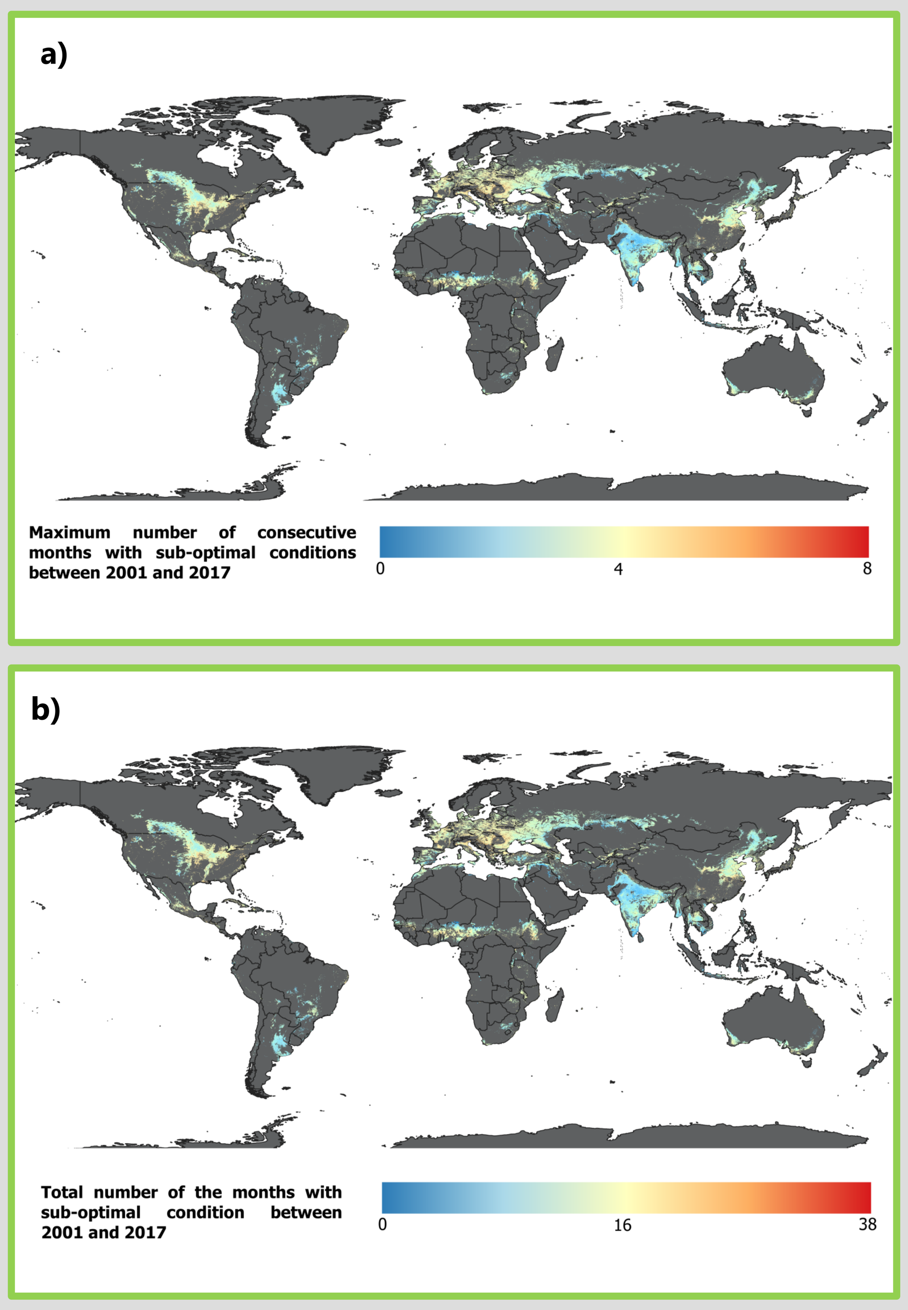


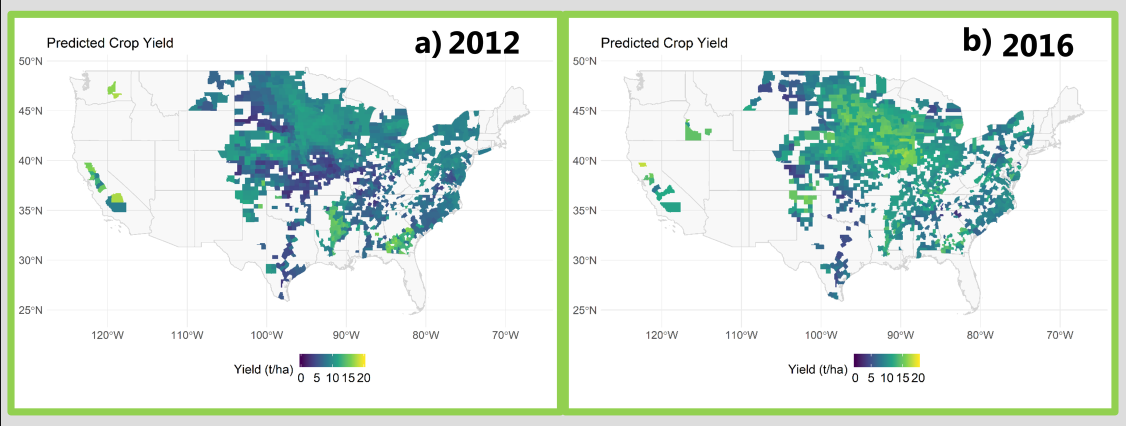
Figure 1: (a) Maximum number of consecutive months and (b) Total number of the month with ESI anomaly <-1 in the period 2001-2017

How can Remote Sensing contribute to drought and its impact monitoring?

The use of Remote Sensing based time series provides opportunities for applications in drought characterization and yield monitoring at different scales.

