Assessment of Climatic Impact Drivers in Kenya

Focus Counties: Bungoma, Kakamega and Siaya

This assessment describes seven important climatic impact drivers for Kenya, with a special focus on the counties Bungoma, Kakamega and Siaya. It shows how the climatic impact drivers are projected to change under two climate change trajectories in the future (2030, 2050 and 2080). The presented drivers are mean temperature, mean precipitation, precipitation cycle, very hot days, heavy precipitation frequency and intensity as well as extremely dry months. For further guidance and background information about the figures and analyses presented here kindly refer to the supplemental information on how to read the assessment of climatic impact drivers.

Kenya has a diverse climate from hot desert to tropical rainforest. Here, we analyze projections for the for the western regions of Kenya (west of 38°E), which includes the three focus counties: Bungoma, Kakamega and Siaya. This part of Kenya is mountainous and borders Lake Viktoria.

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Mean Temperature

Temperatures in West Kenya show a large range due to the diverse topography with the lowest temperatures in the highest altitudes (Figure 1). Under both RCP scenarios, climate models project a temperature increase in all of the western part of the country. While the temperature increase stays below 1.3° under the strong mitigation scenario, there is a local increase of up to 3.4°C under the no-mitigation scenario by 2080.

The three focus counties show a very similar temperature development with a projected increase of 1.2°C under RCP 2.6 and an increase of around 3.7 under RCP 7.0 by 2080 (Figure 2). Also, the model range is very similar for the three focus counties and all models agree on a positive trend.

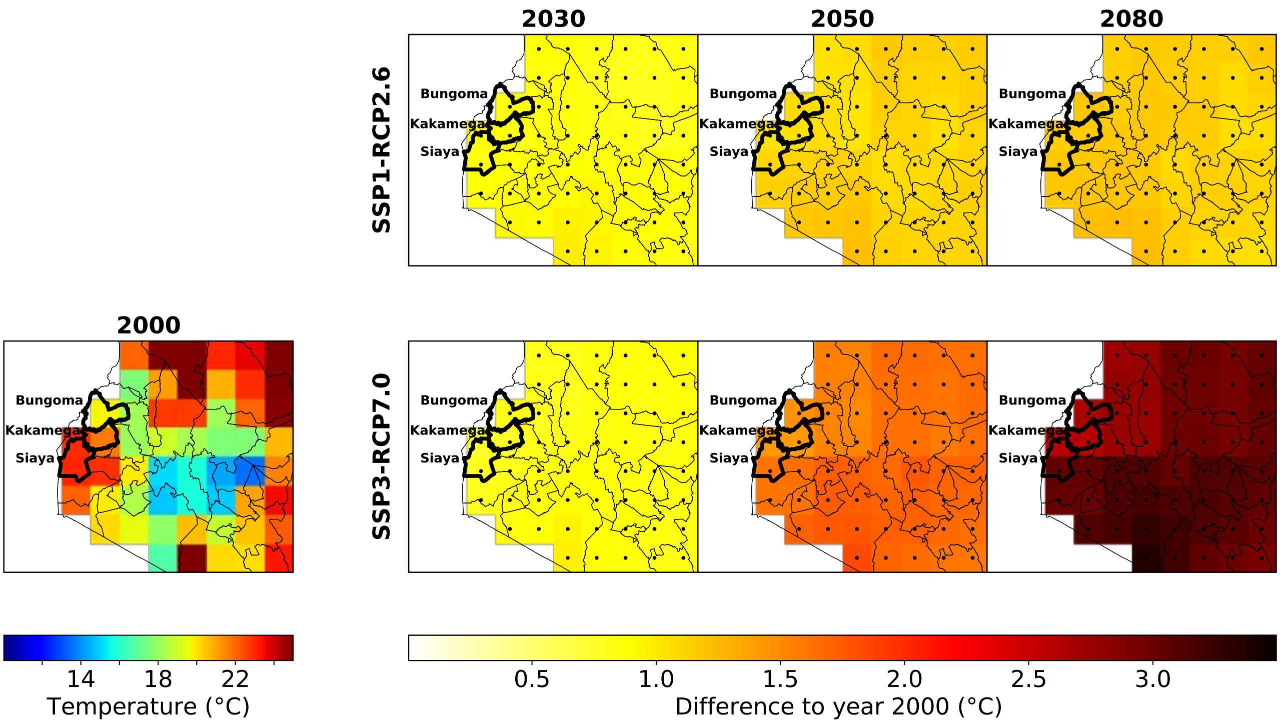

Figure 1: Projected change of mean temperature across West Kenya in 2030, 2050 and 2080 under two different trajectories compared to 2000. Dots indicate that at least 9 out of 10 models agree on the sign of change in this location.

