Illegal Logging Update Meeting, Chatham House, London, 5 – 6 July 2011

Southeast Asian Deforestation Rates and Agricultural Conversion

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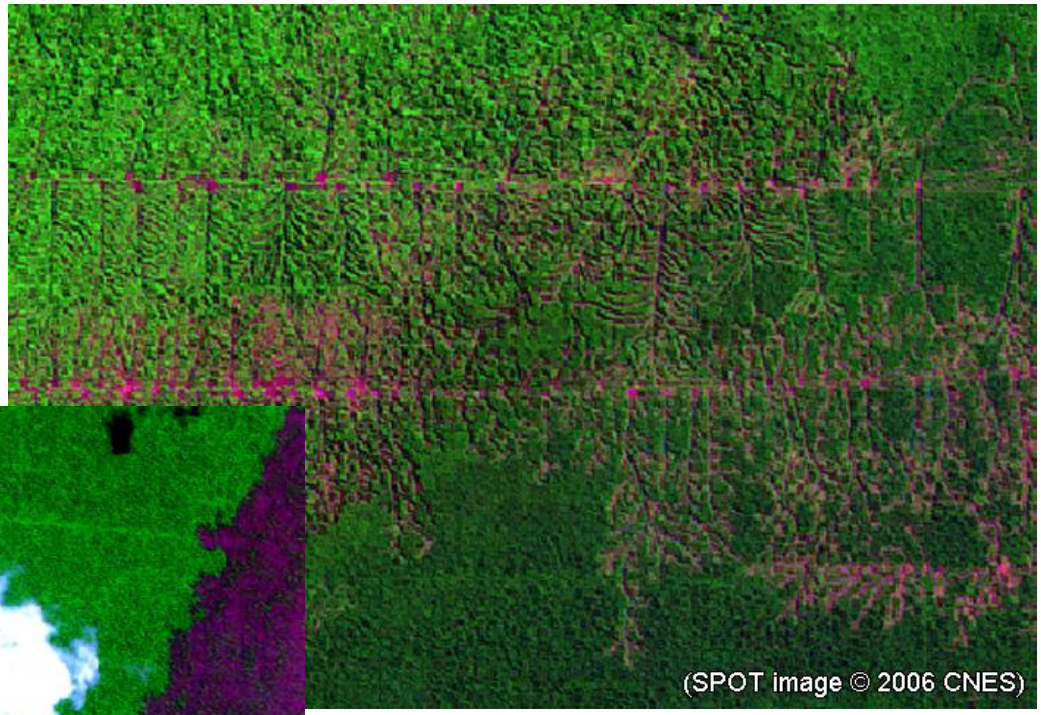
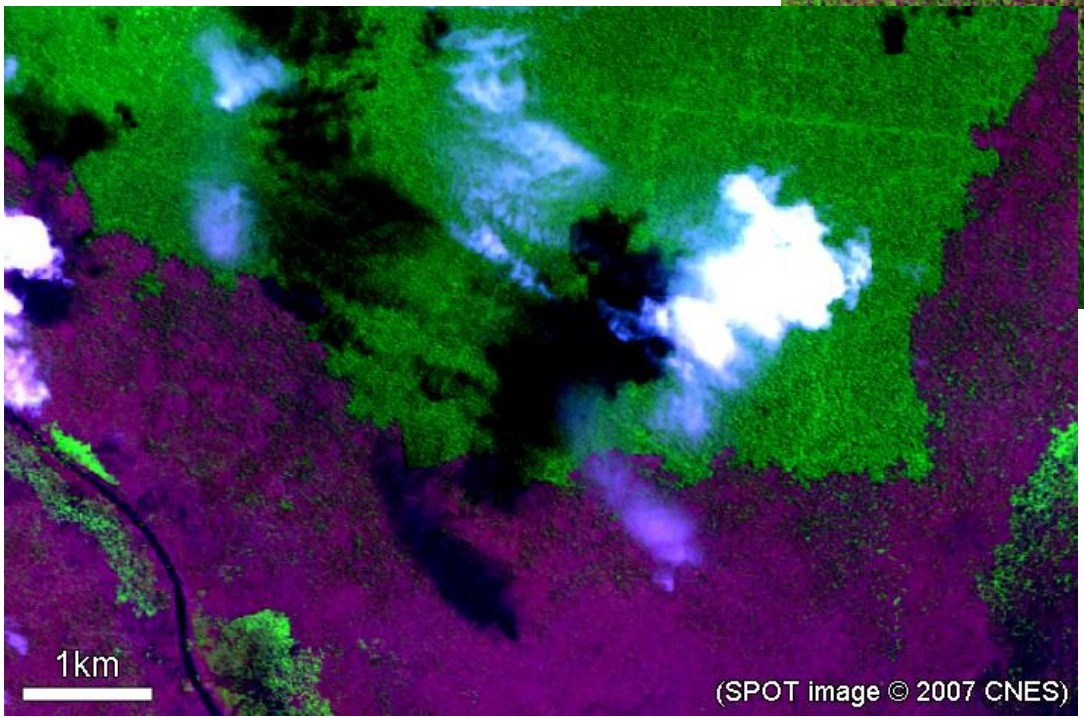
Land cover change in insular Southeast Asia

Degradation of forest

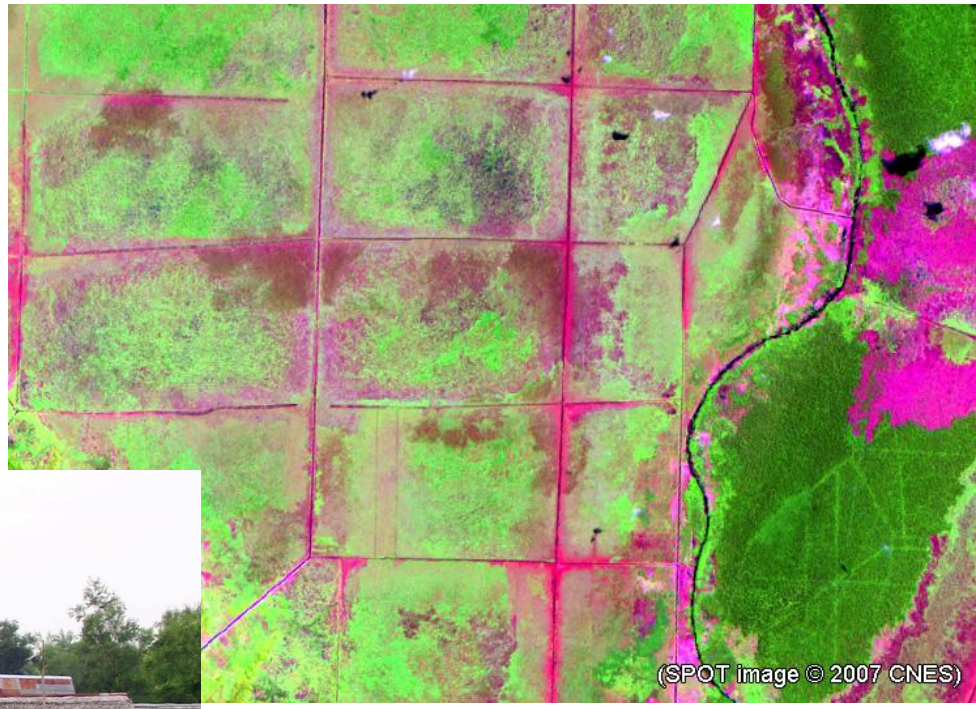




Deforestation…

Land cover change in insular Southeast Asia

Draining peatlands



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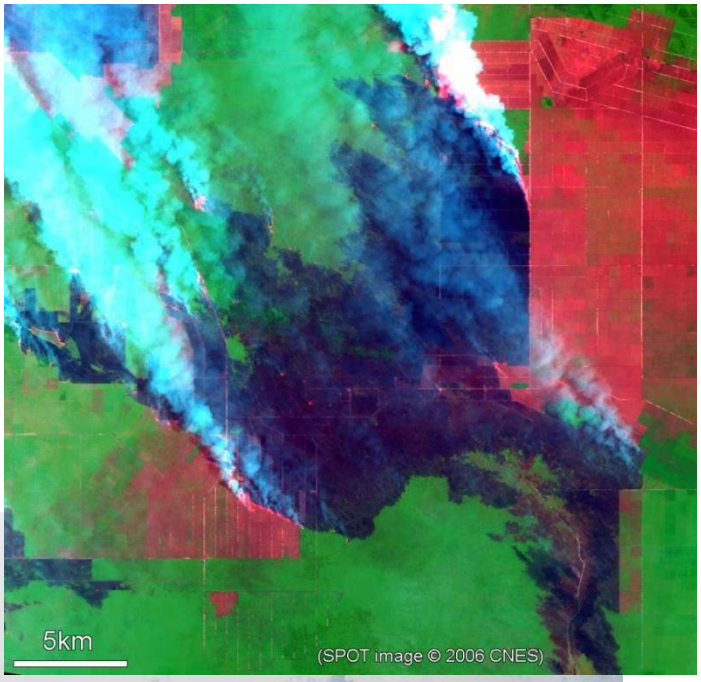
Land cover change in insular Southeast Asia

