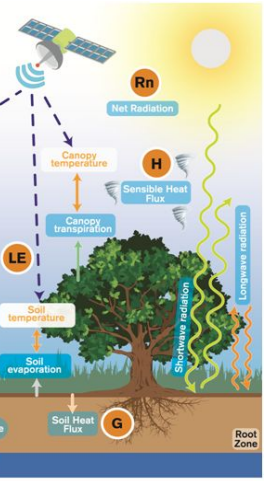
EGU-6608

WHY?

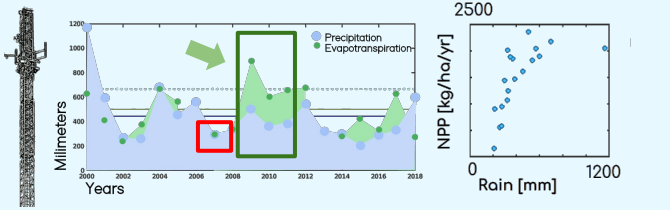
Savanna vegetation in the face of DROUGHT



Energy Balance
Rn = LE + H + G

WHERE?

WHEN?



HOW?

Drought in semiarid mosaic lands

TACTIC

EO AFRICA

DFH

Drought monitoring over the Kruger National Park

Dube, T., Ramoelo, A., Shoko, C., Dominic, M., Gonzalez-Dugo, M. P., Nieto, H., and Andreu, A.

Drought monitoring over the Kruger National Park (2000-2020) integrating remote sensing data.

TACTIC: DroughT impACt on the vegeTation of South African semIarid mosaiC landscapes.

Timothy Dube
Abel Ramoelo
Cletah Shoko
Mazvimavi Dominic
Maria P. Gonzalez-Dugo
Hector Nieto
Ana Andreu

Drought in semiarid mosaic lands TACTIC

GOBACK

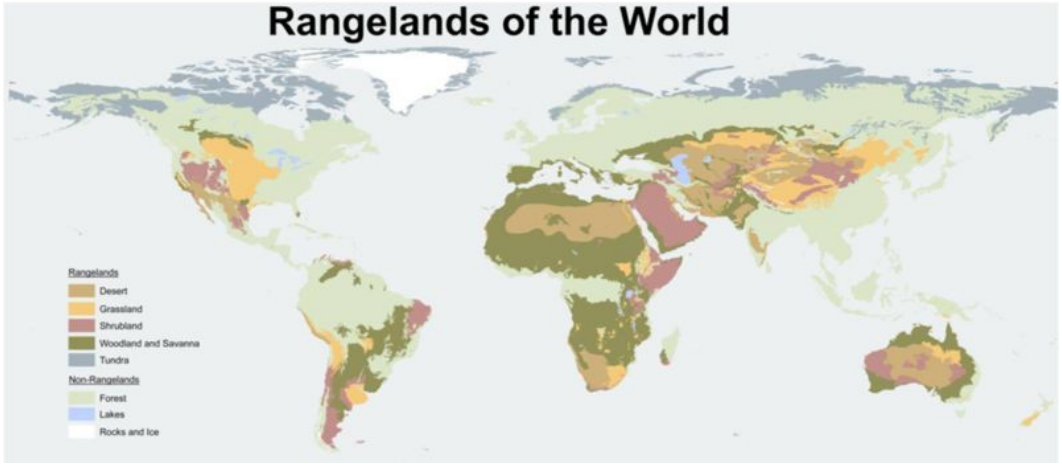
WHY?

GoBack

African semiarid **rangelands** are a **mosaic of land uses**, where extensive **livestock** is the main economic activity.

They are highly controlled by the availability of water.

From A. Andreu. Savanna Tiger Guide.



From University of Idaho. Wikimedia Commons

Why?

GoBack

The increase in **drought intensity**, duration, and frequency, changes in agricultural practices, and other socioeconomic and environmental factors precipitate their degradation.

WHY?

GOBACK

Mapping **water consumption** and **primary production** of **semiarid mosaic crop-rangelands** at the optimal spatiotemporal scales, setting up an open-source cloud framework to monitor these processes' **interaction** in the long term and analyze s**ystem tipping points**.

1) Which are the **optimal spatiotemporal scales** when monitoring semiarid mosaic **vegetation cover, actual ET**, and **biomass**?

2) What is the evolution of these variables and their **anomalies**?

