# How Changes in Harvested Area Impacts the Actual Evapotranspiration of Croplands Using Optical Remote Sensing

Neda Abbasi[1,2*], Hamideh Nouri[1], Pamela Nagler[3], Sattar Chavoshi Borujeni[4,5], Armando Barreto-Muñoz[6], Christian Opp[2], Kamel Didan[6], Stefan Siebert[1]

[1] Department of Crop Sciences, Division of Agronomy, University of Göttingen, Von-Siebold-Straße 8, 37075, Göttingen, Germany [2] Department of Geography, Philipps-Universität Marburg, Deutschhausstraße 10, 35032, Marburg, Germany [3] U.S. Geological Survey, Southwest Biological Science Center, 520 N. Park Avenue, Tucson, AZ 85719, USA
[4] Faculty of Science, University of Technology Sydney, Ultimo, NSW 2007, Australia [5] Soil Conservation and Watershed Management Research Department, Isfahan Agricultural, and Natural Resources Research and Education Center, AREEO, Isfahan 19395-1113, Iran [6] Biosystems Engineering. The University of Arizona, 1177 E. 4th St., Tucson, AZ 85719, USA

## Introduction

There is an imminent need for an accurate and reliable estimation of actual evapotranspiration (ETa), as a key component of the water cycle due to its critical role in agricultural water management. This work aims to investigate the impact of changes in harvested area (HA) overtime on ETa estimates using Landsat-derived 3- and 2-band Enhanced Vegetation Index ET-EVI (and EVI2) in the Zayandehrud River Basin, Iran, where croplands are highly dependent on irrigation and strongly influenced by aridity and recurring drought events. The Vegetation Index-based ETa (ET-VI) method uses optical and near-infrared bands to calculate VIs and combine them with reference ET (ET0) to estimate ETa.