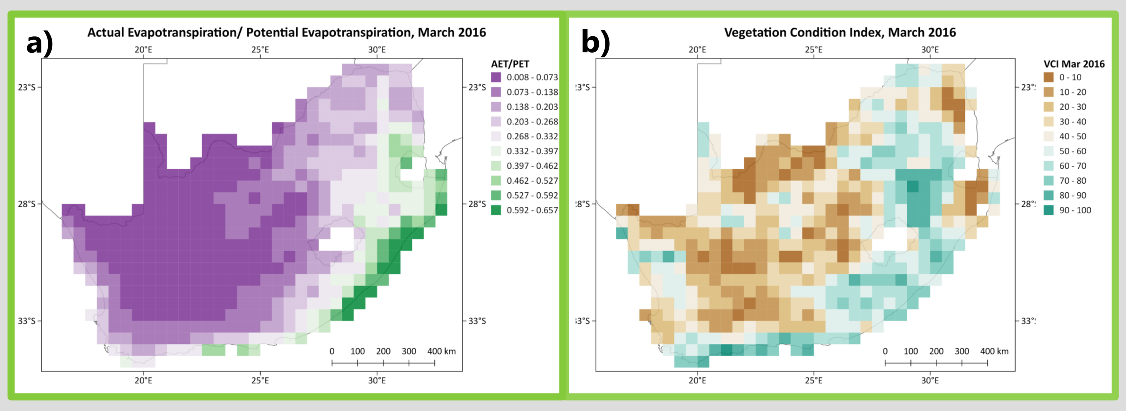
National and Regional Analysis

Figure 2: Comparison of maize yield estimated based on MODIS data and Convolutional Neural Networks a) 2012 and b) 2016.



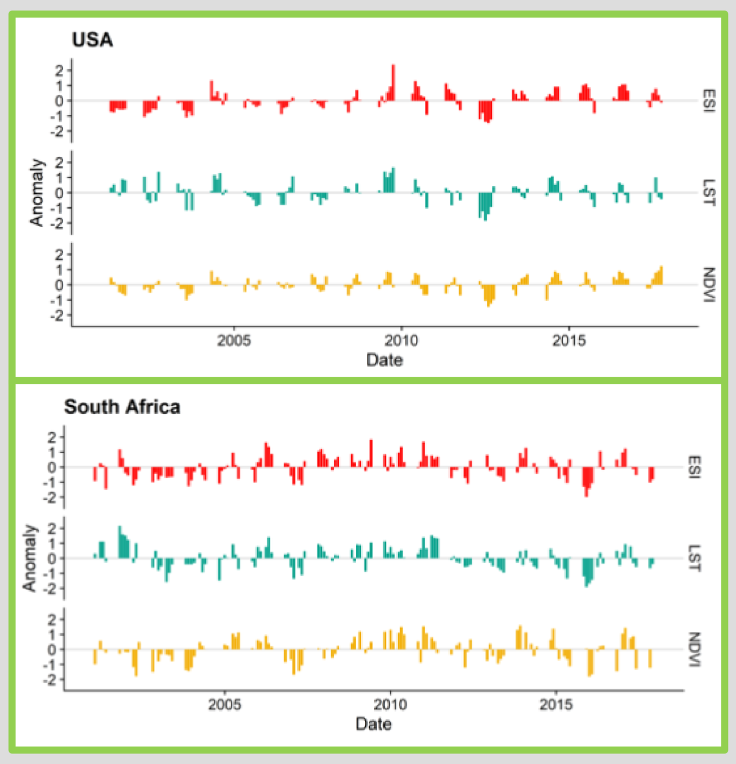
Significantly lower yield can be predicted for 2012 (Figure 2a, which was considered as one of the major droughts in the US.