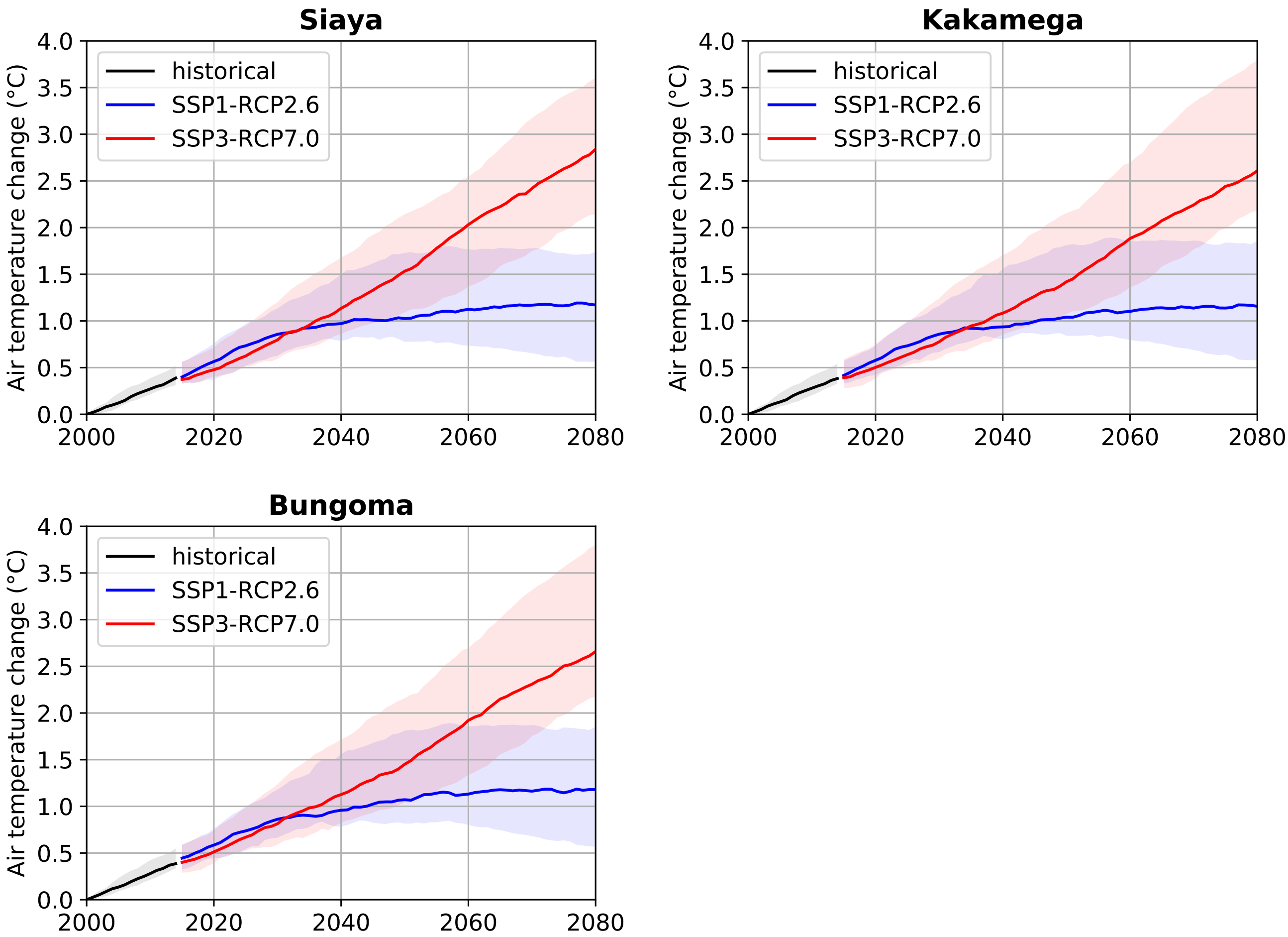

Figure 2: Projected temperature time series (difference to 2000) of the individual Kenyan focus counties for the model medians (lines) and range of the model projections (shading) under two future trajectories.

Mean Precipitation

Precipitation in the region is stronger in the western parts closer to Lake Victoria, while it becomes arid in the more eastern parts, which correspond to central Kenya (Figure 3). Overall, precipitation is projected to increase in most of the analyzed region. Under strong mitigation the increase is stronger in the East of the region (up to 25% by 2080), while under no-mitigation the increase is stronger in the West of the region (up to 17% by 2080). Model agreement on precipitation changes is weak.

While the best estimates of projected precipitation changes are similar for the three focus counties (see lines in Figure 4), the model range varies (shaded areas in Figure 4). For Bungoma, one model projects an increase of 75% under RCP 7.0 by 2080, while another model even projects a decrease of 5%. In contrast, for Siaya the model with the strongest projected increase only results in a 54% increase under RCP 7.0 by 2080. Under RCP 2.6 several models also project a decrease in precipitation for Siaya by the middle of the 21st century (most extreme model projects −12%).

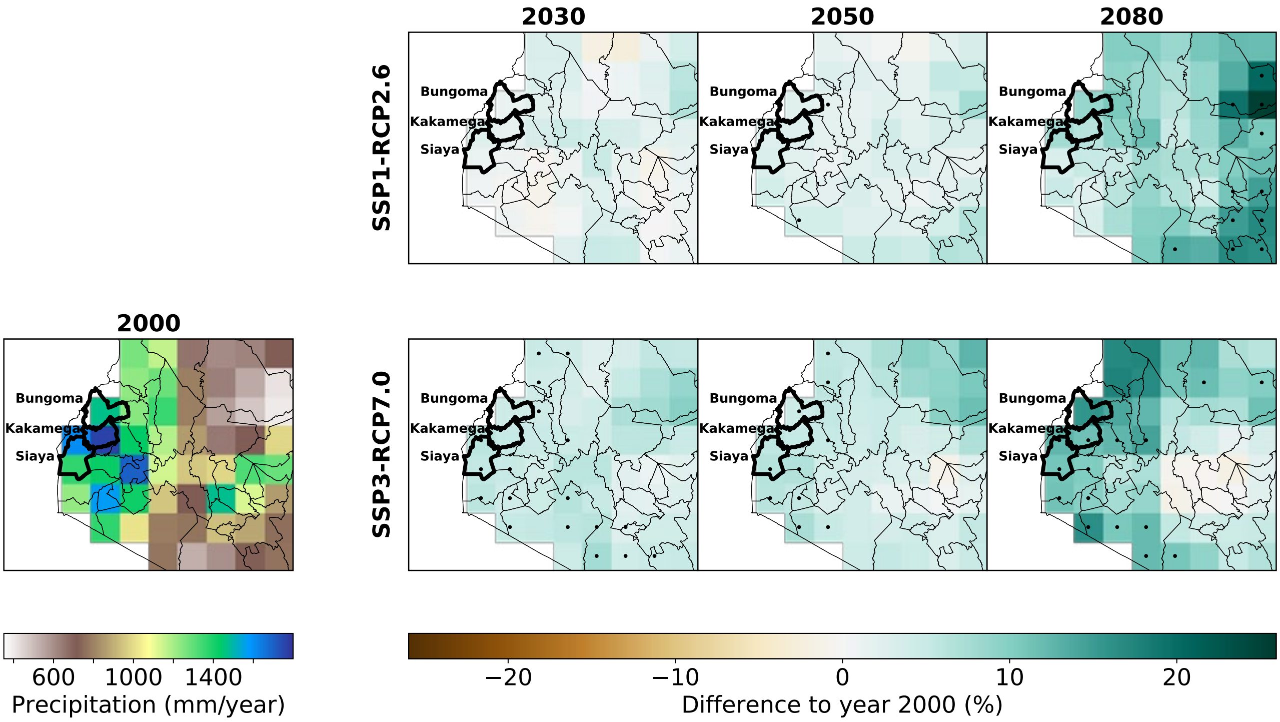

Figure 3: Projected changes of annual precipitation sums over West Kenya in 2030, 2050 and 2080 under two different trajectories compared to 2000. Dots indicate that at least 9 out of 10 models agree on the sign of change.

