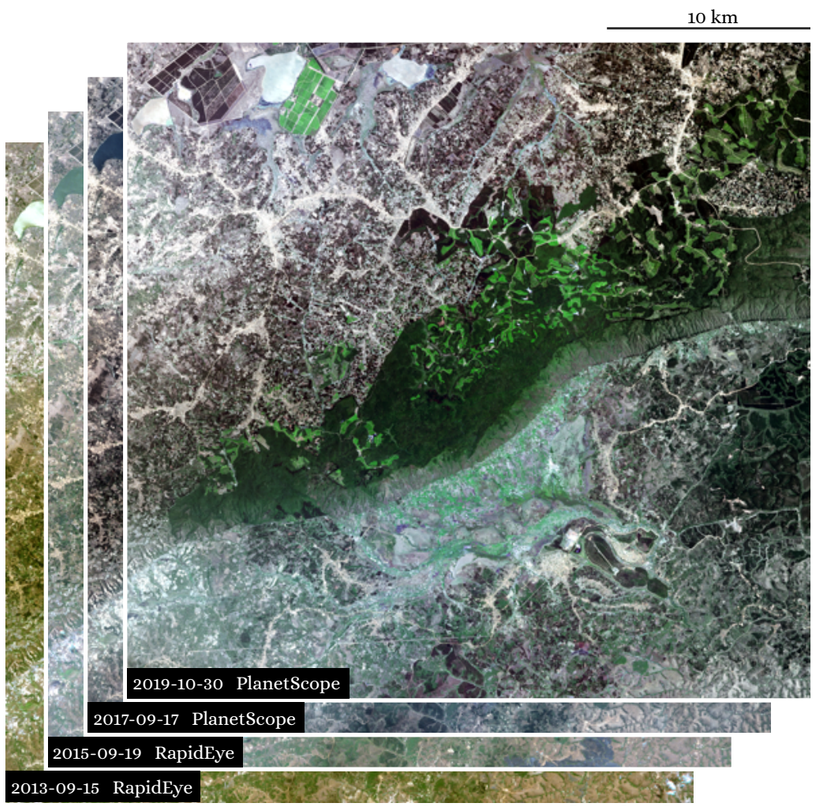
Finding Southern Tanzania's woodlots in Very High Resolution (VHR) satellite imagery

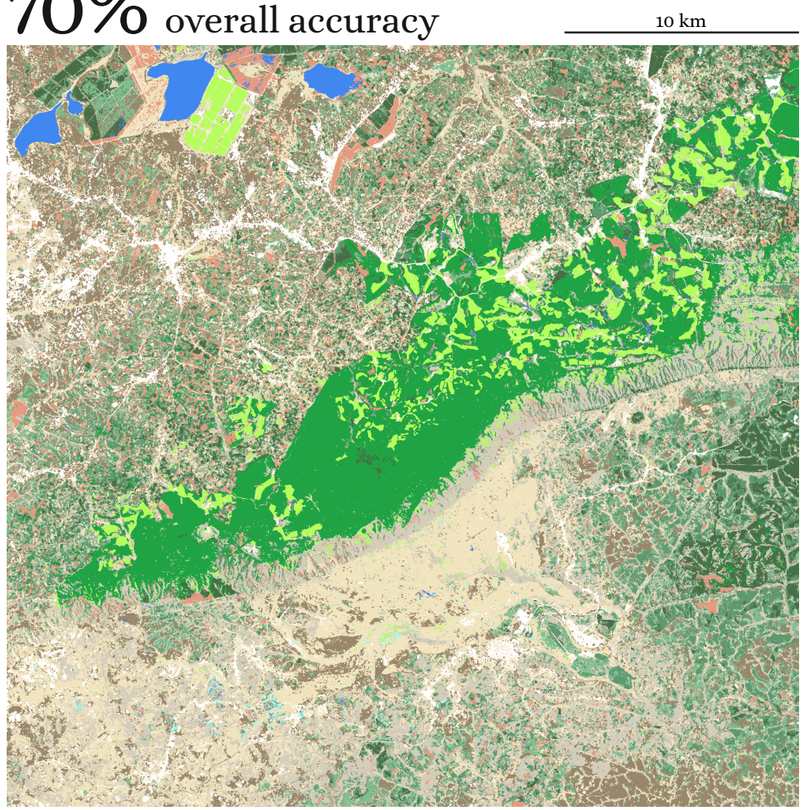
Vincent Falardeau, August 2021

Smallholder woodlots in Tanzania are often less than a hectare in size, making them difficult to distinguish in medium-resolution satellite imagery. Using RapidEye and PlanetScope images at 5- and 3-meter resolution, respectively, it becomes easier to precisely delineate different kinds of land use and land cover. From a temporal stack of four images (left), relatively high accuracies are achievable with cloud masking, image segmentation, and a supervised random forest classification. Among twelve classes, accuracy is estimated at 70 percent; a confusion matrix reveals that much of the error comes from misclassified cropland and trouble differentiating stages of woodlot growth (bottom center). Between woodlot and non-woodlot classes, overall accuracy is estimated at 90 percent, indicating a fairly successful map of woodlot activity (right). To follow the code that generated the two classification maps, see the Google Earth Engine script (bottom left).

