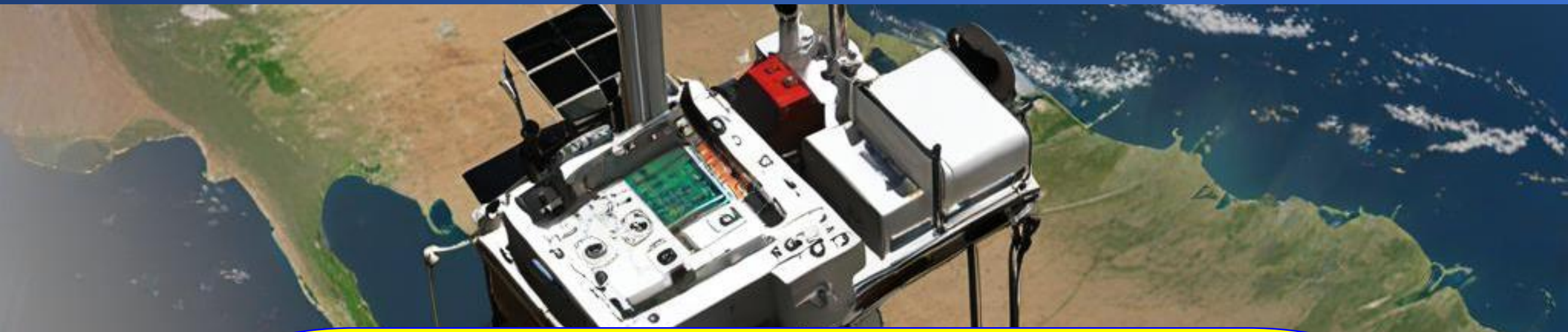
Mapping Meteorological Water Deficit Across Malawi Using Google Earth Engine And Cartographic Scripting



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Presentation Outline

1. Introduction
2. Research Goal
3. Approach
4. Selected Results
5. Conclusions

Introduction

Precipitation — The Amount Of Water Falling As Rain, Snow, Sleet, Or Hail

Water Deficit — Occurs When Precipitation Is Less Than The PET, Leading To A Shortage Of Water For Plants And Other Organisms

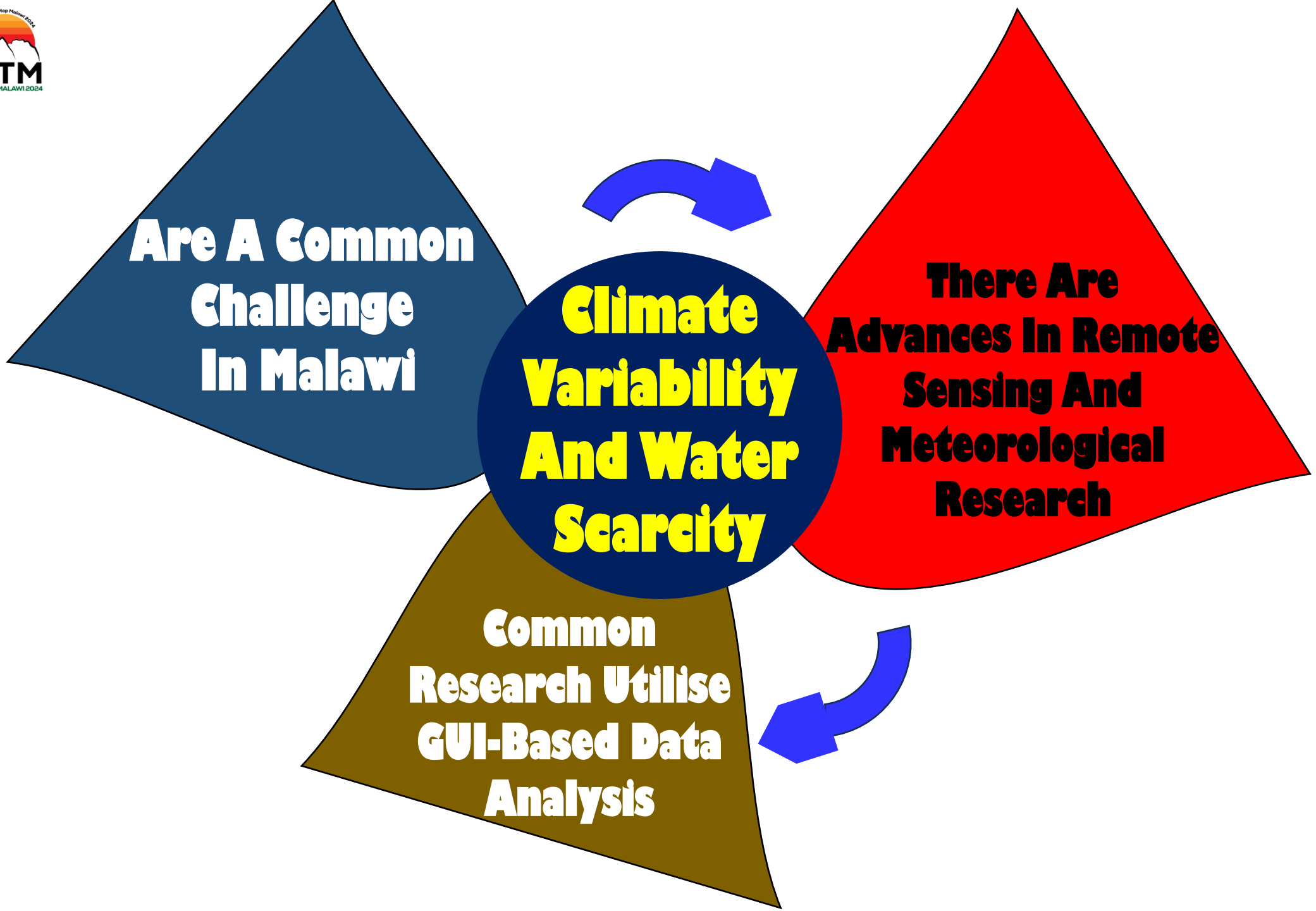
Meteorological Water Deficit Refers To A Situation Where The Precipitation In A Specific Area Is Less Than The Potential Evapotranspiration

Potential Evapotranspiration — The Amount Of Water That Could Be Evaporated Or Transpired By Plants If There Were No Limitation On Water Supply

Water Deficit = Potential Evapotranspiration − Precipitation

$$\begin{cases} \text{Water Deficit} > 0 & \text{indicates a } \textit{deficit} \\ \text{Water Deficit} < 0 & \text{indicates a } \textit{surplus} \end{cases}$$

