

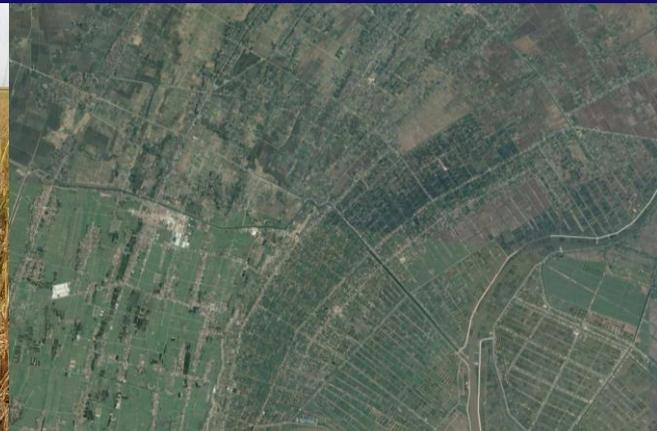
GFSAD 30 Southeast Asia

Cropland Presence Absence at 30m

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GFSAD 30 Workshop, Mountain View CA, February 1, 2017



Cropland vs Noncropland of South East Asia at 30m

Overview



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

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8. Accuracy assessment
9. Area comparisons
10. Closing thoughts & future roadmap



Cropland vs Noncropland of South East Asia at 30m

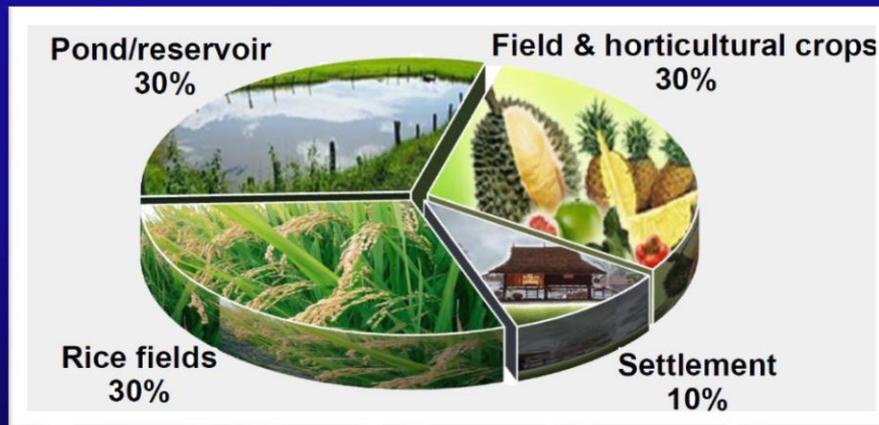
Background



Cropland Presence Absence in Thailand at 30m

Challenges to crop mapping in SE Asia

- Small farm plots intermixed with roads, ponds, forest, settlements
- Roughly half Landsat pixels obscured by clouds each scene



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Total Cropland Area per Crop per Country in ha from Portman et. al

Crop Name	Indonesia	Thailand	Philippines	Myanmar	Vietnam	Malaysia	Japan	North Korea	Cambodia	South Korea	Laos	Taiwan	Papua N Guinea
8 Global Crops													
Rice	11820311	9913451	4040071	6284672	7016776	697783	1820344	597484	2047718	1100170	708596	440492	388
Maize	3436821	1197278	2590539	224845	673882	25788	100113	561555	60832	18113	44675	40713	1303
Soybeans	836503	201150	884	104846	122029	0	126275	318882	35981	90468	5347	433	0
Cotton	22197	25387	2868	294414	24107	0	0	19675	148	0	11440	0	0
Potatoes	62913	7052	5513	26768	32126	0	99329	170355	20	25910	5405	2775	147
Wheat	0	1121	0	92687	0	0	191019	65498	0	1668	0	224	0
Barley	0	7806	0	13	0	0	60350	44898	0	79036	1	10	0
Regionally important crops													
Oil palm	2252746	221834	16228	22	1	3047409	0	1	0	0	38	2	74599
Pulses	334074	339082	78752	2361460	321692	0	61567	351935	29124	20491	16148	4264	5228
Cassava	1248481	1071907	242531	9000	265692	40970	0	6	14827	0	5163	9	11692
Sugar cane	576628	978964	383021	134945	284860	24000	30064	0	7511	0	6239	36920	7923
Coffee	1056091	66317	145375	4385	366657	46829	0	0	295	0	31069	0	82609
Groundnuts	671718	77121	27925	554431	240672	474	12311	2	10731	5775	13147	30684	1028
Fodder grass	0	15159	44400	324492	61	0	838454	1	0	21162	3	21297	0
Cocoa	449022	729	13827	0	0	79153	0	0	0	0	0	0	99783
Citrus	87185	229159	33917	25	72133	4988	79111	35	10586	27253	17160	28419	0
Country Total	31533604	17701953	13310639	13153253	11678547	5812483	4285621	2783986	2435270	2164652	992370	952232	923169



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

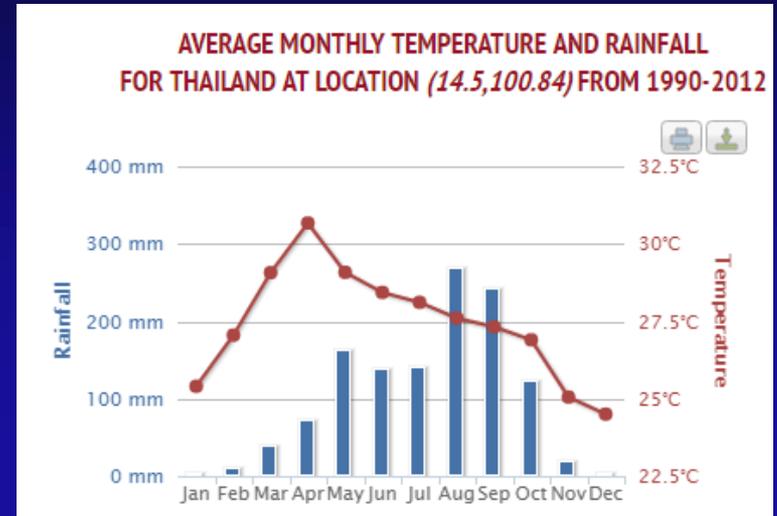
Example: Agriculture in Thailand Tropical Monsoon

Up to 3 crop rotations per season

Major exporter of rice

Wet period: May to October

Dry period: November to April



Crop	Season	Source	Mar	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
Maize	Main	AMIS	p	p	p	p	p	h	h	h	h	h	h	h
Maize	Second	AMIS	h	h	h						p	p	p	h
Rice	Main	AMIS	h		p	p	p	p	p	h	h	h	h	h
Rice	Second	AMIS	h	h	h	h	h	h	h		p	p	p	p
Soybean	Main	AMIS	h	h								p	p	g
Soybean	Second	AMIS			p	p	p	h	h	h	h	h		

p = planting period

g = growth period

h = harvest period



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

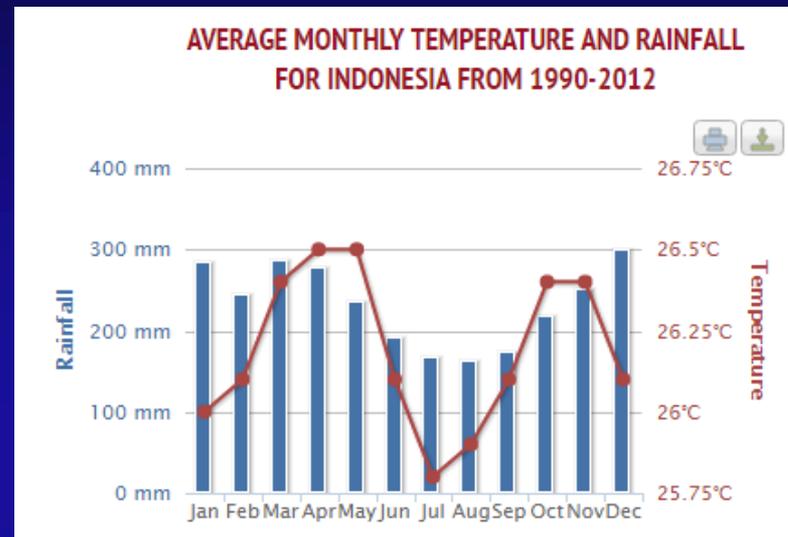
Agriculture in Java & Bali

Tropical Rainforest

Up to 3 crop rotations per season

Major crop rice

Goal is to be self sufficient



Due to consistent rainfall, temperature and irrigation, many crops can be planted and harvested at any time of the year



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m



Cropland vs Noncropland of South East Asia at 30m Goal



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Research Goal and Objectives

Overarching goal of this research will be to produce cropland products at much higher resolutions (250 m and 30 m), resulting in product with greater accuracies and value and also through process of automation.

Specific goals will be:

- 1. To produce cropland products at MODIS 250 m and Landsat 30 m. Products include: (a) croplands vs. non-croplands, (b) irrigated versus rainfed, (c) cropping intensity: single, double, triple, continuous, (d) crop type, (e) croplands versus cropland fallows, (f) change over time and space;**
- 2. Assess accuracies of above products;**
- 3. Develop automated cropland classification algorithms in order to reproduce cropland products year after year without much analyst interactions;**
- 4. Release cropland products and related data (e.g., ground data) to public.**



Cropland vs Noncropland of South East Asia at 30m
Study Area & Zones



Croplands of South East Asia, N&S Korea, and Japan at 30m

Background



- Population per country and percent of population that is rural as of 2011 from FAO
- Percent population working in Agriculture and gross national income, FAO 2011

	Population x 1000	Percent Rural	Percent population in Agg	Gross National Income
Cambodia	14478	80	54.2	880
Indonesia	244769	49.3	38.3	3420
Laos	6374	65.7	NA	1260
Malaysia	29322	27.2	13.3	9800
Myanmar	48724	67.4	NA	NA
Philippines	96471	51.2	33.2	2470
Thailand	69892	65.9	38.2	5210
Timor-Leste	1187	71.7	NA	3670
Viet Nam	89730	69	51.7	1400
Pacific Islands	9488	81.6	NA	2123
Japan	126435	8.7	3.7	47870
North Korea	24554	39.7	NA	NA
South Korea	48588	16.8	6.6	22670
Total	810012	53.4	29.9	9161



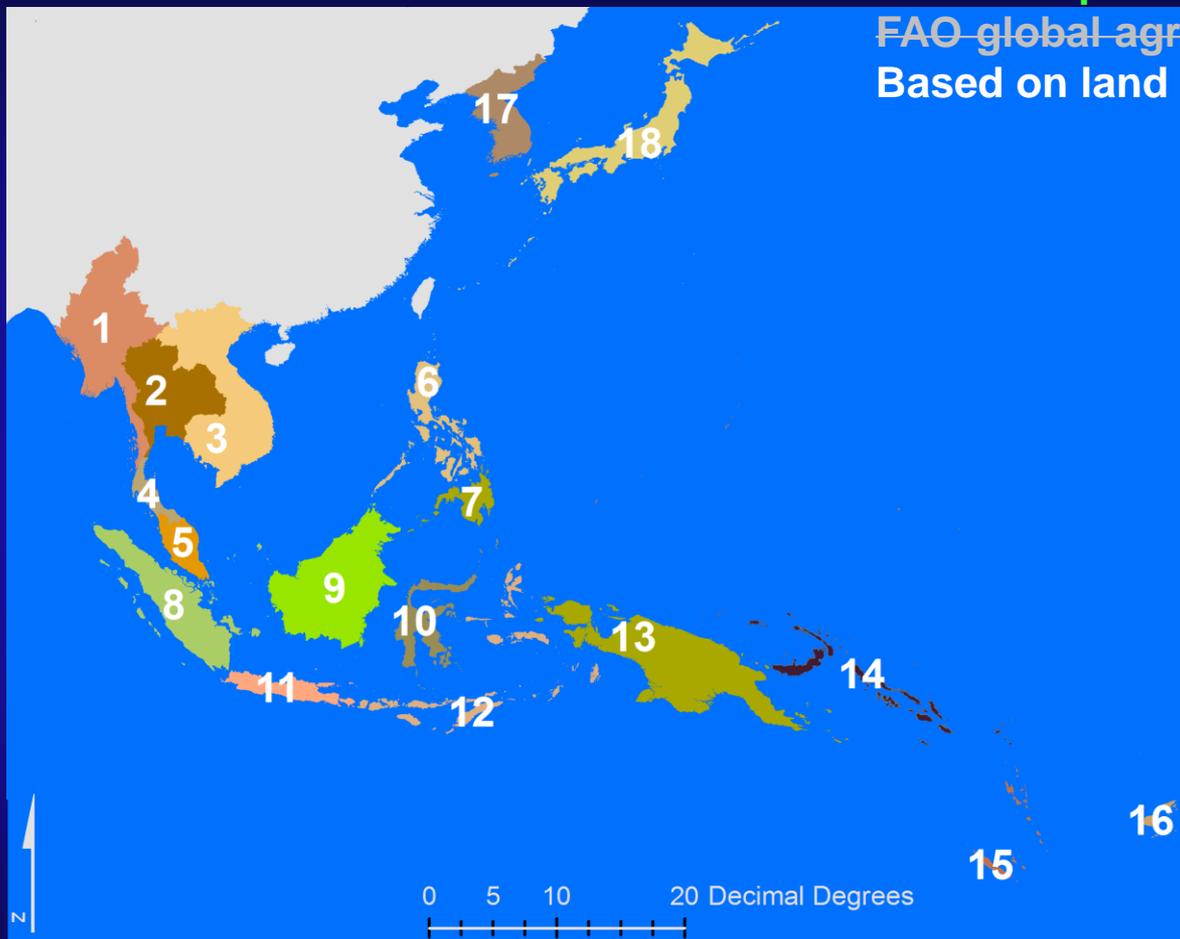
Croplands of South East Asia, N&S Korea, and Japan at 30m

Region Segmentation

How to separate study area into mapping units?

~~FAO global agricultural zones, Country extents~~

Based on land units and classification results



- 1 Myanmar
- 2 Thailand
- 3 Cambodia, Laos, Vietnam
- 4 South Thailand
- 5 Malaysia
- 6 Philippines
- 7 South Philippines
- 8 Sumatra
- 9 Borneo
- 10 Sulawesi
- 11 Java & Bali
- 12 Indonesia Islands
- 13 Papua
- 14 Solomon Islands
- 15 Vanuatu & New Caledonia
- 16 Fiji, Samoa, Tonga
- 17 North & South Korea
- 18 Japan



Cropland vs Noncropland of South East Asia at 30m Input Imagery



Croplands of South East Asia, N&S Korea, and Japan at 30m

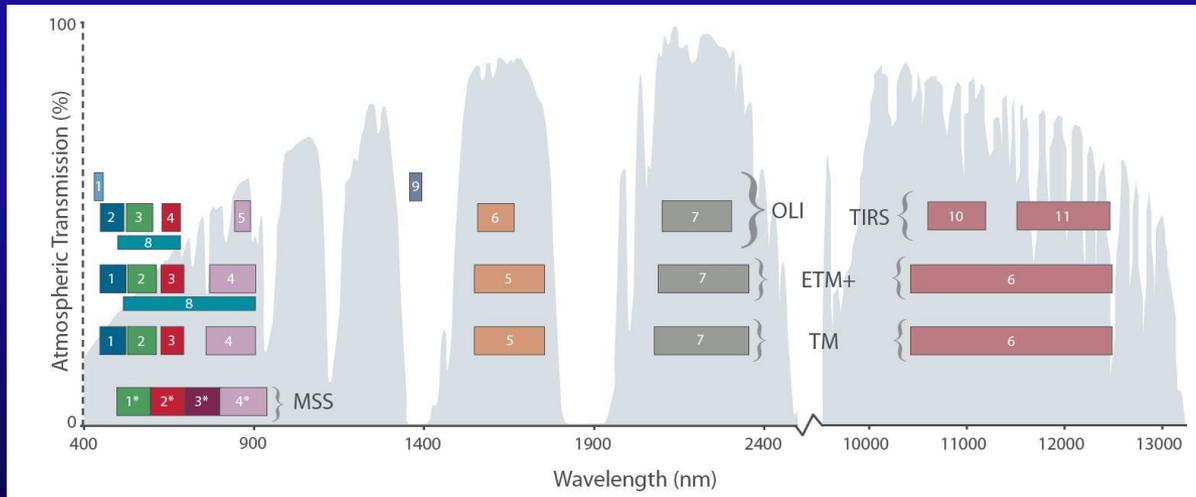
Landsat OLI & ETM+ Sensors

- NASA & USGS partnership
- Data free to use since 2008
- 16 day revisit period per satellite
- Visible to thermal
- From 1982 to present (Landsat 4)

Normalized Vegetation Difference Index $NDVI = \frac{NIR - Red}{NIR + Red}$
 Good for distinguishing different vegetation

Normalized Burn Index 2 $NBR2 = \frac{SWIR2 - SWIR1}{SWIR2 + SWIR1}$
 Good for identifying urban and barren areas

Land Surface Water Index $LSWI = \frac{SWIR1 - NIR}{SWIR1 + NIR}$
 Good for identifying rice paddy



Datasets: Landsat OLI & ETM+ 30-m

Issues

Greatest Issue: Clouds

1. SE Asia is one of the cloudiest and wettest regions on Earth
2. Since Landsat 8 only acquires imagery of an area every 16 days (8 for L7 and L8), the likelihood of a pixel being obscured by a cloud is quite high
3. By comparison, a MODIS 250m image is acquired over a region every day. MOD 16 has 16 opportunities to acquire a pixel without it being obscured by cloud
4. To compensate for cloudcover, images used for classification were composited over set seasonal date periods over multiple years.



