Estimating the likelihood of an Amazon forest dieback and potential socio-economic impacts

Anja Rammig (1), David M. Lapola (2), Patricia Pinho (3), Carlos A.N. Quesada (4), Irving F. Brown (5), Bart Kruijt (6), Adriano Premebida (7), Jean P.H.B. Ometto (8), José A. Marengo (9), Walter Vergara (10), and Carlos A. Nobre (11)

(1) Technical University of Munich, TUM School of Life Sciences, Freising, Germany, (2) University of Campinas, Center for Meteorological and Climatic Research Applied to Agriculture, Campinas, Brazil, (3) University of Edinburgh, School of Geosciences, Edinburgh, United Kingdom , (4) National Institute for Amazonian Research, Manaus, Brazil, (5) Federal University of Acre, Rio Branco, Brazil and Woods Hole Research Center, Falmouth, USA, (6) Wageningen University, Wageningen, Netherlands, (7) Federal University of Rio Grande do Sul, Porto Alegre, Brazil, (8) National Institute for Space Research, São José dos Campos, Brazil, (9) Center for Monitoring and Early Warning of Natural Disasters, São José dos Campos, Brazil, (10) World Resources Institute, Washington DC, USA, (11) National Institute for Science and Technology for Climate Change, São José dos Campos, Brazil

Almost 20 years ago, the Amazon forest-dieback hypothesis has been proposed indicating that a large-scale loss of Amazon rainforest may be caused by climate change which may lead to substantial changes in ecosystem functioning and structure. Here, we revise the likelihood of a potential Amazon forest dieback based on a systematic literature review. We find that still large uncertainties exist about the impacts and drivers of such event. These uncertainties include the effects of increasing temperature and atmospheric CO_2 concentration, and long-term drought on forest stability, the role of nutrient cycling and potential phosphorus limitation on forest productivity and potential climate feedbacks, in particular, the potential disruption of local rainfall recycling. We assess, in the light of these uncertainties, scenarios of potential socio-economic impacts that would result from a large-scale Amazon forest dieback. For our assessment, we consider the economic losses arising from changes in the provision of ecosystem services, decreasing crop yields, reduction of hydroelectric power generation potential, reduction of fish stocks and interruption of shipping waterways. Long-term economic losses are estimated between USD $1,367 to $6,928 billion (16%-80% of Gross Brazilian Amazon Product), arising mainly from changes in the provision of non-market value ecosystem services, decreasing crop yields and reduction of hydroelectric power potential. Trade-off gains coming from such a forest dieback would sum less than half of the losses (USD $576 to $2,880 billion). We conclude that, from a risk-analysis perspective, even with a low probability of occurrence, the high socio-economic impacts of an Amazon forest dieback make it, per se, a high-risk process.