Fires…



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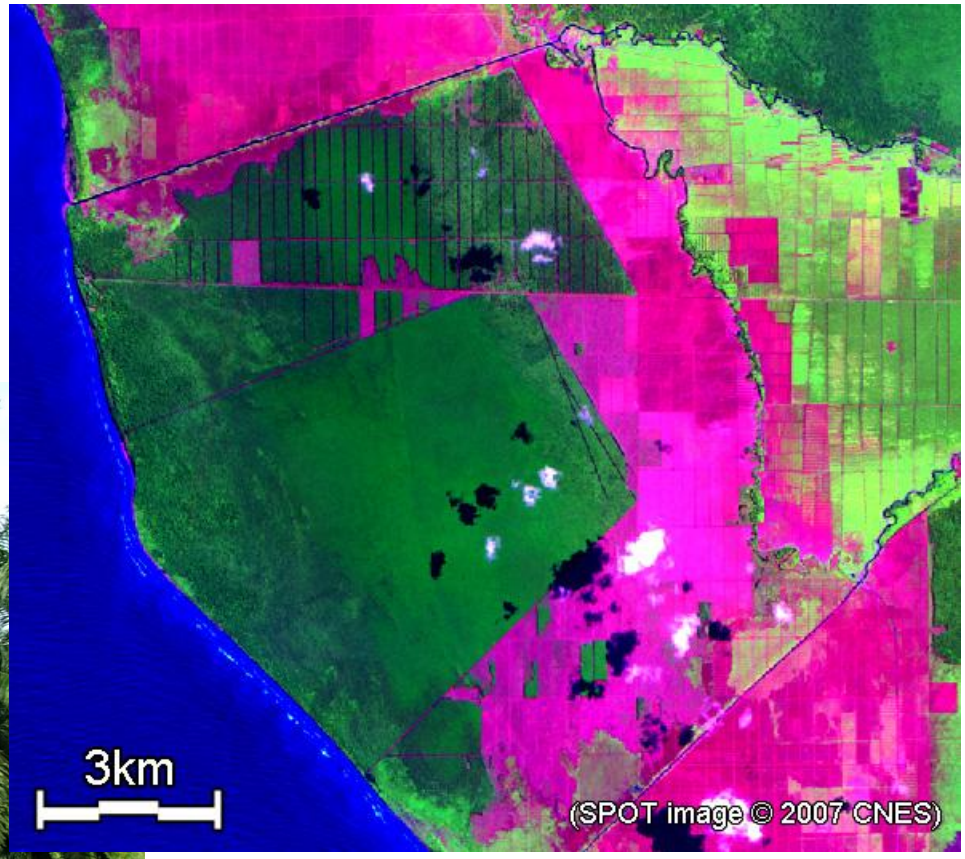
Land cover change in insular Southeast Asia

Plantation Development

photo © Jukka Miettinen 2006-2007



What we did

1. We analysed deforestation rates in insular Southeast Asia over the past decade (2000-2010) using satellite images at various spatial resolutions.

2. We utilized a pair of regional 250m spatial resolution land cover maps to evaluate the spatial variation of deforestation rates within the region, both geographically between different parts of the region and thematically between different forest types.

3. We identified major deforestation concentration areas within the region and examined the current (2010) land cover in areas deforested since 2000.

4. Using high resolution satellite images, we map the spatial extent of industrial plantations in peatlands of Peninsular Malaysia, Sumatra and Borneo in 2000 and 2010 and examined the land cover at the plantation sites a decade before the establishment of the plantations.

The main results have been published in the following papers: (next slide)

Global Change Biology

Global Change Biology (2011) 17, 2261–2270, doi: 10.1111/j.1365-2486.2011.02398.x

Deforestation rates in insular Southeast Asia between 2000 and 2010

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GLOBAL CHANGE BIOLOGY BIOENERGY

GCB Bioenergy (2012), doi: 10.1111/j.1757-1707.2012.01172.x

Extent of industrial plantations on Southeast Asian peatlands in 2010 with analysis of historical expansion and future projections

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MODIS 500m resolution mosaic

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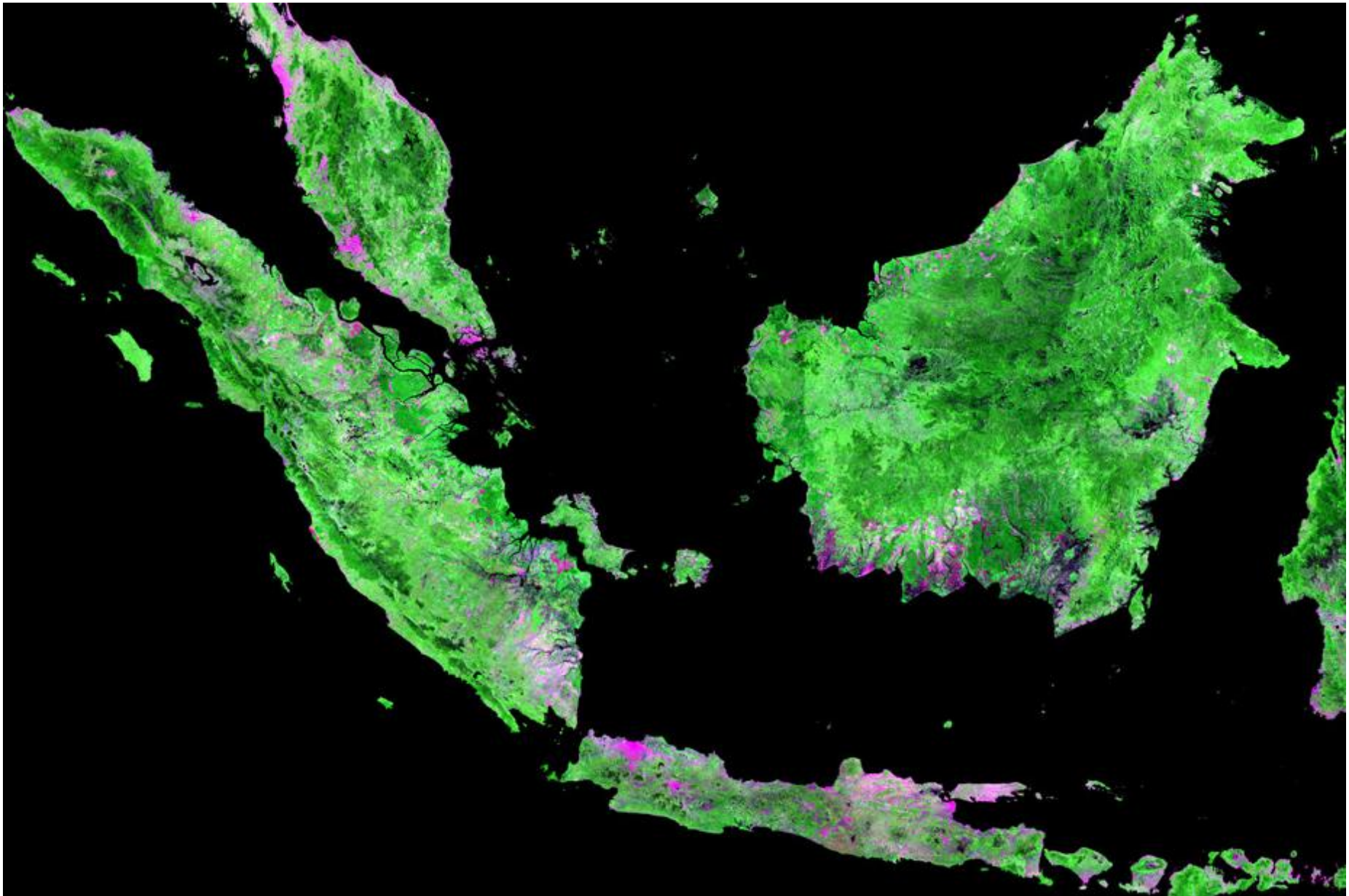