Introduction



Research Goal

Map Meteorological Water Deficit In Malawi

1. Land Surface Temperature (LST)
2. Air Temperature
3. Precipitation
4. Evapotranspiration

Approach

Datasets

1. Moderate Resolution Imaging Spectroradiometer (MODIS)
2. Gridded Datasets

Note: Dataset Window – From 2013 to 2023 Were Utilised

Data Processing

1. Google Earth Engine
2. Cartographic Scripting

Approach

Datasets

1. Moderate Resolution Imaging Spectroradiometer (MODIS)
2. Gridded Datasets

Data Processing

1. Google Earth Engine
2. Cartographic Scripting

Note: Java And Bash Scripting

Selected Results

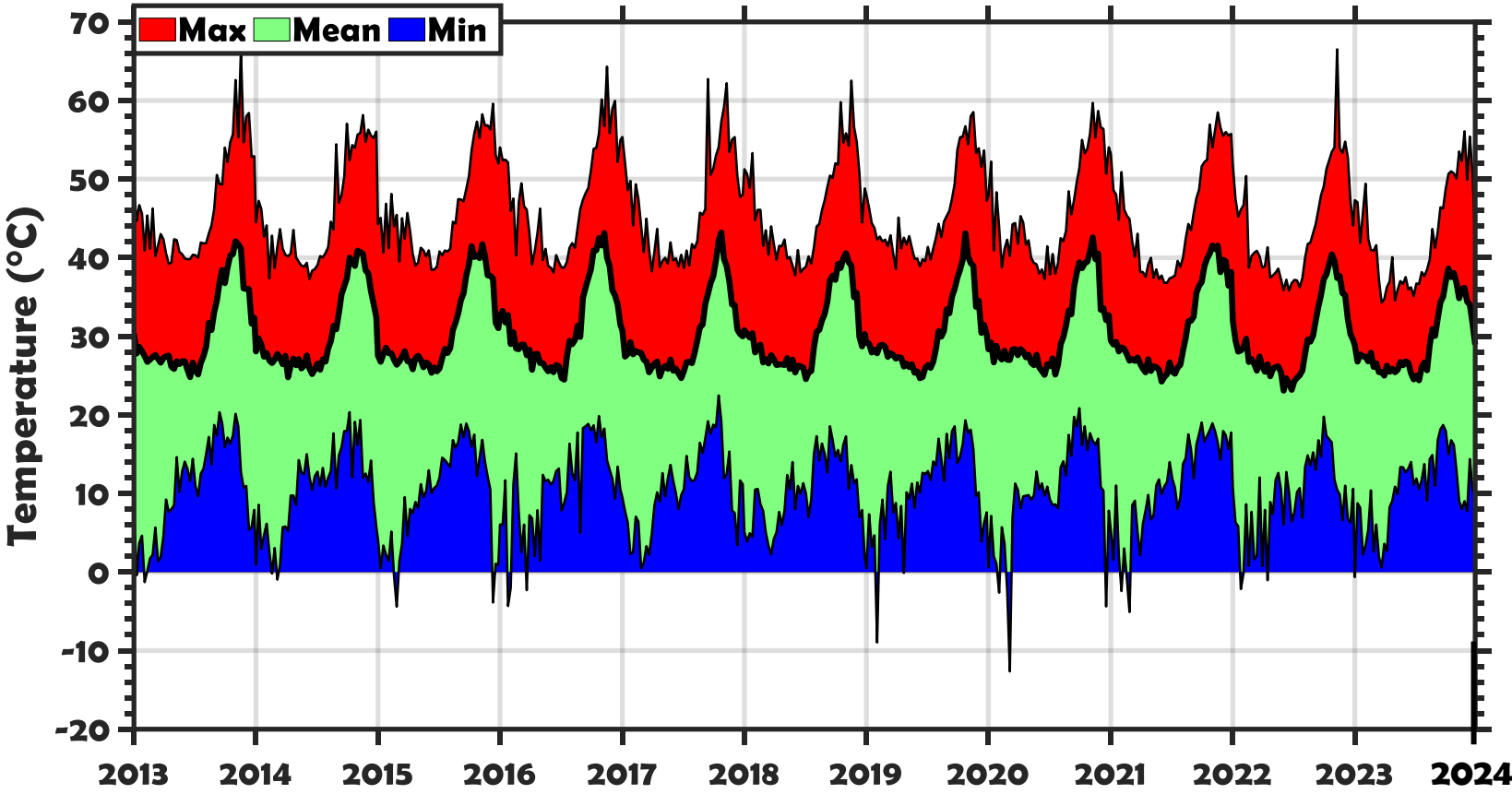
Land Surface Temperature Over Time

