Background

An increasing body of evidence shows that our earth climate system is changing and as a result we are experiencing an increasing intensity and frequency of weather and climate- related hazards and conditions. These effects are already being felt mostly in Africa and other developing regions of the globe where much of the livelihoods of populations depend on weather and natural resources based livelihoods. The situation is made complicated in island states where the constraints of land and resources presentsfurther challenges for adaptation planning and disaster risk management. For a small Island state like Mauritius which derives significant revenue from eco-tourism, the emerging threat of climate change is also a sustainable development challenge.

To this end, the government of the Republic of Mauritius (ROM) is actively engaged in international and local efforts to manage climate change. A major effort of ROM is the African Adaptation Programme where integrated and comprehensive approaches to climate change adaptation and disaster management have been adopted to mainstream climate change into policy and decision-making. To make informed decisions, robust climate data and information is required. However, the generation of robust climate information is a challenging effort that most developing countries, particularly Small Island states, may not be able to undertake on their own. Although international efforts such as the WMO-led CORDEX initiative have been established as a collective attempt to address data gaps, the dynamic modeling resolution adopted is inconsistent with scales at which adaptation is undertaken in Mauritius and other Island states. As if these were not problematic enough, the model outputs have a range of inherent uncertainties that needs to be quantified and applied through statistical techniques to reduce these uncertainties.

In this study, climate analyses focusing on the Vacoas and Plaisance areas are presented. A tool for climate analysis at fine resolution, the University of Cape Town Climate Information Portal (CIP), is used to assess both the current/baseline climate for the period 1961 – 2000 and future climate projections for the periods 2046 -2065 and 2080 – 2100 for a high emission scenario (A2) and a low emission scenario (B1). Additionally, hydro-climatic and bio-physical assessment of the current climate is undertaken for Vacoas, Plaisance and Rodrigues Island, using the Food and Agriculture Organization (FAO) Climate Locator model.

Finally, national trends are presented using a set of indicators related to climate change, including rainfall, water balance, carbon dioxide emissions, biodiversity, forests, and health.

Approach

Statistical downscaling approaches that provide point estimates consistent with the adaptation scales in Mauritius are adopted for this assessment. To reduce the uncertainties in model predictions, a multi-model ensemble approach using the CMIP 3 models is adopted. The 10^{th} and 90^{th}percentiles inter-annual rangeof model projections are used to build an envelope around the median. Observed current inter-annual variability of precipitation has been found to be quite significant compared to future projections and hasbeen factored into the climate analysis. The plots for the projections (B1 and A2) are compared to the control/baseline simulations (1961 - 2000) and the corresponding anomalies are provided as part of the plots.

The multi-model envelopes provide a measure of model uncertainty as they enable us to capture the range of uncertainties in model predictions. The narrower the envelopes the more confident the results will be. This provides a robust approach to interpreting the anomaly.

Two data/information sources and tools are used for climate analyses. First, the Climate Systems Analysis Group of the University of Cape Town Climate Information Portal (CIP) -which uses statistical downscaling and CMIP3 models- is applied for the baseline and projections for the indicators. Secondly, the FAO Climate Locator (LoClim) is used to undertake a baseline assessment of the hydro-climatic and vegetation/biophysical. Several hydro-climatic and bio-physical indicators are assessed.

As for national trends, both national historical time series and international data sources were used to inform the analysis. In particular, projections of climate change impacts on health (Figure 27) are based on the study “Climate Vulnerability Monitor. A guide to the cold calculus of a hot planet.” (Climate Vulnerability Forum, 2012).

VACOAS

Rainfallanalysis for Vacoas

Due to lack of quality data on climatic indicators of extremes, the analysis will focus on the temperature and precipitation indices of monthly rain days, monthly significant/heavy rain days (>10 mm/day) and monthly dry spell duration. These are indicators that are widely used by many sectors and cover much practical applications. In addition, basic temperature and precipitations projections are provided.

Monthly Rain Days

The Monthly Rain Days is a useful measure of the type of daily rainfall for a given month and is mostly important sectors sensitive to frequency of rainfall events. Figure 1 provides a baseline assessment of the mean monthly rain days. The corresponding projected scenarios of A2 and B1 are given in figures 2a – 2d. In particular, figures 2a and 2c show the mean Monthly Rain Days for the SRE A2 scenario for the periods 2046 – 2065 and 2081 – 2100;figures 2b and 2d show the corresponding SRE B1 scenario for the same periods. For each plot, the top panel show the 10th to 90th percentile multi-model range of mean Monthly Rain Days for 20th Century (grey) and future period (red). The bottom panels show the 10th to 90th percentile multi-model range of the mean Monthly Rain Days anomalies between the future simulation period and the 20th Century simulation period

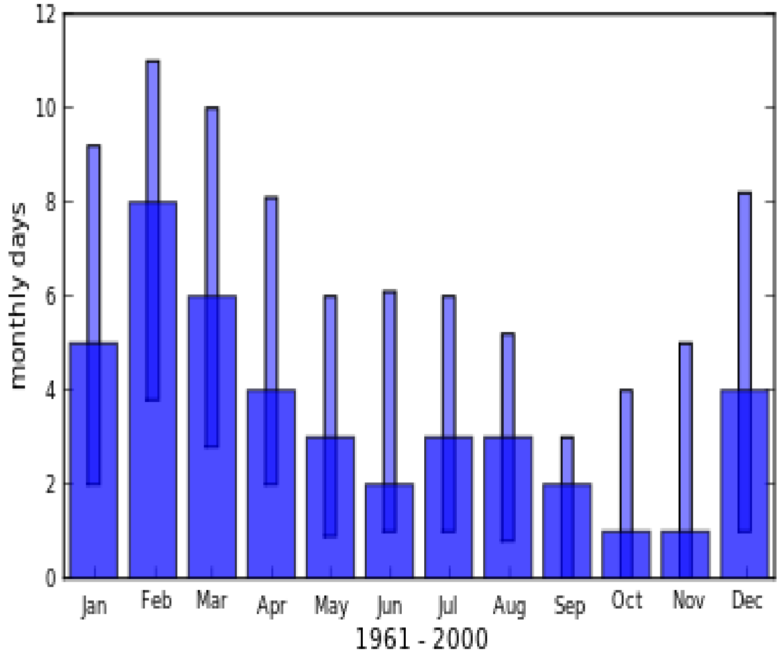


Figure 1: Observed monthly rain days climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)

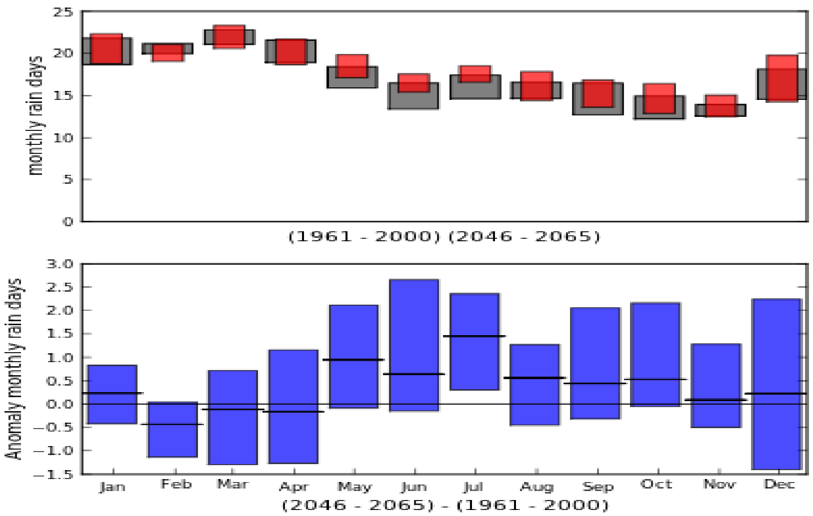


Figure 2a:Monthly Rain Days (10mm) Projections A2 (2046 – 2065)

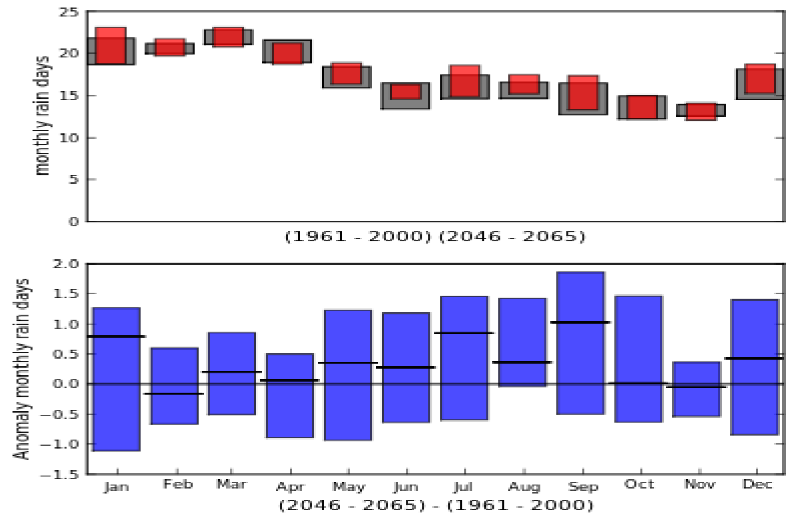
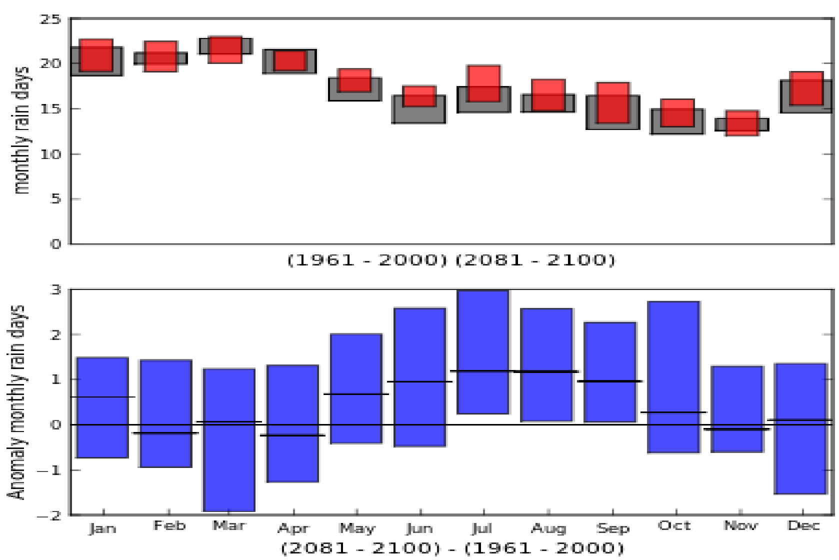


Figure 2b:Monthly Rain Days (10mm) Projections B1 (2046 - 2065)



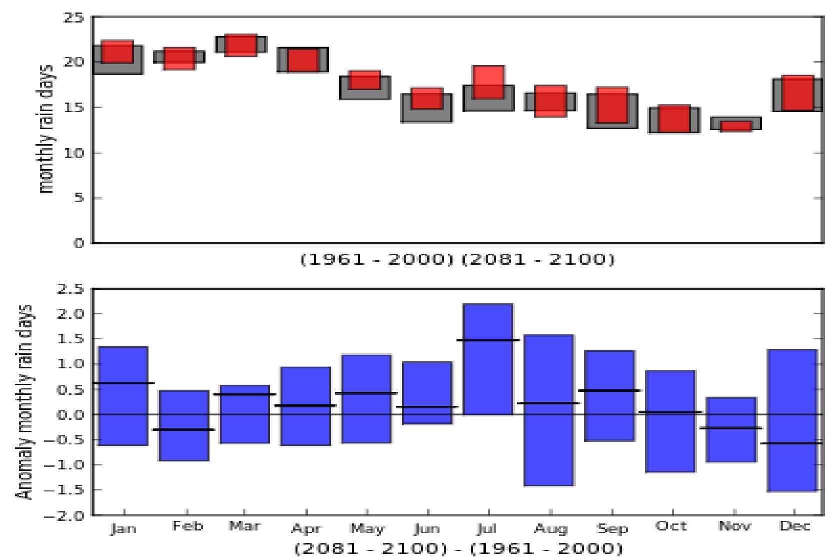


Figure 2c: MonthlyRain Days (10mm) Projections A2 (2081 - 2100)

Figure 2d:Monthly Rain Days (10mm) Projections for B1 (2081 - 2100)

Monthly Significant Rain Days

Monthly Significant Rain Days (> 10mm/day) is a measure of heavy precipitation events in a given month and useful for sectors that are impacted by heavy precipitation and their frequencies. Figure 3 provides a baseline assessment of the mean monthly significant rain days. The corresponding projected scenarios of A2 and B1 are given in figures 4a – 4d. In particular, figures 4a and 4c show the monthly heavy rain days for the SRE A2 secanrio for the periods 2046 – 2065 and 2081 – 2100, while figures 4b and 4d show the corresponding SRE B1 scenario for the same periods. For each plot, the top panel show the 10th to 90th percentile multi-model range of mean monthly heavy rain days for 20th Century (grey) and future period (red). The bottom panels show the 10th to 90th percentile multi-model range of the mean monthly heavy rain days anomalies between the future simulation period and the 20th Century simulation period.

