Annual and in-season mapping of cropland at field scale with sparse labels

Gabriel Tseng, Hannah Kerner, Catherine Nakalembe, Inbal Becker-Reshef

Knowing where crops are being grown is important in adapting to and mitigating climate change

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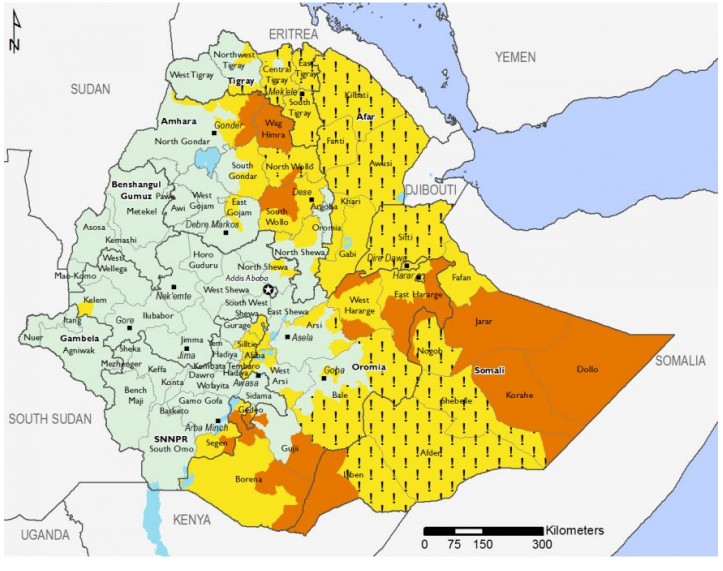
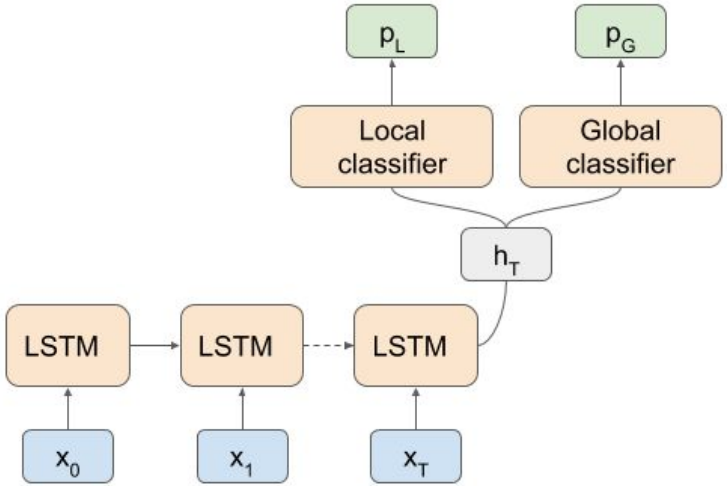


October 2020 - January 2021

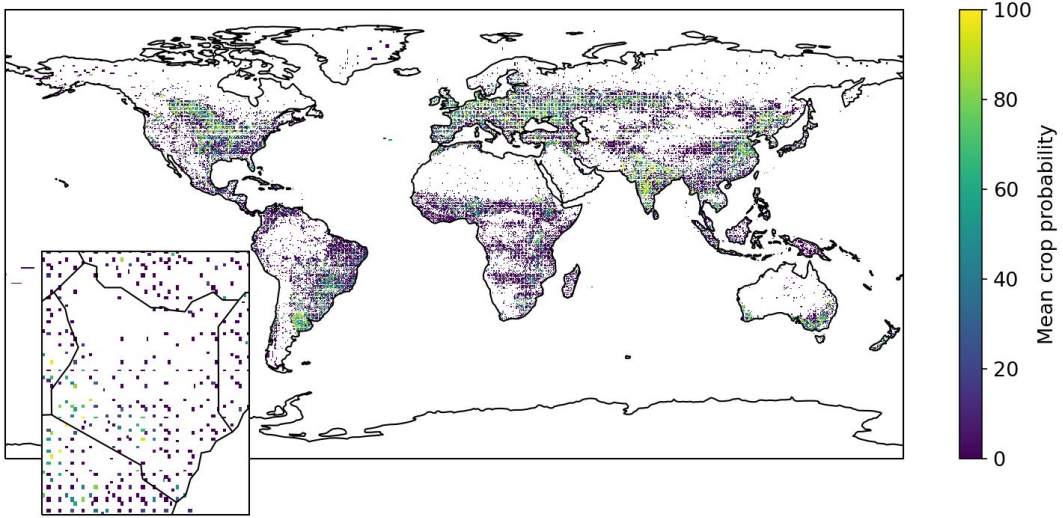
Agriculture is very region specific, so it can be challenging to construct crop maps in areas with few data points

