Crop yield prognosis using ML and EO data

Peter Fogh – Data Scientist at SEGES

GeoPython 2021

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STØTTET AF

Promilleafgiftsfonden for landbrug

Agenda

1. Yield map prognosis
2. Model development
3. Final product
4. Machine learning DevOps

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Yield map prognosis

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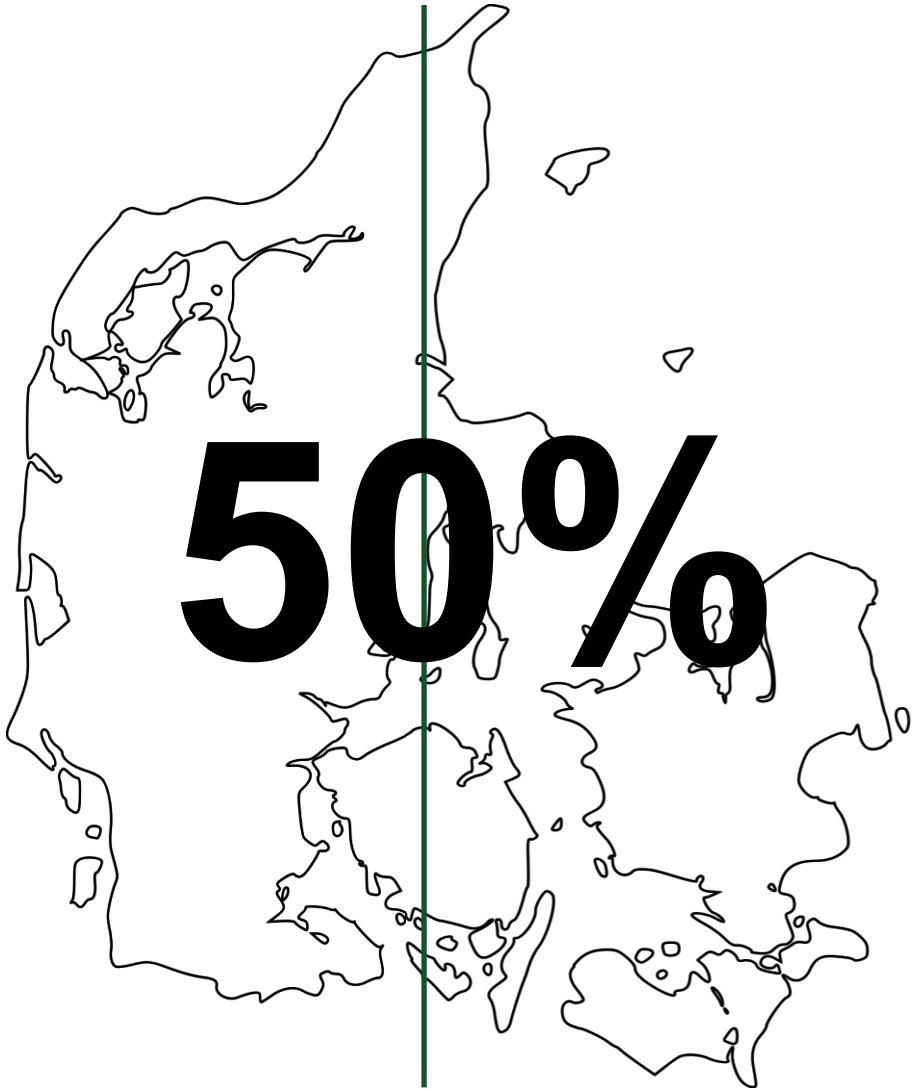