Croplands of South East Asia, N&S Korea, and Japan at 30m

Three Seasonal Landsat Composites

1. Four years of Landsat OLI and ETM+: 2013-2016;
2. Top of atmosphere reflectance product;
3. Three distinct composites leading to 3 images.
4. Image composites were, Julian days:
 - 1-120 120-240 240-365
5. Median value of each taken from all cloud free images within composite period
6. Standard deviation was calculated for 2014
7. Total of 10 bands per composite image
 - (e.g., 1-120 Julian day has 10 bands which are as follows):
 - bands 1, 2, 3, 4, 5, 7, and NDVI, LSWI, and NBR2.
8. Slope and elevation from SRTM30
9. Total of 3 seasonal composites * 10 bands + standard deviation from 2014 = 40 band stack

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2013												
2014	*****Period 2014*****											
2015	Period 1				Period 2				Period 3			
2016												



Croplands of South East Asia, N&S Korea, and Japan

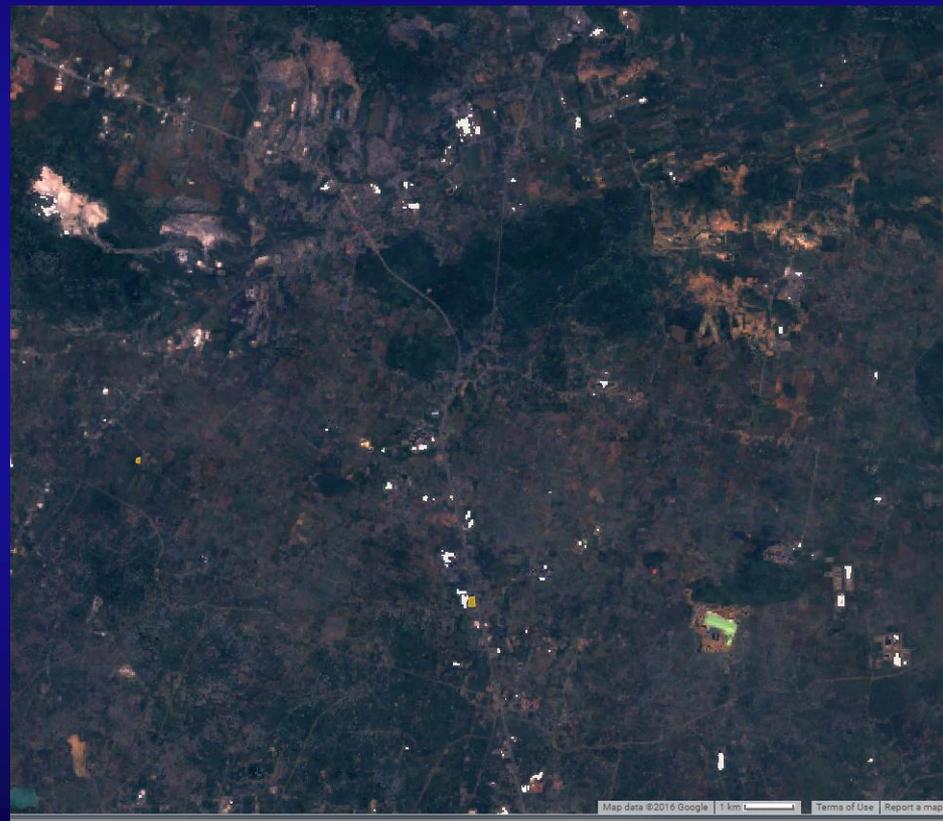
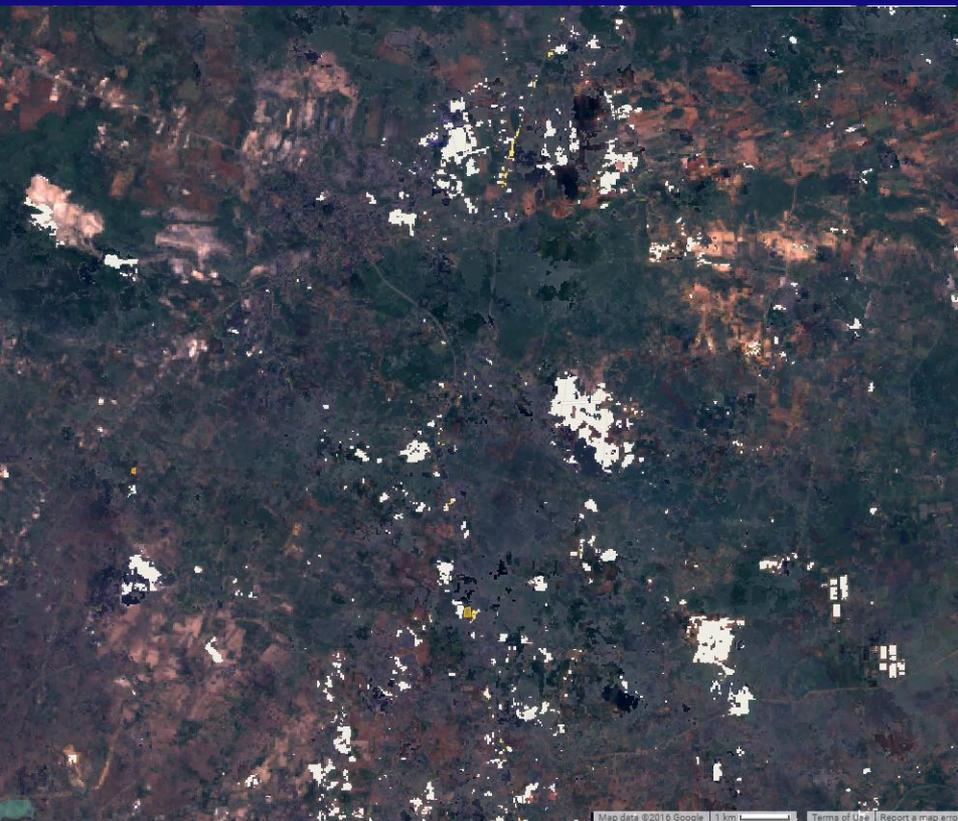
Cropland Presence Absence at 30m

Composites have to be visually checked for clouds & missing data

DOY 180 to 240

(shown here in white)

DOY 120 to 240



Croplands of South East Asia, N&S Korea, and Japan at 30m

Mean vs Median in Kalimantan

Cloud free seasonal image composites calculated using

Mean

Median



110.581, -2.825



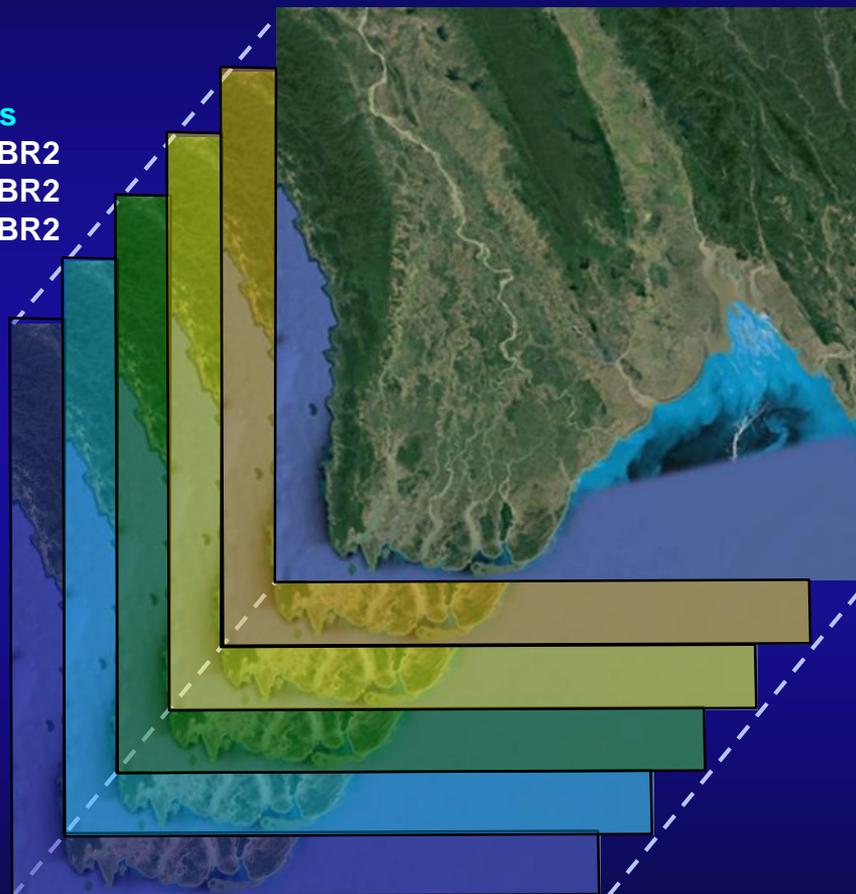
Datasets: Landsat OLI & ETM+ 30-m

Data Compositing and Strategy to Overcome Issues

Composite Period

Years	Julian days	Composited Landsat Bands
2013-2016	1-120	1,2,3,4,5,6,7,NDVI, LSWI, NBR2
2013-2016	121-240	1,2,3,4,5,6,7,NDVI, LSWI, NBR2
2013-2016	241-365	1,2,3,4,5,6,7,NDVI, LSWI, NBR2
2014-2014	1-365	1 σ , 2 σ , 3 σ , 4 σ , 5 σ , 6 σ , 7 σ , NDVI σ , NBR2 σ , & LSWI

4 composite periods * 10 bands = **40 Landsat bands**
40 Landsat bands + **SRTM slope & elevation** = **42 input variables in model**

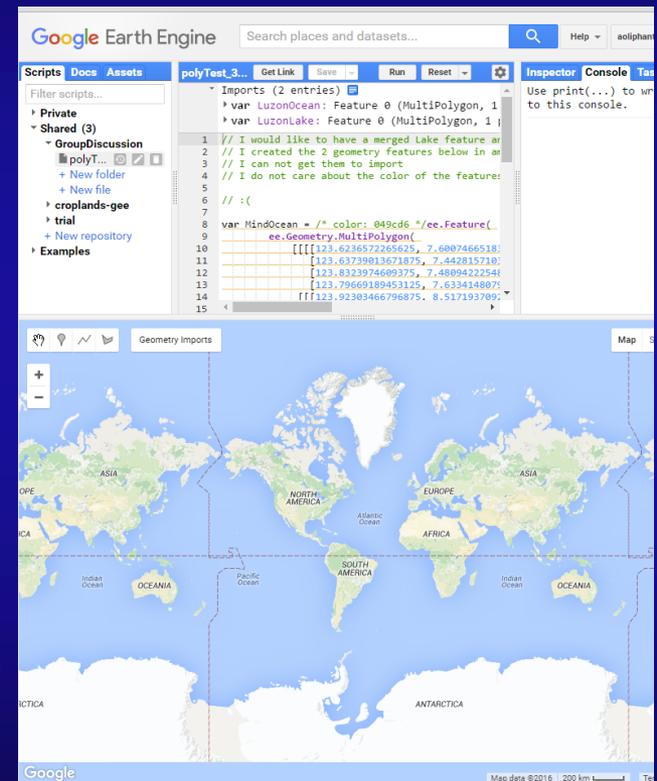


Cloud Computing on GEE

Strengths and Limitations of Cloud Computing

Strengths of Google Earth Engine

1. Eliminated the time and resource intensive step of data download and local preprocessing
2. Allows large classifications to be preformed without expensive workstations and software
3. Allows algorithms to be scaled from being implemented regionally to globally
4. Exceptional speed with multitemporal pixel based classifications (generally supervised)



Weaknesses of Google Earth Engine

1. Restricted to a limited (although rapidly expanding) set of functions
2. Limited performance and results with object based classifications (generally unsupervised)
3. Many common remote sensing and GIS tasks are not intuitive

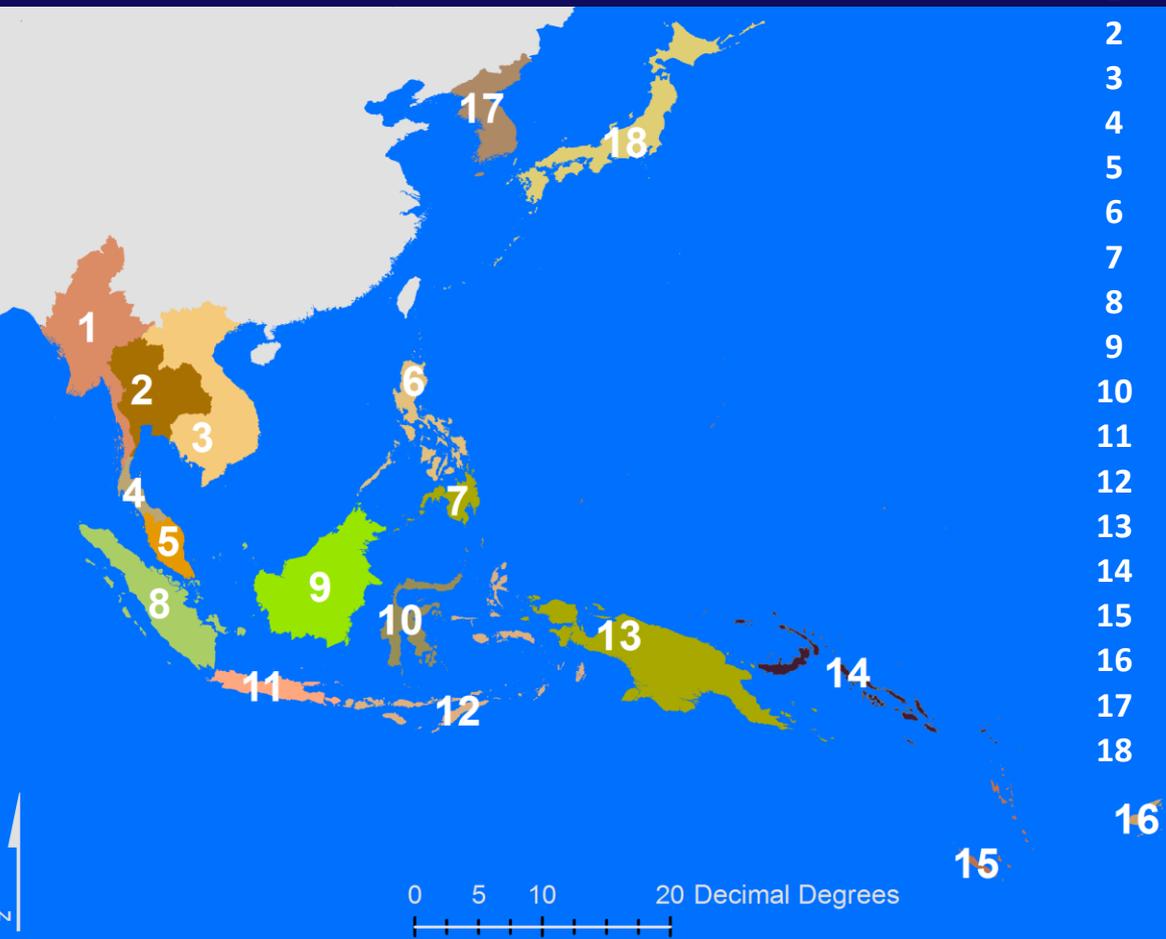


Cropland vs Noncropland of South East Asia at 30m Reference Data



Croplands of South East Asia, N&S Korea, and Japan at 30m

Training for Random Forest Model

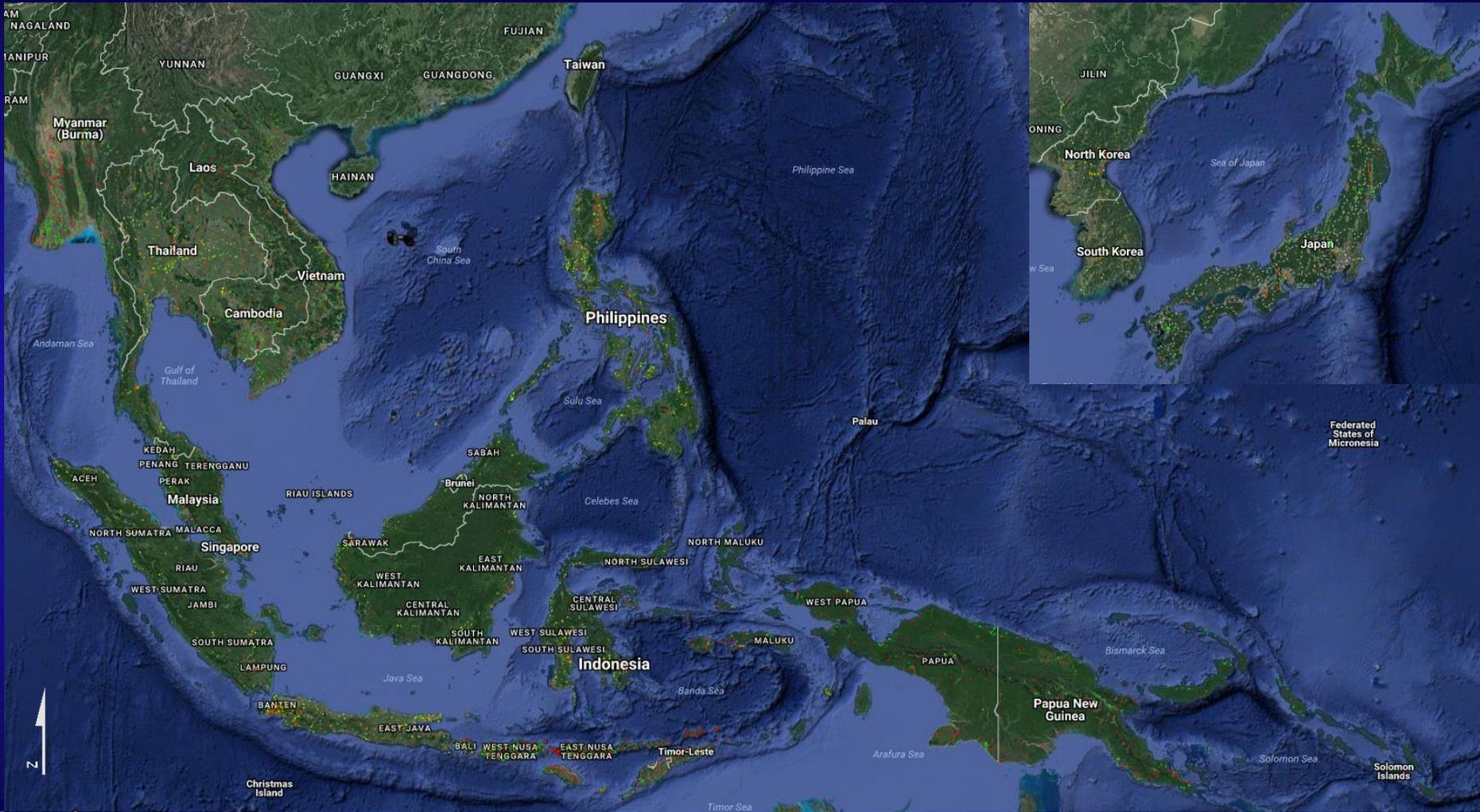


		Crop	Non Crop
1	Myanmar	409	361
2	Thailand	415	407
3	Cambodia, Laos, Vietnam	502	484
4	South Thailand	103	135
5	Malaysia	132	101
6	Philippines	247	238
7	South Philippines	89	116
8	Sumatra	143	165
9	Borneo	213	245
10	Sulawesi	259	276
11	Java & Bali	292	259
12	Indonesia Islands	268	405
13	Papua	122	171
14	Solomon Islands	54	82
15	Vanuatu & New Caledonia	65	61
16	Fiji, Samoa, Tonga	56	133
17	North & South Korea	188	218
18	Japan	158	251
	Total	3715	4108



Croplands of South East Asia, N&S Korea, and Japan at 30m

Training for Random Forest Model



Croplands of South East Asia, N&S Korea, and Japan at 30m

Training for Random Forest Model



		Crop	Non Crop
17	North & South Korea	188	218
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Croplands of South East Asia, N&S Korea, and Japan at 30m

Training for Random Forest Model



		Crop	Non Crop
6	Philippines	247	238
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14	Solomon Islands	54	82
15	Vanuatu & New Caledonia	65	61



Croplands of South East Asia, N&S Korea, and Japan at 30m

Method Overview

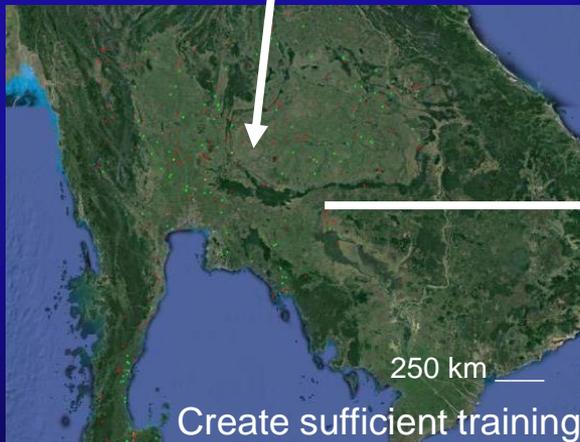
Training polygon creation
from high resolution imagery



