

Improved Vote Aggregation Techniques for the Geo-Wiki Cropland Capture Crowdsourcing Game

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Challenge

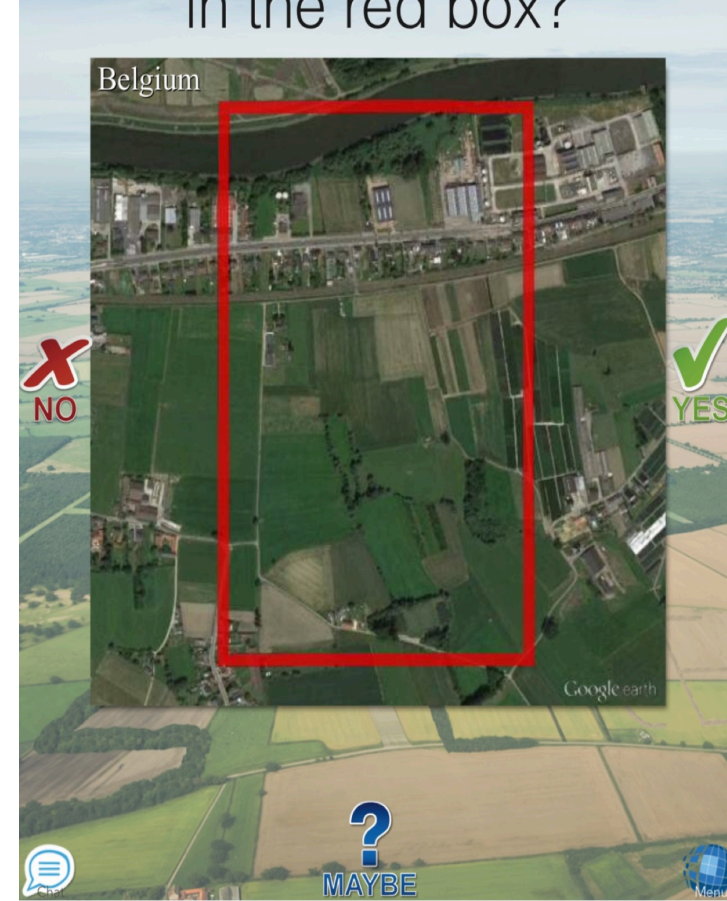
How to aggregate votes from non-experts?

