

# Supplementary Material for: Patterns of land-cover transitions from satellite imagery of the Brazilian Amazon

Finn Müller-Hansen<sup>1,2</sup>, Manoel F. Cardoso<sup>3</sup>, Eloi L. Dalla-Nora<sup>3</sup>, Jonathan F. Donges<sup>1,4</sup>, Jobst Heitzig<sup>1</sup>, Jürgen Kurths<sup>1,2</sup>, and Kirsten Thonicke<sup>1</sup>

<sup>1</sup>Potsdam Institute for Climate Impact Research, Telegrafenberg A31, 14473 Potsdam, Germany

<sup>2</sup>Department of Physics, Humboldt University Berlin, Newtonstraße 15, 12489 Berlin, Germany

<sup>3</sup>Center for Earth System Science, National Institute for Space Research, Rodovia Presidente Dutra km 40, 12630-000 Cachoeira Paulista, São Paulo, Brazil

<sup>4</sup>Stockholm Resilience Center, Stockholm University, Kräftriket 2B, 114 19 Stockholm, Sweden

*Correspondence to:* mhansen@pik-potsdam.de

**Table S1.** Overview of land-cover classes in the TerraClass data set and assignment to simplified classes used in the paper.

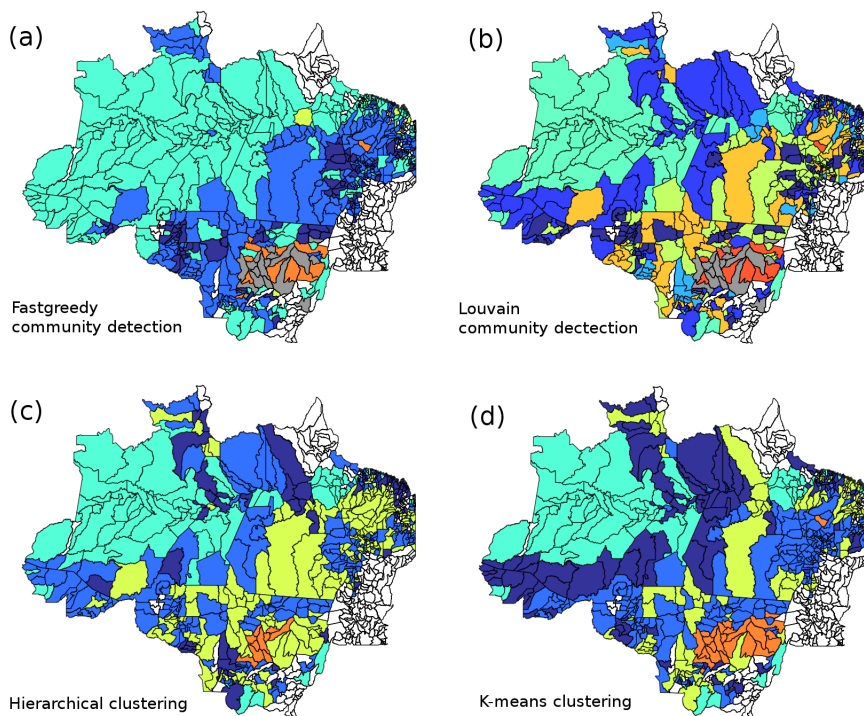
TerraClass no.	TerraClass category	Simplified classes
01	Annual crops	Annual crops
02	Mosaic of uses	Other
03	Urban area	Other
04	Mining	Other
05	Herbaceous pasture	Clean Pasture
06	Shrubby pasture	Dirty Pasture
07	Regeneration with Pasture	Dirty Pasture
08	Pasture with exposed soil	Dirty Pasture
09	Secondary Vegetation	Secondary Vegetation
10	Others	Other
11	Non-observed area	(Discarded)
12	Reforestation	Other
13	No forest (cerrado biome)	(Discarded)
14	Primary forest	Forest
15	Hydrography (rivers/lakes)	(Discarded)
16	Recently deforested areas	Forest

**Table S2.** Markov transition matrix  $\mathbf{p}$  as depicted in Fig. 3(a). If the rows do not sum up exactly to 1, this is due to rounding.

