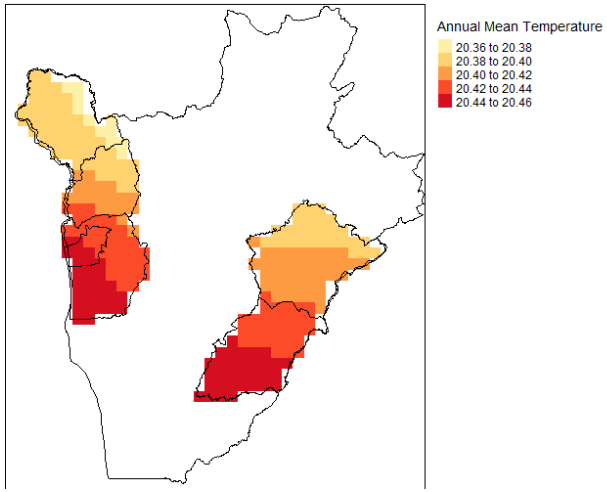
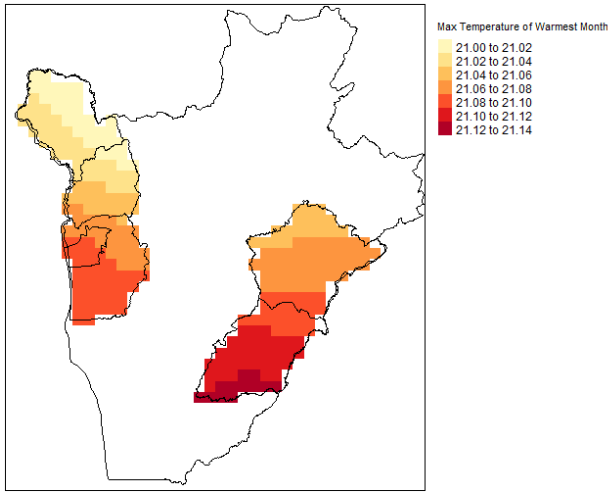
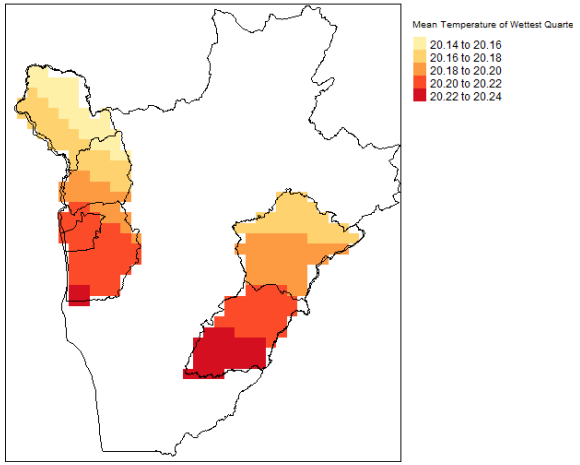
# Appendix 16: Climate Data and Graphs

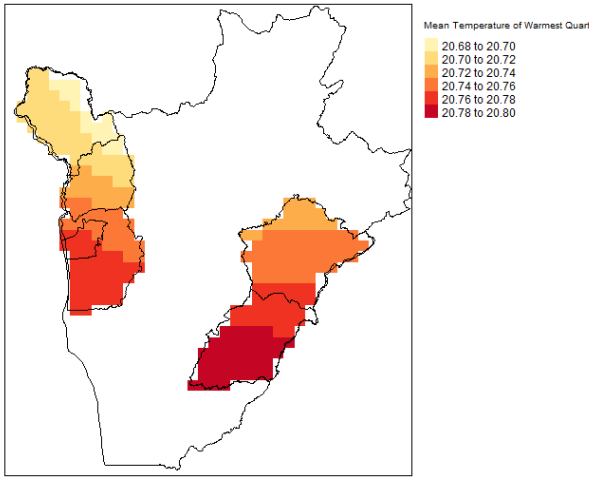
## Observational Data – Meteorological stations

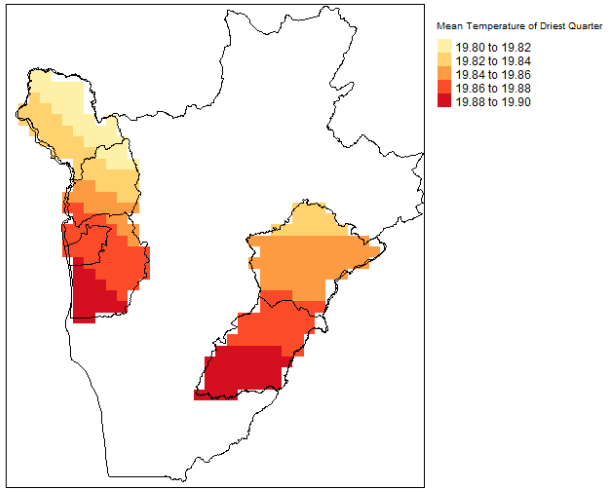


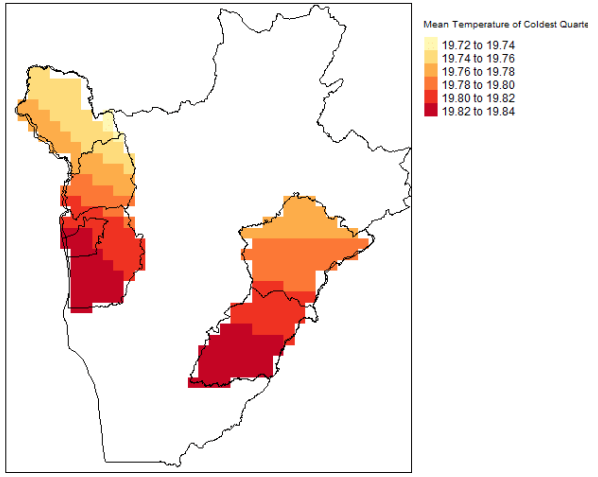



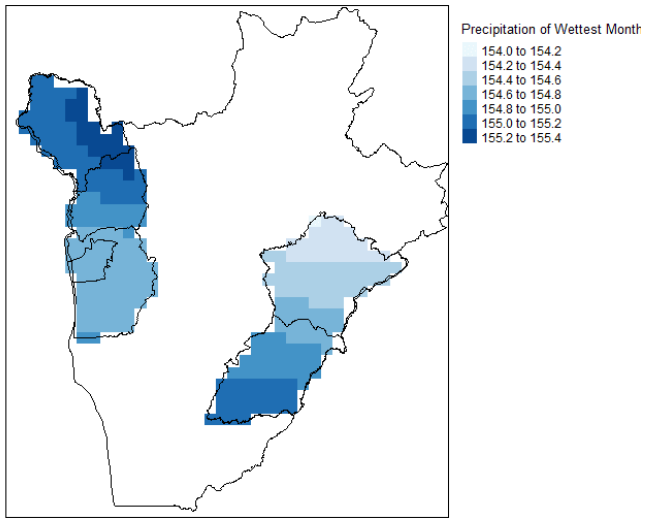



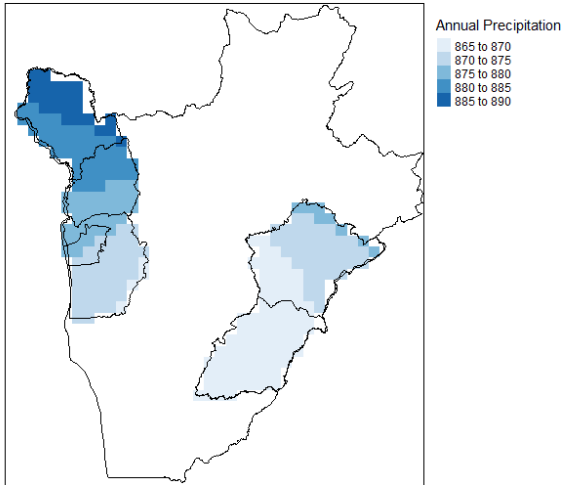

The observed temperature averages in the two basins are illustrated above and below with slightly higher values in the southern parts of both basins.

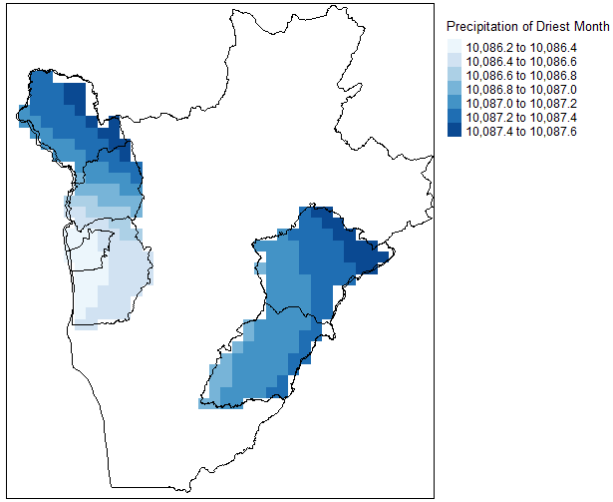


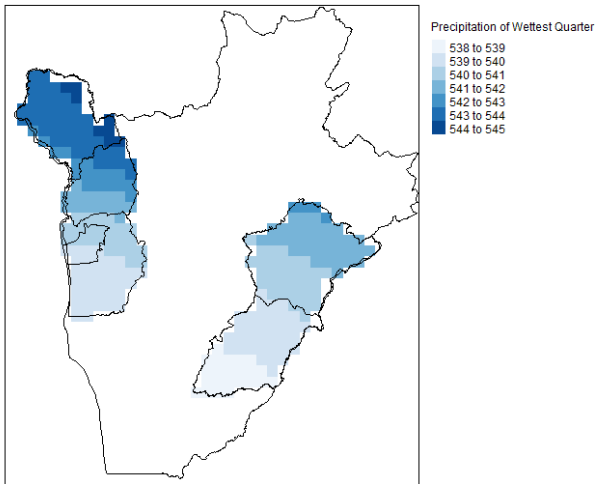



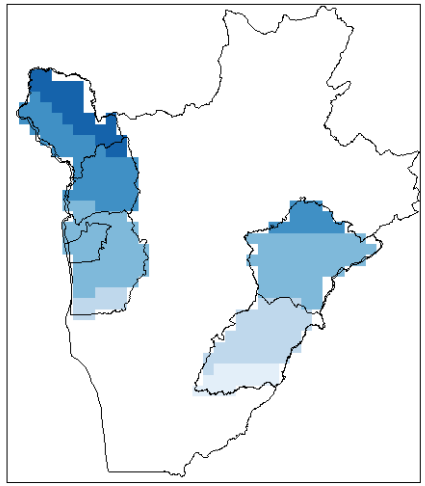


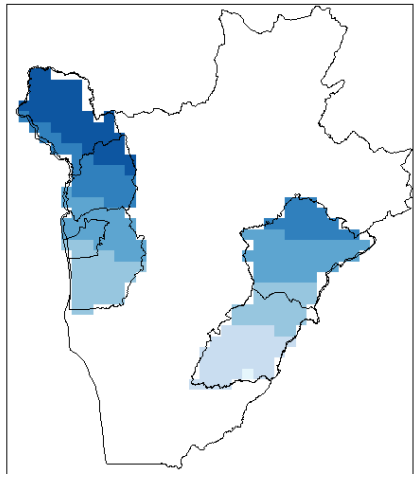




Observed precipitation averages are illustrated in the preceding and subsequent figures for both Imbo and Moso basins.