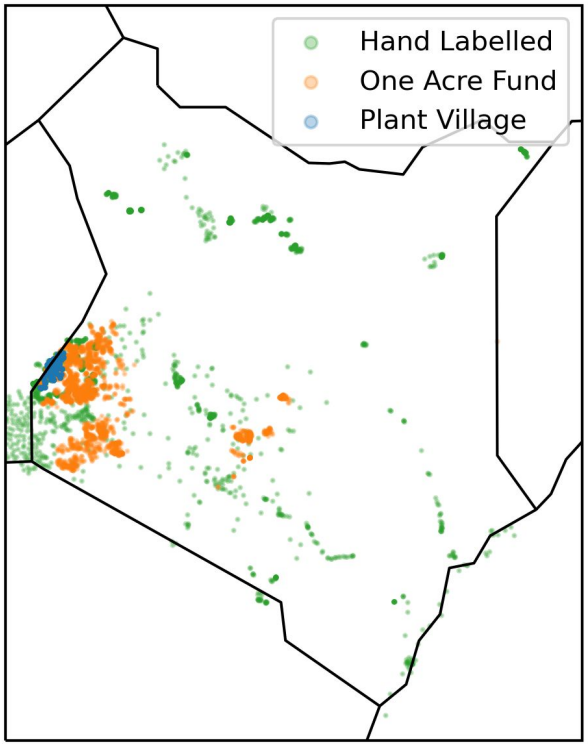
In previous work, we developed an LSTM-based model to develop maps in data-sparse areas using global datasets

12 months of least-cloudy multispectral Sentinel-2 data

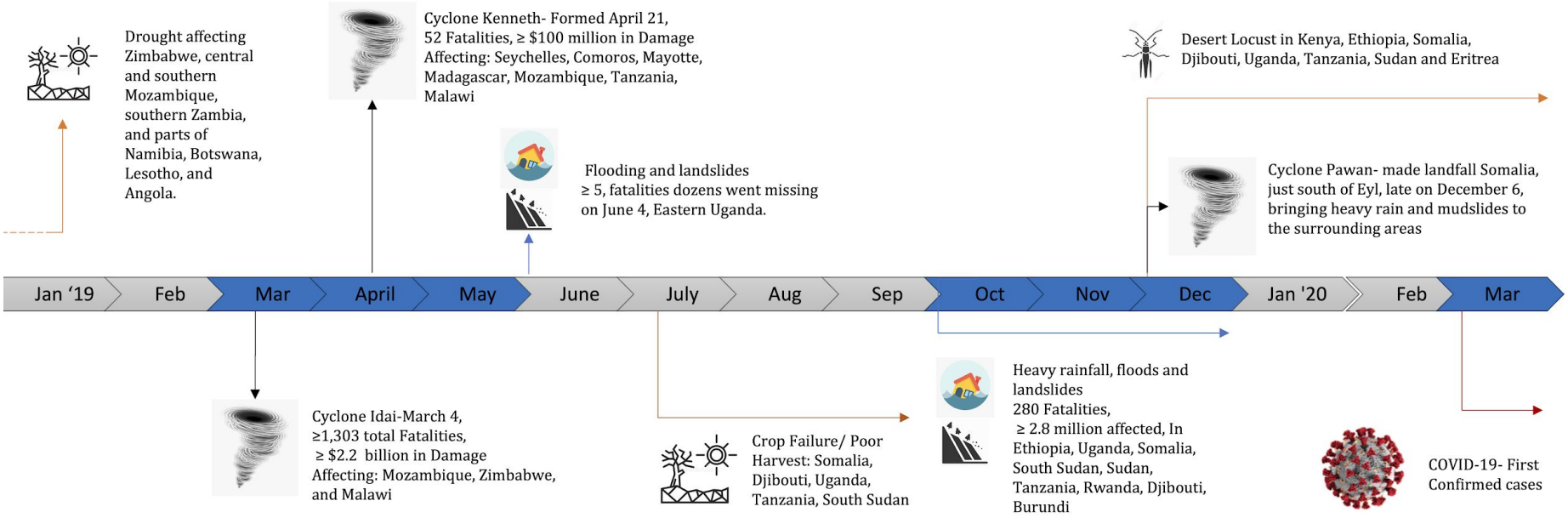


To generate a crop map for Kenya, we combined a global dataset with 3 Kenya-specific datasets