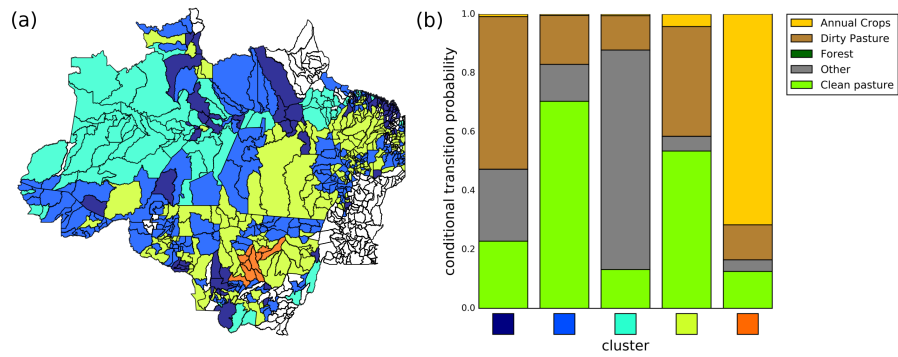
TC2012 TC2010	Secondary Vegetation	Clean Pasture	Dirty Pasture	Forest	Annual Crops	Other
Secondary Vegetation	0.87	0.07	0.037	0	0.0038	0.019
Clean Pasture	0.026	0.84	0.11	0	0.018	0.009
Dirty Pasture	0.16	0.42	0.39	0	0.0066	0.03
Forest	0.0008	0.00091	0.0012	0.9987	0.00006	0.00031
Annual Crops	0.016	0.098	0.025	0	0.85	0.011
Other	0.15	0.17	0.14	0	0	0.54

**Table S3.** Conditional transition matrix  $\mathbf{q}$  as depicted in Fig. 3(b).

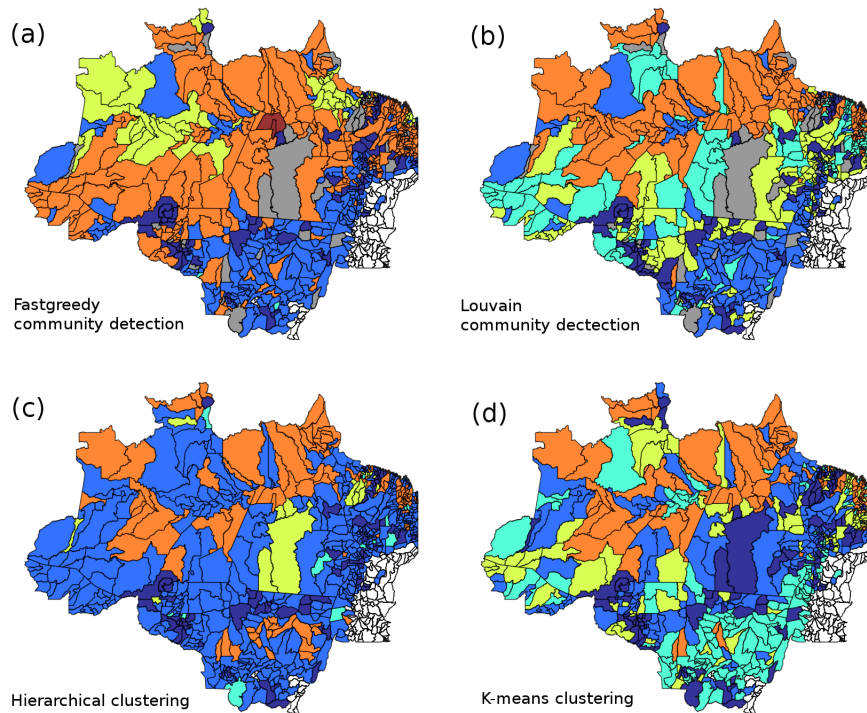
TC2012 TC2010	Secondary Vegetation	Clean Pasture	Dirty Pasture	Forest	Annual Crops	Other
Secondary Vegetation	-	0.54	0.28	0	0.029	0.15
Clean Pasture	0.16	-	0.67	0	0.11	0.056
Dirty Pasture	0.26	0.68	-	0	0.011	0.05
Forest	0.25	0.28	0.36	-	0.019	0.097
Annual Crops	0.1	0.66	0.17	0	-	0.071
Other	0.32	0.37	0.31	0	0	-