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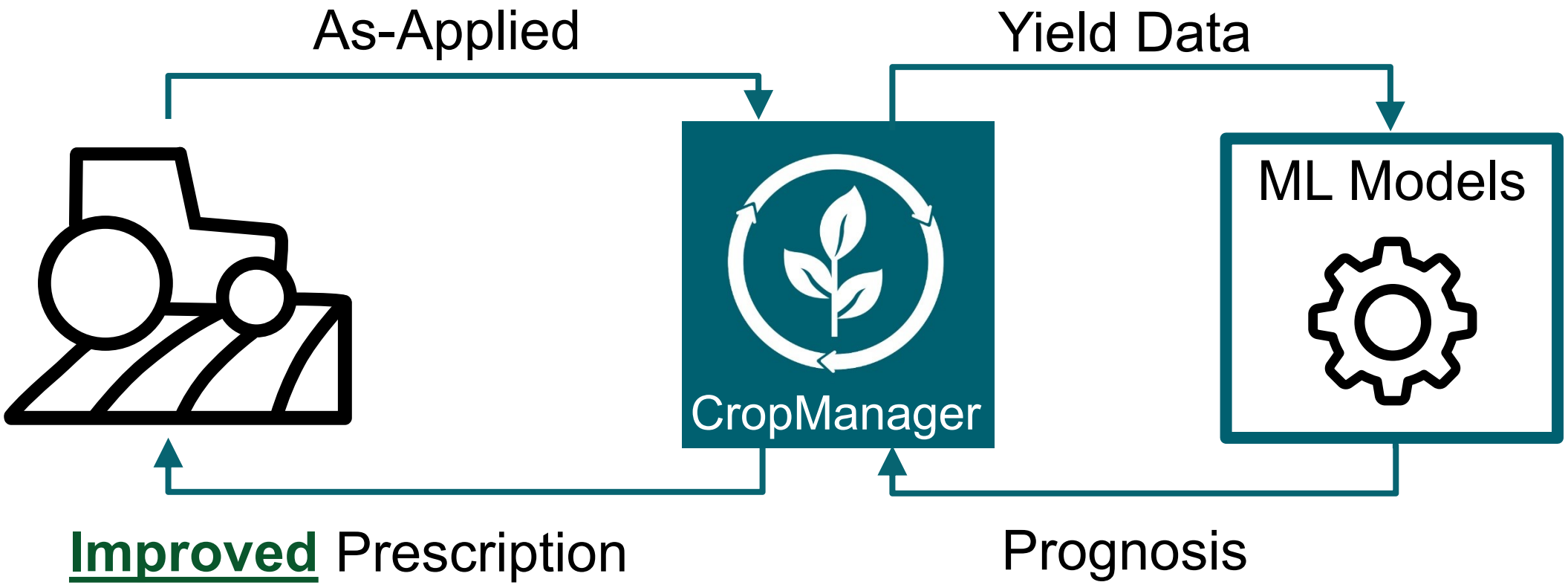
As-Applied
Yield Data
ML Models
CropManager
Improved Prescription
Prognosis

