AMAZALERT

A research project on impacts of climate change and land use change in Amazonia

Factsheet

Issue 7
November 2014

Impacts of Climate and Land-Use on Tropical Forests in Amazonia

Summary of AMAZALERT results

The AMAZALERT project (2011-2014) has: i) addressed and quantified uncertainties in future changes in the Amazon as a consequence of climate change and deforestation; ii) improved the projections of the impacts of these changes; iii) identified potential effective regional and global policies and iv) analysed the possibilities for warning and prevention of large-scale loss of ecosystem services.
This fact sheet provides an overview of the main results of AMAZALERT.
Most of the Amazon is not likely to degrade severely as a result of climate change this century, if deforestation is kept low. The south-east is more vulnerable. Uncertainties about the effects of CO_2 and temperature increases, drought and policies are high and Amazon forests need to be monitored to ensure early prediction of degradation.

AT A GLANCE

- *AMAZALERT started in 2011 and finishes in 2014*
- *Budget: 4.7 M Euro total*
- *14 partners in 6 EU and 3 South-American countries*
- *3 global land-climate models*
- *5 dynamic vegetation models*
- *4 hydrological models*
- *New land-use change scenarios*
- *4 stakeholder workshops*
- *Analysis of regional and global policies*
- *Datasets on biomass dynamics*
- *New data on temperature response and drought impact*
- *Analysis on tipping points*
- *'Blue-print' of an Early Warning System*

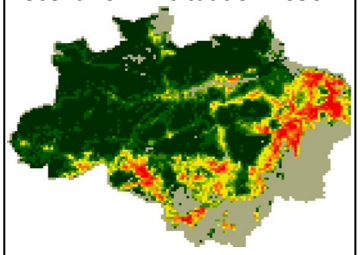
Introduction

The Amazon is under threat through the combined effects of unsustainable regional development and climate change. As summarised in the IPCC reports of 2007 and 2014, studies in the past ten years have indicated that these effects can lead to deforestation, regional disturbance of temperatures and the water cycle, as well as loss of carbon stocks and biodiversity. In turn, these changes can lead to forest loss , droughts, low river levels, floods, loss of hydropower energy and many other ecosystem services and even enhanced risk of diseases and loss of agricultural productivity.

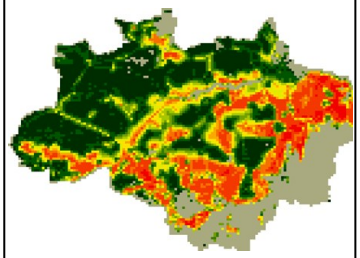
The AMAZALERT project aimed to quantify these risks and addressed four questions outlined in this fact sheet.

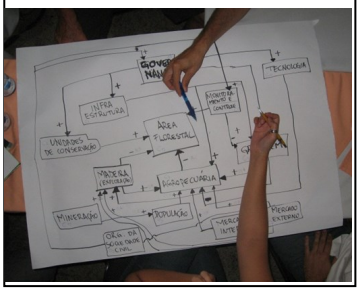
1)**Which ecosystem services in the Amazon are most important to maintain forests?** The forests of the Amazon are essential in the hydrological cycle to maintain rain, control floods and droughts, store CO_2 from the atmosphere, and protect many other ecosystem services. Stakeholders pointed out the importance of the practical services 'near to the people' to local populations such as food security, river transportation, hydropower and disease control.

