



**Global 25 m Resolution PALSAR-2
Forest/Non-Forest Map (FNF) (Ver.2.0.0)
Dataset Description**

**Japan Aerospace Exploration Agency (JAXA)
Earth Observation Research Center (EORC)**

Revision history

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1 Overview of the dataset

Global 25 m resolution PALSAR-2 Forest/Non-Forest Map (hereinafter referred to as “PALSAR-2 FNF”) are free and open datasets generated by a lot of images obtained with Japanese L-band Synthetic Aperture Radars (PALSAR-2) on Advanced Land Observing Satellite-2 (ALOS-2).

The L-band SAR backscatter coefficient is highly sensitive to vegetation, especially forests, with large values indicating forests and small values indicating non-forests or water areas. The Earth Observation Research Center (EORC) of the Japan Aerospace Exploration Agency (JAXA) has been attempting to create a global forest map by classifying images based on these characteristics. The purpose of this dataset is to make the results available to the general public and to use them to understand forest distribution and its time-series changes.

Since the first release of FNF in 2010, the Earth Observation Research Center has classified images using the "threshold method," in which regions in HV polarimetric images that show backscatter intensity above a certain value are classified as forests and regions that show intensity below that value are classified as non-forests. However, in Ver. 2.0.0, the Random Forest (RF) method is newly adopted for PALSAR-2 data to improve the accuracy and to divide forests into two categories by canopy cover (canopy cover of 90% or more and canopy cover of 10 to less than 90%). Below is an explanation of how to create the new forest/non-forest map.

2 Definition of forest and dataset categorization

The term "forest" in this dataset uses the definition given by the Food and Agriculture Organization of the United Nations (FAO). Specifically, the definition is as follows (from FRA2015) Terms and Definitions;

- Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.
- Includes areas with young trees that have not yet reached but which are expected to reach a canopy cover of at least 10 percent and tree height of 5 meters or more.
- Includes forest roads, firebreaks, and other small open areas.
- Includes windbreaks, shelterbelts, and corridors of trees with an area of more than 0.5 hectares and a width of more than 20 meters.
- Includes abandoned shifting cultivation land with the regeneration of trees that have, or are expected to reach, a canopy cover of at least 10 percent and tree height of at least 5 meters.
- Includes rubberwood, cork oak, and Christmas tree plantations
- Excludes tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations, and olive orchards.

As described above, this dataset uniquely and globally applies the term "forest" to all standing trees, including planted forests, that are 5 m or taller, 0.5 ha or larger in area, and have a canopy cover of 10% or more. Therefore, FNF can be used under the same definition without distinction by region. In addition, we did collection and interpretation of training data and validation data for image classification and accuracy assessment based on this definition. Since the objective of this dataset is to represent the global forest distribution, there are basically three classification categories: forest, non-forest, and water area. However, since the backscatter coefficient from L-band SAR is highly correlated with forest biomass, it is possible to distinguish between forests with a closed canopy (high canopy cover), which have a high biomass per space, and forests with gaps in the canopy (low canopy cover), which means low biomass per space. Based on the above characteristics, the forest categories in this dataset are set to 2 categories in which forests are classified according to the canopy rate as shown in Table 2.1, and the final data defines 4 categories in total including non-forest and water area.

Table 2.1 Category for classification of FNF

Value	Category
1	Forest (>90% canopy cover)
2	Forest (10-90% canopy cover)
3	Non-forest
4	Water
0	No data

3 Collection of Training data and validation data

Based on the forest definition and category settings described above, we acquired training data for classification and validation data for accuracy assessment. The training data and validation data were obtained by drawing a circle with a radius of 40 m centered on the target point on Google Earth and visually interpreting the image inside the circle. The 40-meter radius circle was set at each target point in order to comply with the FAO definition of forests as having an area of 0.5 ha, and in particular to visually determine the canopy cover in forests.

In this dataset, "non-forest" is defined as only one category, but multiple categories are set and acquired for the non-forest of the training data used for classification. Even though the term "non-forest" is used in one word, backscatter coefficients show different characteristics for different land covers, such as urban areas and agricultural land. In order to distinguish between these categories and perform the classification process, multiple "non-forest" categories were set and acquired training data, as shown in Table 3.1, and used in the classification process described below.