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Model Development

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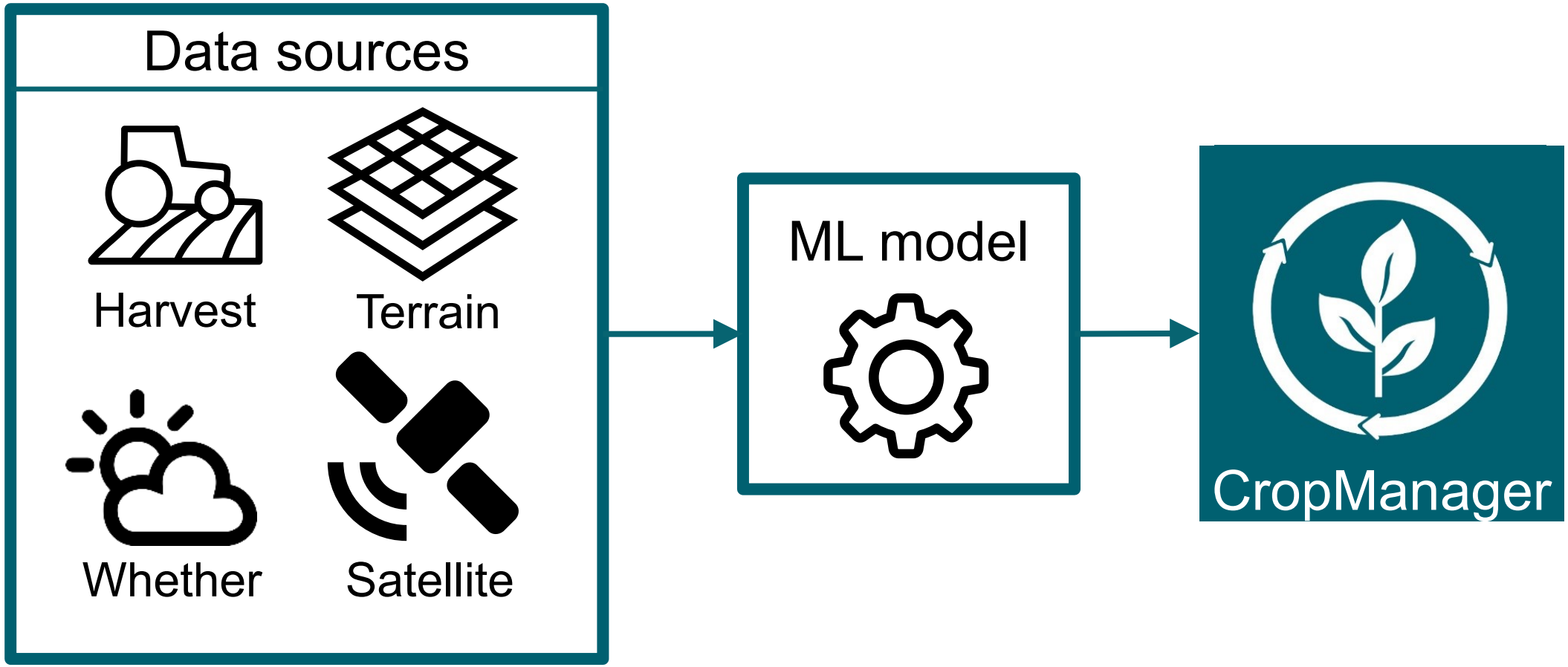
Data sources
Harvest
Terrain
Whether
Satellite
ML model
CropManager

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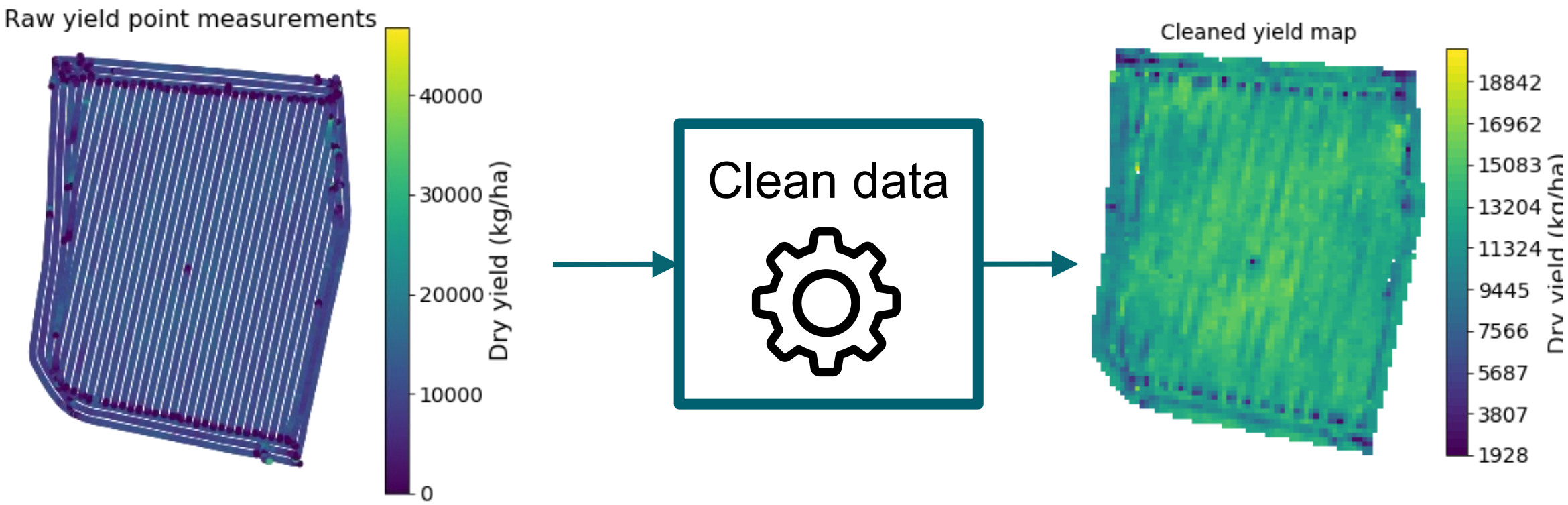
Harvest data



