Prediction of the long-term change in precipitation in Kenya by use of GSMaP data

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1. Introduction

Over the recent years, Africa has been facing major catastrophe related to precipitation. The wet seasons are characterized by high amount of rainfall which end up in floods while the dry seasons are characterized by long period of sunshine resulting in drought and water shortage. Kenya is a country which has been facing major water shortage over the recent years. The per capita water storage of the country has reduced from 11m3/yr in 1965 to 4.4m3/yr in 2005, more than 50% decrease and this has raised a lot of concern.

The country has a total forest cover of only 1.7% hence a high rate of soil erosion, surface runoff and evapo-transpiration. Furthermore, changes in land use have caused drastic negative effects on the rivers and lakes in Kenya seen by the diminishing of lakes like L. Naivasha and L. Turkana. This has been due to deforestation and uncontrolled irrigation from the lakes and rivers in the areas. This study is aimed at predicting water crisis in Kenya by utilizing the remote sensing technology of applying GSMaP data and introducing water quality as another parameter in the study. This paper shows the first part of the study in which the average precipitation over a period of 100 years was calculated.

2. Study Area

The proposed are of study is as seen on the **Fig. 1**. The map is a map of Kenya which lies between. (00 37N 034 10E, to 02 00N 038 07E). Country has a total surface area of 580,367Km2 with 2.3% of the area covered by water. The country is characterized by highlands in the central areas, savanna grassland to the south east and arid and semi arid regions to the north. The total annual rainfall ranges between 100mm in the Northern and North-Eastern regions to 2000mm in the Highlands. The weather also varies according to the region where it is hot and humid in the Coastal regions and cooler towards the Central regions.

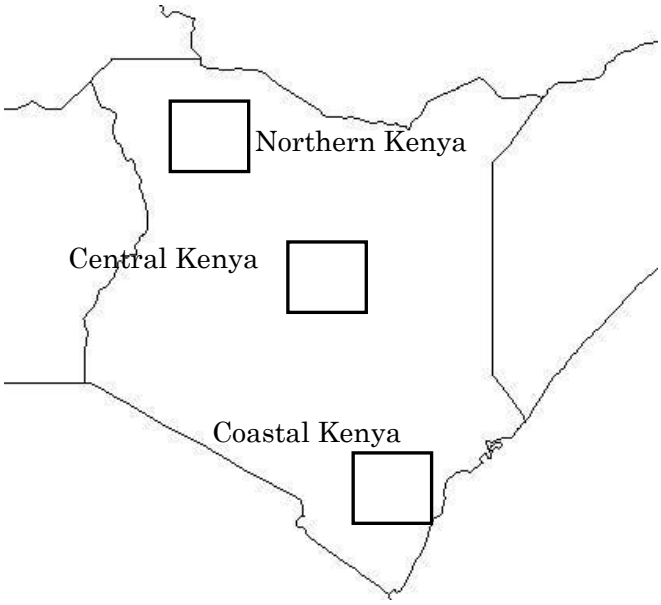

Fig. 1　Map of Kenya

3. Method

HadCam3 data with a resolution of 90x90 was utilized in this study. Three regions representative of the Coast, Central and Northern Kenya were selected and the precipitation, for a period from 2000 to 2099 was mapped out and the average calculated. Fig 2 indicates the global precipitation for the year 2000.