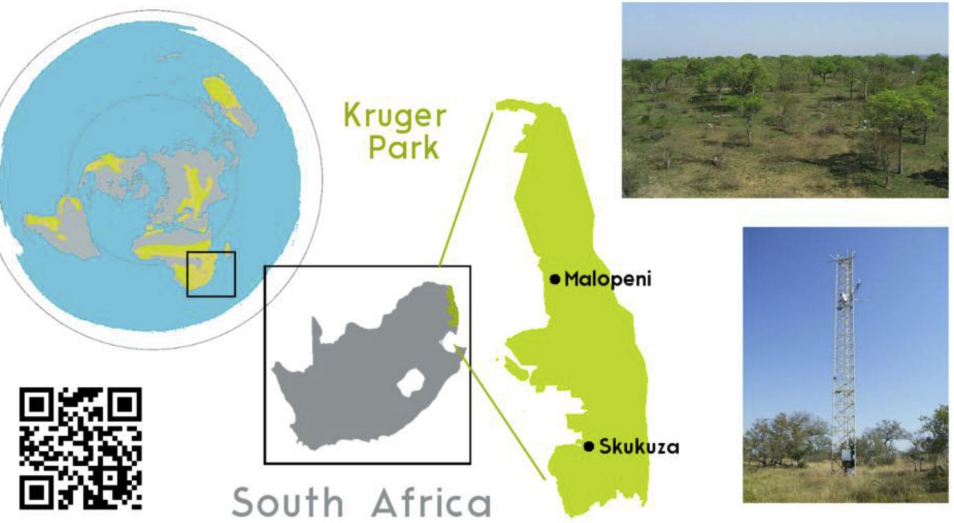
3) What **impact drought** events have?

4) The implementation of this monitoring framework as an **open-source tool** for **long term** analysis.

Where?

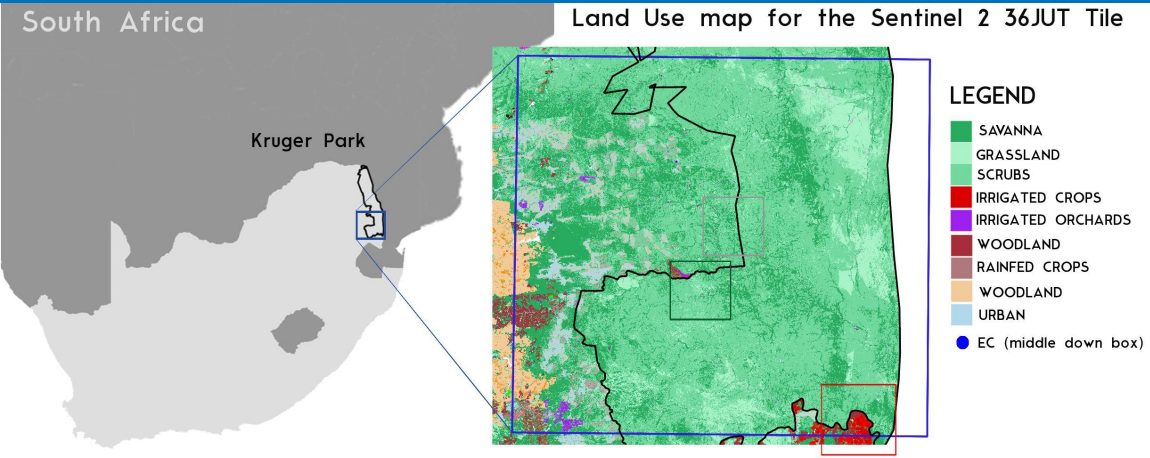
GoBack

Our **pilot area** is located in the Limpopo region, with great agricultural importance but subject to periodic droughts, and home of the **Kruger National Park**.



WHERE?

GoBack



HUNTING RESERVE AREA - RGB S2

SKUKUZA AREA - RGB S2

CROP AREA - RGB S2

How?

