Climate and biofuels in Brazil

H. Vuollekoski[1], R. Makkonen[2], A. Asmi[1], R. Hillamo[3], T. Petäjä[1] and M. Kulmala[1]

[1]Department of Physics, University of Helsinki, Helsinki, 00014, Finland
[2]Department of Geosciences, University of Oslo, Oslo, 0371, Norway
[3]Finnish Meteorological Institute, Helsinki, 00560, Finland
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Presenting author email: henri.vuollekoski@helsinki.fi

Introduction

Biofuels represent a renewable source of energy that may increase the energy independence and economic well being of nations, as well as help reduce the net greenhouse gas emissions. These are some of the reasons why the usage of biofuels especially in transport is increasing rapidly. However, while this replacement of fossil fuels may decrease the net carbon dioxide emissions, the growing demand of biofuels may have consequences related to e.g. human health, agriculture and climate.

One example of such nation is Brazil, which has had a pro-biofuel regulatory environment already since 1975, and is the current world-leader in terms of vehicles running on sugarcane ethanol. If Brazil manages to replace all its consumption of fossil fuels by biofuels in the near future, what kind of climatic implications would this conversion potentially have? The transition would require significant agricultural changes to enhance sugarcane production, and these plantations would likely replace currently forested regions. The current methods of harvesting sugarcane often involve burning, which causes serious air pollution in certain regions (Lara *et al.*, 2005). Also, the primary emissions caused by combustion of ethanol fuel differ from those of traditional gasoline. The scope of our research is limited to the aforementioned effects, although a more realistic scenario would likely include the likely socio-economic side effects.

The land area of Brazil accounts for less than 6% of the global land surface. With this in mind, we try to identify the potential global climatic effects of the Brazilian transition to biofuels. We approach this question with global climate modeling.

Methods

All modeling in this study has been performed with the ECHAM5.5-HAM2 (Zhang *et al.*, 2012), which is a general circulation model that includes parameterizations for the effects of aerosols on climate. The sensitivity studies implemented so far have been executed by replacing the characteristic size of emissions due to fossil fuel combustion, according to current estimates (Stier *et al.*, 2005), in a region covering Brazil, while leaving rest of the world as it was. This change in size of the emitted particles is based on experimental laboratory studies on car engines.

Preliminary results

The first sensitivity study consisted of a 5.5-year control run and an otherwise identical run but with emissions in smaller size over Brazil. The results indicate significant increase in Aitken mode particles on surface level over Brazil, but this is likely due to the mass-based emission scenario. There is also a slight increase in the concentration of cloud condensation nuclei, but this and other effects may be attributed to noise.

We therefore conducted a similar set of runs for duration of 20 years. These suggest small changes in total cloud cover (see Figure 1), but more detailed analysis has to be carried out before conclusions.

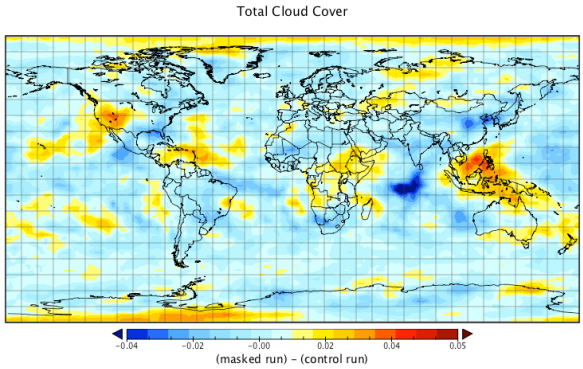

Figure 1. The difference in total cloud cover in a 20-year-long sensitivity test.

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