ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS ASSOCIATED WITH THE PRODUCTION AND CONSUMPTION OF SUGARCANE ETHANOL IN SOUTH CENTRAL BRAZIL

Bernardo Friedrich Theodor Rudorff

National Institute for Space Research (INPE) / Ministry of Science, Technology and Innovation (MCTI)

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This research project intends to cover topics related to environmental and socioeconomic impacts of the sugarcane ethanol production and consumption in the South-Central Brazil. With remote sensing imagery and geographic information systems, the project initially mapped the major and recent sugarcane crop expansion since 2003, as well as the sugarcane fields harvested with the straw burning practice in São Paulo since 2006. Furthermore, the land use and land cover change (LULCC) observed since 2000, due to sugarcane expansion, was evaluated based on time-series of remote sensing images (*Fig. 1*). The observed sugarcane expansion dynamic has supported the generation of scenarios to plausible spatial patterns for sugarcane expansion in the short- and medium-terms. These scenarios will drive biosphere-atmosphere interaction models, designed to assess physical-chemical changes in the atmosphere related to LULCC and to trace gases and aerosol atmospheric emissions in response to sugarcane expansion. The quantitative outcomes in terms of atmospheric chemistry will provide the spatial-temporal distribution of green-house gases, toxic primary or secondary gases, and aerosols, which will be used to access the impacts on human health. Runoff from agricultural fields is one of the main routes of nonpoint source pollution with sediments, organic residues, pesticides, nutrients, and bacteria, which can induce eutrophication in surface waters. A temporal-spatial evaluation of inland aquatic system's eutrophication will be carried out by integrating in situ and remote sensing time series to detect change in water optical properties linked to algal blooms. Econometric and economic models will be conceived to analyze the resulting changes of production and consumption of sugarcane ethanol in urban network and infrastructure, natural environment assets, social well-being, jobs market and related scientific-technological scenario, agri-business economics, agricultural financing policies, commodities market and food security, and trade balance. The knowledge should provide information to increase the understanding of the complex relationships among the sugarcane production and consumption and its environmental and socioeconomic impacts, providing a strategic contribution to public policies and actions aiming at maximizing the benefits and minimizing at the undesirable side effects and externalities.

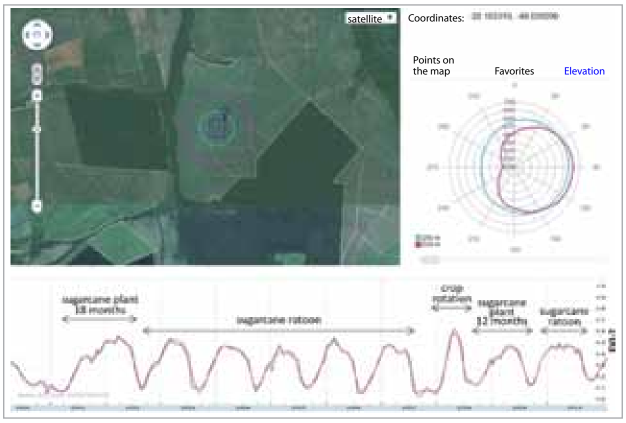

Figure 1. The bottom part of the figure represents a time-series of vegetation index values (EVI2) derived from remote sensing images (MODIS) showing a 10-year series of the crop growth cycle dynamic for a sugarcane field pixel depicted in the balloon of the virtual globe of Google Maps (www.dsr.inpe.br/laf/series)

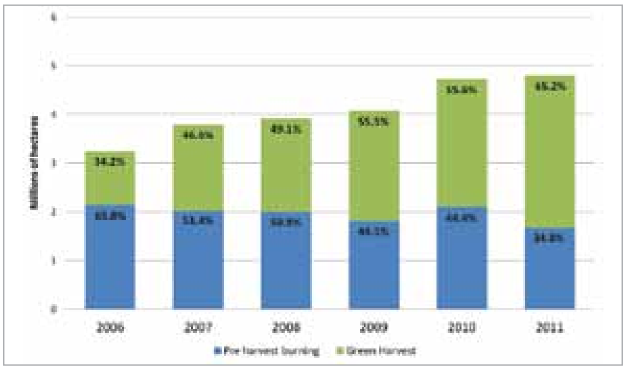

Figure 2. Annual proportions of the sugarcane harvest practice with pre-burning and green harvest in São Paulo from 2006 to 2011

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

The annual sugarcane crop mapping has been performed for the South-Central since 2003, within the context of the Canasat project (www.dsr.inpe.br/laf/canasat/). *Figure 2* illustrates the annual proportions of the pre-harvest burning and green harvest in São Paulo since 2006, indicating the relative increase of green harvest (www.dsr.inpe.br/laf/canacrua/). *Figure 3* illustrates the dynamic of land conversion. This information is now used to subsidize studies concerning the environmental and socioeconomic impacts associated to the current and predicted extensive production of ethanol. With the Dinamica-EGO modeling platform, scenarios in the short- and medium-terms will be generated. These scenarios will support several aims in the current project generating annual LULCC scenarios (2008 to 2020) with the indication of sugarcane areas to be harvested with and without the pre-burning practice. Maps showing the spatial distributions of algal blooms along time are expected to be obtained based on *in situ* measurements of an automatic data collecting system (SIMA), and on remote sensing and GIS techniques for a selected reservoir. It is also expected to have a series of spatial information about the phytoplankton distribution in selected reservoirs subjected to algal blooms. An assessment of the impacts associated with sugarcane production and derived biofuel use in São Paulo will be generated based on the limited-area atmospheric model coupled on-line with a chemistry transport model: CCATT-BRAMS (Chemistry-Coupled-Aerosol-Tracer Transport model to the Brazilian developments on the Regional Atmospheric Modeling System). CCATT-BRAMS fed with the LULCC scenarios and estimated emissions inventories will allow an evaluation of the associated changes on the planetary boundary layer properties, hydrological cycle and air quality. Direct measurements of several pollutants concentration in areas affected by sugarcane burning activities will also be conducted. A consistent database integrating direct measurements and modeling results will be available for atmospheric chemistry processes understanding and evaluation of levels of air pollutants exposure and the potential human health effects. With the social-economical study it is expected to assess the parameters that could be used to establish public and private measures in relation to the sector.

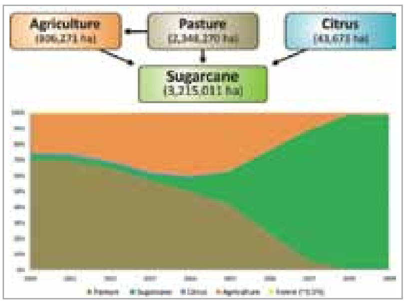

Figure 3. The dynamic of land conversion in South-Central Brazil

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Bernardo Friedrich Theodor Rudorff

Instituto Nacional de Pesquisas Espaciais (Inpe)
Ministério de Ciência e Tecnologia (MCT)

Av. dos Astronautas, 1758
CEP 12227-010 – São José dos Campos, SP – Brasil

+55-12-3208-6490
bernardo@dsr.inpe.br