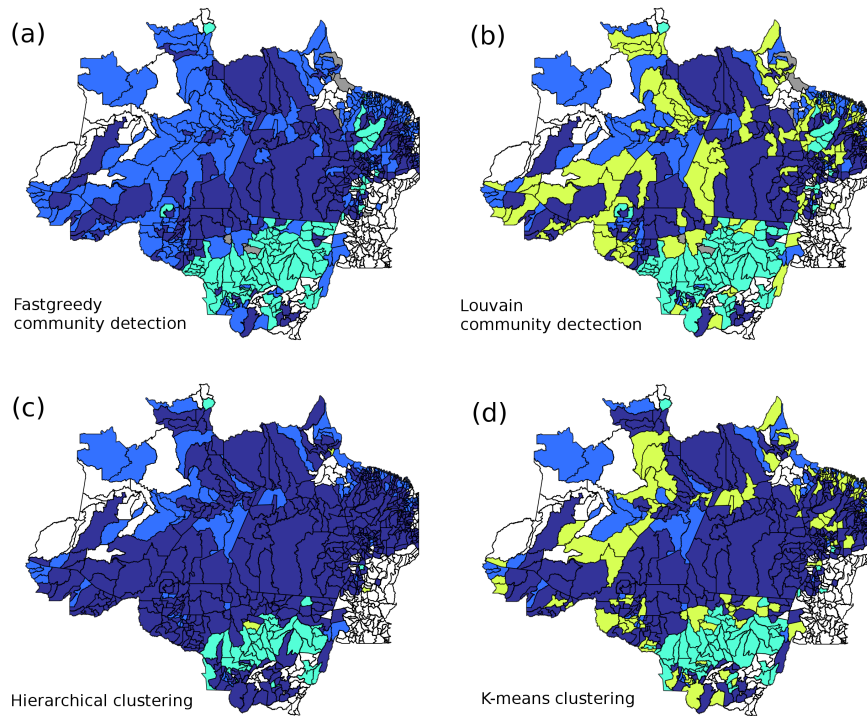
**Figure S1.** Comparison of network (a, b) and classical (c, d) clustering algorithms for transitions from secondary vegetation to other land-use classes between 2010 and 2012. The (arbitrary) colors indicate municipalities belonging to the same cluster. White regions lack data to estimate the transition matrix, grey regions are not connected to the similarity network.



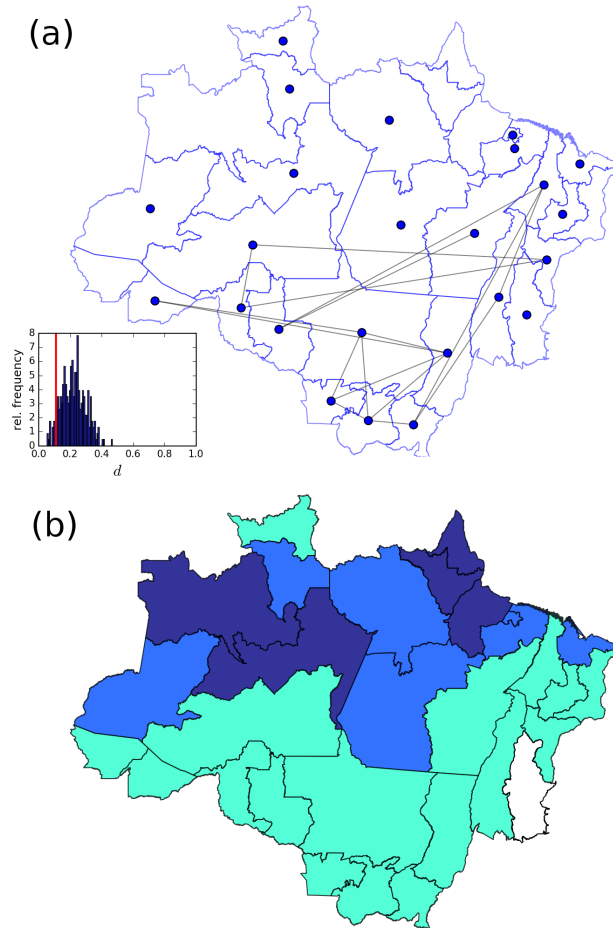
**Figure S2.** (a) Hierarchical clustering as in Fig. S1(c). (b) Corresponding cluster centroids showing the average conditional transition probabilities of the respective clusters.



**Figure S3.** Comparison of network (a, b) and classical (c, d) clustering algorithms for the whole Markov matrices  $\mathbf{p}$  between 2010 and 2012. Each cluster is visualized by one color. White regions lack data to estimate the transition matrix, grey regions are not connected to the similarity network.



**Figure S4.** The same analysis as in Fig. 7 but with transitions between 2008 and 2010.



**Figure S5.** Illustration of the clustering with mesoregions as spatial partition for the whole Markov matrices  $\mathbf{p}$  between 2010 and 2012. (a) Similarity network: Because there are only few significant links and only few nodes connected to the network, the community detection is not feasible. (b) Result of the hierarchical clustering with 3 clusters.