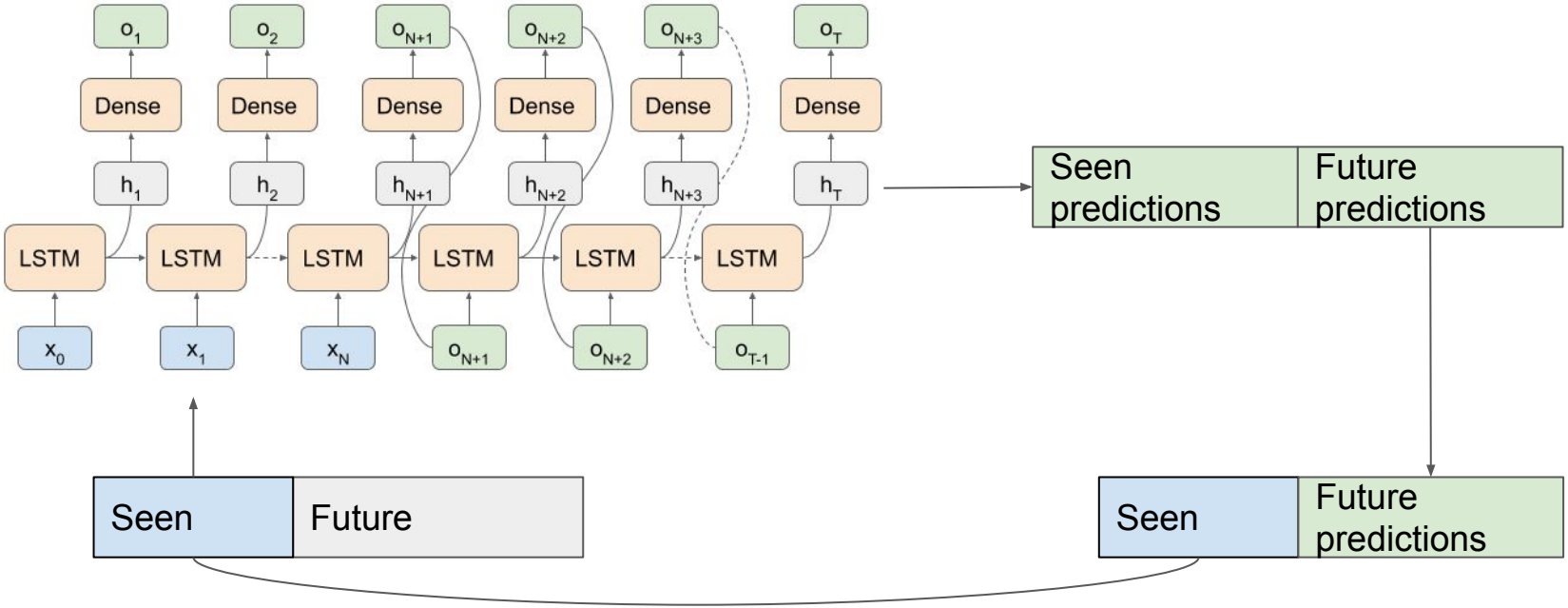


To respond to food system shocks, in season crop maps are important

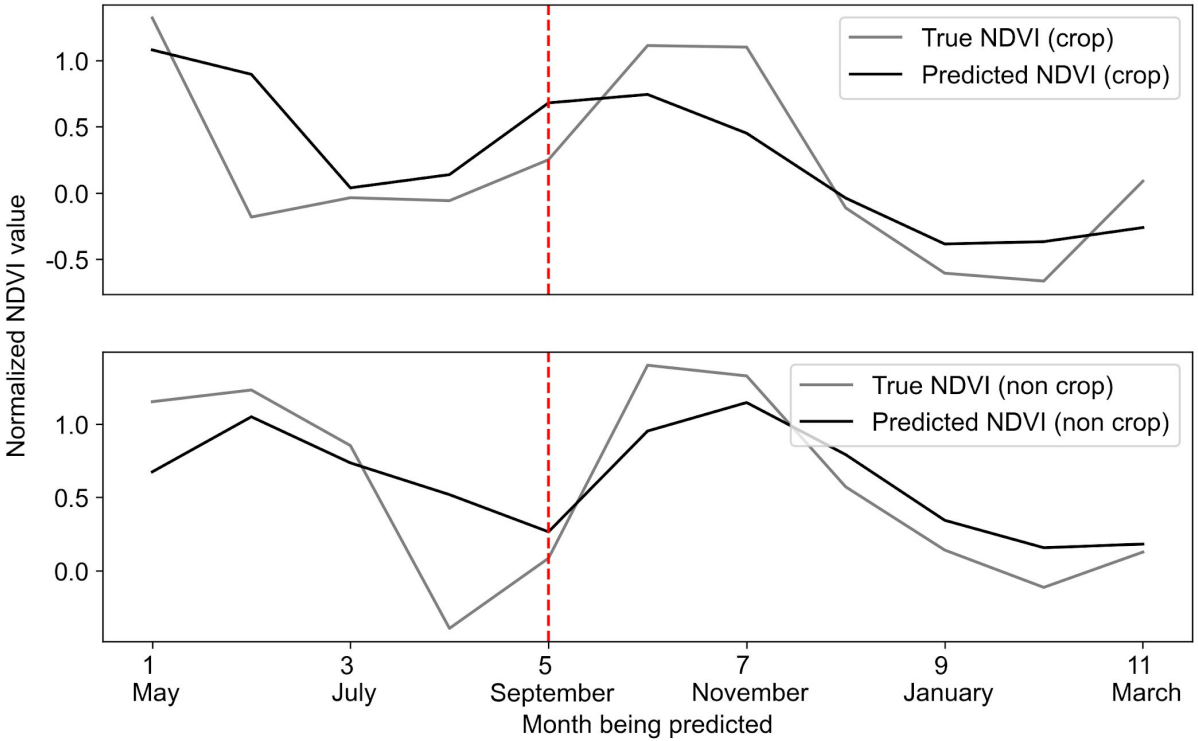


Source: Catherine Nakalembe (2020). Urgent and critical need for Sub-Saharan African countries