Table 3.1 Category for training and validation data sets.

ID	Category
1	Forest (>90% canopy cover)
2	Forest (10-90% canopy cover)
3	Water
4	Urban
5	Cropland
6	Grassland
7	Bare soil
8	Snow and ice
9	Oil palm plantation

4 Classification by Random Forest

4.1 Creation of classifier and division of classification area

For the image classification method, Random Forest, which is a common machine learning algorithm widely used in land cover classification, was used. Based on the aforementioned training data, a classifier was created using the global 25m resolution PALSAR-2 mosaic as input data, and the classification was performed. The creation of a classifier and classification was performed on a continental basis with continuous forests (see Figure 4.1). This prevents the forests from becoming spatially discontinuous in the classification results. It is also taken into account that the characteristics of forests, such as tree species, differ depending on the region, even if they are the same forest.

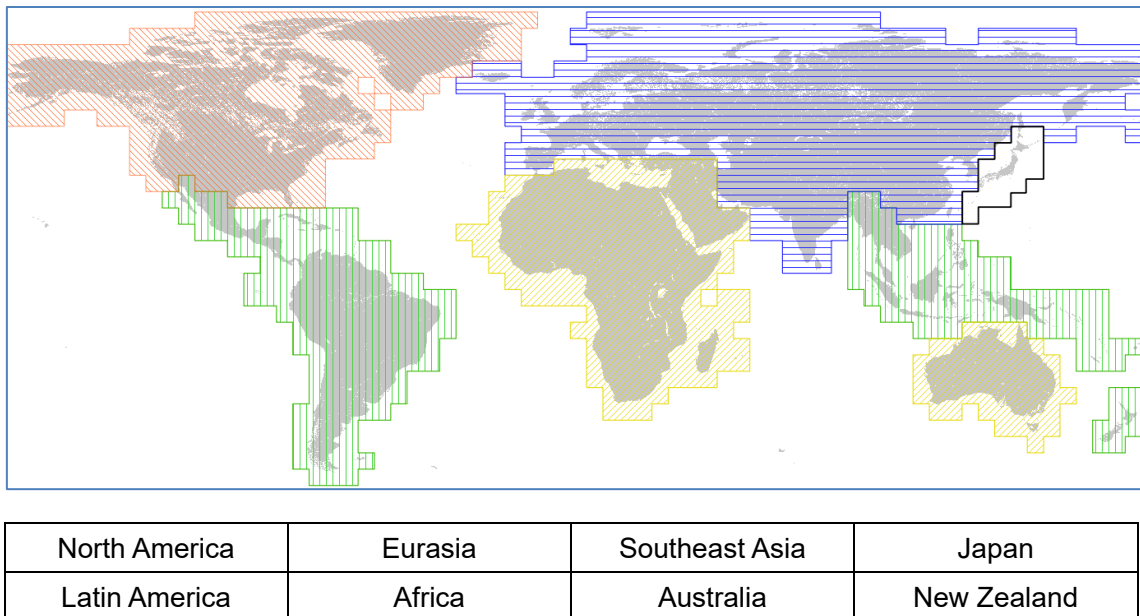


Figure 4.1 Division of continents for classification

4.2 Stacking of input data for classification

Regarding the input global 25m resolution PALSAR-2 mosaic for classification, data for the past year is additionally used in addition to the data for the target year to be created. For example, when creating the 2020 FNF map, the global 25m resolution mosaics of 2019 and 2020 are stacked and used as input data for classification. The target year mosaic is weighted 3 times more than the past year mosaic when stacked. In this way, the stacked data can represent the forest change by retaining the effect of the target year on the areas where the forest has changed. In addition,

two polarizations, HH and HV, are used for classification.

In this way, we are trying to improve the classification accuracy by using multi-year data. However, this method cannot be applied to the area where the global 25m resolution global mosaic used for input exists only for the data observed in the corresponding year and there is no data for the previous year. For areas where such data exists for only one corresponding year, we applied the classification processing results by a classifier using a single-year global 25m resolution mosaic, apart from the method using stack data for two years. Unfortunately, for areas where such complementary processing cannot be performed due to no observation for two years, there are treated as lacked area.