GoBack

1. Assessing water consumption and vegetation water stress
    1. Adaptation of the Kc-FAO 56 crop-coefficient method (Allen et al., 1998, Carpintero et al., 2020)
    2. Two Source Energy Balance model (Kustas and Norman, 1999) & STARFM (Gao et al., 2006)
    3. Ratio ET/ETo anomalies

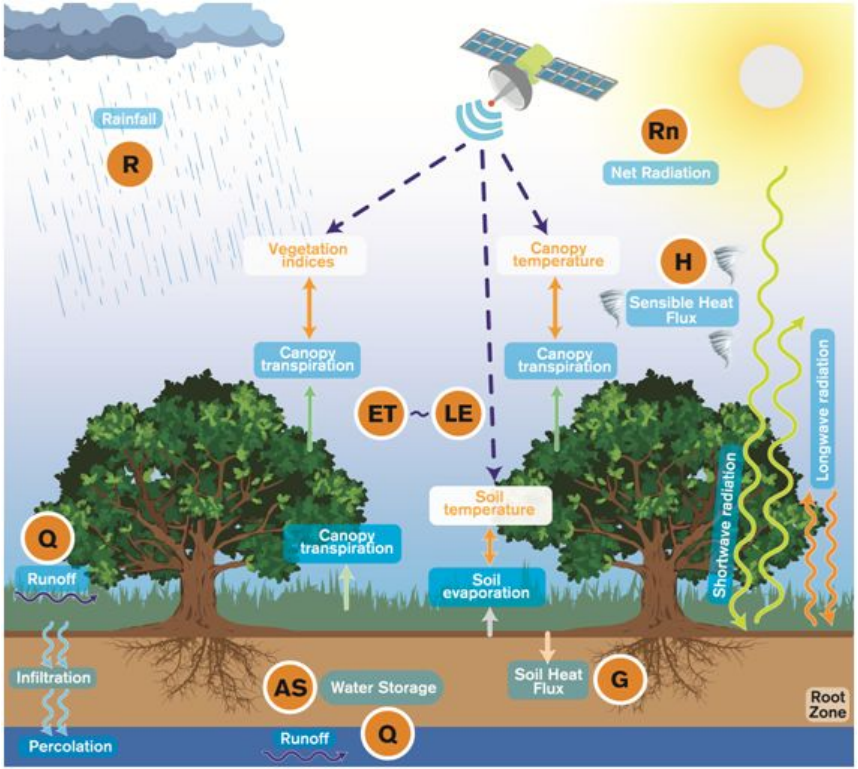
2. Assessing biomass production (Light Use Efficiency model). (Monteith et al., 1997, Gomez-Giraldez et al., 2019)

3. Assessment of the drought impact on grass/crop production (Gonzalez-Dugo et al., 2021)

Components of the **water** and **energy** budgets

GoBack

Kc-FAO56 approach



Water Balance
R = ET + Q + AS

Energy Balance
Rn = LE + H + G

TSEB model

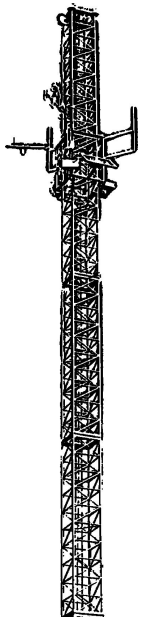
HOW?

