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Change in the carbon emission from wild fire to the periodic variation of precipitation and temperature over Africa

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1 Introduction

In semi-arid regions of Africa, wildfire frequently occurs during dry season. The wildfires strongly constrain the structure, dynamics, and distribution of vegetation, and emit the large amount of carbonaceous aerosol. The atmospheric carbonaceous aerosol has ability to change climatic system, because it absorbs or reflects shortwave radiation. The change pattern of the carbon emission from wild fire to the fluctuation of precipitation was estimated using a dynamic global vegetation model. However, in order to change the cycle of sea surface temperature of the Atlantic and Indian Oceans, annual precipitation varies periodically in Africa. In addition, because the vegetation response to be sensitive to changes in temperature as well as precipitation, it is necessary to pay attention to the temperature as well. Our purpose is to estimate the change in the amount of carbon emissions from the fire to the periodic variation of annual mean temperature and annual precipitation in Africa.

2 Experiments

In this study, we estimate the rate of change of carbon emissions from wild fire for periodically changing precipitation and temperature using SEIB-DGVM (Spacialy Explicit Individual Base Dynamic Global Vegetation Model). The study area is African continent (37N-34S, 17W-59S). The following three experiments were conducted. First, control experiments: the simulation was run for 13 years from 1997 to 2009. Second, there is no period of climate change: the average value of the annual mean temperature and annual precipitation from 1982 to 2009 were used as the input climate data set. Third, climate change 6, 10, 20 year period: the precipitation and temperature data, which changes periodically based on the standard deviation, were used as the input climate data set.

3 Results and Discussion

3-1. Control Experiment: The simulation was in good agreement with the spatial distribution of the annual carbon emissions from wild fire obtained from satellite observations GFEDv3. However, the mean values in each of the northern and southern hemispheres of carbon emissions were overestimated than the observed value. This is caused due to over-estimation of the biomass.

3-2. There is no periodic variation in annual precipitation and mean annual temperature: The Carbon emissions in the northern hemisphere are decreased, while it increased in the southern hemisphere. A tree coverage and biomass were increased because of tree mortality was reduced by extreme drought and high temperatures was eliminated. The reduced carbon emission in the northern hemisphere, because the probability of occurrence of fire was reduced by an increase in tree coverage. On the other hand, in the Southern Hemisphere, the amount of carbon emissions increased by an increase in biomass.

3-3. The annual precipitation and annual mean temperature varies in a cycle of 6, 10, and 20 years: the rate of change of carbon emission for the period change of precipitation is greater than temperature. In the northern hemisphere, there is a tendency to increase carbon emission in the short period. In the long period of climate change, there was very difference in carbon emissions by phase. In the northern hemisphere, the tree coverage showed a relatively low value when there is no variation in the periodic precipitation. As a result, carbon emissions increased due to the relatively high probability of fire.

4 Summary

A carbon emission from the current fire is affected by cyclical fluctuations climate (especially precipitation). In the Northern Hemisphere of Africa, the impact on carbon emissions from the change in tree coverage was strong in the short-period variation in precipitation. In the long-period variation of precipitation, there is a large difference in carbon emissions by phase.

Keywords: DGVM, carbon emission, fire, Africa