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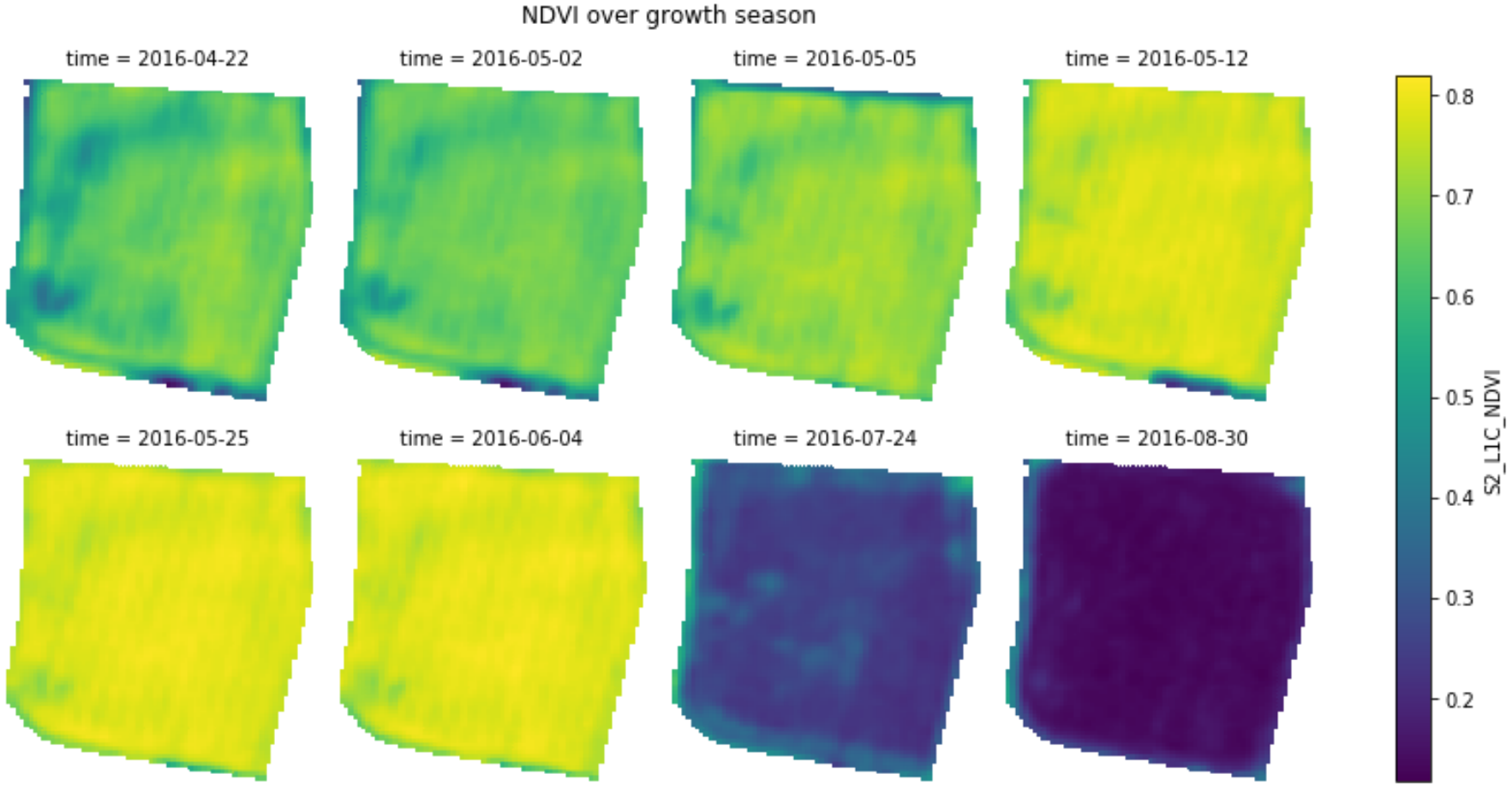
Satellite data



