

Analysis of critical transitions at the Global Forest

the idea is to do a global analysis using early warning signals of ecological transitions [1]

Thus the question is how near/far is the global forest from a catastrophic transition?

We will use the MODIS vegetation continuous field, so we can analyse temporal changes.

- Most probably multiple process influence the distributions of patch size at a continental scale, so we are trying to extract the main generic ones.
- Hypothesis: two power laws, small patches related to deforestation dynamics, large patches related to forest inner dynamics.

Methods

- The United Nations' International Geosphere-Biosphere Programme definition of forest (Belward 1996) defined forest as pixels with tree cover equal or greater than 30%
- We should define areas with different levels of degradation to apply the spatial indicators [Very difficult because is not possible to establish reliable controls]
- The distribution of patches is continuous but the data is discretized so we discard the lowest values and start fitting patch sizes greater than 10. Latter we found the X_{min} around 15 for the lower portion of the data.
- If we truncate the data set in two and estimate for the lower part we will get higher power exponent than the real ones (less heavy tails), if we use the complete data set because the lower part have a more importan influence in fitting (because of the greater number of small patches) we will estimate lower power exponents than the real ones (because the tails of the two procesess are mixed)
- We should use 2D DFT and multifractals in continuous data and fit patch size distributions in discretized data.[Not implemented]
- Rates of growth an shrink of patches [2]
- Portfolio concept relating [2] and [4]

1 Results

2 South America

Table 1: Model selection using Akaike criterion, and goodness of fit calculated by bootstrap. The models were fitted using maximum likelihood with three different data sets: *Complete*, the full data set; $\geq X_{min}$, values greater than or equal than X_{min} threshold; $< X_{min}$, values less than X_{min} .

							GOFp
year	Data_Set	xmin	model_name	par1	par2	AICc_weight	
2000	Complete	9	Power	1.918	NA	0.7372	1
			PowerExp	1.919	3.794e-12	0.2628	NA
			LogNorm	-3.444	3.043	0	NA
			Exp	0.001303	NA	0	NA
2010			Power	1.898	NA	0.9196	1
			PowerExp	1.894	9.513e-10	0.08036	NA
			LogNorm	-2.593	2.903	0	NA
			Exp	0.001471	NA	0	NA
2000	$\geq X_{min}$	265	Power	2.013	NA	0.6332	1
			LogNorm	-1486	38.46	0.2017	NA
			PowerExp	2.003	1.38e-13	0.1651	NA
			Exp	0.0005124	NA	0	NA
2010		216	Power	2.021	NA	0.6279	1
			PowerExp	2.015	6.11e-12	0.1976	NA
			LogNorm	-1213	34.66	0.1744	NA
			Exp	0.0005397	NA	0	NA
2000	$< X_{min}$	16	PowerExp	1.561	0.007014	1	NA
			Power	2.169	NA	0	1
			LogNorm	2.701	1.167	0	NA
			Exp	0.02767	NA	0	NA
2010		14	PowerExp	1.493	0.009059	1	NA

							GOFp
year	Data_Set	xmin	model_name	par1	par2	AICc_weight	
			Power	2.165	NA	0	1
			LogNorm	2.732	1.103	0	NA
			Exp	0.03171	NA	0	NA

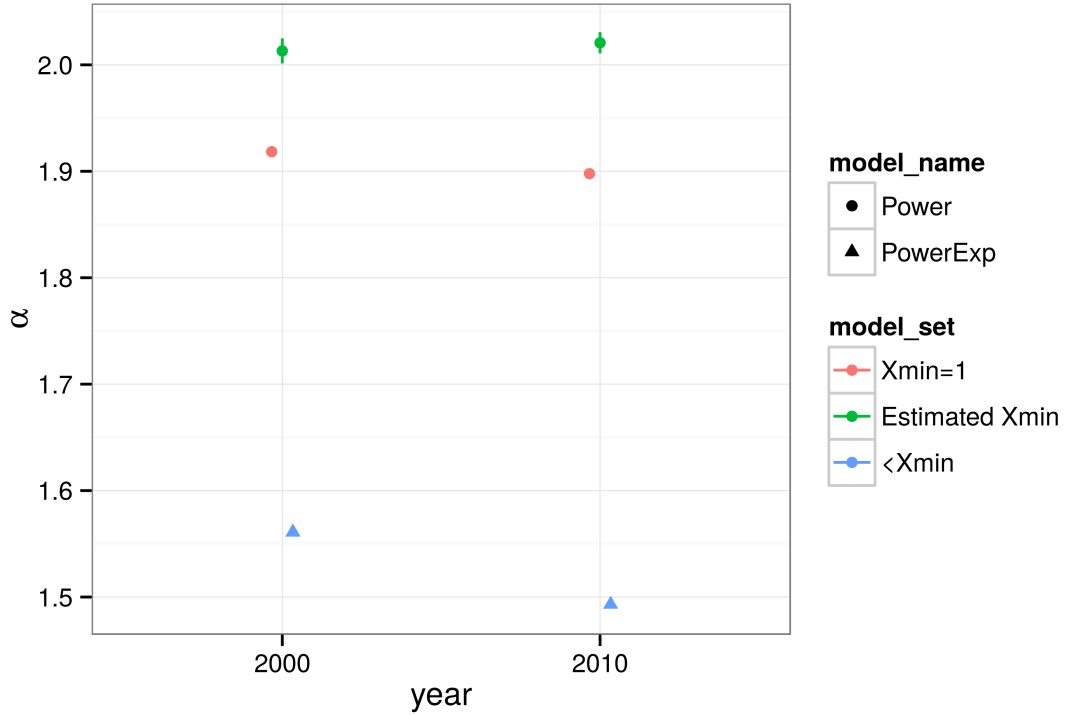


Figure 1: Power law exponent of best models by year and with different data set: $<Xmin$ the data is less than the estimated minimum patch size, *Estimated Xmin* the minimum patch size was estimated from data, and only patch sizes greater than or equal to Xmin was used.

- The α with Estimated Xmin correspond to big forest patches and natural forest dynamics, and there is no variation in these. The α with xmin=1 correspond to small patches probably influenced by deforestation.
- Besides the power law distribution is the best model is not a valid model for the complete data set. For the patch sizes greater than Xmin the best model is the power law and it is not rejected by the goodness of fit test (GOF). For patches less than Xmin, the best model is power law with exponential cutoff, the second best is power law but it was rejected by GOF.

Related papers

- About fitting power laws [5] [6]
- About global maps [7] [8] [9]
- About cluster statistics [10] [2]

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