The Cropland Capture

iOS Game Android

Score Week 26: 250

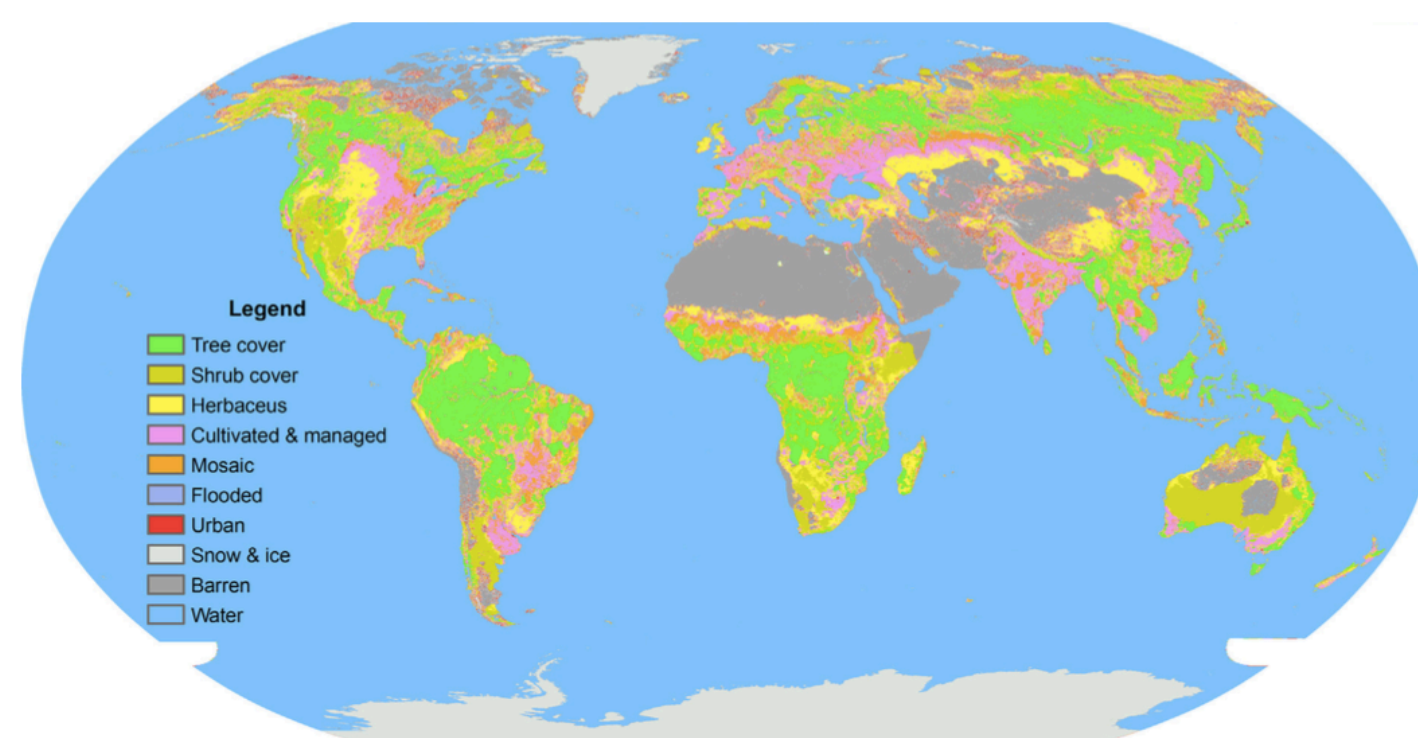
Is there any cropland in the red box?



Over 5 million opinions from non-experts

HOW?