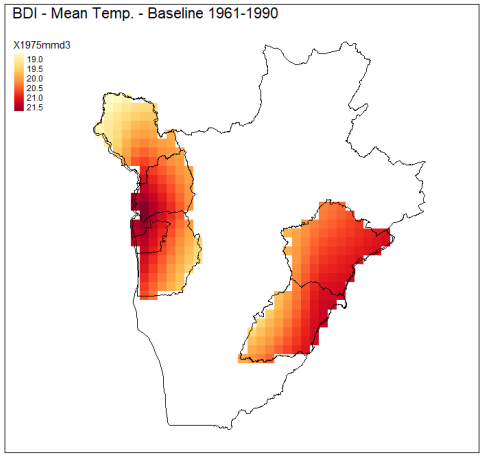


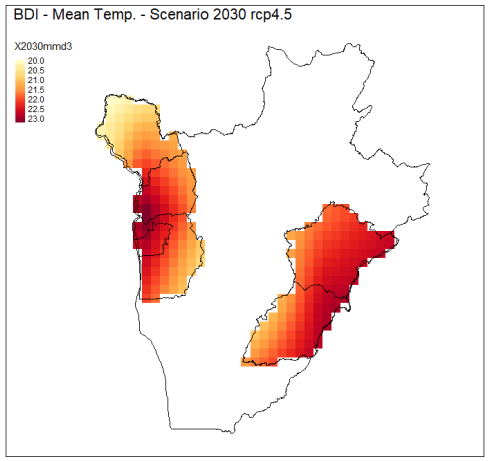



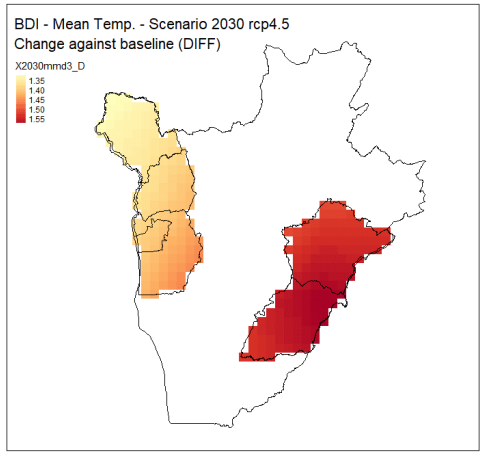




**Source: Climate Information Platform for Copernicus**

## Mean Annual Temperature



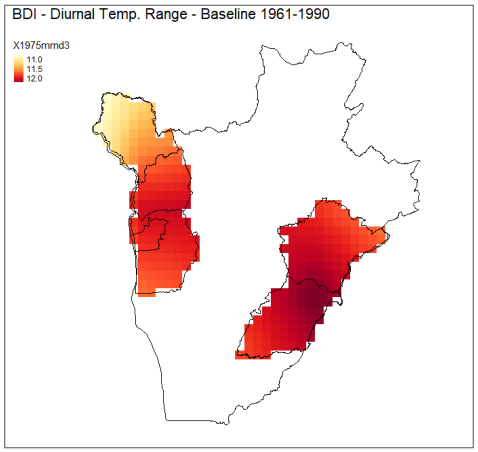



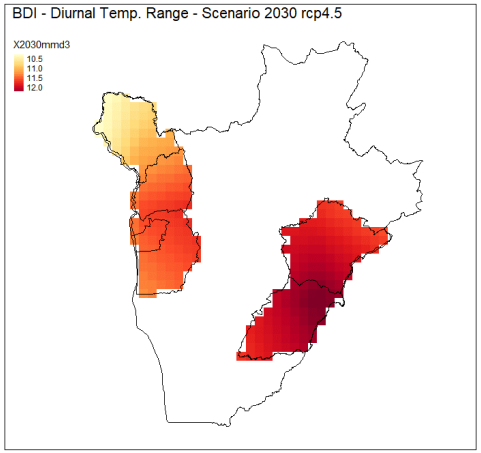



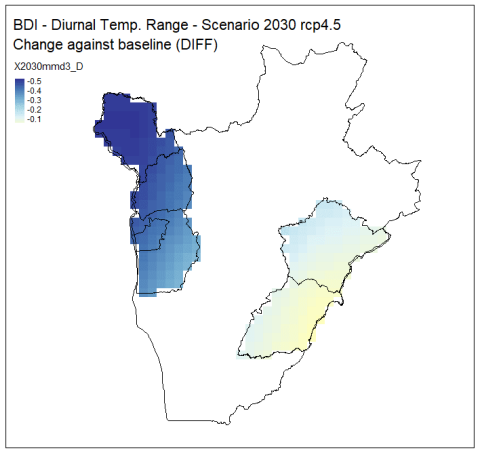

**Annual Mean Temperature** (°C) depicts an increase for both the Imbo and Moso basins under the RCP 4.5. The higher temperature increases are expected in the Moso basin.

**Productive Landscape Relevance**: Increases in annual mean temperature will impact the productivity of crops in the area such as the maize crop and legumes. Ecosystems status will also be impacted.

## Mean Diurnal Range



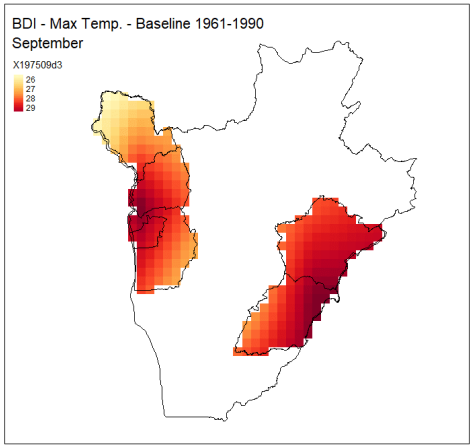



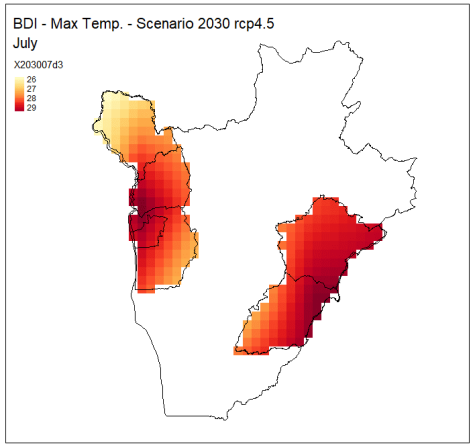



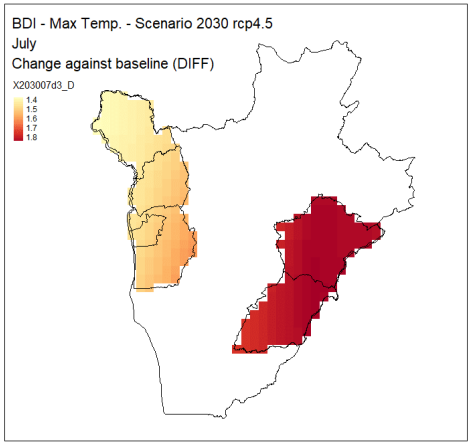

**Mean Diurnal Range (° C)** depicts a slight decrease of the range in both basins, with the higher change in Imbo basin.

**Productive Landscape Relevance** the diurnal range indicates the relevance of temperature fluctuation for different species in the productive landscape.

## Maximum Temperature of Warmest Month



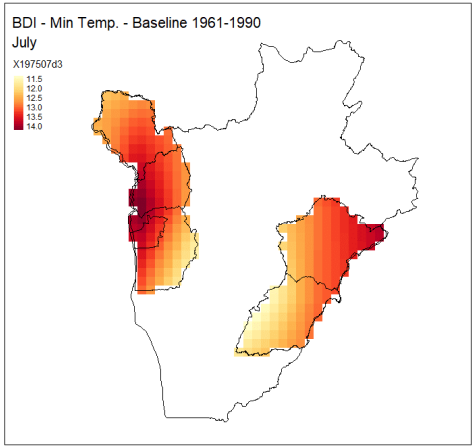



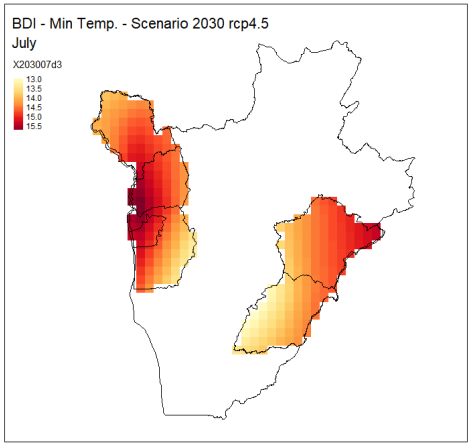



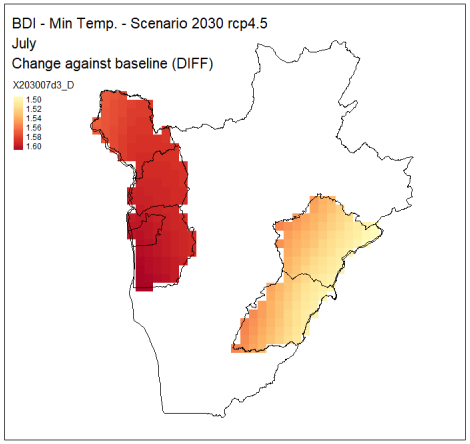

**Max Temperature of Warmest Month (° C)** depicts an increase in for the two basins with higher increase in Moso.

**Productive Landscape Relevance** Temperature increases may lead to increased evapotranspiration and soil moisture loss and thus adverse impacts on the ecosystems, crop yields and water balance.

## Minimum Temperature of Coldest Month



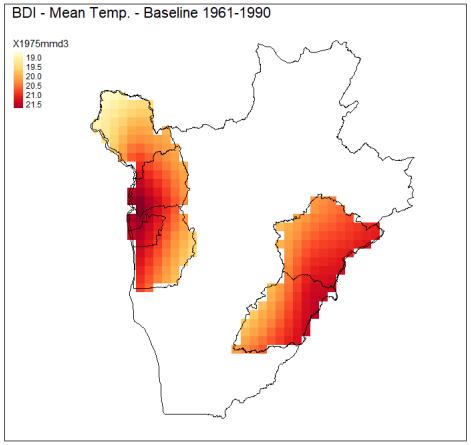



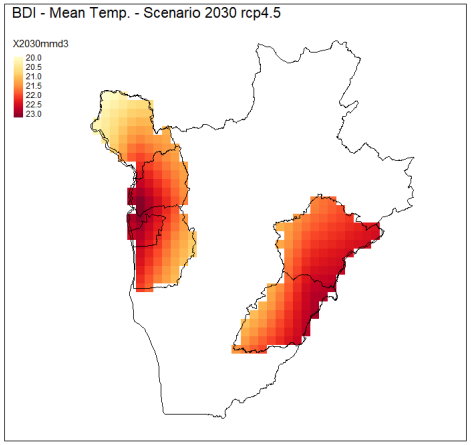



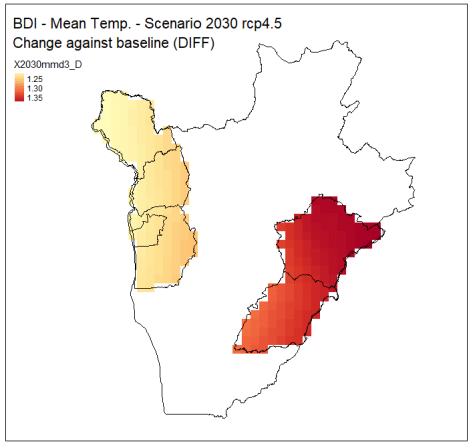

**Minimum Temperature of Coldest Month** depicts an increase in both basins with higher temperature increases expected in the Imbo basin.

**Productive Landscape Relevance**: Increases minimum temperature may impact the productivity of specific crops in the area such as the maize.