Create cloud free composite
imagery over specified time period



Generate binary crop / noncrop
image



Create sufficient training
polygons across region

Input imagery
In Random
forest
model

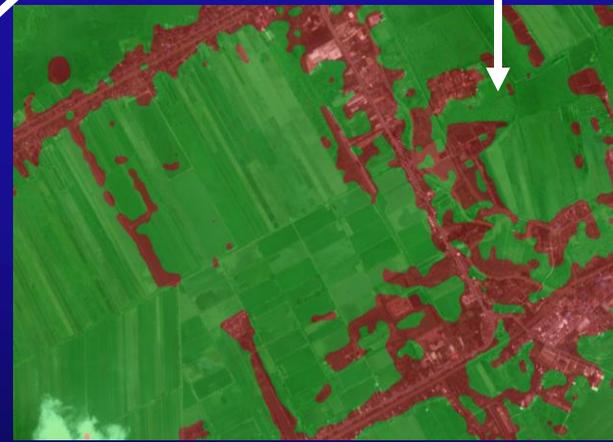
Explanation:

Cropland

Non-Cropland

Location:

100.9877, 14.1278

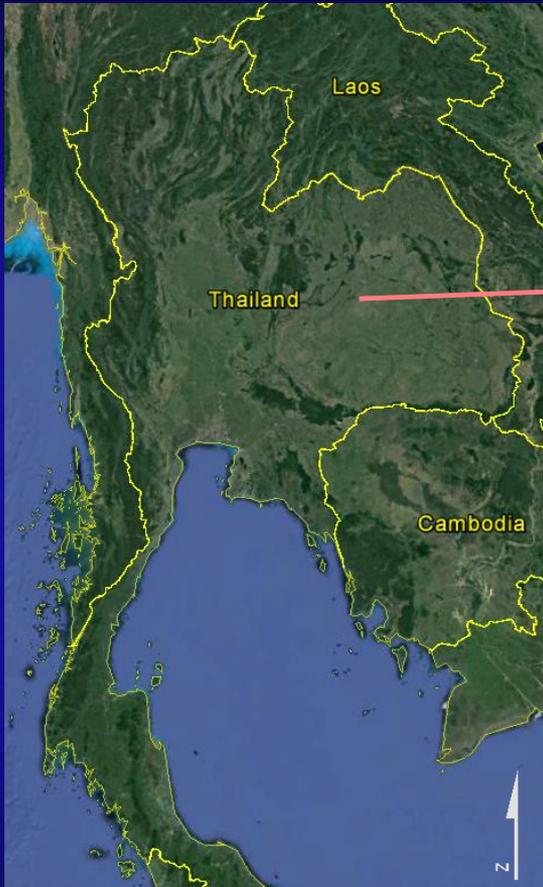


Post Processing to improve
classification



Croplands of South East Asia, N&S Korea, and Japan

Random Forest Algorithm Training Data



Cassava



Explanation:

Cropland

Non-Cropland



Croplands of South East Asia, N&S Korea, and Japan

Random Forest Algorithm Training Data



Sugarcane



Explanation:

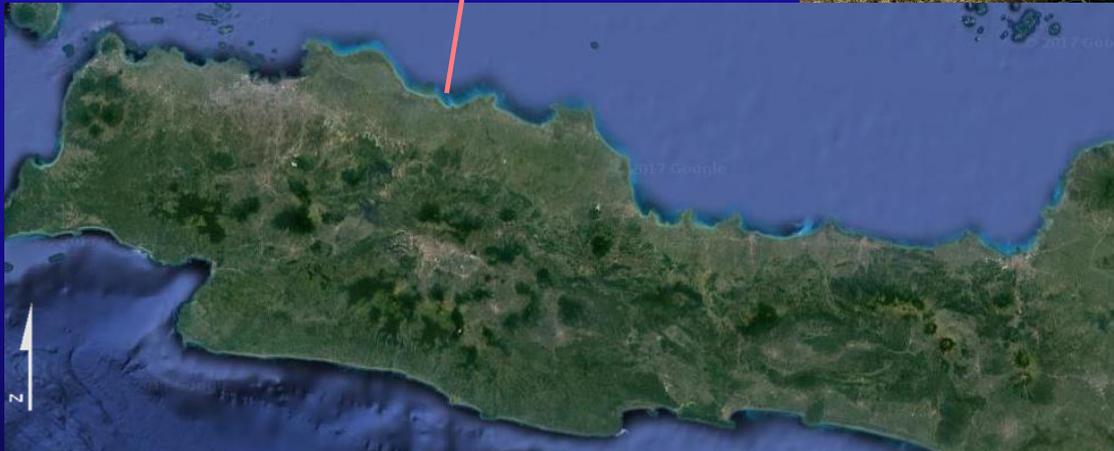
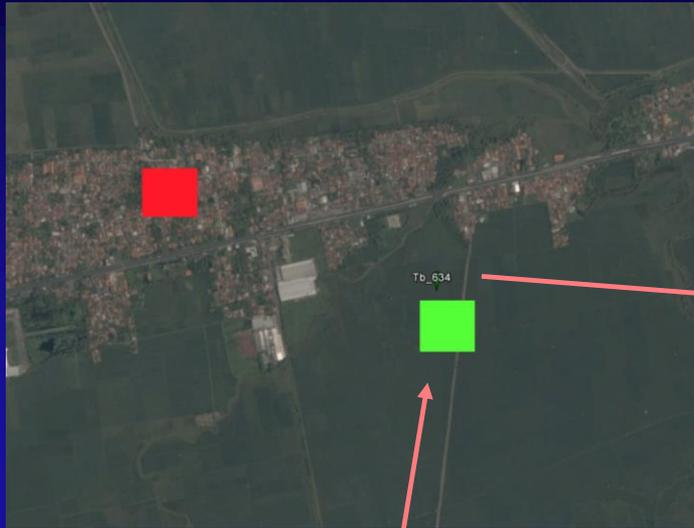
Cropland

Non-Cropland



Croplands of South East Asia, N&S Korea, and Japan

Random Forest Algorithm Training Data



Explanation:

Cropland

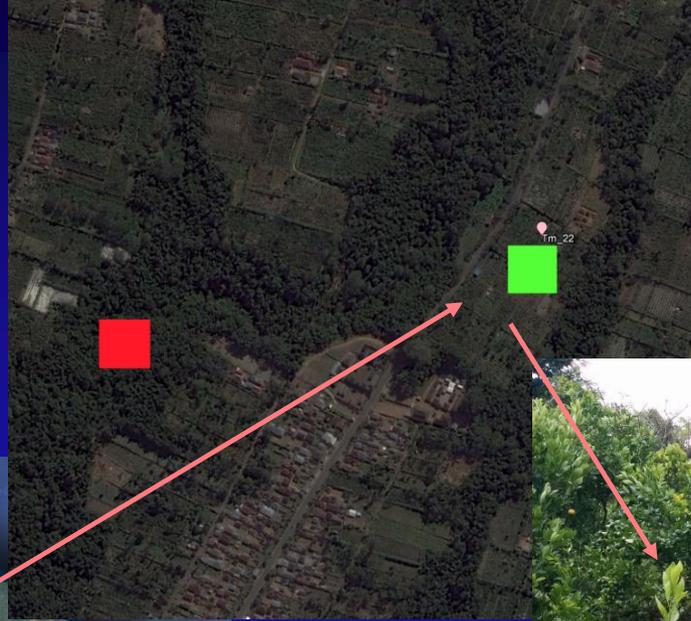
Non-Cropland



Croplands of South East Asia, N&S Korea, and Japan

Random Forest Algorithm Training Data

Guava



Explanation:
Cropland
Non-Cropland

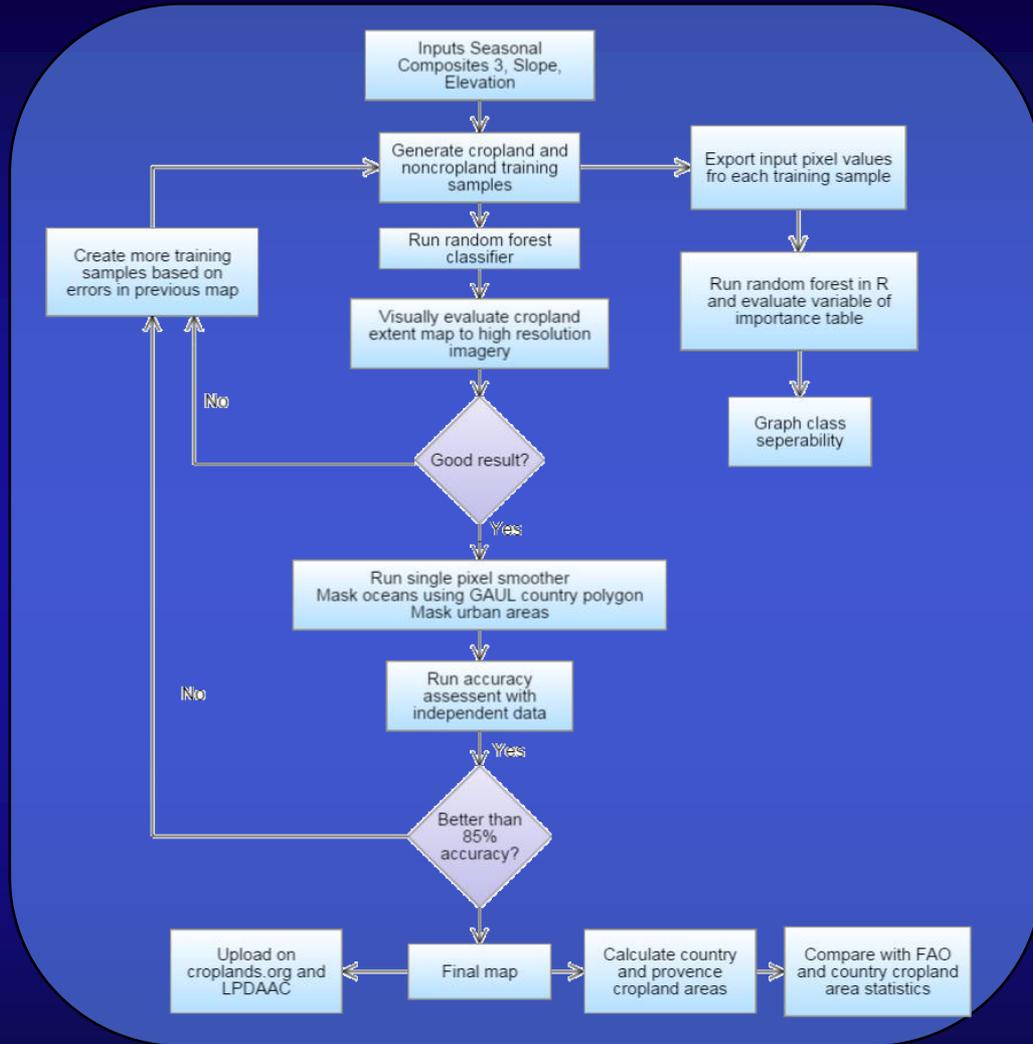


Cropland vs Noncropland of South East Asia at 30m
Methods: Overview



Croplands of South East Asia, N&S Korea, and Japan at 30m

Classification Flowchart



Cropland vs Noncropland of South East Asia at 30m

Methods: Knowledge Capture

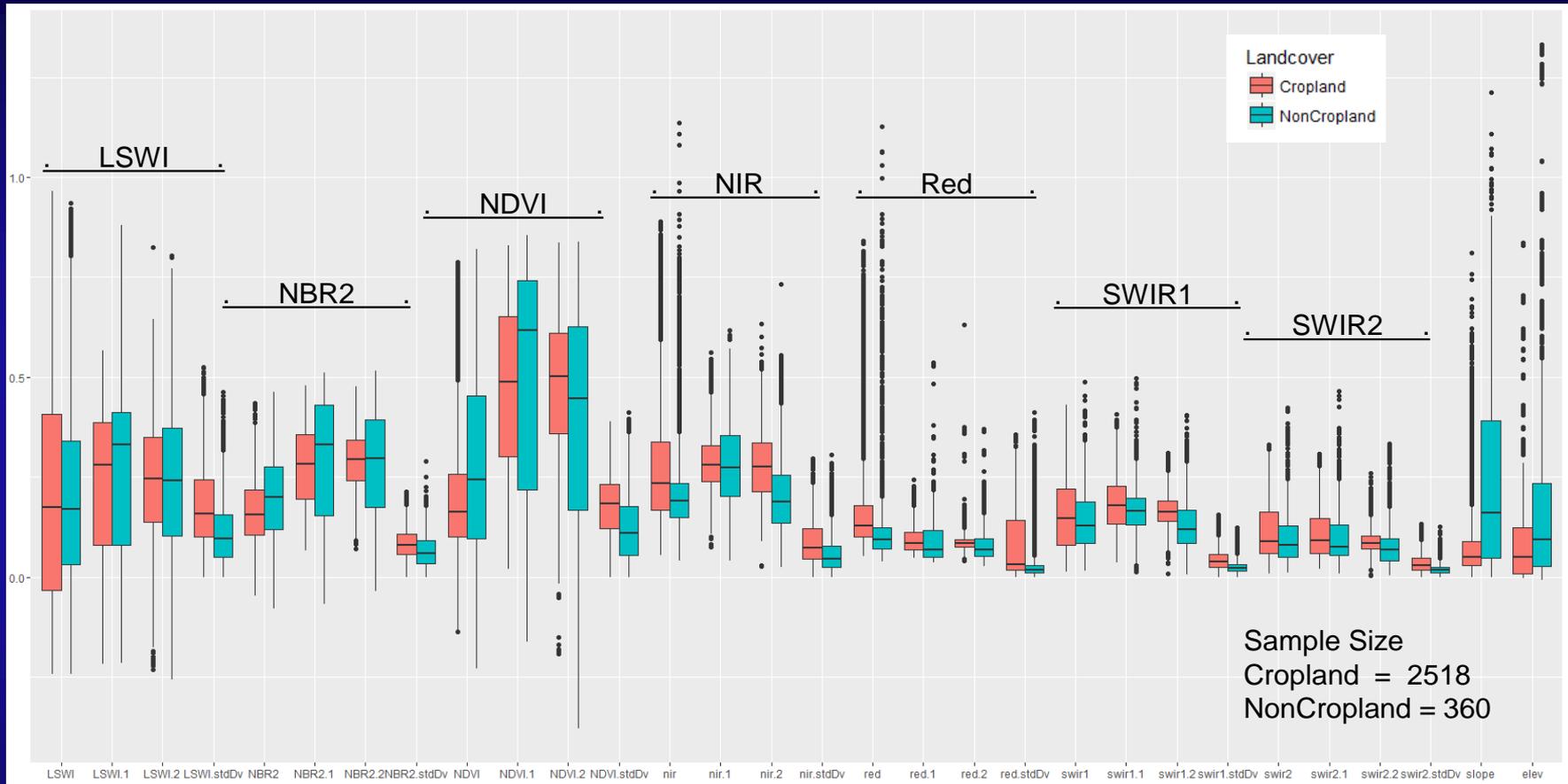


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Croplands of South East Asia, N&S Korea, and Japan at 30m

Knowledge Extraction: Japan

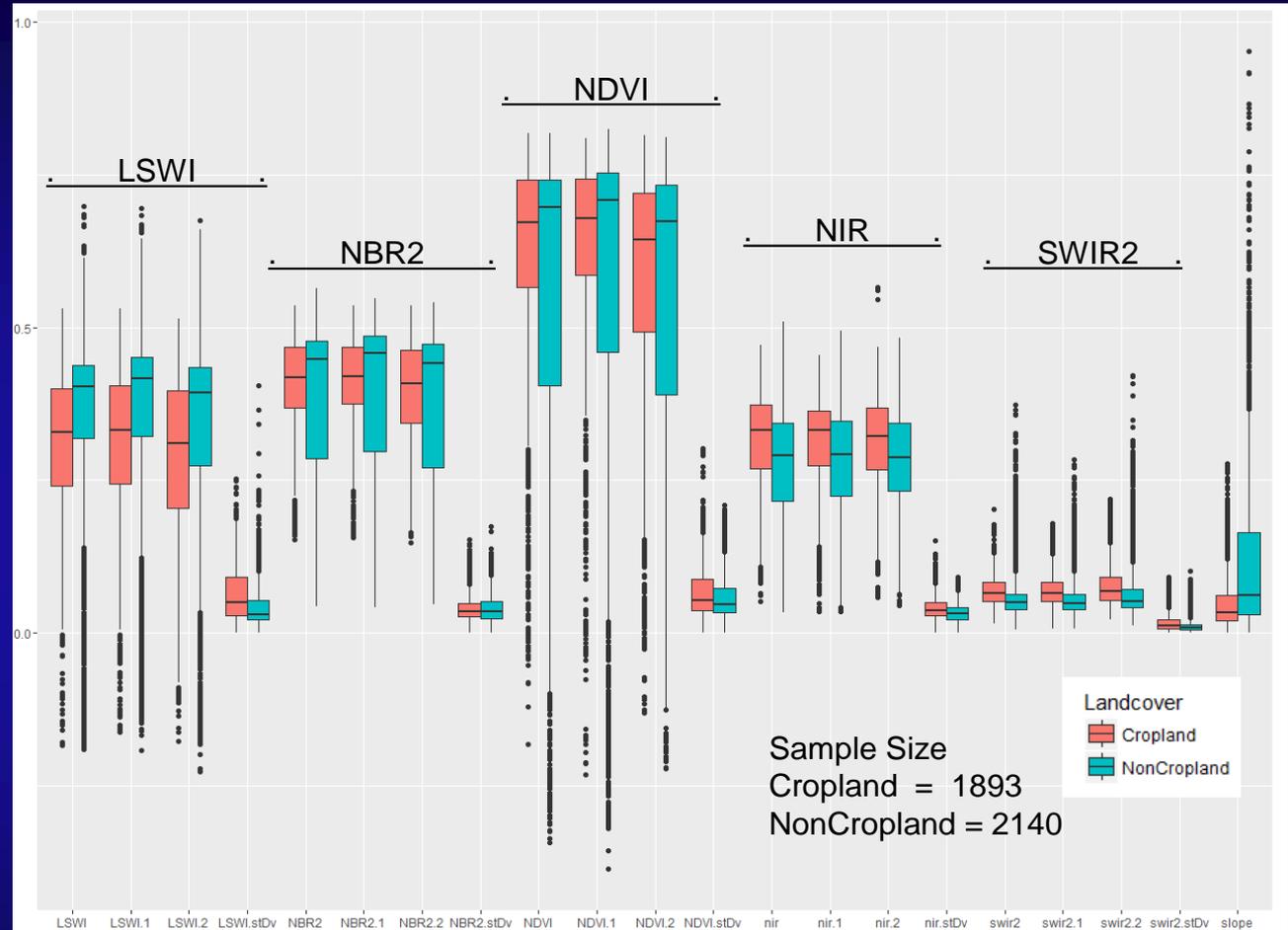


Note: Slope was divided by 50, temperature divided by 300, and temperature standard deviation divided by 10 to scale these variables from 0-1 for plotting