Statistics

45.64

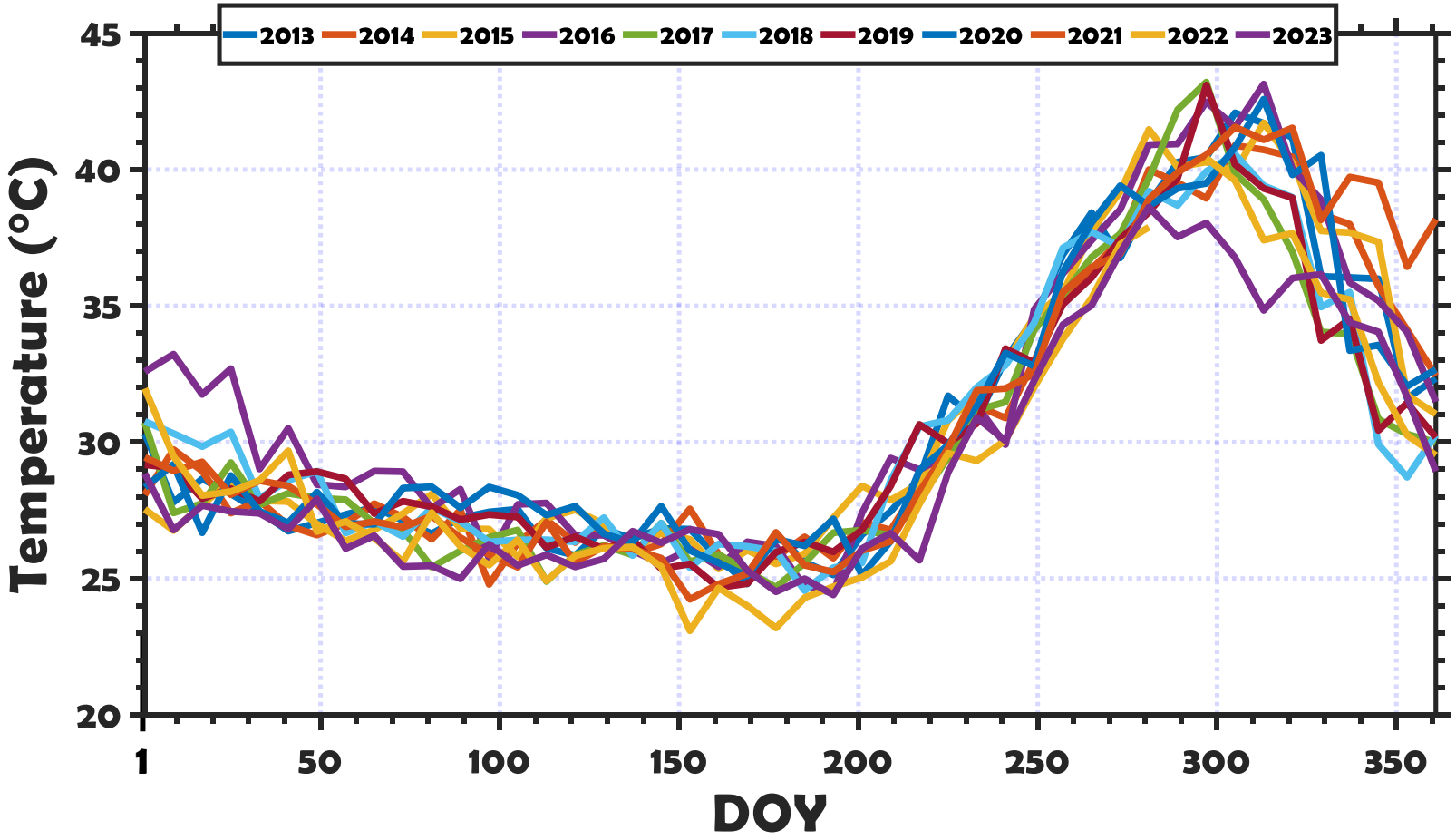
30.48

10.24



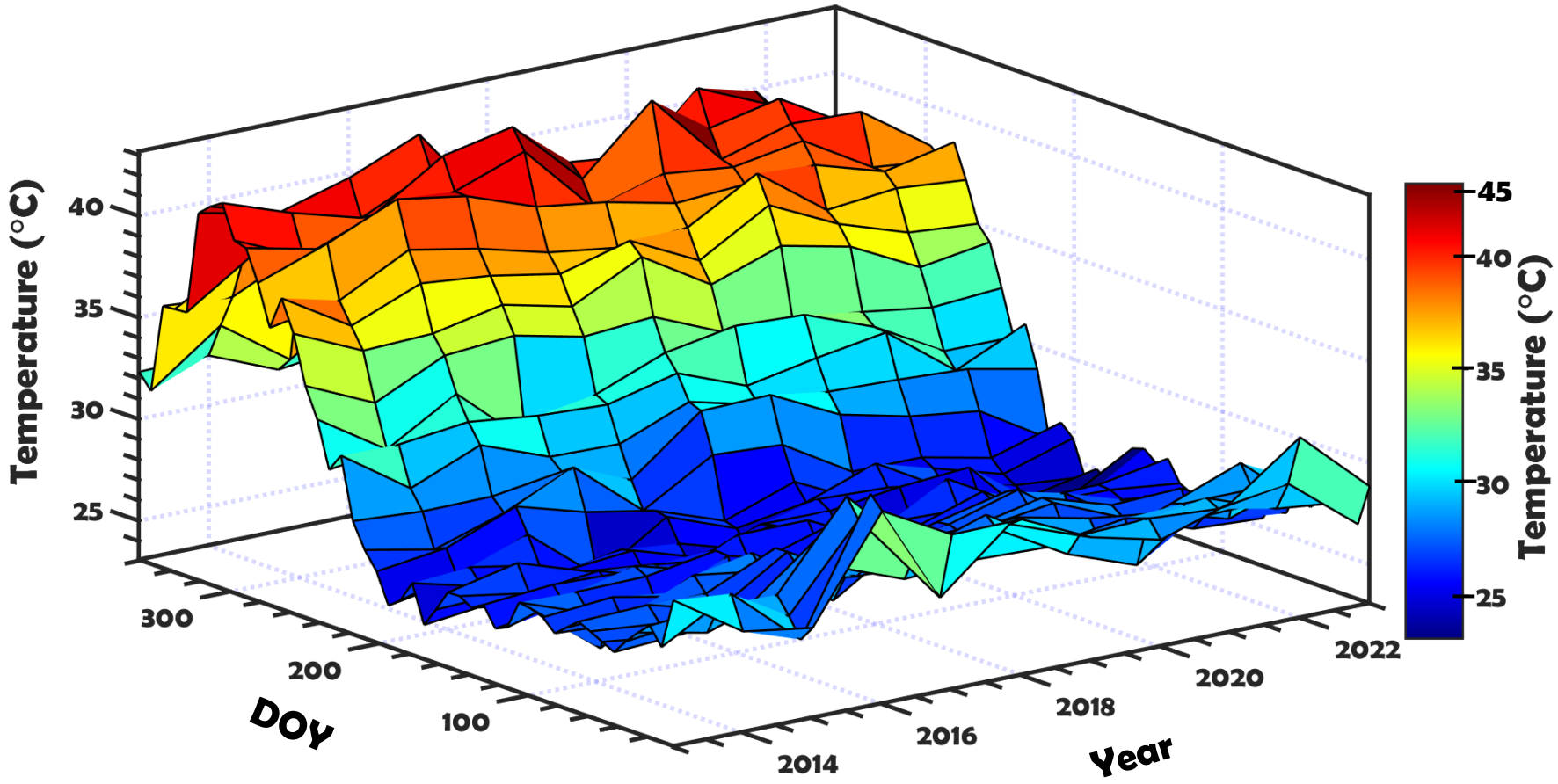
Land Surface Temperature Over Time

Selected Results



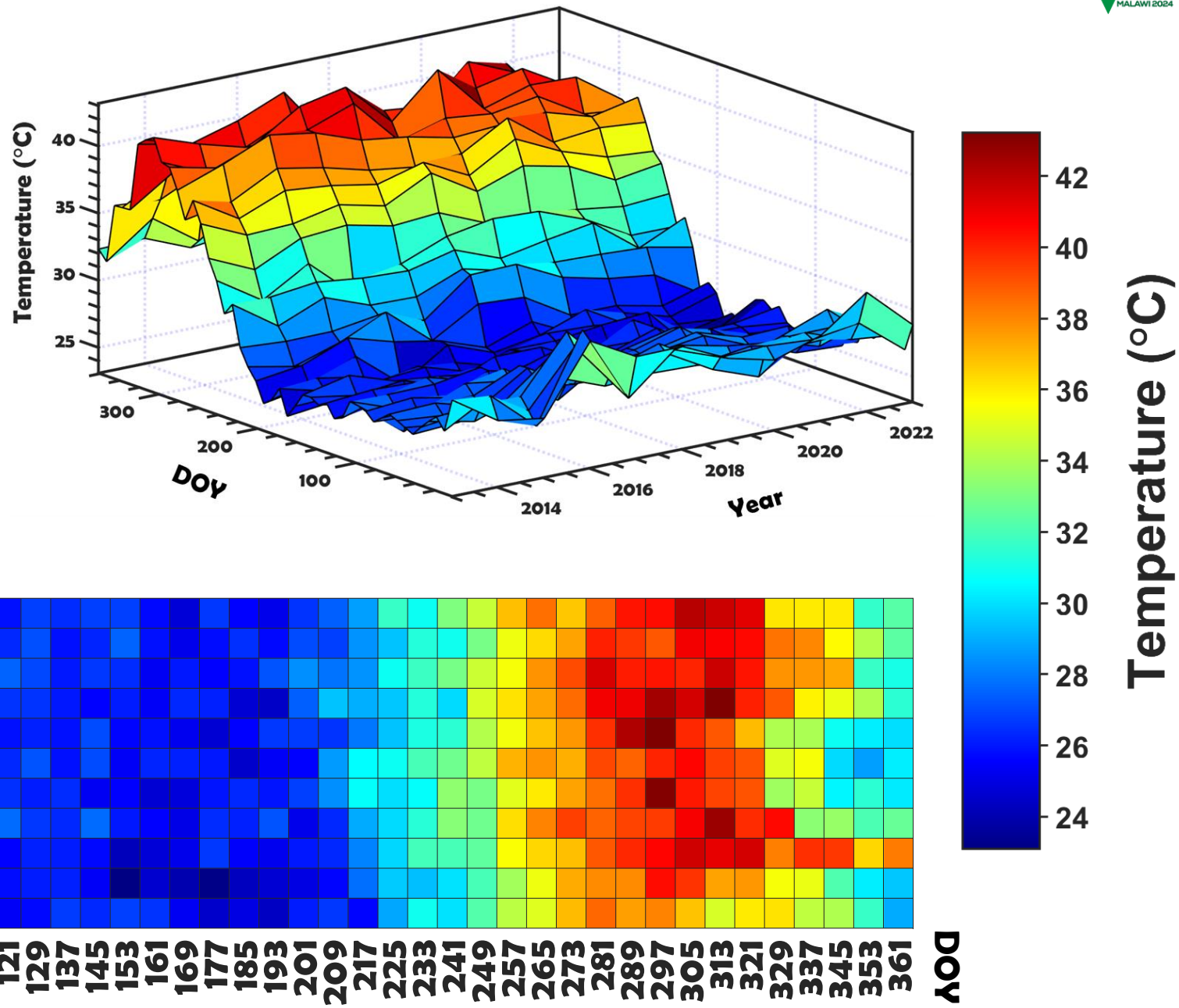
Selected Results

Land Surface Temperature Over Time



Land Surface Temperature Over Time

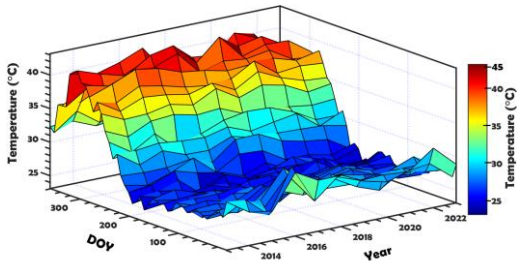
Selected Results



Noticeable Increase of LST — Dry Season

Selected Results

Noticeable Increase — Dry Season



There Is Less Moisture In The Soil And Vegetation

↓

Leading To Decreased Evaporative Cooling

↓

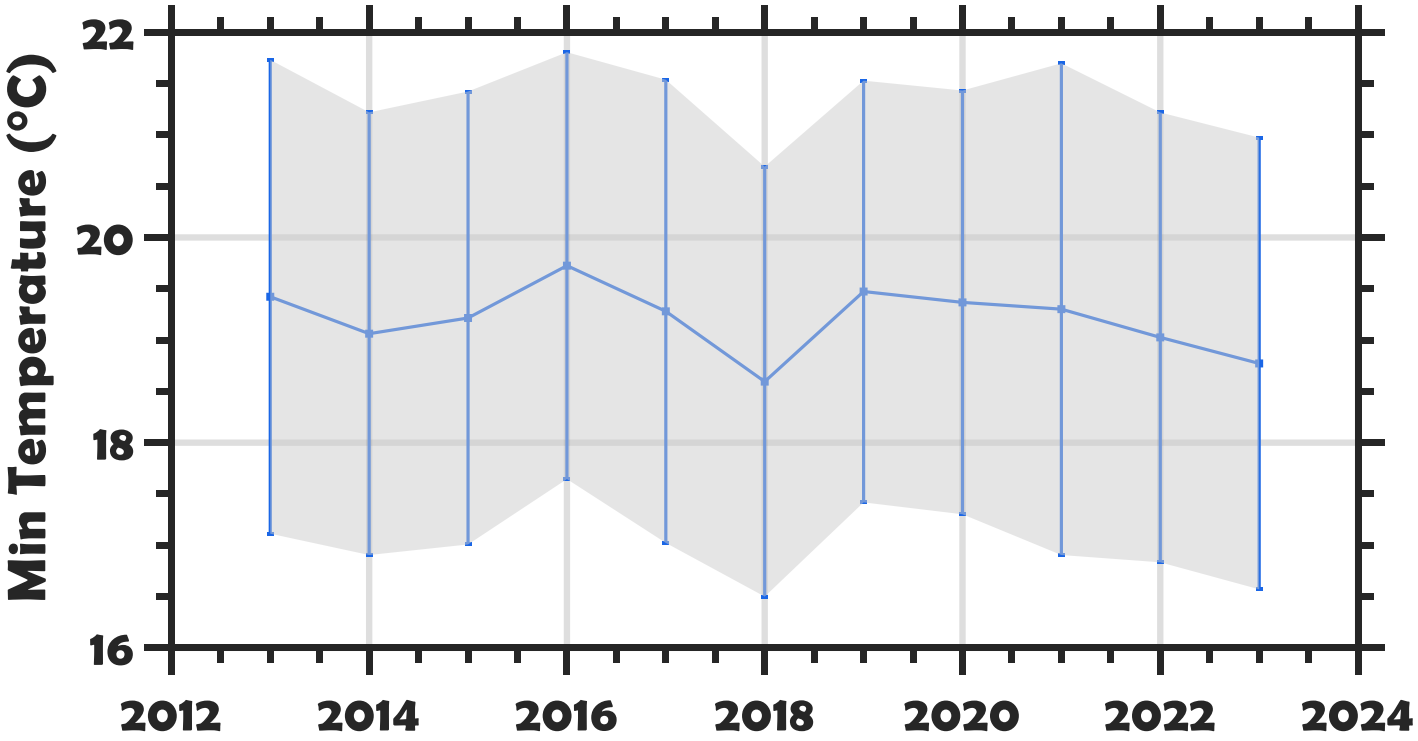
This Allows The Land Surface To Absorb More Solar Radiation