Land cover map



Expert-quality decisions about 190 000 images

Results

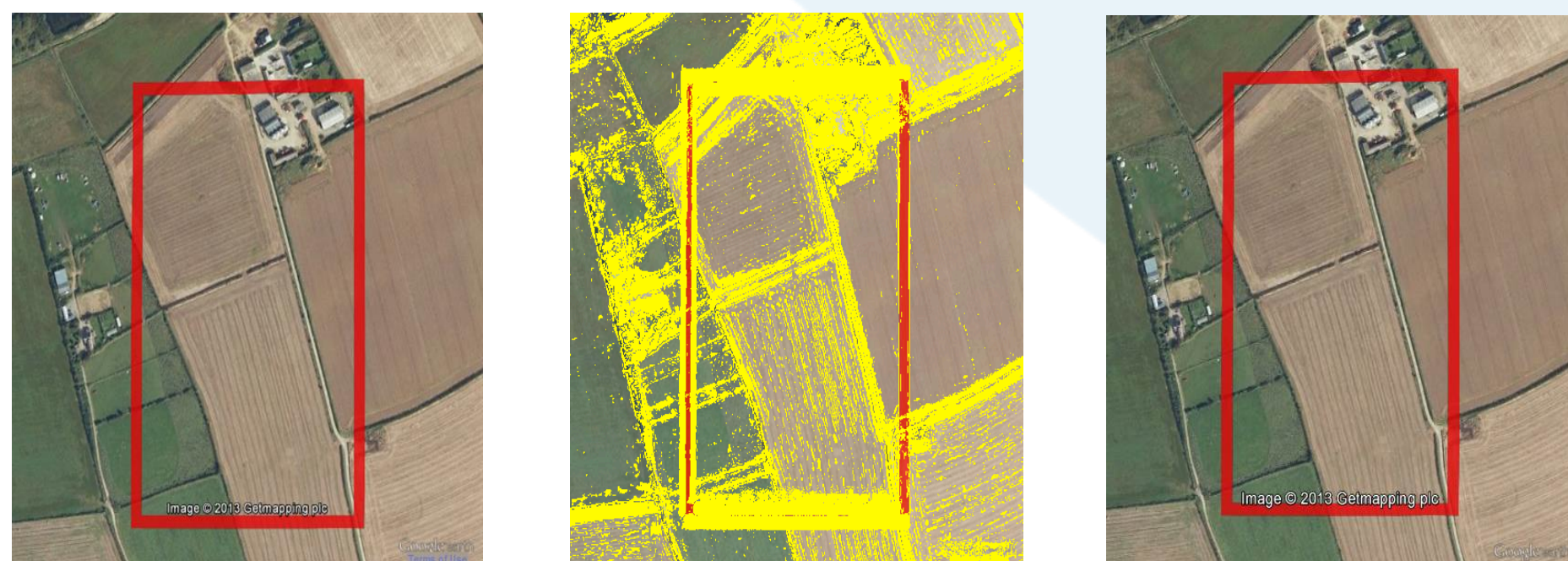
We increased the accuracy of “Cropland Capture” data from **76% to 91%**