Croplands of South East Asia, N&S Korea, and Japan at 30m

Knowledge Extraction: Kalimantan

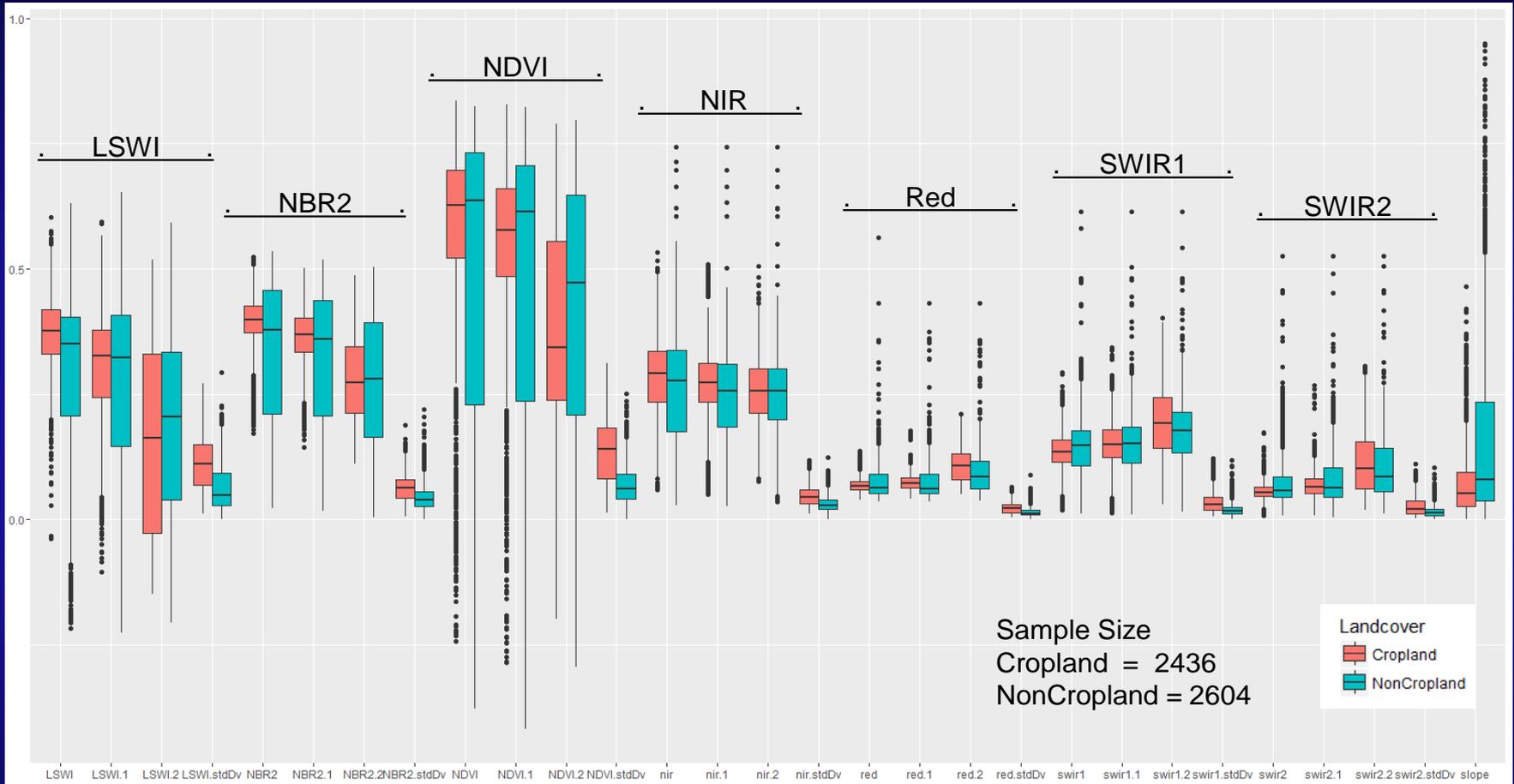


Note: Slope was divided by 50, temperature divided by 300, and temperature standard deviation divided by 10 to scale these variables from 0-1 for plotting



Croplands of South East Asia, N&S Korea, and Japan at 30m

Knowledge Extraction: Java



Note: Slope was divided by 50, temperature divided by 300, and temperature standard deviation divided by 10 to scale these variables from 0-1 for plotting



Cropland vs Noncropland of South East Asia at 30m
Methods: Random Forest

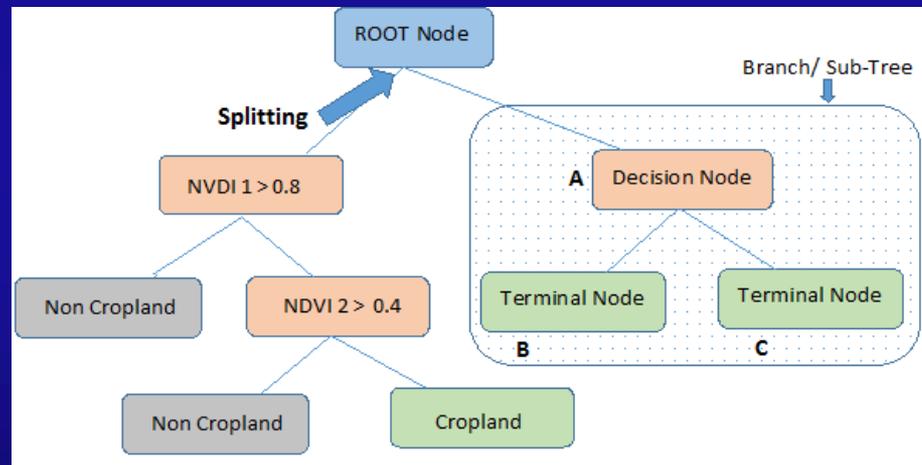


Random Forest Algorithm

Description

Random Forest basics

Random forests are a combination of tree predictors such that each tree depends on the values of randomly selected vectors. After a large number of trees is generated, they vote for the most popular class.



From: Breiman, L. 2001. RANDOM FORESTS.
<https://www.stat.berkeley.edu/~breiman/randomforest2001.pdf>



Random Forest Algorithm

Description

Key features

1. Resilient to highly correlated data and high data dimensionality
2. Internal estimates are used to measure variable importance
3. Resistant to overfitting because of the Law of Large Numbers
4. Variable of importance table notes which variables are most and least important to classification
5. **No single decision tree**

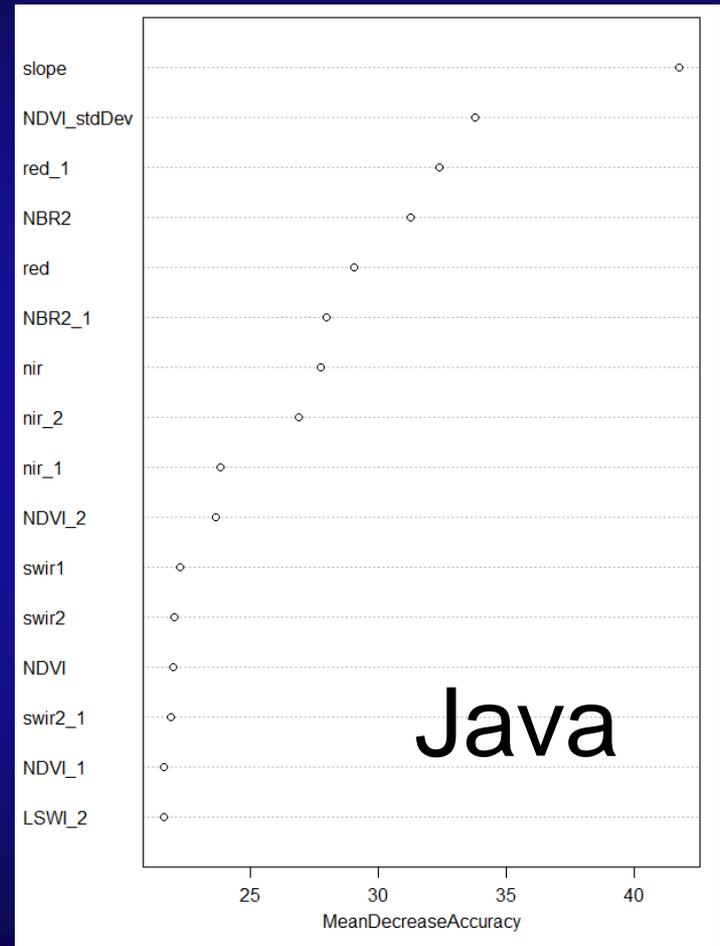
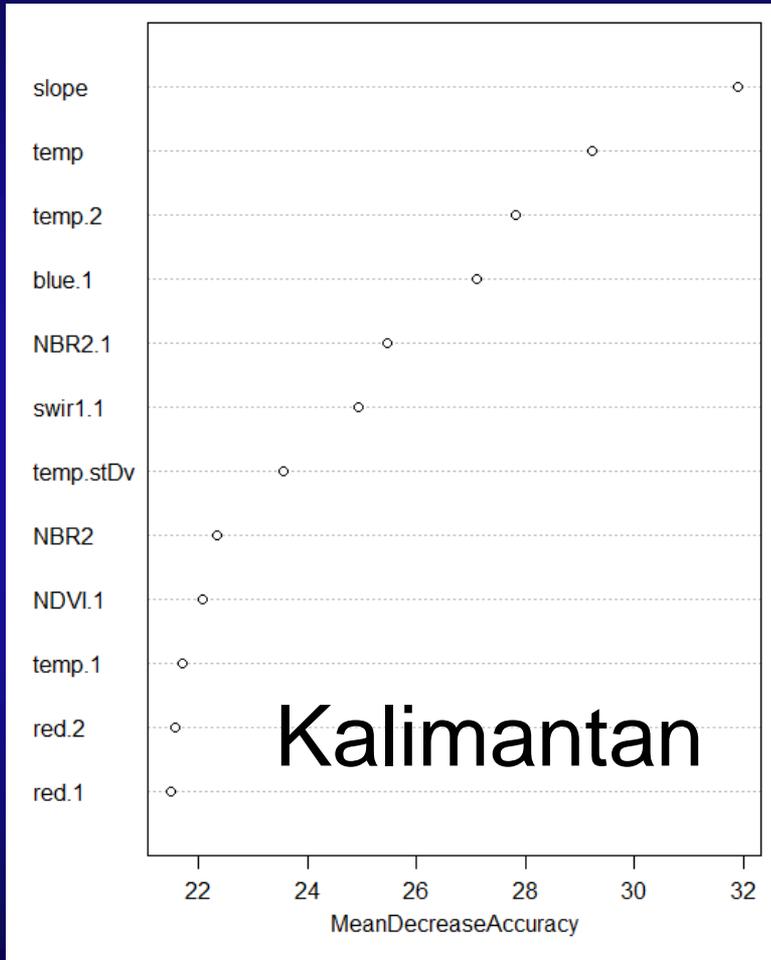
From: Breiman, L. 2001. RANDOM FORESTS.
<https://www.stat.berkeley.edu/~breiman/randomforest2001.pdf>



Croplands of South East Asia, N&S Korea, and Japan

Random Forest Algorithm

Variable of Importance Table



Cropland vs Noncropland of South East Asia at 30m
Results: Preliminary



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Java



108.561, -7.436



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Java



108.561, -7.436



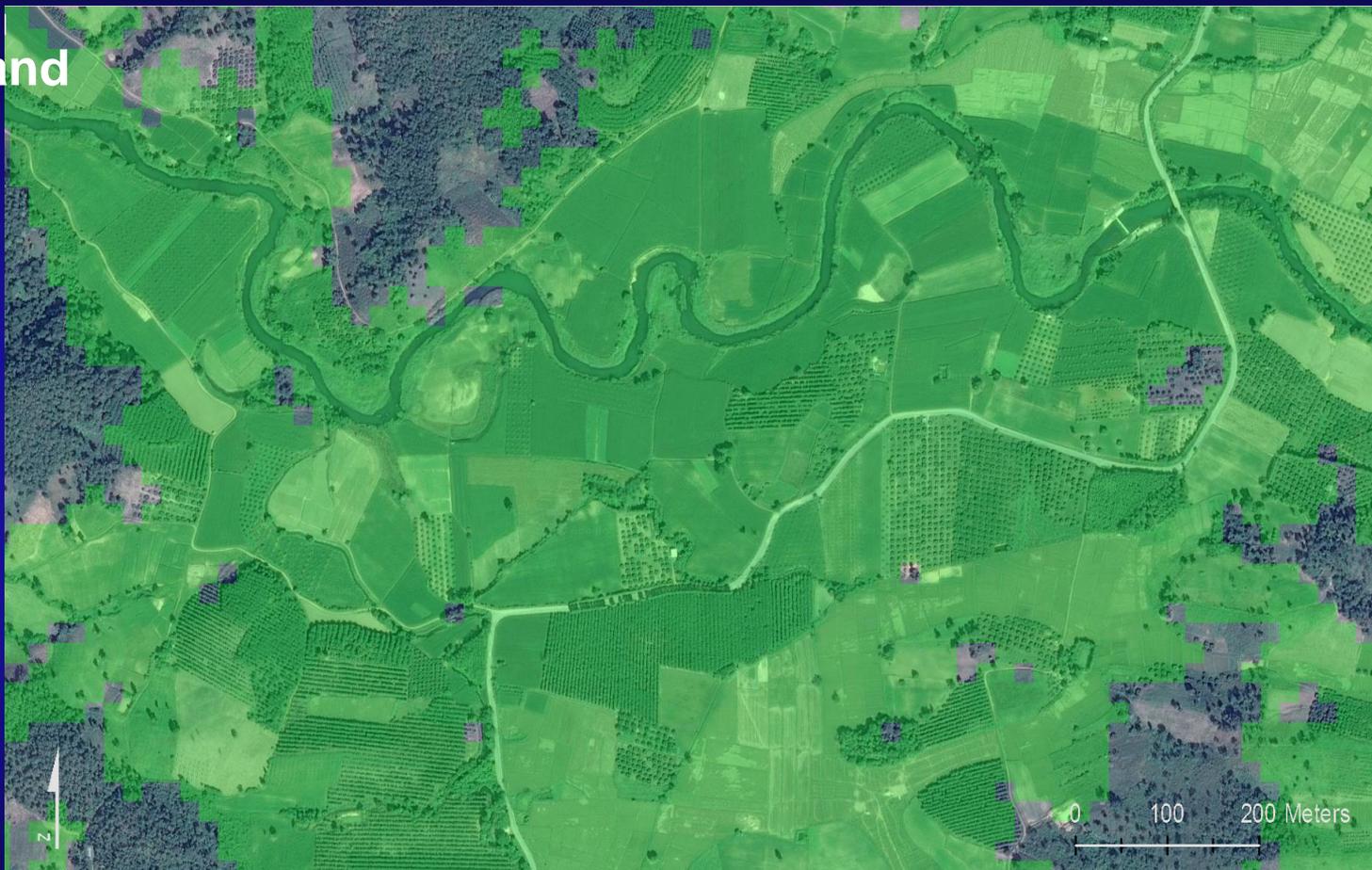
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Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Thailand



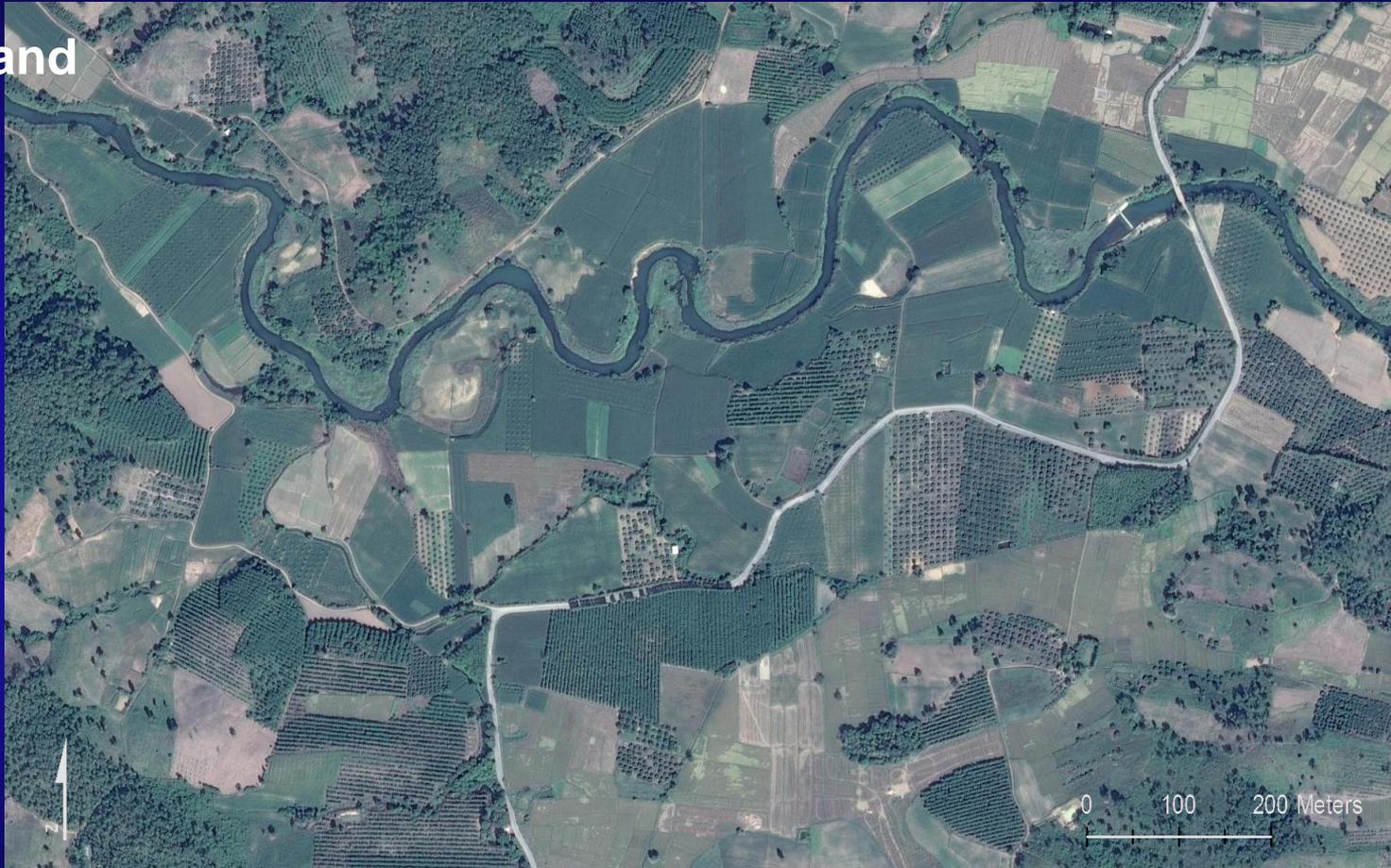
100.236, 19.236



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Thailand



100.236, 19.236



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Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Vietnam



