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Biogeosciences
Discussions

Interactive comment on "Change in tropical forest cover of Southeast Asia from 1990 to 2010" *by* H.-J. Stibig et al.

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Point 1:

We agree that a more explicit explanation of the application of the FAO forest definition would be useful. Referring to canopy density and tree height we would specify:

"It should be noted that the forest definition criteria on canopy density and tree height could be used as guideline, but not in the sense of rigorous measures. From Landsat imagery neither the 10% tree-cover threshold nor the 5 m height threshold can be precisely determined. The consistent mapping of the 10% canopy density threshold remained a challenge. We took advantage of the fact that the vast majority of forest canopies in Southeast Asia has notable higher canopy densities, and that we could

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use a large number of high–resolution reference imagery for supporting our class assignment in case of very open tree cover. Referring to tree height, the differentiation between tree cover above and below the height threshold could only be approximately deduced from the spectral response and textural pattern of tree canopies."

For supporting the mapping of tree cover close to the minimum canopy density threshold (specifically an issue on the continent), we could rely on a number of Kompsat 1-4m high-resolution satellite imagery (for > 70 sample sites on for SE-Asia). For many sites there was also good Google Earth high-resolution reference data available. Indeed, the minimum canopy density threshold did not present a major obstacle for evergreen and mixed deciduous forests as the vast majority of forests has tree cover densities notably higher than 10%. It became only an issue in cases of very degraded areas and very 'open' dry Dipterocarp forests.

There is no way to 'measure' tree heights from the satellite data used. However, we have achieved a good approximate differentiation between tree cover above and below the 5m class threshold based on spectral values and image texture. As the pattern of illuminated and shaded crown portions becomes increasingly distinct with 'stand age', we kept canopies of 'rough' texture and 'lower' spectral reflectance as tree cover, those of 'smoother' texture' and 'higher' spectral response were assigned to 'Other Wooded Land'. Also here we took advantage of our high resolution satellite imagery and of field experience. In comparison to field inventory we may have to tolerate potential slight over- or underestimations of the forested area in specific sites due to the difficulty to assign precise height thresholds (as specified later in the text), assuming that there will be some compensation across the regional sample.

As far as the minimum mapping unit (MMU) is concerned, we will explicitly specify in the text that

"...we increased the minimum size criterion from 0.5 ha to 5 ha in view of the pantropical scale of the study and the limitations of the spatial resolution of Landsat im-

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agery".

It would not have been feasible to apply a 0.5ha MMU based on Landsat TM imagery and at regional scale. We expect that differences in individual sites due to the discrepancy in size of minimum mapping units may level out across the regional sample.

Point 2:

Firstly, we propose to address this point by specifying in the text that:

"We calculate land cover proportions for each sample unit and estimate the total area of land cover change using the Horovitz-Thomson Direct Expansion Estimator (e.g. Eva et al., 2012)(Supplement 1)."

Secondly, we propose a Supplement for detailed description of the estimation process and the estimators (see Supplement 1).

Point 3:

We agree to change the expression 'natural forest canopies' to 'natural forests'. Our point was indeed only to differentiate between 'non-plantation forests' and 'plantation forests'.

Point 4

Following the referees recommendation we present the result of the accuracy assessment as a table (Table 4) and will adapt the text accordingly. In the table we will show the overall agreement based on the three land cover categories: 'Tree Cover', 'Tree Cover Mosaic' and all other land cover.

It is not possible to present figures for specific forest types as the latter were not mapped separately. However, we are able to provide a sub-region related splitting, that reflects two different biomes and therefore a broad differentiation in forest types.

We would therefore add a paragraph:

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“A difference can be observed for the two sub-regions, closely related to main forest types. The level of agreement in mapping the mainly evergreen humid tropical forests of the insular sub-region is, on average, up to 8% higher than that for the predominantly mixed and dry deciduous forests on the continent (Tab 4), reflecting the complexity of mapping the seasonal forest formations of continental Southeast Asia.”

!Table 4 is uploaded below as Fig.1!

Point 5

As proposed by the referee we give the estimators of the standard error (se) in the supplement and consistently indicate two decimals for se in the text.

Point 6:

Following the referees proposal we have shortened chapter 3.1, summarizing on the main figures and trends only, and leaving further details to be derived from Table 3:

“In total, the forest-covered area of Southeast Asia (incl. PNG and the Solomon Islands) has changed from 268.0 Mha in 1990 to 236.3 Mha in 2010 (Tab. 2). The total net loss of tree cover was 17.5 Mha in the 1990s, and 14.5 Mha in the 2000s, which corresponds to annual change rates of 0.67 % and 0.59 %, respectively (Tab. 3). At the same time, the land area covered by other wooded land (OWL = shrubs, young tree plantations, tree regrowth, oil-palm) increased during these two periods by about 10.6 Mha and 7.1 Mha, respectively. The forest covered area of continental Southeast Asia makes up almost one third of Southeast Asia’s forested area, displaying for the 1990s and 2000s annual rates of forest loss of 0.21 Mha and 0.48 Mha, respectively (Tab. 3). Insular Southeast Asia holds more than two third of the regional forest cover, however, having faced high rates of annual forest loss of about 1.51 Mha in the 1990s and 0.96 Mha in the 2000s (Tab 3). Although the sampling strategy used in this study has been designed for regional scales, a country estimate may be given for Indonesia (incl. East Timor), which holds almost two third of the forest area as well

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as of the sample units (156) of insular Southeast Asia. According to this estimate, the forest-covered area of Indonesia has decreased from 123.8 Mha in 1990 to 104.4 Mha in 2010 (Tab. 3), with high rates of annual forest loss of 1.15 Mha (0.98 %) and 0.82 Mha (in 0.76 %) in the 1990s and 2000s, respectively. Deforestation in Indonesia contributed therefore at almost 80 % to the sub-regions forest loss (incl. PNG and Solomon Islands)."

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/10/C6191/2013/bgd-10-C6191-2013-supplement.pdf

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Table 4: Results of overall accuracy assessment

	(I)			(II)			(III)		
	Cont. SEA	Insular SEA	All SEA	Cont. SEA	Insular SEA	All SEA	Cont. SEA	Insular SEA	All SEA
No. polygons	(185)	(320)	(505)	(308)	(759)	(1067)	(493)	(1079)	(1572)
Year	%	%	%	%	%	%	%	%	%
1990	79	86	85	58	75	74	69	78	77
2000	83	86	85	63	65	65	73	71	71
2010	81	94	91	69	72	72	75	78	77
Average	81	89	87	63	71	70	72	76	75

(I) = Systematically selected polygons; (II) = Change polygons (III) = All polygons

Fig. 1.

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