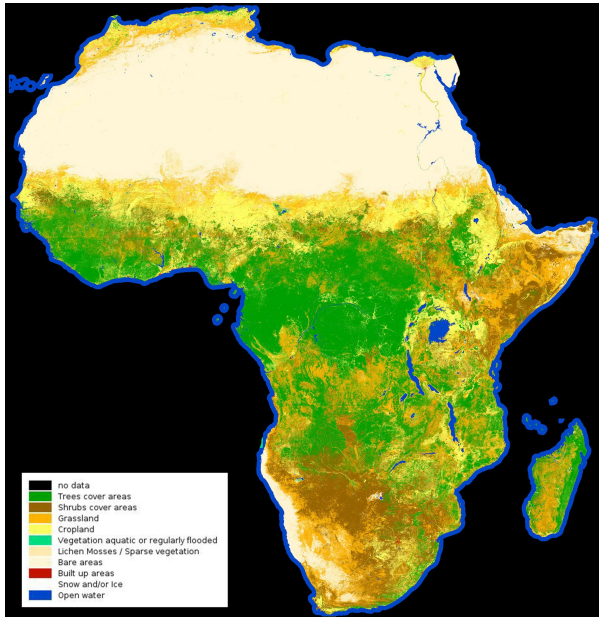
GoBack

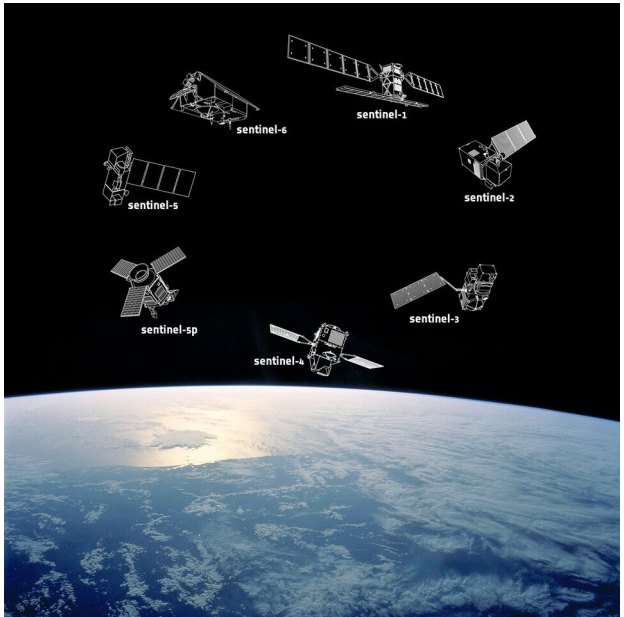
Remote Data from **Sentinel 2 and Sentinel 3 missions**. **MODIS** and Landsat and, if possible ECOSTRESS. Other input data will be obtained from land cover maps.

We validate with **eddy towers** and field data.

- 1st TEST: Meteo data from a Skukuza Savanna Fluxnet tower.
- 2nd TEST: Meteo data from ECMWF ERA5 data.





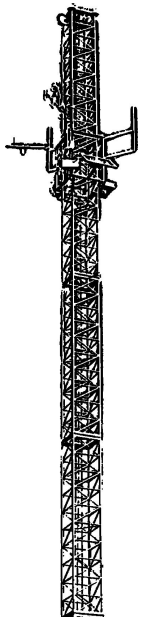


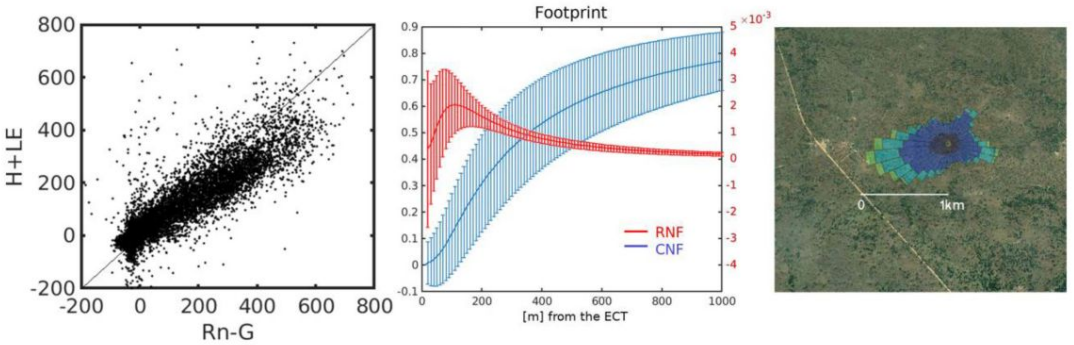
Algorithms & DATA for now * in red now tasks

- **pyTSEB** GitHub - hectornieto/pyTSEB **-- validated Andreu et al., 2019 & ~Burchard et al., 2021.**
  - MODIS (LST MOD11A1 & 8D composite) & Fc (NDVI MODQ13)
  - Meteo Skukuza 2015-2018 // ECMWF ERA5 Reanalysis
- **Kc-FAO56** Matlab -- in R
  - Test with preliminary Meteo & we need Soil data
    - Sentinel 2 (2016)
  - Vegetation Index
    - Modis
    - Sentinel 2
    - Landsat
- **LUE model** -- validation with tower & field campaign
  - Relation for savanna grassland & generic crops
  - GitHub -Ablazcar & MJOSEMUGO
    - Modis
    - Sentinel 2