## Mean Temperature of Wettest Quarter



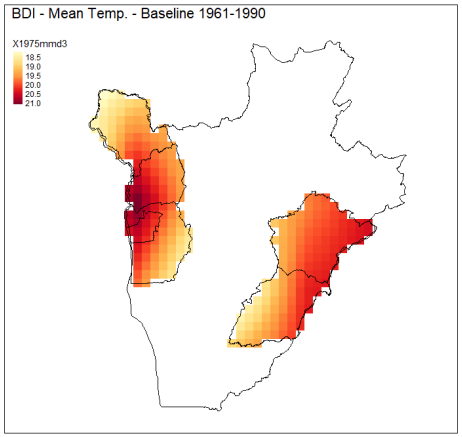



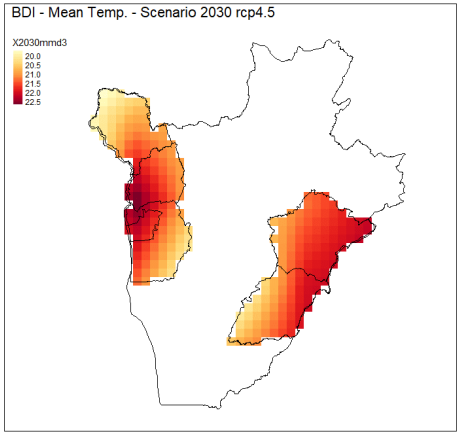



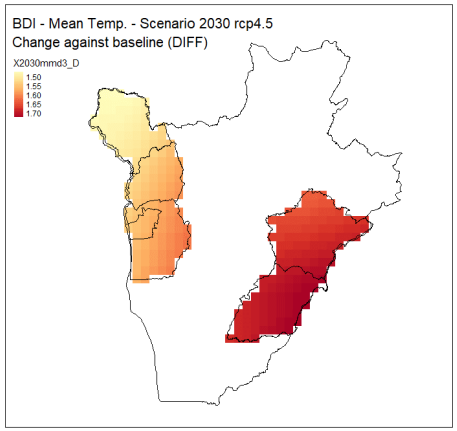

**Mean Temperature of Wettest Quarter** depicts an increase for both the basins under the RCP 4.5. The higher temperature increases are expected in the Moso basin.

**Productive Landscape Relevance**: Increases in the wettest quarter mean temperature will impact the soil moisture content and thus the productivity of cultivated crops.

## Mean Temperature of Driest Month



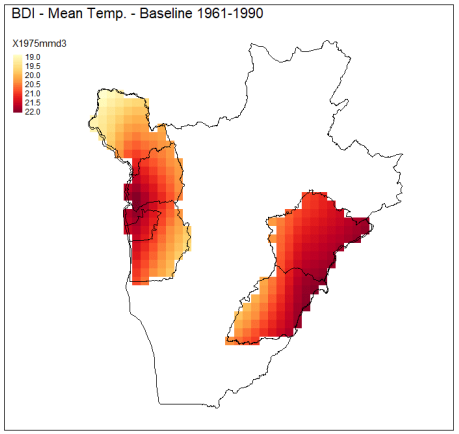



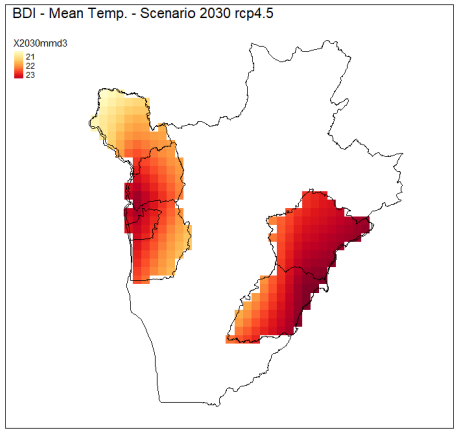



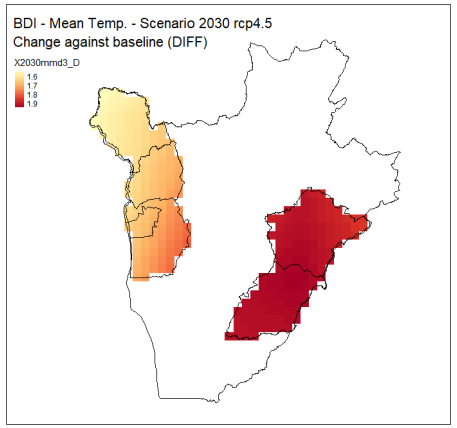

**Mean Temperature of Driest Month** depicts an increase for both basins with higher temperature increases expected in the Moso basin.

**Productive Landscape Relevance**: Increases in the driest quarter mean temperature will impact soil moisture content and adversely affect crop productivity.

## Mean Temperature of Warmest Quarter



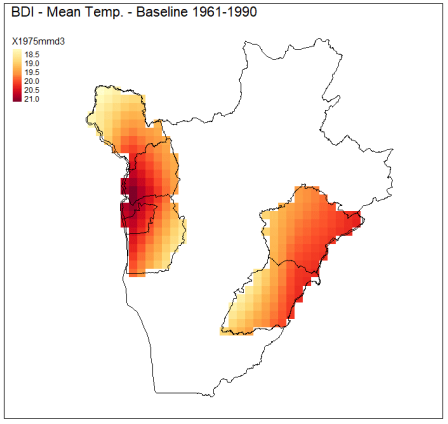



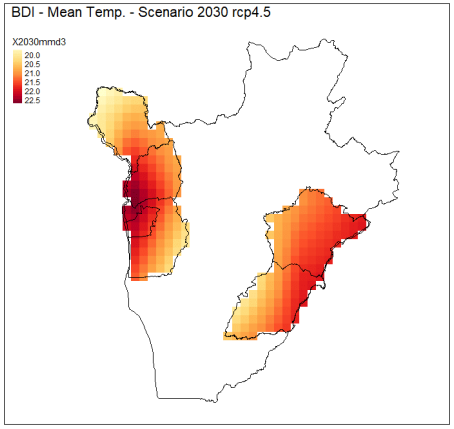



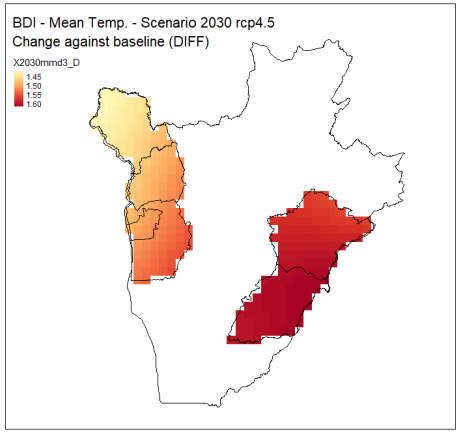

**Mean Temperature of Warmest Quarter** depicts an increase in both basins with higher temperature increases expected in the Moso basin.

**Productive Landscape Relevance**: Increases in mean temperature will impact the productivity of crops in the two basins.

## Mean Temperature of Coldest Quarter



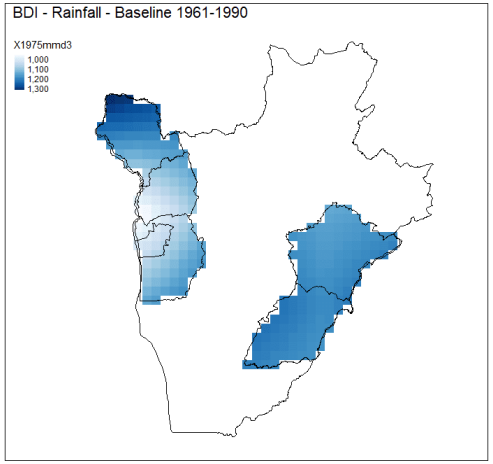



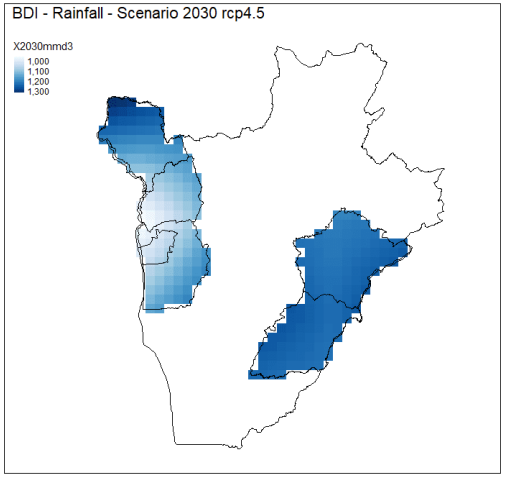



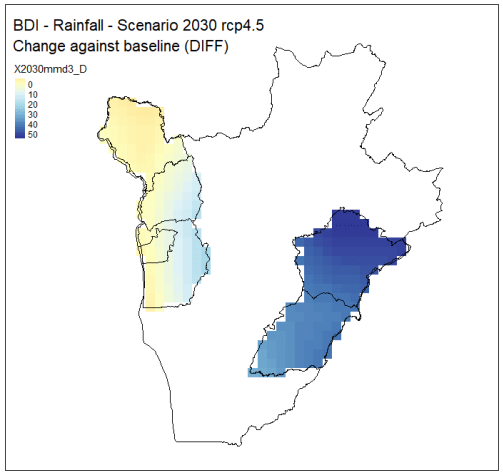

**Mean Temperature of Coldest Quarter** depicts an increase in both basins with higher temperature increases expected in the Moso basin.

**Productive Landscape Relevance**: Increases in mean temperature will soil moisture content and productivity of the agricultural landscape.

## Annual Precipitation



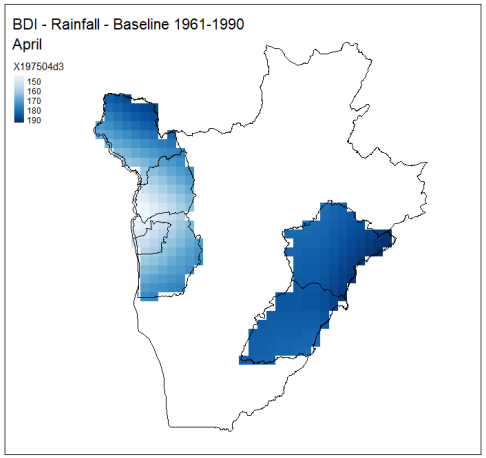



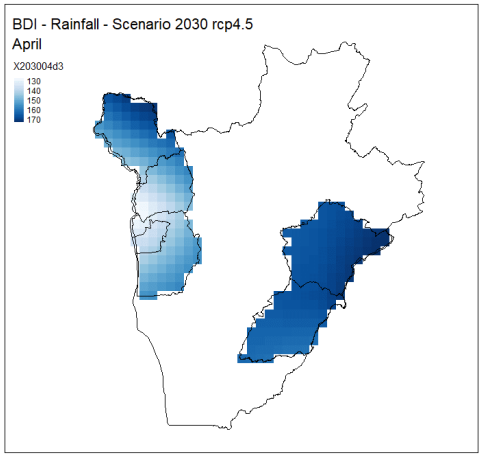



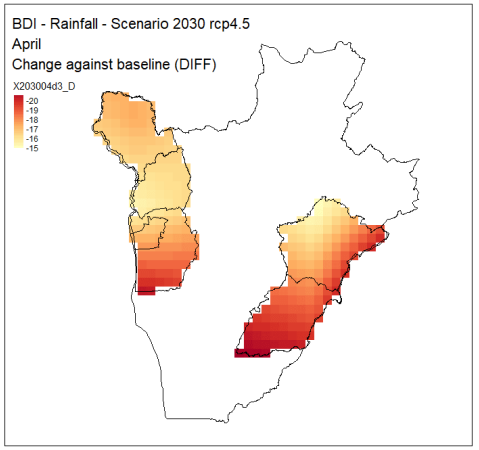

**Annual Precipitation** depicts an increase in south east part of the Imbo basin and all of the Moso basin under the RCP 4.5. The higher precipitation increases are expected in the northern part of the Moso basin.

**Productive Landscape Relevance**: Increases in annual precipitation may result in increased rainfall intensity that will increase rates of soil erosion and thus adversely impact crop productivity.