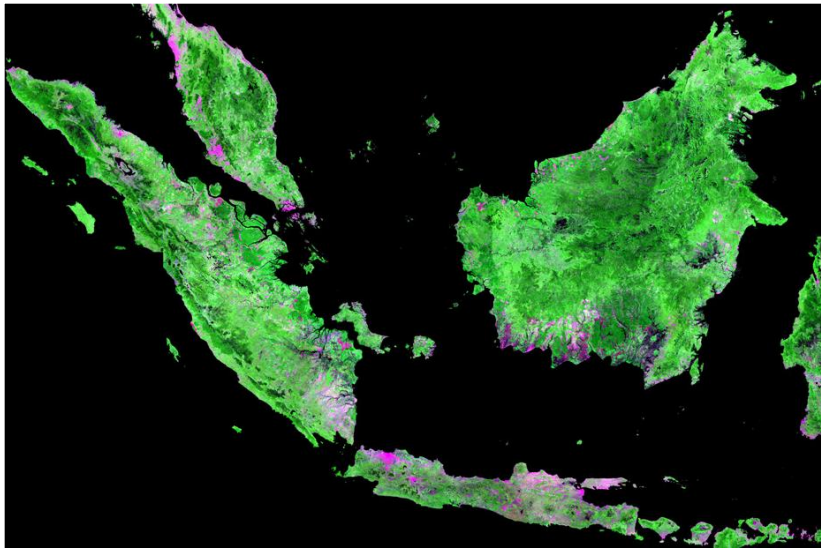

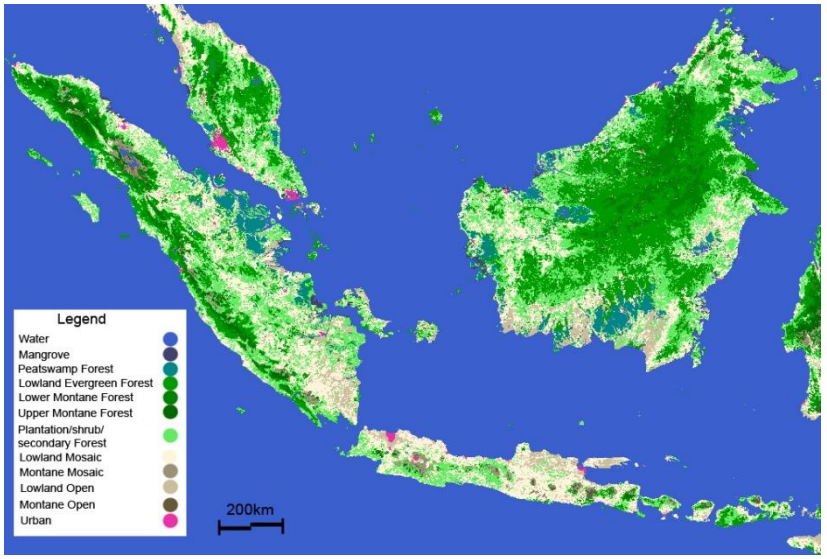

500m resolution MODIS mosaic

500m resolution land cover map

Miettinen, J., Wong C.M and Liew S.C. (2008). New 500m spatial resolution land cover map of the western insular Southeast Asia region. *International Journal of Remote Sensing* 29: 6075-6081.

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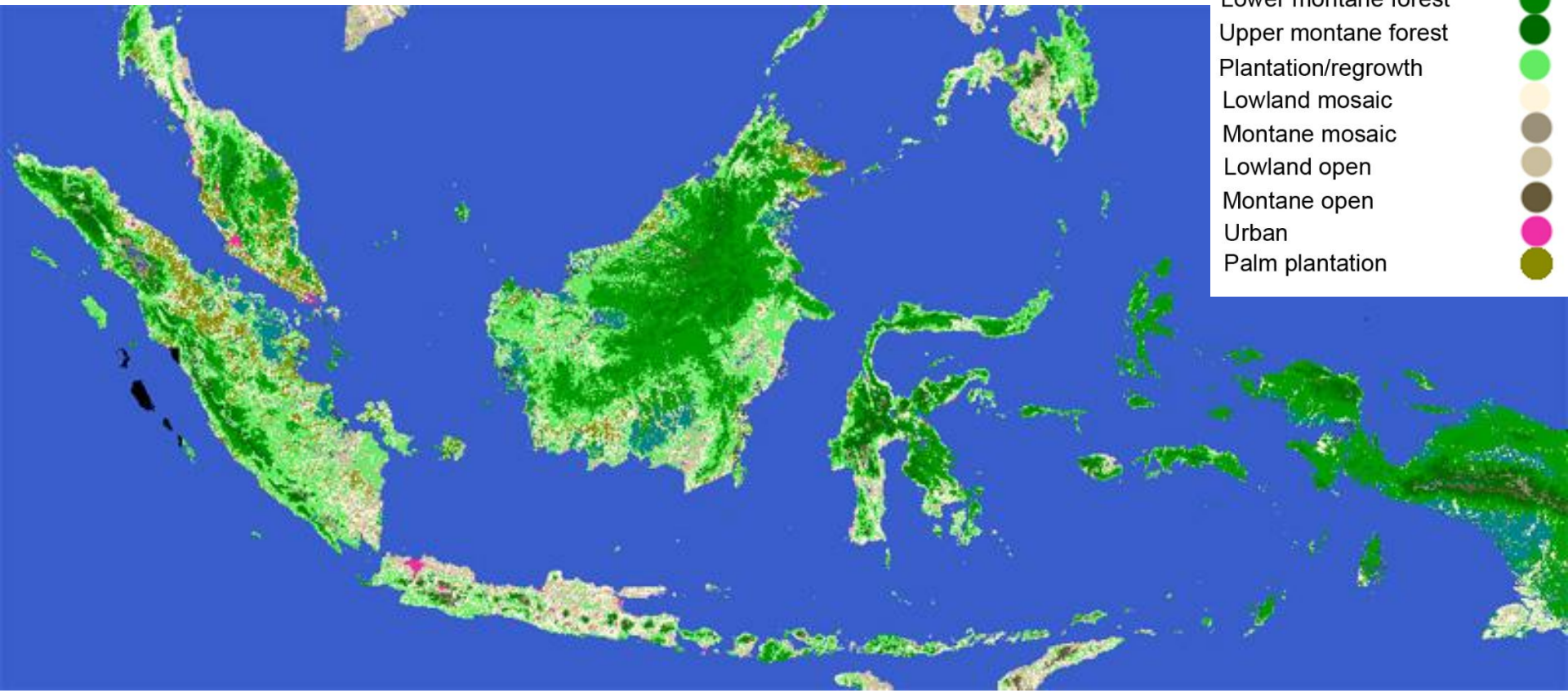
2010 land cover map (250m resolution)



