Feasibility of an AI-powered observatory for crop yield prediction using satellite images

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Image created using DALL·E 3

Satellite images & cropland & Vegetation index

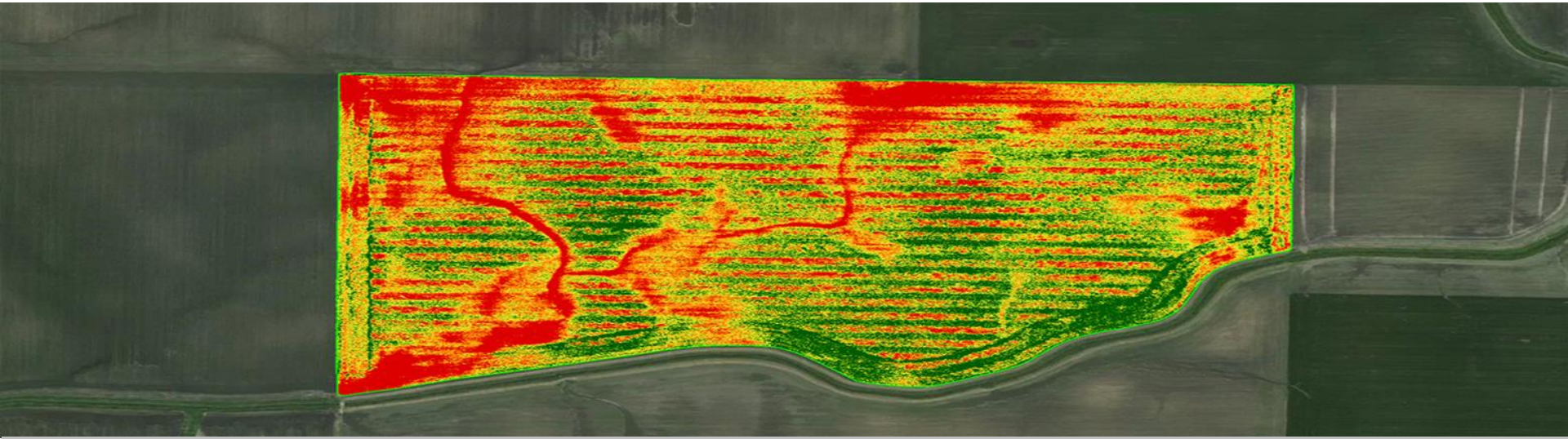


Image source: Helimetrex. "Multispectral NDVI Surveys." URL: https://www.helimetrex.com.au/multispectural-ndvi-surveys/ (Accessed on October 20, 2023)

NDVI = (NIR – RED)/(NIR + RED)