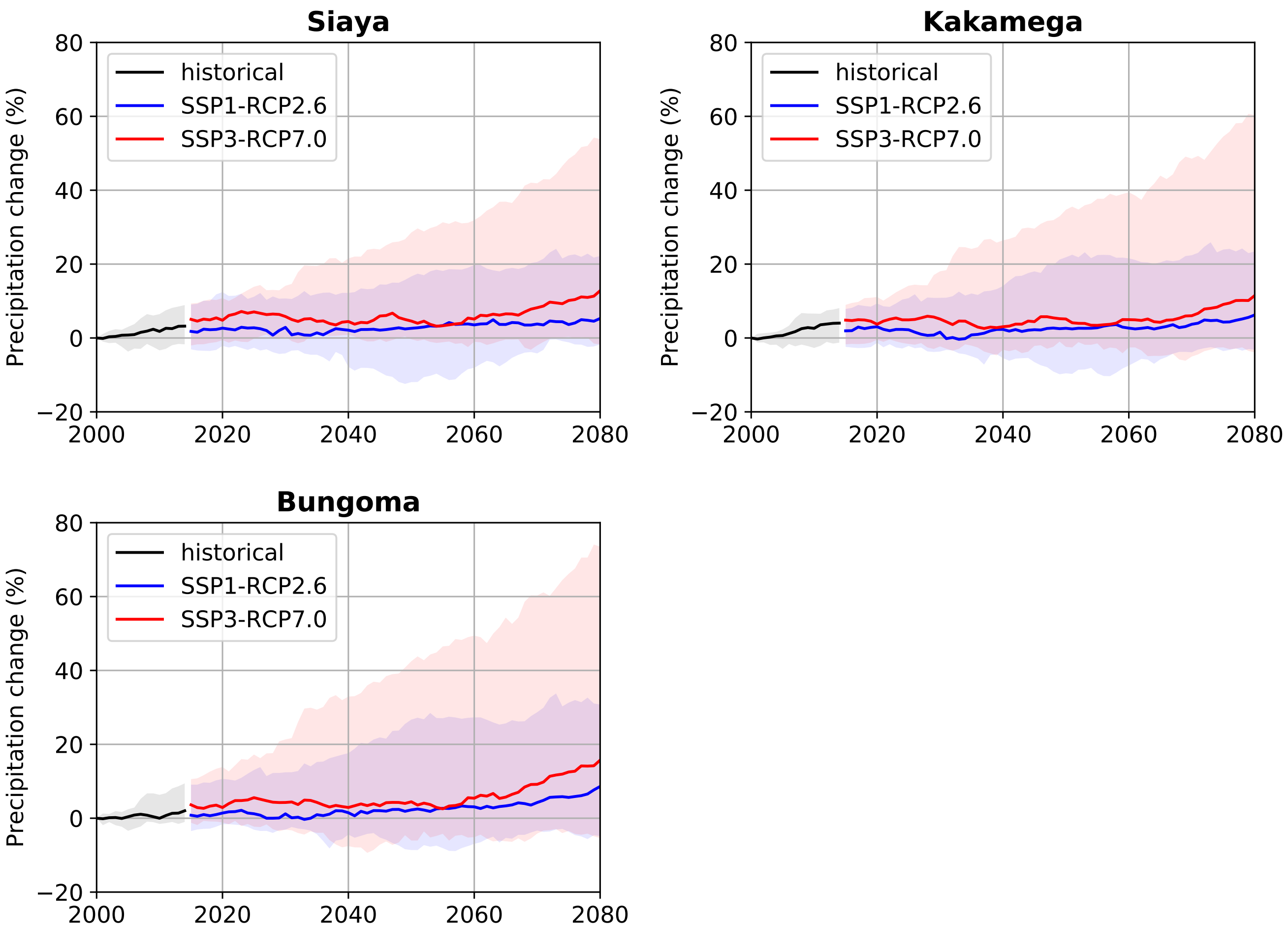

Figure 4: Projected precipitation time series of the individual Kenyan focus counties for the model medians (lines) and range of the model projections (shading) under two future trajectories.

Precipitation Cycle

The seasonal cycle of precipitation is similar in the three focus counties, with one major rainy season in March, April and May and a secondary rainy season in September, October, November, which is not very pronounced in Bungoma (Figure 5). There are only small changes in the monthly precipitation rates under RCP 2.6. Under RCP 7.0, the projected precipitation increase is mainly found early in the year with the beginning of the rainy season.