## Study area

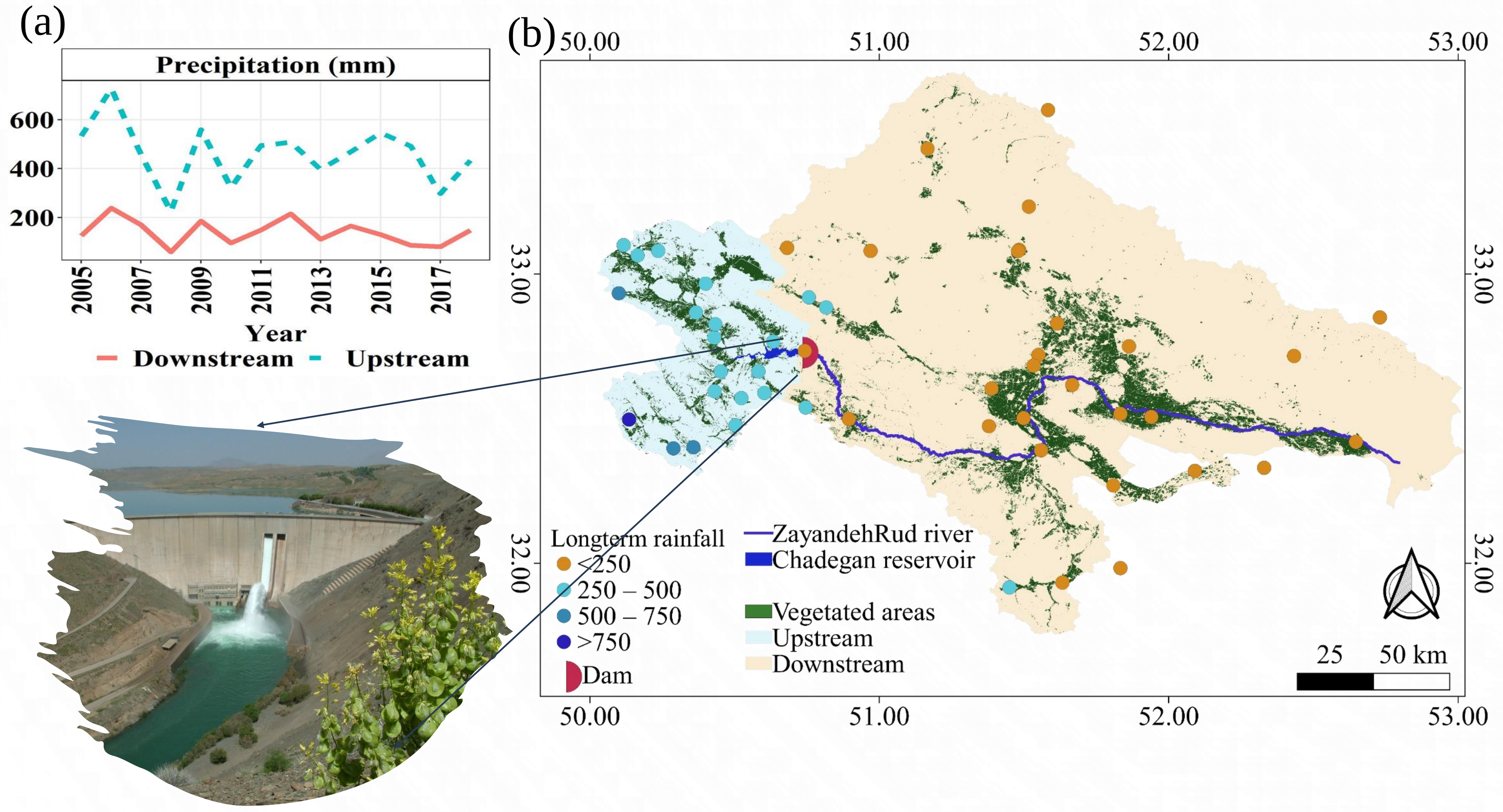



Figure 1. Study area, a) Average annual precipitation (mm), b) Zayandehrud river basin.

The ZayandehRud River basin (Iran) has an area of 26972 km2 and flows 400 kilometers eastward before ending in the Gavkhuni Swamp.

## Data and methods

**Google Earth Engine (GEE)**, a cloud-based open-access platform for accessing and analyzing the RS data, was used to derive ETa and VIs https://earthengine.google.com/