NDVI: Normalized Difference Vegetation Index, NIR: near-infrared, RED: red light

Crop biomass and yield

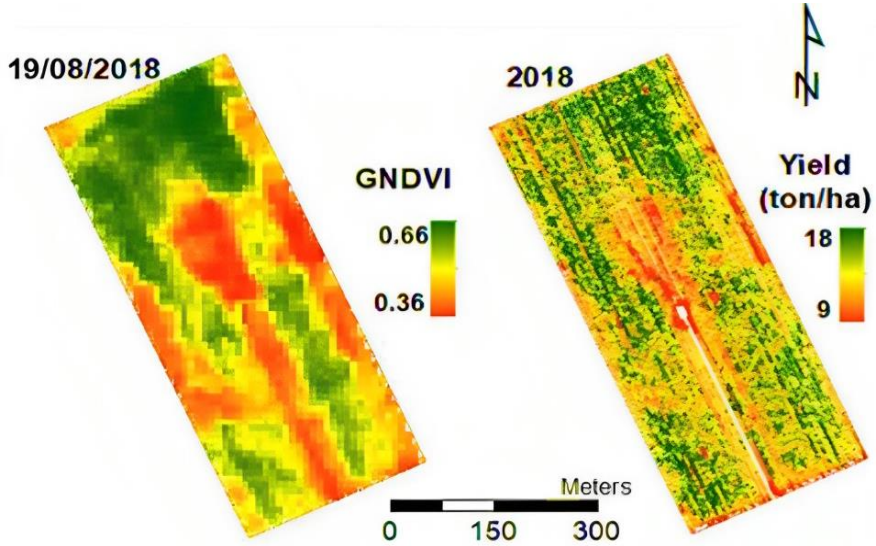
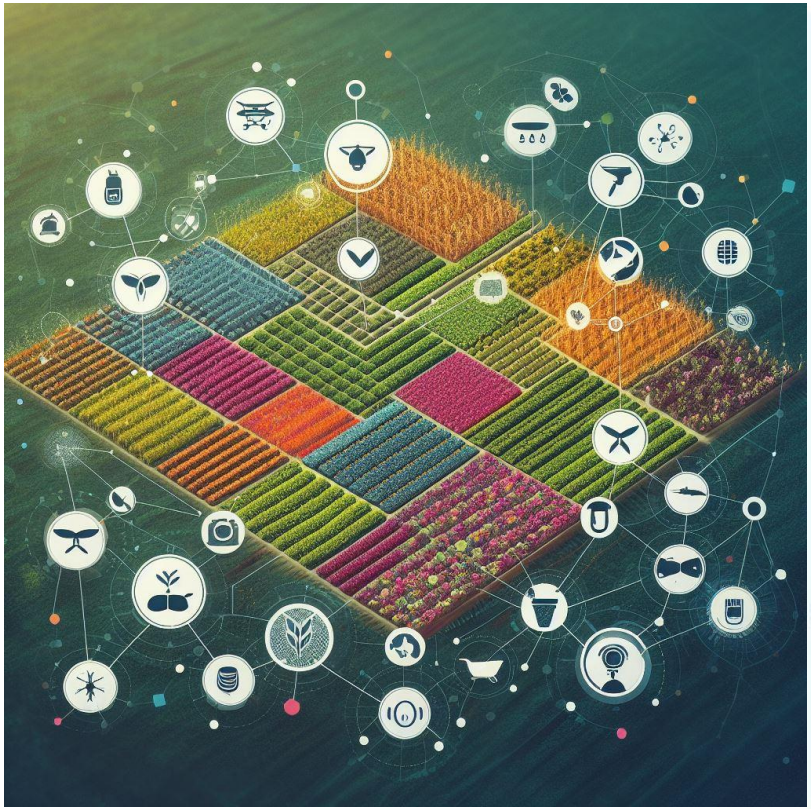


Image created using DALL·E 3

Kayad, A. et. al 2019

Disease detection



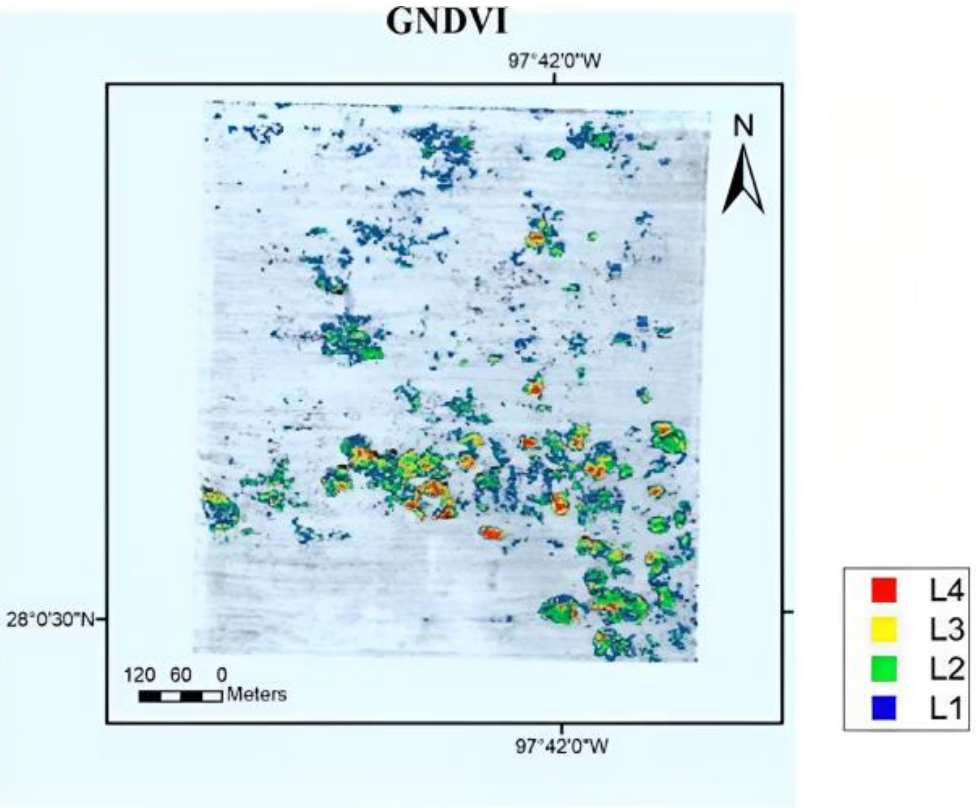


Image created using DALL·E 3

Zhao, H., et. al 2020

Research Gap

- Traditional methods of gathering cropland information involve time-consuming manual data collection
- Large-scale segmentation of maize fields remains underrepresented