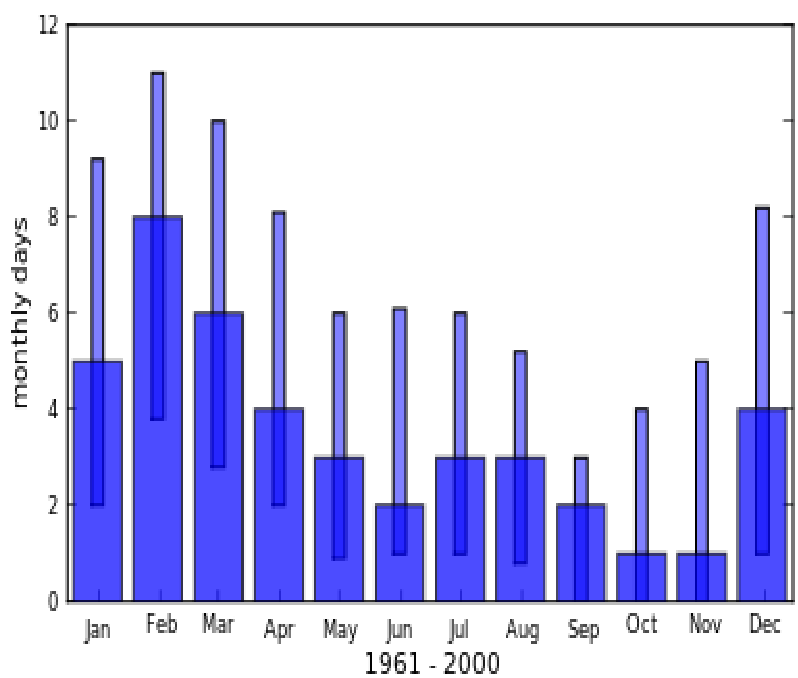


Figure 3: Observed monthly significant/heavy rain days (rainfall > 10mm/day) climatology (wide bars) with 10th to 90th percentile inter-annual range

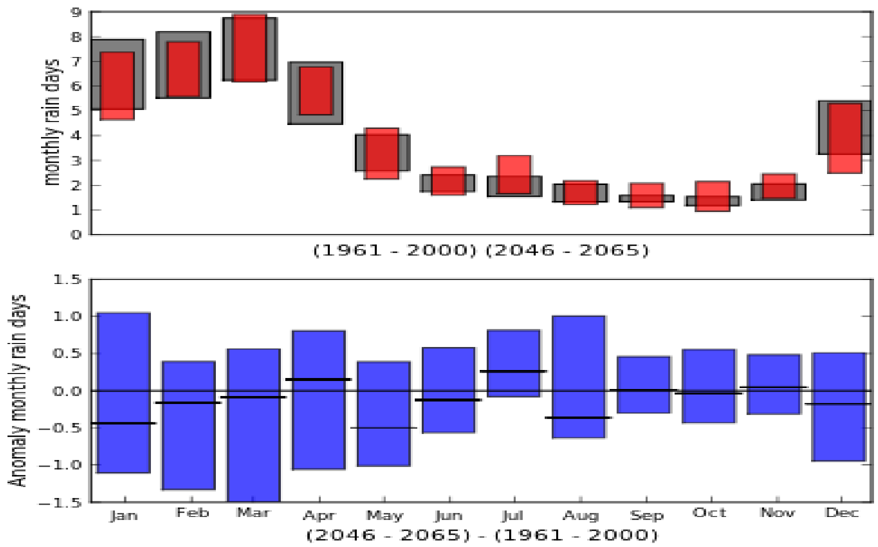


Fig. 4a: Monthly heavy Rain Days (> 10mm/day) Projections A2 (2046 - 2065)

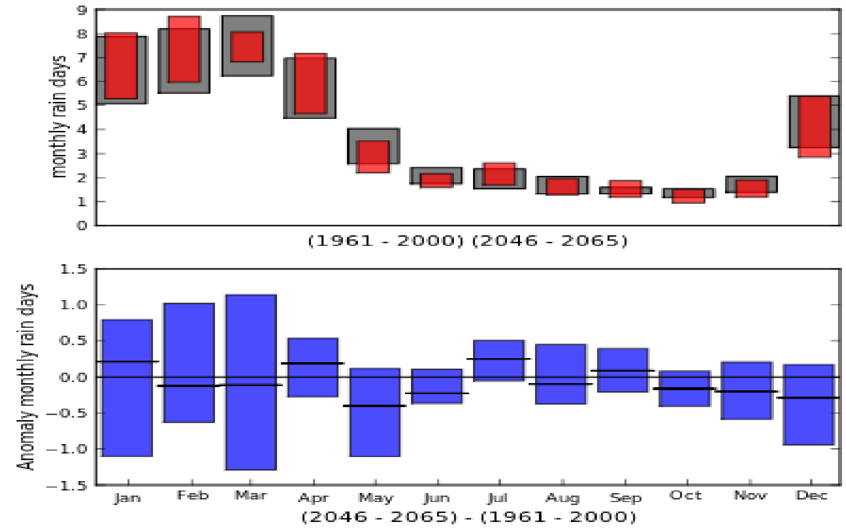


Fig. 4b: Monthly heavy Rain Days (> 10mm/day) Projections B1 (2046 - 2065)

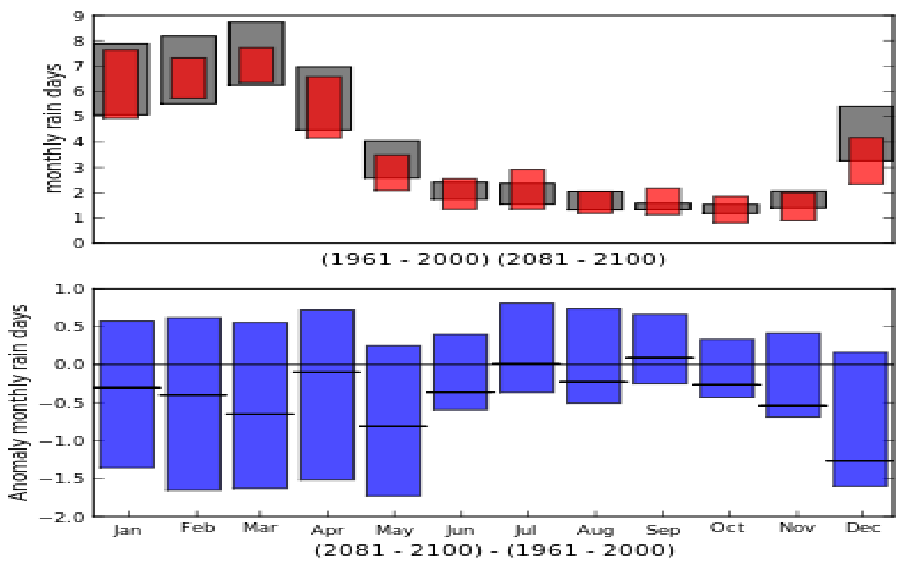


Fig. 4c: Monthly heavy Rain Days (> 10mm/day) Projections A2 2081 - 2100)

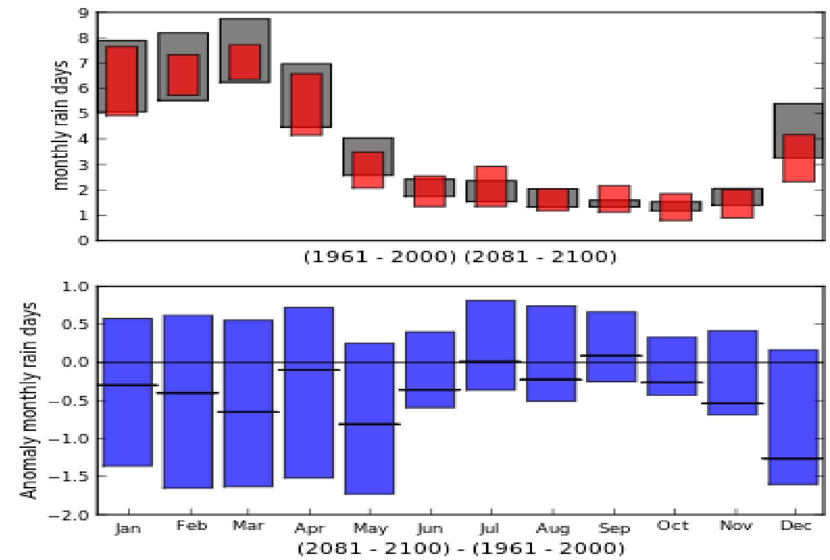


Fig. 4d: Monthly heavy Rain Days (> 10mm/day) Projections B1 (2081 - 2100)

Monthly Dry Spell Duration

Monthly Dry Spell Durationis a measure ofthe number of consecutive dry days between two wet days and an indicator of the day-to-day nature of dry periods. It is useful for sectors that are influenced by drought or absence of rain. Figure 5 provides a baseline assessment of the mean monthly Dry Spell Duration. The corresponding projected scenarios of A2 and B1 are given in figures 6a – 6d. In particular, figures 6a and 6c show the monthly heavy rain days for the SRE A2 secanrio for the periods 2046 – 2065 and 2081 – 2100, while figures 6b and 6d show the corresponding SRE B1 scenario for the same periods. For each plot, the top panel show the 10th to 90th percentile multi-model range of mean monthly heavy rain days for 20th Century (grey) and future period (red). The bottom panels show the 10th to 90th percentile multi-model range of the mean monthly heavy rain days anomalies between the future simulation period and the 20th Century simulation period.

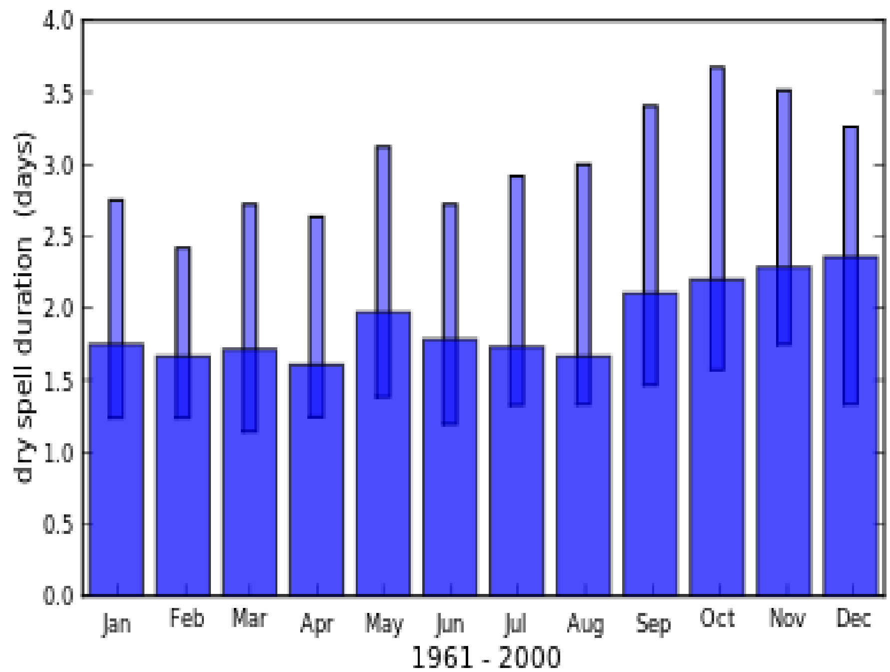


Fig. 5: Observed monthly mean length of dry spells climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)

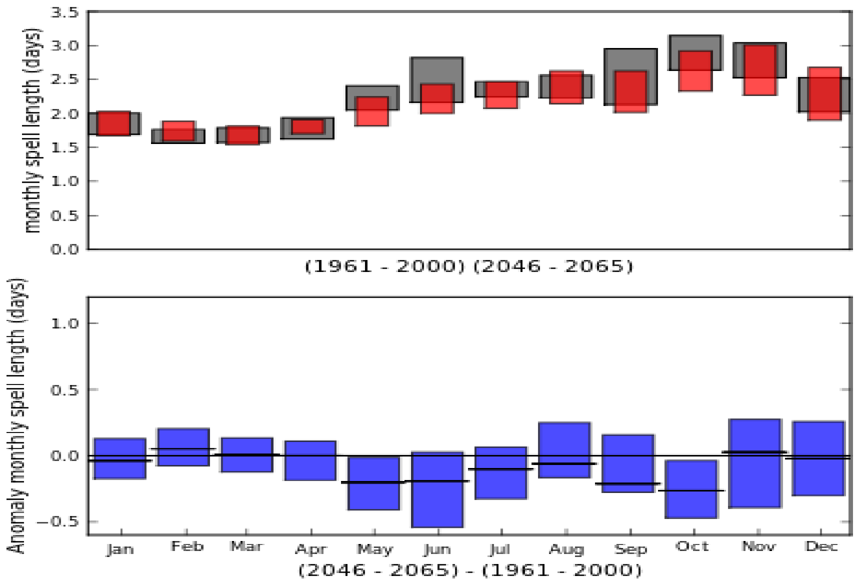


Fig. 6a: Monthly Dry Spell Duration Projections A2 (2046 - 2065)

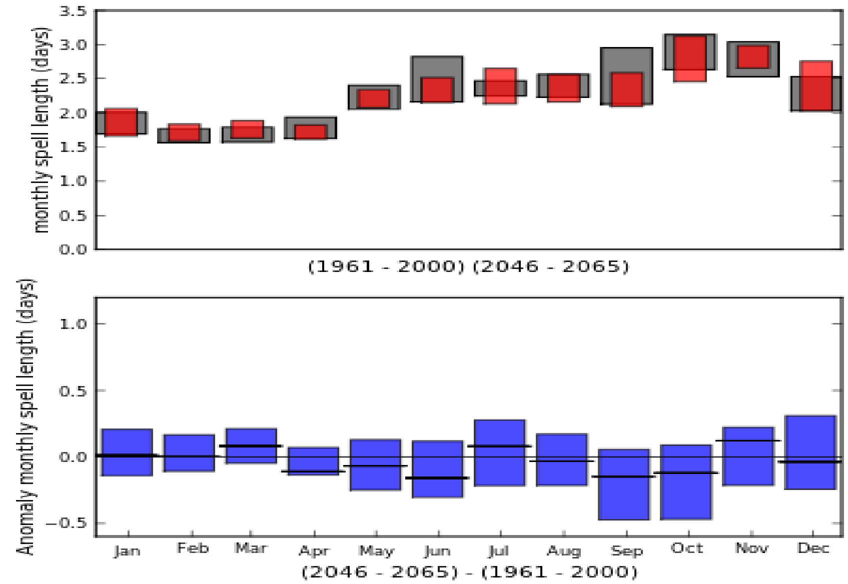


Fig. 6b: Monthly Dry Spell Duration Projections B1 (2046 - 2065)

