Weed map generation from UAV image mosaics based on crop row detection

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2016-06-28

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Why generate weed maps?

- UAV provides overview of the field
- Generation of weed maps
- Show distribution of weed plants in the field
- Can target weed infestations at the right time

Our approach

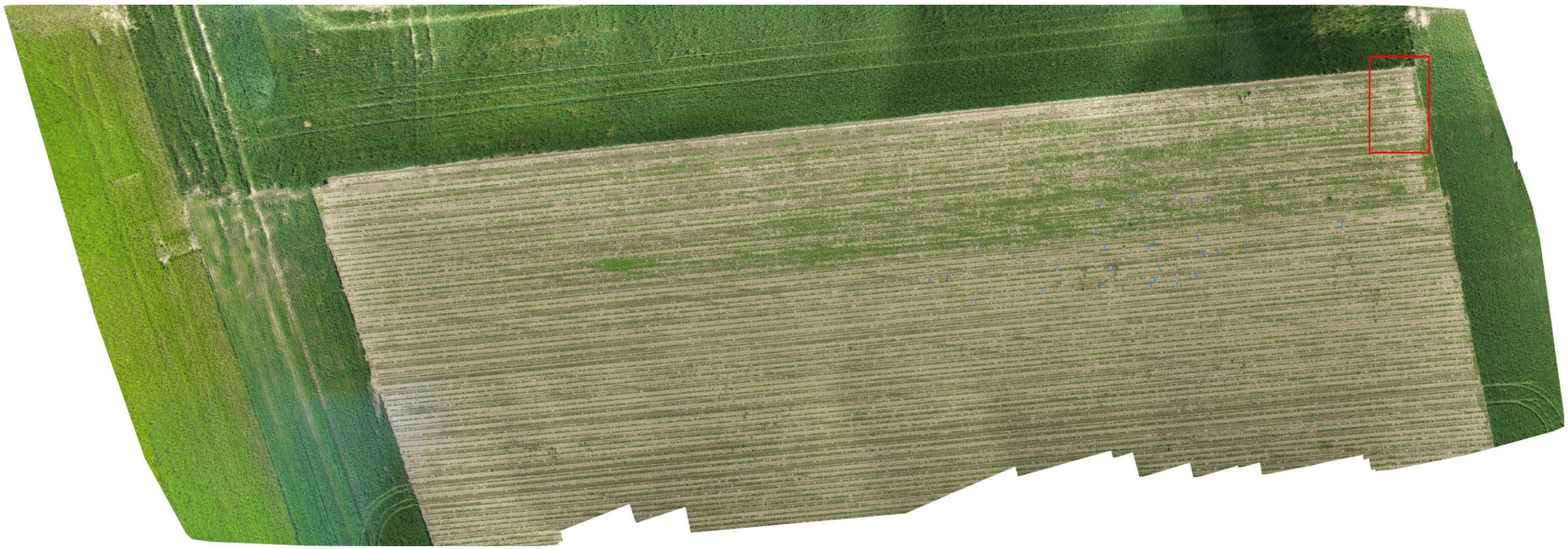
- Assume that weeds are uniformly distributed
- Detect crop rows
- Remove crop rows
- Remaining vegetation must be weeds

Image acquisition

Hexacopter
Image acquisition height: 16 meters

Canon PowerShot G15
Resolution: 4000 x 3000

Generated mosaic

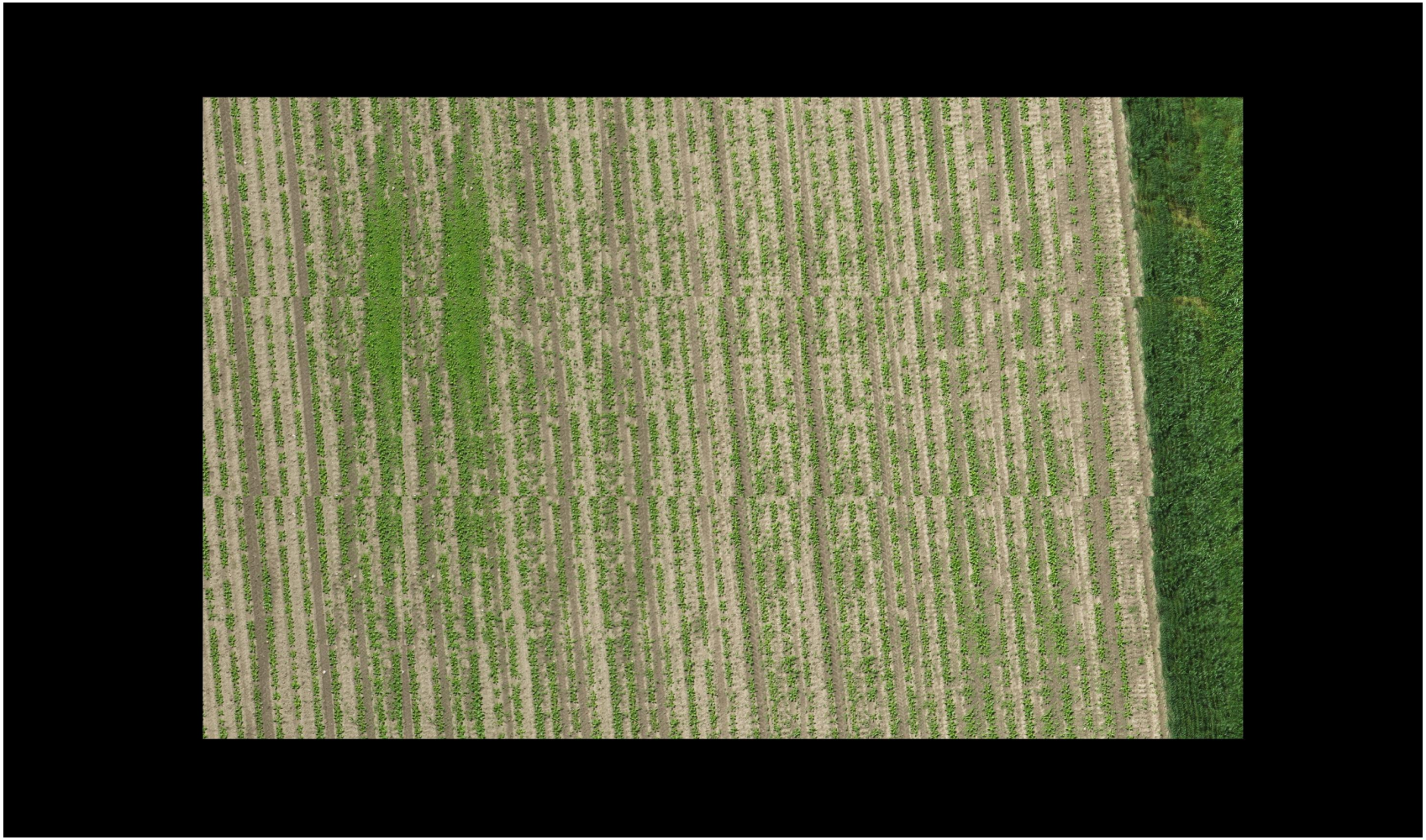


Pix4D is used for assembling the orthomosaic
Dimensions of ortomosaic: $8206 \times 23713 \sim 195 MP$.