## Precipitation in the Wettest Month



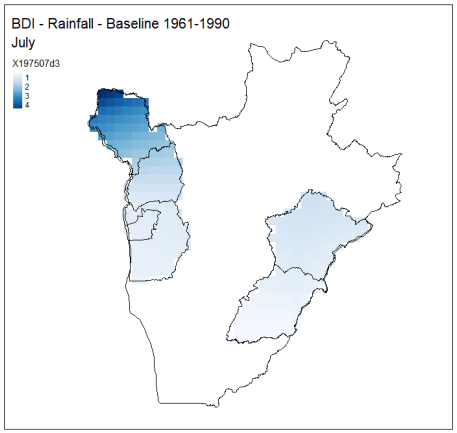



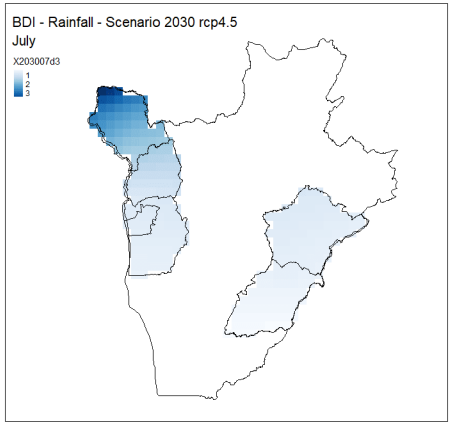



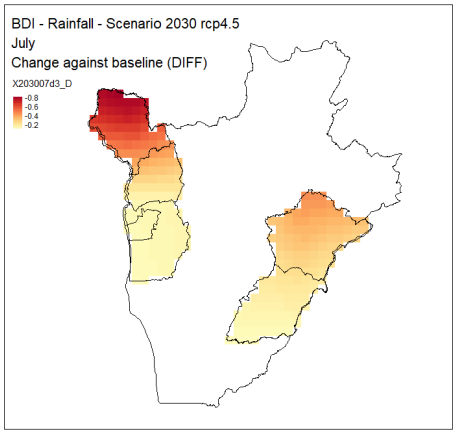

**Precipitation in Wettest Month** depicts a decrease for both the Imbo and Moso basins with the highest decreases anticipated in the south for Imbo and southern and eastern Moso.

**Productive Landscape Relevance**: The decrease in precipitation will result in reduced water balance in the agricultural landscape.

## Precipitation in the driest month



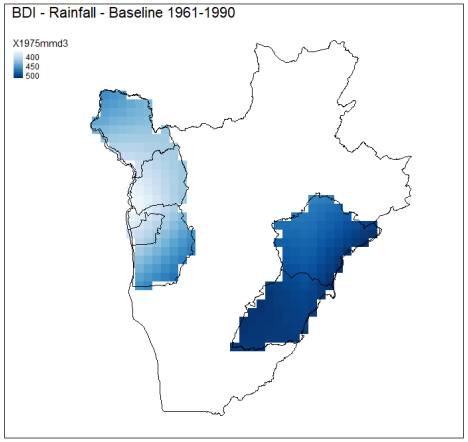



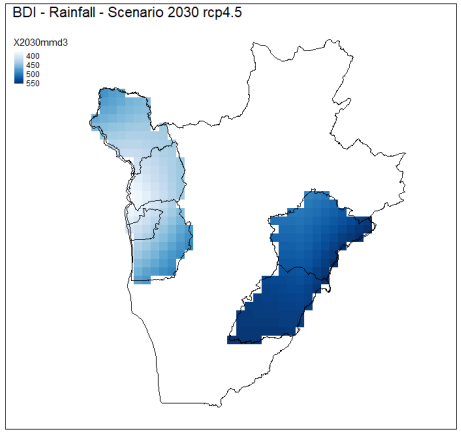



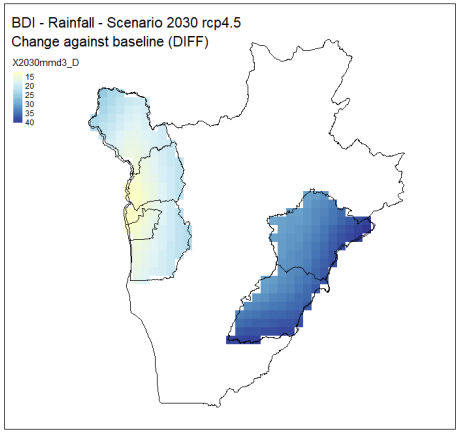

**Precipitation in the driest month** depicts a slight decrease for both the Imbo and Moso basins with changes slightly more pronounced in the northern Imbo basin.

**Productive Landscape Relevance**: Decreases in the precipitation over the driest month will impact the soil moisture content and thus productivity of the agricultural landscape.

## Precipitation in the wettest Quarter



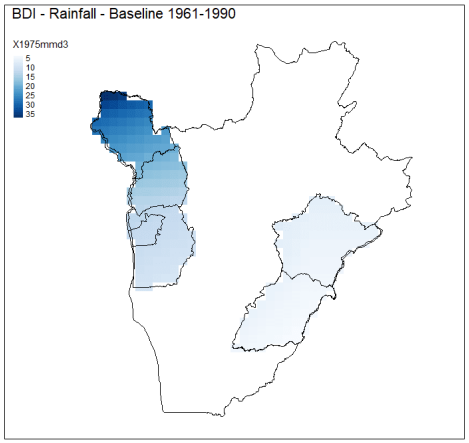



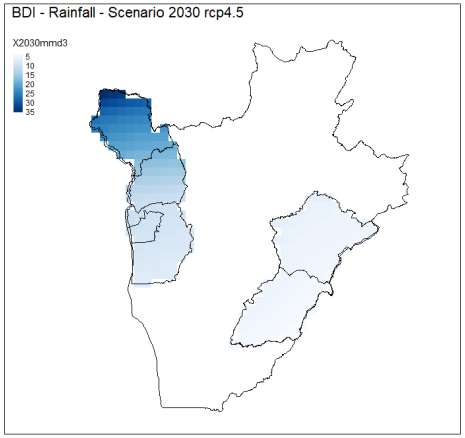



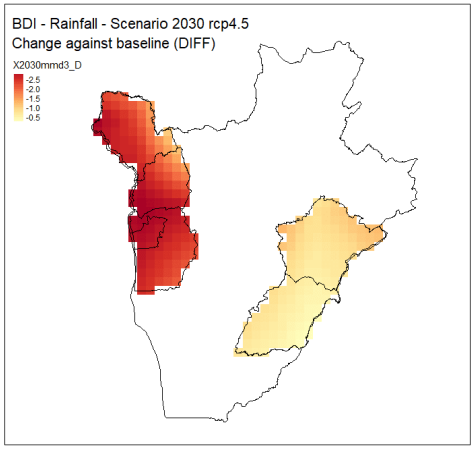

**Precipitation in the wettest Quarter** depicts an increase for most of the Imbo basin and all of the Moso basin. The increased precipitation will be more pronounced in the south eastern Moso basin.

**Productive Landscape Relevance**: Increased precipitation may result in increased rainfall intensity that will increase rates of soil erosion and thus adversely impact crop productivity.

## Precipitation in the driest Quarter



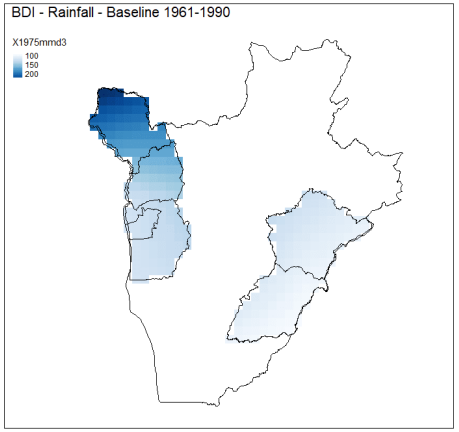



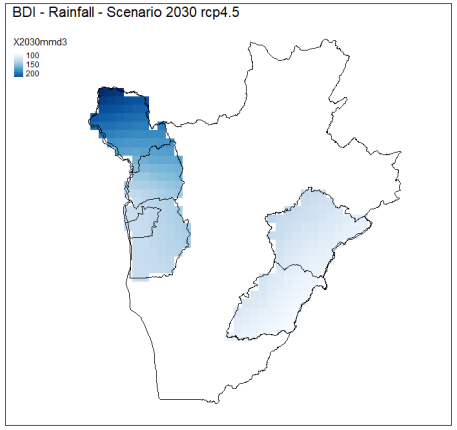



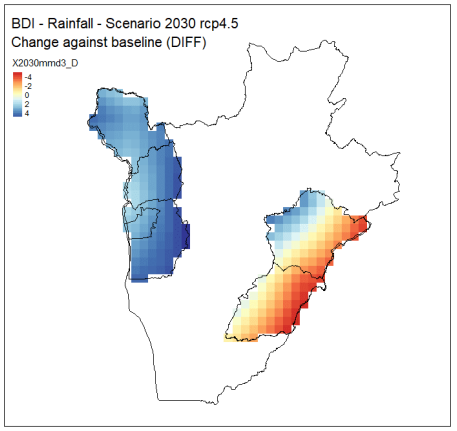

**Precipitation in the driest Quarter** depicts a decrease in the both basins with the changes in the Imbo basin being more pronounced.

**Productive Landscape Relevance**: decreases in precipitation will lead to reduced soil moisture levels and increased stress on the agricultural landscape.

## Precipitation in the warmest quarter



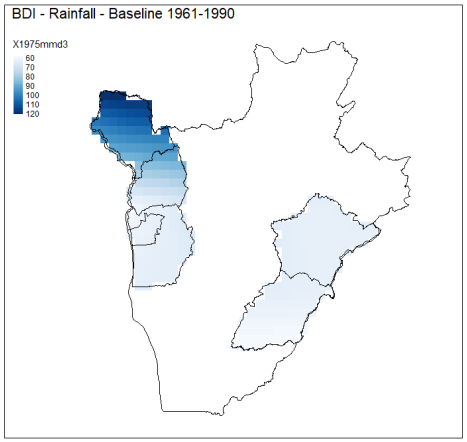



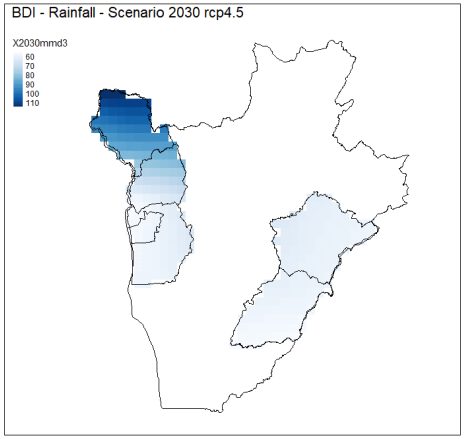



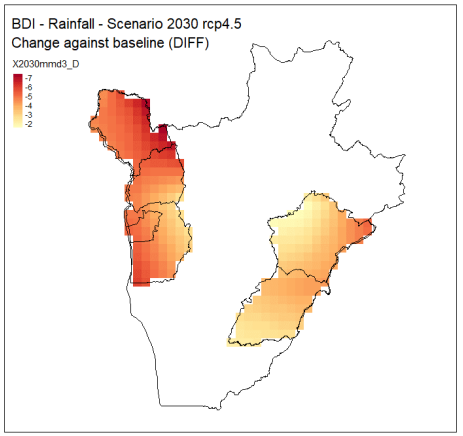

**Precipitation in the warmest quarter** depicts an increase in the Imbo basin and a mixed indication in the Moso basin. The eastern part of the basin is expected to have decreased precipitation.

**Productive Landscape Relevance**: Levels of precipitation have an impact on the agricultural productivity of the staple banana crop, maize and legumes.

## Precipitation in the coldest quarter




**Precipitation in the coldest quarter** depicts a decrease in both the Imbo and Moso basins with changes being more pronounced in the former.

**Productive Landscape Relevance**: decreases in precipitation will lead to reduced soil moisture levels and increased stress on the agricultural landscape.

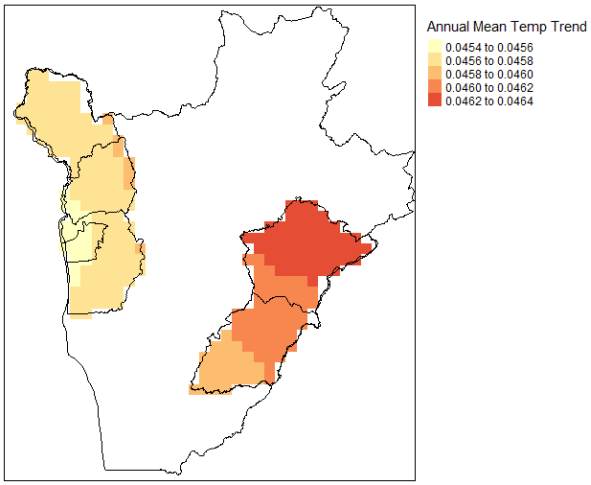
**Observational data - Trends analysis of selected climate parameters**

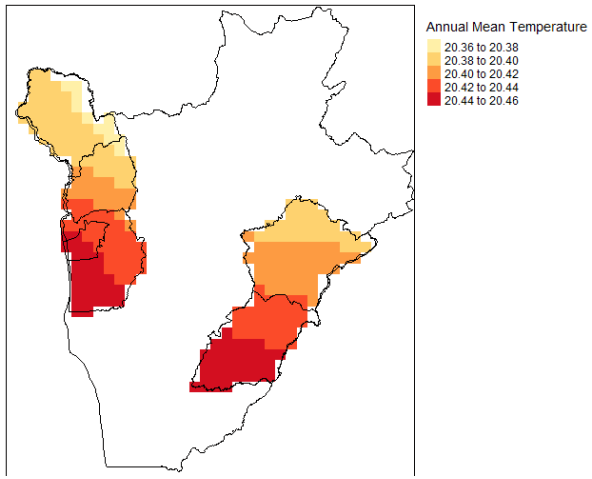
The trends analysis presented below is of observational data sets obtained from the nearest meteorological stations to the Imbo and Moso basins that have recorded monthly temperature and precipitation parameters consistently over the last 30 years (1989-2019).