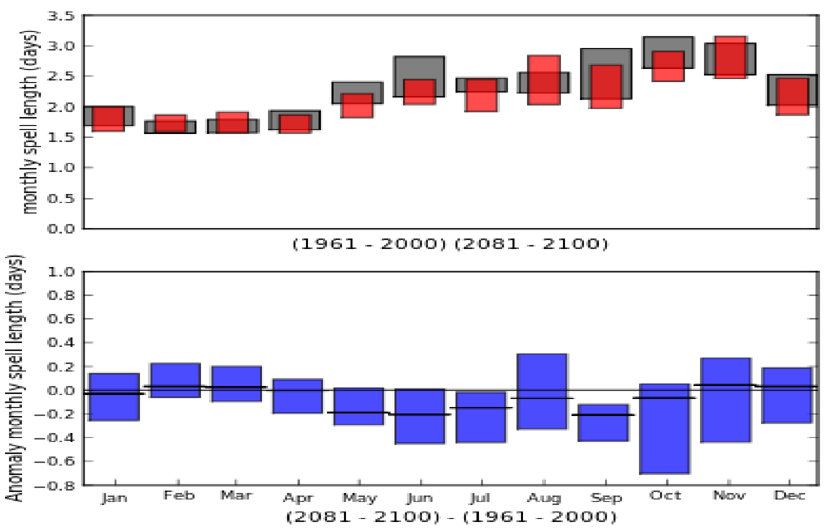


Fig. 6c: Monthly Dry Spell Duration Projections A2 (2081 - 2100)

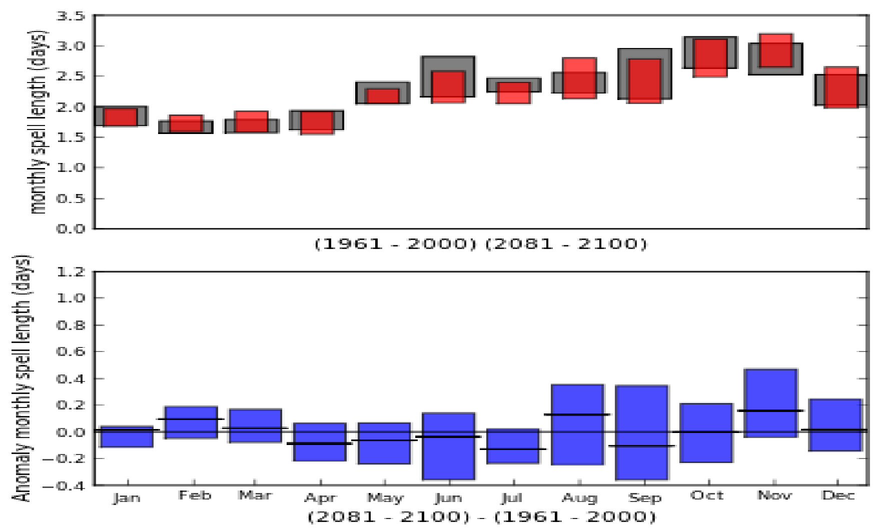


Fig. 6d: Monthly Dry Spell Duration Projections B1 (2081 - 21000

Temperature Analysis for Vacoas

Daily Minimum Temperature

Figures 7a and 7c show the daily minimum temperature for the SRE A2 scenario for the periods 2046 – 2065 and 2081 – 2100. The fig. 7b and 7d show the corresponding SRE B1 scenario for the same periods. For each plot, the top panel show the 10th to 90th percentile multi-model range of monthly mean daily minimum temperatures for 20th Century (grey) and future period (red). The bottom panels show the 10th to 90th percentile multi-model range of monthly mean daily minimum temperature anomalies between the future simulation period and the 20th Century simulation period.

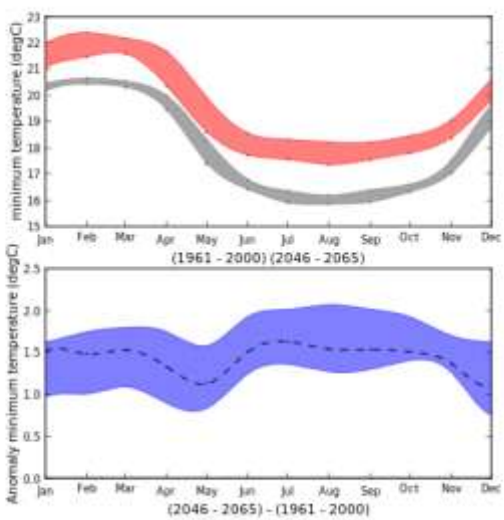


Fig. 7a: A2 scenario for the period 2046 - 2065

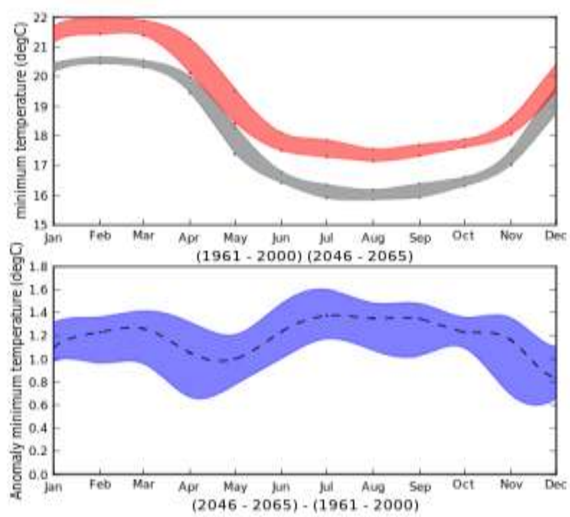


Fig. 7b: B1 scenario for the period 2046 - 2065

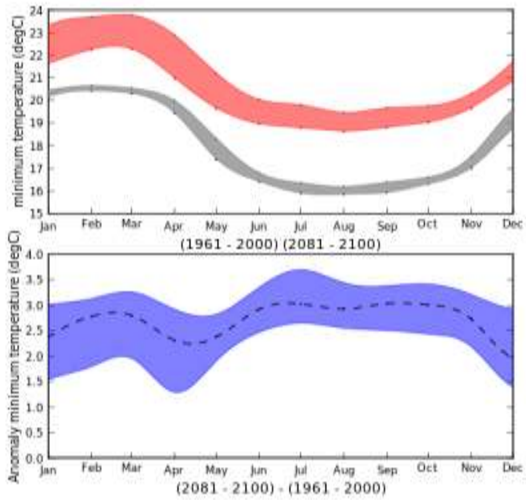


Fig. 7c: A2 scenario for the period 2081 - 2100

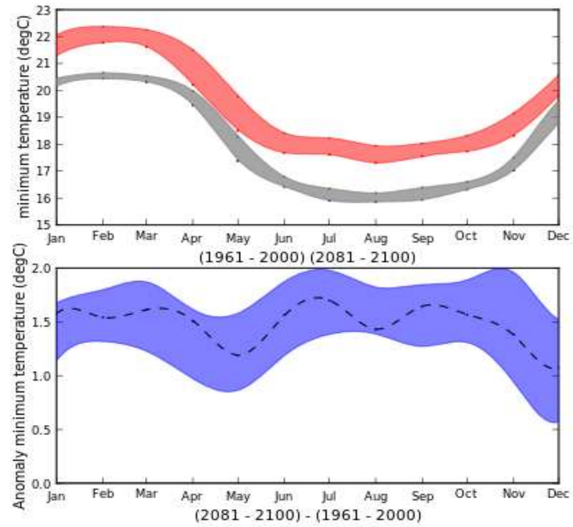


Fig. 7d: B1 scenario for the period 2081 - 2100

Daily Maximum Temperature

The fig. 8a and 8c show the daily maximum temperature for the SRE B1 scenario for the periods 2046 – 2065 and 2081 – 2100. The fig. 8b and 8d show the corresponding SRE A2 scenario for the same periods. For each plot, the top panel show the 10th to 90th percentile multi-model range of monthly mean daily maximum temperatures for 20th Century (grey) and future period (red). The bottom panels show the 10th to 90th percentile multi-model range of monthly mean daily maximum temperature anomalies between the future simulation period and the 20th Century simulation period.

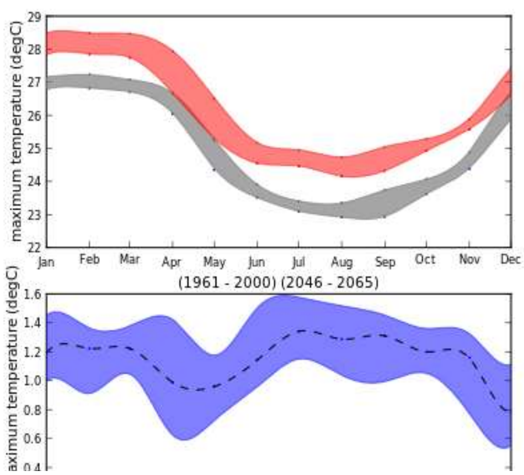


Fig. 8a: B1 scenario for the period 2046 - 2065

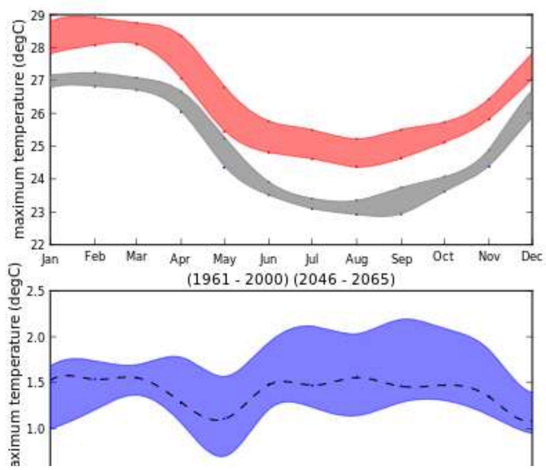
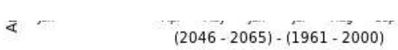
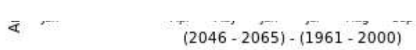


Fig. 8b: A2 scenario for the period 2046 - 2065





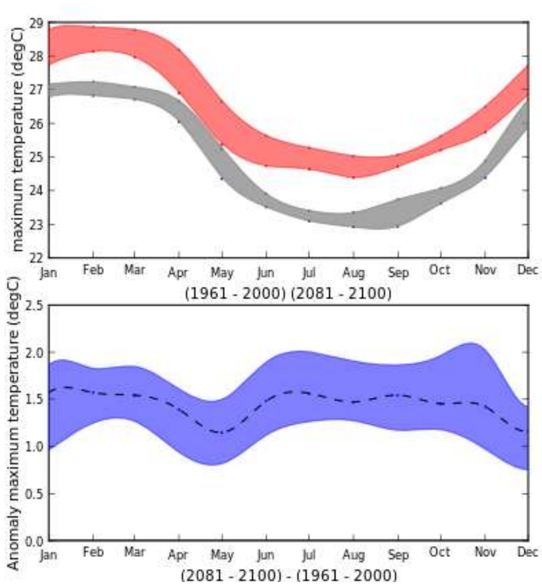


Fig. 8c: B1 scenario for the period 2081 - 2100

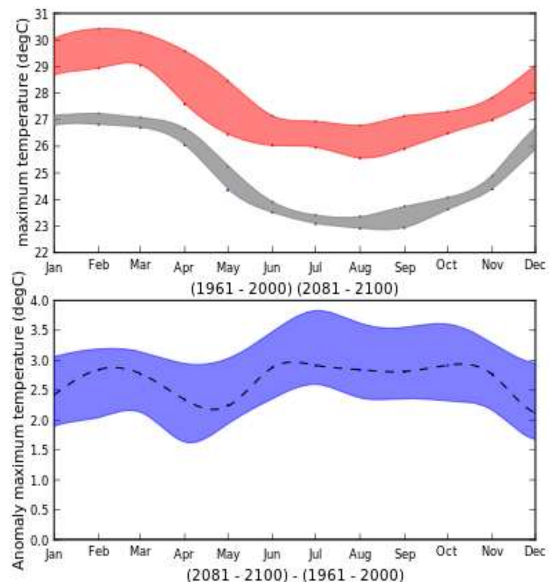


Fig. 8d: A2 scenario for the period 2081 - 2100

Observed hydro-climatic and biophysical indicatiors for Vacoas (1961 - 1990)

Geo-location

<u>Longitude</u>: 57.5°

<u>Latitude</u>: -20.3°

<u>Altitude</u>: 300m

Vegetation period information

Vacoas has one of the best climates in Mauritius that favour vegetation growth all year round. The vegetation period and growing season lengths for both the humid and moist period are shown in figure 1. The corresponding values for the lengths, start and end dates of the total (sum of humid and moist) and humid are given in table 1. This indicates the absence of a dry period and year round rain-fed farming potential.