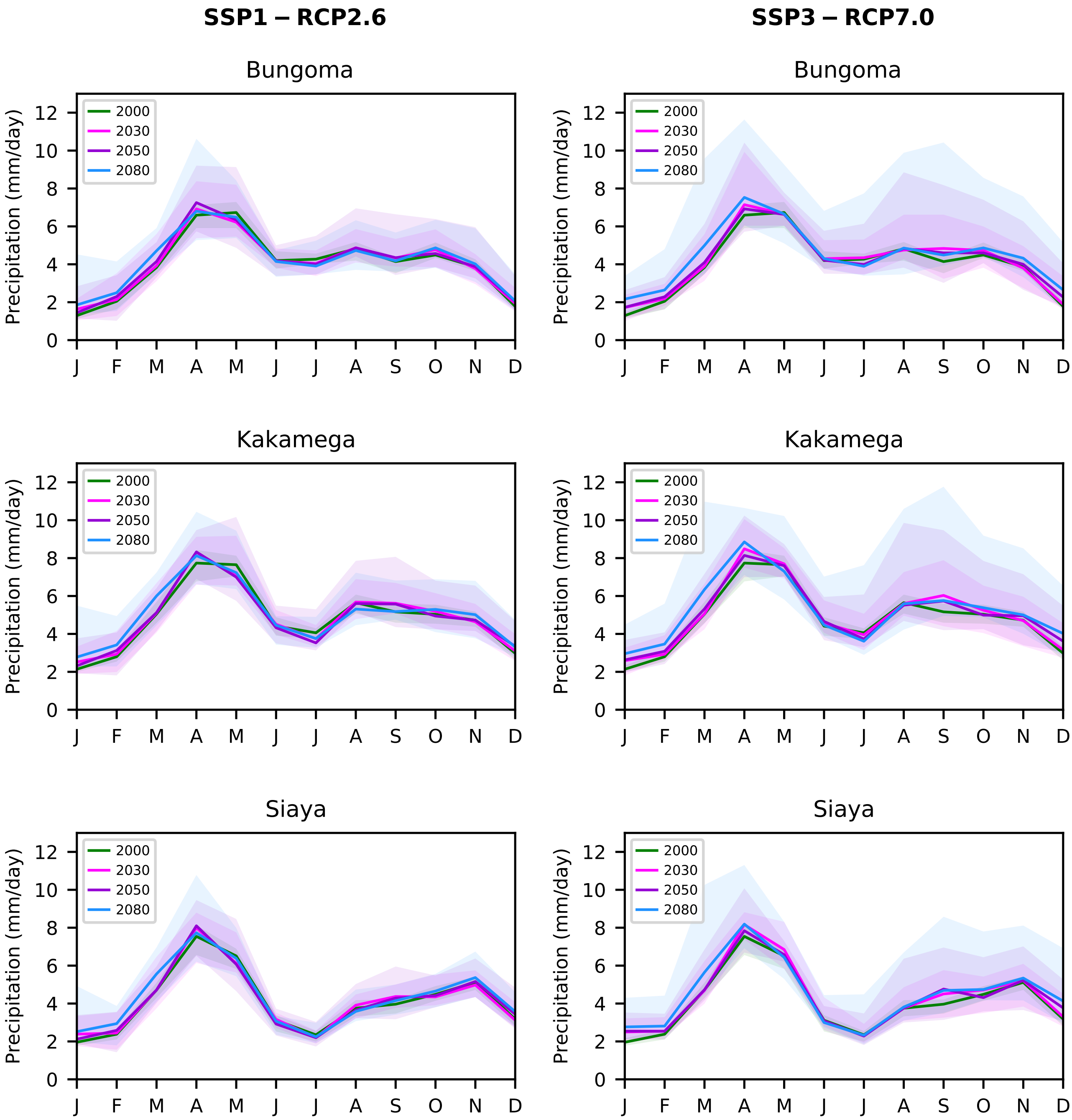

Figure 5: Projected monthly mean precipitation rates for the individual Kenyan focus counties, shown as the model medians (lines) and range of the model projections (shading) under two future trajectories.

Very hot days

Very hot days are rare in western Kenya but projected to increase (Figure 6). The main occurrence and increase is in the North of the country, with up to 180 more days by 2080 under RCP 7.0.

However, the projected increase in the focus counties is much smaller (Figure 7). For Bungoma, there is no change under RCP 2.6, while the models project an increase between zero and 20 days under RCP 7.0 by 2080. In Kakamega and Siaya, there is a slight increase under RCP 2.6 (zero to 12 days by 2080) and under RCP 7.0 the models project between 4 and 84 more very hot days by 2080.

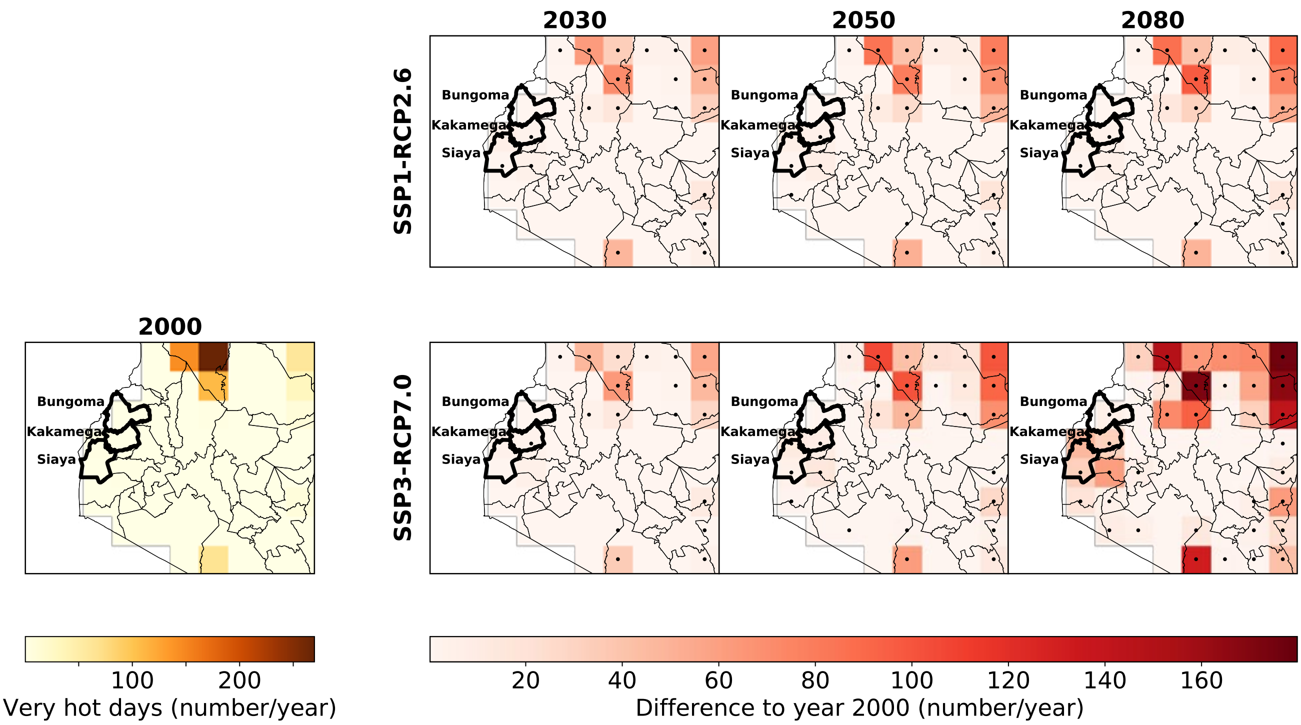

Figure 6: Projected changes in the number of very hot days in West Kenya in 2030, 2050 and 2080 under two different trajectories compared to 2000. Dots indicate that at least 9 out of 10 models agree on the sign of change.