The distinction between the FNF area based on the above two-year data and the FNF area based on the one-year data can be confirmed by referring to the "Processing mask information" included in PALSAR-2 mosaic dataset. For details on "Processing mask information", please refer to Section 4 of the document "Global 25m Resolution PALSAR-2 Mosaic (Ver.2.0.0) Dataset Description".

4.3 Applying the mask data

It was pointed out that water bodies and urban areas were not correctly classified in the previous version of FNF. Therefore, after the classification process using the RF described above, the water area was once replaced with non-forest, and then the water area was masked using the water area data of OpenStreetMap (OSM) †. We applied an urban area mask for urban areas using the urban area data of GHSL (Global Human Settlement Layer) ‡.

†OSM Water Layer: http://hydro.iis.u-tokyo.ac.jp/~yamadai/OSM_water/

‡GHSL: <https://ghsl.jrc.ec.europa.eu/knowledgeOverview.php>

5 Accuracy assessment of classification results

The accuracy assessment of the classification result was confirmed by calculating the validity with validation data acquired in Section 3. There is no difference in how to interpret training data and validation data. However, non-forest areas such as urban areas and croplands were combined into one category in the evaluation. Table 5.1 shows the overall accuracy (OA) of the FNF in comparison with the existing FNF for each area. The results of the RF-based classification results show an improvement in accuracy of about 5-10% compared to the conventional method in any region and any year. The Kappa coefficient is also 0.68-0.94, ensuring the reliability of classification. The Confusion Matrix and Kappa coefficient for each region are described in the appendix at the end of this document. (Table 5-1 shows the information as of the Ver. 2.0.0 release. Detailed information will be added in the appendix for newly released versions thereafter).

Table 5.1 Comparison of overall accuracy by year, area, and existing method

Area	FNF (Random Forest) Ver. 2.0.0				Conventional FNF (Threshold method) Ver.1.0	
	2020	2019	2018	2017	2017	2016
Latin America	93.54%	94.68%	94.79%	95.26%	78.48%	77.78%
Southeast Asia	90.34%	92.72%	92.21%	91.35%	81.80%	83.43%
Africa	91.85%	91.39%	91.47%	91.71%	81.43%	80.51%
Australia	91.24%	94.70%	96.35%	95.62%	75.18%	72.26%
North America	85.03%	86.18%	85.29%	86.75%	79.81%	81.66%
Europa + Siberia	92.95%	94.33%	92.71%	91.62%	78.45%	78.71%

6 Data and naming convention

6.1 Naming convention

The data and its file naming convention are as follows.

- LLLLLLL: latitude/longitude
e.g., north latitude 0 degrees, east longitude 100 degrees: LLLLLLL = "N00E100"
- YY: year
e.g., the year 2020: YY = "20"
- C: represent forest/non-forest map data are stored

Table 6.1 Data types, naming convention, and data type

Data list	Filename	Data type
Forest/non-forest map	LLLLLLL_YY_C.tif	8bit-unsigned

6.2 Data values stored in forest/non-forest map file

Table 6.2 shows the correspondence between the numerical values stored in FNF and the contents.

Table 6.2 Relationship between the numerical value and classified category stored in the FNF file

Value	Category
0	No data
1	Forest (>90% canopy cover)
2	Forest (10-90% canopy cover)
3	Non-forest
4	Water

7 Other information

7.1 FNF creation algorithm of the previous version

As for the FNF creation algorithm of the previous version, detailed information is described in Shimada et. al. (2014) listed in Section 10. Data format documentation of the previous version is available from the JAXA EORC Web site.

7.2 Comparison of FNF between present version and the previous version

Although the definition of forest is basically the same for both versions, the image classification algorithm and the forest category settings (one category for the previous version and two categories for Ver. 2.0.0) are different, which may cause discontinuity in the temporal direction. Therefore, it is not recommended to mix old and new versions of FNF to monitor temporal changes in the forest. It is recommended to use each version separately.