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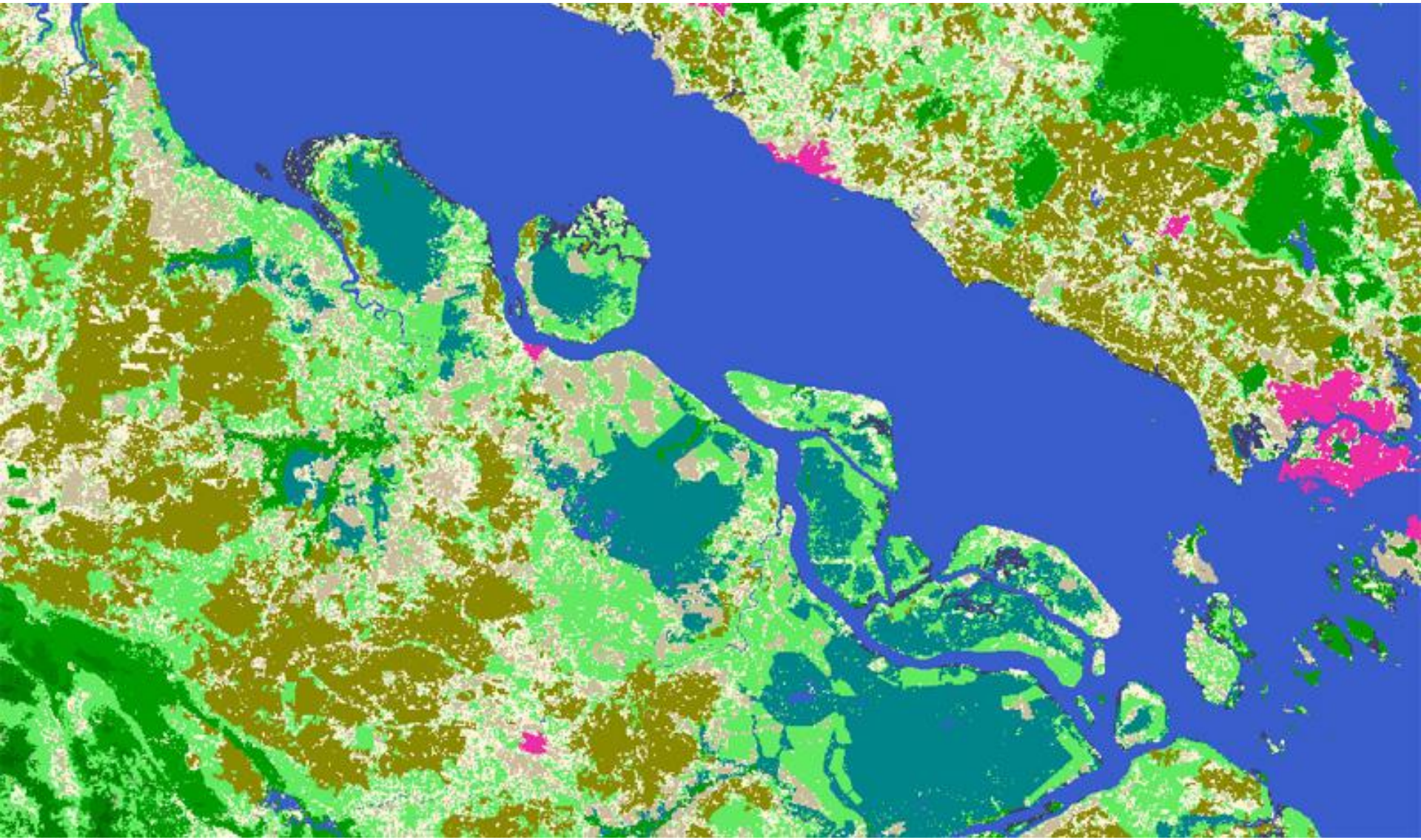
2010 land cover map subset (250m resolution)



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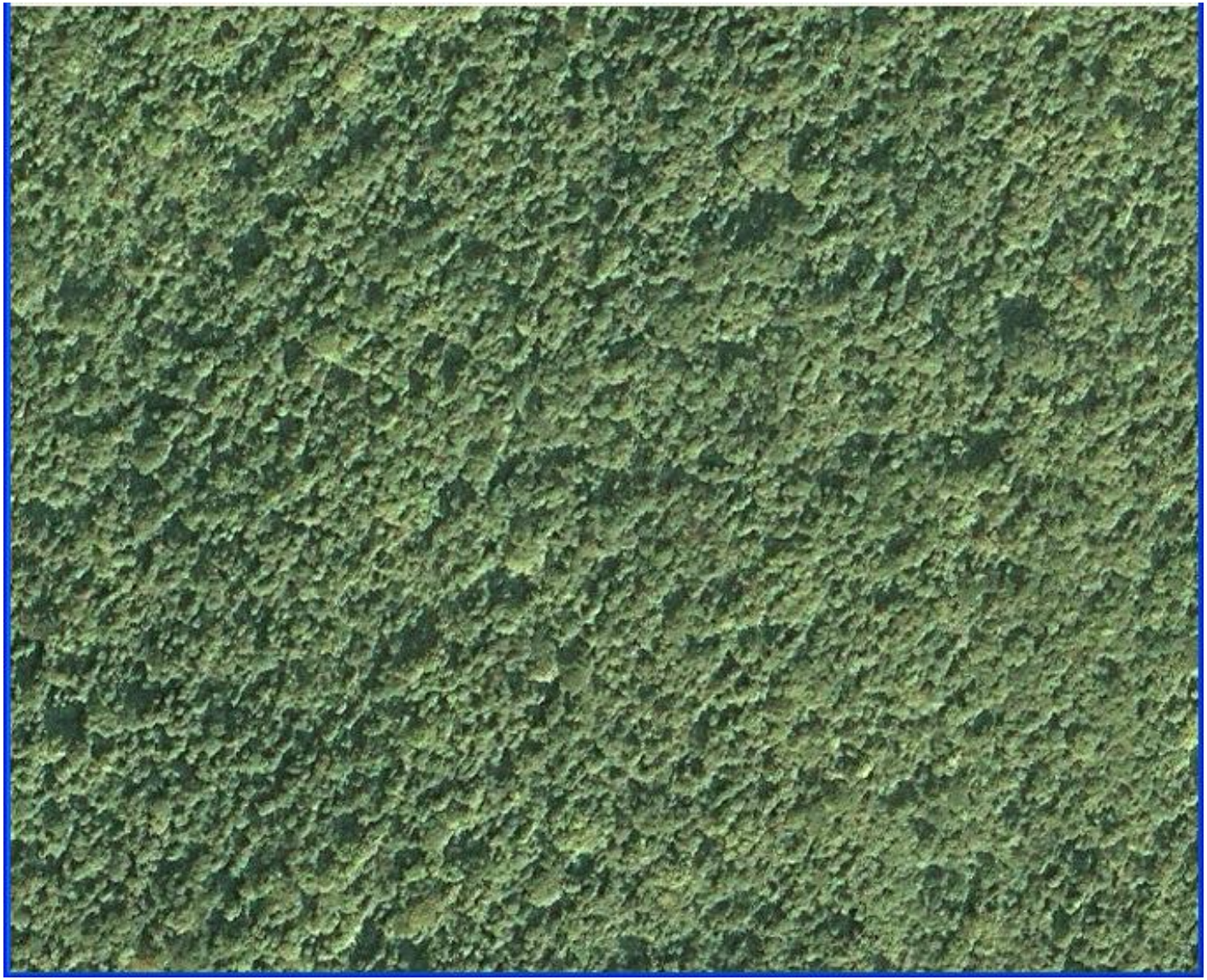
SPOT4

20m resolution

Ikonos image– 1m resolution



Results – deforestation rates by forest type

	Forest cover (2000)		Forest cover (2010)		Change 2000-2010		
	Kha	%	kha	%	kha	%	%/year
Mangrove	2706	1.2	2367	1.1	-339	-12.5	-1.3
Peat swamp forest	13970	6.4	11214	5.1	-2756	-19.7	-2.2
Lowland evergreen f.	70889	32.2	63020	28.7	-7869	-11.1	-1.2
Lower montane forest	18397	8.4	18019	8.2	-378	-2.1	-0.2
Upper montane forest	6574	3.0	6814	3.1	240	3.6	0.4
Total forest area	112536	51.2	101434	46.1	-11102	-9.9	-1.0

From Miettinen, Shi and Liew, Global Change Biology (2011).