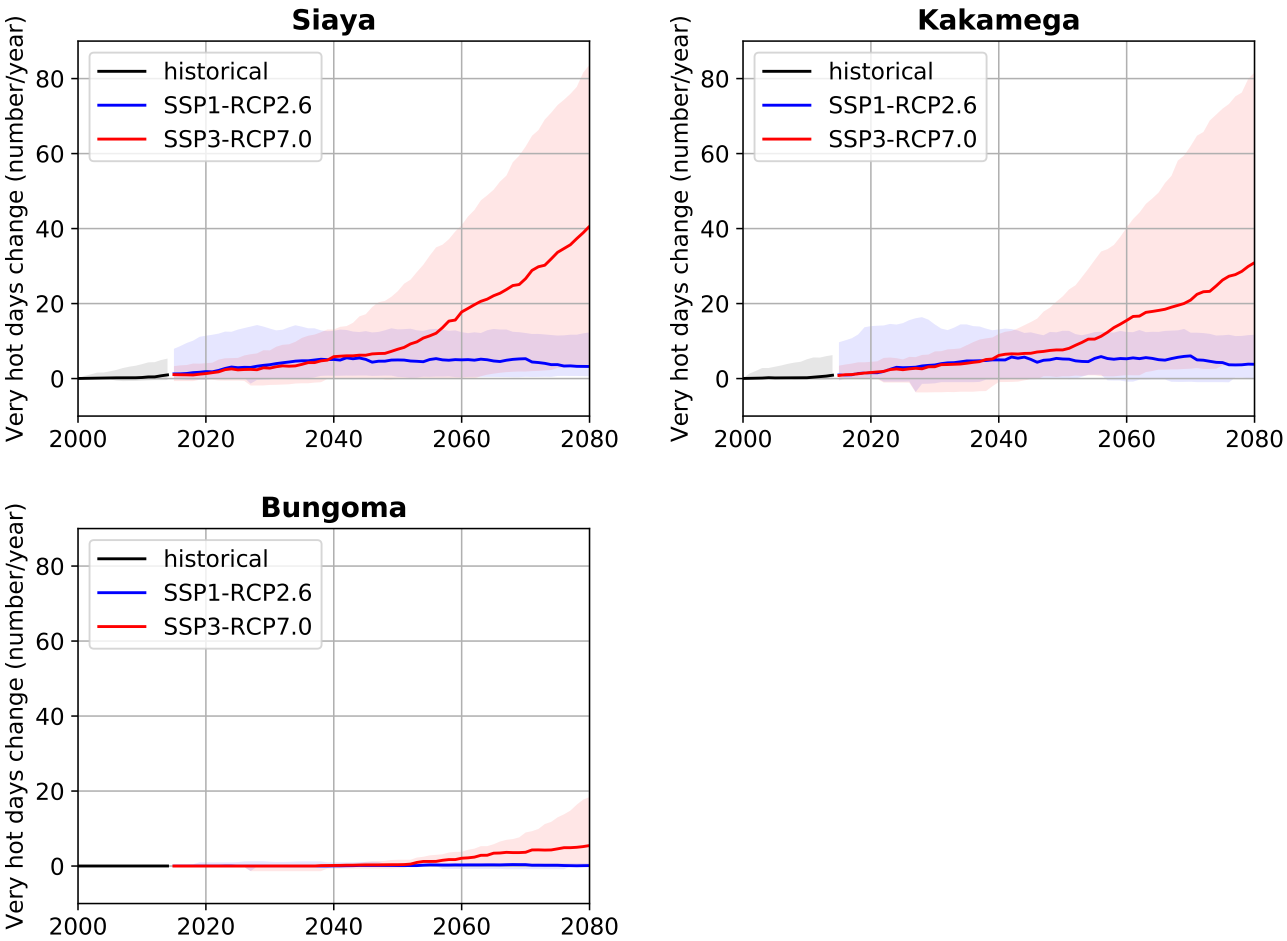

Figure 7: Projected number of hot days per year in the individual Kenyan focus counties, model medians (lines) and range of the model projections (shading) under two future trajectories.

Heavy precipitation frequency

The number of heavy precipitation days is projected to increase in the whole region of analysis (Figure 8). The increase is stronger under no-mitigation. With strong mitigation, the local increase is up to 2.6 more days per year by 2080. Without mitigation the local increase is up to 5.3 more days per year by 2080 and the climate models mostly agree on the sign of the change. The increase is strongest in the very west of the region where the focus counties are located.

The best estimates for the projected changes in heavy precipitation frequency are of similar magnitude in the three counties (Figure 9). By 2080, the strongest increase is projected for Kakamega with 2.6 more days under RCP 2.6 and 4.3 more days under RCP 7.0. The weakest increase is projected for Siaya with 2.1 more days under RCP 2.6 and 4.1 more days under RCP 7.0. The model ranges are large in comparison to the best estimates. For Bungoma, the model with the strongest increase projects an increase of more than 10 days even with strong mitigation, while at least one other model projects zero change.

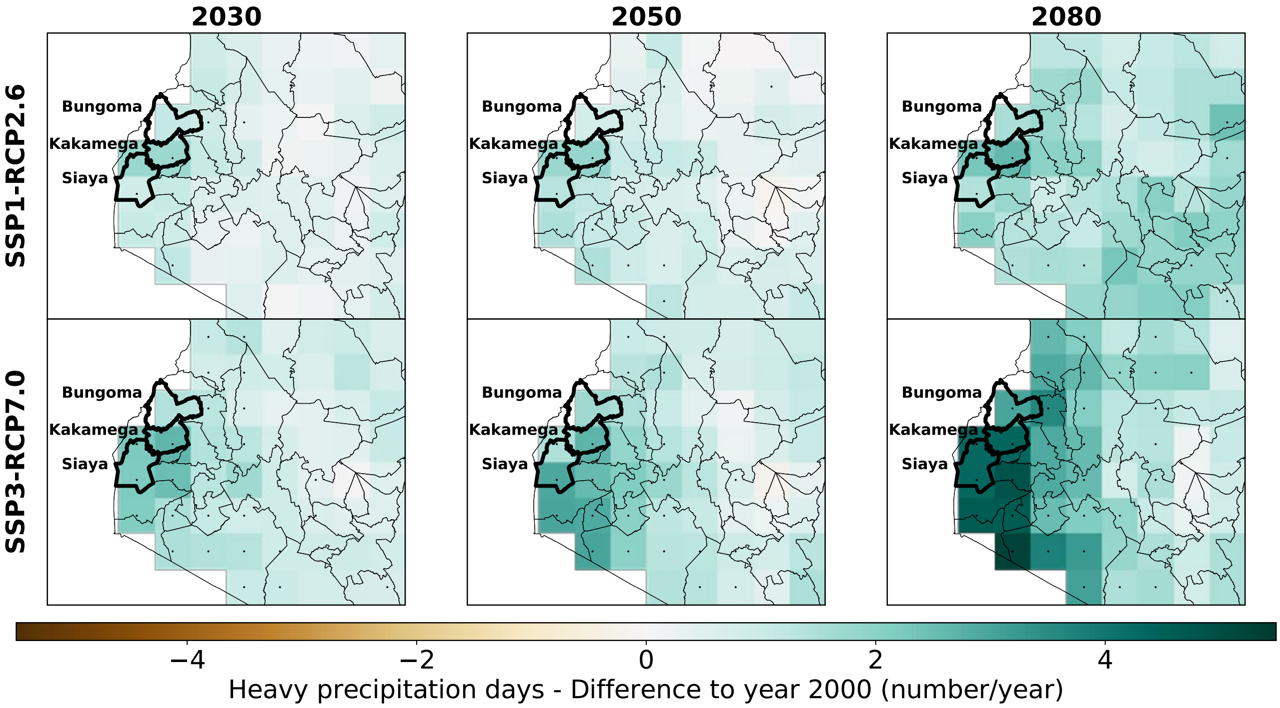

Figure 8: Projected changes in heavy precipitation events in West Kenya in 2030, 2050 and 2080 under two different trajectories compared to 2000. Dots indicate that at least 9 out of 10 models agree on the sign of change.

