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.

- 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]
- 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]

Results

South America

Table 1: Model selection using Akaike criterion, and goodness of fit calculated by bootstrap. The models were fited using maximum likelihood with three different data sets: *Complete*, the full data set; >=Xmin, values greater than or equal than *Xmin* threshold; <Xmin, values less than *Xmin*.

year	Data_Set	xmin	model_name	par1	par2	delta_AICc	GOFp
2000	Complete	1	Power	1.918	NA	0	0
			PowerExp	1.918	3.36e-11	2.019	NA
			LogNorm	1.151	1.631	683753	NA
			Exp	0.003986	NA	7511320	NA
2010			Power	1.833	NA	0	0
			PowerExp	1.831	2.233e-10	6.217	NA
			LogNorm	1.266	1.653	577578	NA
			Exp	0.003998	NA	6827242	NA
2000	>=Xmin	265	Power	2.013	NA	0	1
			LogNorm	-1486	38.46	2.288	NA
			PowerExp	2.003	1.38e-13	2.688	NA
			Exp	0.0005124	NA	139893	NA
2010		216	Power	2.021	NA	0	1
			PowerExp	2.015	6.11e-12	2.312	NA
			LogNorm	-1213	34.66	2.562	NA
			Exp	0.0005397	NA	150593	NA
2000	<Xmin	265	PowerExp	1.936	0.0006666	0	NA
			Power	1.956	NA	1522	0
			LogNorm	1.389	1.338	818292	NA
			Exp	0.08521	NA	1822635	NA
2010		216	PowerExp	1.829	0.001763	0	NA

year	Data_Set	xmin	model_name	par1	par2	delta_AICc	GOFp
			Power	1.877	NA	5615	0
			LogNorm	1.499	1.319	713859	NA
			Exp	0.08257	NA	1525334	NA

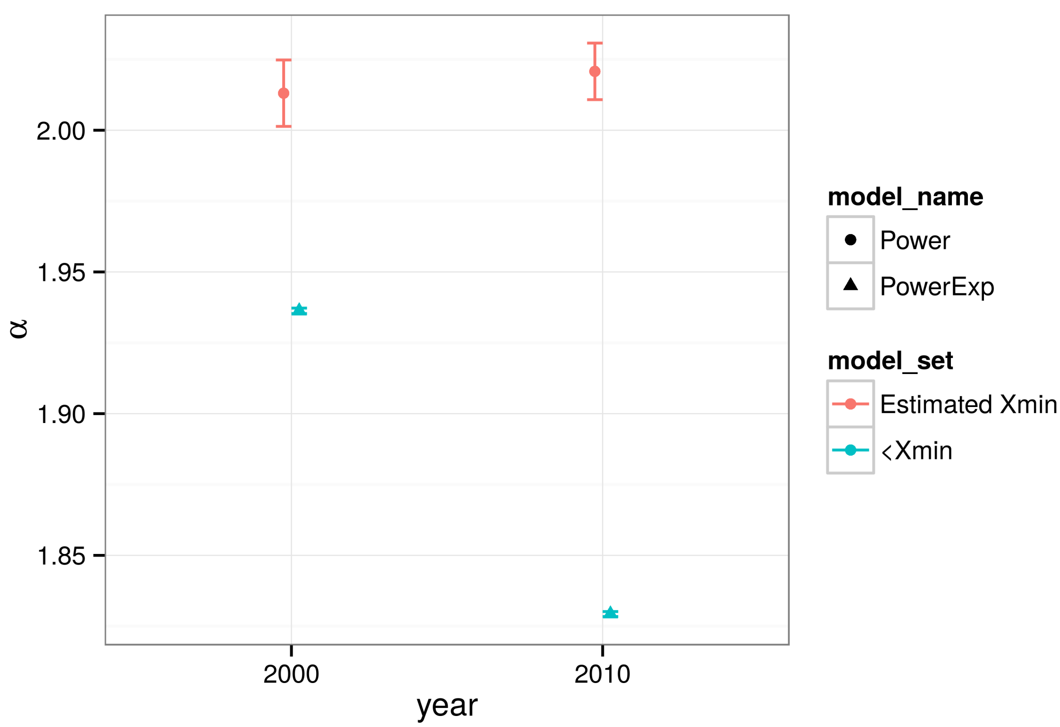

Figure 1: Power law exponent of best models by year and with different data set: *<Xmin* the data is less than the extimated minimum patch size, *Estimated Xmin* the minimum patch size was estimated from data, and only patch sizes greater than or equal to Xmin was used.

- 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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