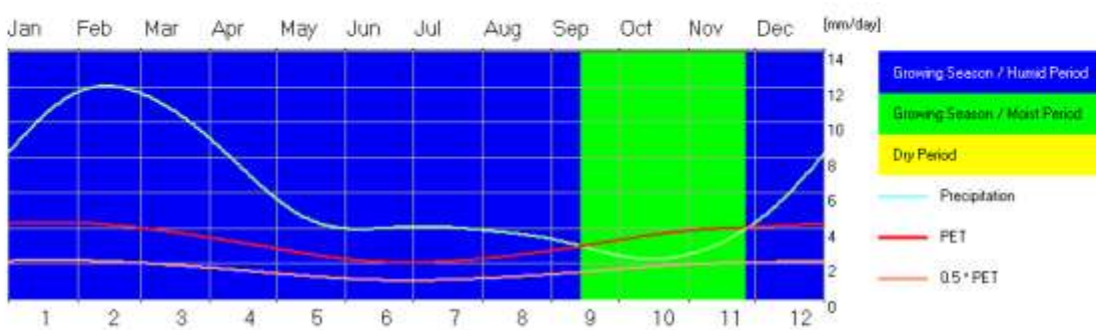


Figure 9: The vegetation period showing the growing season length, the humid and moist period.

	Length	Begin Date	Begin Day	End Date	End Day	T_Mean °C	T_Min °C	T_Max °C	Precip. mm/day	PET mm/day	Wind Speed	Sunfract. %	Vapor Pressure hPa

											km/h		
Moist+Humid	365	1 JAN	1	31 DEC	365	21.1	17.5	24.6	5.9	3.3	2.8	57.7	19.9
Humid	291	27 Nov	331	13 SEP	256	21.3	17.8	24.8	6.7	3.2	2.7	58	20.4

Table1: Growing season period and related information

Hydro-Climatic Information

Hydro-climatic indicators provide a measure of how the soil, vegetation and the atmosphere interact and particularly impacts on the hydrological cycle and general ecology. The hydro-climatic indicators for this assessment constitute Koeppen, Budyko, aridity, net primary producton and the GorczynskiContinentality indices that are summarized in tables2 and3 below. These indicators enable the characterization of the climate and biophysical processes of a given area and provide a basis for environmental and development planning. As climate change gathers pace, it is envisaged that these indicators will also change and thus could be useful entry point for adaptation planning and development strategies. For example, precipitation deficit is -947 mm/year indicating a surplus of 947 mm/year; an evaporation ratio of 59% and 41% runoff ratio indicate majority of the rainfall is lost through evaporation. This information can be used to develop adaptation strategies to minimize evaporation so that more water is made available for both residential and industrial use.

Koeppen Class: Cfa
C = Warm Temperate Climate
f = fully humid
a = hot summer

Budyko Climate: Forest
Radiation index of Dryness: 0.755
Budyko Evaporation: 259 mm/year
Budyko Runoff: 876 mm/year
Budyko Evaporation: 59 %
Budyko Runoff: 41 %

Aridity: humid
Aridity Index: 1.8
Moisture Index: 80 %.
DeMartonne Index: 69
Precipitation Deficit: -947 mm/year

Climatic net primary production: 2273 g(DM)/m2/year

NPP(Temperature): 2300 g(DM)/m2/year
NPP(Precipitation): 2273 g(DM)/m2/year
NPP is precipitation limited.

GorczynskiContinentality Index: 11.5

Table 2: Climate and vegetation classification

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Effective Rain [mm]	158	158	158	143	106	100	99	89	77	61	87	129	1363
Effective Rain Ratio [%]	48	48	48	65	78	80	80	83	86	89	83	71	64
Rainy Days	24	22	24	19	14	14	14	13	11	9	12	17	198

Table 3: Annual hydrological indicators of rainfall and its effective use for land surface processes.

<u>Data and information source: FAO Climate Locator Software (NewLoclim).</u>

PLAISANCE

Rainfall Analysis for Plaisance,

The session provides an analysis of the observed/baseline mean monthly rainfall and rainfall-based indicators of heavy rainfall days and mean dry spell duration for Plaisance over the period 1951 - 2000. The corresponding future projections are undertaken for the period 2046 – 2065 and 2081 – 2100 for the A2 and B1 SRE scenarios. The baseline/observed climatology (wide bars) consisting of the 10th to 90th percentile inter-annual range (narrow bars) annual cycle of mean indicators over the period 1951 to 2000 are presented. For the projected scenarios, analysis of the 10th to 90th percentile multi-model range of an indicator for 20th Century (grey) and future period (red) are presented. In addition, analysis of the corresponding 10th to 90th percentile multi-model range of indicator anomalies between the future simulation period and the 20th Century simulation period are also undertaken. The subsequent sessions provides a detailed analysis of the rainfall statistics.

Observed Monthly Rain Days

Fig 10 shows the observed mean monthly rain days climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars) annual cycle of mean monthly rain days over the period 1951 to 2000 in Plaisance. The rainfall shows a bimodal distribution with highest peak in March (22 days) and lower peak in July (21 days). Majority of months have over 18 days (January to August) and October to November having the lowest (13 days).

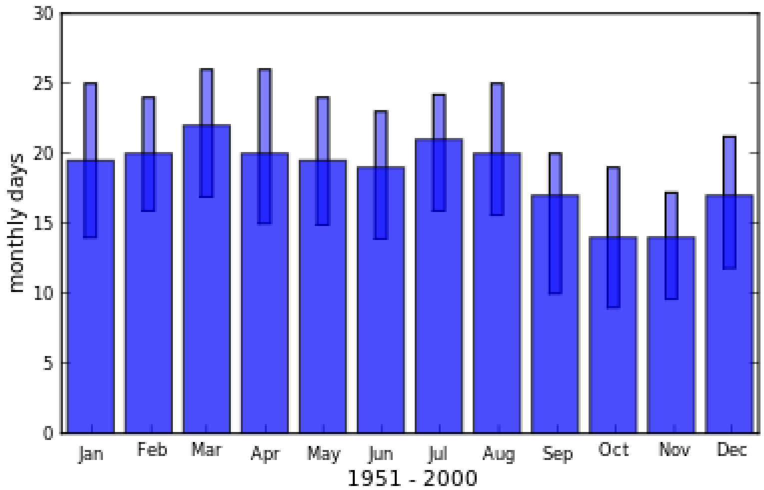


Fig. 10: Observed monthly rain days climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)

Observed Mean Monthly Heavy Rain Days (> 10mm/day)

Fig 11 shows the observed mean monthly heavy rain days (rainfall > 10mm/day) climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars). The distribution show a mono-modal pattern with peak (about 5 days) evenly distributed from January to April and begin to decrease from May reaching its lowest value (about 1 day) from August to October. The inter-annual variability is higher for the peak months (particularly March which also the month with the highest monthly rain days).

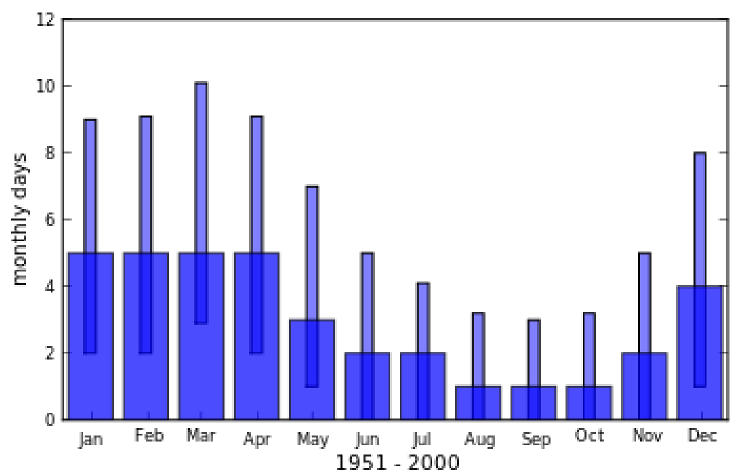


Fig.11: Observed monthly rain days (rainfall > 10mm/day) climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)

Observed Monthly Mean Dry Spell Duration

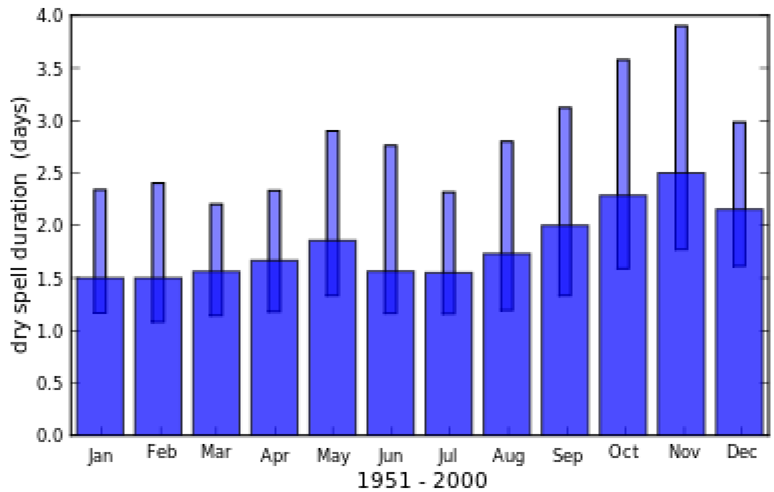


Fig. 12: Observed monthly mean length of dry spells climatology (wide bars) with 10th to 90th percentile inter-annual range (narrow bars)

The observed monthly mean dry Spell duration is illustrated in fig 12. It follows a bi-modal distribution with a maximum peak in November (about 2.5 days) minimum peak in May (about 1.8 days) which is an inverse relation with the mean monthly rain days climatology of fig p1. The lowest value is found in January and February (1.5 days) and March, June and July (about 1.6 days) not too different from the minimum.

Projected monthly rainfall statistics

The projected monthly rainfall statistics based on the SRE A2 and B1 scenarios for the period covering 2046 -2046 and 2081 – 2100 are presented in this section and illustrated in figures (13 – 15). The top panels of the plots represents the 10th to 90th percentile multi-model range of an indicator for 20th Century (grey) and future period (red). The bottom panels represent the corresponding 10th to 90th percentile multi-model range of indicator anomalies between the future simulation period and the 20th Century simulation period. For the anomaly (bottom panel), the black line at the zero represents the reference where there is no change between the future and baseline climates whereas the (short) black line in the blue box (10th to 90th percentile multi-model range) for each month represents the median value for that particular month. When the (short) black line is above zero then there is a positive change (high probability of an increase) and a negative change (high probability of a decrease) when below zero. The analysis for each indicator is provided below.

Projected Monthly Mean Dry Spell Duration

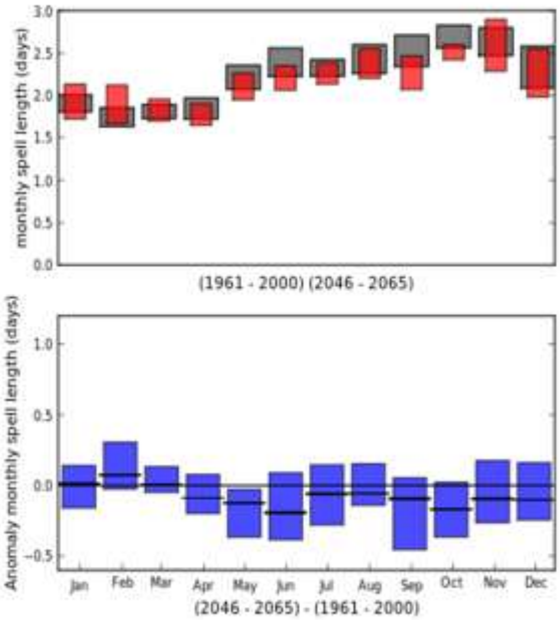
The projected Monthly Mean Dry Spell Duration for the SRE A2 and B1 scenarios for the period 2046 – 2065 and 2081 – 2100 can be found in figure 13a - 13d. The median of the effective changes in the duration of dry spells analyzed from the anomaly plots show for the period 2046 -2065 and 2081 – 2100 and for both A2 and B1 scenarios are about ± 0.2 days for A2 and less than ± 0.2 for B1. Majority of the changes show a more reduction in dry spell duration. Although these changes may not be significant, they are consistent with the projections for the mean monthly rain days where there is a tendency for an increase in rainfall episodes.

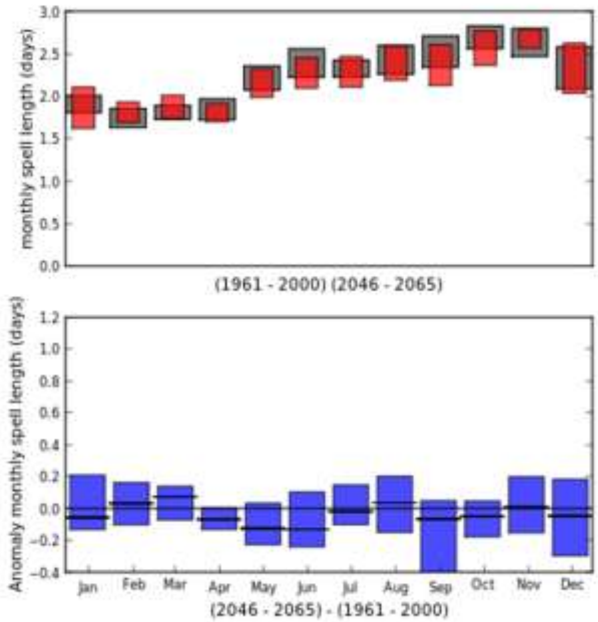
Projected Mean Monthly Heavy Rain Days (> 10mm/day)

Figure 14a – 14d illustrates the projected changes in Mean Monthly Heavy Rain Days (> 10mm/day) for the SRES A2 and B1 scenarios for the period 2046 – 2065 and 2081 – 2100. For the period 2046 – 2065 A2 has a median of 0.5 days (an increase) for April whereas remaining months had a decrease of up to 0.5 days. For the B1 scenario, four months had increases of up to 0.5 days, seven months with decrease of up to 0.5 days and one month with no change (April). For the corresponding scenarios for the period 2081 – 2100, there is a consistent decrease for all months with a range of 0.2 - 0.8 days for A2 scenario and 0.2 - 0.5 days for the B1 scenario.