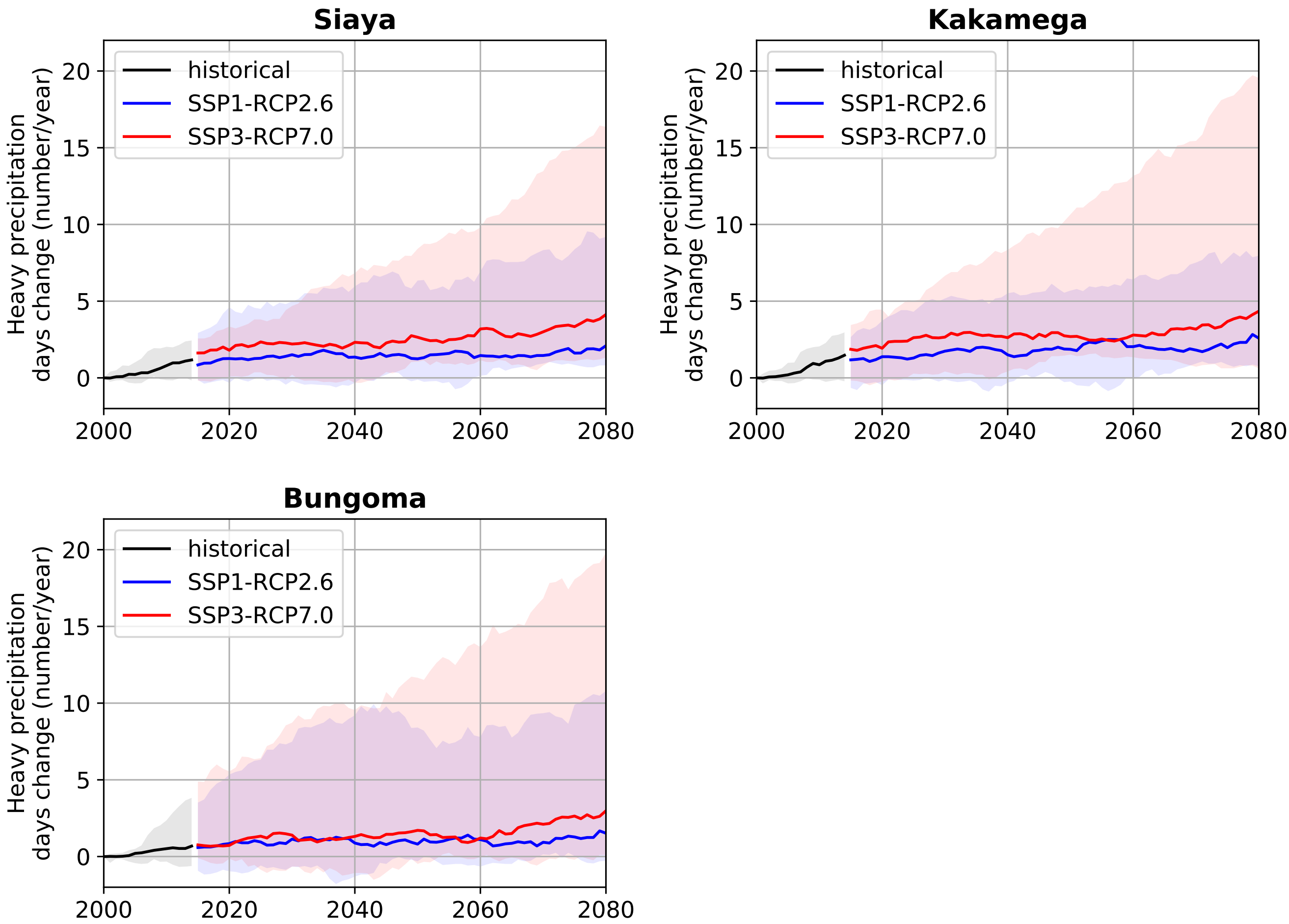

Figure 9: Projected number of heavy precipitation events per year in the individual Kenyan focus counties, model ensemble medians (lines) and range of the model projections (shading) under two future trajectories.

Heavy precipitation intensity

The intensity of precipitation varies in West Kenya, partly in line with total precipitation amounts (Figure 10). The lowest intensities seem to follow the North-South extent of the Rift Valley. The precipitation intensity is projected to increase in the 21st century. With strong mitigation, the increase is between 3 and 13% in West Kenya by 2080, but model agreement is low. Under the no-mitigation scenario RCP 7.0, the increase is up to 21% in the very West of Kenya with high model agreement, while there is no projected increase further inland.

The focus counties show a clear increase in precipitation intensity under both scenarios, and all models agree on the sign of the change (Figure 11). The ranges of the model projections are large and similar between the regions. Like heavy precipitation frequency, we find the largest model range for Kakamega (2% – 87% under RCP 7.0 by 2080) and the smallest model range for Siaya (5% – 77% under RCP 7.0 by 2080).

