Geophysical Research Abstracts
Vol. 20, EGU2018-389, 2018
EGU General Assembly 2018

Land cover change effect on climate in the Central Gulf Coast of Mexico

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The Central Gulf Coast of Mexico has been historically affected by land cover change. The deforestation of temperate forest, tropical forest and wetlands —due to the expansion of agricultural and livestock activities— is the main cause of that change. This process modifies the physical properties of land surface, so the carbon, energy and moisture fluxes with the atmosphere are altered; and this has consequences on the regional climate.

The biogeophysical effect of land cover change on seasonal temperature and precipitation of the region was evaluated. It was used the Regional Climate Model RegCM version 4.3, that is coupled with the Biosphere-Atmosphere Transfer Scheme (BATS). It was replaced the predefined land cover in the BATS scheme by the one of the National Institute of Statistics and Geography (INEGI, in Spanish) for the years 1980, 2010 and the primary vegetation. It was evaluated the cover change from 1980 to 2010 and from the primary vegetation to 2010. With the purpose to find a consistent response in temperature and precipitation, independently to the atmospheric conditions, experiments were made for a dry and a wet year, defined by the precipitation anomalies in respect to a normal period. The difference between experiments with the same atmospheric conditions and distinct land covers was considered the impact of land cover change on regional climate.

In general, the change from tropical forest to grassland had a warming effect, which was more intense during the wet season (May-October). The increase in temperature goes from 0.2°C to 1.5°C; with a stronger warming in more extended areas of change. On the other hand, the irrigation had a cooling effect (from -1°C to -1.5°C), mainly in the experiments of the dry year, where the contribution of irrigation was more important. The results in precipitation showed more uncertainty in its response to land cover change; however, in some regions like the south of Veracruz, there is a decrease in precipitation, from 10% to 40% (∼100 to 400 mm), that can be associated to grassland expansion. Likewise, it is possible to associate a precipitation increase (20%-60%) with more extended irrigated areas, especially in the dry year.

It was concluded that the most important driver of these changes was the difference in evapotranspiration, which affected directly the sensible and latent heat fluxes and, therefore, the surface energy budget. The decrease in roughness was identified as a key factor that altered precipitation, probably due to the increase in moisture flux. Knowing the sign and magnitude of the response of temperature and precipitation to the biogeophysical mechanisms of land cover change, will benefit the management of agricultural and forestry resources in the region.