CARIWIG Case Study Report 2

Drought and Agricultural-related Forest Fires in Belize

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Summary

This case study summarizes the use of the CARiDRO tool to assess how climate conditions are related with agricultural forest fires by using drought indexes. The focus geographical area is the Maya Golden Landscape (MGL) area in the Toledo District of Belize. The results demonstrate that CARiDRO and the drought indexes it produces can provide a useful contribution for warning about escaped agricultural fires and forest fire management. Thus, we suggest that the tool should be improved to facilitate the inclusion of updated climate data in order to use it for real-time monitoring of dry/wet conditions.

Aim and objectives

Forest fires are strongly connected to weather and climate. In southern Belize, forest fires, primarily escaped agricultural fires, are one of the main causes of deforestation.

Efforts to address this issue are ongoing to assist in the management and planning of burning activities in the community. Other ongoing efforts are related with the assessment of the risk of such burns getting out of control due to the influence of changing weather patterns. The latter is precisely the context in which this case study intends to contribute. Thus, the objectives of this study are:

- Verify if there are some kind of relationships between fires and drought indexes;
- Identify the potential use of CARiDRO in the evaluation of forest fires risk and suggest the possible modification of the tool to achieve this goal

Which tools were used? How and why?

The tool used is the Caribbean Assessment of Regional Drought (CARiDRO) tool described by Centella et al in the Case study report No. 1. Data on the annual number of forest fires which occurred in the MGL area during 2001 to 2012 (Zuniga, 2014) were compared with SPEI (Standardized Precipitation Evaporation Index) drought indexes produced by CARiDRO. In this case, CRU observed gridded data were considered. The rationale behind this approach is to determine if it is possible to obtain some kind of relationship between fires and the SPEI drought index, because the latter could reflect in a better way the existing wet or dry environment conditions rather than considering rainfall alone. Different time steps were used to compute the SPEI in order to determine which of them better correlates with the occurrence of forest fires.

The findings

As shown in Figure 1, the annual number of forest fires and SPEI 12 (i.e., SPEI accumulated over the last 12 months) drought index indicates the existence of some relationships, mainly for severe and extreme drought events. This seems to be, at least in part, a logical finding because SPEI reflects the existing dry/wet environmental conditions at the time when farmers carry out burns and try to keep the fire under control. However, although the meteorological relationship is a contributing factor to such fire outbreaks, changes in land-use, specifically "Milpa" farming (a traditional method used by farmers which uses fire to prepare the land, i.e., 'slash and burn') is seen to be the leading cause of fire escapes in the MGL area (Zuniga, 2014). This is perhaps one reason for the lack of a relationship in some years such as 2004 or 2011. Similar results were produced considering SPEI 6 (not shown) but are less robust.

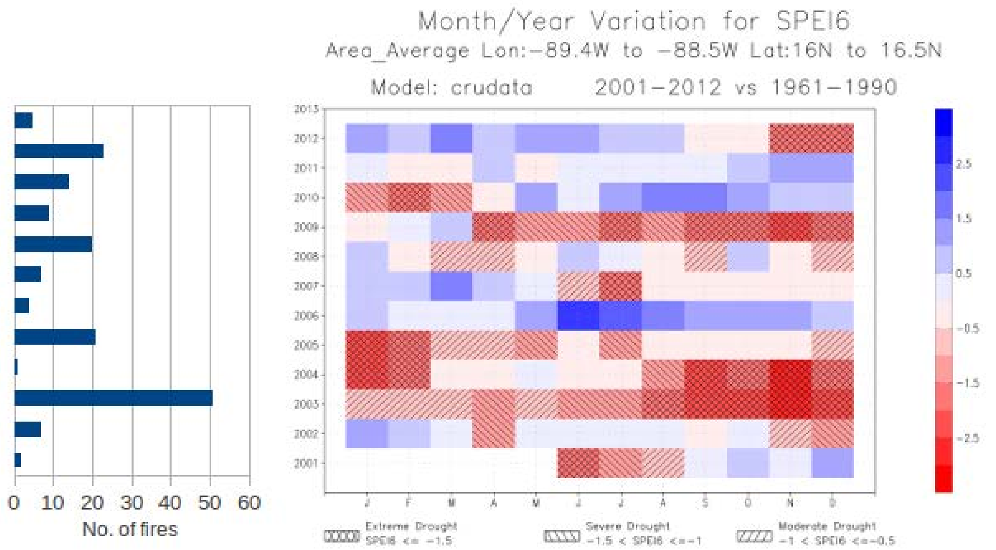

Figure 1. Annual number of forest fires (left) and SPEI12 month/year variation (right) from 2001 (bottom) to 2012 (top). The vertical axis in the left panel is the same as that in the right. Red (blue) areas in the right panel indicate dry (wet) conditions. Hatching indicates the strength of these conditions (moderate, severe or extreme).

As Zuniga (2014) concludes, the use of single climate variables (temperature or precipitation) does not allow a reasonable explanation of climate and forest fires relationship. However an index such as SPEI appears to be more informative because it is able to capture the dry/wet state of the environment and take into account the memory of these conditions for a defined previous time period (in this case, 6 and 12 months). Thus, the use of a tool such as CARiDRO can be useful as a component of an early warning system together with a forest fire index such as suggested by Zuniga (2014) in order to increase the capacity of the MGL community to alleviate severe impacts of fire incidences. After running CARiDRO for the seven regional experiments available, a clear signal is evident indicating that future drought events will be more frequent, having a 1 in 5 year recurrence time on average (the seven ensemble member average, with a range across the models of from 1 in 3 to 1 in 12 years). Also, Figure 2 clearly reflects a common multi-model projection picture in the increase of the area affected by drought after the middle of XXI (21^{st}) Century.

Implications for policy and planning

Future reduction in precipitation and the expected increase in temperature will produce more frequent episodes of negative SPEI values, which are indicative of more frequent and intense future drier conditions, and the increased risk of escaped agricultural fires. In this context, it is imperative to strengthen community awareness, land use planning and fire management in order to reduce escaped fires and the associated negative impacts. It is also suggested that the "Milpa" practice be discontinued and a more suitable land use practice be used.

Feedback on the tools

CARiDRO was developed primarily for the purpose of drought assessments related with future climate conditions based on past observed climates as well as future climate projections. However, this case study serves to show another potential use of the tool in providing relevant information as part of an early warning system related with forest fires management. To this end, the tool should be improved by developing a regional climate monthly database which incorporates variables such as temperature and precipitation. Such a database should be updated regularly to allow the real-time monitoring of dry/wet conditions and thus to provide useful and timely information.

What more could be done?

Further and additional work should be done in order to increase knowledge about the relationships between climate and escaped agricultural fires along with showing stronger signals between them. Although the case study presents some important findings with respect to such relationships, it would be appropriate to collect more data on escaped agricultural fires, including farming practices, transpiration rates of flora and soil moisture content. This would facilitate more robust findings that would help to improve recommendations to stakeholders.

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