- Note the clearly highest deforestation rate in peat swamp forests.

- Remember that the estimates for overall deforestation rates for the 1990's reached up to 1.7%/a (but 0.8%/a before 1997).

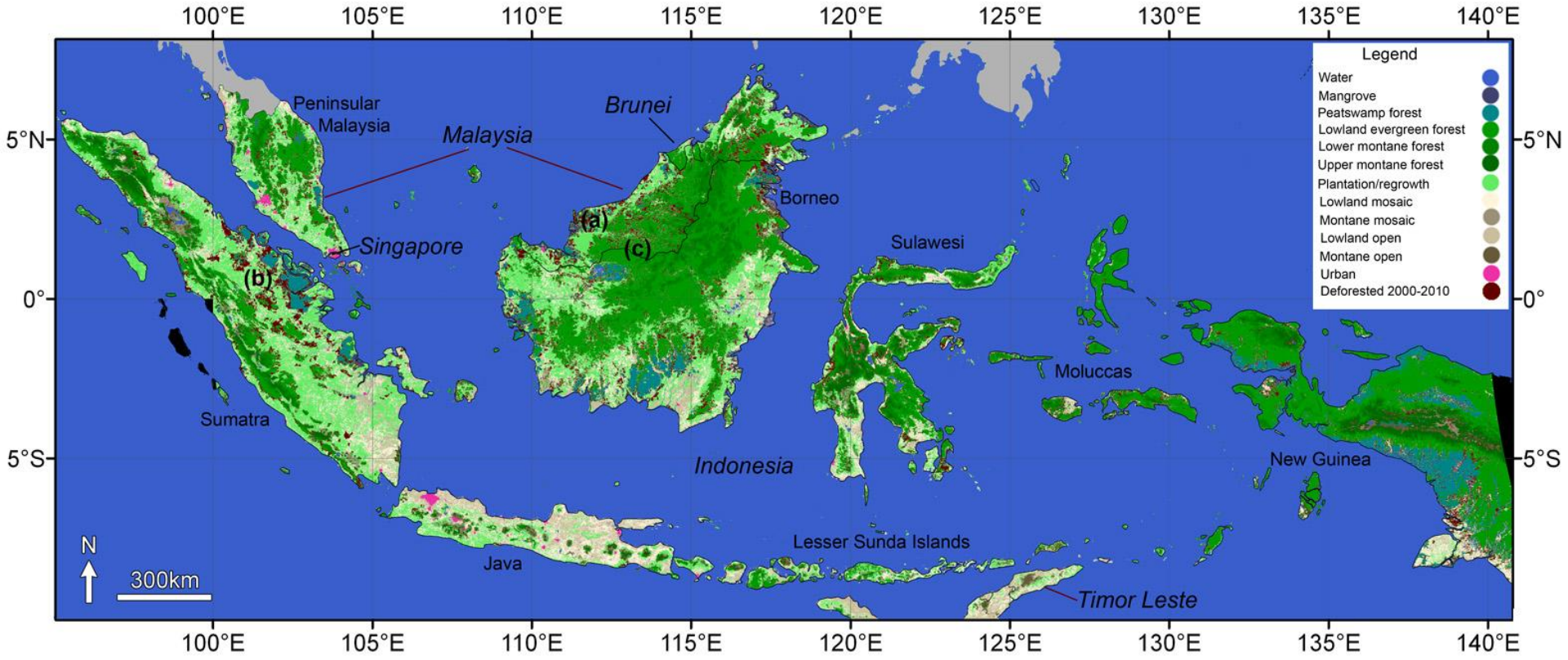
Results – deforestation rates by sub-region

	Forest cover (2000)		Forest cover (2010)		Change 2000-2010		
	kha	%	kha	%	kha	%	%/year
Peninsular Malaysia	5388	41.1	4947	37.7	-441	-8.2	-0.9
	287	*2.2*	*235*	*1.8*	*-52*	*-18.0*	*-2.0*
Sumatra	14555	33.5	11104	25.5	**-3451**	-23.7	**-2.7**
	3131	*7.2*	*1839*	*4.2*	***-1292***	*-41.3*	***-5.2***
Borneo	41688	56.6	36688	49.8	**-5000**	-12.0	-1.3
	4182	*5.7*	*3144*	*4.3*	***-1038***	*-24.8*	***-2.8***
Java	866	6.8	902	7.1	37	4.2	0.4
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Sulawesi	8959	53.0	7993	47.1	-966	-10.8	-1.1
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
New Guinea	31625	84.8	30859	82.7	-767	-2.4	-0.2
	6336	*17.0*	*5970*	*16.0*	*-366*	*-5.8*	*-0.6*
Indonesia	94867	51.3	86039	46.5	-8828	-9.3	-1.0
	12740	*6.9*	*10541*	*5.7*	*-2199*	*-17.3*	*-1.9*
Malaysia	17242	52.4	14962	45.4	-2281	-13.2	-1.4
	1230	*3.7*	*673*	*2.0*	*-557*	*-45.3*	***-5.9***

Note: The second row in each cell refers to forest cover on peatland only.

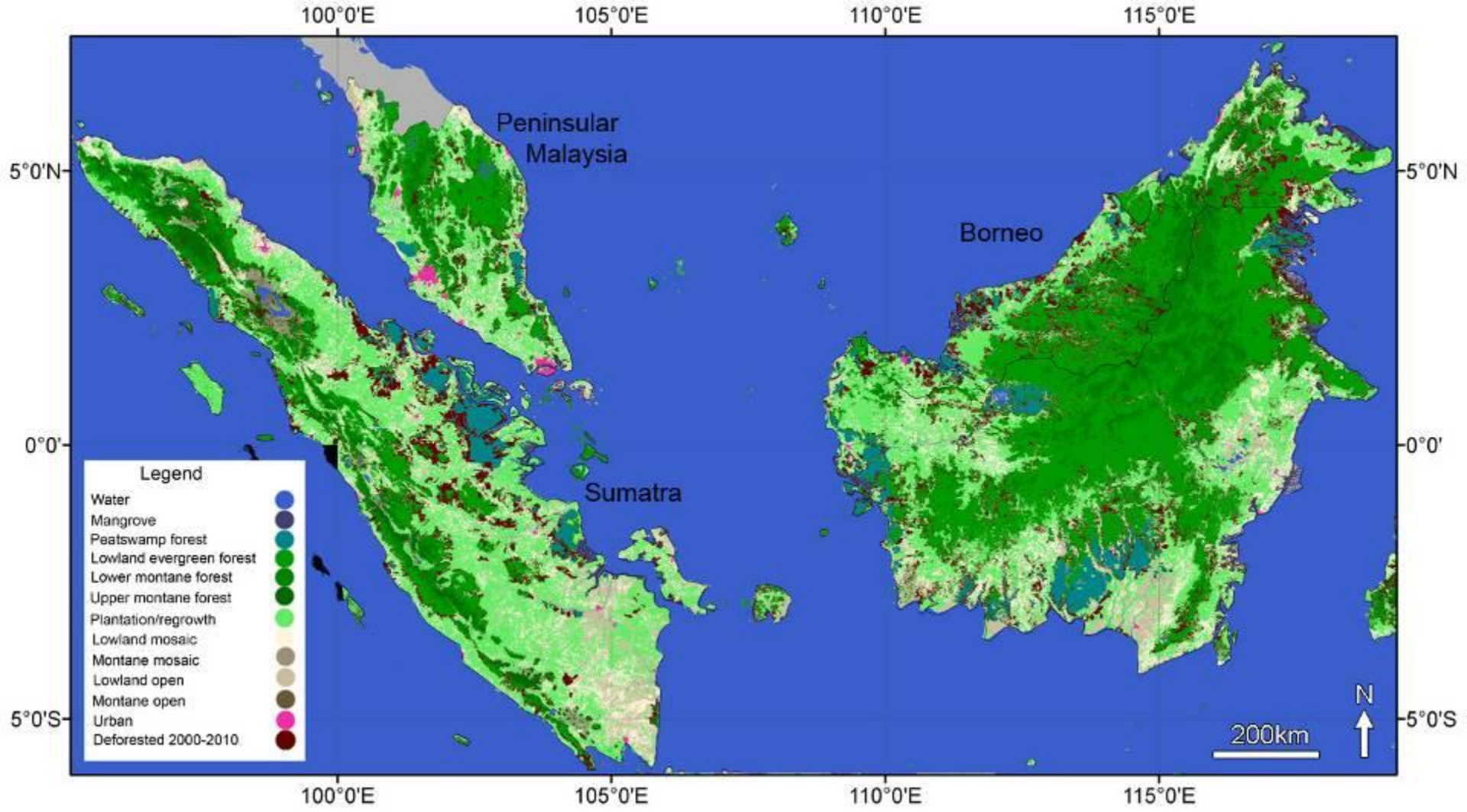
From Miettinen, Shi and Liew, Global Change Biology (2011).