- ✓ Improved quality of image dataset;
- ✓ Improved majority voting estimates;
- ✓ Benchmarked state-of-the-art algorithms;
- ✓ Demonstrated that these algorithms perform on a par with majority voting. **Explanation:** all volunteers are reliable, the task assignment is highly irregular.
- ✓ Accuracy is **96%** for images with more than 9 votes.

Approach

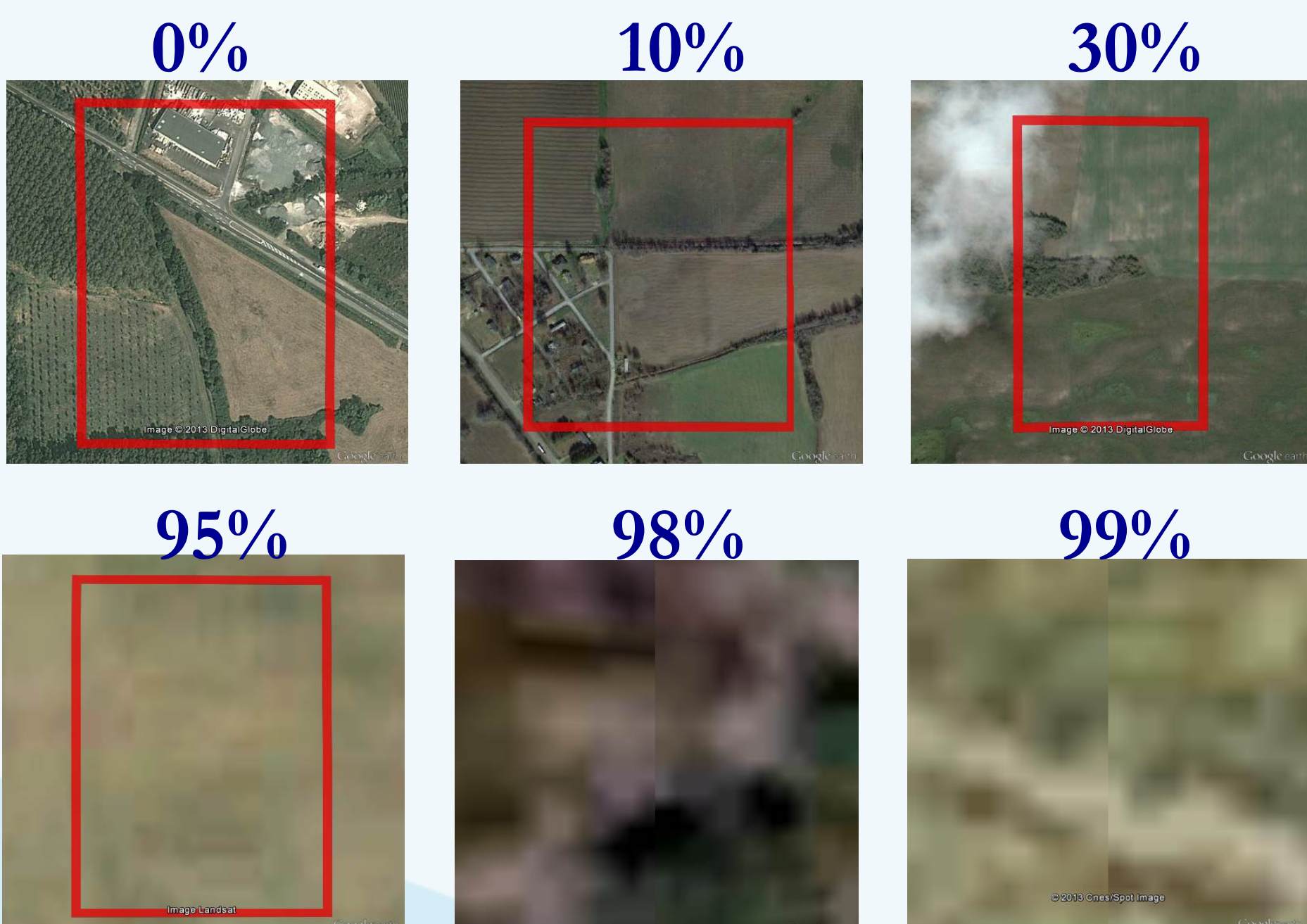
Data preprocessing

1) Detection of similar images using pHash (perceptual hash) [Zauner, 2010].



→ 5% of images are not unique

2) Detection of low quality images using Blur detection algorithm [H Tang, 2012].



→ 2% of images are discarded

Volunteers' ROCs

Individual performance of volunteers is studied with respect to the number of votes [Rayker, 2012].