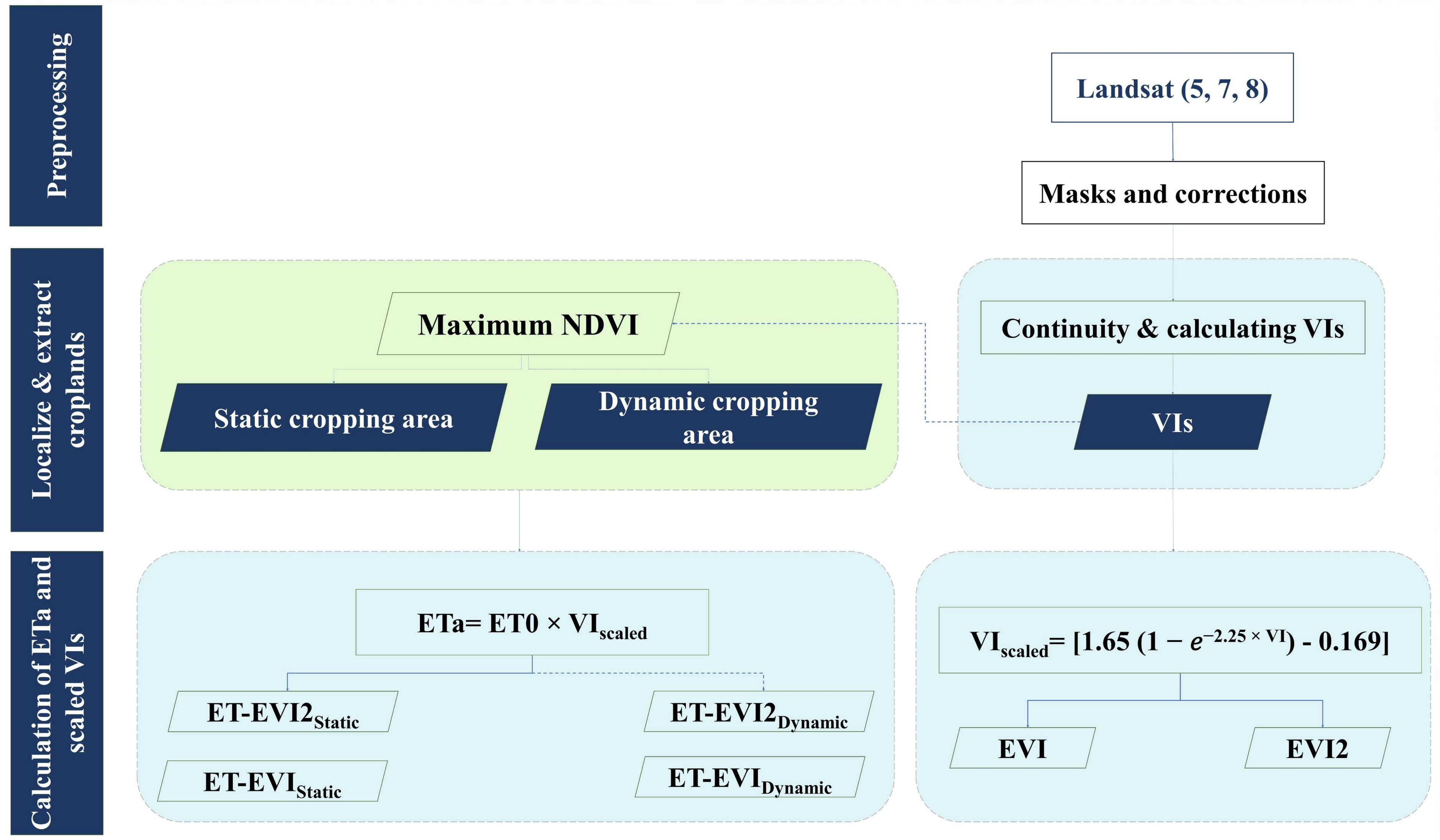



Figure 2. Workflow of ETa and Harvested area calculation, ET0: GCWM data[1,3], Blue box: Calculation of ET-VIs and VIs using