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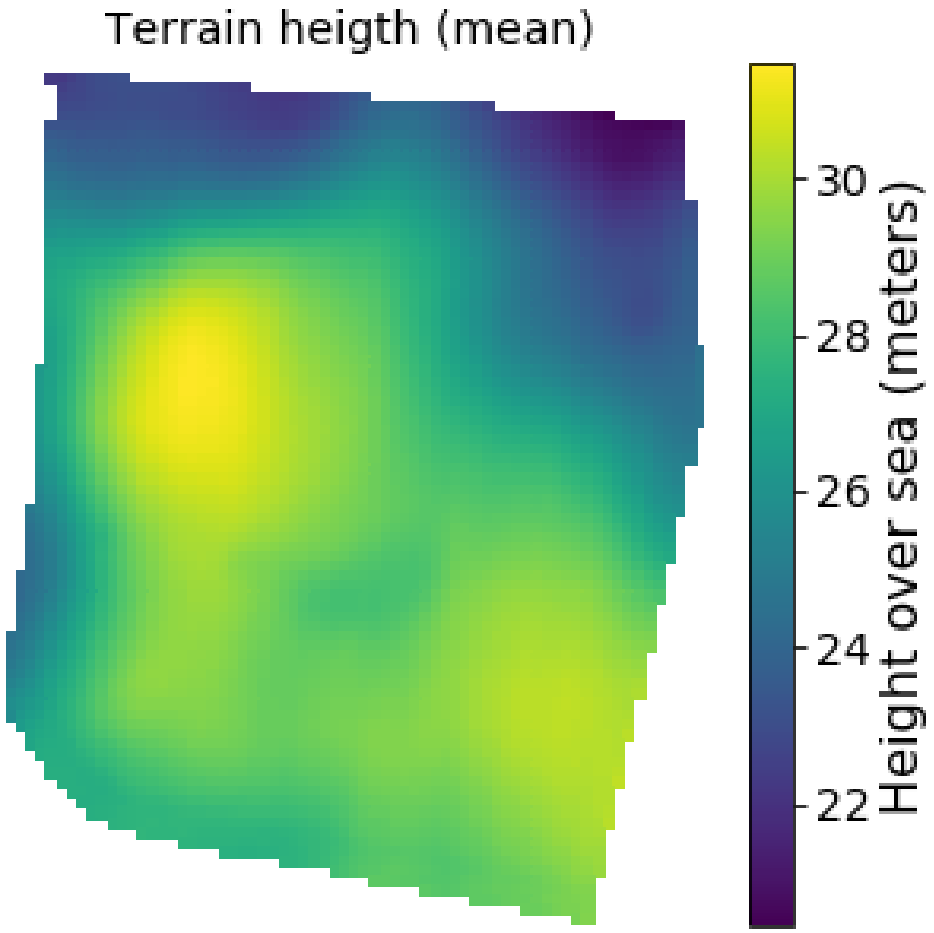
Danish terrain height (DTH)