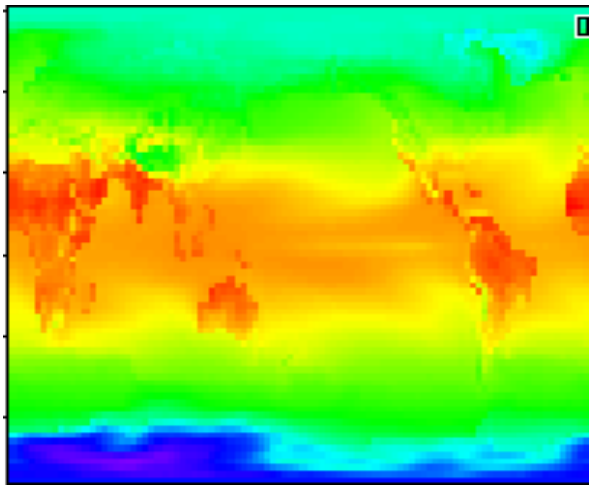

Fig 2 Precipitation map for the year 2000

4. Results

Fig 3 shows the calculated precipitation predicted from the Year 2000 to 2099.

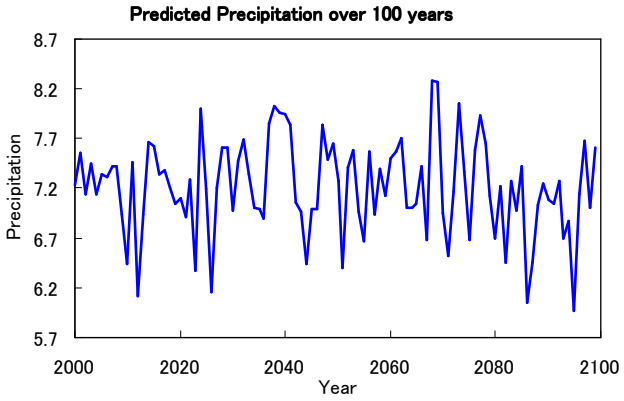

Fig 3. Precipitation for a period of 100 years

4. Discussion

Annual average precipitation

The graph in Fig 4 shows that the change in precipitation is predicted to form a zigzag pattern where precipitation is to increase drastically in some years and reduce drastically in others. The areas showing upward peak indicate high precipitation which would result in catastrophe like floods. On the other hand, areas indicating a downward peak indicate decrease in precipitation which would lead to draught. From the graph, the fluctuation from high to low precipitation is seen to maintain a constant pattern through the century. It can also be deduced that the results of the graph indicate that periods of severe drought can be expected to be around 2009 - 2015, 2028, 2089 and
2095 while periods of high precipitation which could lead to severe flood are expected around 2026, 2040 and 2070. Between 2035 and 2045, very high precipitation is expected for 10 years in a row and this would be followed by a period of drought.

5. Crisis cause by these changes

High precipitation might seem to have positive effects on of supporting agriculture as it is the main source of livelihood in Kenya. However, this is not actually the case. Floods would not only lead to loss of lives and displacement of people but would form major breeding grounds for parasites like mosquito and this would cause outbreak of diseases like malaria. The sanitation problem would also be a case of diseases such as typhoid, cholera and dysentery.

At the same time, periods of low precipitation would be a major cause of draught and famine as a big population of people in Africa still depend on agriculture. Draught would cause malnutrition which is also known to be major cause of child deaths in Africa.

6. Pending studies

The next level of this study will be to calculate and the average changes in minimum and maximum temperature for the same period and evaluate its relationship with the change in precipitation while at the same time observing the trend over the same period of time. Very high minimum and maximum temperature would lead to an increase in the precipitation and prolonged drought while too low minimum and maximum temperature would result in low performance in the agricultural sector.

Moreover, as a new parameter, this study will involve attaining the water quality data from the rivers, lakes and wells around Kenya and utilizing them to predict the water crisis expected. Low precipitation and very high rate of evapo-transpiration leads to increase in the concentration of salts and heavy metals in the water bodies making it unusable by man. Very high precipitation leads to floods which dissolves many minerals on the way and this also increases the concentration of minerals in the water bodies. The study aims at evaluating the effect of water quality on the water crisis over the period of time.

7. References

1）Madelene Ostwald, Deliang Chen; Impacts of climate variations and policies among small-scale farmers in the Loess Platue, China, Elsevier, Remote sensing of Environment, pp231-245, 2004.