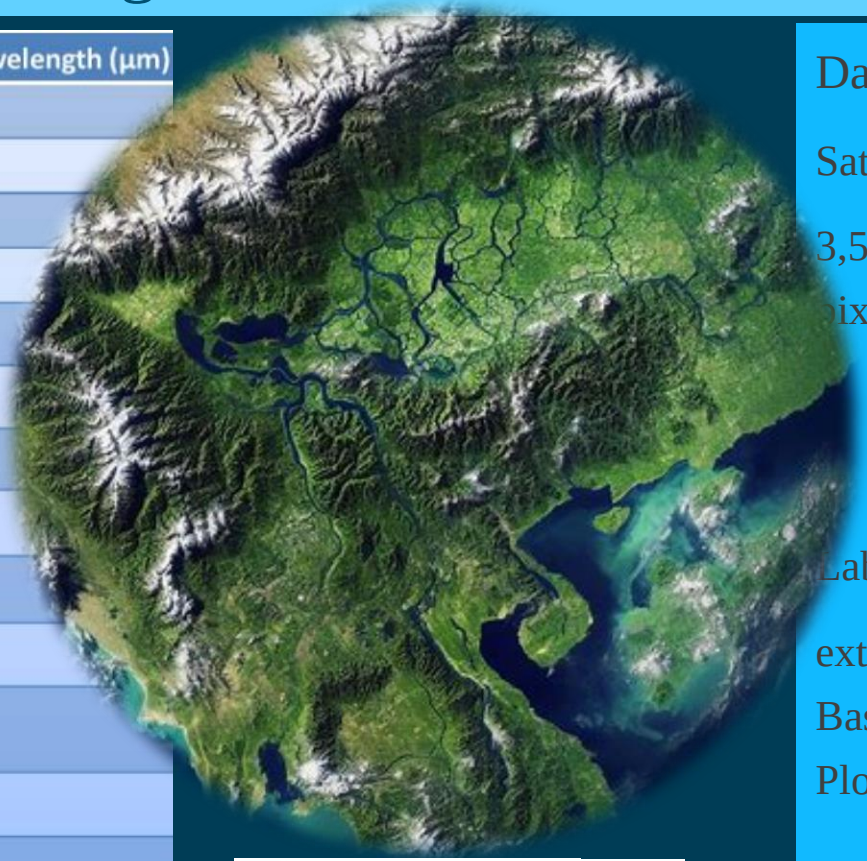
Image created using DALL-E 3

Research aim

Assess feasibility of AI-powered cropland segmentation on satellite images, ultimately to be used for crop yield prediction

Image data from Sentinel 2

Sentinel-2 Bands	Central Wavelength (µm)
Band1 - Coastal Aerosol	0.443
Band2 - Blue	0.490
Band3 - Green	0.560
Band4 - Red	0.665
Band5 - Near Infrared	0.705
Band6 - Near Infrared	0.740
Band7 - Near Infrared	0.783
Band8 - Near Infrared	0.842
Band 8A - Near Infrared	0.865
Band 9 - Water Vapour	0.945
Band 10 - Shortwave Infrared (Cirrus)	1.375
Band 11 - Shortwave Infrared	1.610
Band12 - Shortwave Infrared	2.190



Data:

Satellite images:

3,500 km^2 (35,000,000 pixels) in the Netherlands.

Label: maize land

extracted from the Dutch Basic Registration of Crop Plots (BRP) database.

Image created using DALL·E 3

Methods

Model: nnU-Net deep learning framework

Input: Thirteen-band multispectral images.

Output: Binary segmentation maps for maize land

Model development: Data was split into train set (80%) and hold-out test set (20%) based on geographical location

Model evaluation: Performance was assessed using Dice coefficient and intersection over union (IoU).