Results – 2010 land cover with deforested areas



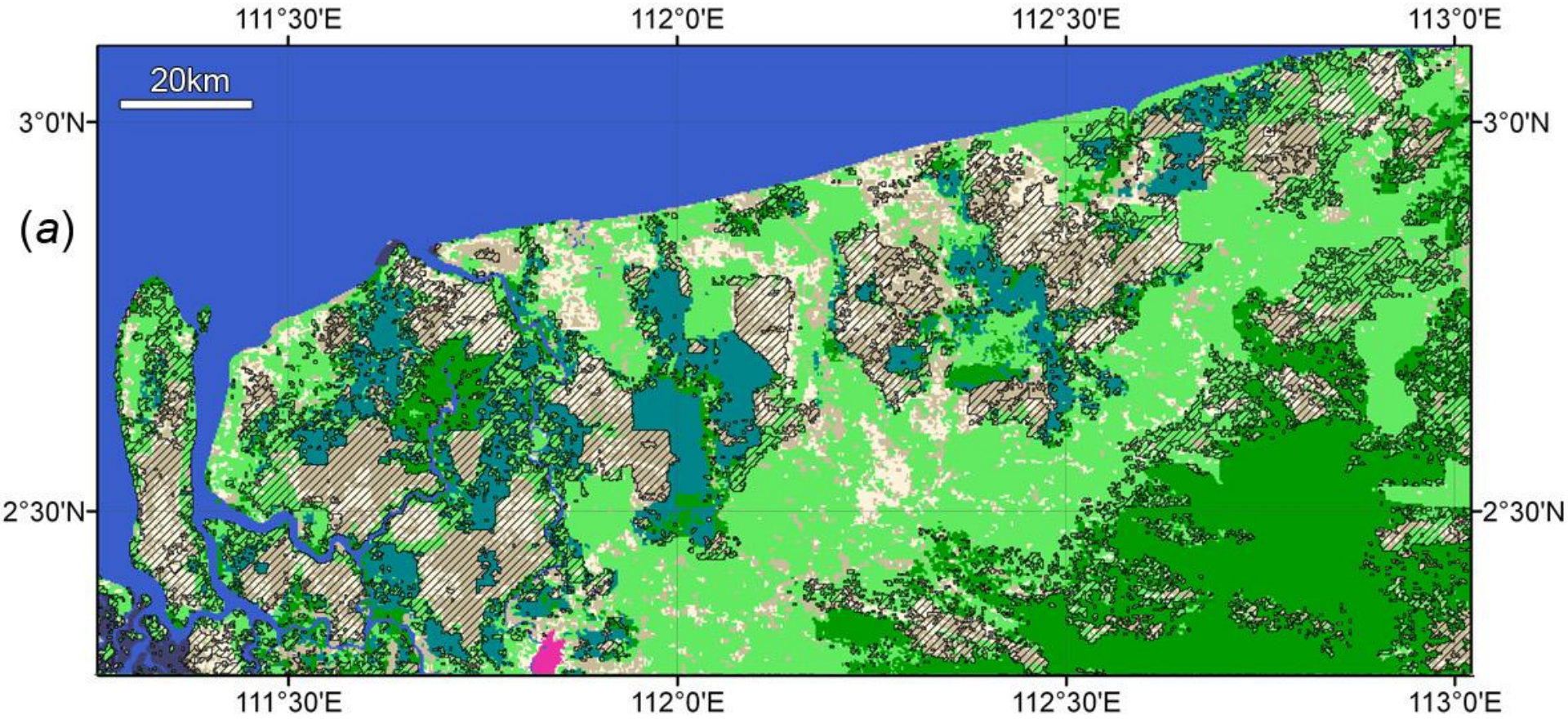
From Miettinen, Shi and Liew, Global Change Biology (2011).

2010 land cover with deforested areas in the western part of insular Southeast Asia



From Miettinen, Shi and Liew, Global Change Biology (2011).

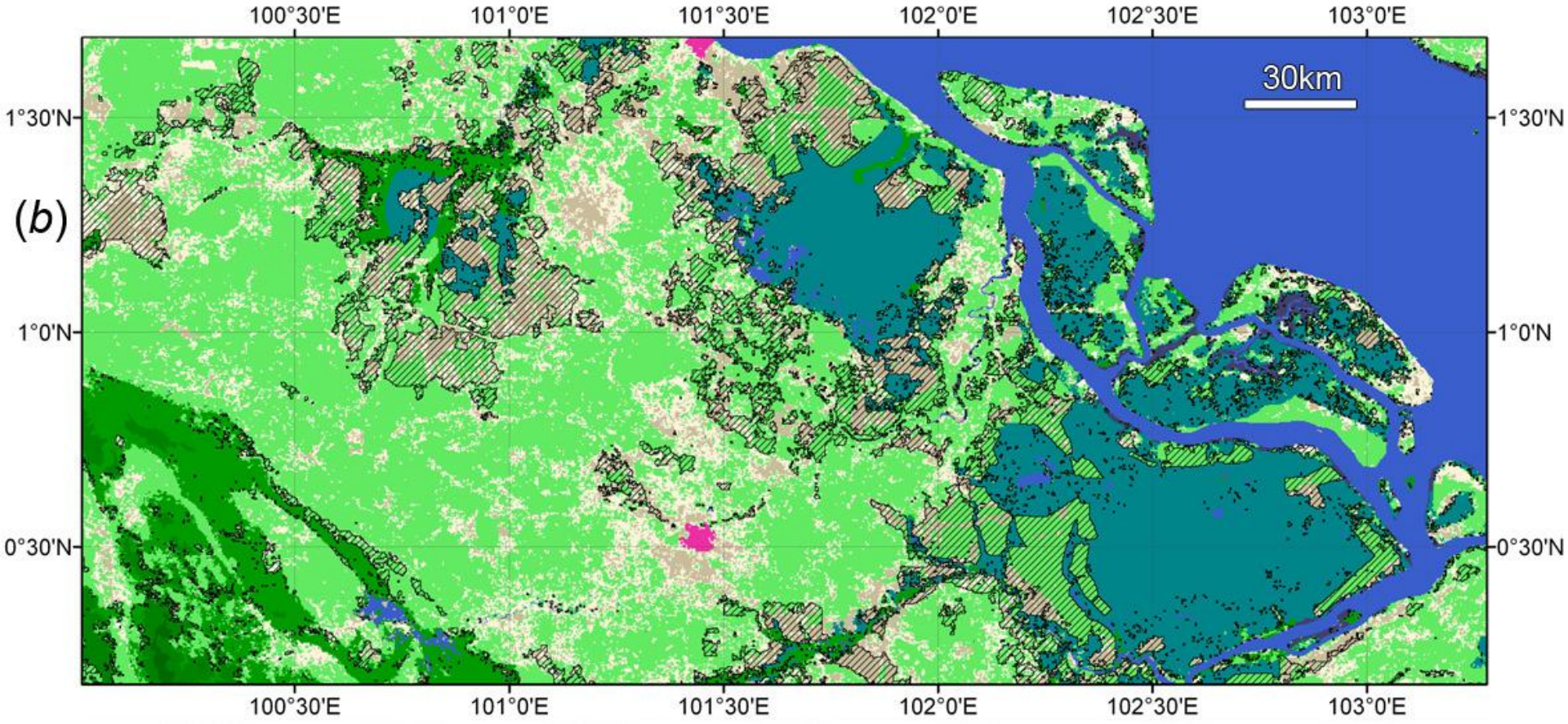
Deforestation in the peatlands of Sarawak



From Miettinen, Shi and Liew, Global Change Biology (2011).