Projected Monthly Rain Days

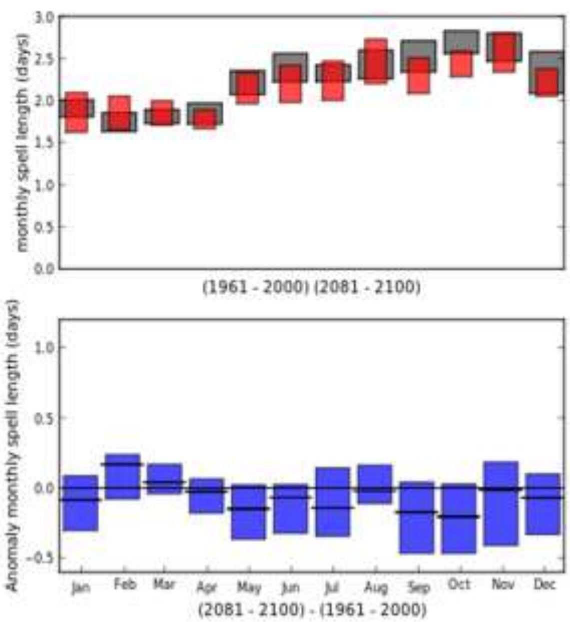
A similar analysis to the above indicators is presented for the projected monthly rain days and illustrated in figures Figure 15a – 15d illustrates the projected changes in Mean Monthly Rain Days (mm/day) for the SRES A2 and B1 scenarios for the period 2046 – 2065 and 2081 – 2100. For the period of 2046 – 2065, the median values for the A2 scenario ranges from -0.4 to 1.0 with highest occurring in July whereas the corresponding B1 scenario has a range of -0.5 to 1 with the highest also occurring in July. For the period 2081 – 2100, the median values for the various months range from -0.2 to 1 for the A2 scenario and -0.2 to 1.2 for the B1 scenario with peaks also occurring in July for both scenarios.

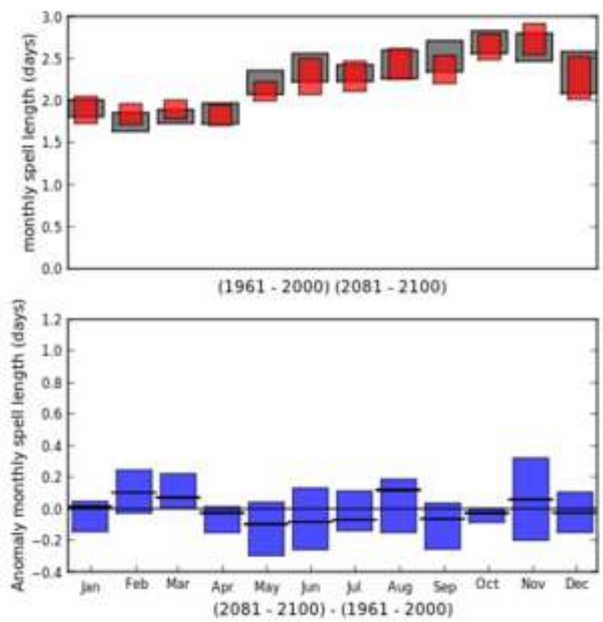




a) A2 (2046 - 2065) **Monthly Dry Spell Duration Projections**

b) B1 (2046 - 2065) **Monthly Dry Spell Duration Projections**

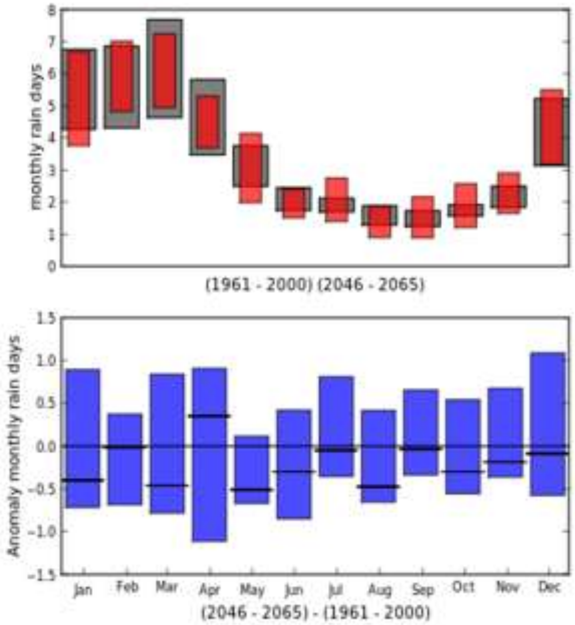




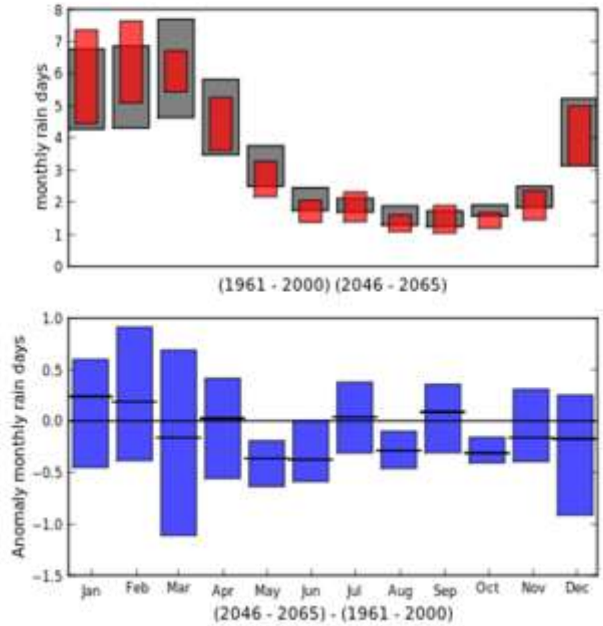
c) A2 (2081 - 2100) **Monthly Dry Spell Duration Projections**

d) B1 (2081 - 2100) **Monthly Dry Spell Duration Projections**

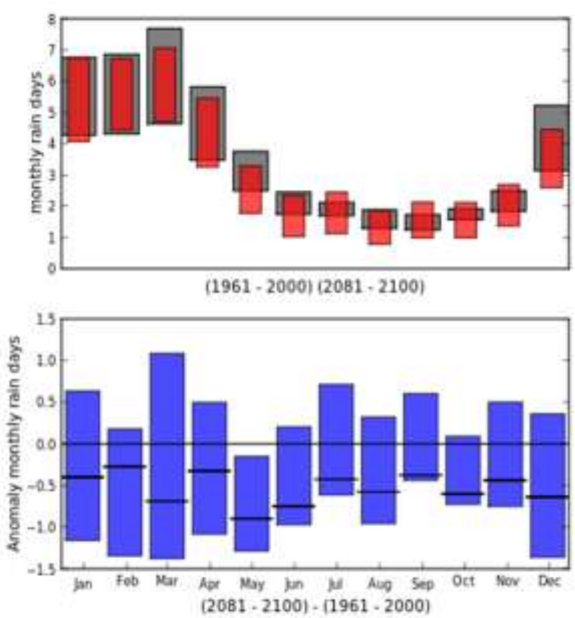
Figure 13: Top panel: 10th to 90th percentile multi-model range of monthly dry spell duration for 20th Century (grey) and future period (red). Bottom panel: 10th to 90th percentile multi-model range of monthly dry spell duration anomalies between the future simulation period and the 20th Century simulation period.



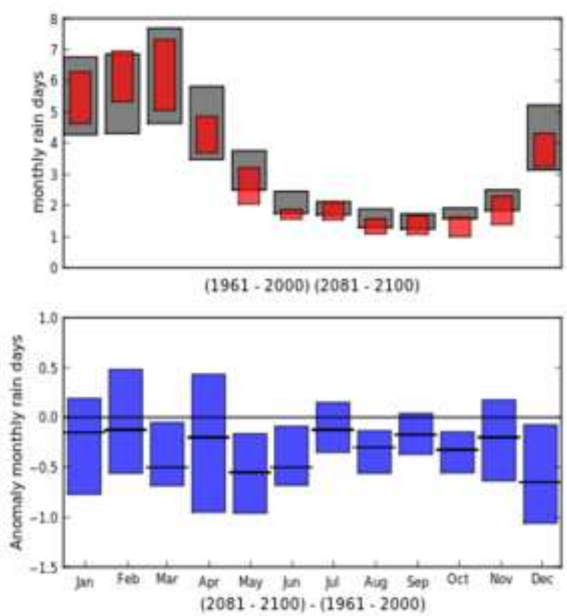
a) A2 (2046 - 2065) Monthly Rain Days (> 10mm/day) Projections



b) B1 (2046 - 2065) Monthly Rain Days (> 10mm/day) Projections

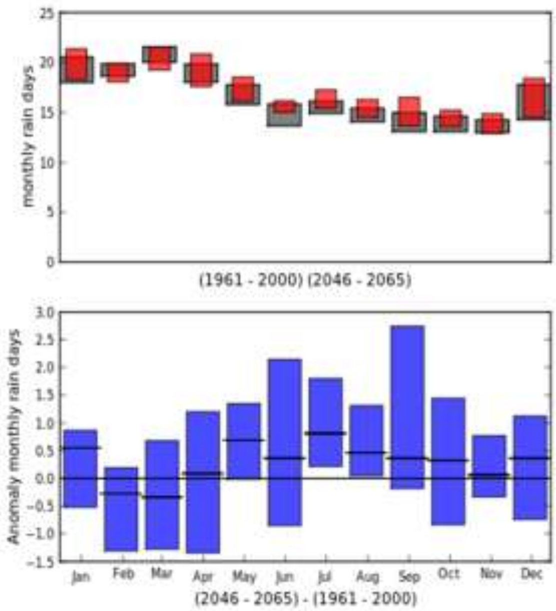


c) A2 (2081 - 2100) Monthly Rain Days (> 10mm/day) Projections

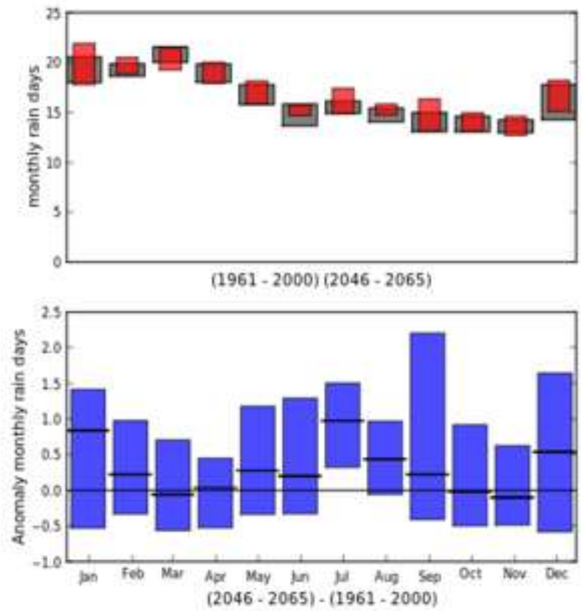


d) B1 (2081 - 2100) Monthly Rain Days (> 10mm/day) Projections

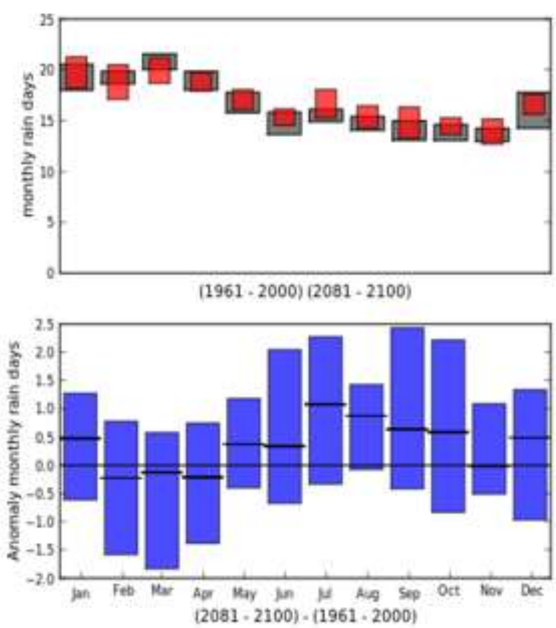
Figure 14: Top panel: 10th to 90th percentile multi-model range of monthly heavy rain days for 20th Century (grey) and future period (red). Bottom panel: 10th to 90th percentile multi-model range of monthly heavy rain days anomalies between the future simulation period and the 20th Century simulation period.



