**Supplementary Information**

**SI Figure 1**. Example of validation process in Sumatra. We selected validation points inside oil palm plantations, and within a 25 km buffer of observed plantations.

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**SI Figure 2.** Comparison of estimates of oil palm plantation area in Sumatra, Kalimantan and Papua from this study and from previous studies.

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**SI Figure 3.** Area of suitable land for cultivation of oil palm, by province. Suitable areas which were not forested in the year 2011 are black, while suitable areas which were forested in 2011 are in grey.

**SI Table 1.** Schema used to reclassify land cover classes from the Ministry of Environment and Forestry.

|  |  |
| --- | --- |
| **MoEF Class** | **This study** |
| Built Environment | Other |
| Water Bodies |
| Mining |
| Scrubland | Scrubland, Bare land, Savannah |
| Bare Land |
| Savannah |
| Swamp Scrubland | Swamp and Swamp Scrubland |
| Swamp |
| HTI | Timber Plantation |
| Dry Rice Land | Agriculture |
| Dry Rice Land Mixed with Scrub |
| Rice Land |
| Transmigration areas |
| Plantations |
| Primary Dry Land Forest | Primary Forest |
| Primary Mangrove Forest |
| Primary Swamp Forest |
| Secondary Dry Land Forest | Secondary Forest |
| Secondary Mangrove Forest |
| Secondary Swamp Forest |

**SI Table 2.** The proportion of oil palm plantations replacing primary or secondary forest cover in the periods 2000 – 2005, 2005 – 2010, and 2010 -2015, according to Margono et al. forest extent map and the MoEF forest extent map. Margono et al. note that their ‘primary degraded’ class corresponds to MoEF secondary forests, and their ‘primary intact’ class corresponds to MoEF primary forest.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2000 - 2005 | | 2005 - 2010 | | 2010 - 2015 | |
|  | Margono et al. | MoEF | Margono et al. | MoEF | Margono et al. | MoEF |
| Secondary forest/ Primary degraded | 23.6% | 22.6% | 21.9% | 20.2% | 16.4% | 16.6% |
| Primary forest / Primary intact | 0.2% | 1.5% | 0.1% | 0.7% | 1.0% | 1.4% |
| **Total Forest** | **23.8%** | **24.0%** | **22.0%** | **20.9%** | **17.4%** | **18.0%** |

**SI Table 3.** Validation of oil palm plantation maps. The confusion matrices provide the proportion of oil palm plantation observations (predictions) which we confirmed using high resolution imagery (actual occurrences), for each year. We report the overall accuracy, sensitivity (rate of true positives) and specificity (rate of true negatives).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2015 | | Observed Landsat | | | | |
| Not Plantation | | | Plantation | Total |
| Observed High Resolution Imagery | Not Plantation | 243 | | | 36 | 279 |
| Plantation | 6 | | | 189 | 195 |
| Total | 249 | | | 225 | 474 |
| Overall Accuracy | | | 91.1% | | | |
| Sensitivity | | | 96.9% | | | |
| Specificity | | | 87.1% | | | |
| 2010 | | Observed Landsat | | | | |
| Not Plantation | | | Plantation | Total |
| Observed High Resolution Imagery | Not Plantation | 231 | | | 32 | 263 |
| Plantation | 17 | | | 196 | 213 |
| Total | 248 | | | 228 | 476 |
| Overall Accuracy | | | | 89.7% | | |
| Sensitivity | | | | 92.0% | | |
| Specificity | | | | 87.8% | | |
| 2005 | | Observed Landsat | | | | |
| Not Plantation | | | Plantation | Total |
| Observed High Resolution Imagery | Not Plantation | 227 | | | 21 | 248 |
| Plantation | 19 | | | 201 | 220 |
| Total | 246 | | | 222 | 468 |
| Overall Accuracy | | | | 91.5% | | |
| Sensitivity | | | | 91.4% | | |
| Specificity | | | | 91.5% | | |
| 2000 | | Observed Landsat | | | | |
| Not Plantation | | | Plantation | Total |
| Observed High Resolution Imagery | Not Plantation | 225 | | | 20 | 245 |
| Plantation | 20 | | | 198 | 218 |
| Total | 245 | | | 218 | 463 |
| Overall Accuracy | | | | 91.4% | | |
| Sensitivity | | | | 90.8% | | |
| Specificity | | | | 91.8% | | |
| 1995 | | Observed Landsat | | | | |
| Not Plantation | | | Plantation | Total |
| Observed High Resolution Imagery | Not Plantation | 217 | | | 27 | 244 |
| Plantation | 23 | | | 198 | 221 |
| Total | 240 | | | 225 | 465 |
| Overall Accuracy | | | | 89.2% | | |
| Sensitivity | | | | 89.6% | | |
| Specificity | | | | 88.9% | | |