8 Note for data use

- For details on JAXA's site policy and terms of use, please check the following URL:
<https://earth.jaxa.jp/en/data/policy/>
- JAXA retains ownership of the dataset. JAXA cannot guarantee any problem caused by or possibly cause by using the datasets.
- Anyone wishing to publish any results using the datasets should clearly acknowledge the ownership of the data in the publication.

9 FAQ and Contact

If you have any questions to use the dataset, please refer to the online “Frequently Asked Questions” (FAQ) on

https://www.eorc.jaxa.jp/ALOS/en/inquiry/faq_e.htm

Further questions, please contact the secretariat of ALOS series Research Group, Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA)

E-mail: aproject@jaxa.jp

10 References

- Global 25 m Resolution PALSAR Mosaic and Forest/Non-Forest Map (FNF) Dataset Description (Ver. N)
- Global 25 m Resolution PALSAR-2 Mosaic (Ver.2.0.0) Dataset Description
- Masanobu Shimada, Takuya Itoh, Takeshi Motooka, Manabu Watanabe, Shiraishi Tomohiro, Rajesh Thapa, and Richard Lucas, "New Global Forest/Non-forest Maps from ALOS PALSAR Data (2007-2010)," Remote Sensing of Environment, 155, pp. 13-31, December 2014. DOI=10.1016/j.rse.2014.04.014.
- Generation of Global Forest / Non-forest map Using ALOS/PALSAR: (Oct. 21, 2010)
https://www.eorc.jaxa.jp/ALOS/en/dataset/fnf/forestmap_oct2010_e.htm
- PALSAR 10 m mosaic: (Nov. 4, 2010)
- https://www.eorc.jaxa.jp/ALOS/en/dataset/fnf/pal_10m_mosaic_e.htm

Appendix

Comparison of the accuracy of each year, each area,
and the Confusion Matrix

Table A1-1 Classification accuracy (Overall Accuracy: OA) comparison results and Kappa coefficient in the case of 4 categories and 3 categories (2017 and 2018)

Year	2018 FNF (RandomForest) Ver. 2.0.0				2017 FNF (RandomForest) Ver. 2.0.0				2017	2016
Area	4 categories	3 categories	kappa coef. (4 categories)	kappa coef. (3 categories)	4 categories	3 categories	kappa coef. (4 categories)	kappa coef. (3 categories)	Conventional FNF (Threshold method)	Ver.1.0
Latin America	86.09%	94.79%	0.794593	0.904111	86.64%	95.26%	0.802781	0.912671	78.48%	77.78%
Southeast Asia	86.87%	92.21%	0.780176	0.860803	86.50%	91.35%	0.774276	0.845281	81.80%	83.43%
Africa	84.38%	91.47%	0.729630	0.838803	84.51%	91.71%	0.732641	0.843363	81.43%	80.51%
Australia	92.70%	96.35%	0.892296	0.942774	91.97%	95.62%	0.881544	0.931202	75.18%	72.26%
North America	76.75%	85.29%	0.680175	0.778959	77.01%	86.75%	0.683779	0.800707	79.81%	81.66%
Europa + Siberia	86.16%	92.71%	0.776006	0.875434	85.11%	91.62%	0.756264	0.855812	78.45%	78.71%

Table A1-2 Classification accuracy (Overall Accuracy: OA) comparison results and Kappa coefficient in the case of 4 categories and 3 categories (2019 and 2020)

Year	2020 FNF (RandomForest) Ver. 2.0.0				2019 FNF (RandomForest) Ver. 2.0.0				2017	2016
Area	4 categories	3 categories	kappa coef. (4 categories)	kappa coef. (3 categories)	4 categories	3 categories	kappa coef. (4 categories)	kappa coef. (3 categories)	Conventional FNF (Threshold method)	Ver.1.0
Latin America	84.12%	93.54%	0.765959	0.881177	85.67%	94.68%	0.788502	0.902008	78.48%	77.78%
Southeast Asia	82.53%	90.34%	0.704767	0.810600	87.28%	92.72%	0.788304	0.870317	81.80%	83.43%
Africa	84.27%	91.85%	0.728868	0.845986	84.21%	91.39%	0.727402	0.837384	81.43%	80.51%
Australia	86.13%	91.24%	0.792656	0.860867	89.39%	94.70%	0.844405	0.916914	75.18%	72.26%
North America	77.45%	85.03%	0.688490	0.775057	77.53%	86.18%	0.690602	0.792144	79.81%	81.66%
Europa + Siberia	86.12%	92.95%	0.774107	0.879323	88.11%	94.33%	0.807726	0.903474	78.45%	78.71%