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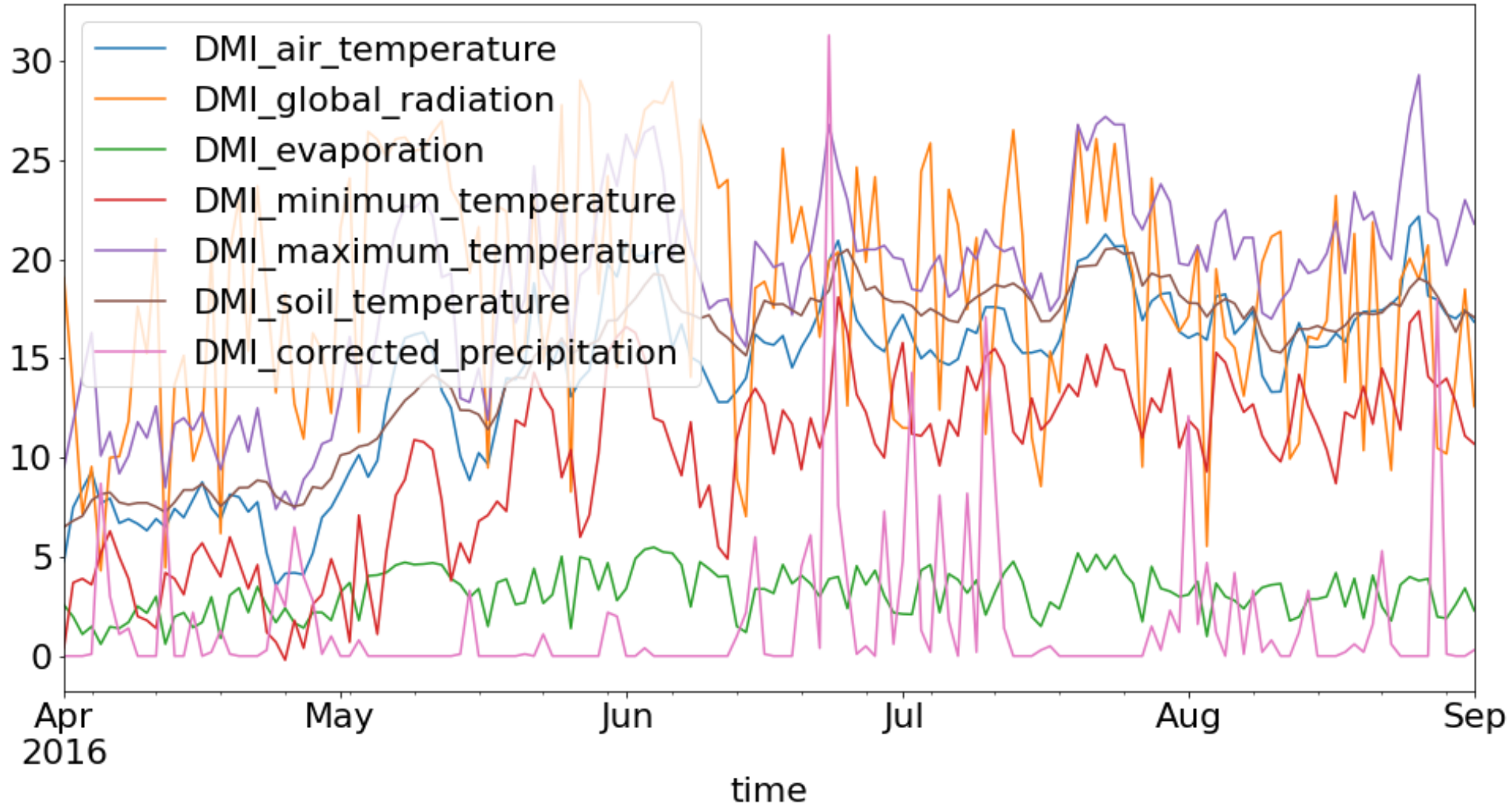
Weather data