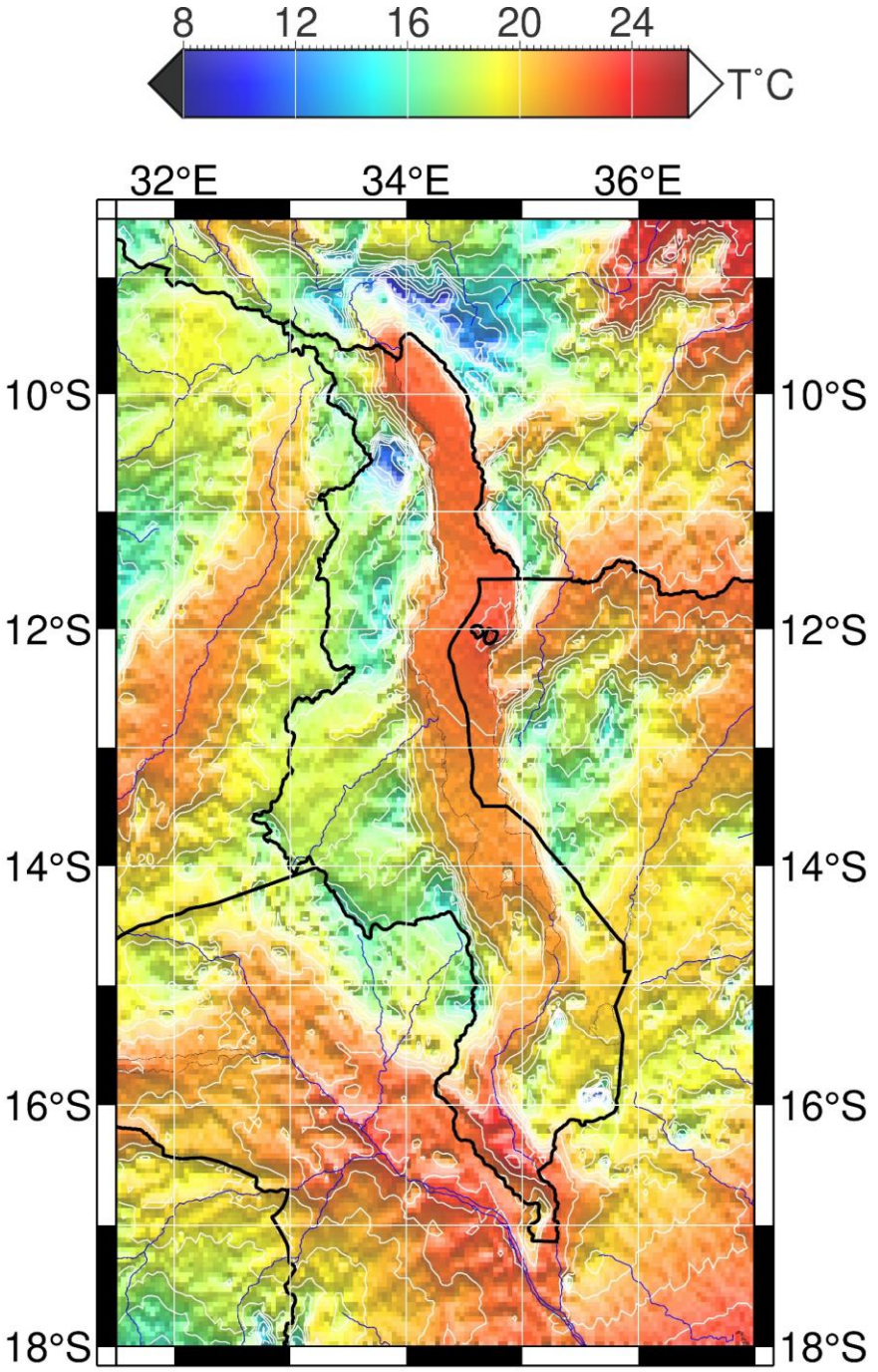
↓

Causing An Increase In Land Surface Temperature

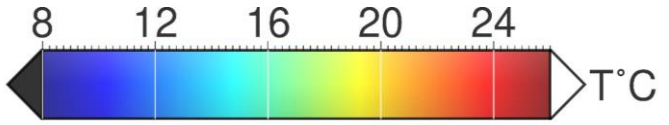
Min Temperature

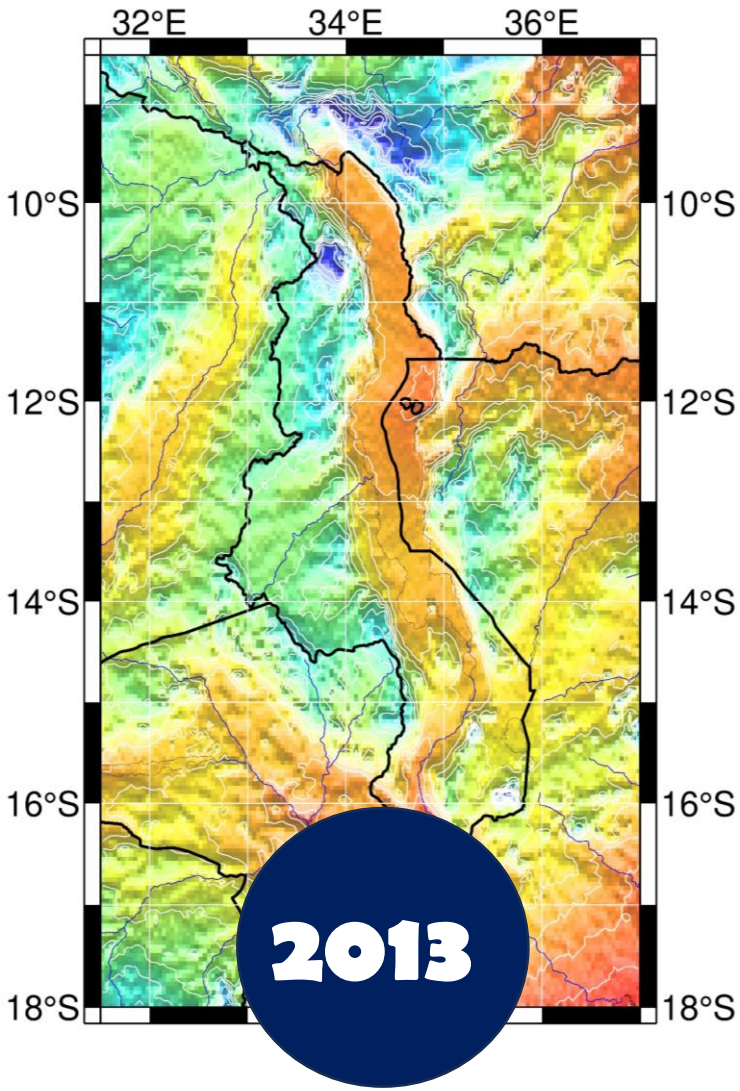
- Reference Year — 2016
  - Mean : 19.73
  - STD : 2.08