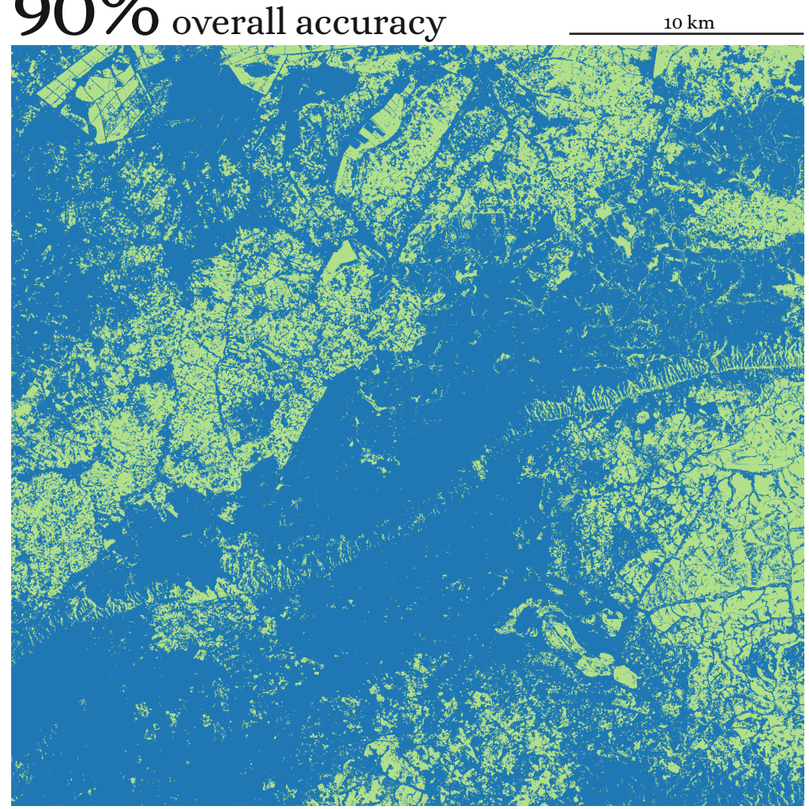


Images courtesy of Planet Labs, Inc.

70% overall accuracy



90% overall accuracy



GEE Script

CLASSIFICATION

VALIDATION	Cropland	Forest	Grassland	Harvested	Tea	Urban	Water	Wetland	Woodland	Young	Intermediate	Mature		User's Accuracy
Cropland	12	0	2	1	0	1	0	0	0	1	0	0	17	0.71
Forest	0	24	0	0	0	0	0	0	0	0	0	0	24	1
Grassland	1	0	27	0	0	0	0	0	0	1	0	0	29	0.93
Harvested	3	0	0	22	0	0	0	0	0	2	0	0	27	0.81
Tea	0	0	0	0	10	0	0	0	0	0	0	0	10	1
Urban	2	0	1	0	0	6	0	0	0	0	0	0	9	0.67
Water	0	0	0	0	0	0	9	0	0	0	0	0	9	1
Wetland	11	0	0	0	0	0	0	0	0	0	0	0	11	0
Woodland	3	1	0	0	0	0	0	0	19	0	2	0	25	0.76
Young	1	0	4	0	0	1	0	0	2	14	14	2	38	0.37
Intermediate	0	0	0	0	0	0	0	0	4	2	25	7	38	0.66
Mature	0	1	0	0	0	0	0	1	3	0	11	34	50	0.68
	33	26	34	23	10	8	9	1	28	20	52	43	287	
Producer's Accuracy	0.36	0.92	0.79	0.96	1	0.75	1	0	0.68	0.7	0.48	0.79		

CLASSIFICATION

VALIDATION	Non-Woodlot	Woodlot		User's Accuracy
Non-Woodlot	143	9	152	0.94
Woodlot	20	133	153	0.87
	163	142	305	
Producer's Accuracy	0.88	0.94		

Note: A moderate degree of spatial auto-correlation between training points and validation points may artificially increase accuracy estimates, including overall, user's, and producer's accuracies.

Next Steps

1. While Planet has high spatial resolution, Landsat and Sentinel have the advantage of high temporal resolution. Could a combination of spatial and temporal depth yield even better results?
2. How significantly will results differ if image segmentation and classification are instead carried out in other software, such as eCognition?
3. Could an end-to-end open source workflow be coded in R or Python such that these methods can be easily replicated in other study regions?