Table A1-3 Classification accuracy (Confusion Matrix) in the case of 4 categories and 3 categories in 2020. Upper matrices show 4 categories case and lower matrices show 3 categories case.

Africa

	10-90	90-100	NF	water		
10-90	647	87	17	0	751	86.15%
90-100	136	125	2	0	263	47.53%
NF	175	38	1,566	5	1,784	87.78%
water	0	0	3	143	146	97.95%
	958	250	1,588	148	2,944	
	67.54%	50.00%	98.61%	96.62%		84.27%

	Forest	Non-Forest	Water	総計	
Forest	995	19	0	1,014	98.13%
Non-Forest	213	1,566	5	1,784	87.78%
Water	0	3	143	146	97.95%
	1,208	1,588	148	2,944	
	82.37%	98.61%	96.62%		91.85%

Southeast Asia

	10-90	90-100	Non-Forest	Water	総計	
10-90	21	39	2	0	62	33.87%
90-100	88	754	4	0	846	89.13%
NF	83	60	511	4	658	77.66%
water	1	2	1	56	60	93.33%
	193	855	518	60	1,626	
	10.88%	88.19%	98.65%	93.33%		82.53%

	Forest	Non-Forest	Water	総計	
Forest	902	6	0	908	99.34%
Non-Forest	143	511	4	658	77.66%
Water	3	1	56	60	93.33%
	1,048	518	60	1,626	
	86.07%	98.65%	93.33%		90.34%

Latin America

	10-90	90-100	NF	water		
10-90	110	16	10	0	136	80.88%
90-100	105	459	7	0	571	80.39%
NF	58	1	422	2	483	87.37%
water	3	1	1	90	95	94.74%
	276	477	440	92	1,285	
	39.86%	96.23%	95.91%	97.83%		84.12%

	Forest	Non-Forest	Water	総計	
Forest	690	17	0	707	97.60%
Non-Forest	59	422	2	483	87.37%
Water	4	1	90	95	94.74%
総計	753	440	92	1,285	
	91.63%	95.91%	97.83%		93.54%

Australia

	10-90	90-100	Non-Forest	Water	総計	
10-90	16	1	2	0	19	84.21%
90-100	6	11	0	0	17	64.71%
NF	8	0	61	1	70	87.14%
water	0	0	1	30	31	96.77%
	30	12	64	31	137	
	53.33%	91.67%	95.31%	96.77%		86.13%

	Forest	Non-Forest	Water	総計	
Forest	34	2	0	36	94.44%
Non-Forest	8	61	1	70	87.14%
Water	0	1	30	31	96.77%
	42	64	31	137	
	80.95%	95.31%	96.77%		91.24%

Eurasia

	10-90	90-100	Non-Forest	Water	総計	
10-90	287	75	20	0	382	75.13%
90-100	147	196	7	0	350	56.00%
NF	130	45	1,731	15	1,921	90.11%
water	7	2	3	584	596	97.99%
	571	318	1,761	599	3,249	
	50.26%	61.64%	98.30%	97.50%		86.12%

	Forest	Non-Forest	Water	総計	
Forest	705	27	0	732	96.31%
Non-Forest	175	1,731	15	1,921	90.11%
Water	9	3	584	596	97.99%
	889	1,761	599	3,249	
	79.30%	98.30%	97.50%		92.95%

North America

	10-90	90-100	NF	water		
10-90	212	35	9	0	256	82.81%
90-100	84	142	3	1	230	61.74%
NF	121	8	493	90	712	69.24%
water	3	0	0	369	372	99.19%
	420	185	505	460	1,570	
	50.48%	76.76%	97.62%	80.22%		77.45%

	Forest	Non-Forest	Water	総計	
Forest	473	12	1	486	97.33%
Non-Forest	129	493	90	712	69.24%
Water	3	0	369	372	99.19%
	605	505	460	1,570	
	78.18%	97.62%	80.22%		85.03%

Table A1-4 Classification accuracy (Confusion Matrix) in the case of 4 categories and 3 categories in 2019. Upper matrices show 4 categories case and lower matrices show 3 categories case.