109.234, 12.908



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Vietnam



109.234, 12.908



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Laos



102.643, 18.148



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Laos



102.643, 18.148

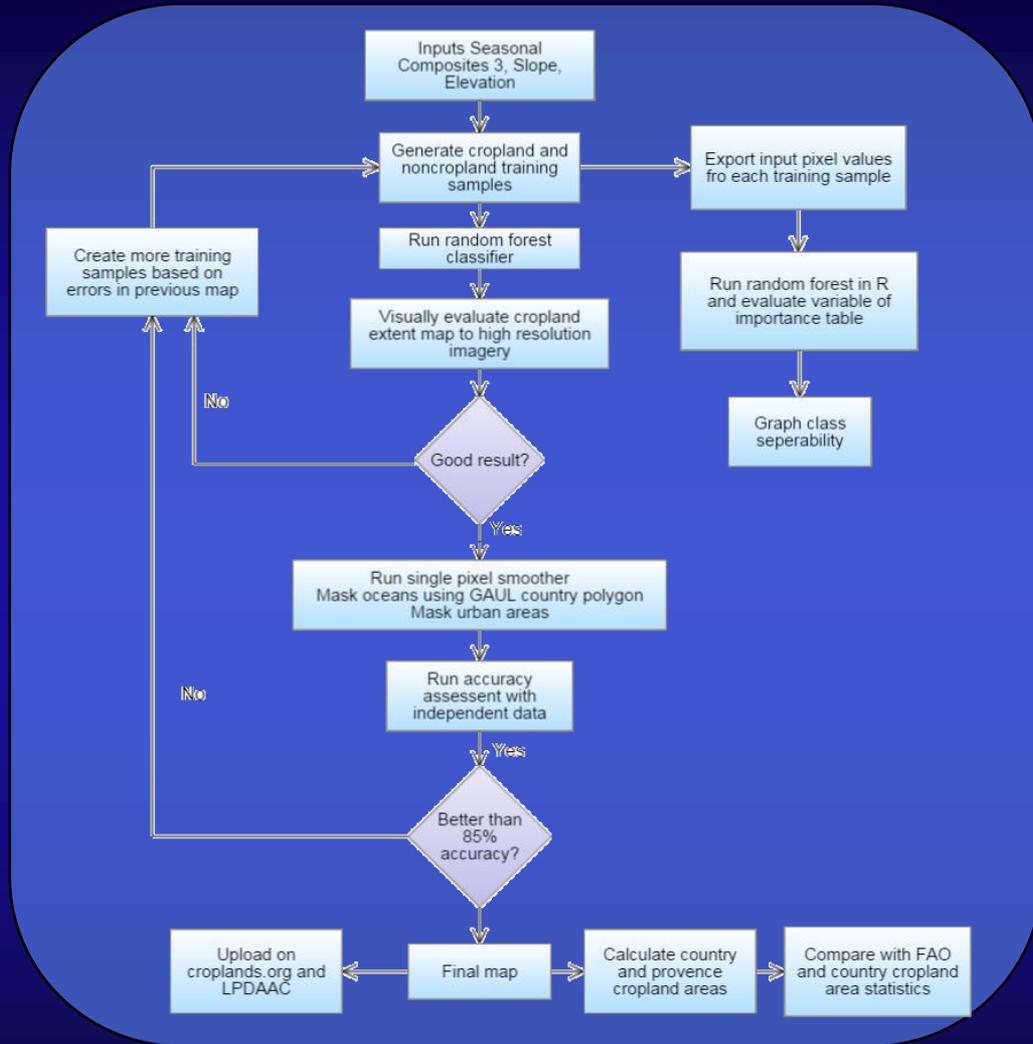


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Croplands of South East Asia, N&S Korea, and Japan at 30m

Classification Flowchart



Cropland vs Noncropland of South East Asia at 30m
Results: Revised



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Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Map improvement through sample selection in Thailand



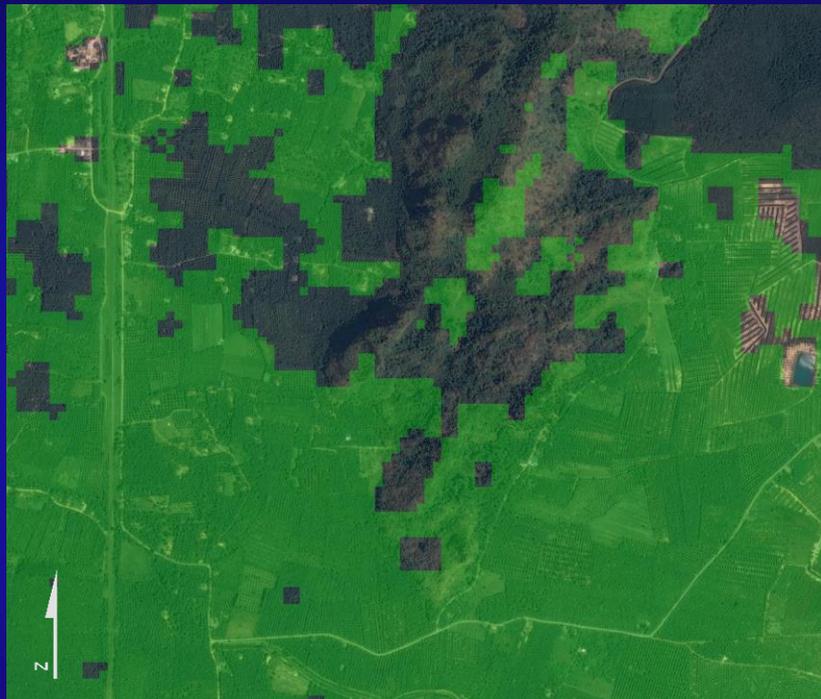
100.164, 13.606



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Splitting Thailand in 2 sections



99.105, 10.037



Cropland vs Noncropland of South East Asia at 30m
Results: Post Processing



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Post processing smoothing



Goal:

To change isolated pixels to the surrounding landcover class within GEE
To reduce noise in classified image (salt and pepper)
To produce map which better matches landscape



Code

Run focal filter, method: mode, radius: 35 meters, kernel: circle, units: meters, iterations: 2
`var newImg = Image.focal_mode(35,'circle','meters',2)`



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

GHSL - Global Human Settlement Layer:

Global classification of urban areas at 15m, 30m, and 60m

Product covers 4 epochs 1975, 1990, 2000, 2014

By Joint Research Centre and Directorate of Regional Development Policy of the European Commission

Available for free from <http://ghsl.jrc.ec.europa.eu/index.php>

Available on GEE at [users/christinacorbane/MT_comp_proj](https://code.earthengine.google.com/users/christinacorbane/MT_comp_proj)

Legend:

- 0 = no data
- 1 = water surface
- 2 = land no built-up in any epoch
- 3 = built-up from 2000 to 2014 epochs
- 4 = built-up from 1990 to 2000 epochs
- 5 = built-up from 1975 to 1990 epochs
- 6 = built-up up to 1975 epoch



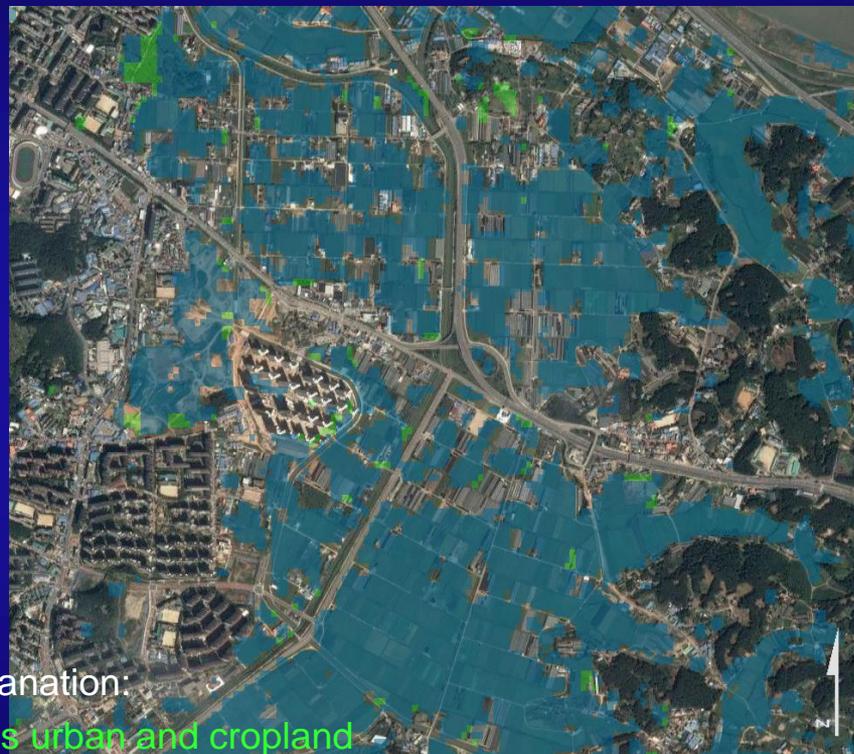
Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

Masked product with GHSL



125.634, 7.118



Explanation:

Classified as urban and cropland

Classified as non urban and cropland

126.74, 37.598



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data



Explanation:

Classified as urban
and cropland

Classified as non
urban and cropland



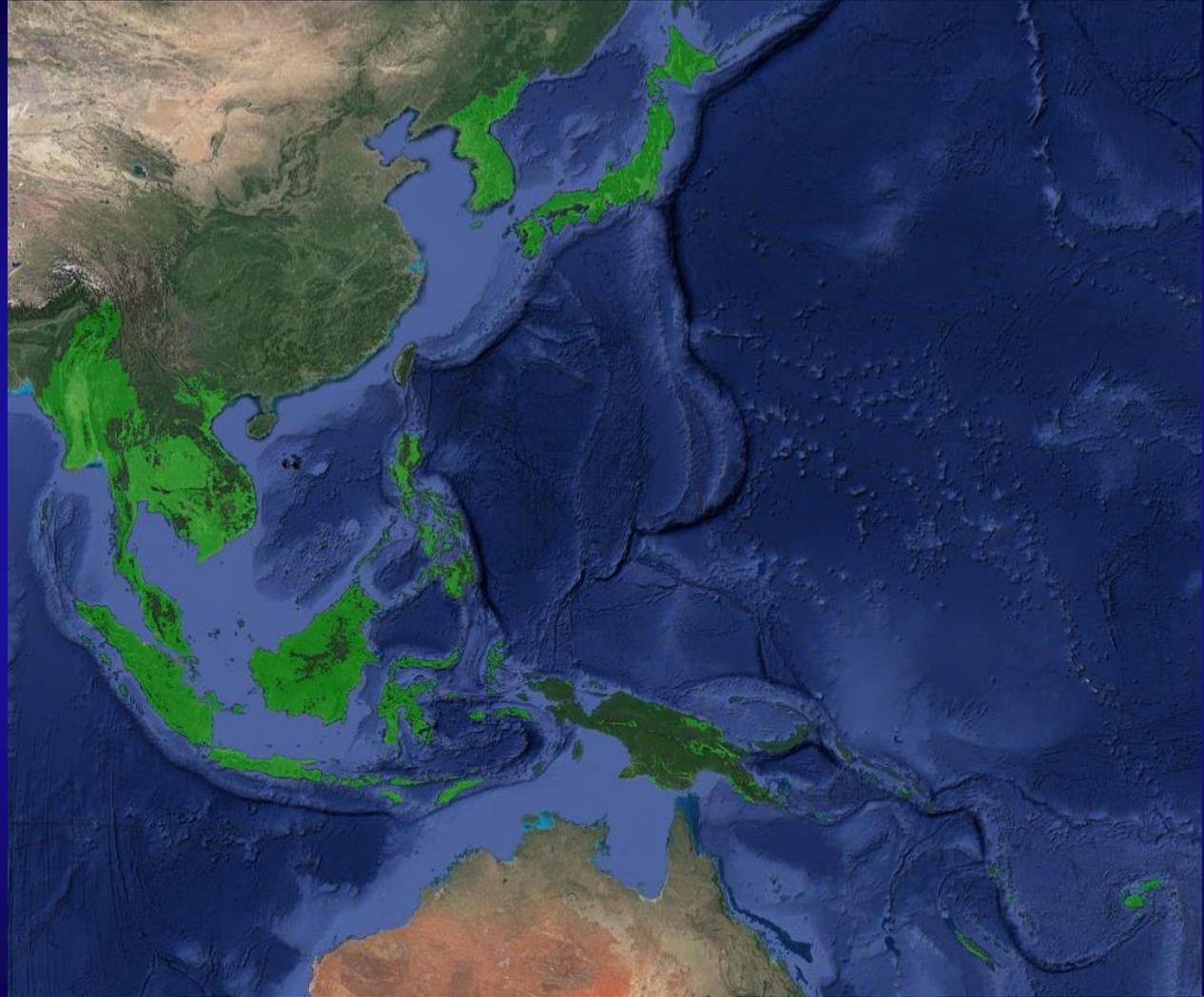
Cropland vs Noncropland of South East Asia at 30m

**Results: Entire SE Asia,
N&S Korea, and Japan**



Croplands of South East Asia, N&S Korea, and Japan at 30m

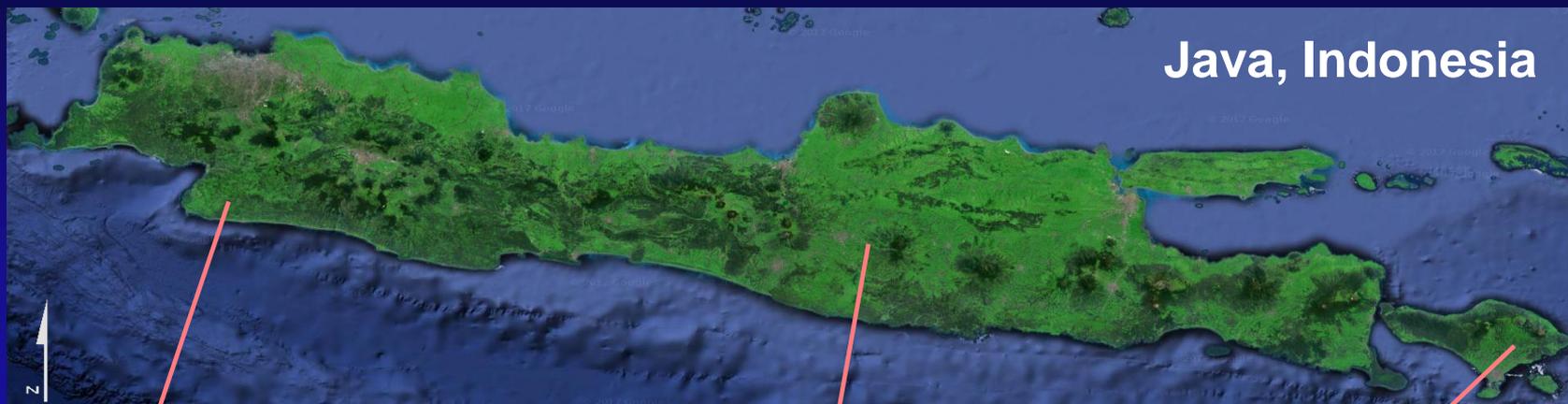
Cropland Presence Absence at 30m



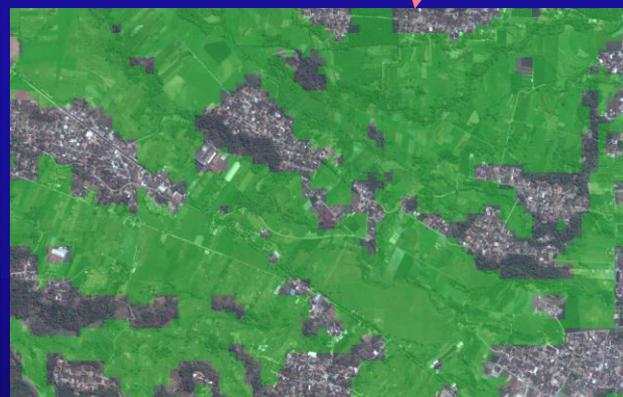
Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Java, Indonesia



106.6433, -7.2959



111.0969, -7.6288

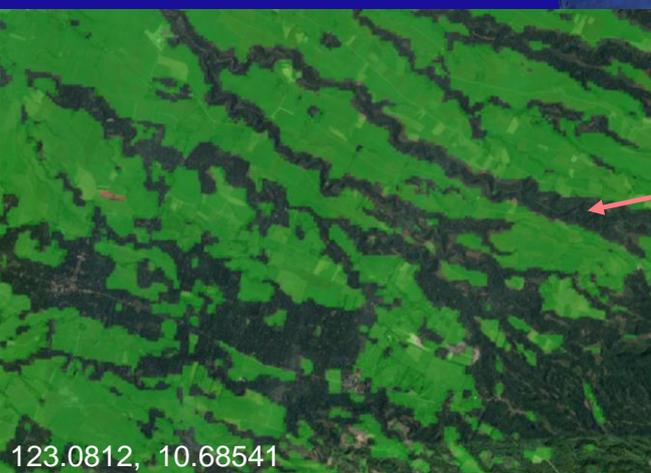
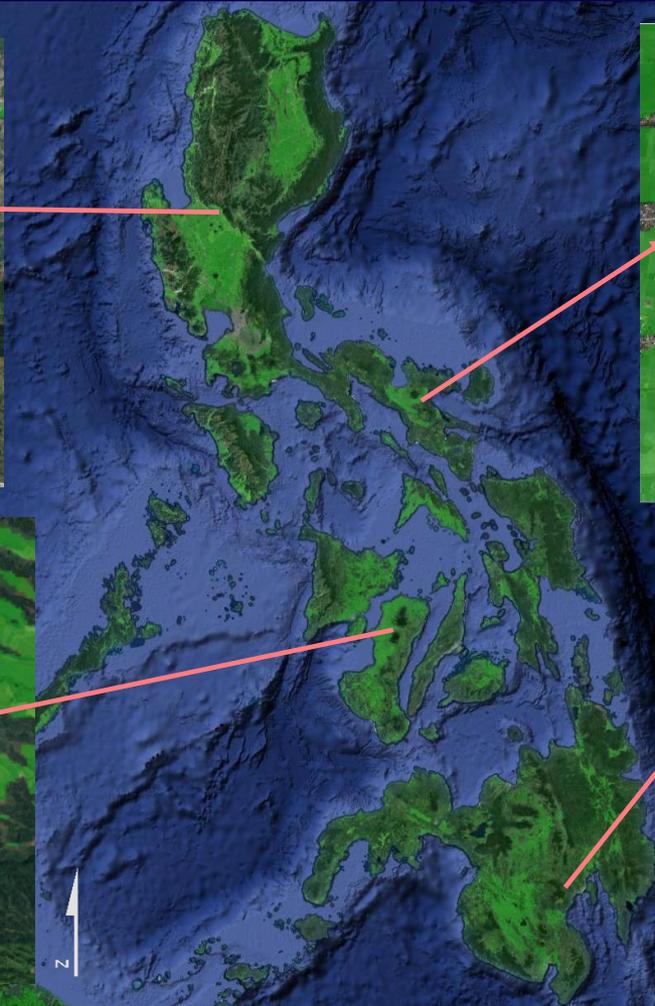