**Temperature**

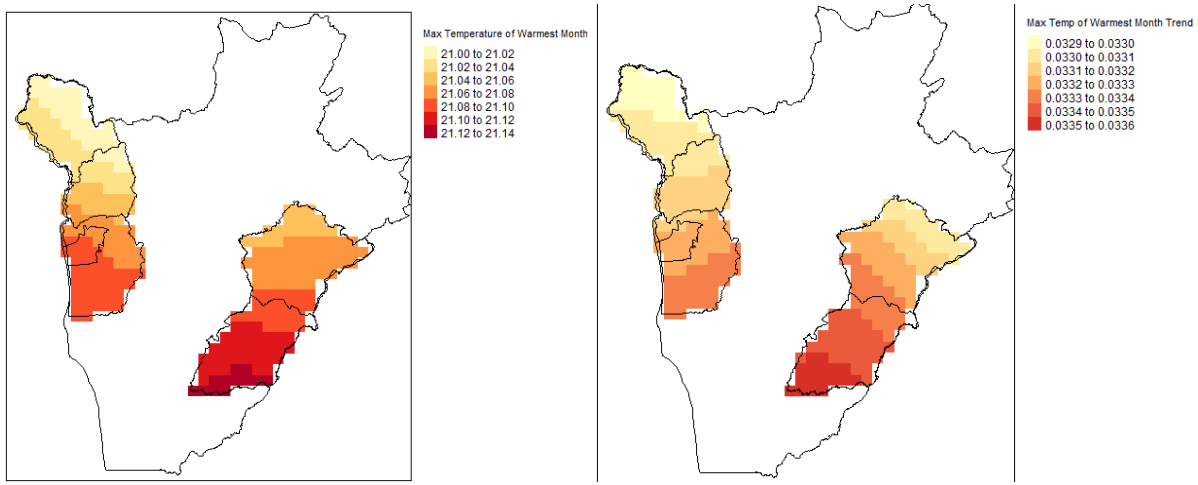
The mean temperature trends analysis shows slight increases for the different selected indices with higher changes in the Moso basin. The highest increases have been observed in the mean temperature of coldest quarter, mean annual temperature and mean temperature of the warmest quarter.

