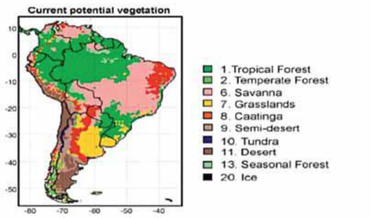
Early warning for global change-induced critical degradation of Amazonia: results of the AMAZALERT project

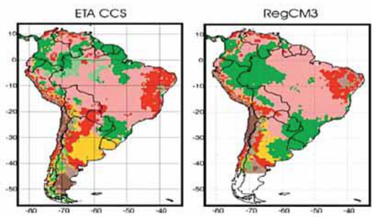
Bart Kruijt[1),2)], Celso von Randow[2)], Peter Good[3)], Gillian Kay[3)], Jan A. Elbers[1)], Gilvan Sampaio de Oliveira[2)], Antoon Meesters[4)], Carlos A. Nobre[5)] and EU-FP7 AMAZALERT project team[6)]

[1)]Wageningen UR, Netherlands; [2)]INPE, Sao José dos Campos, SP, Brazil; [3)]MetOffice, Exeter, UK;[4)]VU University Amsterdam;[5)]CEMADEN, SP, Brazil; [6)]www.eu-amazalert.org

Introduction

- The Amazon is under threat through the combined effects of unsustainable regional development and climate change.
- Risk of critical degradation of the forests has been projected, leading to regional disturbance of the water cycle, loss of carbon stocks and of biodiversity.
- In turn, these changes can lead to loss of many ecosystem services, enhanced risk of diseases and loss of agricultural productivity.
- These projections are uncertain and need to be further tested and quantified.

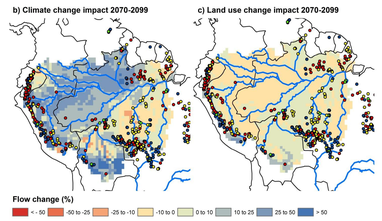


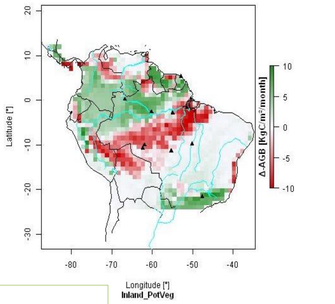


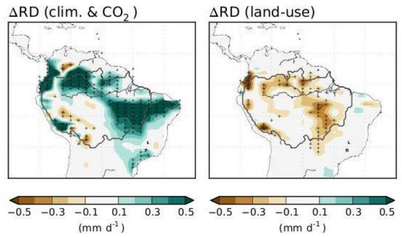
Above: simulations by Lapola et al, 2009, showing that Amazonia under simulated future climate.

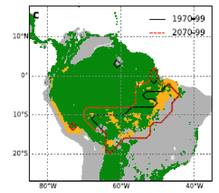
The AMAZALERT project has:

- addressed the uncertainties in the likelihood of degradation of water and carbon cycles in the forests of Amazonia as a consequence of climate change and deforestation
- Refined the forecast of consequences to forests, carbon and water cycles as well as economy of regional and global policies relating to land use and economy of the region
- analysed the possibilities for an early warning system to identify and prevent the large-scale loss of ecosystem services.







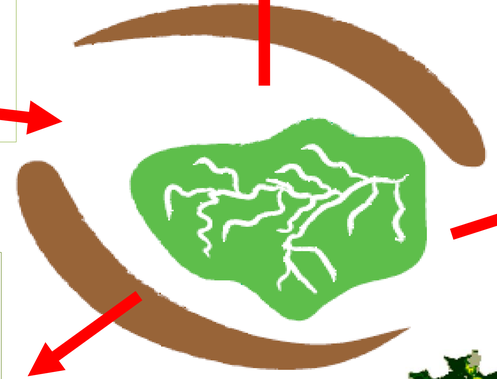


Risk of dieback

*"If deforestation is kept low, it seems unlikely that climate change alone will cause dramatic losses by 2100 in the remaining forest, **except for the SE region**."*

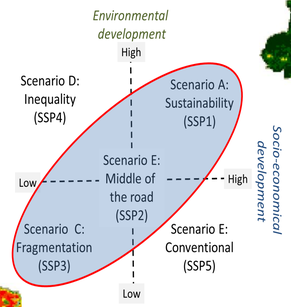
Ecosystem services

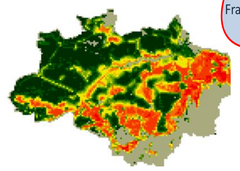
"Amazon forests are of crucial importance for a broad set of services such as safeguarding regional water recycling and carbon storage."

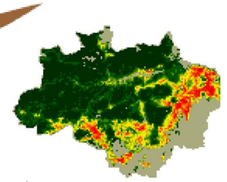


People

"If current Brazilian policies for Amazonia are maintained and enforced, deforestation rates may be kept low, but if global markets grow and regional institutions are weak, 50% of Amazonia could be deforested by 2100."

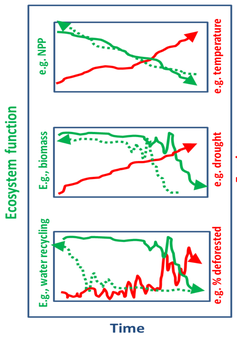


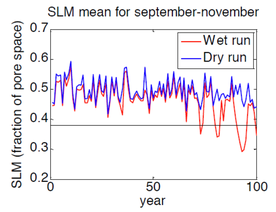




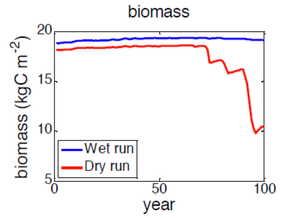
Early warning for critical transitions

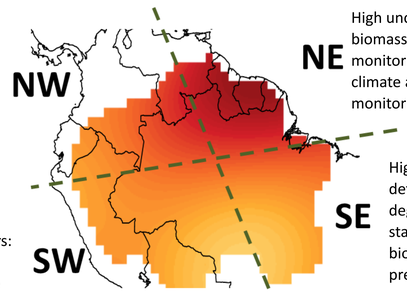
- Monitoring and early warning for degradation is essential to maintain resilience of Amazonia.
- The pathway to transition defines the monitoring and warning strategy
- Changing variability statistics (critical slowing down) appears impossible to detect in time, so trend analysis and model projections are key.





Left and bottom: simulations with a very simple model, showing non-linear degradation in dry climate, with no warning.





Relatively robust hydrological cycle, low population, sparse monitoring: intensify climate monitoring

High uncertainty, high biomass, sparse monitoring: intensify climate and fire monitoring

High importance for hydrological cycle, deforestation frontiers: intensify biomass monitoring, conserve and prepare adaptation

High degree of deforestation, degradation already started: intensify biomass monitoring, prepare adaptation.

Monitoring Amazonia for early warning

- Several monitoring systems already exist (land-use, biomass, diversity, fire, river discharge), but rainfall and (soil) moisture monitoring are scarce.
- We recommend to combine most existing systems, invest in monitoring soil and atmospheric moisture and forest regrowth/mortality.
- Different regions of Amazonia require distinct focus on warning signals and response measures

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Wageningen UR, Alterra
P.O. Box 47, 6700 AA Wageningen
Contact: bart.kruijt@wur.nl
T + 31 317 486440
www.wageningenUR.nl/alterra

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