115.3016, -8.4870



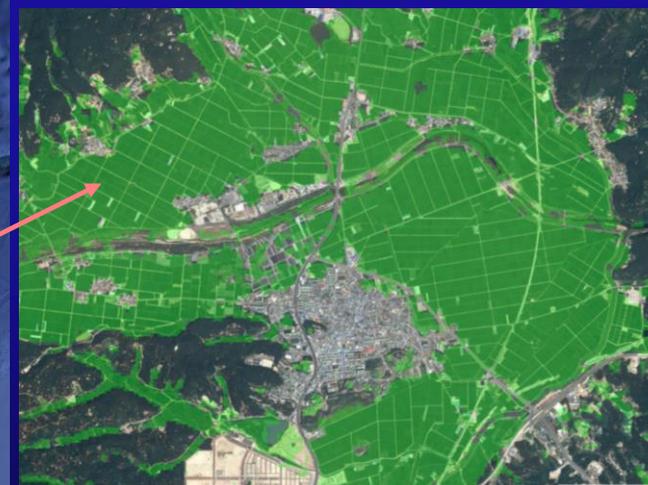
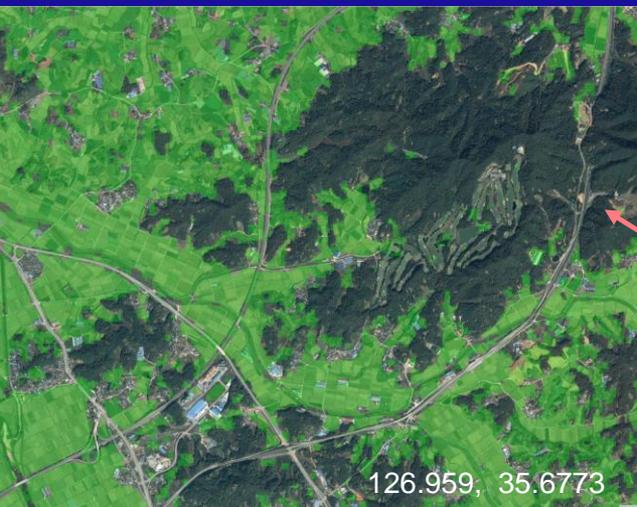
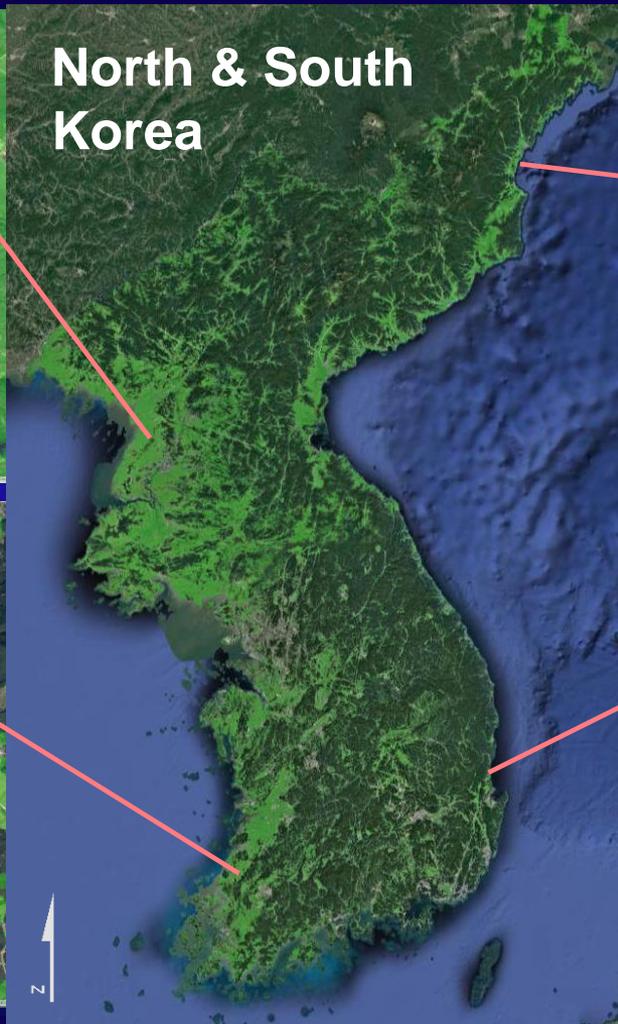
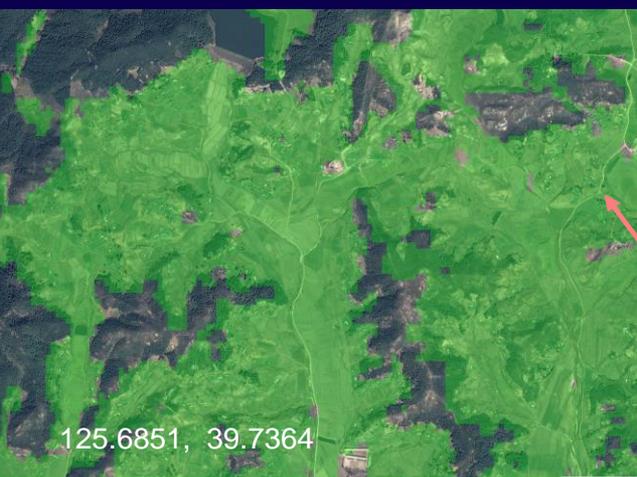
Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m



Cropland vs Noncropland of South East Asia at 30m
Results: Error Matrixes



Croplands of South East Asia, N&S Korea, and Japan at 30m

Error Matrixes

Current Error Matrixes

Java		Reference				Crop	notCrop
		crop	notCrop	ref total	Consumer	94.28	89.47
Tested	crop	33	2	35	Producer	84.61	96.22
Map	notCrop	6	51	57	Overall	91.3	
	map Total	39	53	92	Kappa	0.819	

Sumatra		Reference				Crop	notCrop
		Crop	notCrop	ref total	Consumer	74.19	100
Tested	Crop	23	8	31	Producer	100	81.82
Map	notCrop	0	36	36	Overall	88.05	
	map Total	23	44	67	Kappa	0.755	

Kalimantan		Reference				Crop	notCrop
		Crop	notCrop	ref total	Consumer	87.50	90.19
Tested	Crop	42	6	48	Producer	89.36	88.46
Map	notCrop	5	46	51	Overall	88.88	
	map Total	47	52	99	Kappa	0.777	



Croplands of South East Asia, N&S Korea, and Japan at 30m

Error Matrixes

Current Error Matrixes

Thailand		Reference				Crop	notCrop
		crop	notCrop	ref total	Consumer	87.79	88.58
Tested	crop	151	21	172	Producer	87.79	88.58
Map	notCrop	21	163	184	Overall	88.2	
	map Total	172	184	356	Kappa	0.764	

Philippines		Reference				Crop	notCrop
		crop	notCrop	ref total	Consumer	66.6	96
Tested	crop	24	12	36	Producer	80	92.3
Map	notCrop	6	144	150	Overall	90.32	
	map Total	30	156	186	Kappa	0.669	

Vietnam		Reference				Crop	notCrop
		crop	notCrop	ref total	Consumer	78.26	89.33
Tested	crop	36	10	46	Producer	81.81	87.013
Map	notCrop	8	67	75	Overall	85.12	
	map Total	44	77	121	Kappa	0.682	

Cambodia		Reference				Crop	notCrop
		Crop	notCrop	ref total	Consumer	88.89	85.07
Tested	Crop	80	10	90	Producer	70.80	94.95
Map	notCrop	33	188	221	Overall	86.17	
	map Total	113	198	311	Kappa	0.687	



Cropland vs Noncropland of South East Asia at 30m
Results: Cropland Areas



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Areas

Cropland area in ha

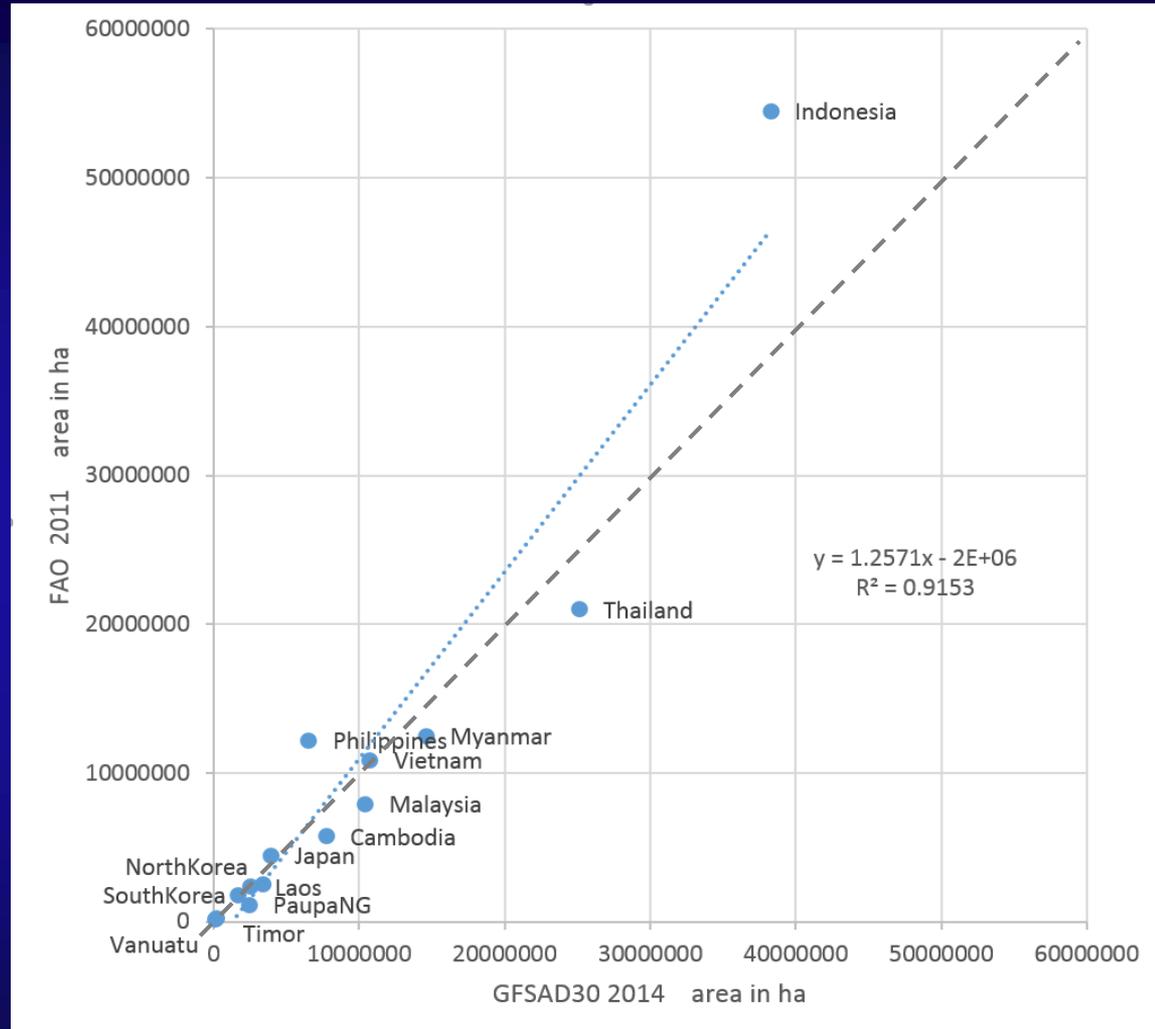
Country	GFSAD30 2015	FAO 2011	Portman 2000	<u>GFSAD30</u>	<u>GFSAD30</u>
	total Agg. area ha	total Agg. area ha	total Agg. area ha	Portman %	FAO %
Indonesia	38,250,522	54,481,000	31,533,604	1.21	0.70
Thailand	25,101,977	21,012,000	17,701,953	1.42	1.19
Myanmar	14,564,109	12,480,000	13,153,253	1.11	1.17
Vietnam	10,704,495	10,850,000	11,678,546	0.92	0.99
Malaysia	10,376,537	7,920,000	5,812,482	1.79	1.31
Philippines	6,508,605	12,180,000	13,310,639	0.49	0.53
Cambodia	7,707,654	5,760,000	2,435,269	3.17	1.34
Japan	3,916,136	4,500,000	4,285,620	0.91	0.87
NorthKorea	3,317,185	2,544,000	2,783,985	1.19	1.30
Laos	2,518,354	2,369,000	992,370	2.54	1.06
PaupaNG	2,414,378	1,170,000	923,168	2.62	2.06
SouthKorea	1,603,571	1,810,000	2,164,651	0.74	0.89
Timor	149,136	242,000	186,409	0.80	0.62
Vanuatu	91,229	153,000	102,508	0.89	0.60
Brunei	55,640		16,028	3.47	
Solomon	25,141	99,000	78,044	0.32	0.25



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Areas

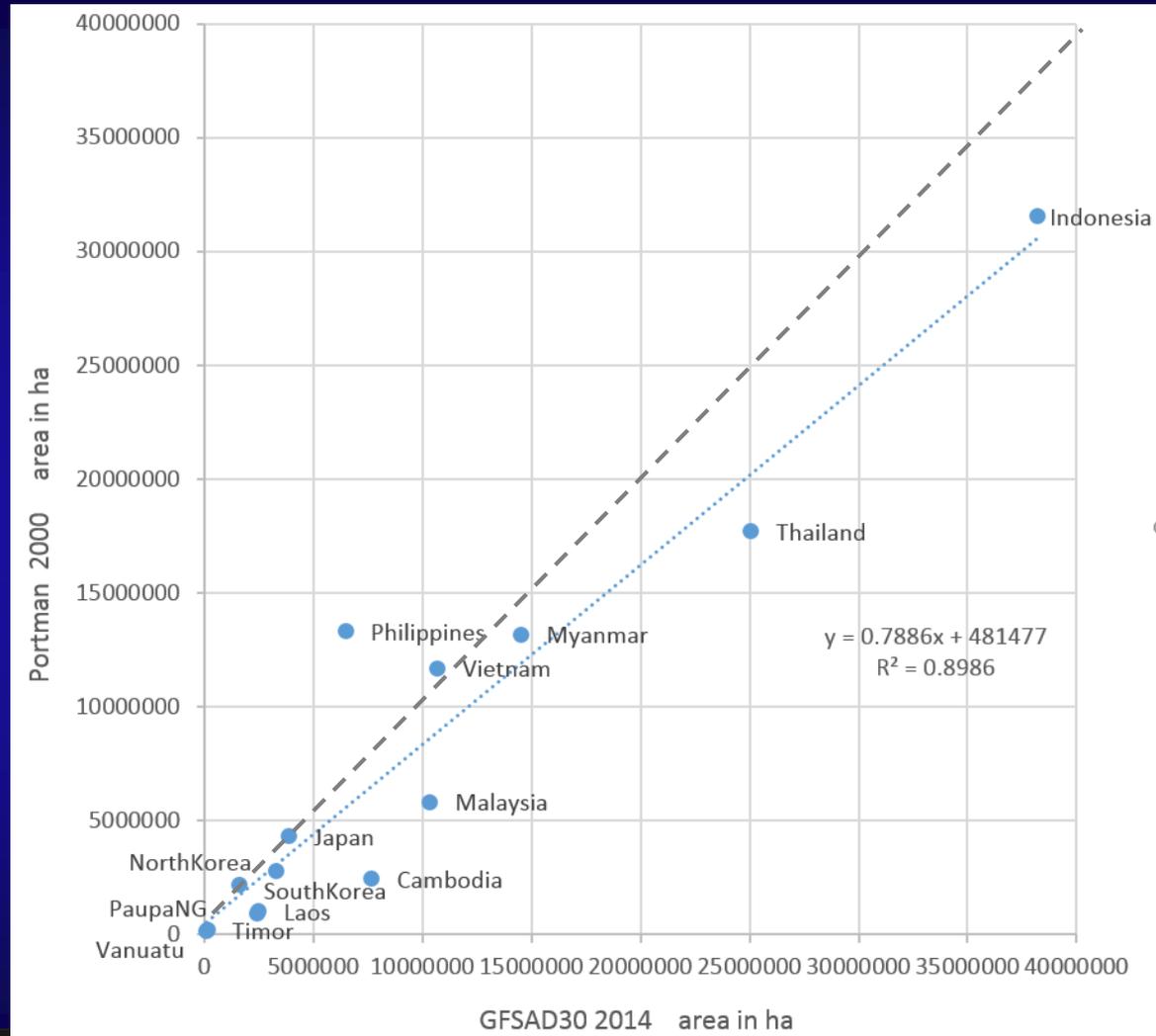
Cropland area in ha



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Areas

Cropland area in ha



Cropland vs Noncropland of South East Asia at 30m
Results: Way Forward



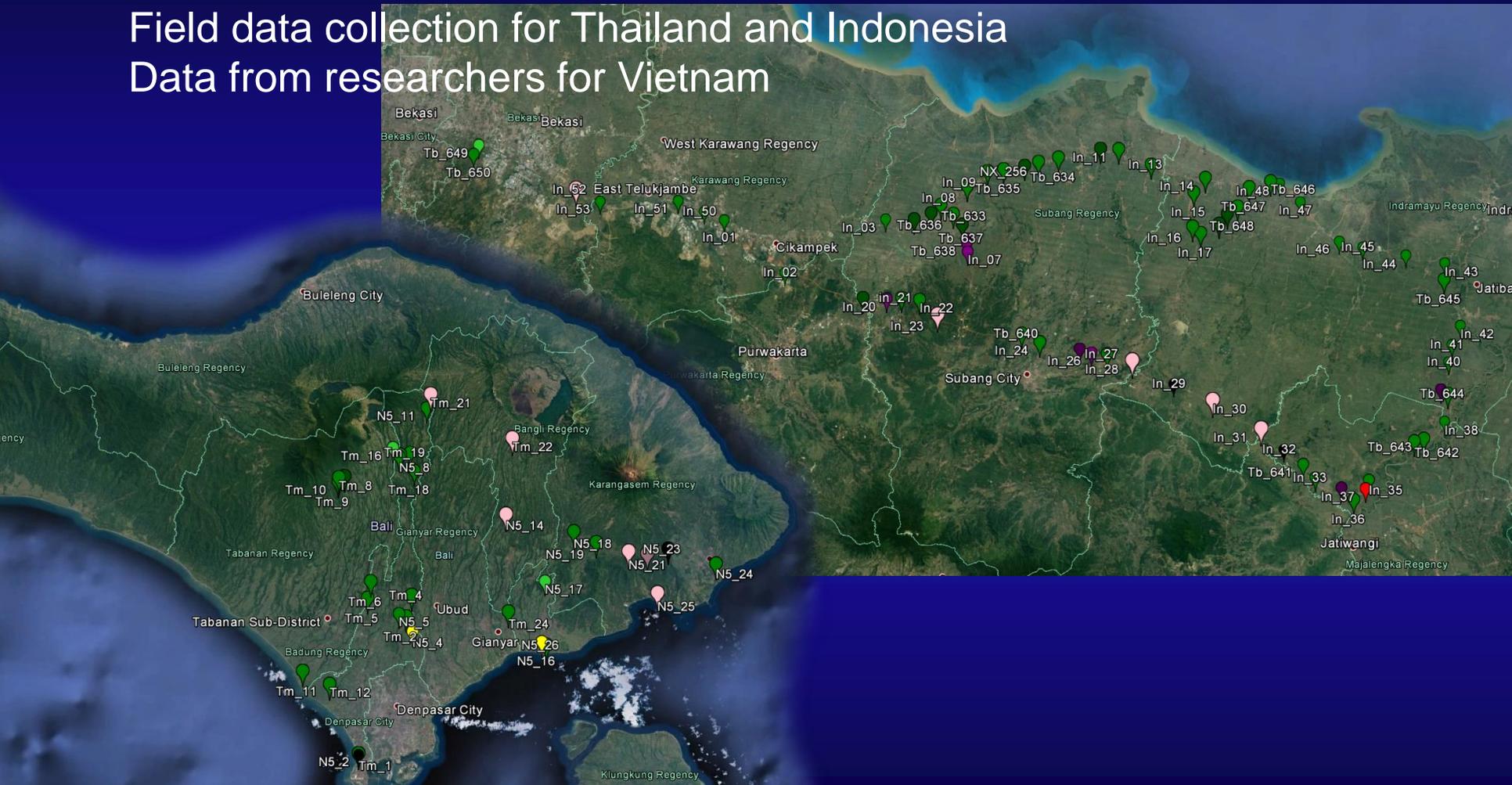
U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

Field data collection for Thailand and Indonesia
Data from researchers for Vietnam