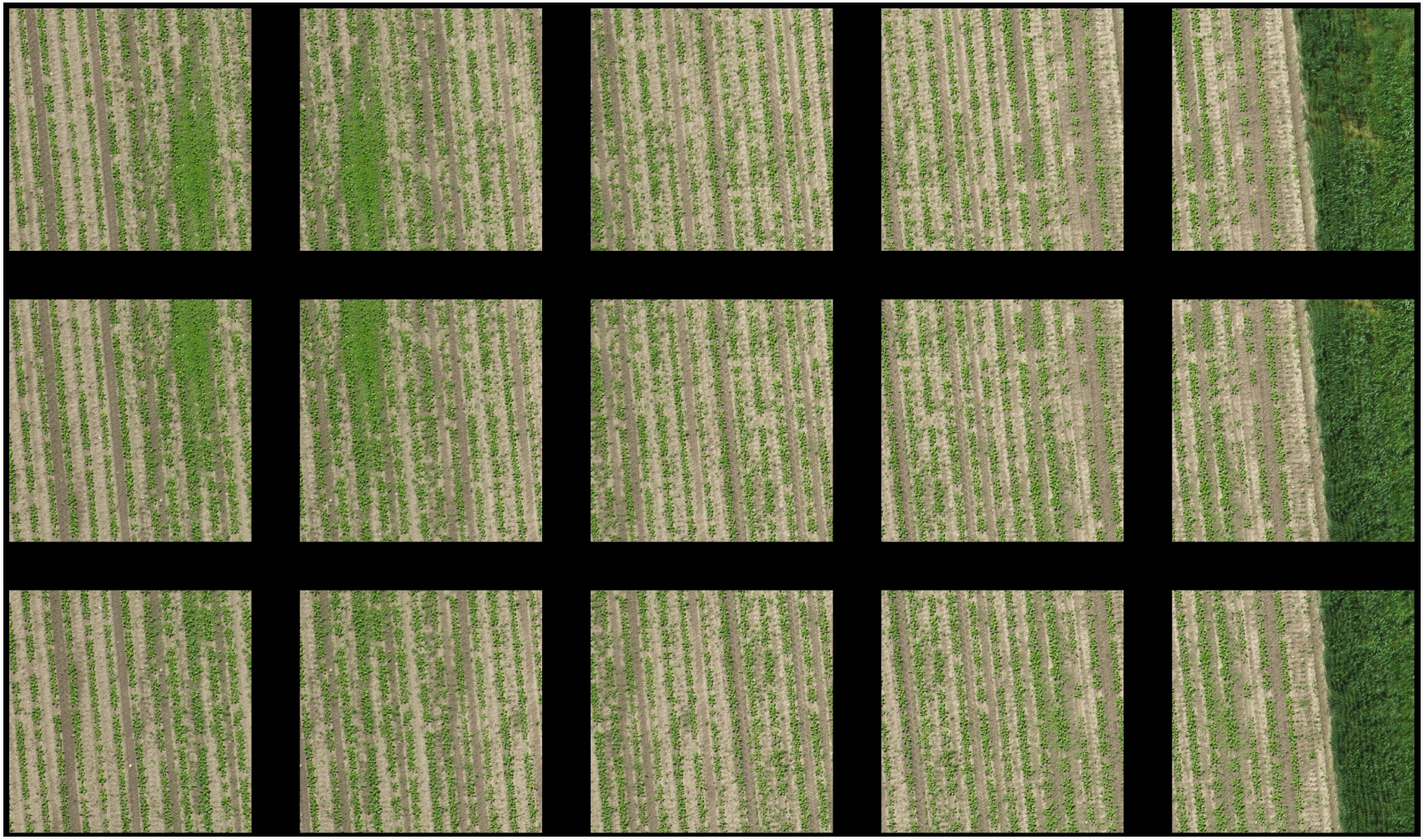
Zoom on mosaic

Extraction of tiles from the mosaic

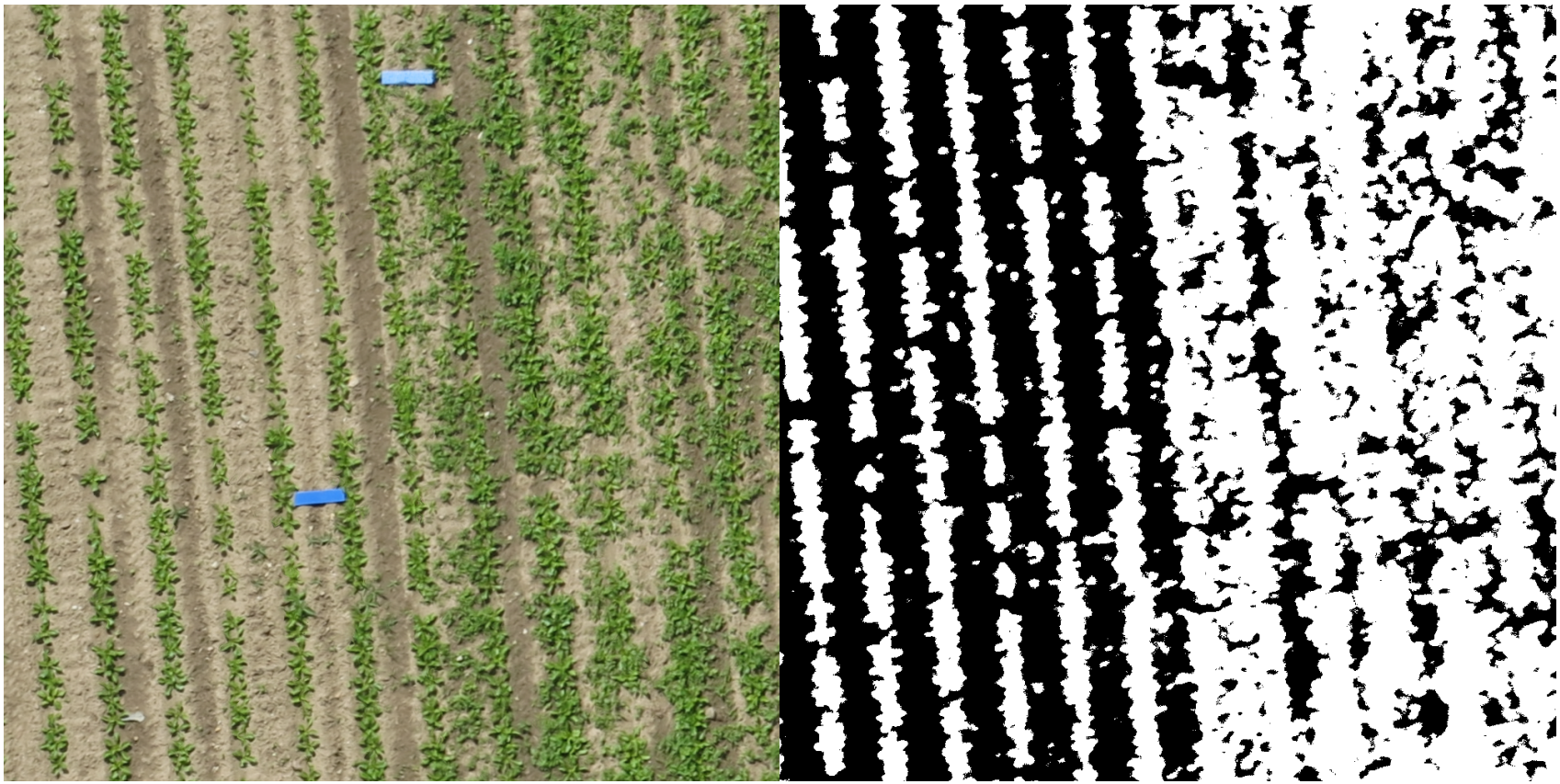
Extraction of tiles from the mosaic



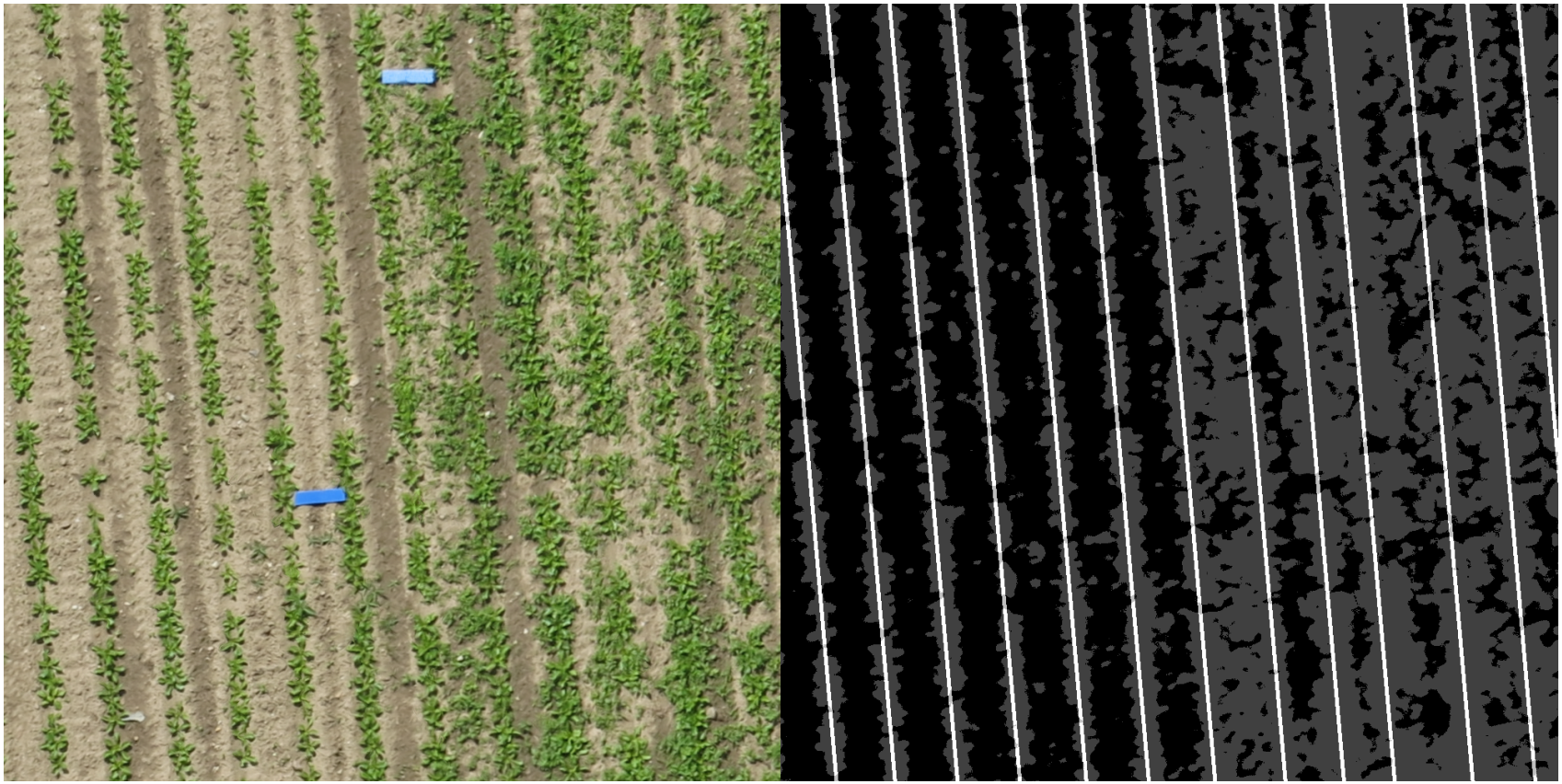
Extraction of tiles from the mosaic



