Article

Detecting and attributing drivers of forest disturbance in the Colombian Andes using Landsat time-series

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Calculating error-adjusted estimator

The area of forest disturbances and land cover obtained directly from a map (i.e. pixel counting) may differ greatly from the true area of change because of map classification error. An error-adjusted estimator is needed once an error matrix is constructed. For instance, in the case of our disturbance class we calculate:

$$\widehat{\boldsymbol{A}}_{\boldsymbol{j}} = \widehat{\boldsymbol{A}}_{\boldsymbol{total}} * \widehat{\boldsymbol{p}}_{\boldsymbol{.j}} \quad (1)$$

where $\widehat{\boldsymbol{A}}_{\boldsymbol{j}}$ is the adjusted area, $\widehat{\boldsymbol{A}}_{\boldsymbol{total}}$ is the total mapped area, and $\widehat{\boldsymbol{p}}_{\boldsymbol{.j}}$ is the column sum of the cell area proportion in the error matrix. See Tables S1 and S2 for checking values used.

$$\widehat{\boldsymbol{p}}_{\boldsymbol{.j}} = \sum_{i=1}^{2} Wi \frac{ni1}{ni.} = 0.139 * 204/211 + 0.861 * 15/381 = 0.168$$

$$\widehat{\boldsymbol{A}}_{\boldsymbol{j}} = 63794.43 * 0.168 = 10717.46 \quad (1)$$

Table S1. Confusion matrix at pixel-level for disturbances and stable forest

		Reference		UA	PA	OA
		Disturbance	Stable Forest			
Map	Disturbance	204	7	0.966	0.926	0.963
	Stable Forest	15	366	0.959	0.981	

Table S2. Full area-weight confusion matrix for disturbances and stable forest

		Reference											
		Disturbance	Stable Forest	Pixels	Total Area Mapped	Wi	Area Adj	CI Area Adj	UA	CI_UA	PA	CI_PA	OA	CI_OA
Map	Disturbance	0.134	0.004	211	8858.25	0.139	10717.46[1]	1095	0.967	0.024	0.798	0.08	0.961	0.017
	Stable Forest	0.033	0.827	381	54936.18	0.861	53076.97	1094	0.961	0.02	0.994	0.004		
			Total	**592**	**63794.43**	**1**								

Table S3. Confusion matrix at object-level for drivers of disturbance using 40% data training from Random Forest.

		Reference			UA	PA	OA
		pasture	agriculture	non-stand			
Map	pasture	141		1	0.993	0.986	0.956
	agriculture		10	1	0.900	0.500	
	non-stand	2	5	45	0.844	0.956	

Table S4. Full area-weight confusion matrix for drivers of forest disturbance

		Reference												
		pasture	agriculture	non-stand	Area Objects	Total Area Mapped	Wi	Area Adj	CI Area Adj	UA	CI_UA	PA	CI_PA	OA	CI_OA
Map	pasture	0.853	0.000	0.004	691.130	8310.420	0.857	8328.916[2]	59.67	0.995	0.005	0.993	0.005	0.980	0.008
	agriculture	0.000	0.021	0.001	42.210	210.330	0.022	290.882	50.34	0.964	0.057	0.706	0.121		
	non-stand	0.006	0.009	0.107	149.040	1175.310	0.121	1085.959	76.44	0.879	0.052	0.955	0.040		
				Total	**882.380**	**9696.060**	**1**								

All areas are in hectares.

[1]The total area disturbed before 1999 was 3495.69 ha (Support Vector Machine classifier). This value is added to area adjusted in Table 2S which is the final value reported in the manuscript.

[2]The total area with pastures before 1999 was 3096.96 ha (Corine Land Cover). This value is added to area adjusted in Table 4S which is the final value reported in the manuscript.

Wi: Proportion of area for a given class. Total area mapped by class / Total Area

UA: User accuracy

PA: Produced accuracy

CI: 95% confident interval.

OA: Overall accuracy