Africa

	10-90	90-100	NF	water		
10-90	650	88	16	0	754	86.21%
90-100	123	124	5	0	252	49.21%
NF	185	38	1,557	5	1,785	87.23%
water	0	0	4	143	147	97.28%
	958	250	1,582	148	2,938	
	67.85%	49.60%	98.42%	96.62%		84.21%

	Forest	Non-Forest	Water	Total	
Forest	985	21	0	1,006	97.91%
Non-Forest	223	1,557	5	1,785	87.23%
Water	0	4	143	147	97.28%
Total	1,208	1,582	148	2,938	
	81.54%	98.42%	96.62%		91.39%

Southeast Asia

	10-90	90-100	Non-Forest	Water		
10-90	38	39	10	1	88	43.18%
90-100	106	770	9	0	885	87.01%
NF	83	79	1,317	5	1,484	88.75%
water	2	2	3	202	209	96.65%
	229	890	1,339	208	2,666	
	16.59%	86.52%	98.36%	97.12%		87.28%

	Forest	Non-Forest	Water	Total	
Forest	953	19	1	973	97.94%
Non-Forest	162	1,317	5	1,484	88.75%
Water	4	3	202	209	96.65%
Total	1,119	1,339	208	2,666	
	85.17%	98.36%	97.12%		92.72%

Latin America

	10-90	90-100	NF	water		
10-90	116	8	6	0	130	89.23%
90-100	107	461	7	0	575	80.17%
NF	47	1	428	2	478	89.54%
water	4	1	0	89	94	94.68%
	274	471	441	91	1,277	
	42.34%	97.88%	97.05%	97.80%		85.67%

	Forest	Non-Forest	Water	Total	
Forest	692	13	0	705	98.16%
Non-Forest	48	428	2	478	89.54%
Water	5	0	89	94	94.68%
Total	745	441	91	1,277	
	92.89%	97.05%	97.80%		94.68%

Australia

	10-90	90-100	Non-Forest	Water		
10-90	19	1	1	0	21	90.48%
90-100	6	11	1	0	18	61.11%
NF	3	0	58	1	62	93.55%
water	0	0	1	30	31	96.77%
	28	12	61	31	132	
	67.86%	91.67%	95.08%	96.77%		89.39%

	Forest	Non-Forest	Water	Total	
Forest	37	2	0	39	94.87%
Non-Forest	3	58	1	62	93.55%
Water	0	1	30	31	96.77%
Total	40	61	31	132	
	92.50%	95.08%	96.77%		94.70%

Eurasia

	10-90	90-100	Non-Forest	Water		
10-90	291	54	29	0	374	77.81%
90-100	140	213	7	0	360	59.17%
NF	102	11	1,667	14	1,794	92.92%
water	7	2	5	579	593	97.64%
	540	280	1,708	593	3,121	
	53.89%	76.07%	97.60%	97.64%		88.11%

	Forest	Non-Forest	Water	Total	
Forest	698	36	0	734	95.10%
Non-Forest	113	1,667	14	1,794	92.92%
Water	9	5	579	593	97.64%
Total	820	1,708	593	3,121	
	85.12%	97.60%	97.64%		94.33%

North America

	10-90	90-100	NF	water		
10-90	207	35	9	1	252	82.14%
90-100	99	143	3	1	246	58.13%
NF	103	5	487	89	684	71.20%
water	3	0	0	364	367	99.18%
	412	183	499	455	1,549	
	50.24%	78.14%	97.60%	80.00%		77.53%

	Forest	Non-Forest	Water	Total	
Forest	484	12	2	498	97.19%
Non-Forest	108	487	89	684	71.20%
Water	3	0	364	367	99.18%
Total	595	499	455	1,549	
	81.34%	97.60%	80.00%		86.18%

Table A1-5 Classification accuracy (Confusion Matrix) in the case of 4 categories and 3 categories in 2018. Upper matrices show 4 categories case and lower matrices show 3 categories case.