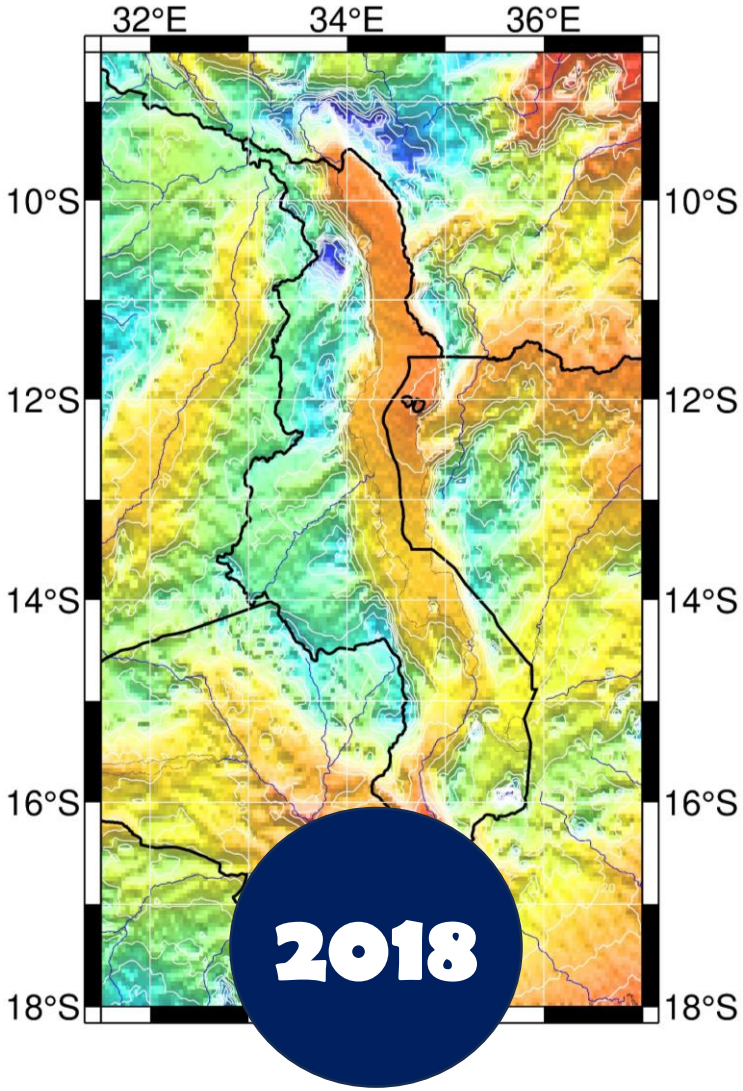


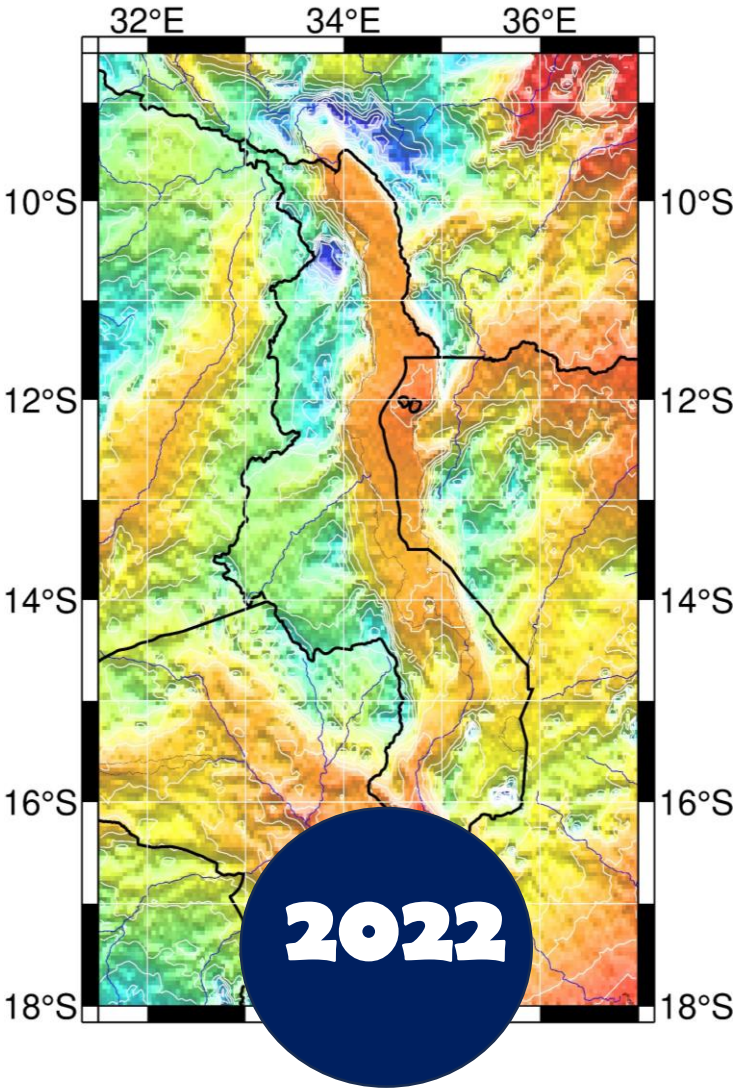


Min Temperature

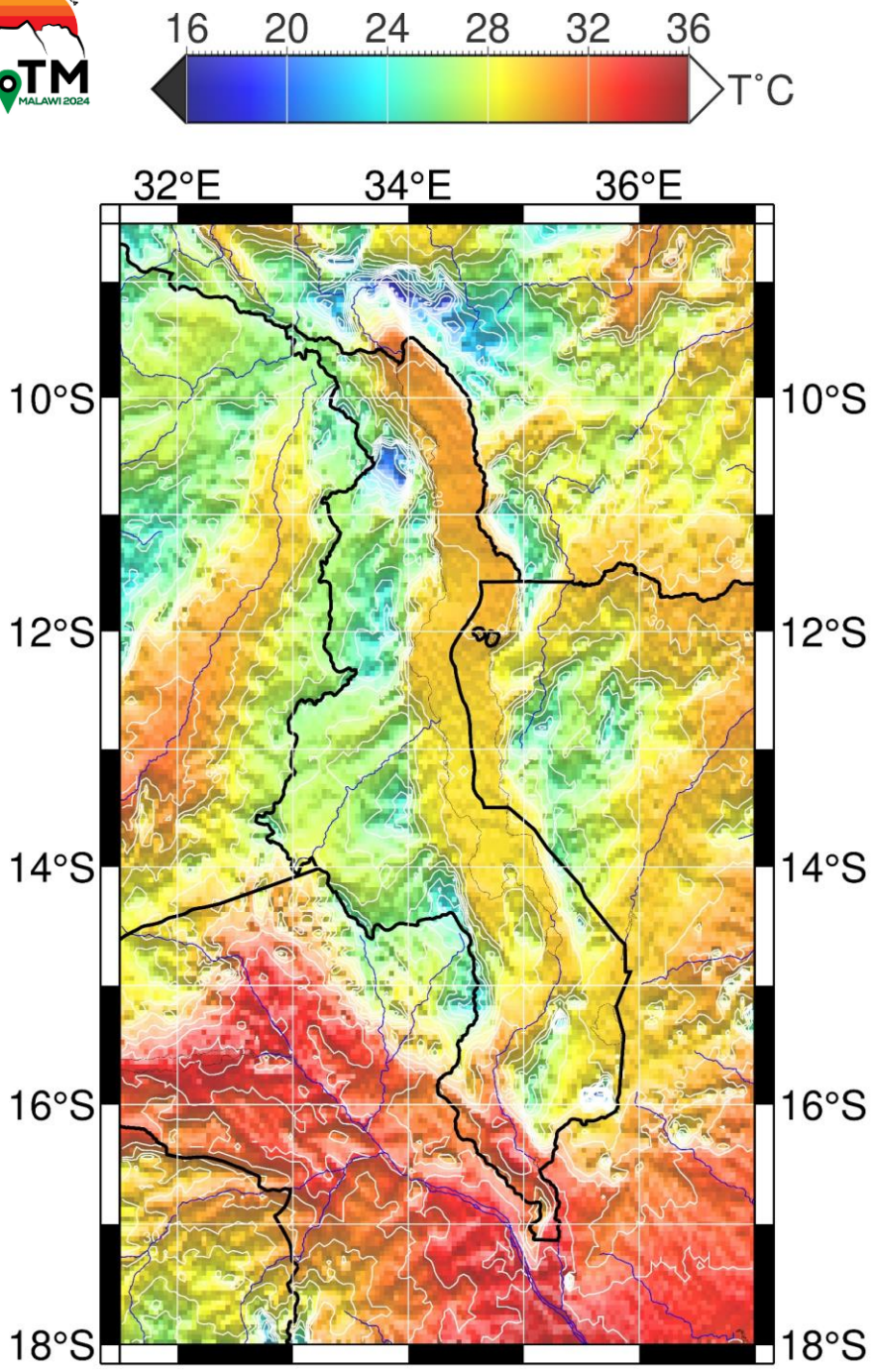






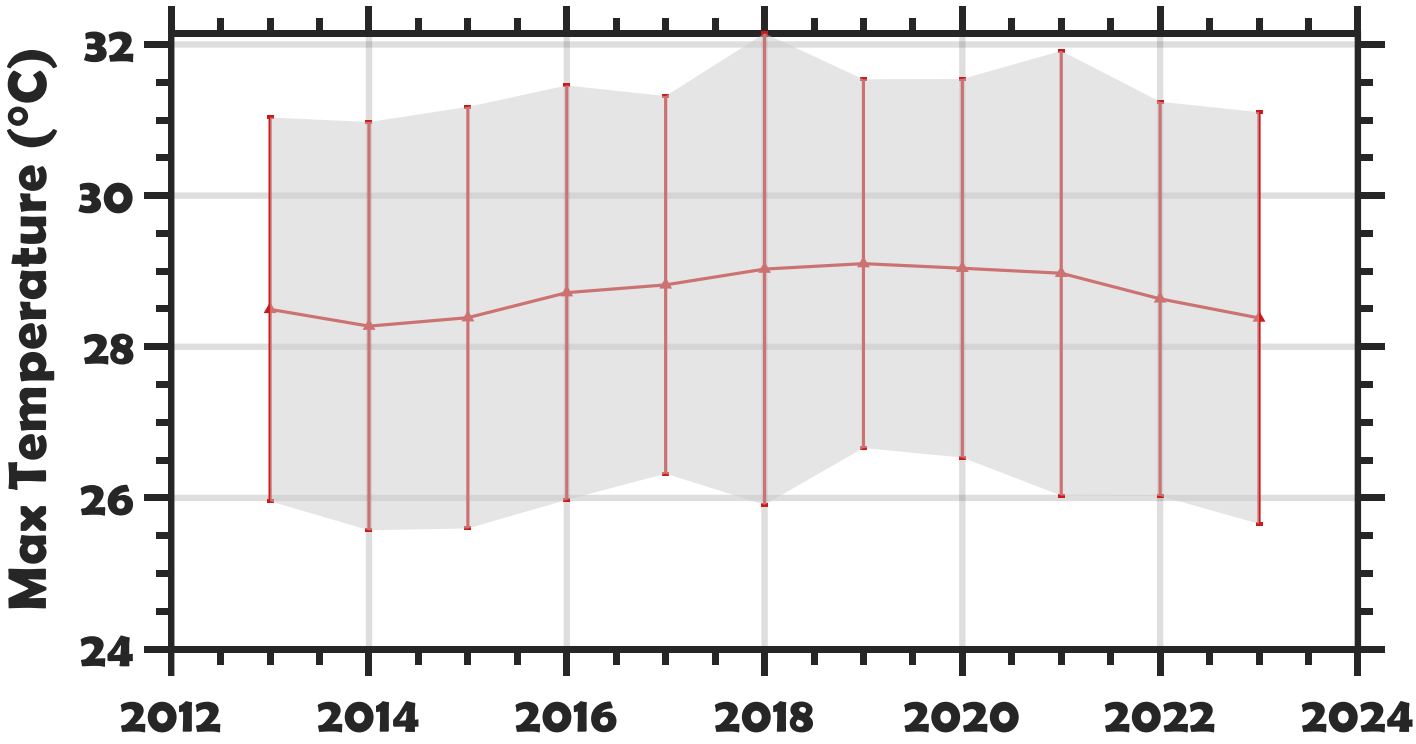


Max Temperature

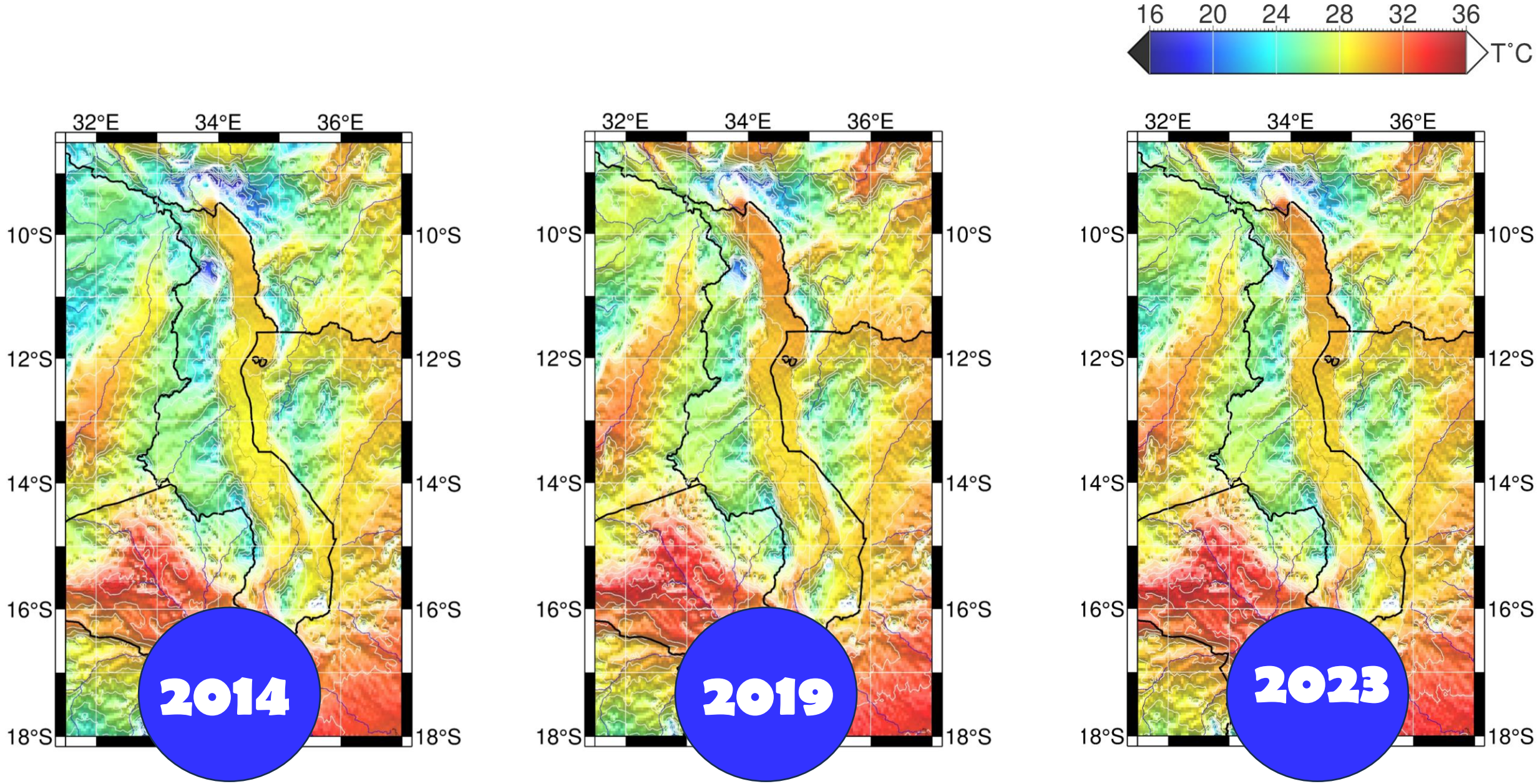