Nagler's[2] method, Green box: Calculation of dynamic and static cropping areas.

## Results

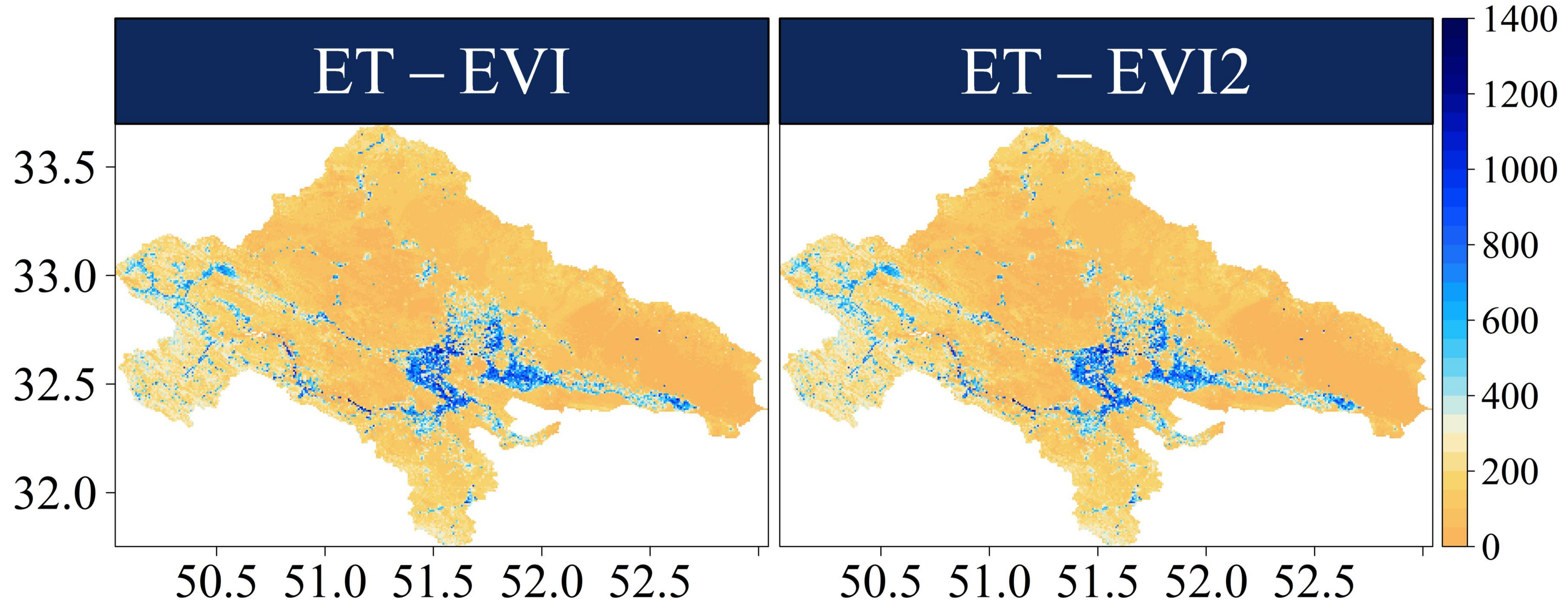
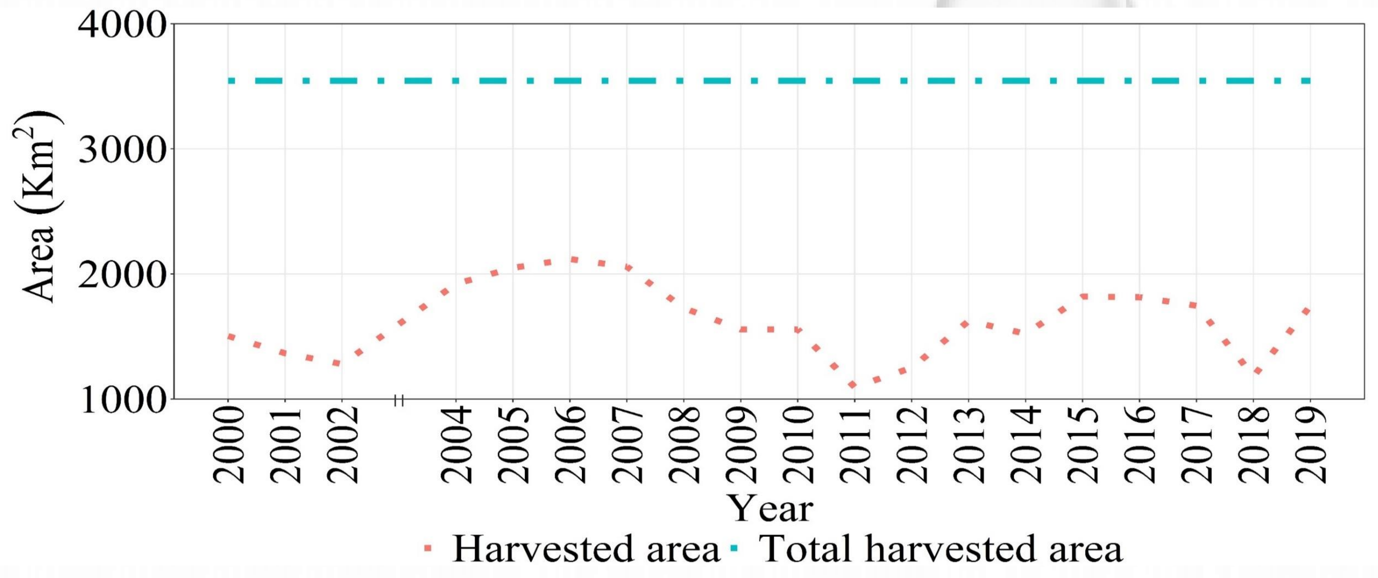