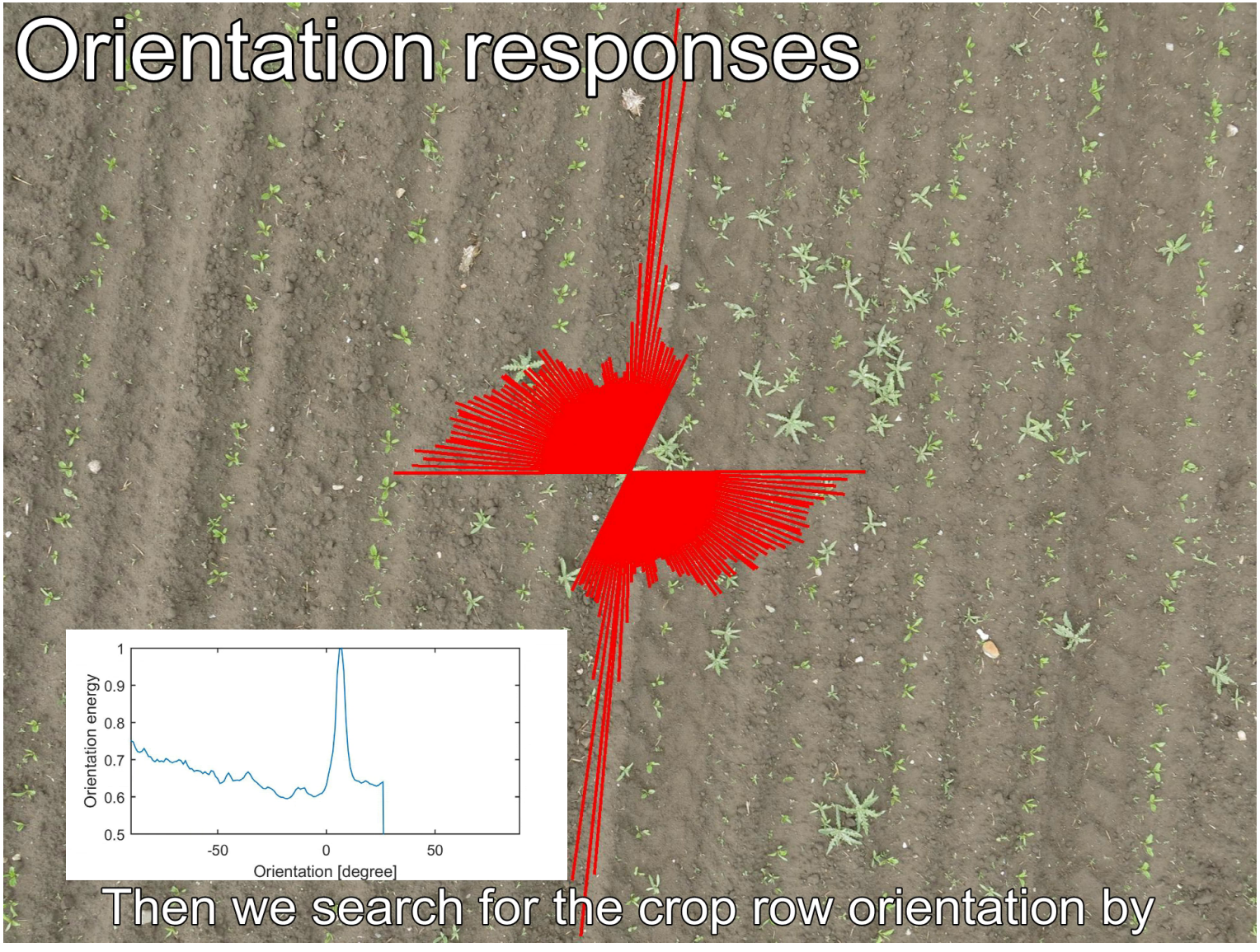
Locating vegetation – thresholding ExG



Located crop rows

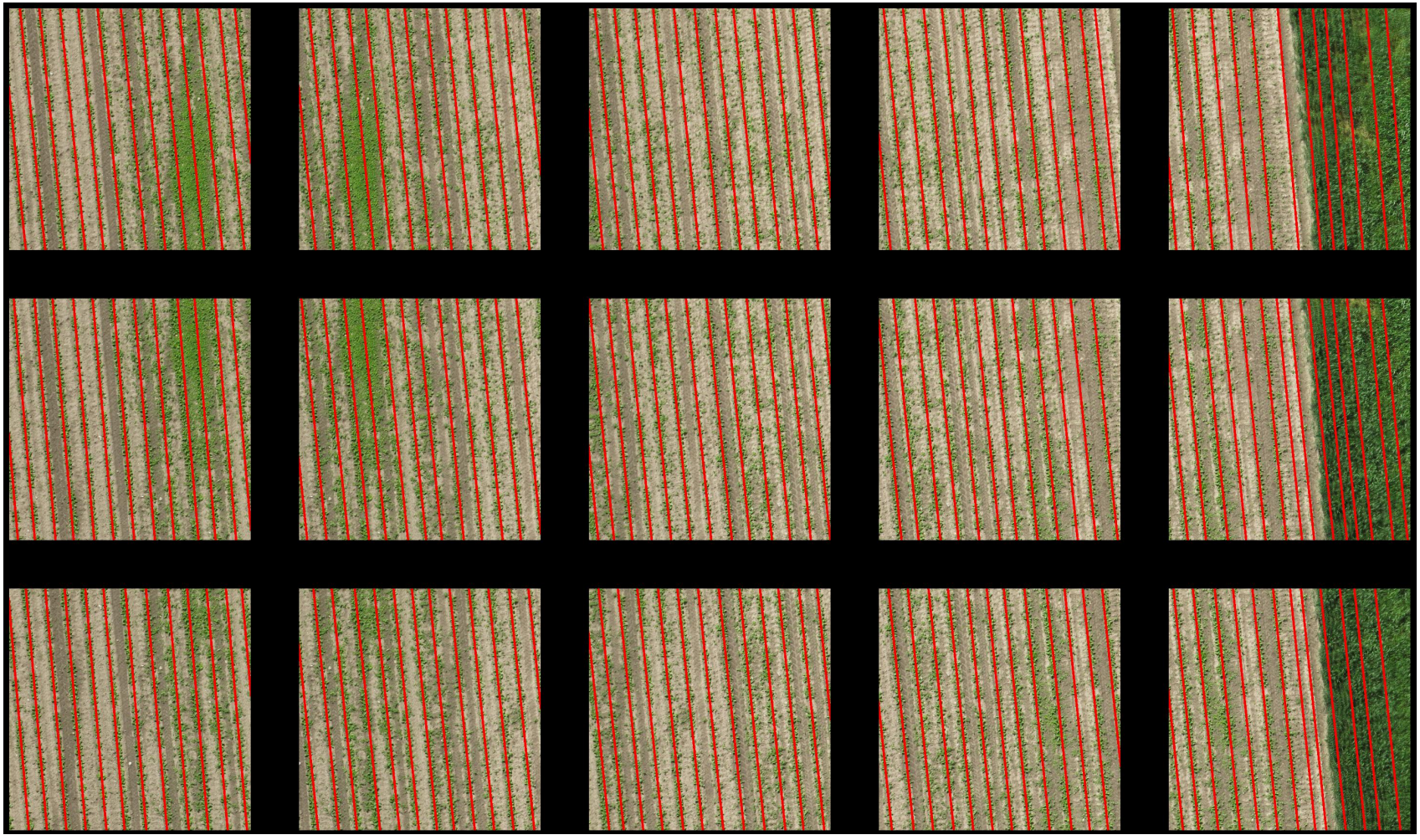


Video

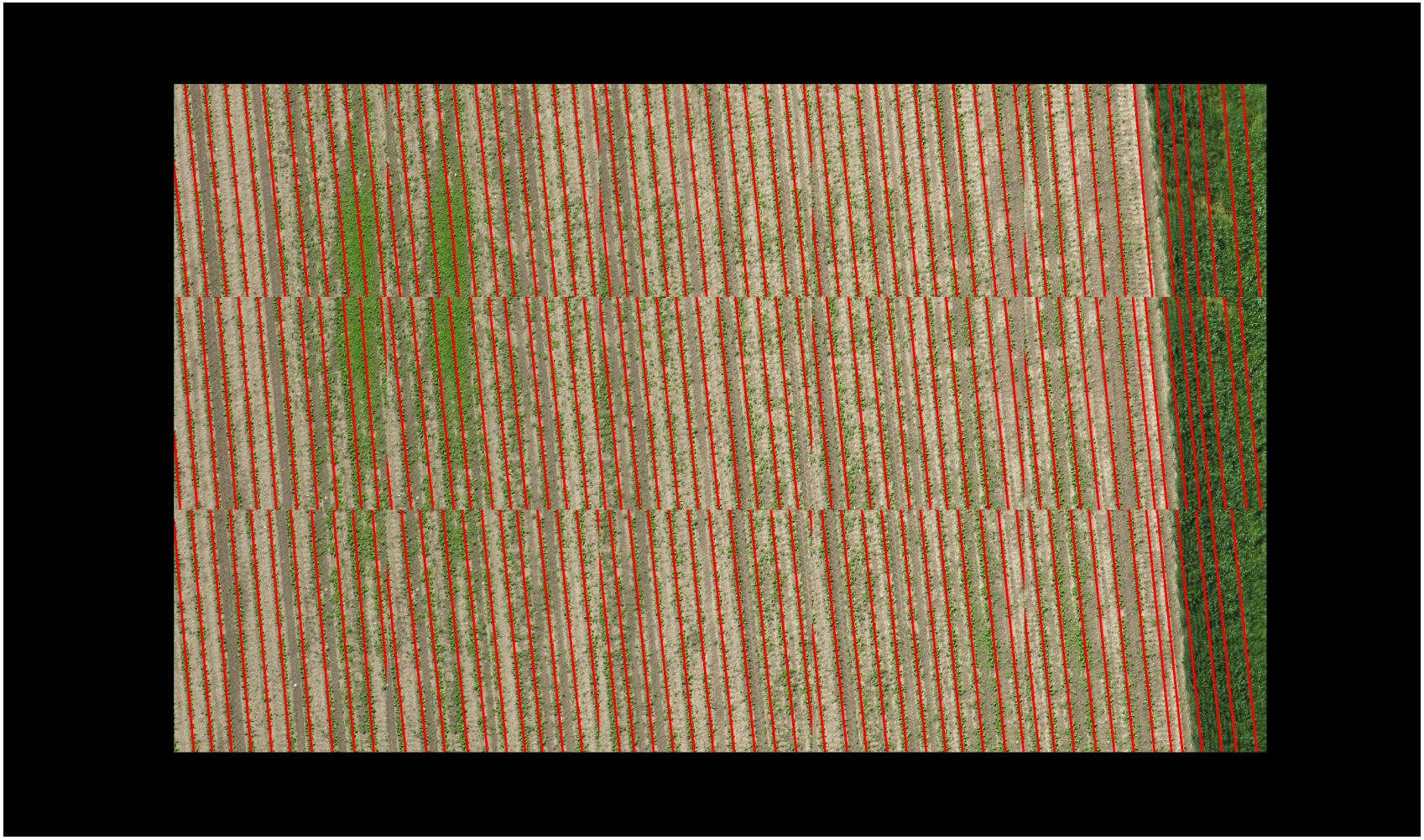


Crop row detection in UAV images – `http://youtu.be/NgzhiiSYFmk`