Reference Year — 2020

- Mean : 29.04
- STD : 2.51

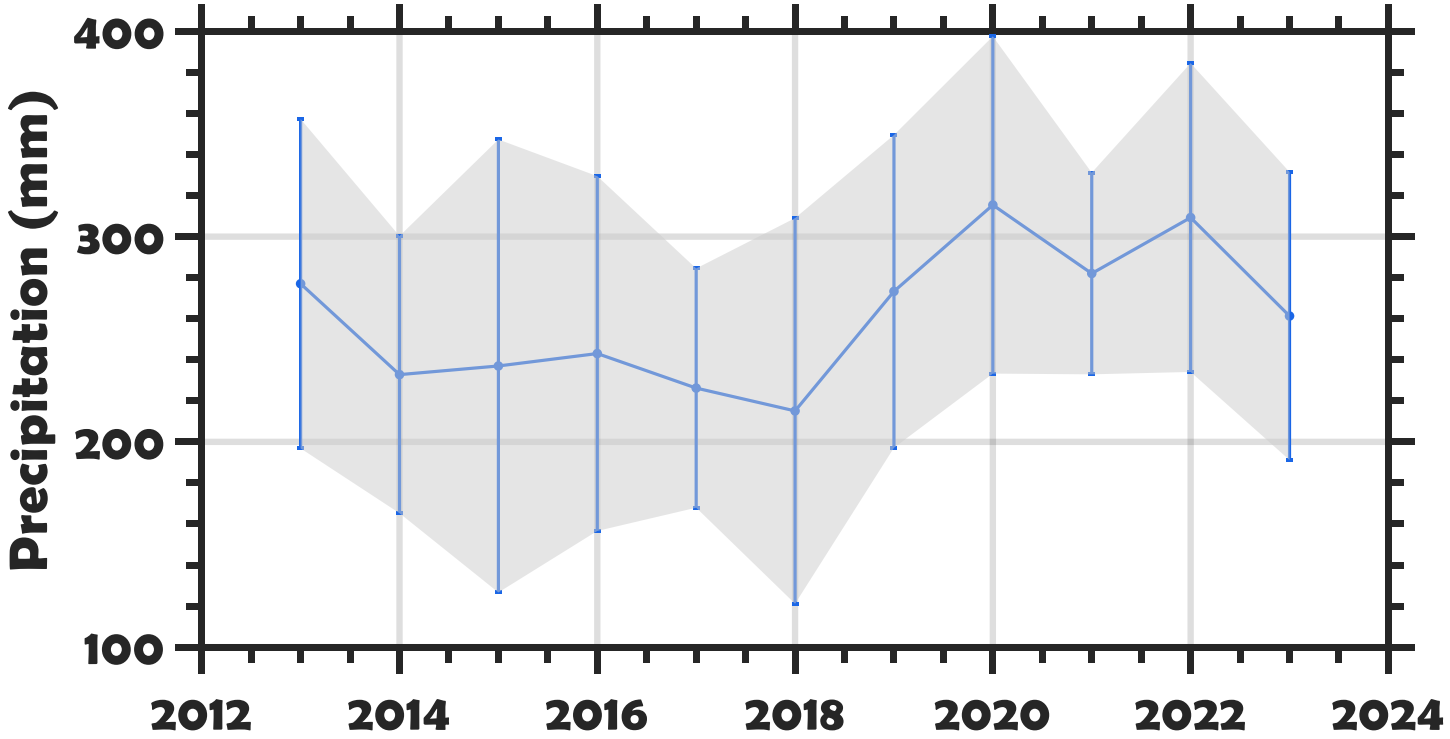


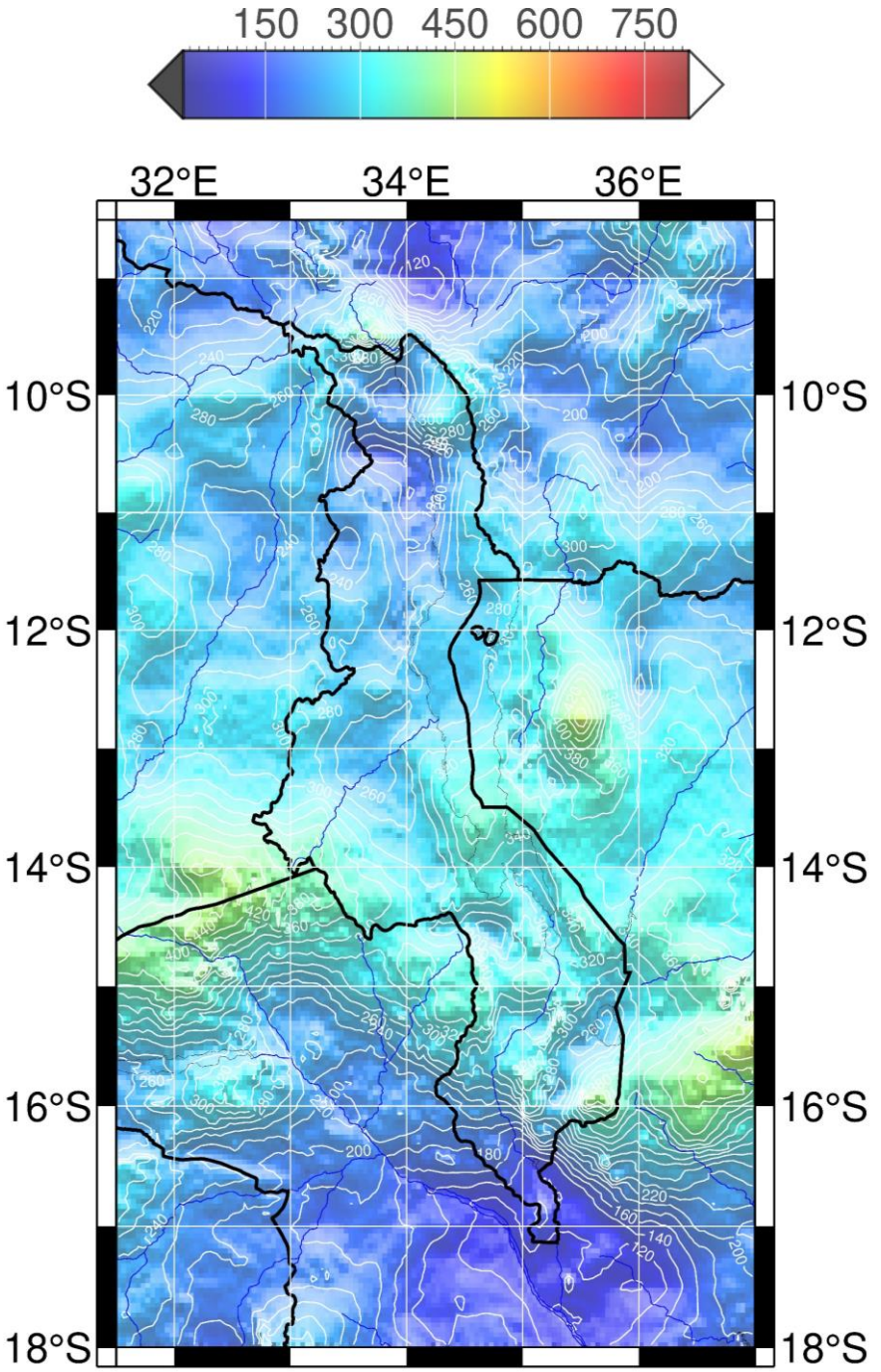
Max Temperature



Estimated Precipitation

- Reference Year — 2023
  - Mean : 261.32
  - STD : 70.13

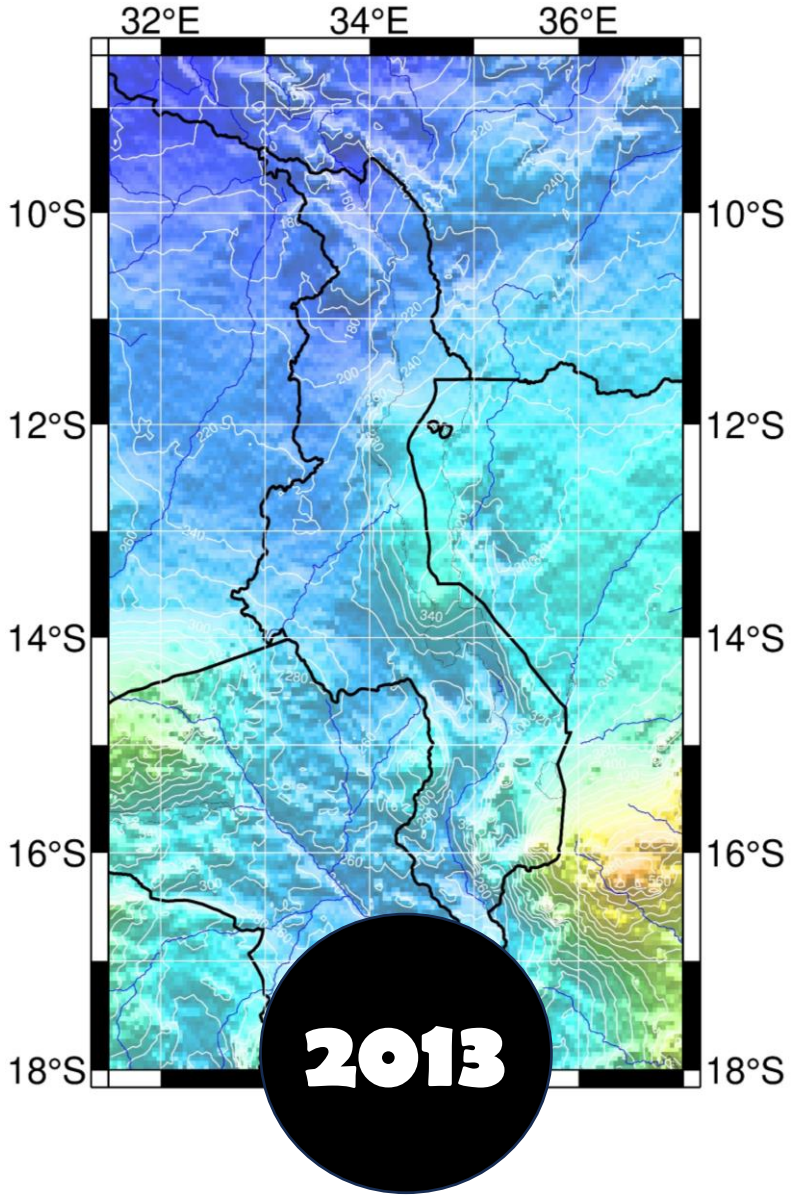