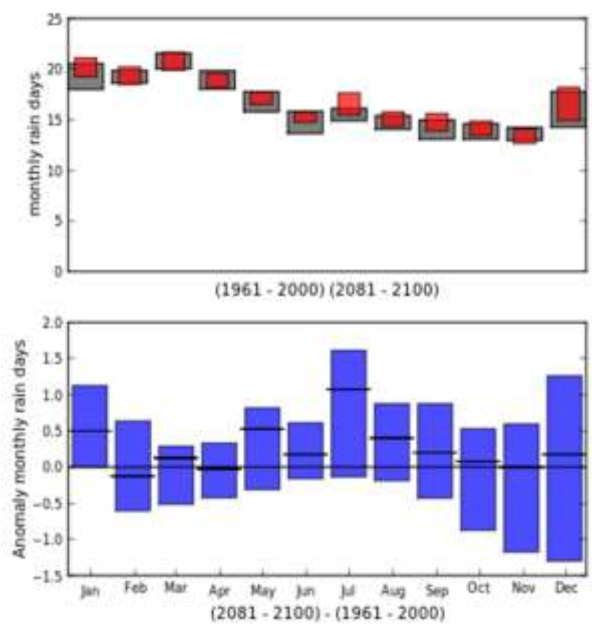
a) A2 (2046 – 2065) Monthly Rain Days



b) B1 (2046 – 2065) Monthly Rain Days



c) A2 (2081 – 2100) Monthly Rain Days



d) B1 (2081 – 2100) Monthly Rain Days

Figure 15: Top panel: 10th to 90th percentile multi-model range of monthly rainfall totals for 20th Century (grey) and future period (red). Bottom panel: 10th to 90th percentile multi-model range of monthly rainfall anomalies between the future simulation period and the 20th Century simulation period.

Observed hydro-climate and vegetation characteristics of Plaisance

Vegetation period and growing season characteristics

The vegetation and growing seasons ofPlaisance is shown in figure 16 and tables 4 and 5. It is characterized by a short dry period of 9 days in length and a long humid and moist periods/growing season of duration 356 days of which 254 days constitute a humid period. The Climatic Net Primary Production (NPP) is precipitation limited with a value of 2088 g(DM)/m2/year. The Koeppen classification indicates an Equatorial climate with full humid rain forest and the Budyko Climate for the area is classified as forest. Plaisance therefore is suitable for agricultural and plantation related activities.

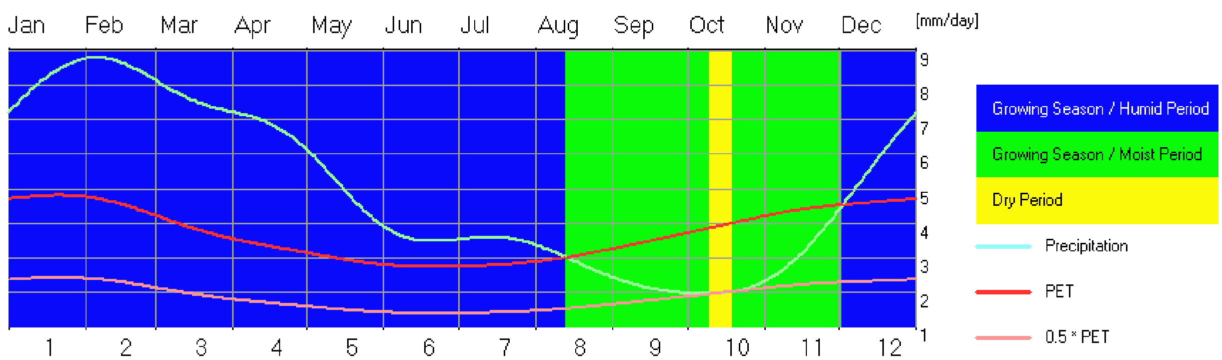


Figure 16: Vegetation periods and growing season characteristics of Plaisance.

	Length	Begin Date	Begin Day	End Date	End Day	T_Mn °C	T_Mx °C	Precip. mm/day	PET mm/day	Wind Speed km/h	Sun fract. %	Vap. Pres. hPa
Dry	9	10 OCT	283	18 OCT	291	18.7	18.7	26	3.9	14	55.7	21.4
Moist +Humid	356	19 OCT	292	9 OCT	282	20.1	26.9	5	3.7	14.1	54.6	23.8
Humid	254	2 DEC	336	12 AUG	224	20.7	27.4	6	3.6	13.9	54.6	24.8

Table 4: Vegetation periods and growing season characteristics of Plaisance.

The hydro-climatic indicators are given in tables 5 and 6. With an evaporation of 1186 mm/year (66.2%), runoff of 607 mm/year (33.8%) and precipitation deficit of -446 mm/year (surplus), Plaisance climate provides a conducive environment for agricultural activities.

Koeppen Class: Af
A = Equatorial Climate
f = full humid rain forest

Budyko Climate: Forest
Radiation index of Dryness: 0.917
Budyko Evaporation: 1186 mm/year
Budyko Runoff: 607 mm/year
Budyko Evaporation: 66.2 %
Budyko Runoff: 33.8 %

Aridity: humid
Aridity Index: 1.33
Moisture Index: 33 %.
DeMartonne Index: 54
Precipitation Deficit: -446 mm/year

Climatic net primary production: 2088 g(DM)/m2/year,
NPP(Temperature): 2442 g(DM)/m2/year
NPP(Precipitation): 2088 g(DM)/m2/year
NPP is precipitation limited.

GorczynskiContinentality Index: 5.9

Table 5: Hydro-climatic classification and indicators in Plaisance.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Effective Rain [mm]	150	149	142	143	113	85	93	76	55	60	76	132	1274
Effective Rain Ratio [%]	60	61	65	65	76	84	82	86	90	89	86	70	71
Rainy Days	20	18	18	18	15	11	12	10	7	8	9	16	162

Table 6: Mean monthly Indicators of effective rainfall and rainy days in Plaisance.

RODRIGUES

Observed hydro-climate and vegetation characteristics of Rodrigues

Vegetation period and growing season characteristics

The vegetation and growing season dynamics of Rodrigues is illustrated in figure 17 and table 7. It is characterize by two clearly distinguished seasons of rainy and dry seasons as well as three vegetation periods of humid and moist periods (growing season/period) where rain-fed farming is possible and a dry period where rain-fed agriculture is not feasible. The humid growing season length is 68 days and starts from 28 January and ends on 5th April. The total growing season length of both moist and dry periods is 257 days with a starting date of 6 December and ending date of 19 August.

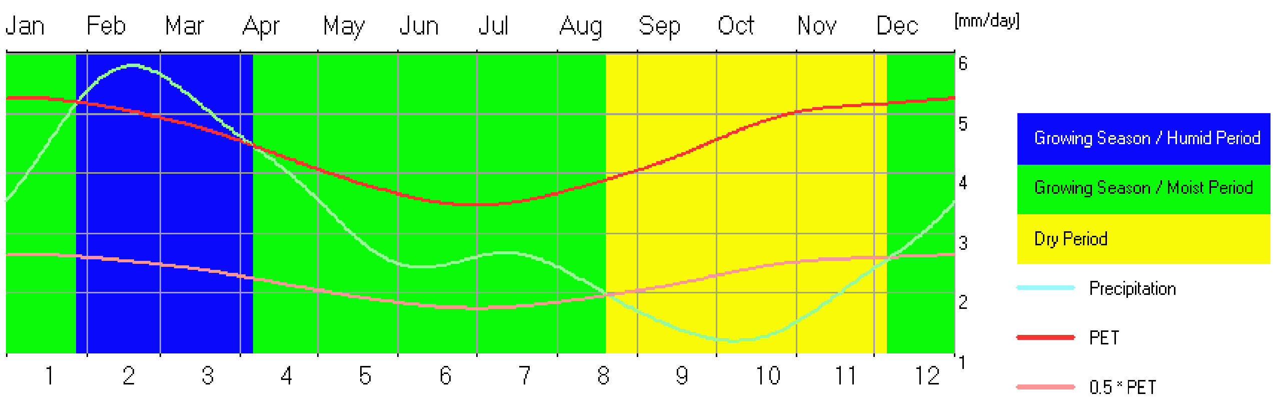


Figure 17: Vegetation periods and growing season characteristics of Rodrigues.

	Length Days	Begin Date	Begin Day	End Date	End Day	T_Mn °C	T_Mx °C	Precip. mm/day	PET mm/day	Wind Speed km/h	Sun fract. %	VapPreshPa
Dry	108	20 AUG	232	5 DEC	339	20	26.1	1.6	4.7	17.8	69.2	20.9
Moist +Humid	257	6 DEC	340	19 AUG	231	21.9	27.4	3.7	4.4	17.6	68.2	24.1
Humi	68	28	28	5 APR	95	23.7	29.2	5.3	4.9	17.9	67.6	27.6

d		JAN										

Table 7: Vegetation periods and growing season characteristics of Rodrigues.

Hydro--Climatic Classification

Rodrigues is characterized by an equatorial climate and savannah with dry winter. Tables 8 and 9 provide details on hydro-climatic indicators of the hydrological and biophysical processes. It has a high evaporation rate of 84.4%, precipitation deficit of 510 mm/year and a low run-off rate of 15%. As a result, it is prone to water shortages. Based on these indicators an adaptation strategy could be developed to enable Rodrigues to meet its water needs. One approach is to reduce the high evaporation by adopting water storage and rainfall harvesting strategies.

Koeppen Class: Aw
A = Equatorial Climate
w = savannah with dry winter

Budyko Climate: Steppe
Radiation index of Dryness: 1.621
Budyko Evaporation 943 mm/year
Budyko Runoff 174 mm/year
Budyko Evaporation 84.4 %
Budyko Runoff 15.6 %

Aridity:subhumid
Aridity Index: 0.69
Moisture Index: -31 %.
DeMartonne Index: 33
Precipitation Deficit: 510 mm/year

Climatic net primary production: 1571 g(DM)/m2/year,
NPP(Temperature): 2476 g(DM)/m2/year
NPP(Precipitation): 1571 g(DM)/m2/year
NPP is precipitation limited.

GorczynskiContinentality Index: 5.9

Table 8: Hydro-climatic classification and indicators in Rodriques.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Effective Rain [mm]	104	123	114	102	75	64	73	55	38	36	57	77	919
Effective Rain Ratio [%]	79	73	76	79	86	88	86	90	93	94	90	86	82
Rainy Days	12	14	13	12	9	8	10	7	5	5	7	9	111

Table 9: Mean monthly Indicators of rainfall efficiency and rainy days in Rodriques.

OTHER CLIMATE CHANGE INDICATORS FOR MAURITIUS

A number of relevant indicators can provide additional information to analyze climate change impacts on ROM, as well as to assess the impact of environmental management approaches and current production and consumption modes on climate change patterns and trends. Some useful figures are proposed hereafter, based on national and international data.

Mean annual rainfall

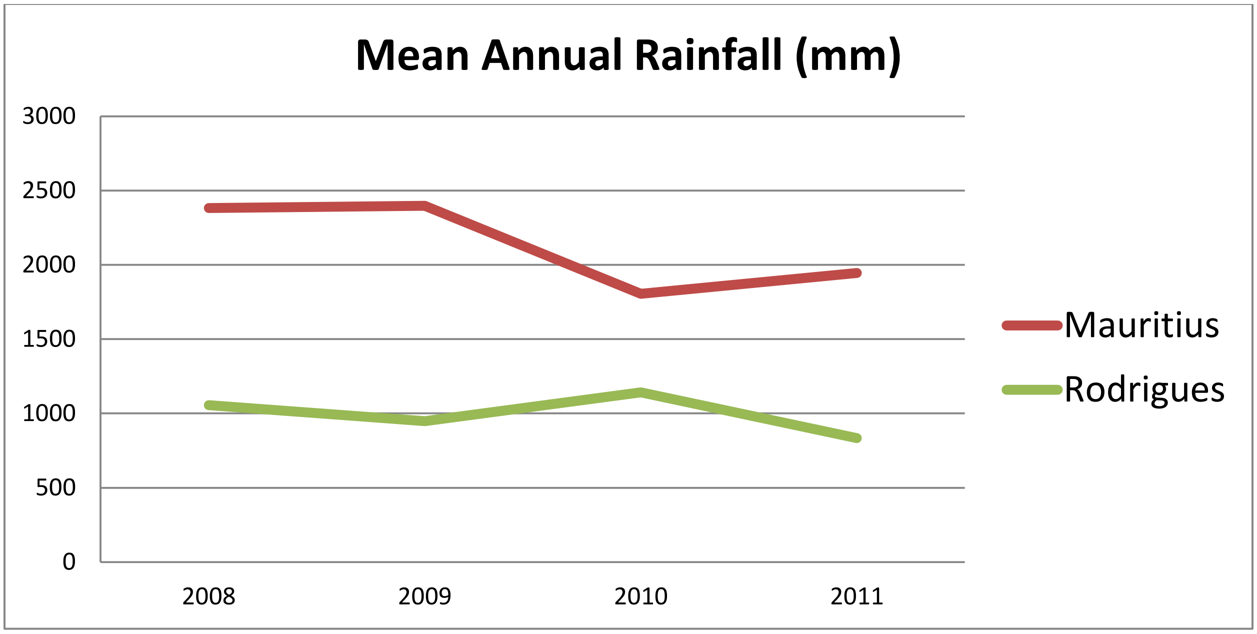


Figure 18. Mean Annual Rainfall (Island of Mauritius and Rodrigues)

Figure 18 illustrates data series on mean annual rainfall in the islands of Mauritius and Rodrigues. Changes in mean annual temperature have certainly contributed to rainfall fluctuations that have been recorded in both islands in the recent years. In particular, the most considerable drop in mean annual rainfall was registered in Mauritius between 2009 and 2010, going from 2,397mm to 1806mm. Interestingly, Rodrigues experienced an increase in rainfall in the same period.