- In Sarawak the extent of peat swamp forests decreased by 55% between 2000 and 2010. Only 26% of the peatlands in Sarawak remained forested in 2010.

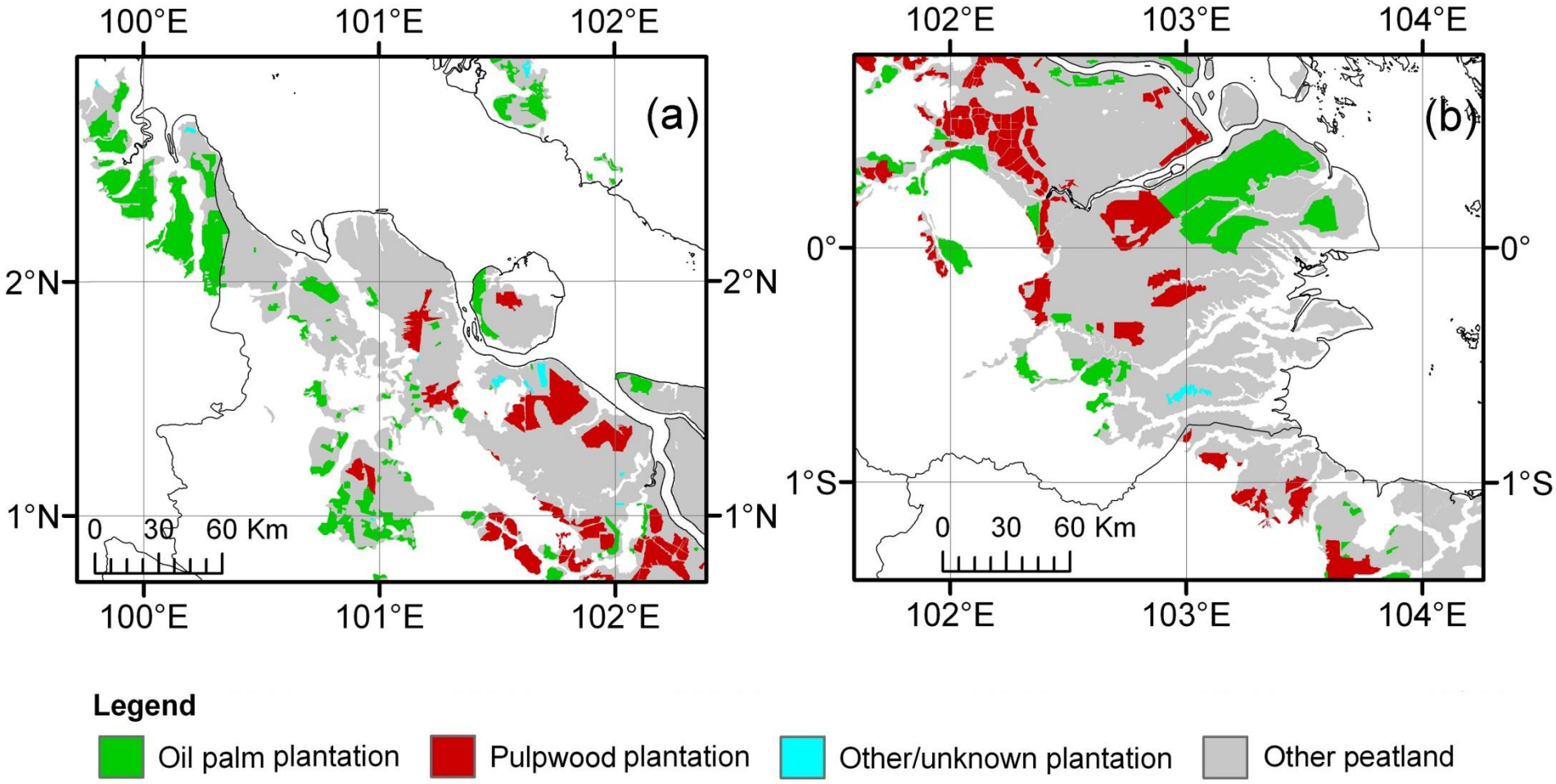
Deforestation in Riau



From Miettinen, Shi and Liew, Global Change Biology (2011).

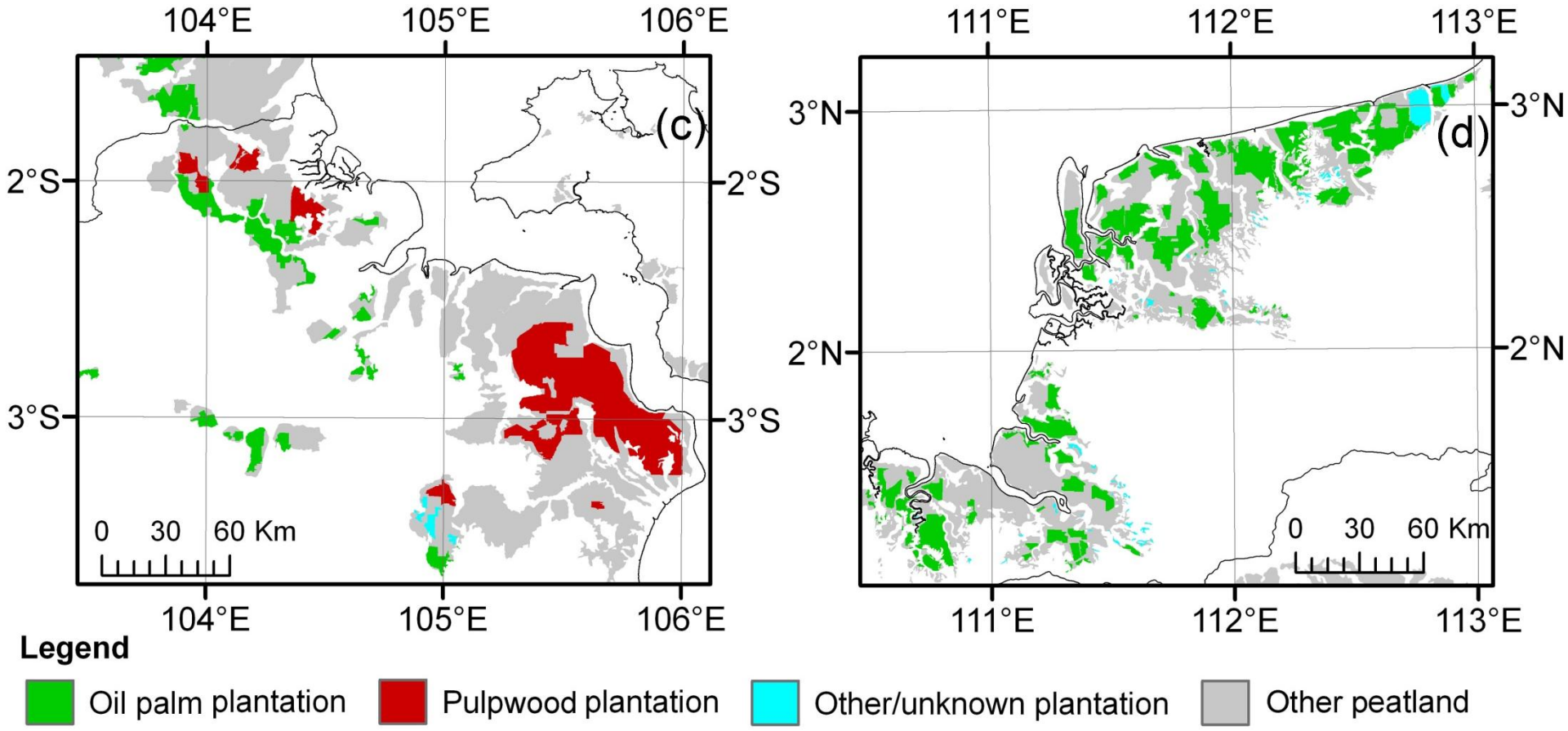
• Riau and Jambi provinces lost 40% of their year 2000 peat swamp forest cover by 2010. Only 35% of the peatlands in Riau and Jambi remained forested in 2010.