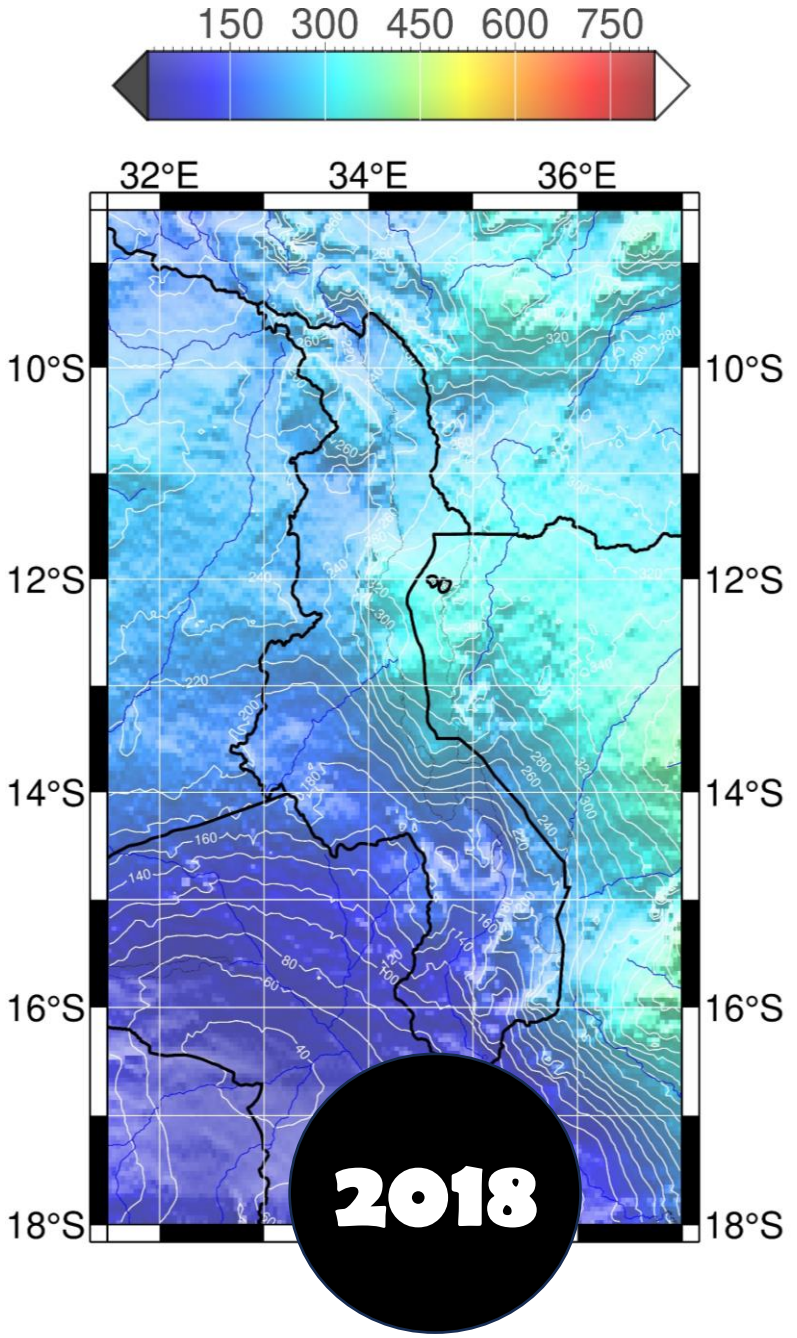


Estimated Precipitation

Year	2013
Minimum	122.30
Maximum	606.90
Mean	277.06
StdDev	80.24

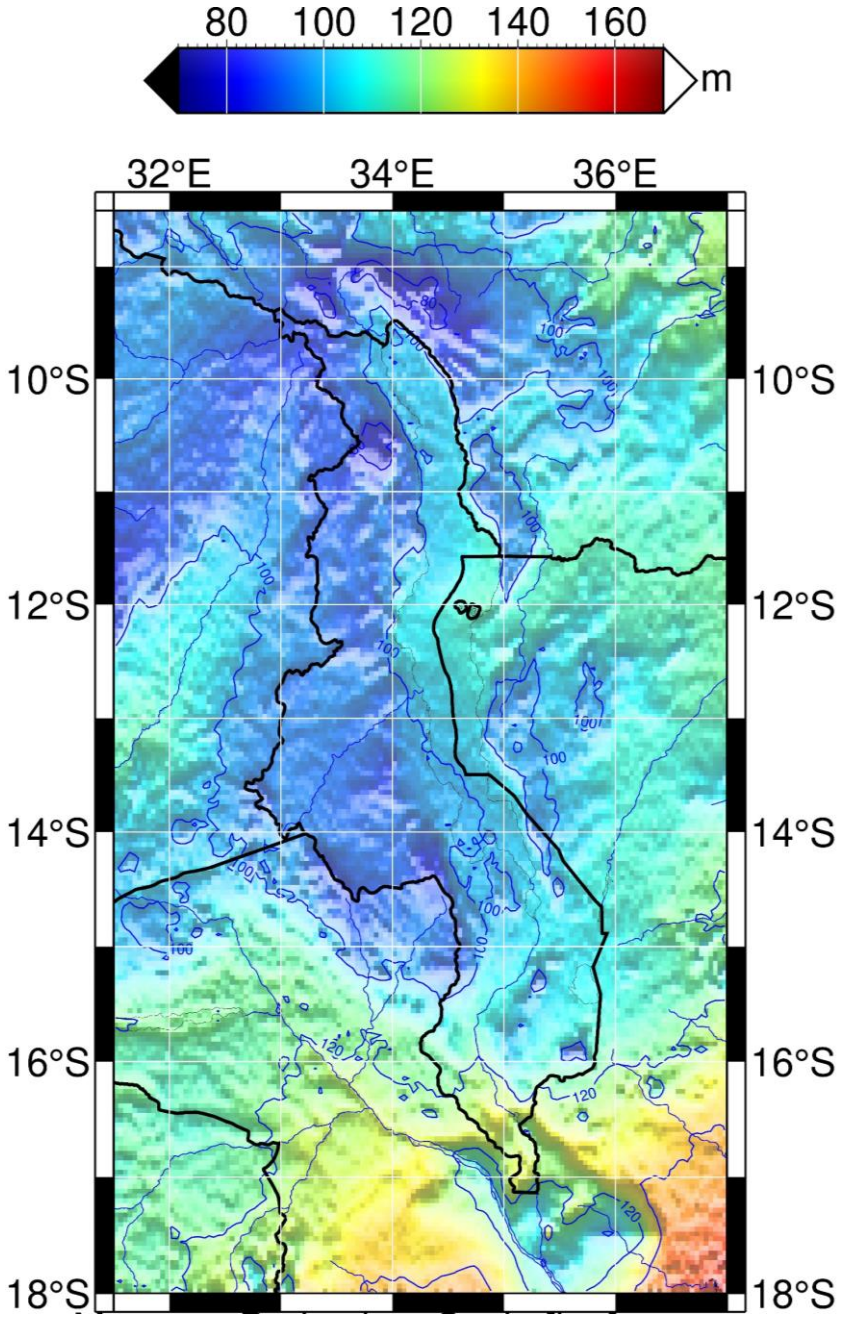
Year	2018
Minimum	33.00
Maximum	413.40
Mean	215.08
StdDev	93.96