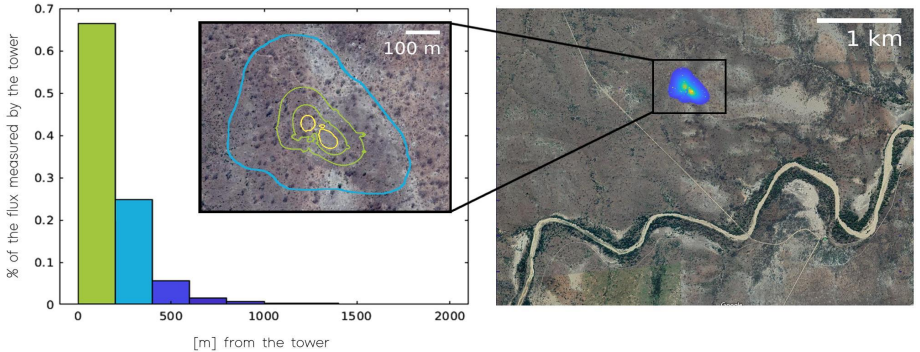
RESULTS› FOOTPRINT

GoBack



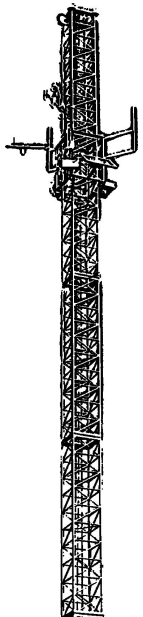


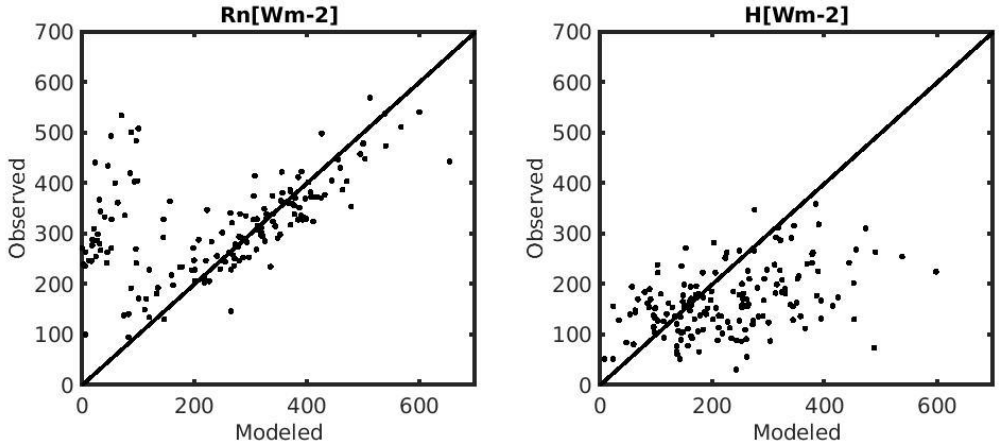
a) b) c)

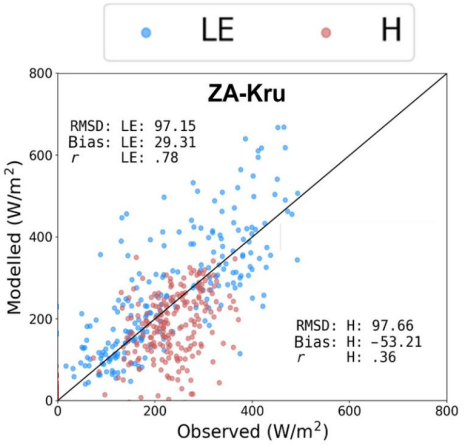


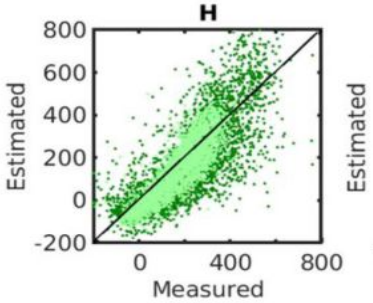
RESULTS› VALIDATION

GoBack









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Physics and Chemistry of the Earth

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Remote sensing of water use and water stress in the African savanna ecosystem at local scale – Development and validation of a monitoring tool

Ana Andreu[a,b,g,*], Timothy Dube[c], Hector Nieto[d], Azwitamisi E. Mudau[e], María P. González-Dugo[a], Radoslaw Guzinski[f], Stephan Hülsmann[g]

Global Change Biology

PRIMARY RESEARCH ARTICLE

A remote sensing-based three-source energy balance model to improve global estimations of evapotranspiration in semi-arid tree-grass ecosystems