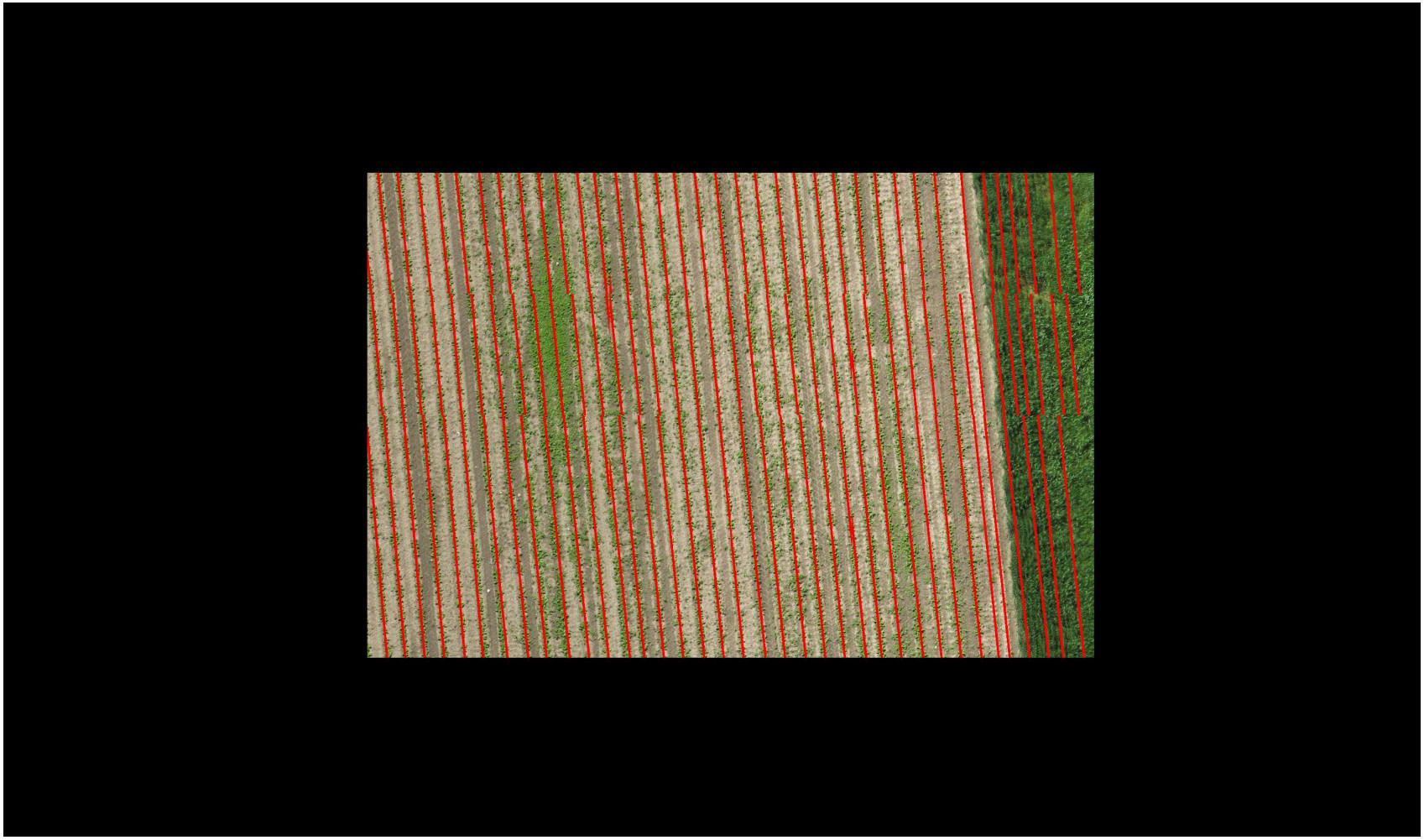
Combining tiles



Combining tiles

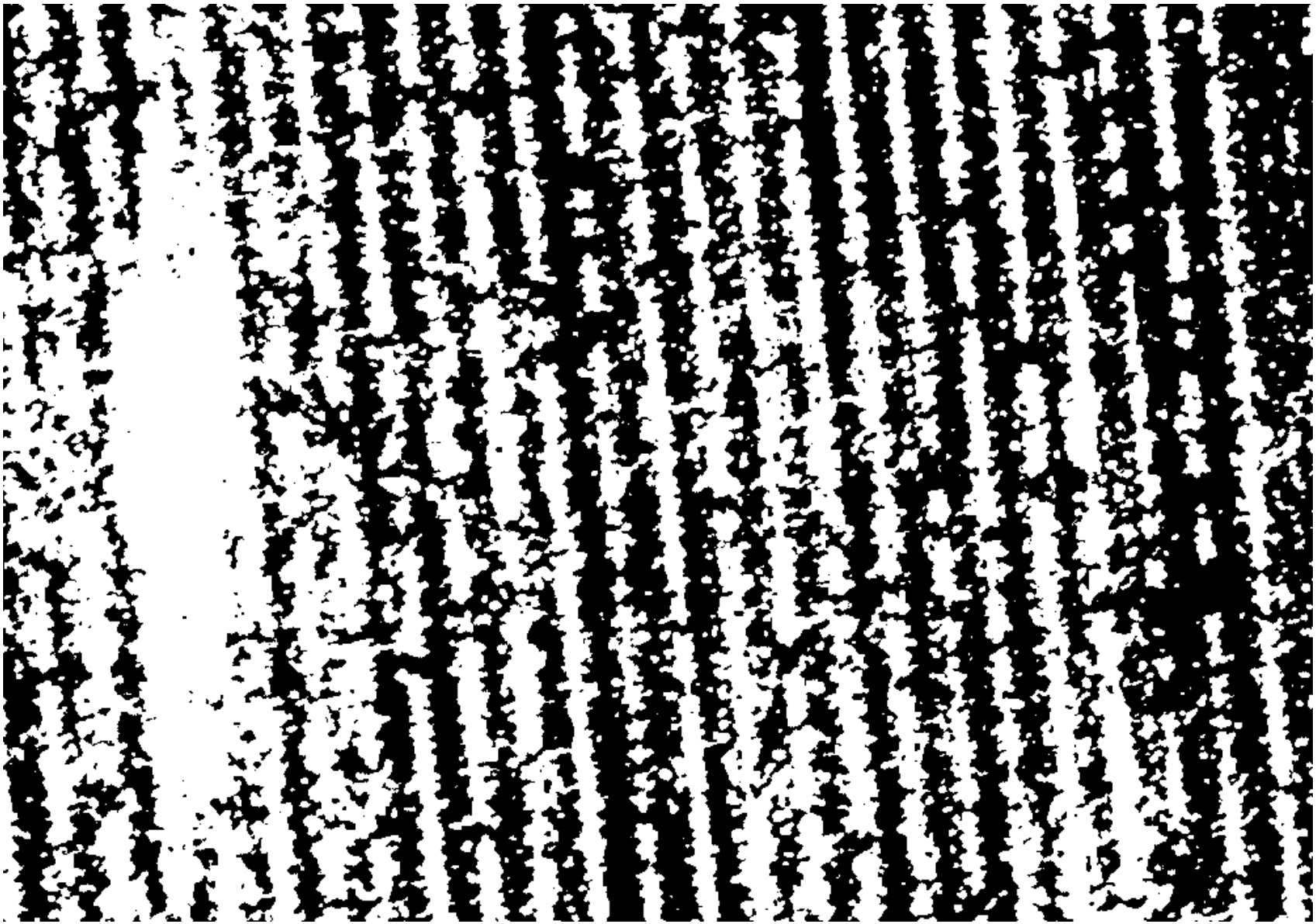


Combining tiles

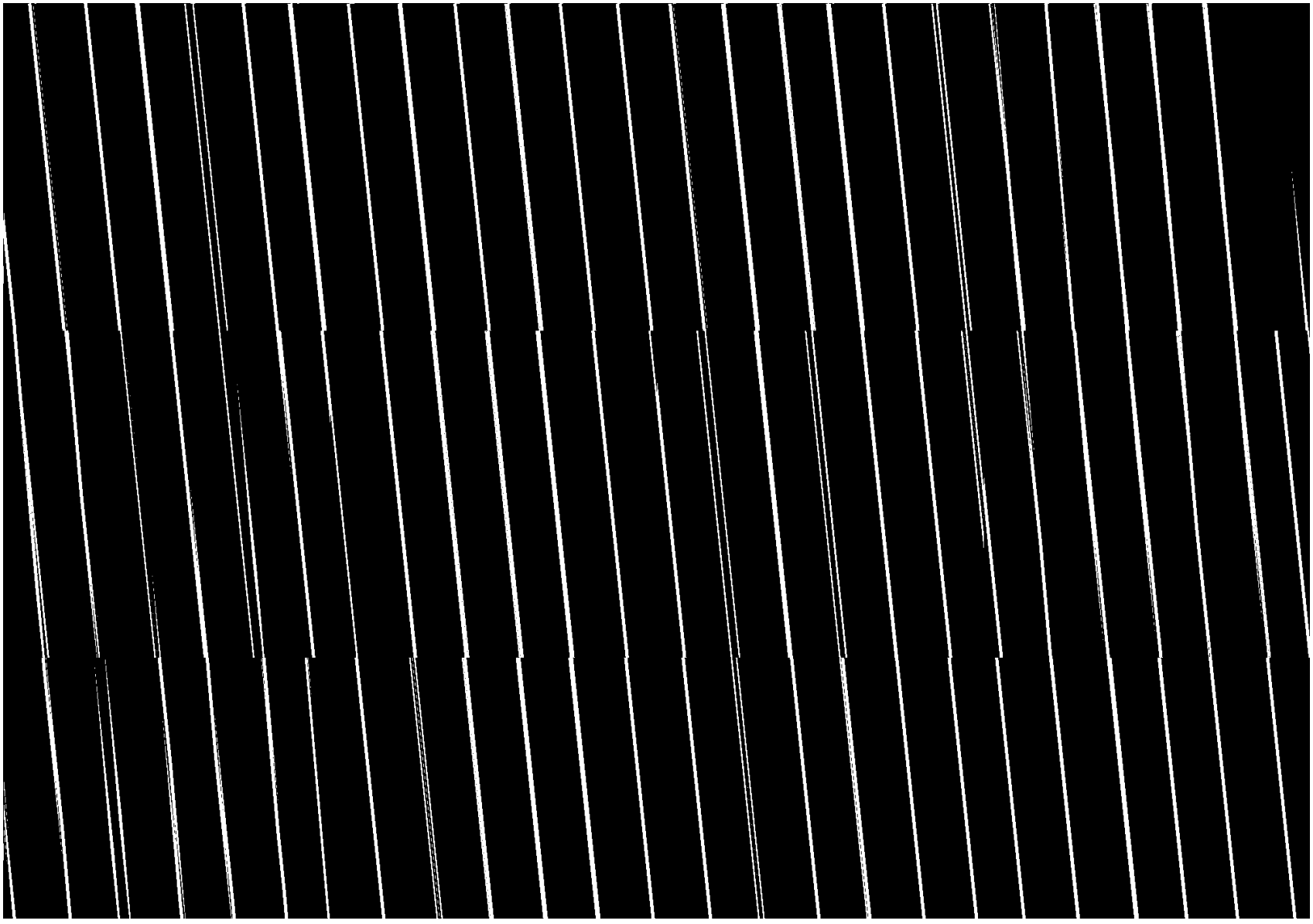


Cropped mosaic

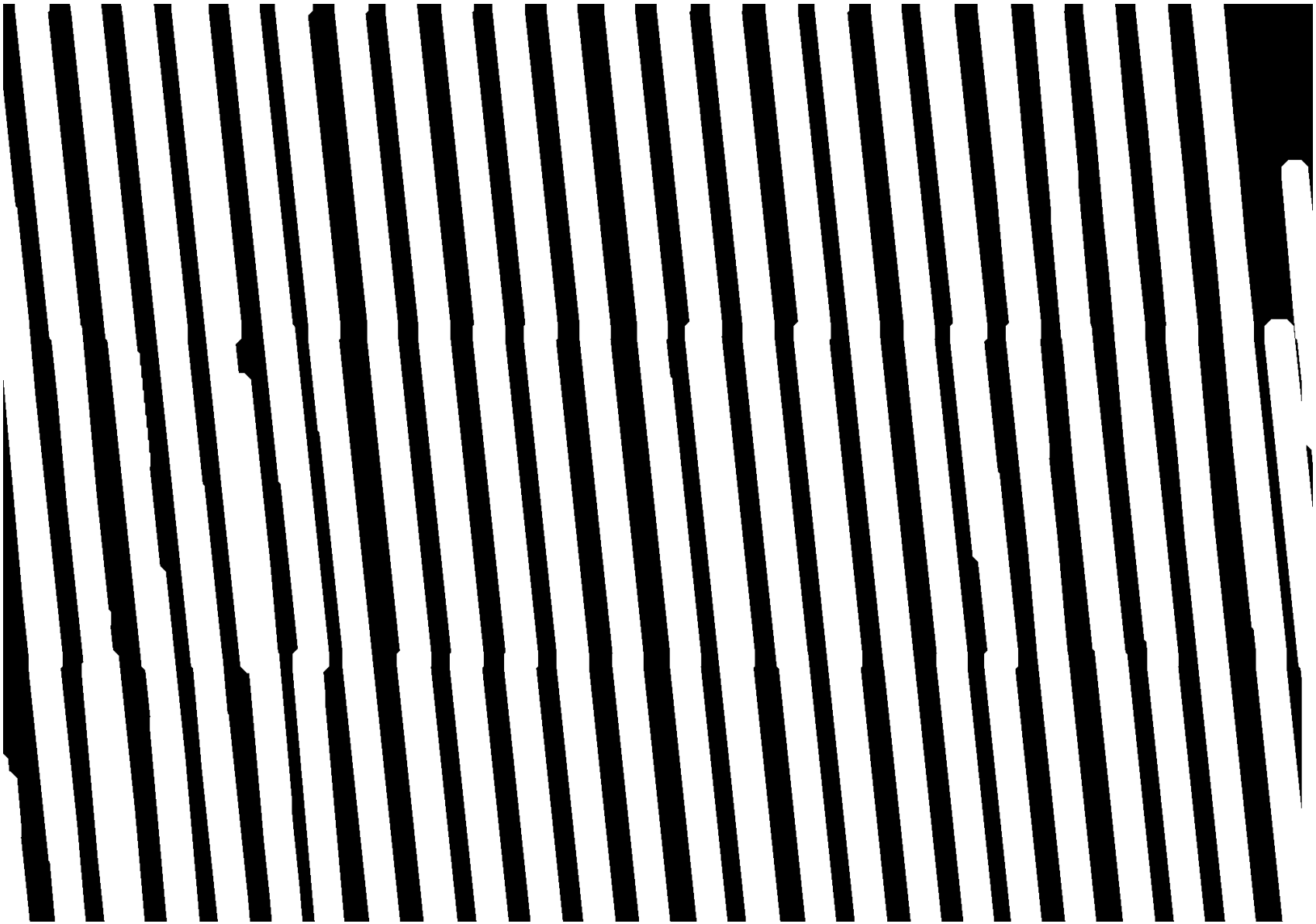
