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Deforestation changes land-atmosphere interactions across South American biomes

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Abstract

South American biomes are increasingly affected by land use/land cover change. However, the climatic impacts of this phenomenon are still not well understood. In this paper, we model vegetation-climate interactions with a focus on four main biomes distributed in four key regions: The Atlantic Forest, the Cerrado, the Dry Chaco, and the Chilean Matorral ecosystems. We applied a three member ensemble al climate model simulation for the period 1981-2010 (30 years) at 25 km resolution over the focus regions to quantify the changes in the regional climate resulting from historical deforestation. The results of computed modelling experiments show significant changes in surface fluxes, temperature and moisture in all regions. For instance, simulated temperature changes were stronger in the Cerrado and the Chilean Matorral with an increase of between 0.7 and 1.4 °C. Changes in the hydrological cycle revealed high regional variability. The results showed consistent significant decreases in relative humidity and soil moisture, and increases in potential evapotranspiration across biomes, yet without conclusive changes in precipitation. These impacts were more significant during the dry season, which resulted to be drier and warmer after deforestation.

Key words: Dry Chaco, Cerrado, deforestation, climate, Chilean Matorral, Atlantic forest, land surface-atmosphere interactions.

1 Introduction

By the year 2000, approximately 55 percent of the Earth's biomes had been converted into pastures, croplands, settlements and other land uses (Ellis et al., 2010). These changes have impacted biotic components of ecosystems such as biodiversity, and also modified land surface-atmosphere interactions through changes in the water and energy balance (Foley et al., 2003). Understanding these processes is important because it can enhance or dampen anthropogenic climate change and therefore increase vulnerability of ecosystems and people to climate variability.

It is well recognised that land use/cover change (LUCC) can affect climate through the absorption or emission of greenhouse gases (biogeochemical impacts) and by modifying the physical properties of land surface (biogeophysical effects). Changes in land use and land cover can lead to changes in surface fluxes of radiation, heat, moisture and momentum that can further impact the