Scenario A— situation 2050

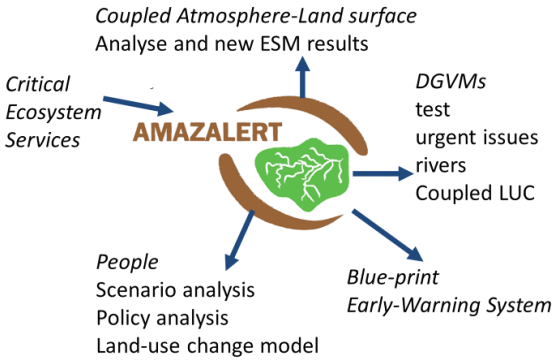


Scenario C — situation 2050





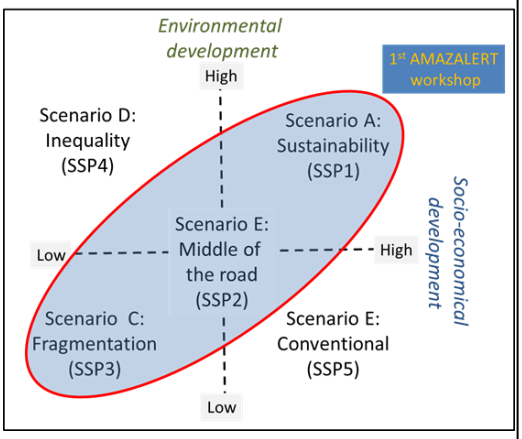
2) How did we assess the impacts of climate change and projected the effects of national policy on ecosystem services of the Amazon?



AMAZALERT brought together a range of global climate predictions from the CMIP5 studies, improved several atmospheric and land surface models and combined them with new scenarios for regional land-use change to assess the likely impact on vegetation and water in the Amazon, in the 21st century. A proposal has been made for an early-warning system for Amazon degradation.

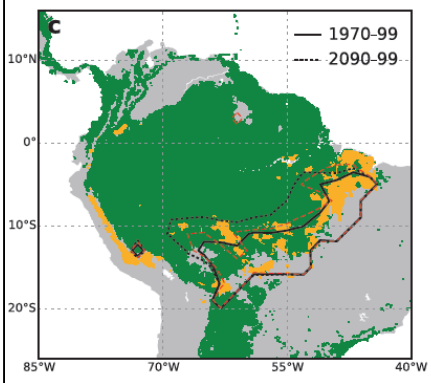
We developed qualitative scenarios that were explicit for the future of land-use in the region. Participative methods were used involving representatives of civil society, businesses, government and scientists. The workshops addressed plausible (policy) solutions within Brazil and realisable strategies from Europe. This allowed us to draft a list of potential "no-regret" policies, related to strengthening civil society as well as international agreements and policies.

3) What are the likely consequences of global change on regional climate and vegetation including land-use change for the future of Amazonia? Is there a high risk of large-scale die-back?

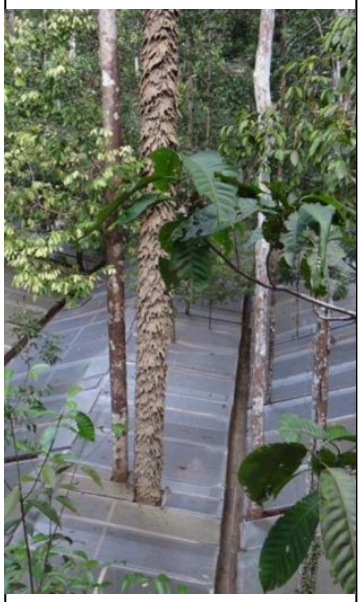


For deforestation, two opposite scenarios were discussed, based on contemporary trends of land-use dynamics in the region. In scenario A, a common future is represented, socially and environmentally highly developed. This was defined in contrast with Scenario C, with low social and environmental development (to the right). These qualitative scenarios were transformed to explicit land-use models using the open-source platform LuccME (www.terrame.org/luccme). The resulting annual land-use maps (for 2050, to the left), in turn were used to explore the interactions between deforestation with the dynamics of the vegetation, hydrology and climate, using various Earth system models.