Water balance

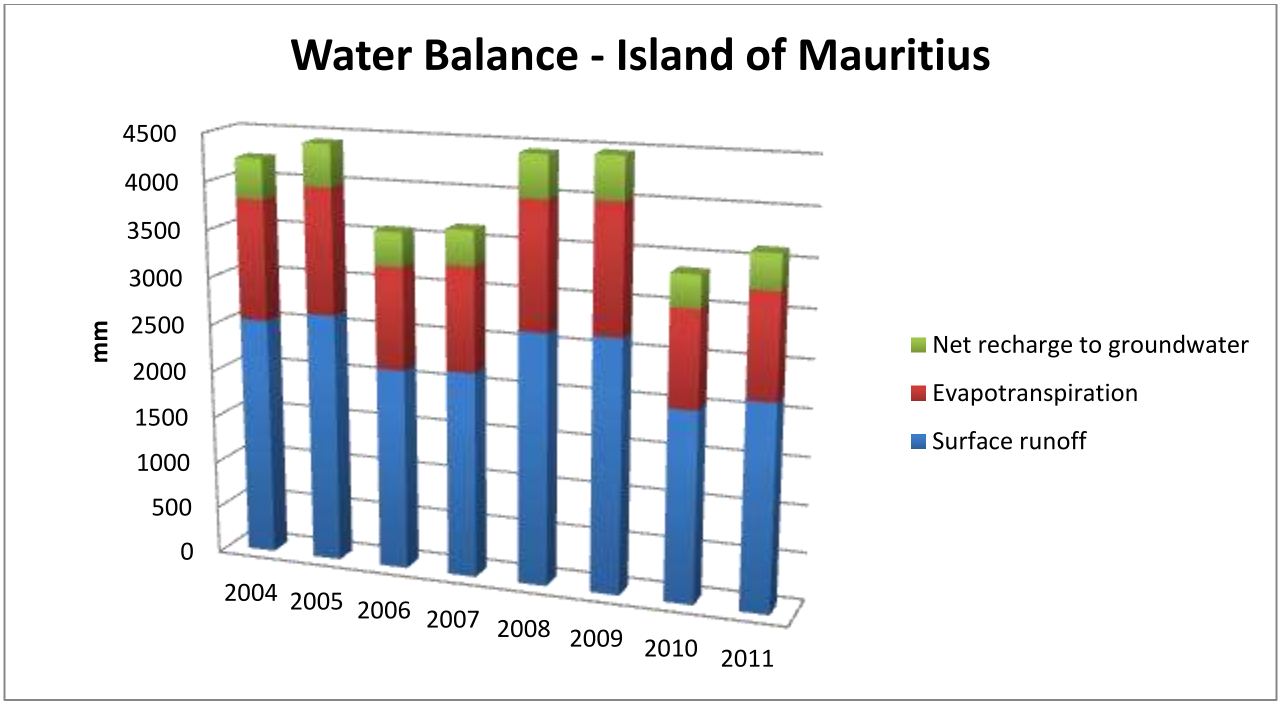


Figure 19. Water Balance (Island of Mauritius)

The water balance of Mauritius Island, shown in Figure 19, illustrates rainfall fluctuations occurred in the recent years. Surface runoffs far exceeded evapotranspiration in the composition of the water balance. Both runoffs and evapotranspiration lower the net recharge to groundwater, which is also influenced by fluctuations in mean annual rainfall. Climate change plays an important role in determining water balance shares, since higher temperatures increase evapotranspiration and negatively impact on groundwater recharge.

Carbon dioxide emissions

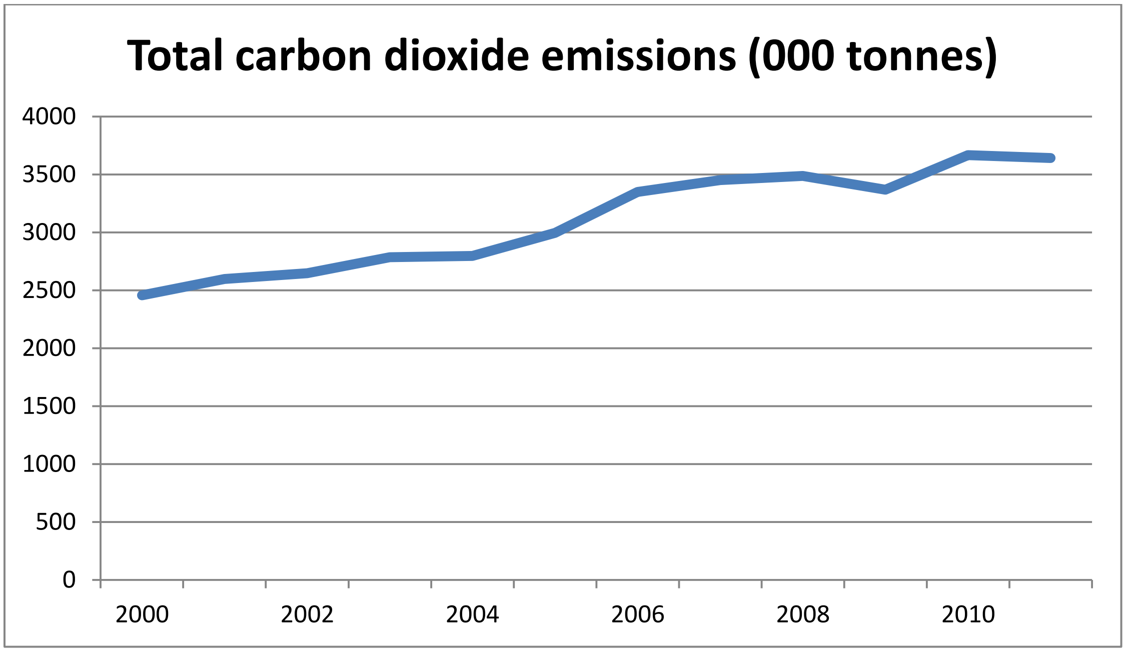


Figure 20. Total Carbon Dioxide emissions

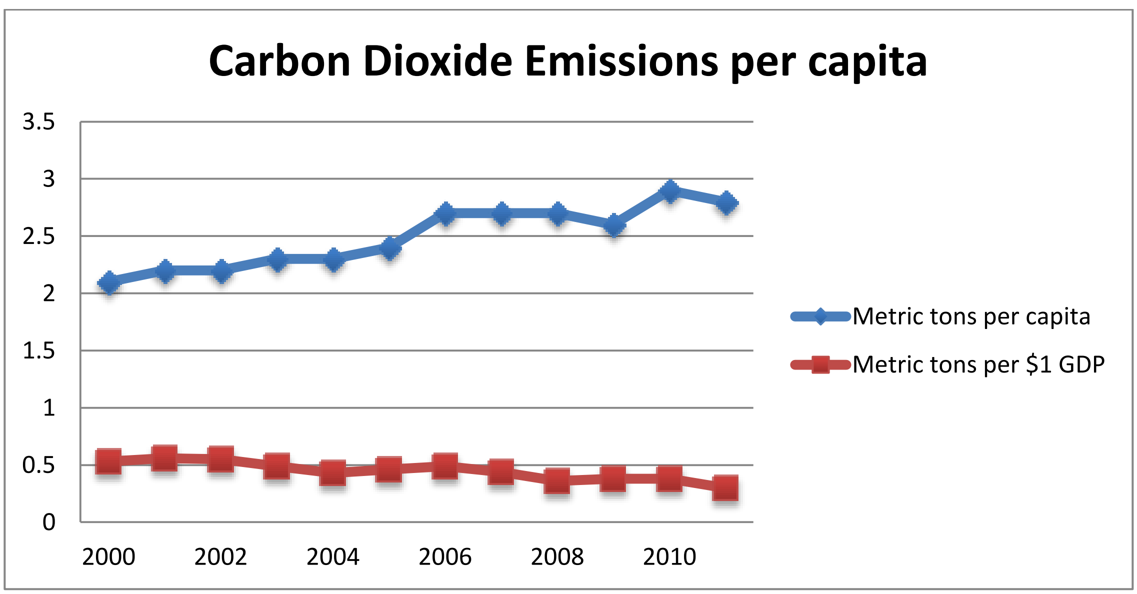


Figure 21. Carbon Dioxide emissions per capita and per $1 GDP

Total carbon dioxide emissions allow analyzing the impact of production and consumption modes on climate change. Monitoring emission trends is essential for policy-makers to make informed decisions on climate change mitigation and the transition to a greener economy. Figure 20 shows the evolution of carbon emissions in ROM, with increasing levels until 2008, followed by oscillations in the recent years. Similar trends are shown in Figure 21 regarding per capita emissions.

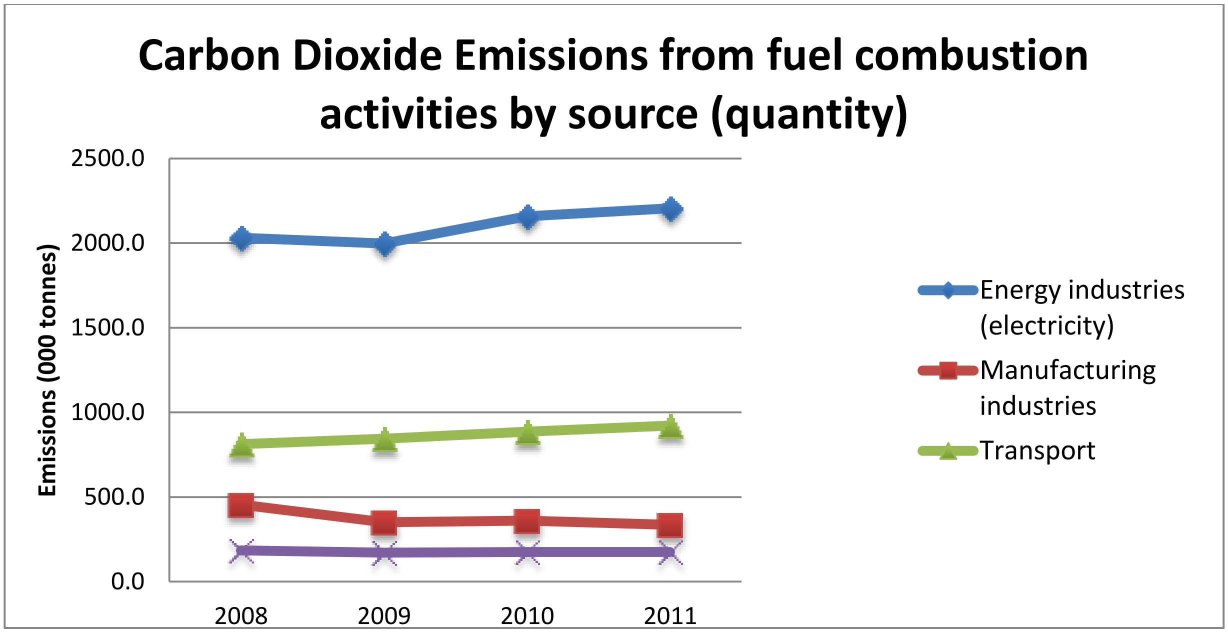


Figure 22. Carbon Dioxide emissions from fuel combustion activities by source

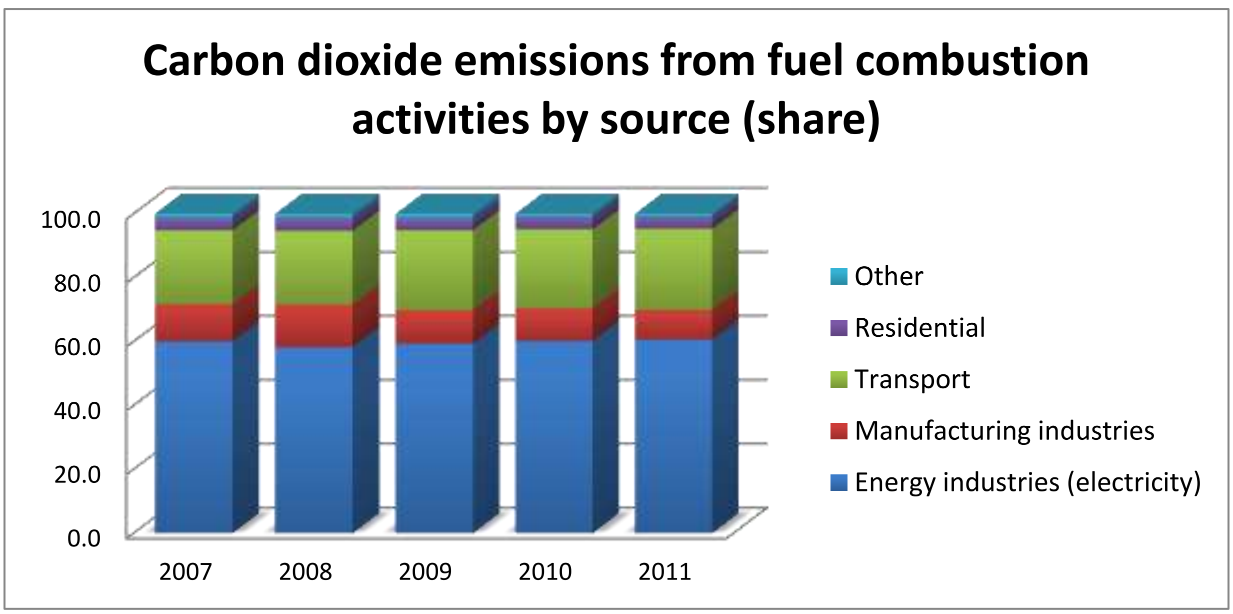


Figure 23. Share of Carbon Dioxide emissions from fuel combustion activities by source

Figures 22-23 show the contribution of key sectors to carbon dioxide emissions from fuel combustion in ROM (both total emissions and share). Such emissions are the main drivers of climate change, and their progressive reduction is a goal of the international community.As can be seen, energy industries are by large the first contributor, followed by the transport sector and manufacturing industries. In 2011, carbon dioxide emissions from electricity production almost doubled the emissions produced by the manufacturing and transport sectors together.