Africa

	10-90	90-100	NF	water		
10-90	659	90	14	0	763	86.37%
90-100	119	119	6	0	244	48.77%
NF	181	41	1,564	5	1,791	87.33%
water	0	0	4	142	146	97.26%
	959	250	1,588	147	2,944	
	68.72%	47.60%	98.49%	96.60%		84.38%

	Forest	Non-Forest	Water	Total	
Forest	987	20	0	1,007	98.01%
Non-Forest	222	1,564	5	1,791	87.33%
Water	0	4	142	146	97.26%
Total	1,209	1,588	147	2,944	
	81.64%	98.49%	96.60%		91.47%

Southeast Asia

	10-90	90-100	Non-Forest	Water	Total	
10-90	24	29	21	0	74	32.43%
90-100	124	831	9	0	964	86.20%
NF	100	77	1,419	7	1,603	88.52%
water	2	2	5	214	223	95.96%
	250	939	1,454	221	2,864	
	9.60%	88.50%	97.59%	96.83%		86.87%

	Forest	Non-Forest	Water	Total	
Forest	1,008	30	0	1,038	97.11%
Non-Forest	177	1,419	7	1,603	88.52%
Water	4	5	214	223	95.96%
Total	1,189	1,454	221	2,864	
	84.78%	97.59%	96.83%		92.21%

Latin America

	10-90	90-100	NF	water		
10-90	118	6	7	0	131	90.08%
90-100	106	469	4	0	579	81.00%
NF	50	1	431	2	484	89.05%
water	2	1	0	90	93	96.77%
	276	477	442	92	1,287	
	42.75%	98.32%	97.51%	97.83%		86.09%

	Forest	Non-Forest	Water	Total	
Forest	699	11	0	710	98.45%
Non-Forest	51	431	2	484	89.05%
Water	3	0	90	93	96.77%
Total	753	442	92	1,287	
	92.83%	97.51%	97.83%		94.79%

Australia

	10-90	90-100	Non-Forest	Water	Total	
10-90	26	2	2	0	30	86.67%
90-100	3	10	0	0	13	76.92%
NF	1	0	61	1	63	96.83%
water	0	0	1	30	31	96.77%
	30	12	64	31	137	
	86.67%	83.33%	95.31%	96.77%		92.70%

	Forest	Non-Forest	Water	Total	
Forest	41	2	0	43	95.35%
Non-Forest	1	61	1	63	96.83%
Water	0	1	30	31	96.77%
Total	42	64	31	137	
	97.62%	95.31%	96.77%		96.35%

Eurasia

	10-90	90-100	Non-Forest	Water	Total	
10-90	288	74	35	0	397	72.54%
90-100	147	243	9	0	399	60.90%
NF	157	14	1,782	15	1,968	90.55%
water	7	2	7	594	610	97.38%
	599	333	1,833	609	3,374	
	48.08%	72.97%	97.22%	97.54%		86.16%

	Forest	Non-Forest	Water	Total	
Forest	752	44	0	796	94.47%
Non-Forest	171	1,782	15	1,968	90.55%
Water	9	7	594	610	97.38%
Total	932	1,833	609	3,374	
	80.69%	97.22%	97.54%		92.71%

North America

	10-90	90-100	NF	water		
10-90	184	26	7	0	217	84.79%
90-100	108	155	1	0	264	58.71%
NF	124	4	497	91	716	69.41%
water	4	0	0	369	373	98.93%
	420	185	505	460	1,570	
	43.81%	83.78%	98.42%	80.22%		76.75%

	Forest	Non-Forest	Water	Total	
Forest	473	8	0	481	98.34%
Non-Forest	128	497	91	716	69.41%
Water	4	0	369	373	98.93%
Total	605	505	460	1,570	
	78.18%	98.42%	80.22%		85.29%

Table A1-6 Classification accuracy (Confusion Matrix) in the case of 4 categories and 3 categories in 2017. Upper matrices show 4 categories case and lower matrices show 3 categories case.