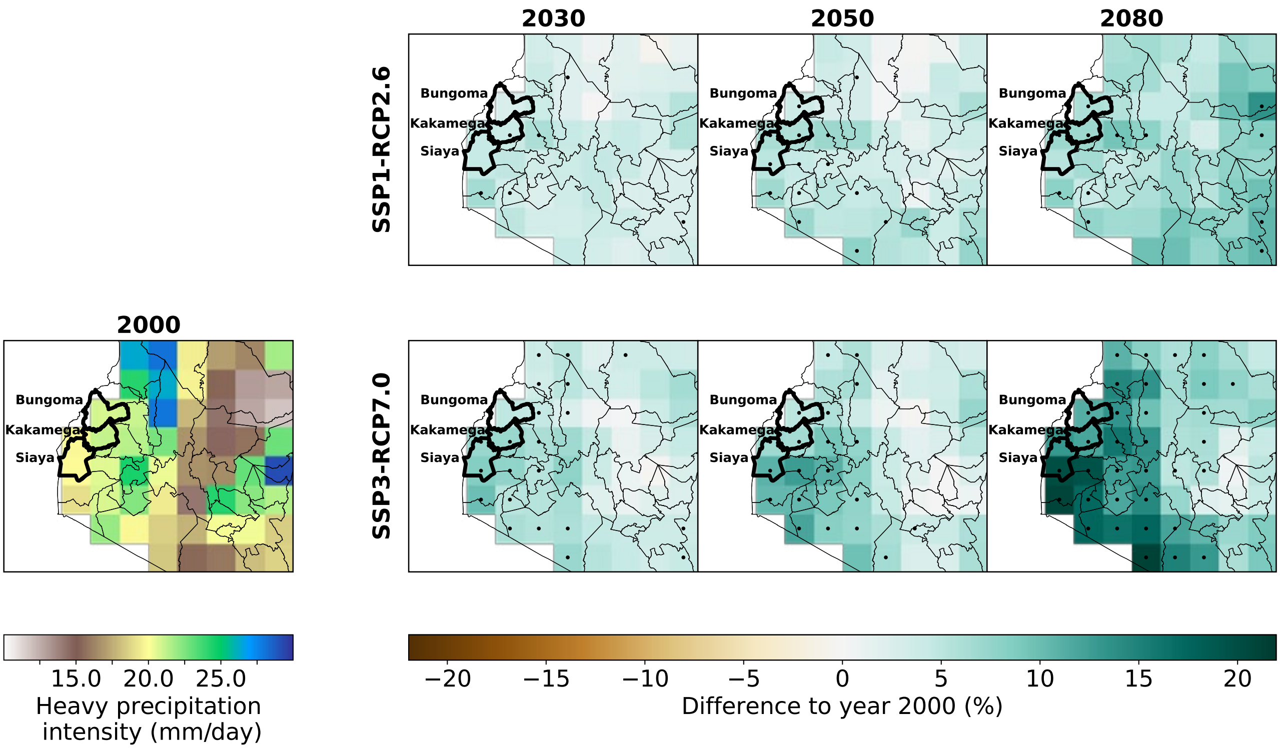

Figure 10: Projected changes in heavy precipitation intensity over West Kenya in 2030, 2050 and 2080 compared to 2000 under two different trajectories. Dots indicate that at least 9 out of 10 models agree on the sign of change.

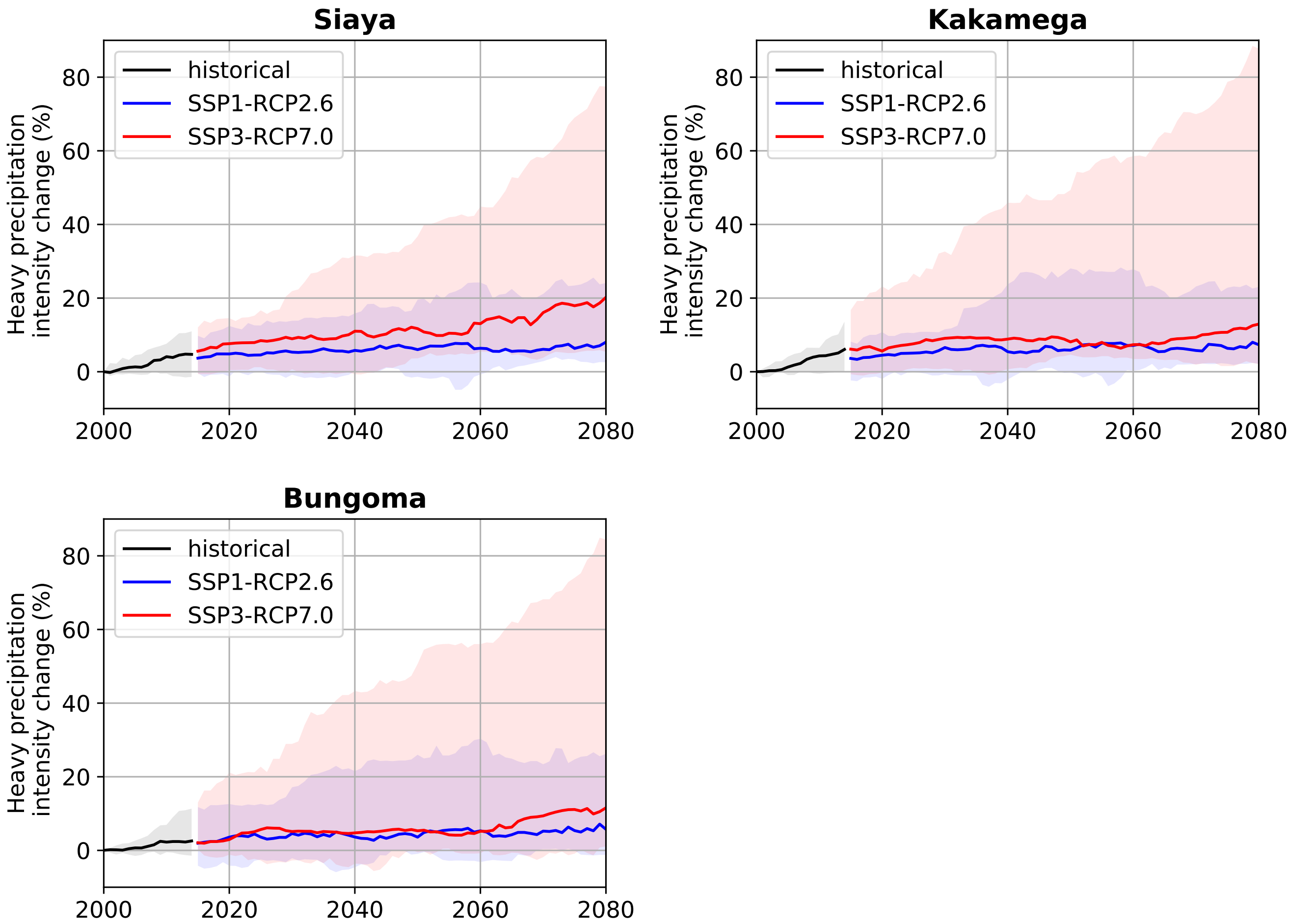

Figure 11: Projected intensity of heavy precipitation in the individual Kenyan focus counties, model ensemble medians (lines) and range of the model projections (shading) under two future trajectories.

Extremely dry months

The climate model ensemble projects an increase in the number of extremely dry months in the 21st century for Western Kenya (Figure 12). Under strong mitigation, this increase stays below 2.4 months per year throughout the 21st century, while without mitigation, local changes of up to 8.7 months more per year are found by 2080. Under both scenarios, the increase as well as the model agreement is strongest in the East of the region of analysis (central Kenya) and there is no clear model agreement in the focus counties.

The time series of the change in extremely dry months for these focus counties show that the best estimate from the model ensemble is an increase of less than one month under RCP 2.6 and between one to two months under RCP 7.0 by 2080 for all three regions (Figure 13). However, only under RCP 7.0 and for Siaya, the models agree on the positive change. For the other scenarios and focus counties, at least one model projects a small decrease, which can mean no extremely dry months at all in the future (as the frequency in the historical period is very small by definition). Such changes that are negative or close to zero indicate, that the precipitation increase can balance the temperature-driven increase in evapotranspiration.