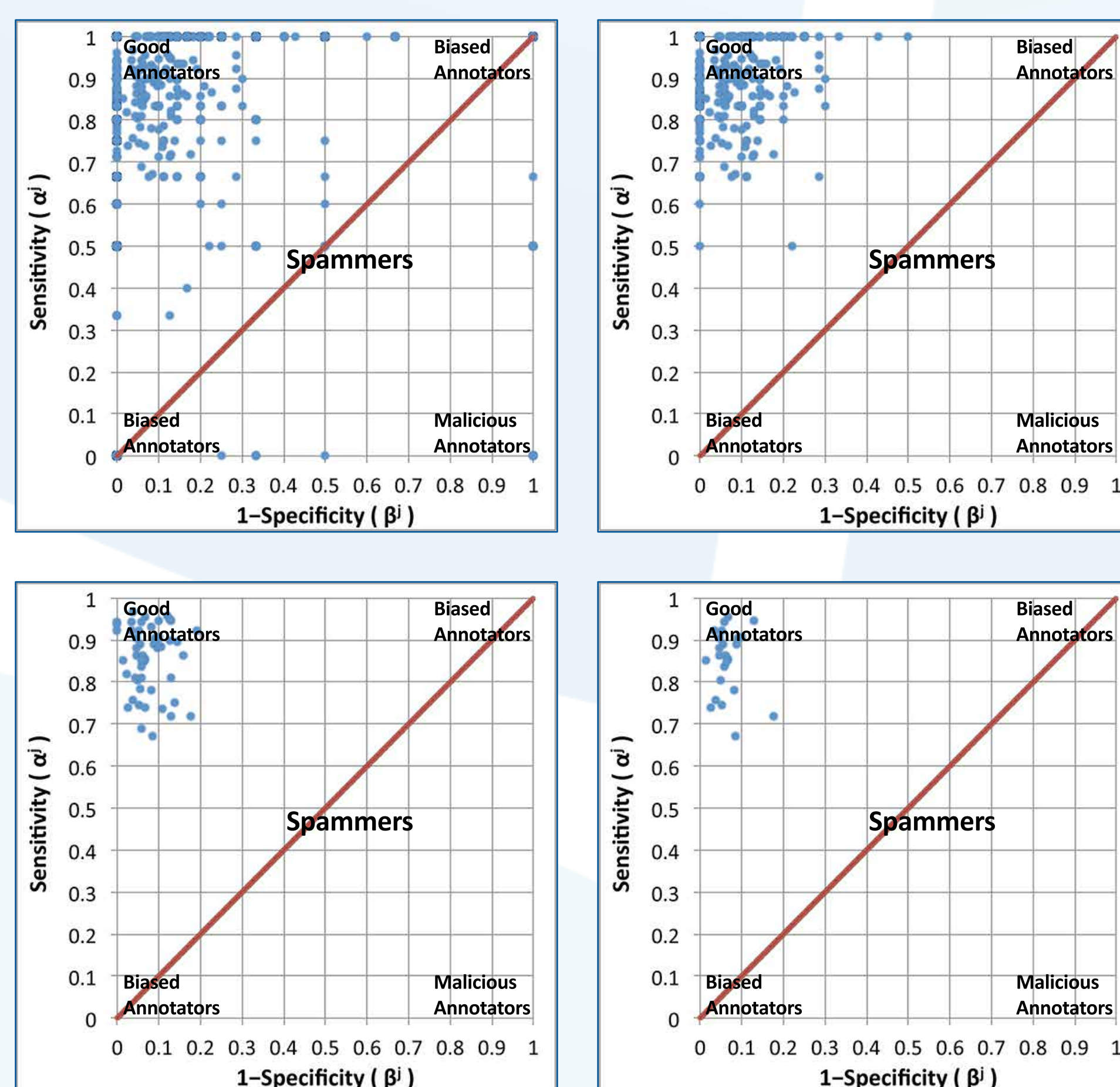


Fig. 1: In the figure we use notation introduced in [11]. Threshold = 0, 12, 44, and 100 votes. These thresholds leave 1813, 262, 52, and 24 volunteers, respectively. ROCs of spammers lie on the red line.

- ✓ There are no spammers among volunteers with more than 12 votes;
- ✓ Good volunteers prevail;
- ✓ Volunteers with >100 votes show higher accuracy than any tested algorithm.

Benchmark

We compare machine learning algorithms and state-of-the-art vote aggregation algorithms:

EM [Dawid, 1979];

KOS, KOS+ [Karger, 2011];

Hard Penalty [Jagabathula, 2014].

Table 1: Baseline algorithms

Number of features	Random Forest	LDA	AdaBoost
5	89.92	87.60	89.15
14	89.14	90.70	89.92
35	88.37	89.53	91.08

Table 2: Accuracy for ‘crowdsourcing’ algorithms without image-vote thresholding

iteration	MV	EM	KOS	KOS+	weighted MV
Base	89.81	89.81	88.99	89.81	90.63
1	90.05	90.16	88.88	90.16	91.45
2	90.05	90.05	88.64	90.16	91.45
3	89.67	89.58	88.17	89.70	91.22

Table 3: Accuracy for ‘crowdsourcing’ algorithms with image-vote thresholding. Only images with at least 10 votes are left in the expert dataset. In this case we have 404 images annotated by 1777 volunteers.

iteration	MV	EM	KOS	KOS+	weighted MV
Base	94.55	94.55	94.06	94.55	95.05
1	94.55	94.55	93.81	94.55	95.05
2	94.55	94.55	93.81	94.55	95.05
3	94.55	94.55	94.06	94.55	95.05

*We use publicly available code (<https://github.com/ashwin90/Penalty-based-clustering>)