**Annual Mean Temperature**

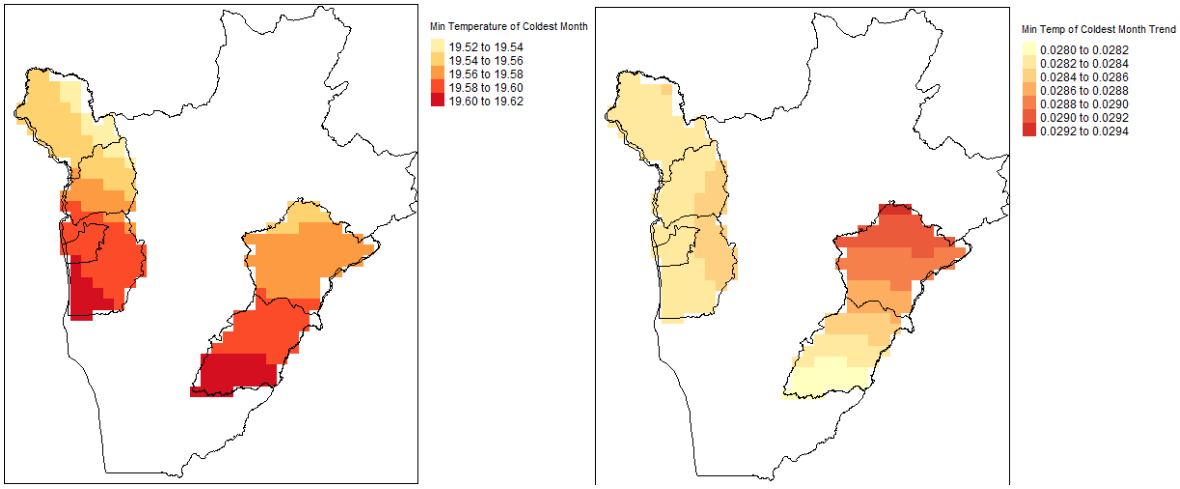


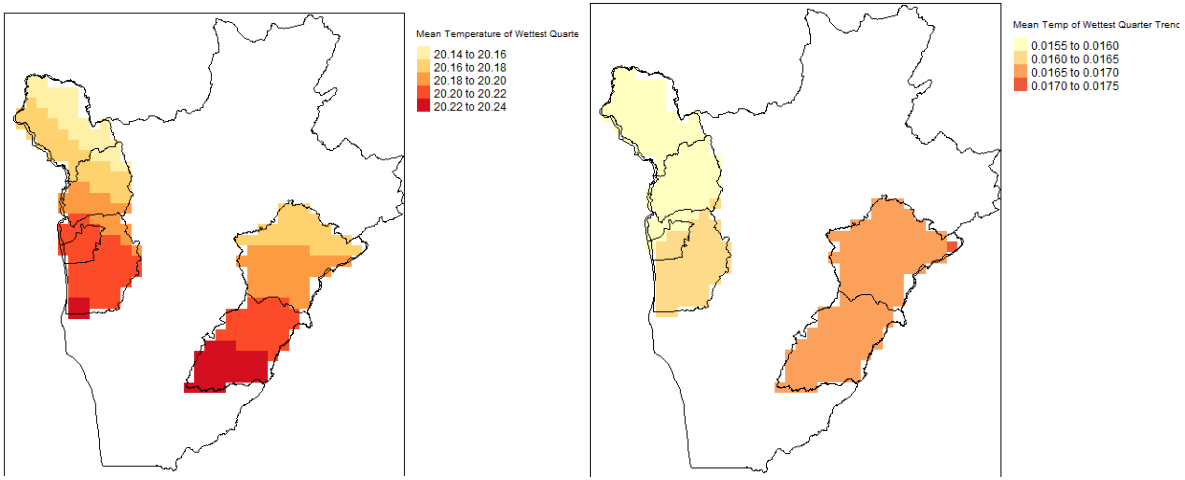
## Max Temperature of Warmest Month



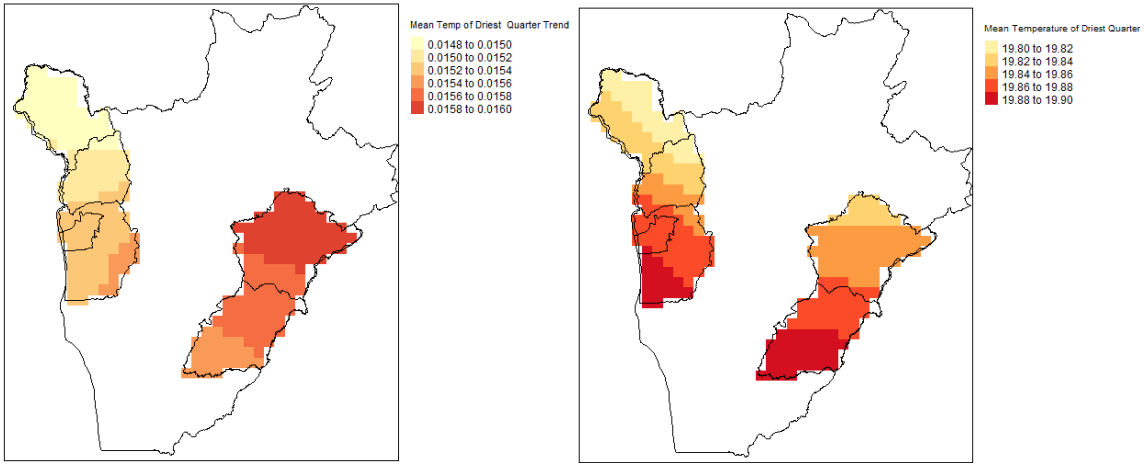

## Min Temperature of Coldest Month



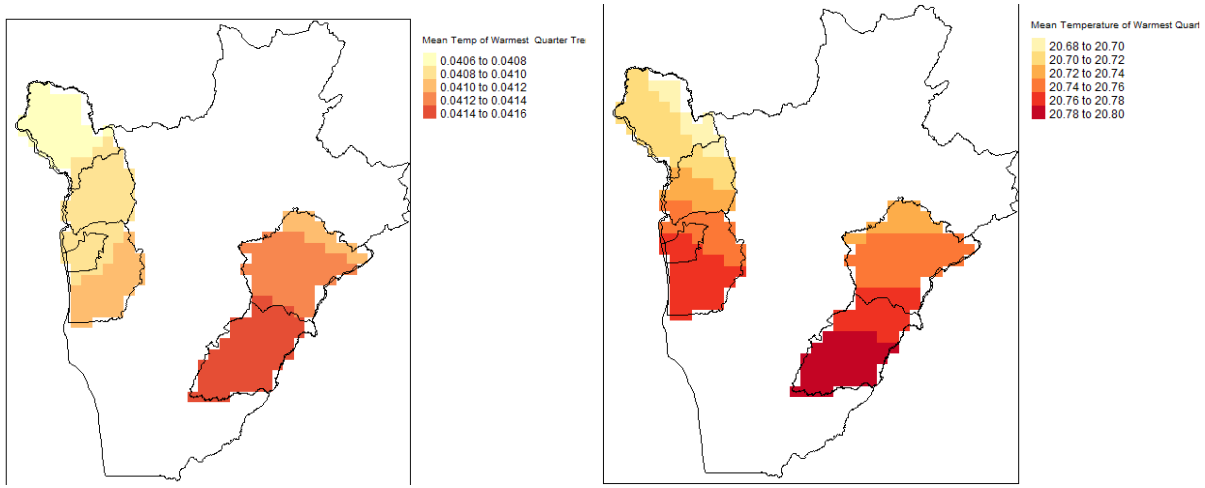
## Mean Temperature of Wettest Quarter



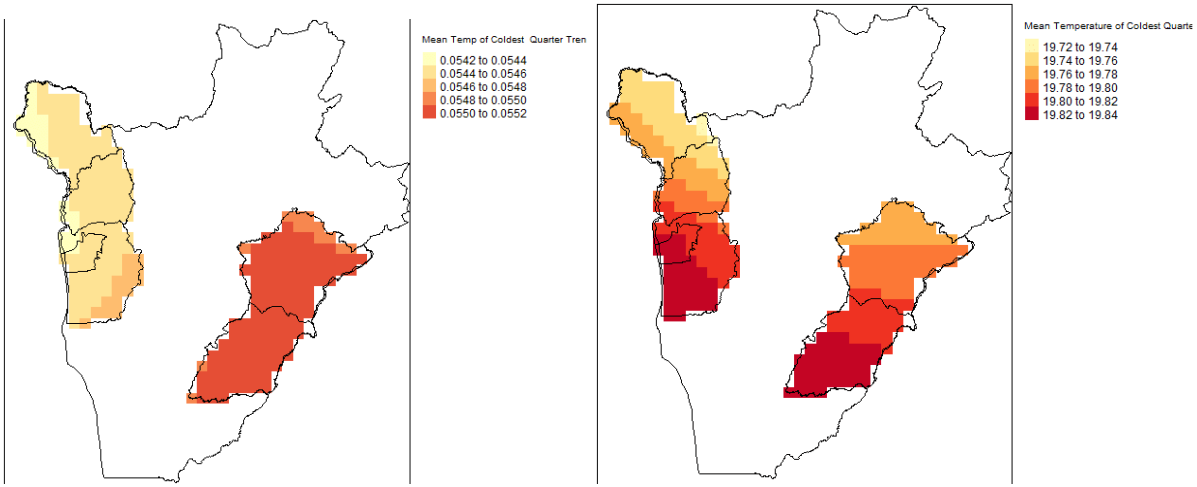

## Mean Temperature of Driest Quarter



## Mean Temperature of Warmest Quarter



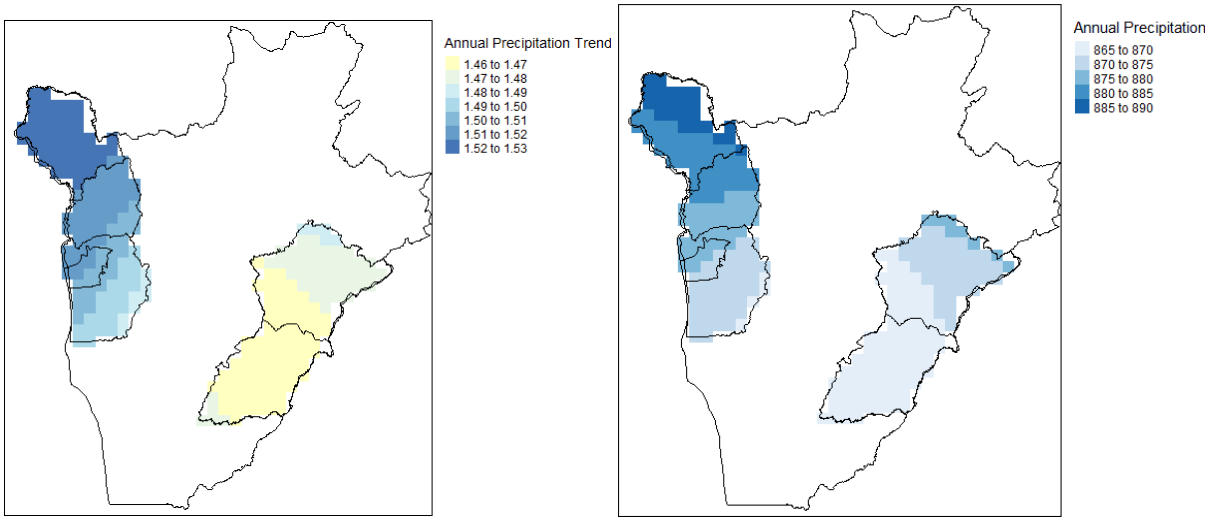

## Mean Temperature of Coldest Quarter



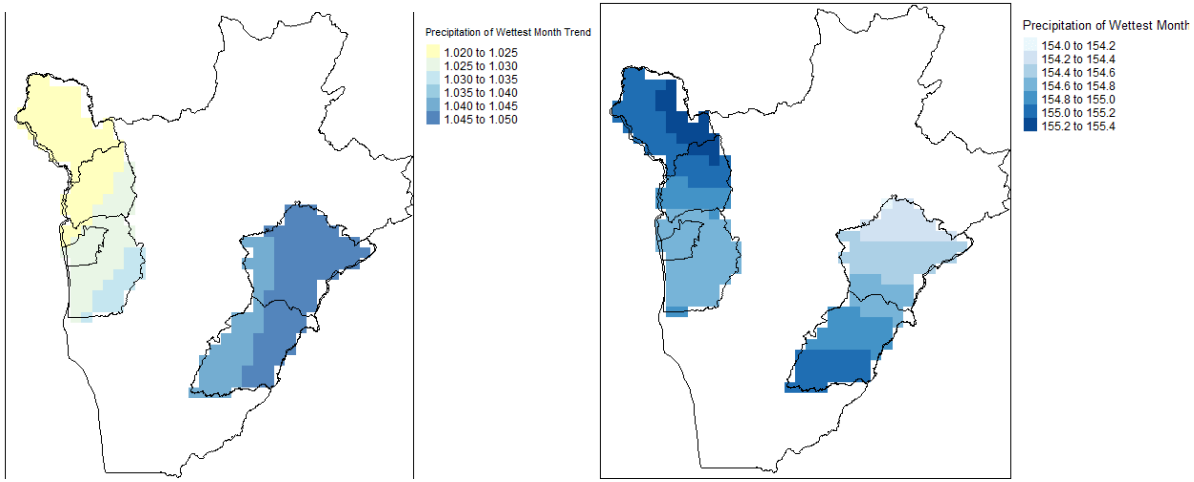
**Precipitation**

Precipitation trends analysis shows increases in the different selected indices. The highest increases have been observed in the precipitation of the wettest quarter, annual precipitation followed by precipitation in the wettest month and warmest quarter. The precipitation changes are more pronounced in Imbo basin for most of the selected indices.