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data



Field Data Collection



U.S. Geological Survey
U.S. Department of Interior



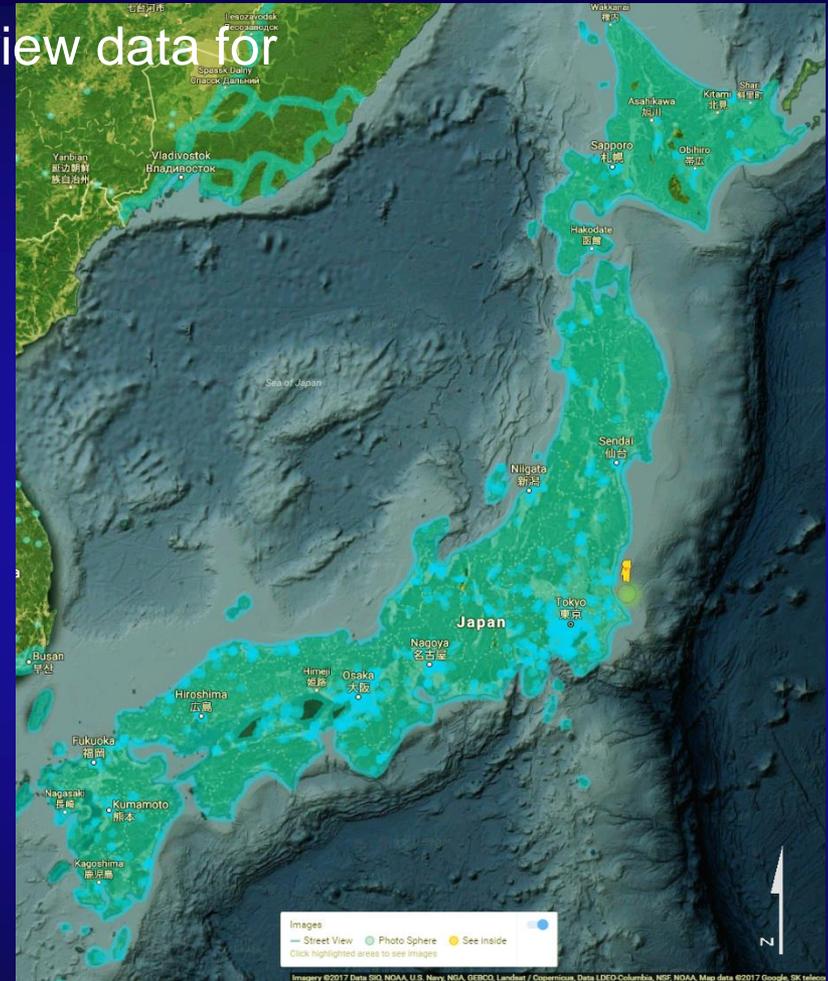
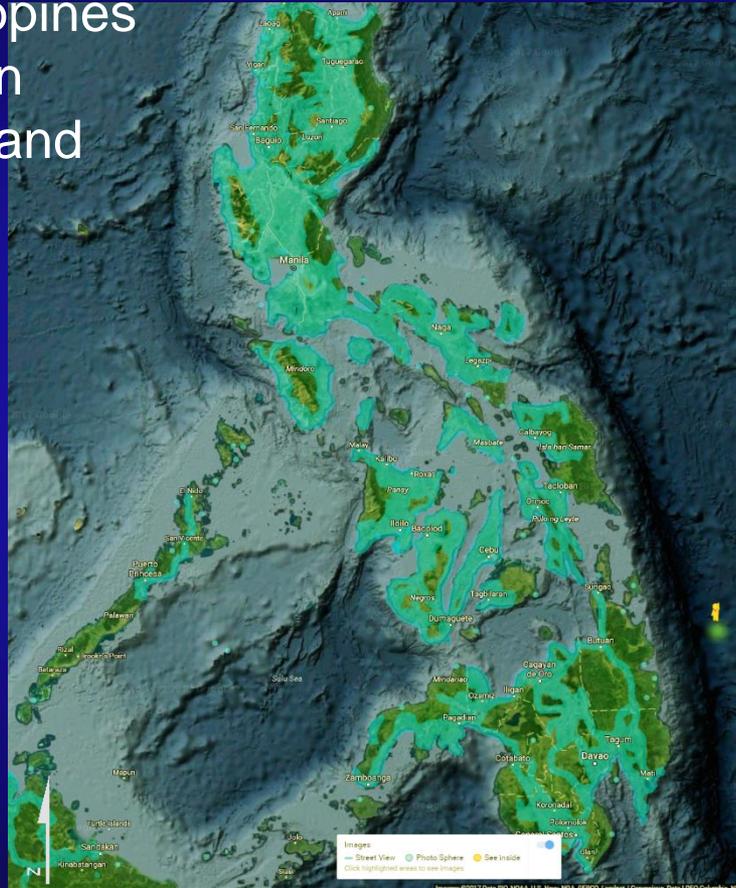
Croplands of South East Asia, N&S Korea, and Japan at 30m Crop Type Reference Data



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

Excellent coverage of Google Streetview data for
Philippines
Japan
Thailand



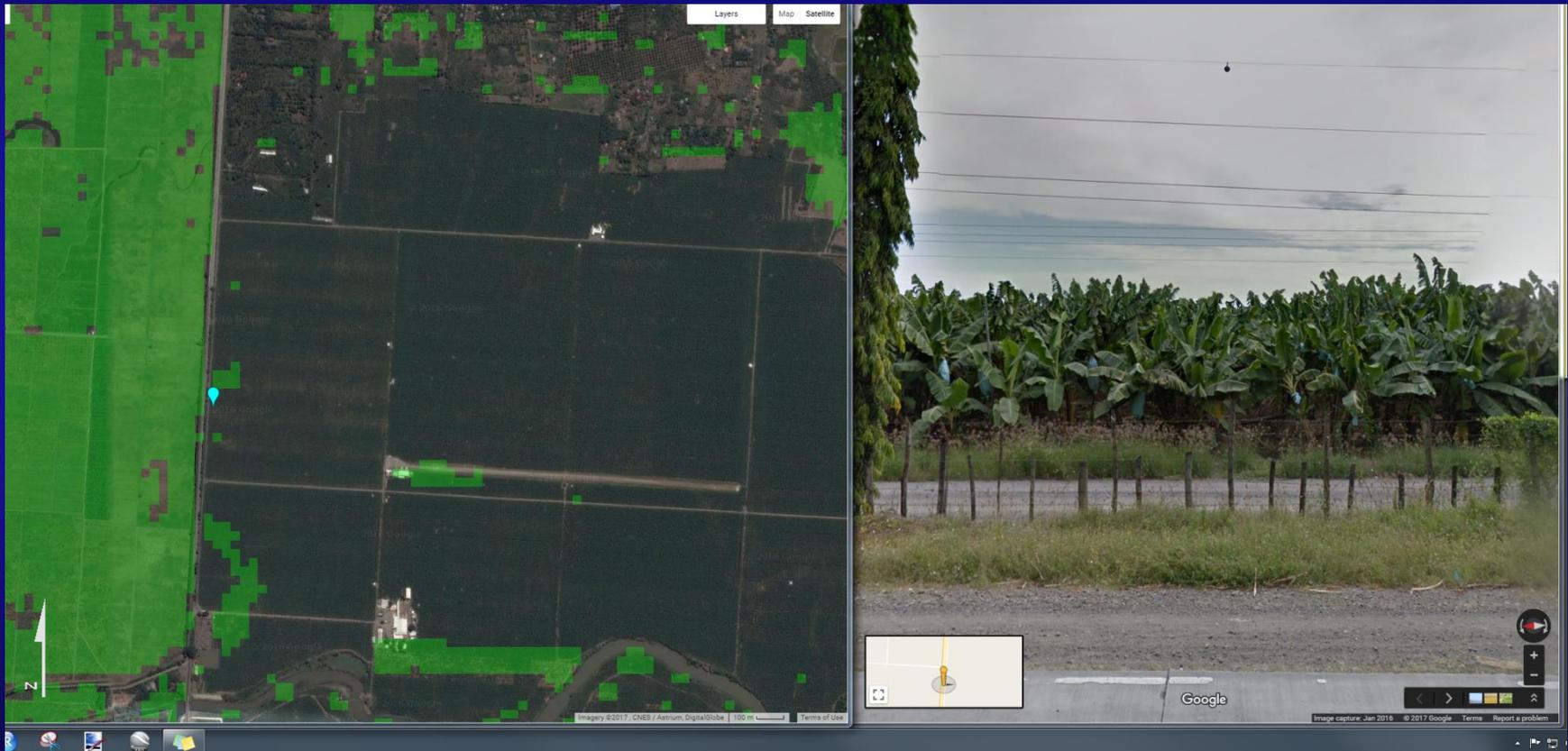
U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

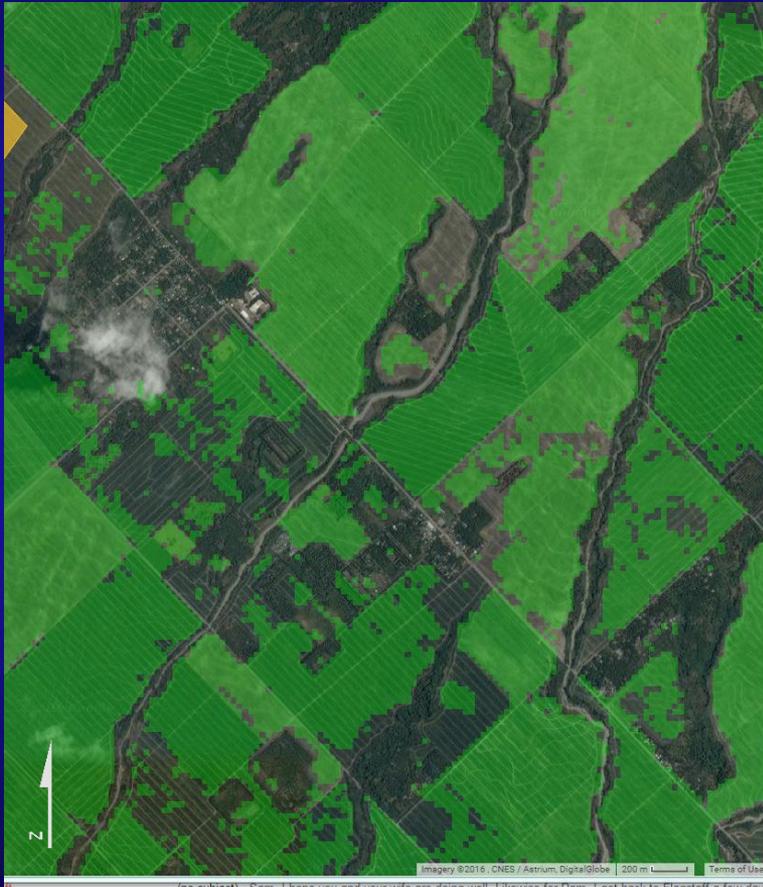
Banana in Philippines



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

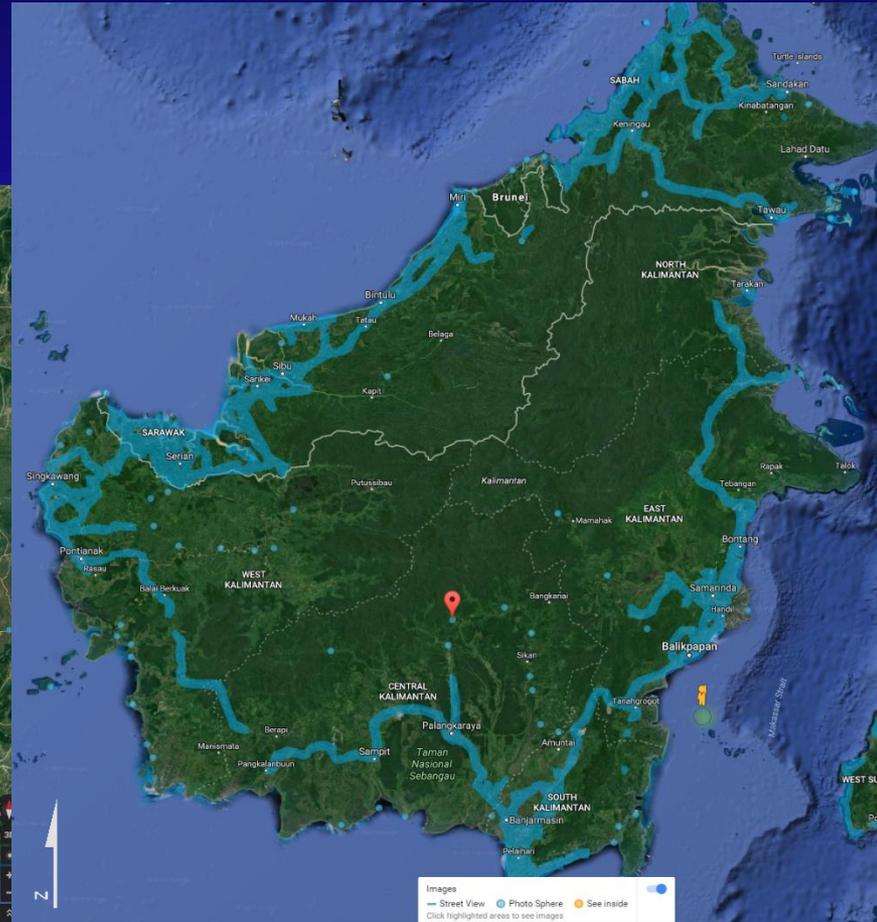
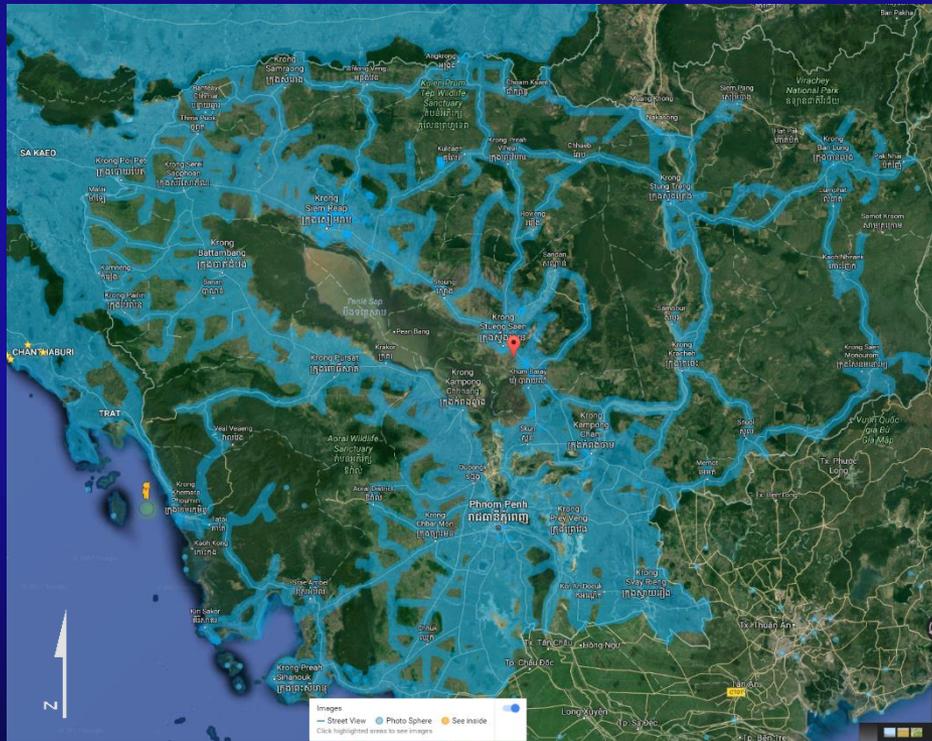
Pineapple in Philippines



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

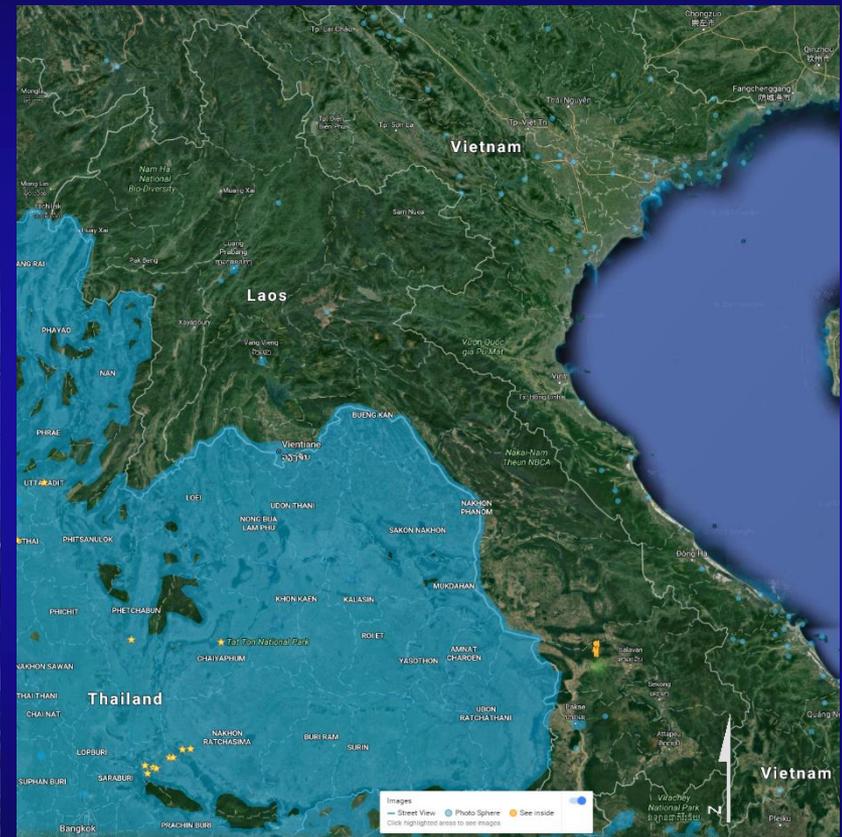
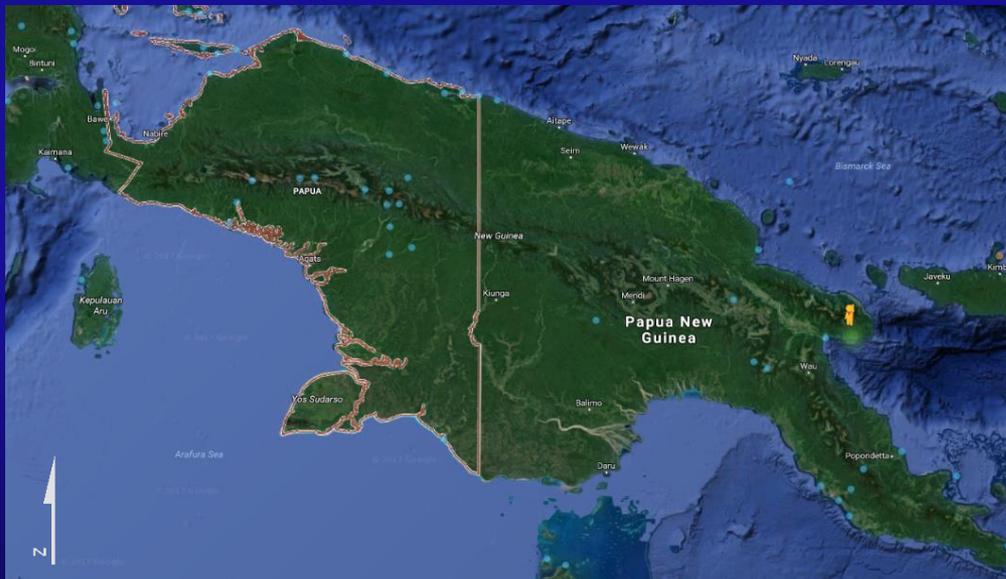
Usable Streetview coverage for
Cambodia
Malaysia
Indonesia