Vicente Burchard-Levine, Héctor Nieto, David Riaño, William P. Kustas, Mirco Migliavacca, Tarek S. El-Madany, Jacob A. Nelson, Ana Andreu, Arnaud Carrara, Jason Beringer ... See all authors

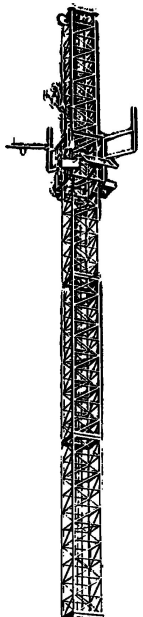
First published: 19 November 2021 | https://doi.org/10.1111/gcb.16002 | Citations: 4

RESULTS› SKUKUZA EDDY FLUX TOWER

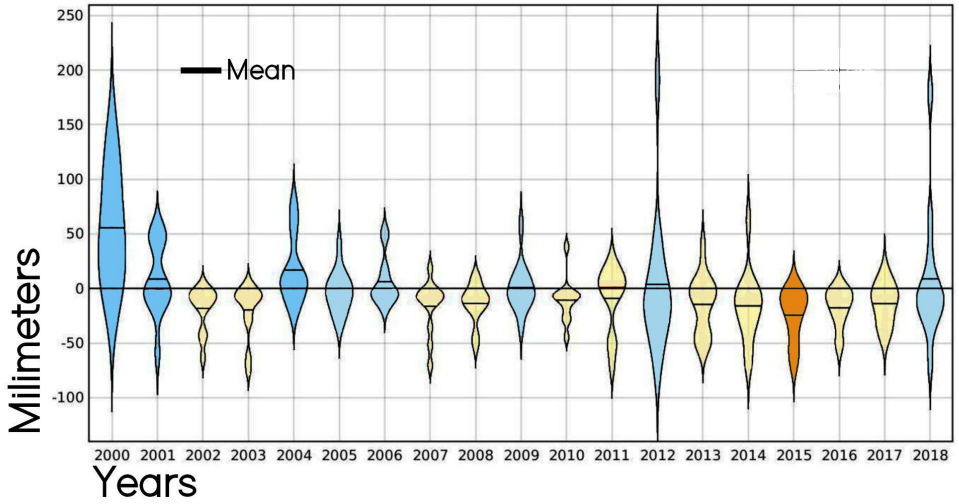
GOBACK

During 2015 and 2016, SA savannas were subjected to a severe drought, associated with a strong El Niño Southern Oscillation (ENSO) event, one of the three most severe on record. El Niño events have a negative correlation with the precipitation during southern Africa wet season, and water scarcity conditions prevailed in large parts of southern Africa during 2014-2016.

To avoid gaps for the 2013-2018 period precipitation was obtained from the data reported by the Skukuza weather station managed by the South Africa Weather Service.



During this period the KNP lost thousands of wild animals as insufficient rain resulted in severe deterioration of the veld condition.