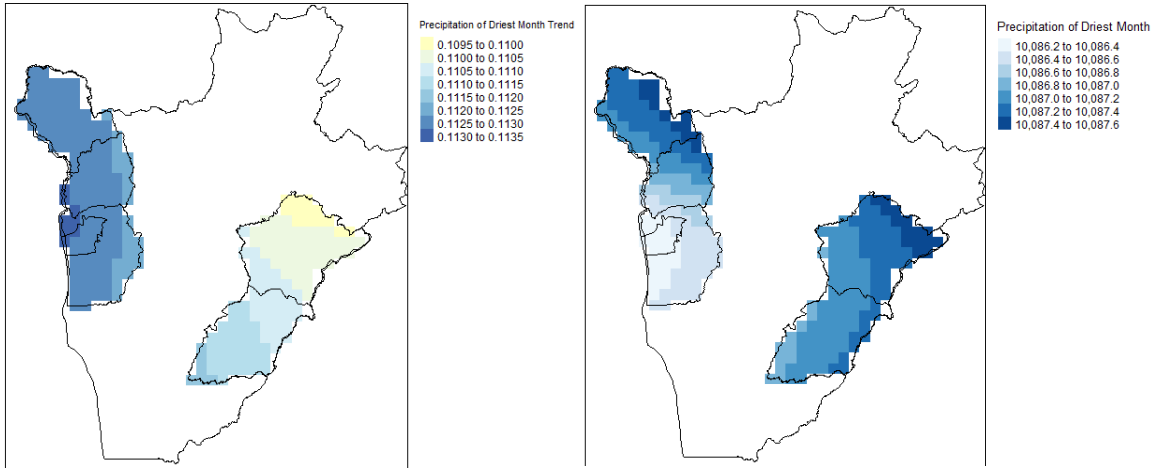
**Annual Precipitation**



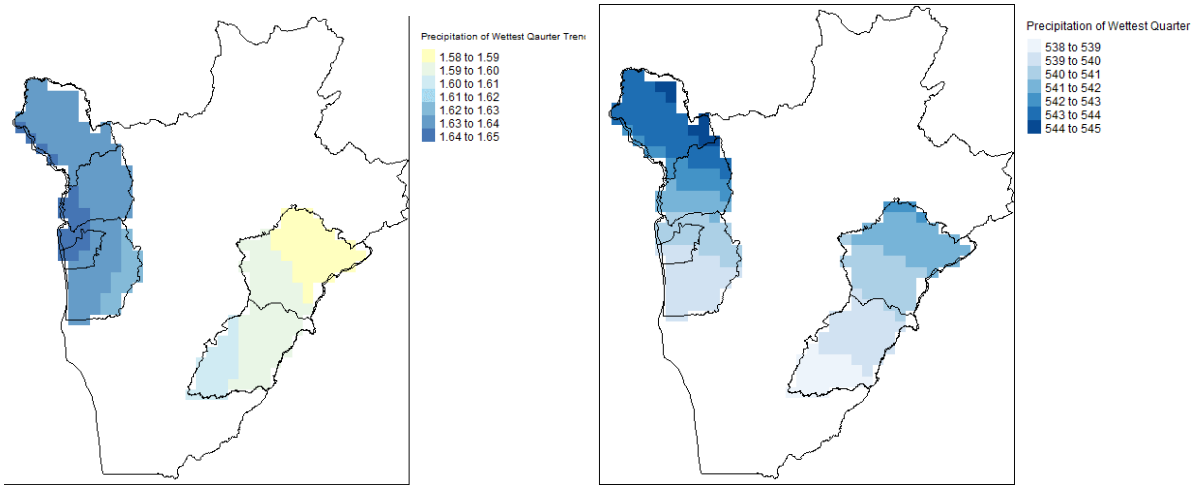
## Precipitation of Wettest Month



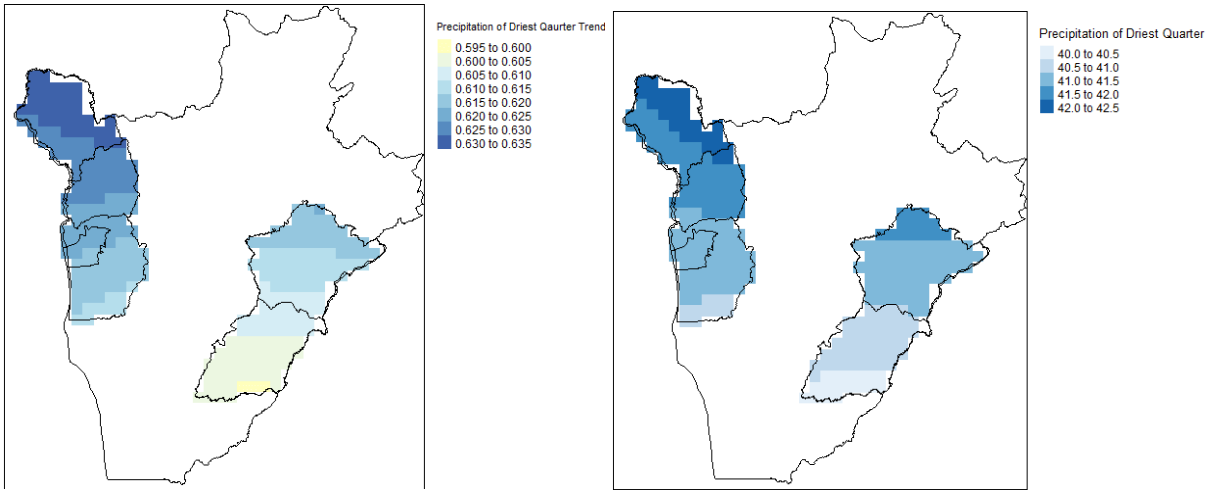

## Precipitation of Driest Month



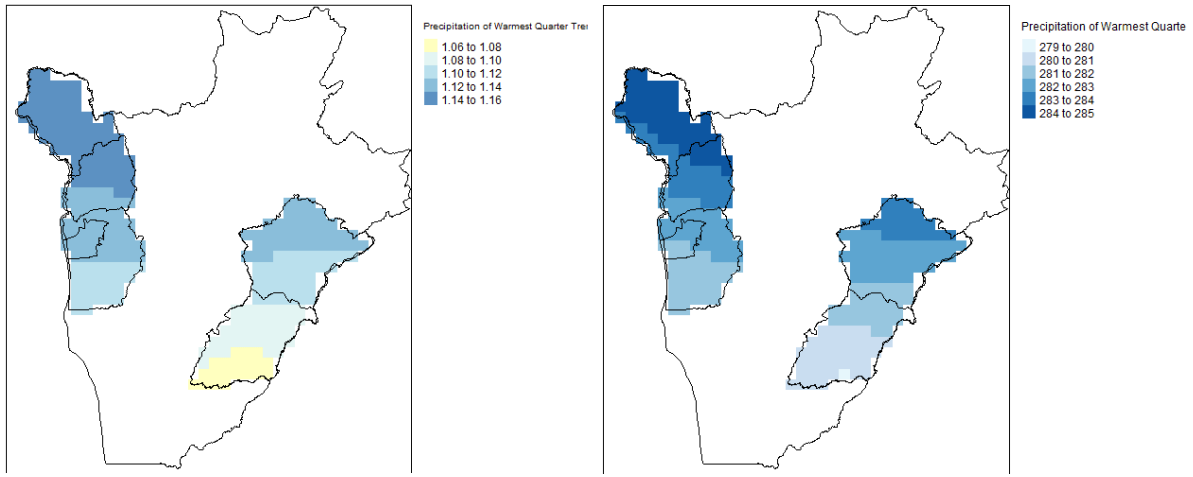
## Precipitation of Wettest Quarter



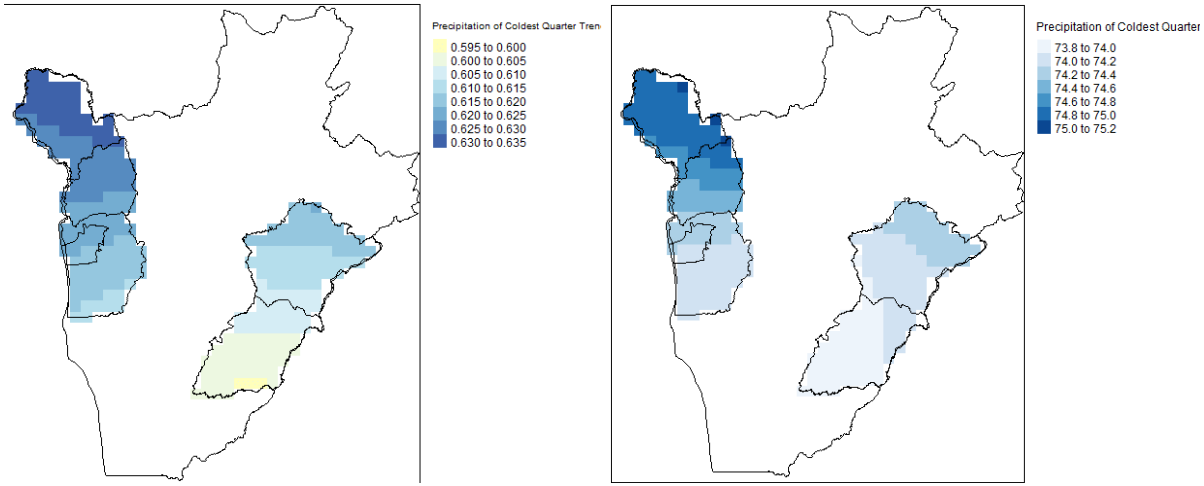

## Precipitation of Driest Quarter



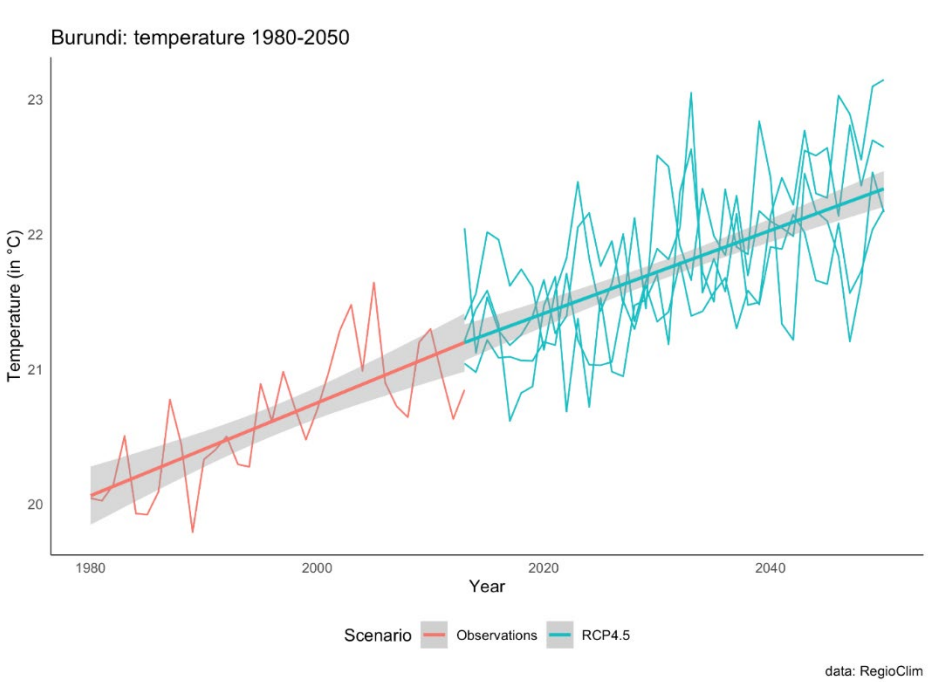
## Precipitation of Warmest Quarter




## Precipitation of Coldest Quarter



**Change in temperature and precipitation patterns (RCP 4.5)**



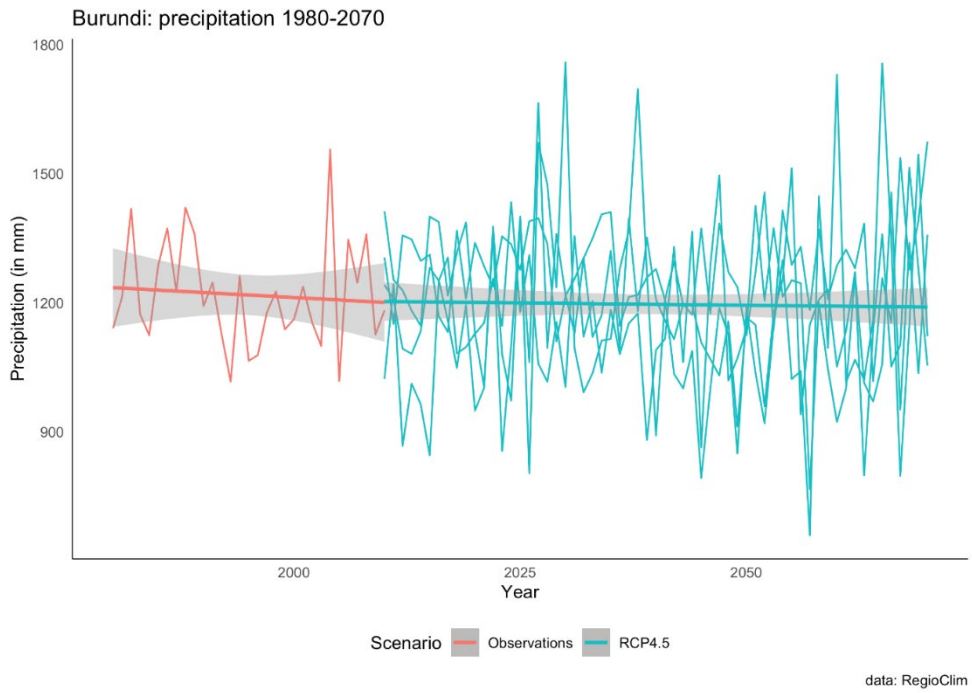




**Fig. A1** Change in mean temperature since 1960 and projected RCP 4.5 scenario. Source: RegioClim (accessed June2020).

**Fig. A2** Change in precipitation patterns since 1960 and projected RCP 4.5 scenario. Source: RegioClim (Accessed June 2020).

"Burundi's exposure to the mean wet precipitation climate changes to about **16.26% (median) in the period 2041-2050** compared to 19.07% in the period 1990-1999 in the high warming scenario (RCP8.5). The predictability of this level of precipitation is also projected to change with the standard deviation (a measure of volatility) ranging from **7.42 for the period 2041-2050** to **8.59 in the 1990s**.

**Evolution of the extreme wet climate (SPI above +2)**

Burundi's exposure to the extreme wet precipitation events changes to about **1.84% (median) in the period 2041-2050** compared to **0.62% in the period 1990-1999** in the high warming scenario (RCP8.5). The predictability of this level of precipitation is also projected to change with the standard deviation (a measure of volatility) ranging from **7.81 for the period 2041-2050** to **4.04 in the 1990s** (also in the high warming scenario).

**Evolution of the extreme dry climate (SPI below -2)**

Burundi's exposure to the extreme dry precipitation events changes to about **1.41% (median) for the period 2041-2050** compared to **0.77% for the period 1990-1999** in the high warming scenario (RCP8.5). The predictability of this level of precipitation is also projected to change with the standard deviation (a measure of volatility) ranging from **6.38 for the period 2041-2050** to **3.79 in the 1990s** (also in the high warming scenario)."

Citation Baarsch et. al (2019).

**Regional distribution of rainfall**

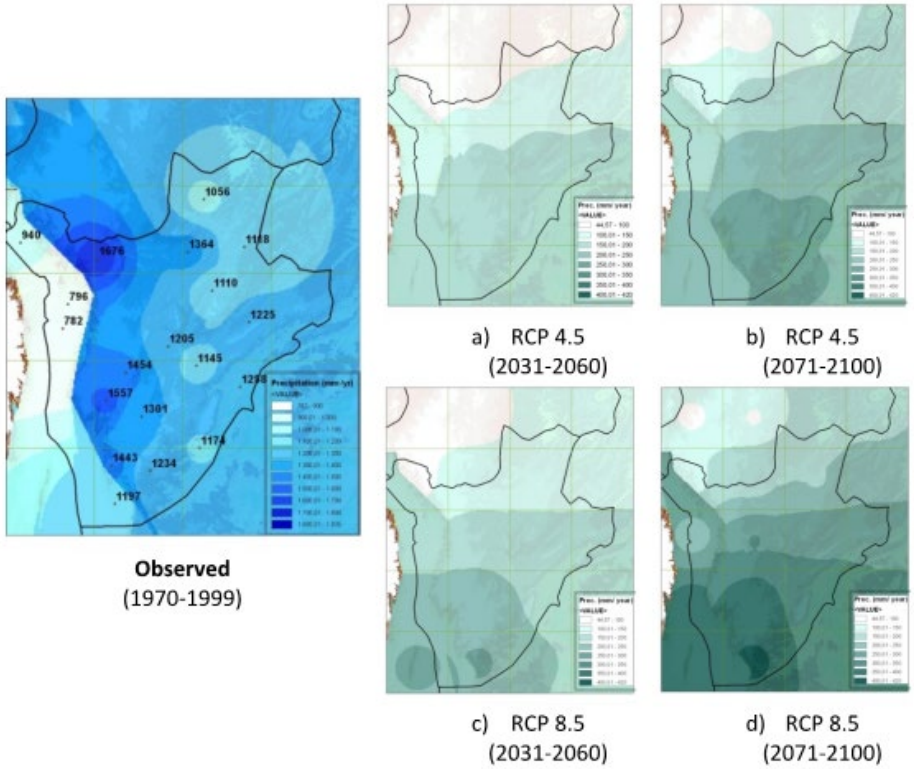



**Fig. A3** Regional distribution of observed rainfall and of projected rainfall changes. Taking RCP 4.5 and the period 2031-2060 as reference, the increase will be strongest in the southern part including the erosion–prone shores of lake Tanganika and of the central north-south mountain ridge where changes amount to 150 – 200 mm or 10 % of rainfall. Source: Liersch et al., 2014.

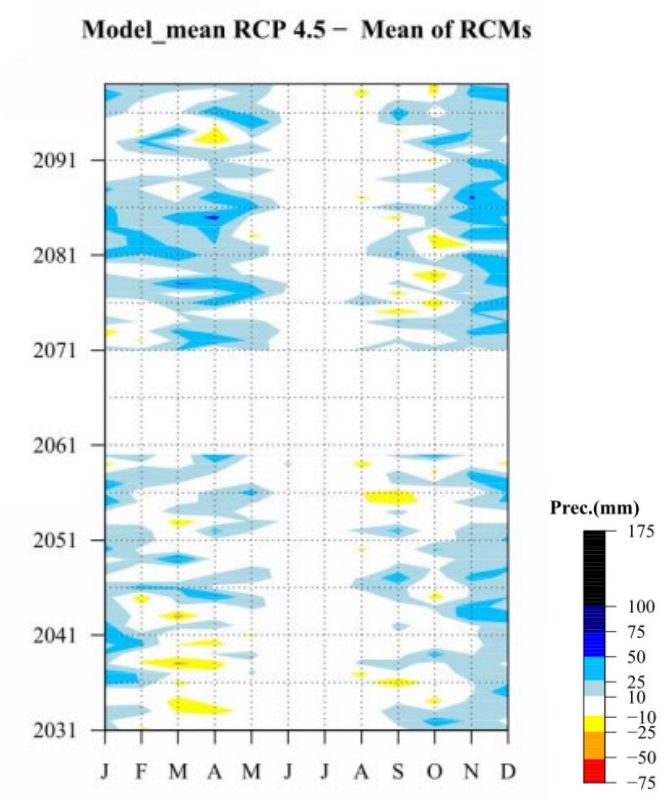



**Fig. A4** Change in the seasonal distribution of rainfall indicating a decrease in March / April and August / September for the period 2031-2041, therefore prolonging the dry period and increasing drought risk and water deficits for rainfed agriculture (Liersch et al., 2014).