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ML models

- **Model objective**:
  - Predict the yield per 5x5 meter within the field
  - Provide a prediction 10th April, 10th May, 15th June, and 6th September
- **ML regression algorithm**: Gradient Boosting from Scikit-learn
- **Non-temporal and spatial model, thus feature engineering is required**:
  - Interpolated temporal data to daily interval and resample it to 14-days interval
  - Training a model for each prediction date, based on data from 9th March to the prediction date
  - One spatially independent prediction per 5x5 meter pixel

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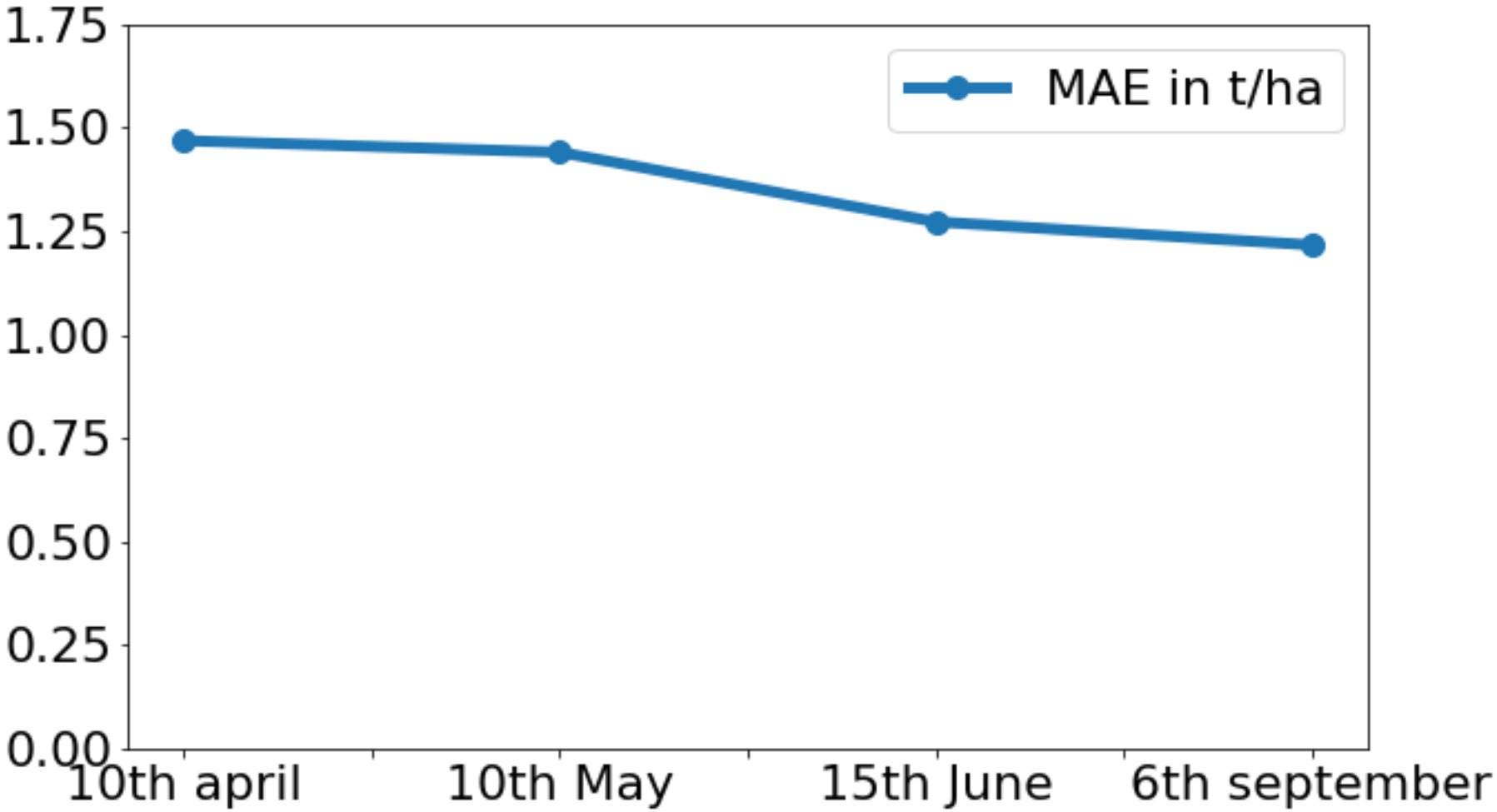
Quantitative validation results