Terrestrial and marine protected areas

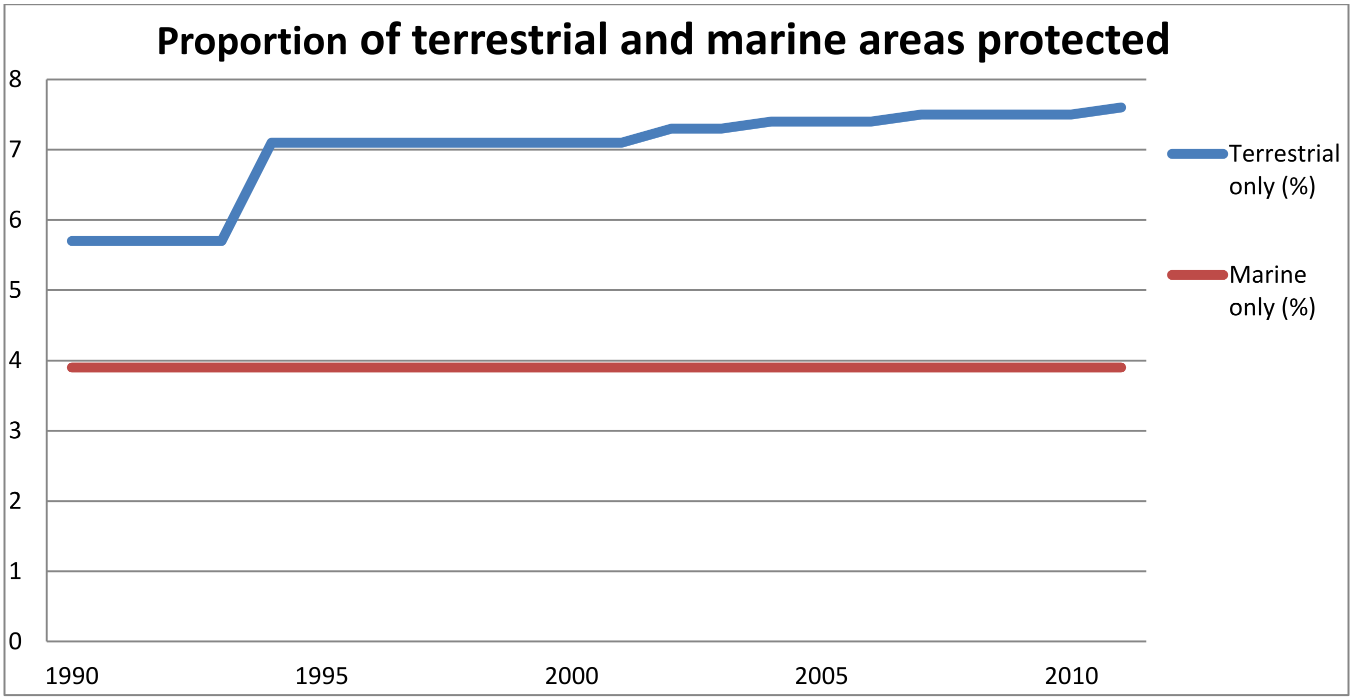


Figure 24. Proportion of terrestrial and marine protected areas

The establishment of terrestrial and marine protected areas represents an effective measure to ensure the preservation of ecosystems and biodiversity. In particular, protected areas are needed to mitigate the impact of climate change on ecosystems and species. Forest protected areas are particularly important under a climate change perspective, since forests contribute to carbon sequestration and, thus, to climate change mitigation. Figure 24 illustrates the evolution of terrestrial and marine protected areas in ROM, as share of terrestrial and marine land, respectively. Terrestrial protected areas have expanded from 5.7% in 1990 to 7.6% in 2011, while the share of marine protected areas has remained stable at 3.9% throughout the same period.

Species at risk of extinction

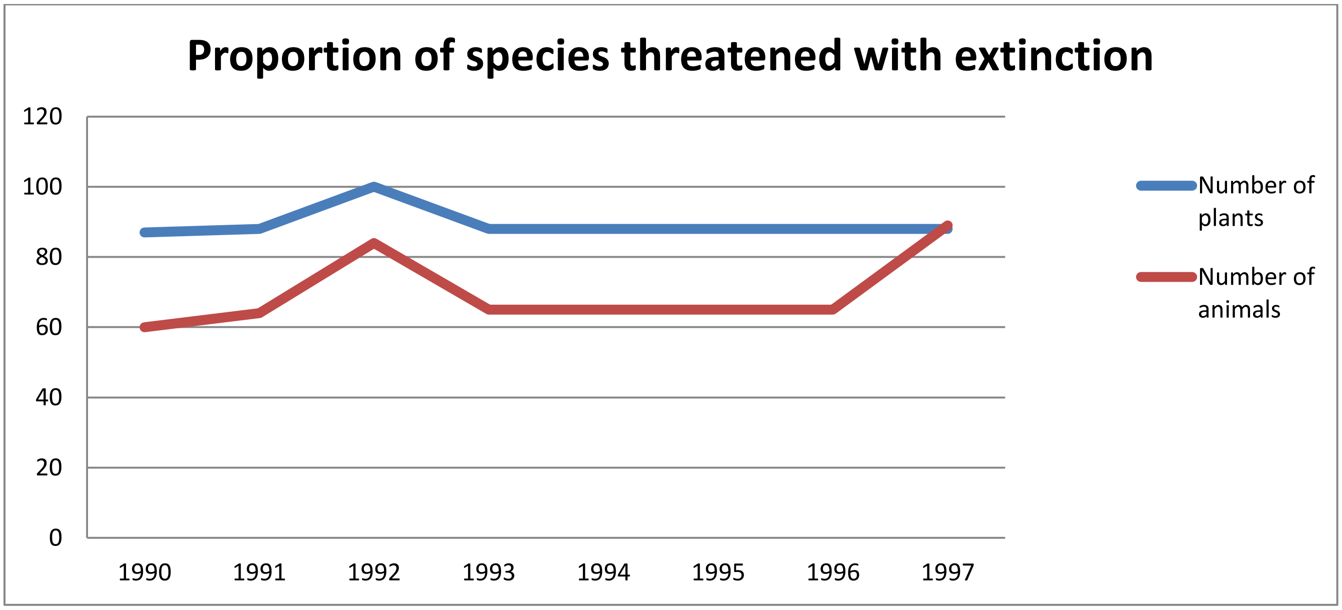


Figure 25. Proportion of species threatened with extinction

Figure 25 shows the number of plants and animals threatened with extinction (data available only from 1990 to 1997). Climate change can increase the risk of extinction for many species by altering their natural ecosystems. As can be noted, while the number of threatened plants remained stable throughout the second half of the 90s, the number of animals at risk has risen sharply from 1996 to 1997. The expansion of terrestrial and marine protected areas is likely to improve the conservation of biodiversity, ensuring better protection for species that are increasingly challenged by climate change impacts.

Fish stock

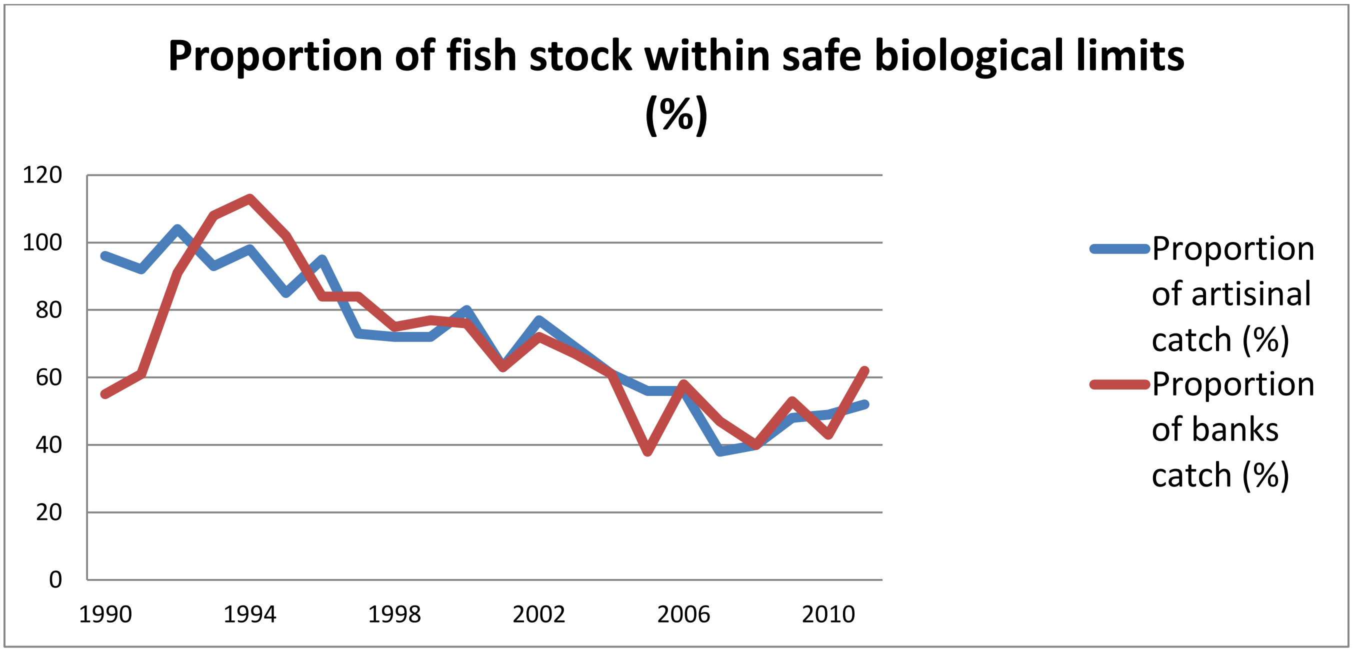


Figure 26. Proportion of fish stock within safe biological limits

The proportion of fish stock within safe biological limits is an indicator of the health of fishery resources in ROM. Fish stock is threatened by overfishing, illegal fishing activities, as well as the impact of climate change -including rising ocean temperatures, ocean acidification and sea level rise- on fish species. Figure 26 represents historic trends related to fish stocks within safe biological limits, both for artisanal and banks catch. The threshold for maximum yearly catch of fish is 1,700 tonnes for artisanal catch, and 4,200 tonnes for banks catch.

Projected CC impacts on health

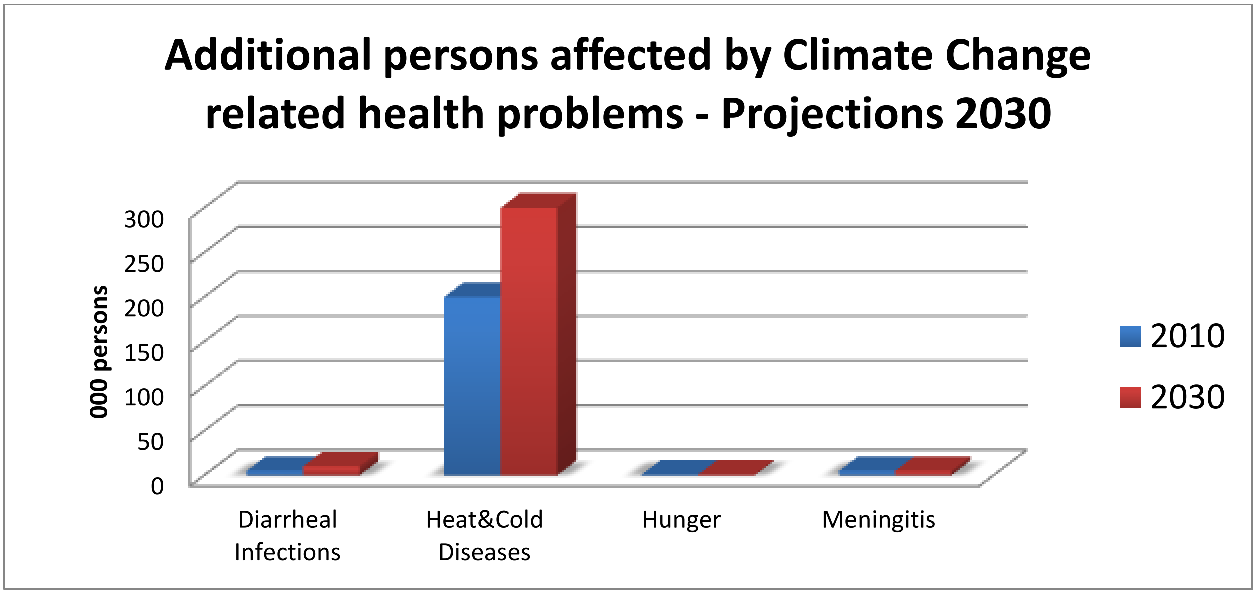


Figure 27. Additional persons affected by climate change related health problems (Projections for 2030)

Based on historic data, projections can be made with regard to future impacts of climate change on health conditions in ROM. Figure 27 uses data from the Climate Vulnerability Forum (DARA, 2012) to illustrate the expected number of persons affected by climate change related health problems in 2030, compared with 2010 levels. It can be noted that heat and cold diseases are the health problems most influenced by climate change, going from 200 persons affected in 2010 to 300 in 2030. Minor impacts are expected on the incidence of other health problems, including diarrheal infections, malnutrition and meningitis.