to invest in Earth observation-based agricultural early warning and monitoring systems, *Environmental Research Letters*.

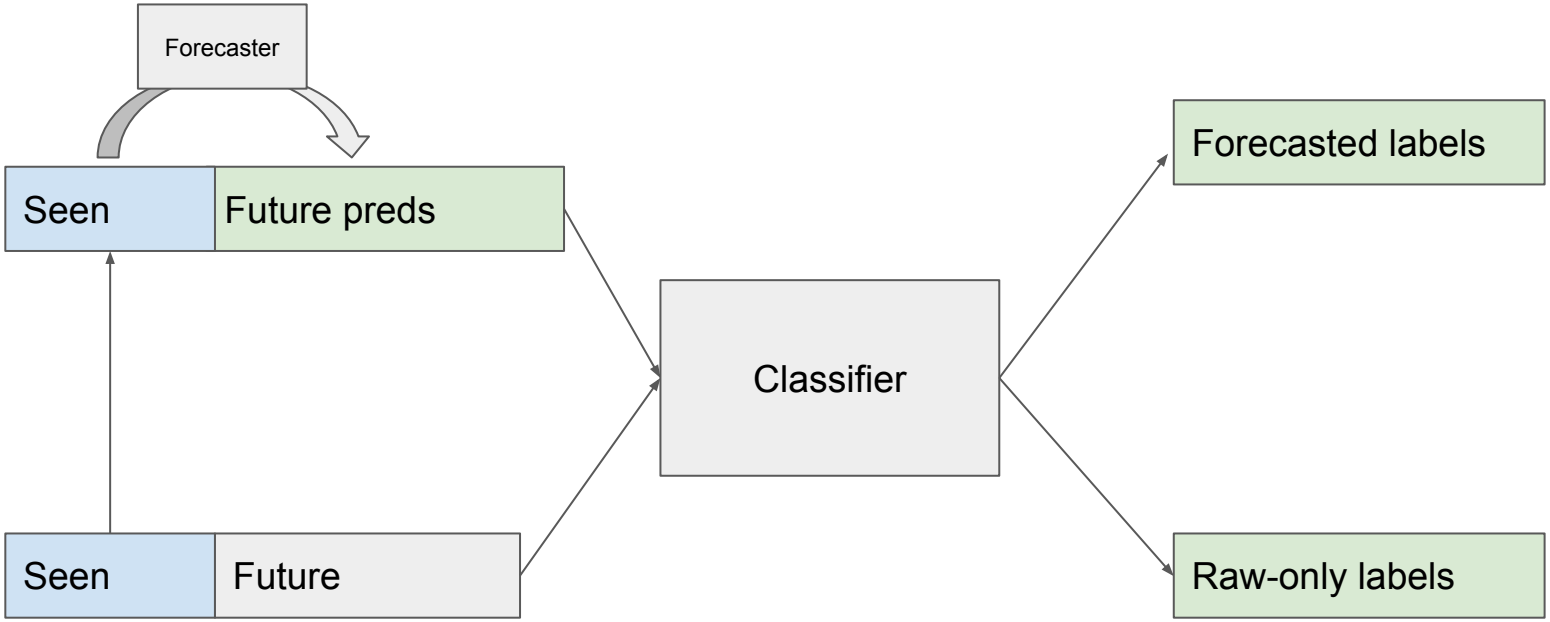
For in-season crop mapping, we trained an LSTM to complete a partial time-series