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

No Streetview data for
Laos, South Korea, North Korea, Papua
New Guinea, Tonga



U.S. Geological Survey
U.S. Department of Interior



Cropland vs Noncropland of South East Asia at 30m

Conclusions



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data



U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data



U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data



U.S. Geological Survey
U.S. Department of Interior



Thank You



U.S. Geological Survey
U.S. Department of Interior

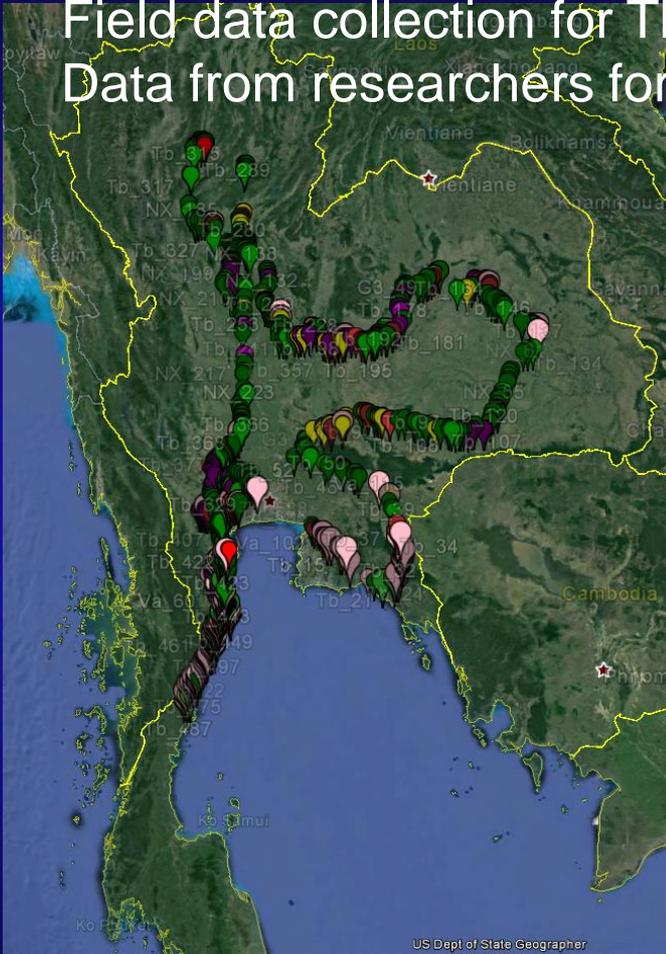




Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

Field data collection for Thailand and Indonesia
Data from researchers for Vietnam



■ Rice	457
■ Maize	60
■ Plantation	71
■ Palm Oil	17
■ Cassava	56
■ Sugarcane	92
■ Rubber	25
■ Pineapple	13
■ Non Crop	21
■ Fallow	12
■ Others	24
■ Potato	1
■ Total	849



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Presentation Overview

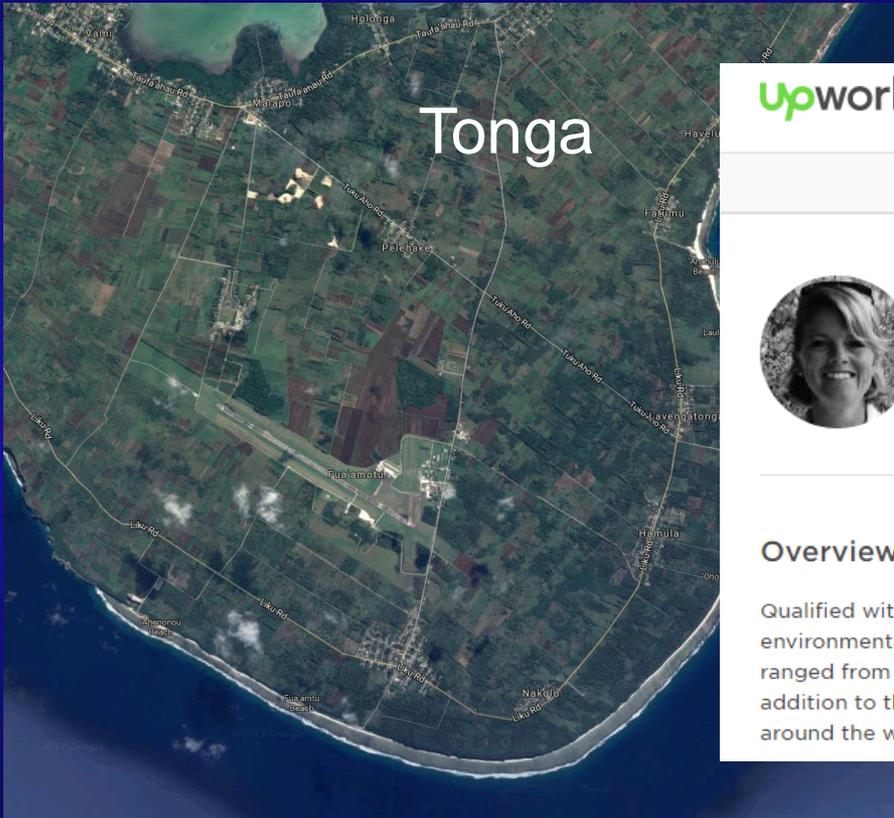
1. Cropland presence absence was mapped over SE Asia with 30m resolution using Landsat imagery;
2. Custom cloud free compositing method was implemented in Google Earth Engine;
3. Random forest classifier was used to create classified map;
4. Results compared with other classified maps and published cropland statistics.



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Outsourcing Field Data Collection through Upwork



upwork™ JOBS FREELANCERS REPORTS MESSAGES 1

 **Kate Walker** \$16.67 /hr

Environmental Planner and GIS Specialist

📍 Vava'u, Tonga - 10:05am local time

Overview

Qualified with a Masters Degree in Marine Environmental Protection, Kate has provided environmental management and consultancy services globally for over ten years. Her clients have ranged from high end luxury resort developers to national park management institutions. In addition to this she has worked with a number of government and funding agencies in SIDS around the world to provide her environmental services, within regulatory frameworks.



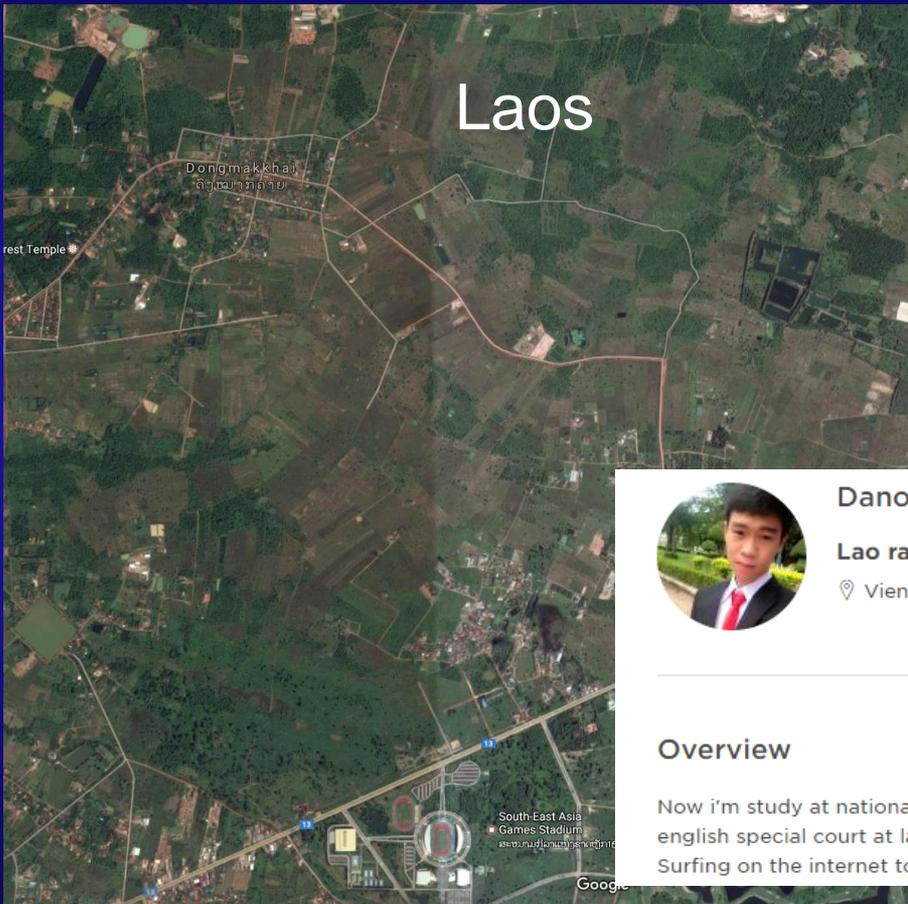
U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Outsourcing Field Data Collection through Upwork



Atul Pandey

\$5.00 /hr

Associate - Project Coordination, Projects

Vientiane, Laos - 3:16am local time

Project Planning

Electrical Engineering

Report Writing

Overview

Experienced Professional in Substation Execution Up to 400kV Level in overseas. MIS Preparation, Reports and Progress updates.

Project Presentations

Project Presentations and progress reports.

Deft at capturing Cost of Poor Quality for the organization and preparing the detailed report for the management



Danouphonh Chanthakoummane

\$5.00 /hr

Lao rater

Vientiane Capital, Laos - 4:10am local time

Overview

Now i'm study at national university of laos faculty of environment science year 5 and I also study english special court at laotop college in the evening year 3. I like to spend my free time with Surfing on the internet to update my knowledge about my IT skill.



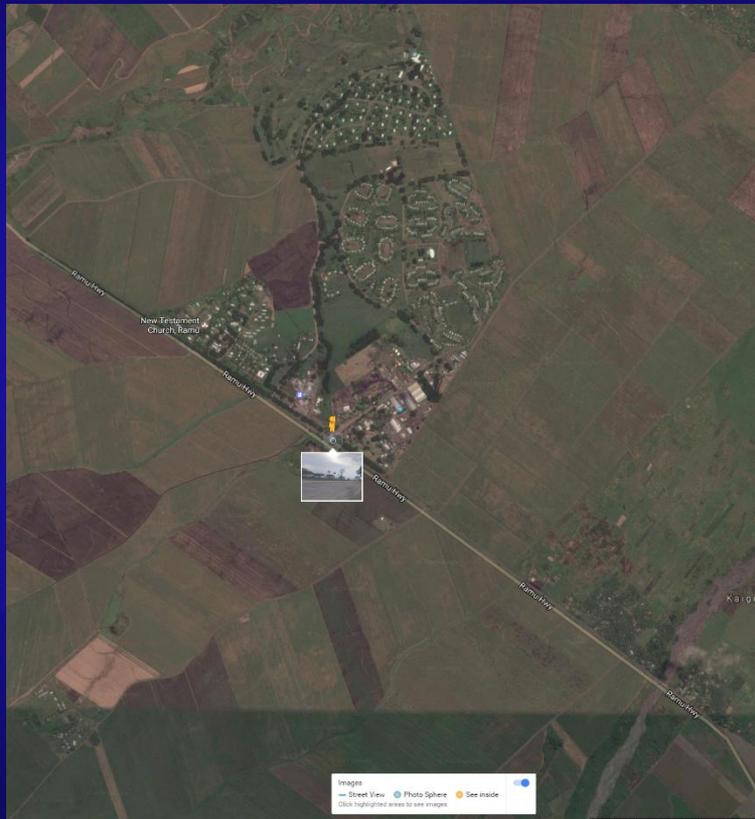
U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Crop Type Reference Data

Google Photo Spheres are no help



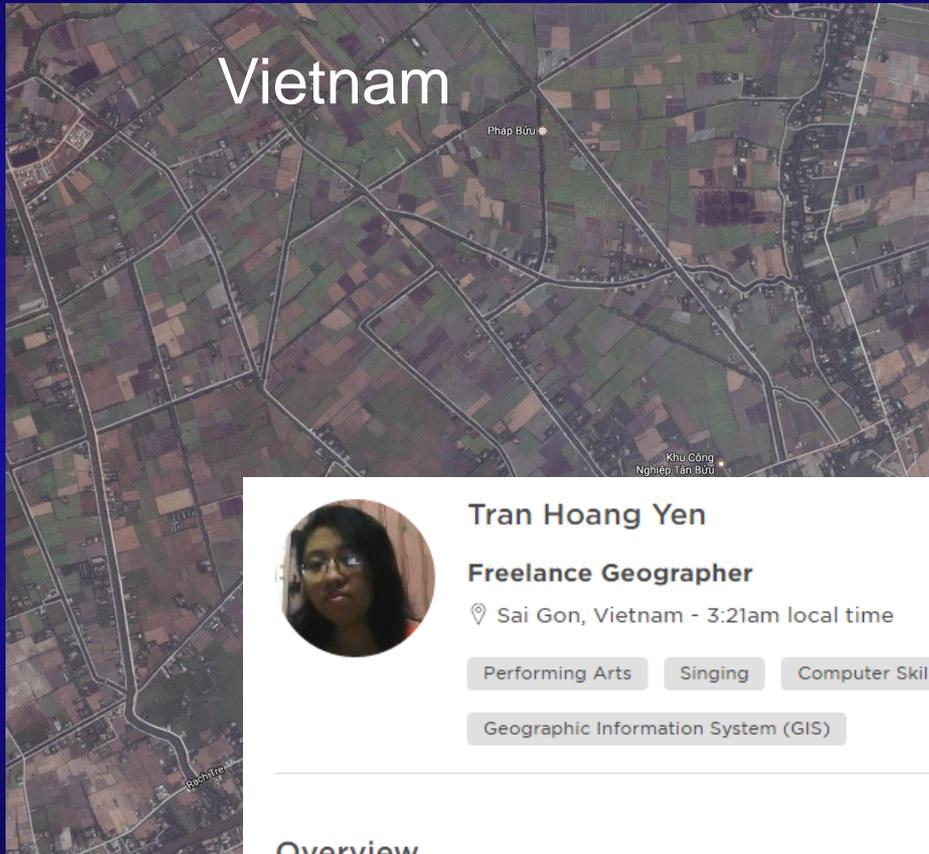
U.S. Geological Survey
U.S. Department of Interior



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Outsourcing Field Data Collection through Upwork



Lan Le Thi

\$15.00 /hr

Map, Google Earth, Powerpoint, Word, Excel, Flowchart, Diagram

Hanoi, Vietnam - 4:19am local time

ArcGIS

Microsoft PowerPoint

Microsoft Visio

Microsoft Word

Adobe Photoshop

more

Overview

- More than 8 years experienced in google earth, Map software, map conversion coordinate system, and collecting data
- Highly experienced in Feasibility projects for transport sector, landscape as making map, collect data, transform map data/ image overlay to Google earth/ Google map
- Figures, diagrams, flowchart, location map by Visio, Gliffy, Smartdraw, mindmap
- Presentation



Tran Hoang Yen

\$5.00 /hr

Freelance Geographer

Sai Gon, Vietnam - 3:21am local time

Performing Arts

Singing

Computer Skills

Geographic Information System (GIS)

Overview

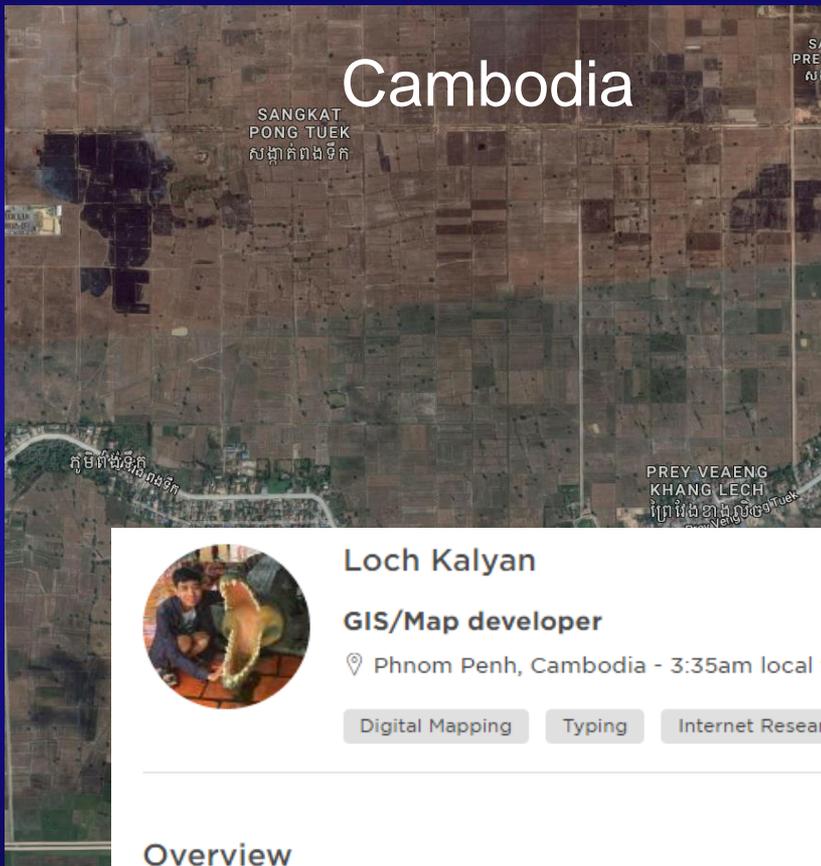
I want to work in Geography field. I love Science Geography.
I want to work in Geography field. I love Science Geography.



Croplands of South East Asia, N&S Korea, and Japan at 30m

Cropland Presence Absence at 30m

Outsourcing Field Data Collection through Upwork



 **Bun H.** \$20.00 /hr

Smart Digital Solution

📍 Phnom Penh, Cambodia - 4:37am local time

Web Design Graphics Programming ✓ Database Management

Geographic Information System (GIS) Website Development

[more](#) ▾

Overview

Extensive experience in management of data center operations, network systems, and application development plus professional in website development, mobile application development, graphic design and experience in web application system integration and e-business solutions.

 **Loch Kalyan** \$15.00 /hr

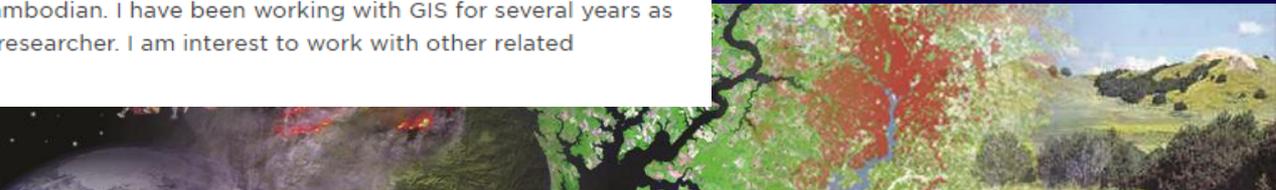
GIS/Map developer

📍 Phnom Penh, Cambodia - 3:35am local time

Digital Mapping Typing Internet Research Desktop Applications

Overview

I'm looking for freelance jobs. I am Cambodian. I have been working with GIS for several years as a mapper, data entries specialist and researcher. I am interest to work with other related computer science as well.



Croplands of South East Asia, N&S Korea, and Japan

Cropland Presence Absence at 30m

Outsourcing Field Data Collection through Upwork

Cambodia



Jiwon Lim

English-Korean translator

seoul, South Korea - 6:46am local time

Translation English Korean ✓

Korean ✓



Jun Park

English to Korean, Chinese to Korean

Seoul, South Korea - 6:51am local time

Translation ✓

Translation English Korean ✓

Korean

Proofreading

more ✓

Overview

Studying in English department in Korea's university.

Have a 895 points in well known English test in Korea named TOEIC.

Lived in Philippines for 4 months.

Went for homestay to America for 1 month

Overview

I have 9 years of experience in translating English to Korean and Chinese to Korean. I have completed a Bachelor degree in Electronic Engineering and completed several translation projects for LG, HP, and small-medium size companies.

My main translation service includes:

Website translation, Stock-related translation, Gaming translation, and general marketing translation.