Figure 3. Long-term average (2000-2019) of ET-EVI and ET EVI2.

Figure 4. Annual changes of dynamic vs. static harvested area in the ZayandehRud river basin.



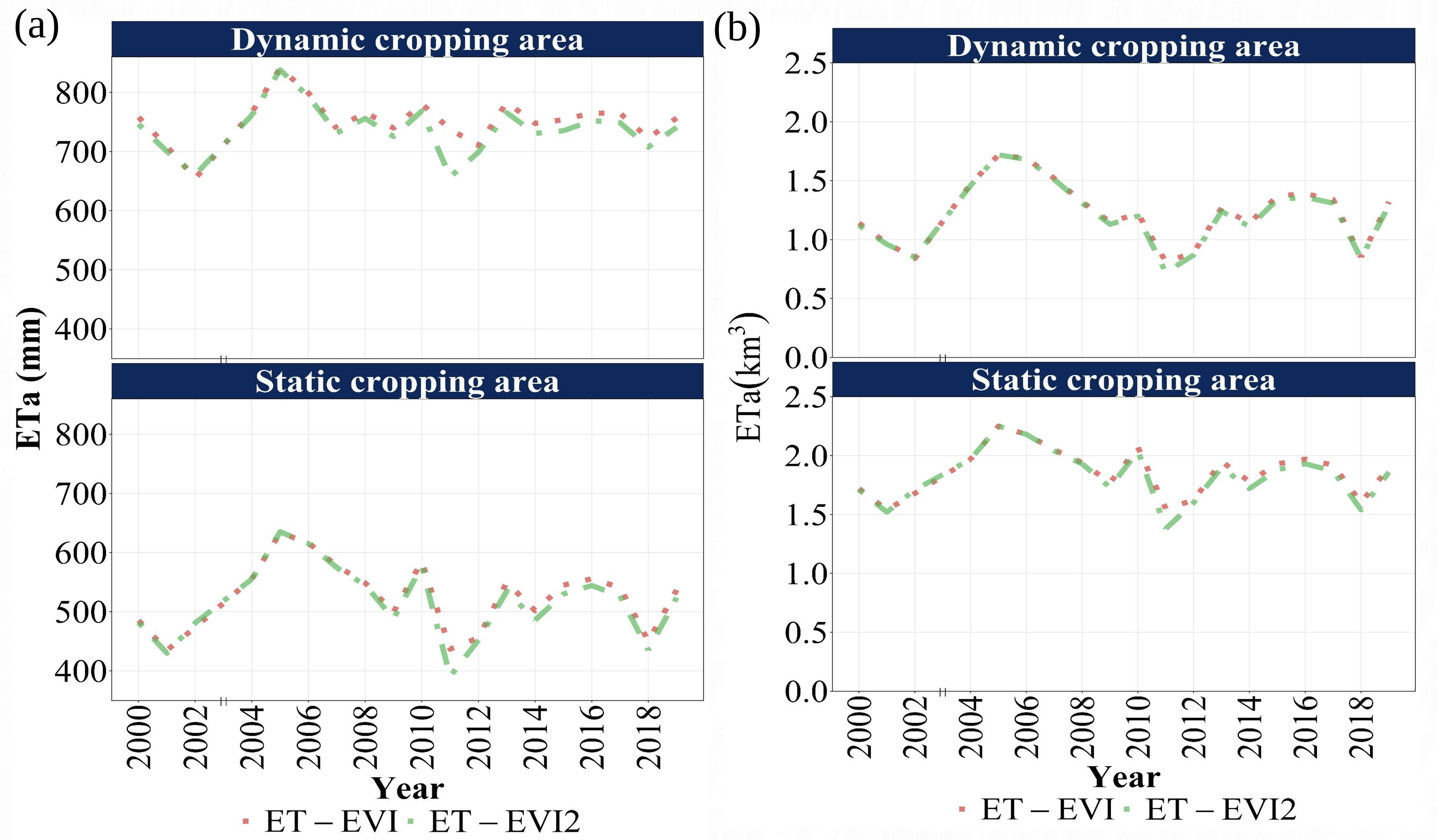




Figure 5a) ET-VIs' estimates changes in mm considering the static and dynamic harvested area, 5b) Volume of ET-VIs' estimates changes in Km[3] considering the static and dynamic harvested area.

## Conclusion

- ❖Incorporating both cropped areas and ETa rates is necessary for water management and drought monitoring of croplands.
- ❖With the advantages of the GEE in big data processing and its high computational speed, RS-based ETa can be used as an efficient and quick tool, for understanding the Spatio-temporal variability of ETa across croplands of drylands.

1. Abbasi, Neda; Nouri, Hamideh; Didan, Kamel; Barreto-Muñoz, Armando; Chavoshi Borujeni, Sattar; Salemi, Hamidreza et al. (2021): Estimating Actual Evapotranspiration over Croplands Using Vegetation Index Methods and Dynamic Harvested Area. In Remote Sensing 13 (24), p. 5167. DOI: 10.3390/rs13245167.
2. Nagler, Pamela; Glenn, Edward; Nguyen, Uyen; Scott, Russell; Doody, Tanya (2013): Estimating Riparian and Agricultural Actual Evapotranspiration by Reference Evapotranspiration and MODIS Enhanced Vegetation Index. In Remote Sensing 5 (8), pp. 3849–3871. DOI: 10.3390/rs5083849.
3. Meza, I.; Eyshi Rezaei, E.; Siebert, S.; Ghazaryan, G.; Nouri, H.; Dubovyk, O.; Gerdener, H.; Herbert, C.; Kusche, J.; Popat, E.; et al. Drought risk for agricultural systems in South Africa: Drivers, spatial patterns, and implications for drought risk management. The Science of the total environment 2021, 799, 149505, doi:10.1016/j.scitotenv.2021.149505.

Contact: neda.abbasi@agr.uni-goettingen.de

Remotely-sensed evapotranspiration (RS-ET), EGU General Assembly 2022, Vienna, Austria & Online | 23–27 May 2022