The forecaster successfully predicted trends when given 5 months of input data

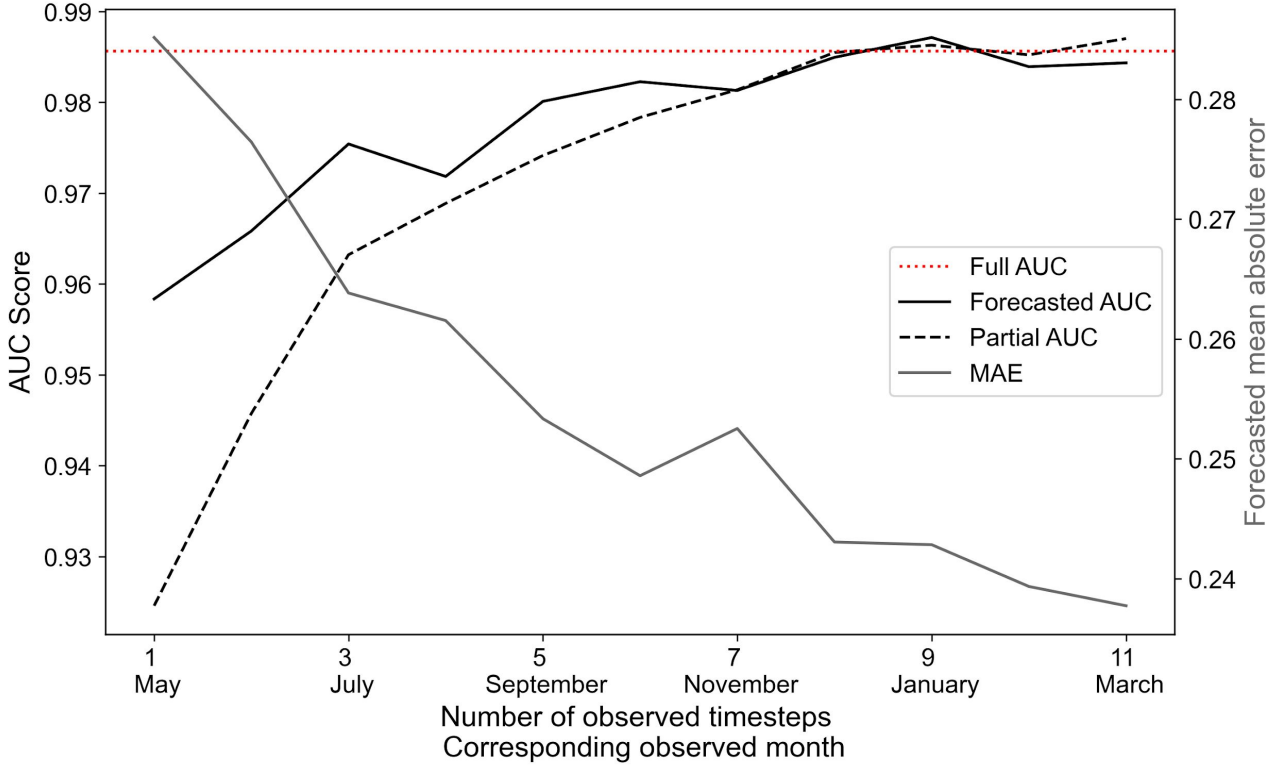


The LSTM-classifier was trained on both the forecasted and raw input



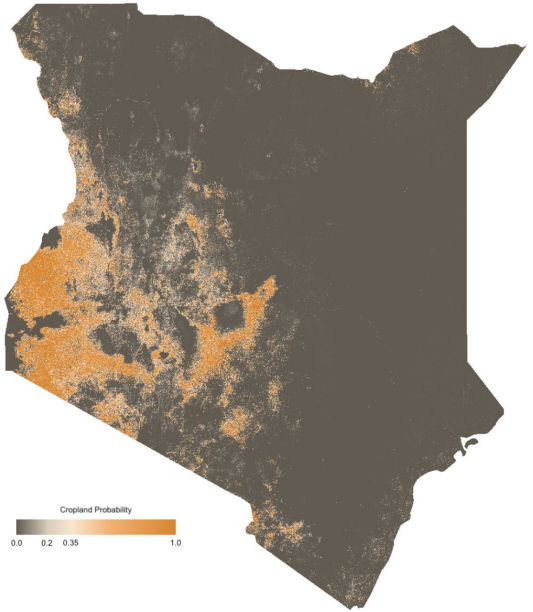
$$\mathcal{L}_{\text{total}} = \mathcal{L}_{\text{encoder}} + \frac{1}{2}(\mathcal{L}_{\text{classifier}}(\mathcal{X}_{\text{observed}}) + \mathcal{L}_{\text{classifier}}(\mathcal{X}_{\text{forecasted}}))$$

This improved results compared to passing the partial inputs to the classifier



We used the LSTM-classifier and the combined system to produce crop maps for Busia and Kenya

Accuracy	Precision	Recall	F1
0.86	0.77	0.92	0.84



(a) Cropland probability map for Kenya (2019)

(b) In-season cropland probability map for Busia county (2020)

Conclusion

Conclusion:

- We present an LSTM crop / non crop **classifier** and a **forecaster** for multispectral time series data. We use these models to produce high resolution (10m) crop maps of Kenya (post-season) and Busia (in-season)

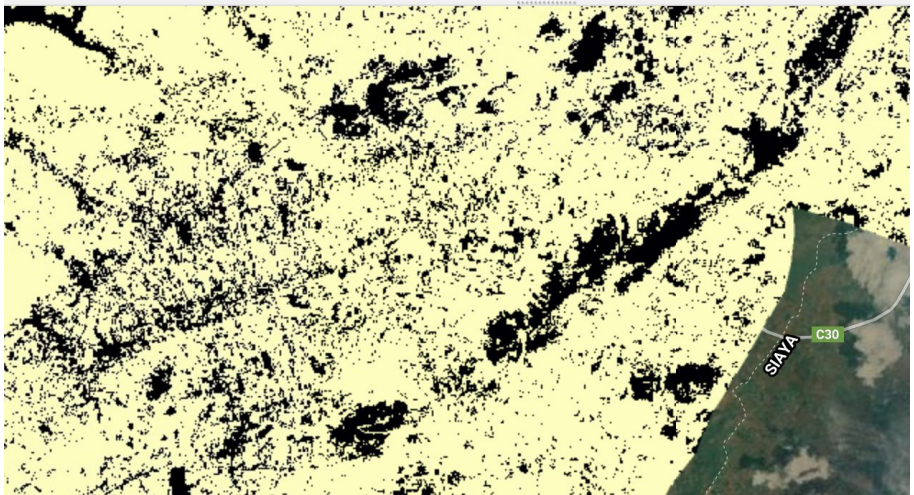
Future work:

- Extending this method for crop-type mapping
- Using these methods to generate crop-maps for previously unseen regions with sparse labelled data

These maps can be explored and downloaded on Google Earth Engine

```
var image = ee.Image('users/gabrieltseng/busia_cropland_binary_in_season');
var busia_cropland = {
  min: 0.0,
  max: 1,
  palette: ['#000004', '#2C105C', '#711F81', '#B63679', '#EE605E', '#FDAE78
};
Map.addLayer(image.select(0), busia_cropland);

```



Thank you!

Code, maps, data are available at: https://github.com/nasaharvest/kenya-crop-mask