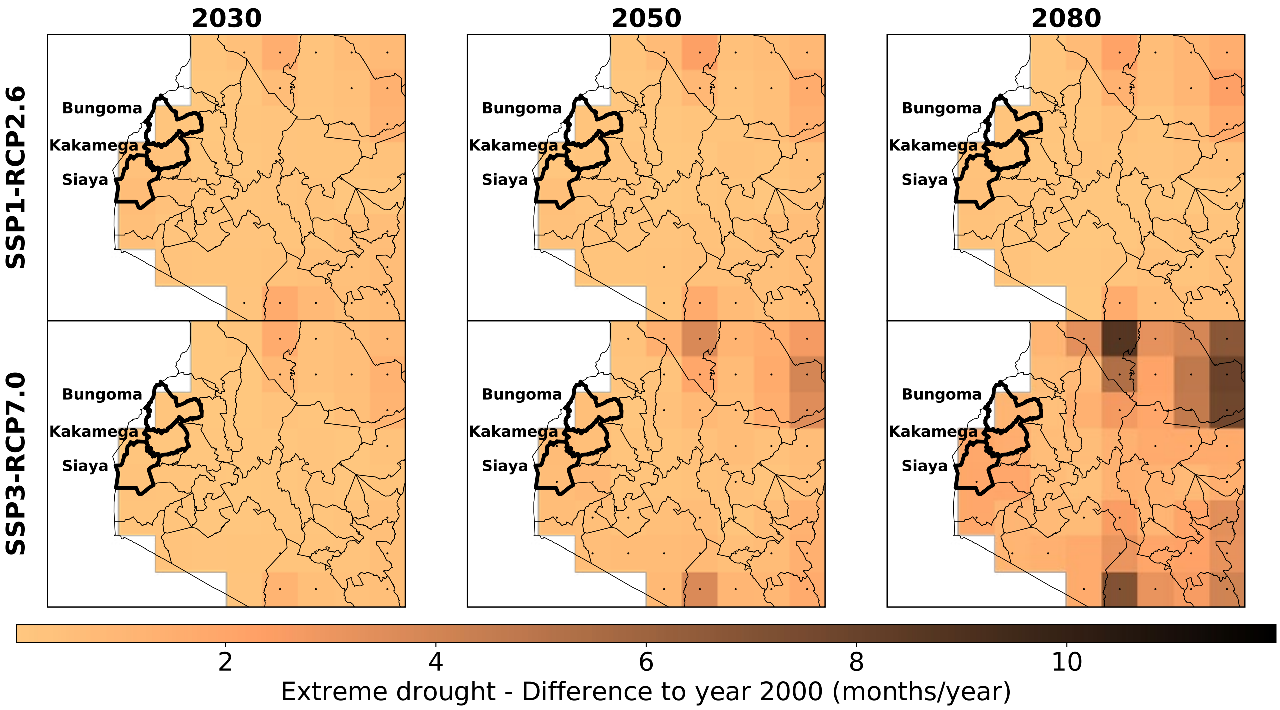

Figure 12: Projected changes in extremely dry months across West Kenya in 2030, 2050 and 2080 under two different trajectories compared to 2000. Dots indicate that at least 9 out of 10 models agree on the sign of change.

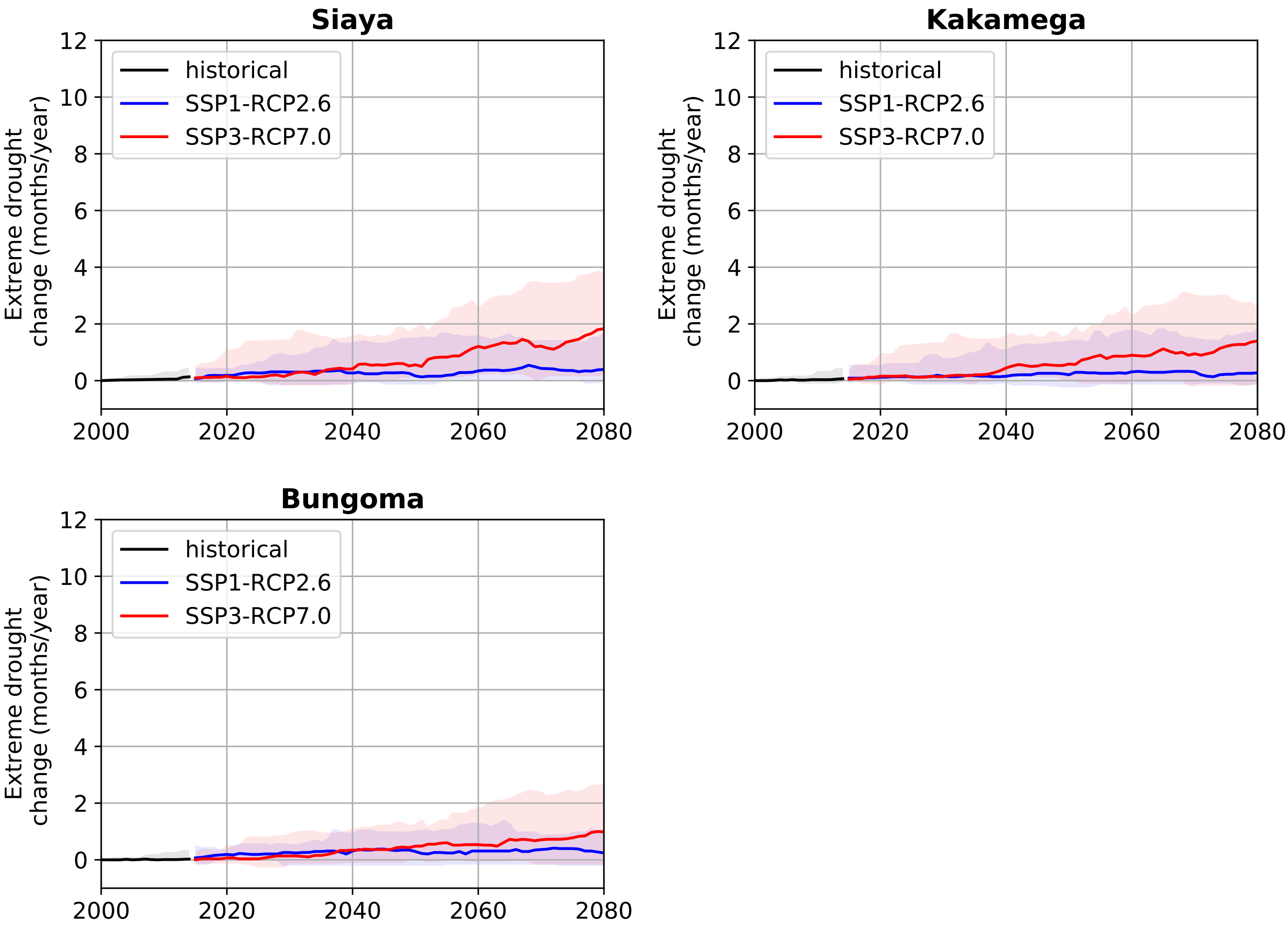

Figure 13: Projected changes in extremely dry months in the individual Kenyan focus counties, model ensemble medians (lines) and range of the model projections (shading) under two future trajectories.

The assessment is based on data and analysis generated as part of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP), which is gratefully acknowledged. Background information about the figures and analysis presented in this profile is available in the supplemental information.

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