Figure 3: Comparison of MODIS-based Vegetation condition index (VCI) and Actual Evapotranspiration 2016 mid growing season aggregated over 0.5 degree grid.



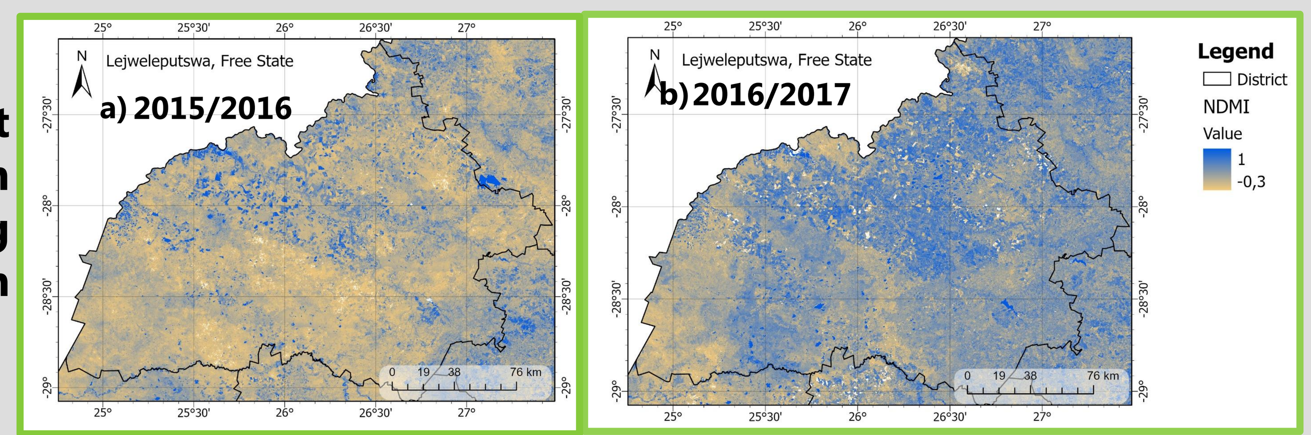
The results show large drought affected areas in 2016 (Figure 3).

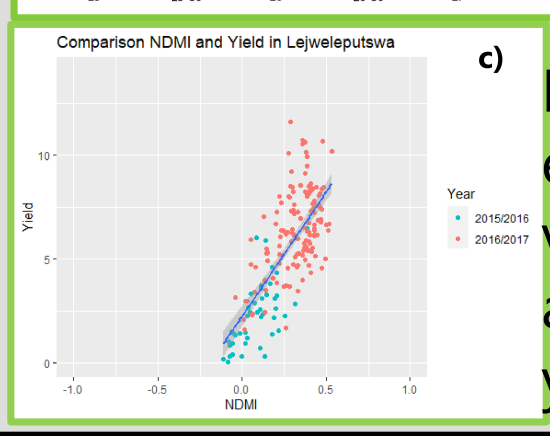
Figure 4: NDVI, LST and ESI anomalies for croplands aggregated over national scale USA and South Africa .



ET and LST show more sensitivity to agricultural drought (2001-2017) (Figure 4).

Figure 5: Landsat based vegetation indices show striking differences between growing seasons





NDMI could be a useful estimator of yield variability as it shows good agreement with field level yield data (Figure 5c).

Acknowledgments

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Further information

GlobeDrought-Project: https://grow-globedrought.net/
GlobeDrought-activities at ZFL: https://www.zfl.uni-bonn.de/research/projects/globedrought
More information on crop yield esimation:
https://meetingorganizer.copernicus.org/EGU2020/EGU2020-13957.html

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