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Dangerous Climate Impacts in Amazonia

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While 'dangerous climate change' can be classified in many ways, one possible definition refers to major changes to key components of the Earth System. Such alterations can result in accelerated or irreversible climate change. For example, the loss of large areas of forest which may result in increased carbon emissions. Hence the impacts of climate change at regional scales are a crucial element of understanding dangerous climate change. If dangerous climate change is to be avoided, the regional changes leading to major impacts should be understood. However, there are considerable uncertainties both in the character of the regional climate changes that would cause significant impacts, and in the likelihood of particular changes occurring as a consequence of specific levels of global warming and greenhouse gas emissions.

Here we present progress towards building a framework to quantify the uncertainties in 'dangerous' regional impacts and to assess the range of emissions trajectories that would risk causing these regional changes. The typical method of assessing regional impacts is to use climate models driven with prescribed greenhouse gas concentrations to produce a range of possible outcomes. This often leads to a large range of uncertainty in the impacts. Our methodology reverses this technique, and instead begins with defining what changes are considered to be dangerous impacts within a specific region. These are quantified using metrics that link the dangerous impact to observational studies of environmental variables. Ensembles of climate models can then use these metrics to look at future changes and uncertainties, and assess when dangerous regional impacts could be realised. By using this 'bottom up' methodology we can begin to address the question of what range of global warming could lead to the impacts that are considered dangerous.

In the case of Amazonia we define a dangerous impact as loss of forest cover, and we use a 'bioclimatic zone' to indicate when this could occur. Levels of annual precipitation and cumulative water deficit are used to define the thresholds in this region where a transition from forest to savannah is observed. We investigate when these thresholds occur using ensembles of Met Office Hadley Centre global climate models (variants of the HadCM3 model from the Quantifying Uncertainty in Model Predictions project, QUMP), and the models from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), to span a range of scenarios and model structures. In this case study, we look at some of the assumptions used in the comparisons of different models and emissions scenarios, and the range of global temperature change where the dangerous thresholds can be reached.