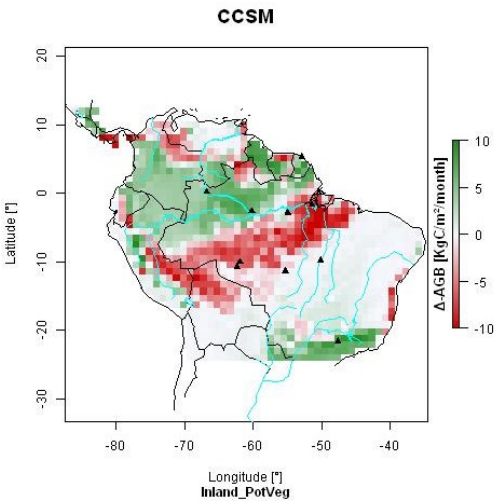
The current generation of climate models (CMIP5) simulates warming of up to 5.6°C over Amazonia. Although projections of annual rainfall changes are mixed, >80% of models project drier and longer dry seasons, especially in the south and east. Changes in dry season length have already been observed in Amazonia, with earlier onset and later demise seen in the recent decades, such as during the devastating drought year of 2010. Dry season length has a strong relationship with forest area, and the region with a long dry season is projected to expand in the future (to the left).



AMAZALERT measurements show that the forests are less sensitive to temperature increase than previously thought. Drought can cause biomass loss.



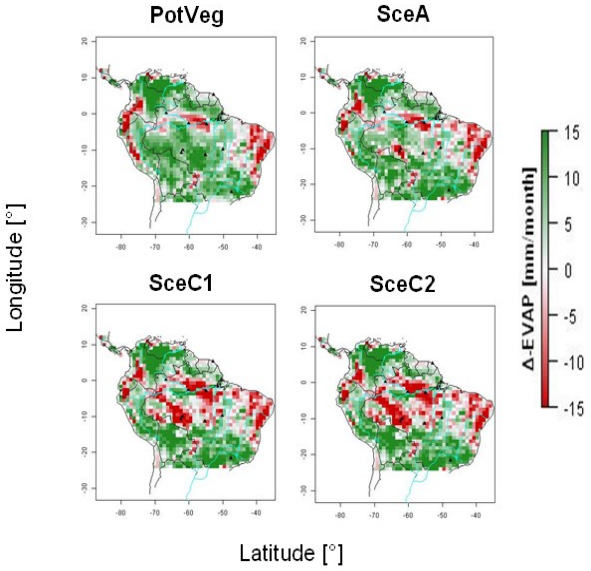
Hydropower generation will have an uncertain future due to dry years but also unexpected peak flow.



Imposing land use scenario C on coupled models resulted in reductions in evapotranspiration and precipitation in Amazonia compared to the standard CMIP5 projections. The range of deforestation scenarios along with three climate scenarios to 2100 were used to drive four Dynamic Global Vegetation Models.

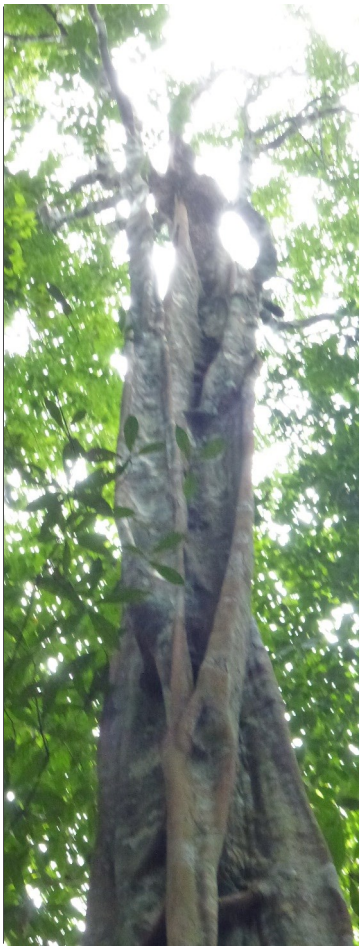
Initial results (to the left) show that biomass increases in the northern Amazon but in the vulnerable south-east it declines, even in intact forests. Further, the combined effects of land-use change, climate change and fire were investigated in a land surface model. Results show that impacts of climate change including higher temperatures and increased dry season length are enhanced by including land-use change and fire.

The land cover change maps were used as inputs to estimate the impacts in the provision of key ecosystem services in the region. Results (to the right, for the ORCHIDEE model) show a clear impact of land-use change on the water cycle in the entire Amazon basin. However, the magnitude and spatial pattern of the simulated impact is model dependent, which means that there is still substantial uncertainty.