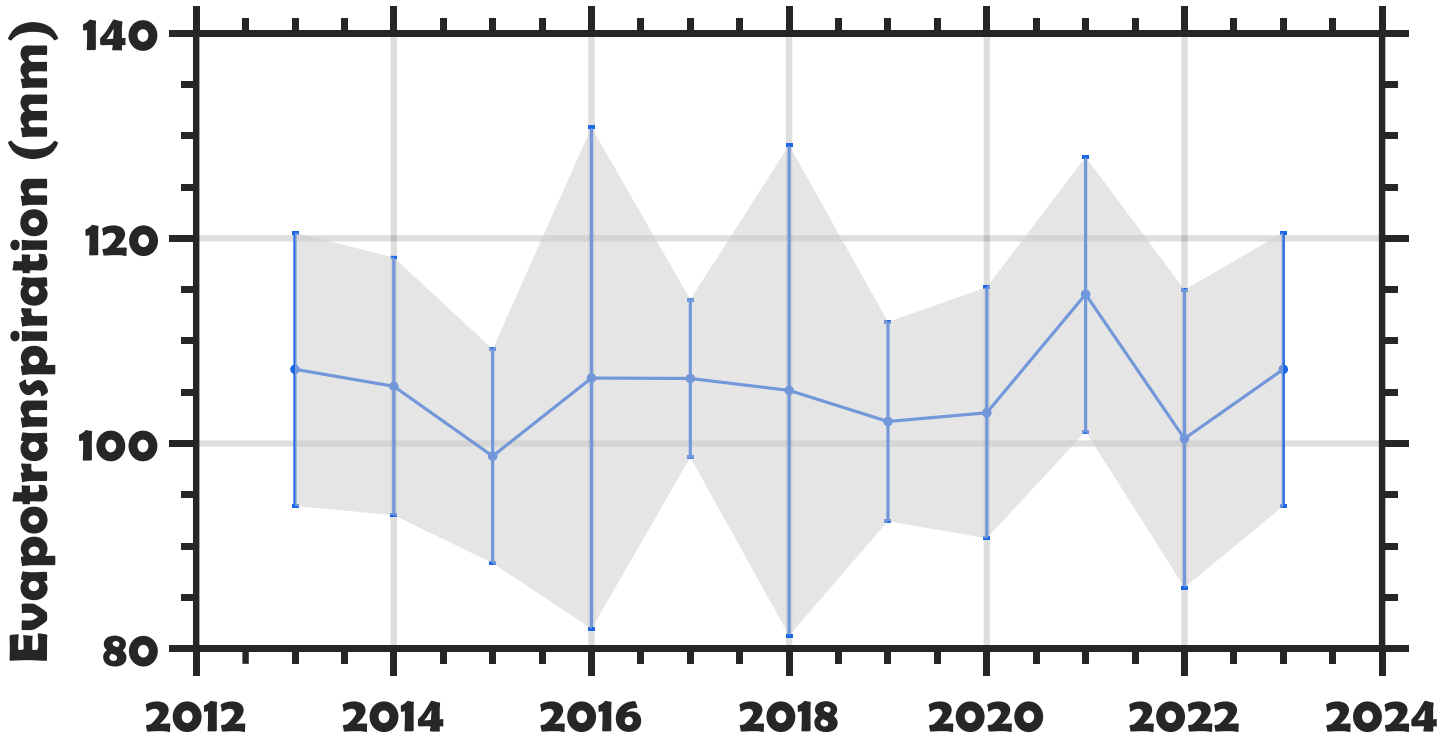
Evapotranspiration

Selected Results

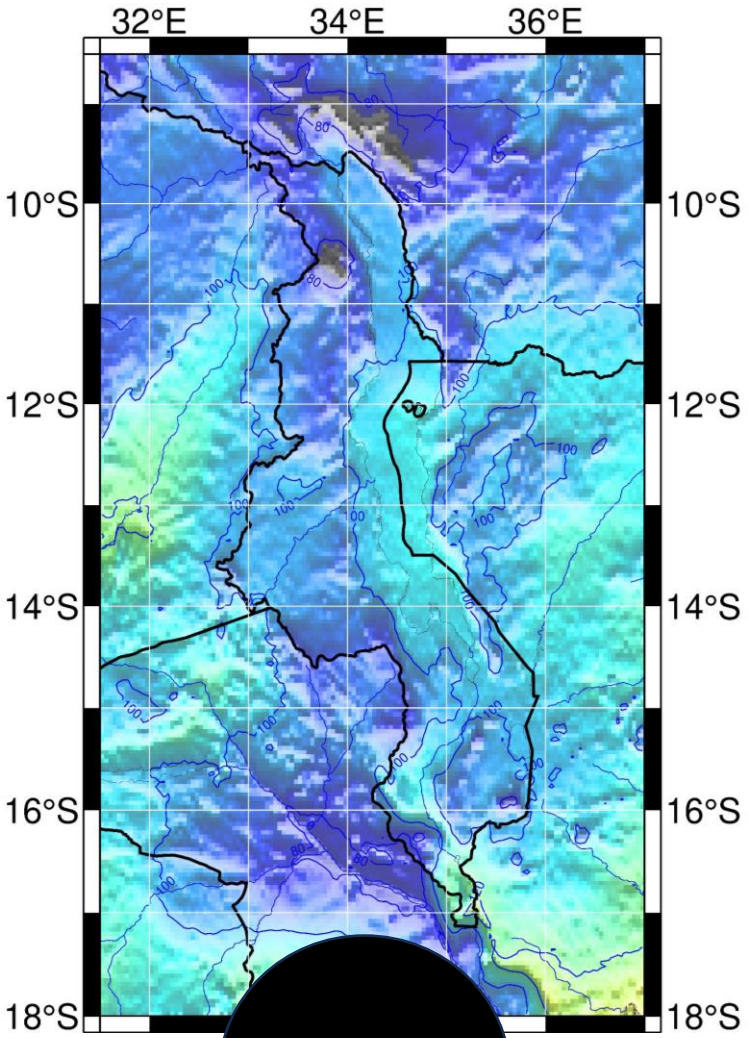


Reference Year — 2023

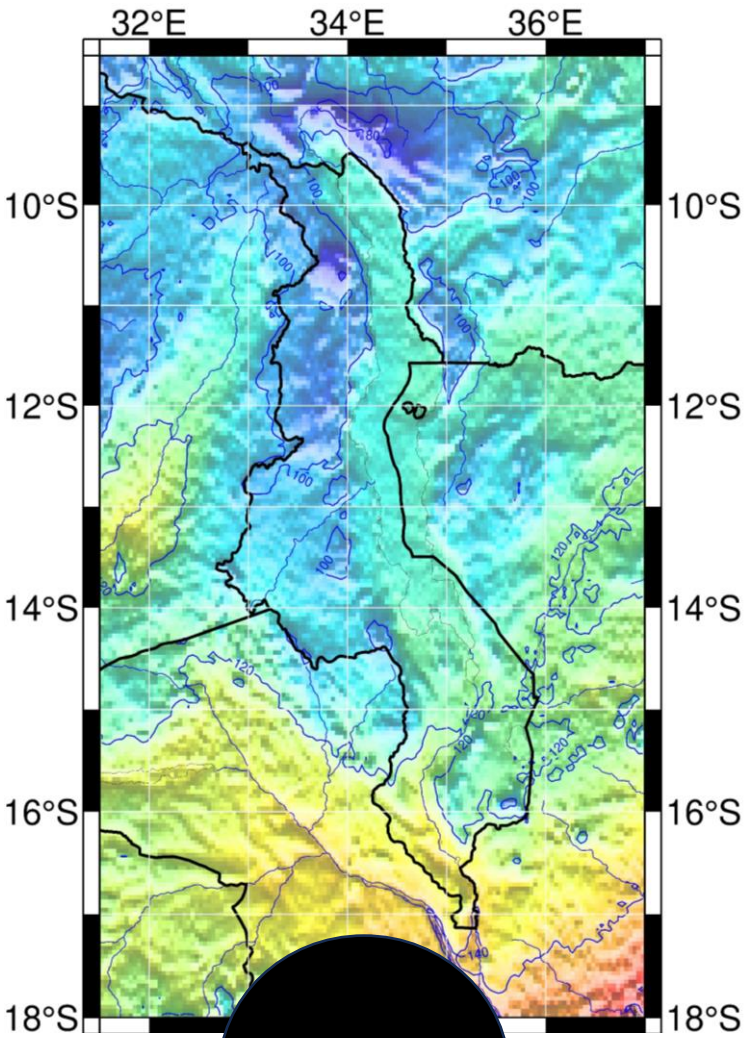
- Mean : 107.24
- STD : 13.33



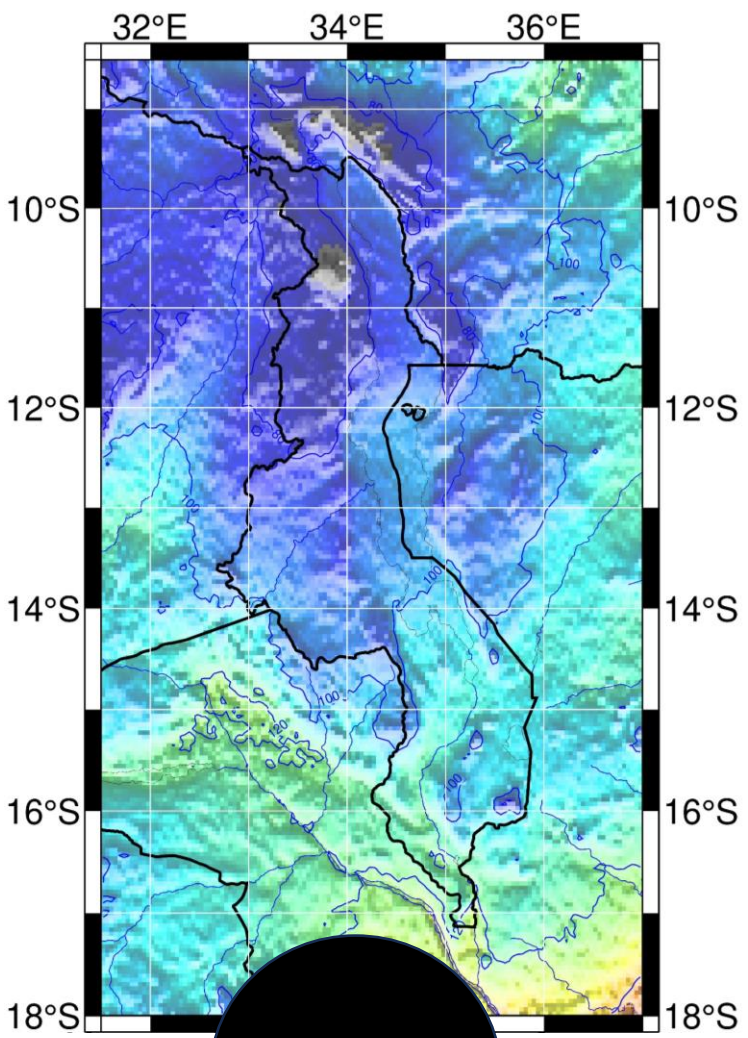
Evapotranspiration



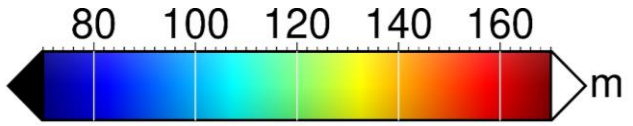
2015



2021



2022



Conclusions

Do You Need More?

Conclusions

The Estimated LST Agree With The Seasons In Malawi

There Is A Noticeable Variation In Meteorological Water Deficit In Malawi In Different Years

Future Research Involves Validation Using Machine Learning

Supplementary Results

In Case You Need Supplementary Results And The Scripts (Java And Bash) Used In The Data Processing, Write An Email To rsuya@mubas.ac.mw