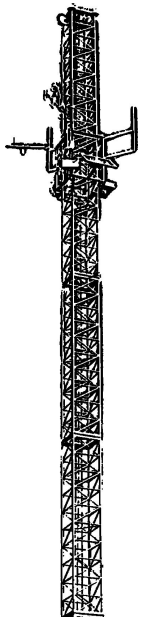


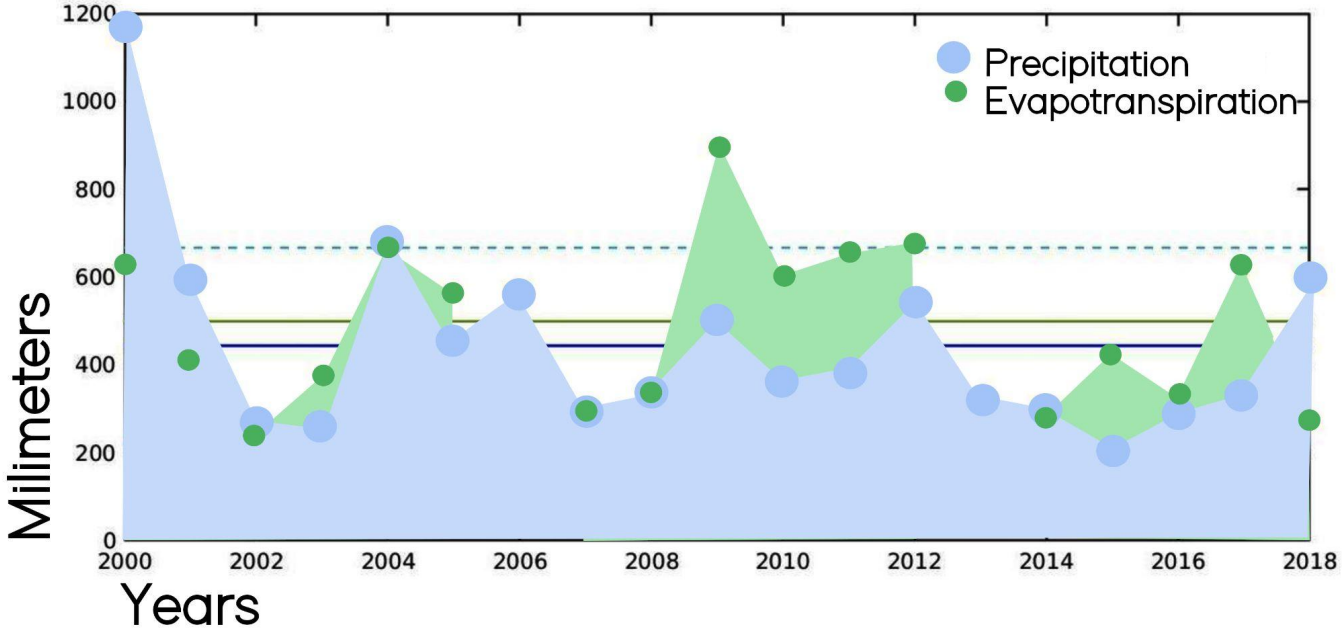
RESULTS› SKUKUZA EDDY FLUX TOWER

GOBACK

ET rates followed precipitation rates, although even the years with low precipitation rate can maintain total ET rates (groundwater).

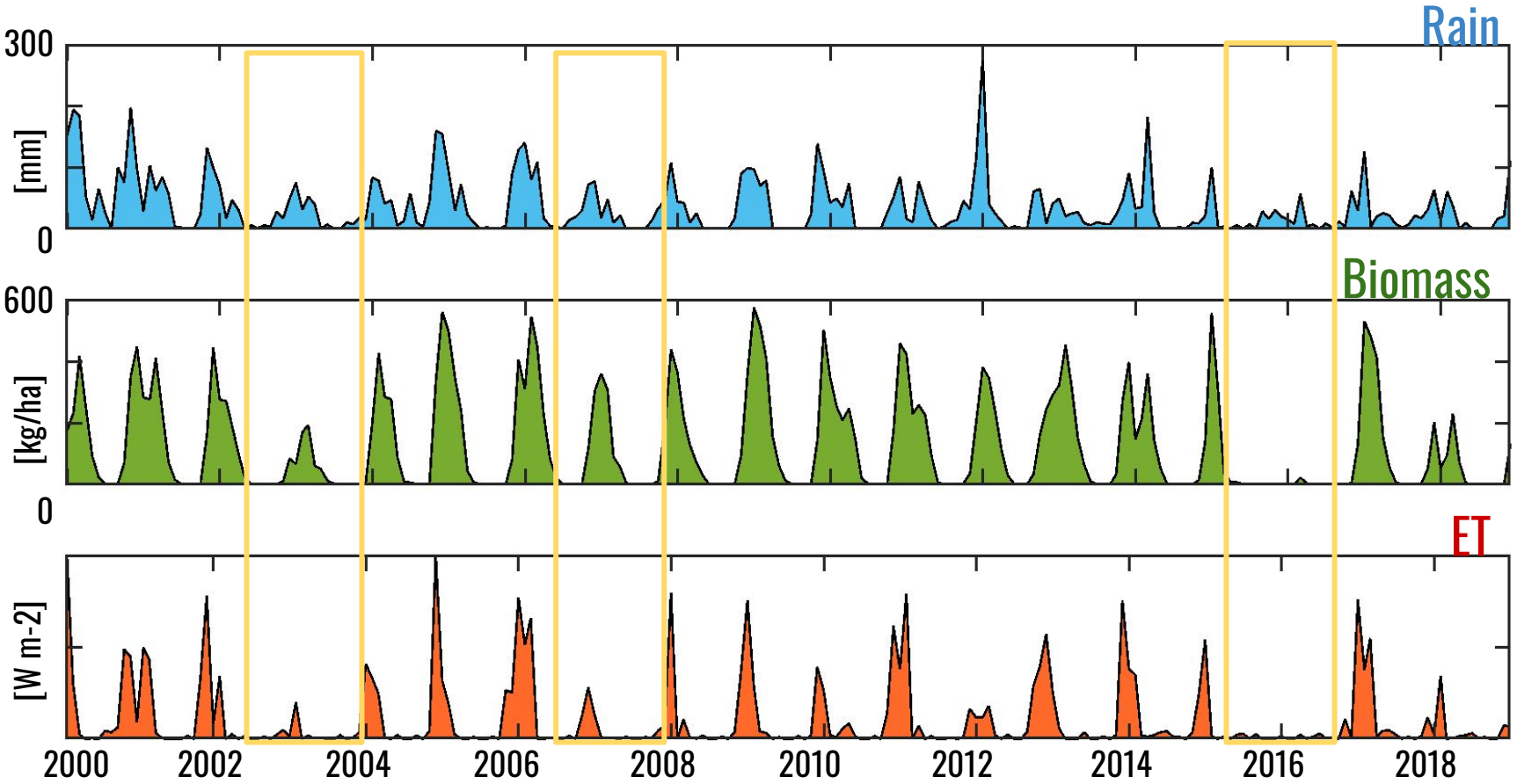
During e.g., 2004, 2009 or 2017, annual total ET rate was much higher than the usual rates (bloom of other species?).





