Submission from the Inter-American Institute for Global Change Research (IAI)

In response to the invitation by the 37th meeting of the Subsidiary Body for Scientific and Technological Advice (SBSTA) to provide information on the technical and scientific aspects of emissions by sources, removals by sinks, and reservoirs of all greenhouse gases, including emissions and removals from terrestrial ecosystems such as steppe, savannah, tundra and peatlands, with a view to identifying and quantifying the impact of human activities, the Inter-American Institute for Global Change Research (IAI), presents in this submission emerging findings from its collaborative research network project on *Human, ecological and biophysical dimensions of tropical dry forest* (Tropi-Dry, http://www.tropi-dry.eas.ualberta.ca).

The Tropi-Dry team has produced comprehensive and comparative land use and policy studies in tropical dry regions in the natural and social sciences and incorporates researchers and institutions from Brazil, Canada, Costa Rica, Cuba, Mexico, United States of America and Venezuela. They have for the past 6 years examined the functioning and management of dry forests across the American continent. Their findings indicate that dry forests are showing strong signals to climate change. Their study employs cutting-edge science, such as multi-spectral remote sensing, and wireless sensor networks that can monitor changes in climate condition and forest productivity.

Knowledge of emissions and sources of greenhouse gases (GHG) in tropical dry forests and their savannah transitions is limited. Information on the overall reservoir size and emissions from key GHGs such as CO_2, NO_x and CH_4 is fundamentally non-existent with the exception of some small sites in the Americas and Australia. In addition, data on contributions from anthropogenic forces, such as conversion from savannah or tropical dry forests to agriculture, are limited. In general, more information on tropical dry forests is available for CO_2 fluxes while information on NO_x and CH_4 is scarce. This not only introduces uncertainties at the global level but it also complicates modeling efforts since there is not enough information available to validate regional or global models.

In savannahs, work by Bristow et al. (2013) that aimed at quantifying differences in CO_2 balances before and after transformation of a tropical savannah to agriculture fields in northern Australia, indicated that emissions of CO2 before transformation *“were very weak”,* generally in the order of ~0.5 Tons of Carbon per hectare per year. Land clearing transformed the region into a long-term source of CO_2. Clearing and burning emitted an overall 31.4 t C or 115.4 t CO2 per hectare. Overall, the authors indicate that the net difference between pre and post clearing was equivalent to 12-years of carbon sequestration for that specific tropical savannah.

Klink and Machado (2005) estimated that up to 50% of all Cerrado ecosystem in Brazil (the largest Neotropical savannah), or 1-million Km^2, has been transformed into agriculture over the last 35-years. If we assume that the observations presented by Bristow et al. (2013) approximate the Cerrado system, current deforestation and land degradation in this important ecosystem are a significant contributor to overall GHGs emissions in the Americas, and it is clear that a sound strategy to better understand GHGs emissions is necessary at the continental level.

Estimates on tropical dry forests GHG emissions are even more difficult to find than those for savannahs. The only network aimed to produce comparative studies from Carbon fluxes in tropical dry forests environments will start producing their first results over the next two years. This IAI network is deploying carbon flux systems in Mexico and Costa Rica with the goal of understanding the temporal and spatial dynamics of CO2 and H2O fluxes on ecosystems that are extremely sensitive to rainfall change and land use conversion.

Information on total carbon reservoirs and emissions for tropical dry forests has been identified only for Mexico. Jaramillo et al. (2003) have estimated that the total Carbon reservoir for Mexico's tropical dry forest may be approximately 2.3 Pg of Carbon. De la Barreda-Bautista et al (2010) consider that, in Mexico, total emissions from tropical dry forest conversion to agriculture and pasture (usually by slash and burn) can reach the order of 708 Tg of Carbon. This estimate is higher than total carbon emissions estimated for tropical evergreen forests in Mexico which are in the order of 569 Tg of Carbon.

Such findings are important because of the high level of anthropogenic pressures that have been historically put on dry forest and savannah ecosystems. For example, based on comparisons between current tropical dry forests extent and historical ecological potential distribution Portillo & Sanchez-Azofeifa (2010) estimated that 66% of the original neotropical dry forest has already been converted to other land uses. In North and Central America, 72% of dry forest has disappeared, while South America has lost 60%. In addition, Portillo & Sanchez-Azofeifa (2010) found that only a small fraction of tropical dry forests and savannahs are being preserved (4.5% of dry forests and only 3.3% of neotropical savannahs are under legal protection). The level of protection for humid forests is much greater and accounts for 1,567,022 km^2 (25%) of its total extent (Scharlemann et al. 2010).

Carbon losses by deforestation in tropical dry forests and savannahs are currently difficult to estimate, since annual deforestation rates have been only calculated for few sites and for specific periods, but there are no systematic continental, national or regional analyses that have calculated annual deforestation rates for these ecosystems.

The identification and quantification of GHGs and emissions from tropical savannahs and dry forests are highly affected by the length of their growing season which is affected by climate change (specifically, timing and duration). Climate variation such as el Niño Southern Oscillation in countries with large fractions of forests on their Pacific Coast also affect phenology. Studies such as this one aim to provide clarity on the overlapping and cumulative effects of climate change and climatic variability. For example, work by Tropi-Dry, on neotropical dry forests and savannahs has found important phenological changes in the duration of the growing and dry seasons for dry forests and savannahs away from the equator, which correspond to long term changes in temperature.

Tropi-Dry will spend the next 5 years improving knowledge on GHGs emissions and reservoirs that is fundamental to better understand global effects of land transformation and land degradation. Their work is supported by outreach and capacity-building initiatives that involve both scientists and stakeholders, which are being used to develop strategies to communicate research findings to decision-makers in IAI member countries.

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