**SI Table 4.** Area of oil palm plantations derived from each land cover classification across Indonesia, and the proportion of each land cover type that overlaid peat soils.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1995 - 2000 | | 2000 - 2005 | | 2005 - 2010 | | 2010 - 2015 | |
|  | Total (kha) | % on Peat | Total (kha) | % on Peat | Total (kha) | % on Peat | Total (kha) | % on Peat |
| Secondary Forest | 757 | 30 | 337 | 33 | 596 | 31 | 540 | 33 |
| Primary Forest | 31 | 38 | 20 | 67 | 20 | 75 | 45 | 25 |
| Swamp, Swamp Scrubland | 85 | 16 | 157 | 41 | 443 | 39 | 541 | 36 |
| Scrubland, Bareland, Savannah | 218 | 9 | 221 | 8 | 684 | 14 | 721 | 13 |
| Agriculture | 323 | 10 | 582 | 5 | 1124 | 10 | 1232 | 8 |
| Timber Plantation | 12 | 2 | 15 | 6 | 33 | 12 | 130 | 35 |
| Other | 35 | 5 | 20 | 2 | 45 | 4 | 38 | 5 |
| Total | 1462 | 21 | 1353 | 18 | 2946 | 20 | 3246 | 19 |

**SI Table 5.** Area and proportion of new oil palm plantations established on each land cover class, for A. Sumatra, B. Kalimantan, and C. Papua.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1995 - 2000 | | | 2000 - 2005 | | | 2005 - 2010 | | | 2010 - 2015 | |
| Area (kha) | % | Area (kha) | | % | Area (kha) | | % | Area (kha) | | % |
| A.      SUMATRA | | | | | | | | | | | |
| Secondary Forest | 646 | 53 | 153 | | 23 | 157 | | 12 | 103 | | 9 |
| Primary Forest | 23 | 2 | 14 | | 2 | 16 | | 1 | 5 | | 0 |
| Swamp Scrubland | 68 | 6 | 79 | | 12 | 192 | | 15 | 214 | | 18 |
| Scrub, Bare land, Savannah | 171 | 14 | 88 | | 13 | 221 | | 17 | 231 | | 20 |
| Agriculture | 280 | 23 | 301 | | 45 | 667 | | 51 | 507 | | 43 |
| Timber Plantation | 7 | 1 | 15 | | 2 | 26 | | 2 | 89 | | 8 |
| Other | 28 | 2 | 17 | | 3 | 36 | | 3 | 19 | | 2 |
| Total | 1222 | 100 | 667 | | 100 | 1314 | | 100 | 1167 | | 100 |
| B.      KALIMANTAN | | | | | | | | | | | |
| Secondary Forest | 101 | 46 | 183 | | 27 | 428 | | 27 | 396 | | 20 |
| Primary Forest | 7 | 3 | 3 | | 0 | 0 | | 0 | 11 | | 1 |
| Swamp Scrubland | 17 | 8 | 78 | | 12 | 250 | | 16 | 325 | | 17 |
| Scrub, Bare land, Savannah | 45 | 21 | 133 | | 20 | 461 | | 29 | 474 | | 24 |
| Agriculture | 37 | 17 | 276 | | 41 | 449 | | 28 | 706 | | 36 |
| Timber Plantation | 5 | 2 | 1 | | 0 | 7 | | 0 | 41 | | 2 |
| Other | 6 | 3 | 3 | | 0 | 9 | | 1 | 19 | | 1 |
| Total | 217 | 100 | 677 | | 100 | 1605 | | 100 | 1972 | | 100 |
| C.      PAPUA | | | | | | | | | | | |
| Secondary Forest | 10 | 45 | 1 | | 6 | 12 | | 43 | 42 | | 39 |
| Primary Forest | 2 | 7 | 3 | | 36 | 4 | | 14 | 29 | | 27 |
| Swamp Scrubland | 0 | 0 | 0 | | 0 | 0 | | 1 | 2 | | 2 |
| Scrub, Bare land, Savannah | 2 | 9 | 0 | | 2 | 2 | | 6 | 15 | | 14 |
| Agriculture | 7 | 30 | 5 | | 52 | 9 | | 33 | 18 | | 17 |
| Timber Plantation | 0 | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 |
| Other | 2 | 8 | 0 | | 3 | 0 | | 2 | 1 | | 1 |
| Total | 23 | 100 | 9 | | 100 | 27 | | 100 | 107 | | 100 |

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