Coupled climate-vegetation models show that if deforestation is low, widespread die-back from climate change alone by 2100 seems unlikely . However, rapid decline cannot be ruled out, because uncertainties remain regarding the sensitivity of Amazon forests to climate and land use change, particularly related to CO_2 fertilisation, fire dynamics, incidence of drought and socio-economic developments. The work undertaken by AMAZALERT indicates that the southern and eastern Amazon Basin is more vulnerable to changes than the north and north-west.

4) Even if it might be potentially unlikely, in the event of imminent die-back, what options are there to warn for it and how can we adapt to or mitigate the resulting impacts? Both the stakeholder processes carried out within AMAZALERT, as well as recent research, indicate that compared to other countries importing Amazon goods, and compared to domestic consumption by Amazon nations, in particular Brazil, Europe has a significant but limited direct impact on Amazon deforestation. Particularly, the importance of the EU's involvement in international initiatives has been highlighted. This includes the establishment and strengthening of trade standards and certification. Stakeholders also perceived



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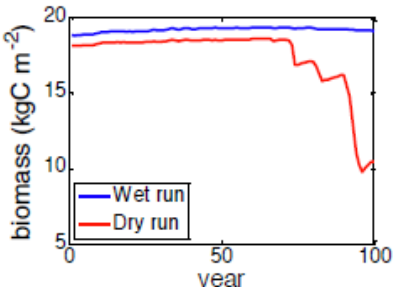
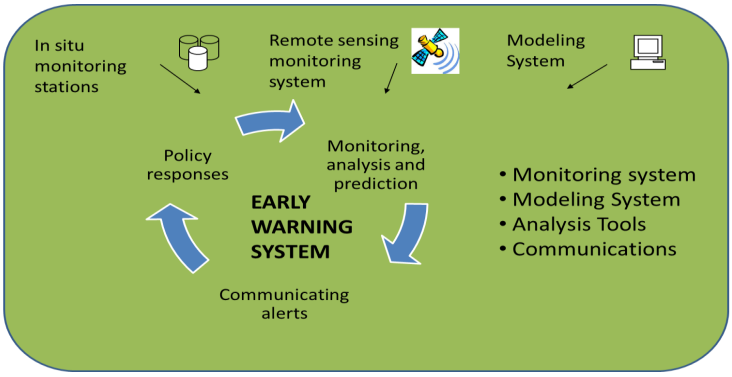
the strengthening of the civil society as important, given its potentially major role in reducing future deforestation through demand-related issues. In relation to this, the potential of the EU to influence the demand for quality products, e.g. soy imports, is high. Enhancing demand for products from the region that meet high environmental standards may reduce direct negative impacts and will generate momentum towards an overall increase in environmental standards. A reduction of import needs may be achievable through increased demand-side and production efficiency within the EU. Supporting domestic actions within Amazon nations is expected to be a particularly effective measure by the EU, due to their major direct impact.

From the Brazilian workshops, a detailed picture emerged from the actions that could be taken in order to reduce deforestation. Overall, stakeholders noted that activities are needed in the environmental, social, and economic sectors. Crucial is the integration of goals over space (also internationally), and across sectors and actors (private and public). In particular, a range of current policies needs to be maintained and enforced, including protecting Conservation Units, PPCDAm, and the Forest Code. Also, valuing forests (PES), diversifying the local economy, and education were singled out as important elements.



AMAZALERT has shown that severe degradation of the Amazon is likely to occur when the climate changes severely and deforestation progresses. However the type of change can vary strongly and the onset of change can be difficult to anticipate, because its may come too late (to the left). Early warning of such change will therefore have to be approached from a broad perspective, where basin-wide monitoring of climate change and weather extremes, moisture indicators, biomass and carbon exchange, combining new and existing networks, are used to detect and predict alarming trends. Thresholds should be defined that account for society's coping capacity as well as with the uncertainty in prediction of degradation. In this system, new scientific insight and technical possibilities should be constantly adopted (below).



Disclaimer: by November 2014, many results in this fact sheet were still unpublished and non-refereed. Please cite with caution

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