Africa

	10-90	90-100	NF	water		
10-90	657	83	15	0	755	87.02%
90-100	129	124	4	0	257	48.25%
NF	173	43	1,565	5	1,786	87.63%
water	0	0	4	142	146	97.26%
	959	250	1,588	147	2,944	
	68.51%	49.60%	98.55%	96.60%		84.51%

	Forest	Non-Fores	Water	Total	
Forest	993	19	0	1,012	98.12%
Non-Fores	216	1,565	5	1,786	87.63%
Water	0	4	142	146	97.26%
Total	1,209	1,588	147	2,944	
	82.13%	98.55%	96.60%		91.71%

Southeast Asia

	10-90	90-100	Non-Fores	Water	Total	
10-90	35	35	22	0	92	38.04%
90-100	104	817	13	0	934	87.47%
NF	110	85	1,414	7	1,616	87.50%
water	1	2	8	214	225	95.11%
	250	939	1,457	221	2,867	
	14.00%	87.01%	97.05%	96.83%		86.50%

	Forest	Non-Fores	Water	Total	
Forest	991	35	0	1,026	96.59%
Non-Fores	195	1,414	7	1,616	87.50%
Water	3	8	214	225	95.11%
Total	1,189	1,457	221	2,867	
	83.35%	97.05%	96.83%		91.35%

Latin America

	10-90	90-100	NF	water		
10-90	122	6	6	0	134	91.04%
90-100	105	470	3	0	578	81.31%
NF	46	0	433	2	481	90.02%
water	3	1	0	90	94	95.74%
	276	477	442	92	1,287	
	44.20%	98.53%	97.96%	97.83%		86.64%

	Forest	Non-Fores	Water	Total	
Forest	703	9	0	712	98.74%
Non-Fores	46	433	2	481	90.02%
Water	4	0	90	94	95.74%
Total	753	442	92	1,287	
	93.36%	97.96%	97.83%		95.26%

Australia

	10-90	90-100	Non-Fores	Water	Total	
10-90	24	1	2	0	27	88.89%
90-100	4	11	0	0	15	73.33%
NF	2	0	61	1	64	95.31%
water	0	0	1	30	31	96.77%
	30	12	64	31	137	
	80.00%	91.67%	95.31%	96.77%		91.97%

	Forest	Non-Fores	Water	Total	
Forest	40	2	0	42	95.24%
Non-Fores	2	61	1	64	95.31%
Water	0	1	30	31	96.77%
Total	42	64	31	137	
	95.24%	95.31%	96.77%		95.62%

Eurasia

	10-90	90-100	Non-Fores	Water	Total	
10-90	273	96	30	0	399	68.42%
90-100	124	216	7	0	347	62.25%
NF	196	19	1,791	15	2,021	88.62%
water	7	2	7	594	610	97.38%
	600	333	1,835	609	3,377	
	45.50%	64.86%	97.60%	97.54%		85.11%

	Forest	Non-Fores	Water	Total	
Forest	709	37	0	746	95.04%
Non-Fores	215	1,791	15	2,021	88.62%
Water	9	7	594	610	97.38%
Total	933	1,835	609	3,377	
	75.99%	97.60%	97.54%		91.62%

North America

	10-90	90-100	NF	water		
10-90	199	40	4	0	243	81.89%
90-100	113	143	3	0	259	55.21%
NF	105	2	498	91	696	71.55%
water	3	0	0	369	372	99.19%
	420	185	505	460	1,570	
	47.38%	77.30%	98.61%	80.22%		77.01%

	Forest	Non-Fores	Water	Total	
Forest	495	7	0	502	98.61%
Non-Fores	107	498	91	696	71.55%
Water	3	0	369	372	99.19%
Total	605	505	460	1,570	
	81.82%	98.61%	80.22%		86.75%