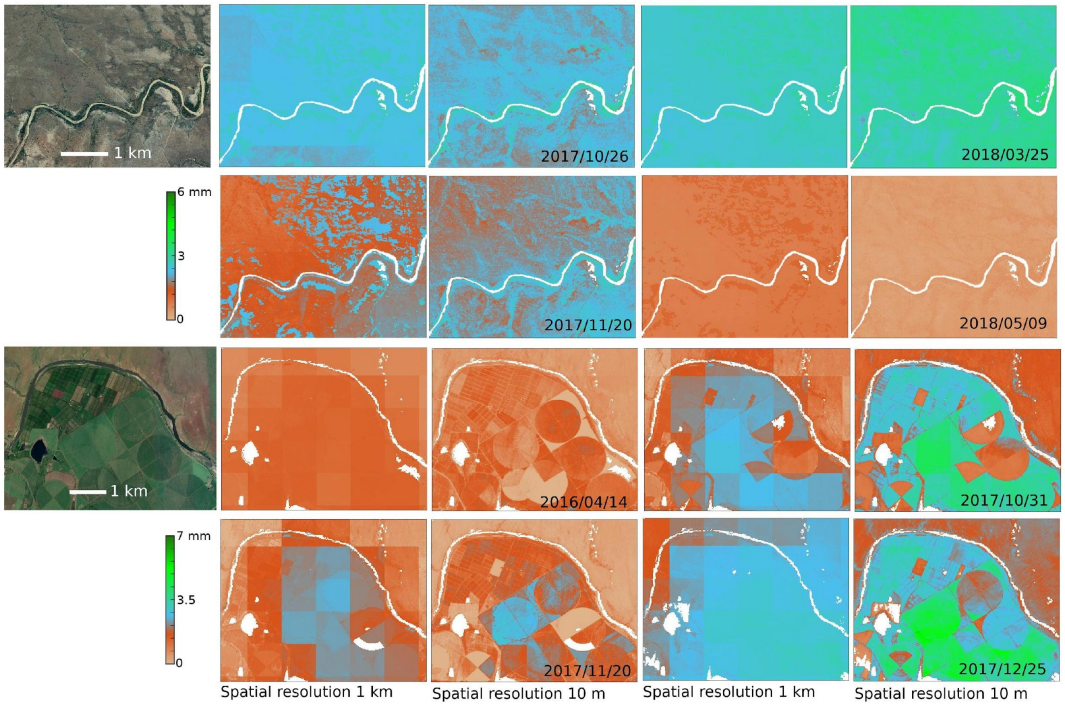
RESULTS› SKUKUZA TSEB

GOBACK



RESULTS› PRELIMINARY RESULTS WITH TSEB AND KC FAO

GoBack



RESULTS› SKUKUZA TSEB & LUE MODEL

GOBACK