**Flood risk**

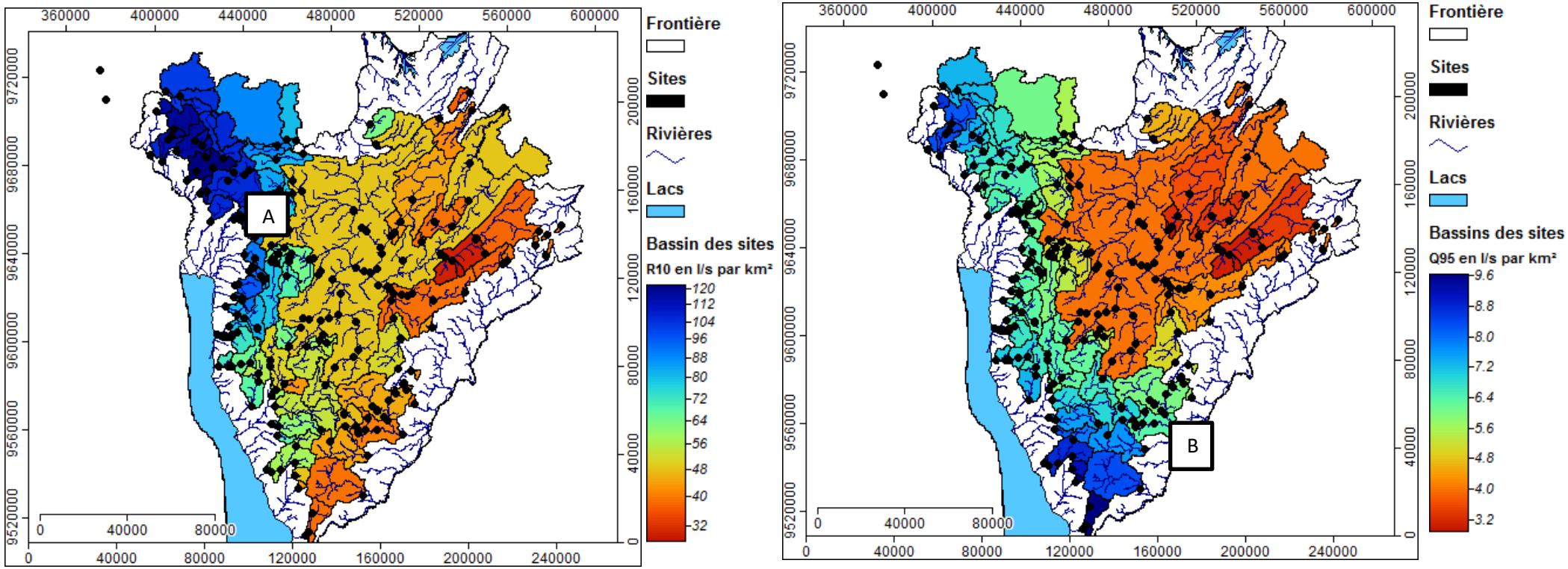



**Fig. A5** Flood risk (above) given as the 10-year flood based on runoff data from Burundi and drought risk given as the 95% quantile of low flow during the dry season (Külls, 2014, Hydropower Atlas of Burundi for Sher Ing.)

**Erosion rates**

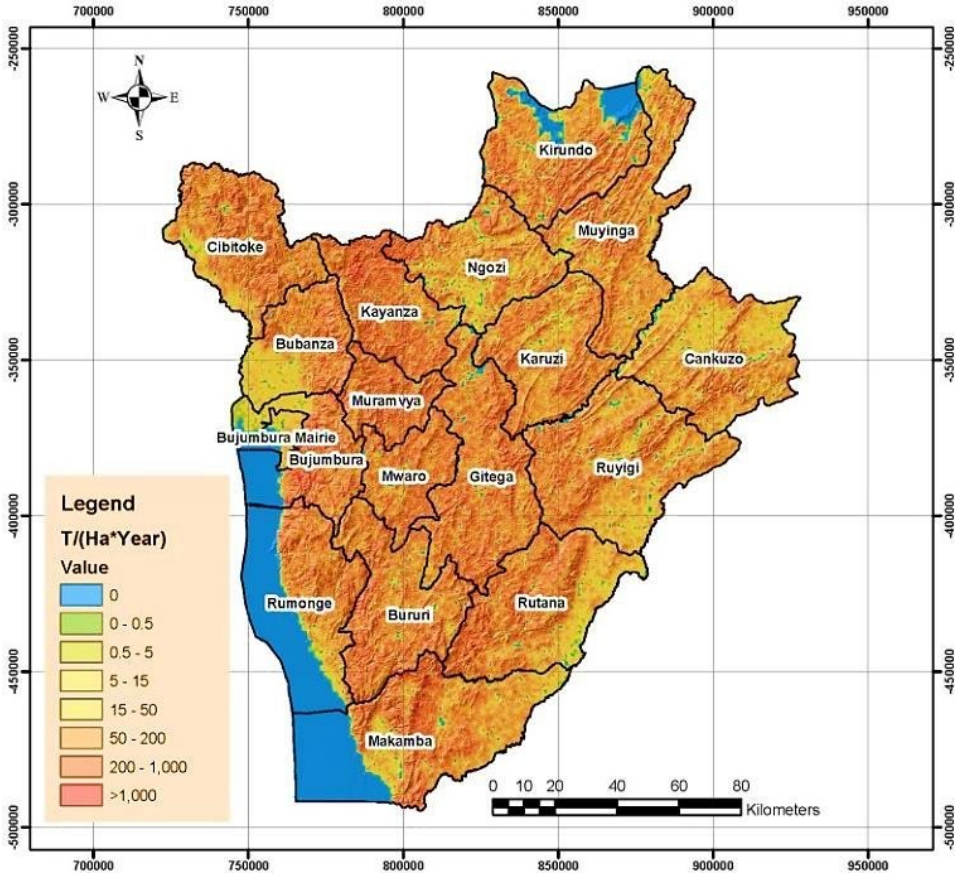
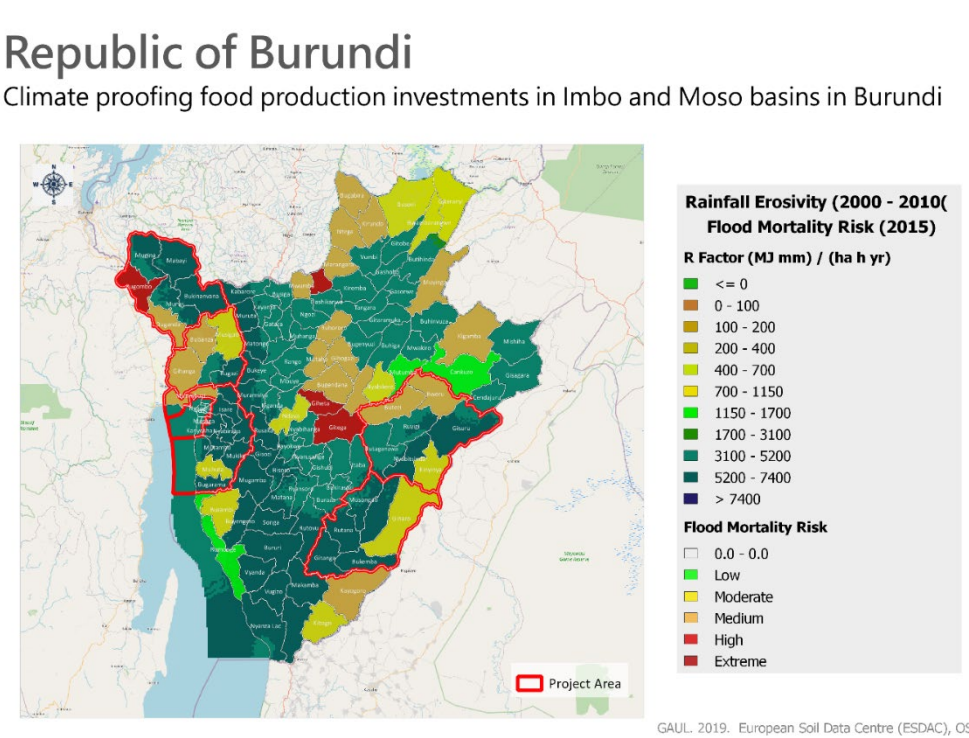
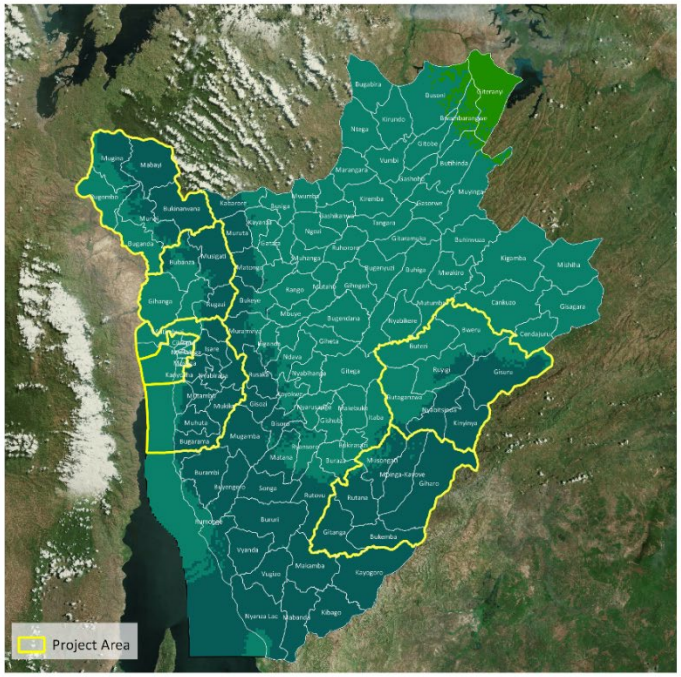



**Fig. A6** Erosion rates of Burundi in T/ha per year. The erosion rates in the study area are classified as severe (50 to 200 t / ha per year). This corresponds to a soil loss of more than 1 cm per year.



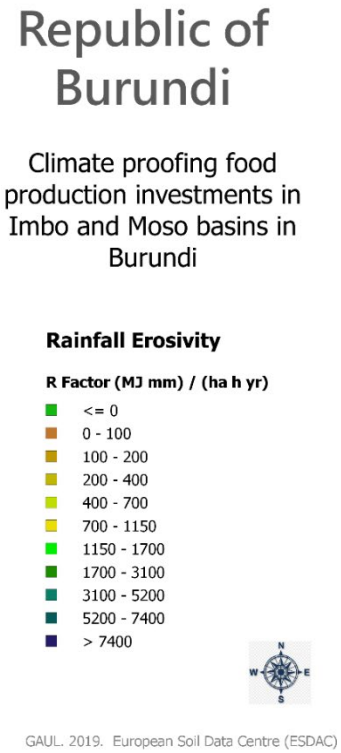




**Fig. A7** Rainfall erosivity rates (2000-2010) and flood mortality risk (2015) in Burundi in the project area (on the left).

**Fig. A8** Rainfall erosivity rates (2000-2010) in Burundi in the project area (on the right).

**References**

Külls C. (2014) Hydro-Power Atlas of Burundi, Hydrological Study. For Sher Ingénieurs.

Liersch S., Rivas R., Fritzsche K. (2014) Climate Change Projections for Burundi - A Summary for Policy Makers. GIZ, April 2014.

Regioclim data sets: http://regioclim.climateanalytics.org/ (Accessed June 2020).

Riveros lizana, C. (2019). Assessment of soil erosion of Burundi using remote sensing and GIS by RUSLE model.