Plantation distribution in the eastern coastal peatlands of central Sumatra in 2010



From Miettinen et al., GCB Bioenergy (2012).

Plantation distribution in South Sumatra and Sarawak in 2010



From Miettinen et al., GCB Bioenergy (2012).

Distribution of industrial plantations in 2010

(Area in kha, % refers to total study area)

	Oil palm IP		Pulp IP		Other/Unknown IP		Total IP		
	Area	%	Area	%	Area	%	Area	%	% of peat
Peninsular Malaysia	**238**	**11**	**0**	**0**	**23**	**20**	**262**	**8**	**29**
Aceh	*46*	*2*	*0*	*0*	*0*	*0*	*46*	*1*	*17*
North Sumatra	*198*	*9*	*0*	*0*	*1*	*1*	*200*	*6*	*57*
Riau	***487***	***23***	***464***	***54***	*18*	*15*	***968***	***31***	*24*
West Sumatra	*89*	*4*	*0*	*0*	*0*	*0*	*89*	*3*	*42*
Jambi	*84*	*4*	*63*	*7*	*0*	*0*	*146*	*5*	*20*
Bengkulu	*2*	*0*	*0*	*0*	*4*	*4*	*7*	*0*	*13*
South Sumatra	*131*	*6*	***309***	***36***	*9*	*7*	***449***	***14***	*31*
Lampung	*10*	*0*	*0*	*0*	*0*	*0*	*10*	*0*	*11*
Total Sumatra	**1047**	**49**	**836**	**98**	**32**	**28**	**1915**	**62**	**26**
Sarawak	***494***	***23***	*0*	*0*	*31*	*26*	***525***	***17***	*36*
Sabah	*50*	*2*	*0*	*0*	*2*	*2*	*52*	*2*	*27*
West Kalimantan	*133*	*6*	*10*	*1*	*13*	*11*	*157*	*5*	*9*
Central Kalimantan	*114*	*5*	*0*	*0*	*4*	*3*	*118*	*4*	*4*
South Kalimantan	*28*	*1*	*0*	*0*	*4*	*3*	*31*	*1*	*10*
East Kalimantan	*39*	*2*	*6*	*1*	*8*	*7*	*53*	*2*	*8*
Total Borneo	**858**	**40**	**16**	**2**	**62**	**53**	**936**	**30**	**13**
Total study area	**2143**	**100**	**852**	**100**	**118**	**100**	**3113**	**100**	**20**

From Miettinen et al., GCB Bioenergy (2012).

Pre-plantation Vegetation Cover

Table 4 Preplantation vegetation (in %)

	1990 vegetation of plantations detected in 2000				2000 vegetation of plantations detected in 2010			
	PSF	Regrowth	Mosaic	Open	PSF	Regrowth	Mosaic	Open
Peninsular Malaysia	56	8	9	27	33	39	12	16
Aceh	97	0	1	2	46	40	7	7
North Sumatra	76	4	1	19	55	24	9	11
Riau	93	1	0	6	83	10	3	5
West Sumatra	88	2	0	10	54	22	11	13
Jambi	83	14	0	3	41	36	19	4
Bengkulu	47	28	3	22	0	72	26	2
South Sumatra	75	18	2	5	11	72	9	8
Lampung	13	15	0	72	0	0	0	0
Total Sumatra	86	3	1	10	52	34	6	7
Sarawak	92	4	3	1	74	17	4	5
Sabah	78	6	2	14	33	24	26	17
West Kalimantan	92	2	1	5	86	9	4	1
Central Kalimantan	23	2	2	73	19	30	36	15
South Kalimantan	0	0	0	0	0	31	37	32
East Kalimantan	100	0	0	0	15	23	30	32
Total Borneo	88	4	2	6	67	16	9	8
Total	85	4	1	10	56	29	7	7

From Miettinen et al., GCB Bioenergy (2012).

Land cover on peatlands 2010

Table 5 Land cover distribution on the peatlands of Peninsular Malaysia, Sumatra and Borneo in 2010

	Peat swamp forest 1000 ha	%	Regrowth 1000 ha	%	Mosaic 1000 ha	%	Open 1000 ha	%	Industrial plantation 1000 ha	%	Other nonforest 1000 ha	%	Total 1000 ha
Peninsular Malaysia	230	26	182	20	128	14	76	9	262	29	13	1	890
Aceh	108	39	94	34	18	6	10	4	46	17	0	0	277
North Sumatra	25	7	69	20	33	9	21	6	200	57	0	0	348
Riau	1382	34	1051	26	326	8	263	7	968	24	24	1	4014
West Sumatra	20	9	62	29	34	16	17	8	78	37	1	0	211
Jambi	181	25	255	36	75	10	60	8	146	20	1	0	717
Bengkulu	0	0	24	46	14	26	7	14	7	13	1	1	52
South Sumatra	107	7	537	37	134	9	220	15	449	31	2	0	1450
Lampung	3	3	24	26	6	7	45	49	10	11	3	3	92
Other provinces	24	32	33	45	4	6	11	15	0	0	1	1	74
Total Sumatra	1850	26	2150	30	643	9	655	9	1904	26	32	0	7234
Sarawak	380	26	403	28	47	3	82	6	525	36	6	0	1443
Sabah	39	20	49	26	15	8	33	17	52	27	3	2	191
West Kalimantan	1042	60	318	18	94	5	101	6	157	9	31	2	1743
Central Kalimantan	1454	48	780	26	291	10	357	12	118	4	8	0	3009
South Kalimantan	4	1	96	29	46	14	149	45	31	10	3	1	329
East Kalimantan	250	36	207	30	62	9	110	16	53	8	7	1	688
Total Borneo	3169	43	1853	25	555	7	832	11	936	13	57	1	7403
Total	5249	34	4186	27	1326	9	1563	10	3102	20	102	1	15528

From Miettinen et al., GCB Bioenergy (2012).

Conclusions

• Overall estimate of deforestation rate 2000-2010 is 1.0% per year, which is significantly lower than the 1.5-1.7%/a estimates provided for 1990's (FAO 2006; Hansen *et al.* 2009). However, this may be due to the fact that no region-wide major fire episode comparable to the El Niño fires 1997-1998 took place during the past decade. Note that 0.8%/a deforestation was estimated by Achard *et al.* (2002) for the period of 1990-1997.

•Main change trajectories are from forest to plantations and secondary regrowth.

•There are remarkable variations in deforestation rates within the region

• Two areas have deforestation rates above 5.0% per year: the eastern lowlands of Sumatra which have already experienced high levels of deforestation since 1990 or earlier (Achard *et al.* 2002) and the peatlands of Sarawak. The deforestation in the peatlands of Sarawak is believe to have escalated heavily during the past five years.

• In contrary, the forests of New Guinea experienced very low rate of forest loss during the past ten years.

Conclusions

• Only 34% of peatlands in the study area remained forested in 2010, down from about 75% in 1990.

• 20% of peatlands in the study area had been converted to industrial plantations by 2010 with uneven distribution in the study area. The highest concentration of plantation per unit area of peatlands occurred in Sumatra, Sarawak and Sabah.

• Over two thirds of industrial plantations were used for oil palm cultivation, with the remainder mainly for pulp wood.

• In the 1990s, plantation development almost entirely took place in forested areas. In 2000 – 2010, only 56% of new plantations were converted from forest. However, in Riau, Sarawak and West Kalimantan, conversion rates from peatswamp forest to plantations remained high at 80%.

• Industrial plantation development is not the only threat to tropical peatlands. Secondary regrowths and small-holding plantations covered 27% of the peatlands, compared to 20% for industrial plantations.

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Thank you