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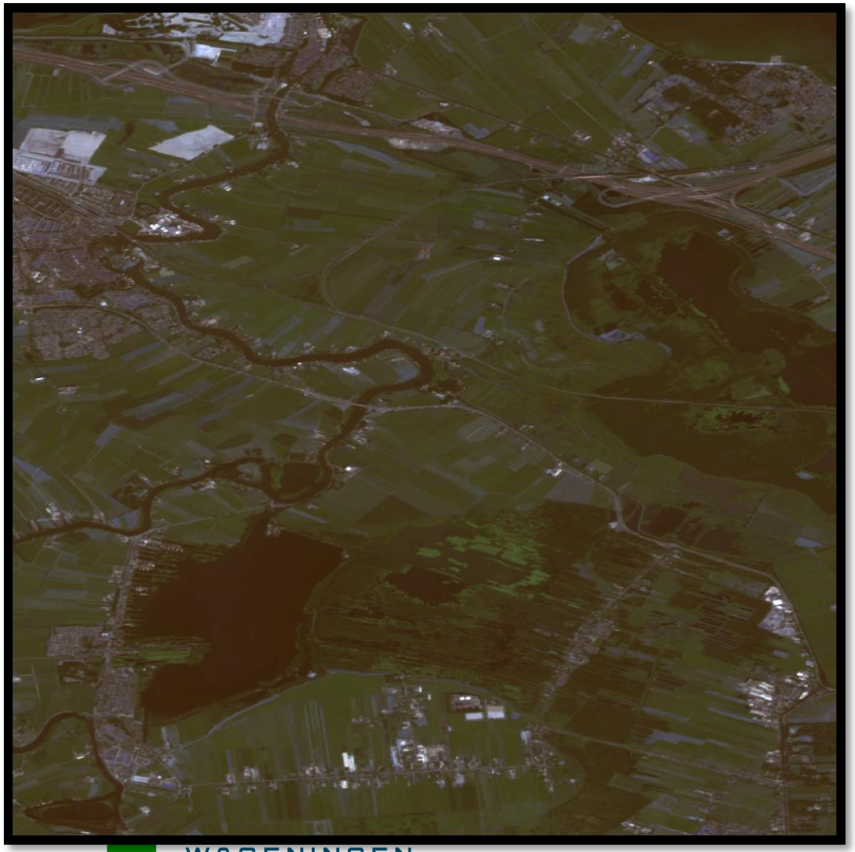
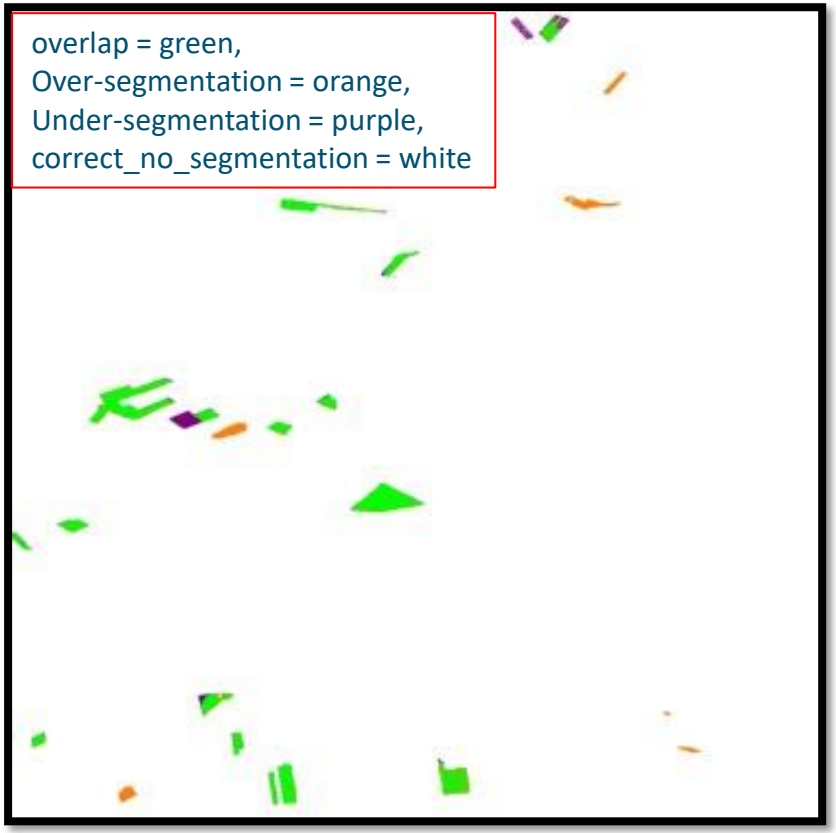
Results



AI



Dice coefficient of 0.88 and an IoU of 0.78

Discussion

- Automated cropland segmentation
- Entire Europe
- Time-series
- Other crops

Application

- Counting of cropland
- Crop growth
- Crop yield
- Irrigation & nitrogen management

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AI-powered observatory is feasible for crop growth monitoring and yield prediction using satellite images

Eco Ready holi food EFRA EXTREME FOOD RISK ANALYTICS

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