Segmented mosaic



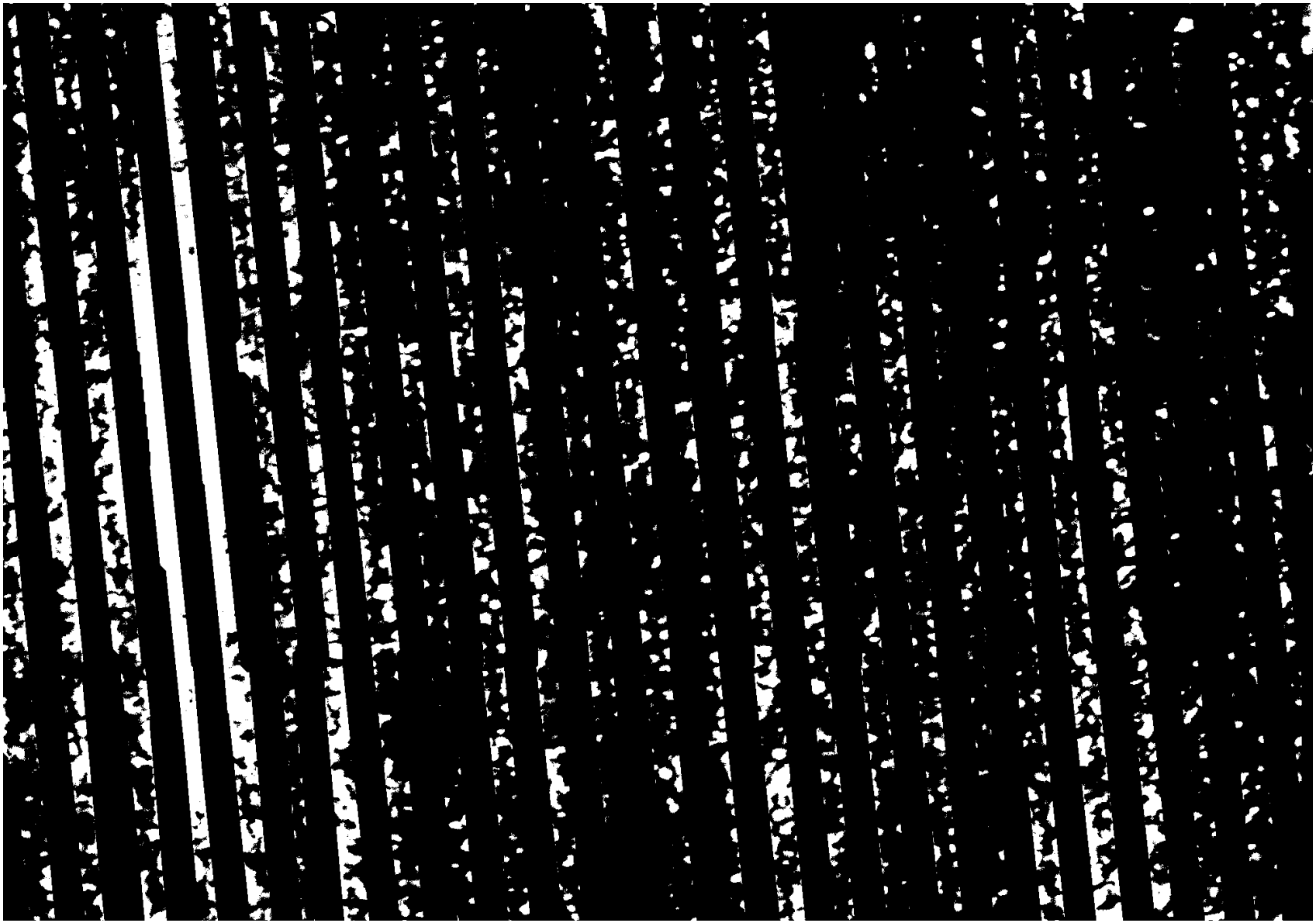
Detected crop rows



Detected crop rows – thickened



Weed map



Emphasis on weeds

Computation transcript

```
10:29:27 Loading mosaic.
10:29:45 Converting to excess green.
10:29:48 Scan over mosaic.
10:35:15 Writing image with detected crop rows.
10:35:35 Writing weed map mosaic.
10:35:39 Loading mosaic.
10:35:49 Creating map with emphasis on weed patches.
10:36:42 Done.
```

Computations

- Number of analysed tiles
  - $14 \times 35 = 490$
- Total computation time
  - 10 min
- Platform
  - Matlab
  - Intel Core I7-3740QM
  - 2.7 GHz
  - 28 GB RAM
  - Ubuntu 14.04 64 bit

Conclusion

Given an orthomosaic we can make a weed map through the following actions

- Split into smaller tiles
- Locate crop rows in each tile
- Combine tiles
- Thicken detected crop rows
- Remove vegetation in the detected crop rows

Funding and questions

Ministeriet for Fødevarer, Landbrug og Fiskeri
NaturErhvervstyrelsen
gudp