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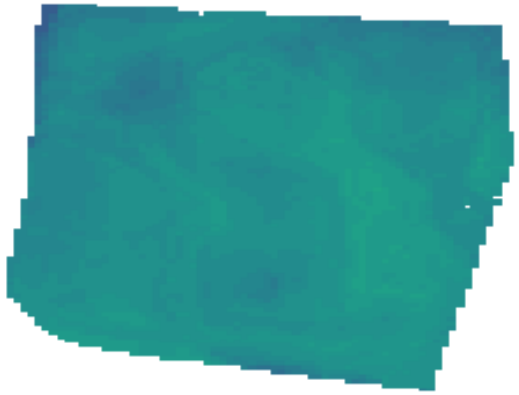
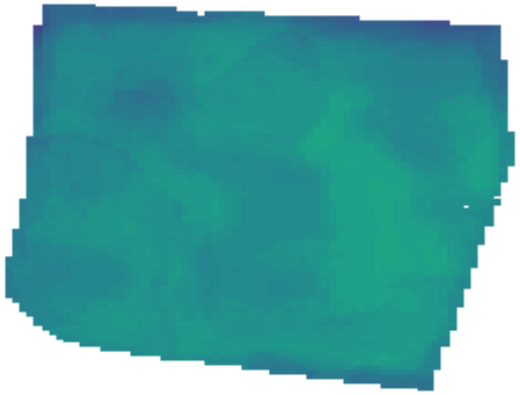
Qualitative results of a whole validation field

Prediction the 10th April
Mean: 10.92

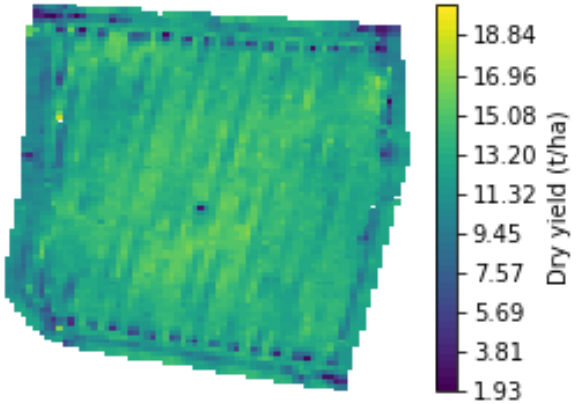


Prediction the 10th May
Mean: 10.90

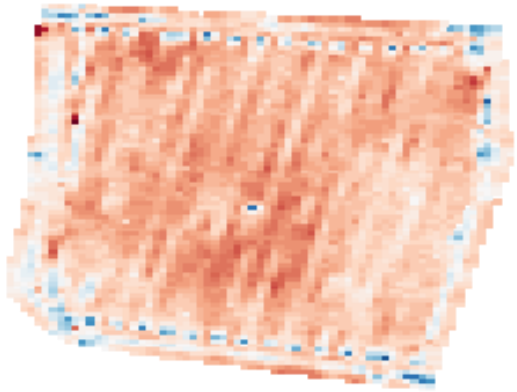


Prediction the 15th June
Mean: 12.17

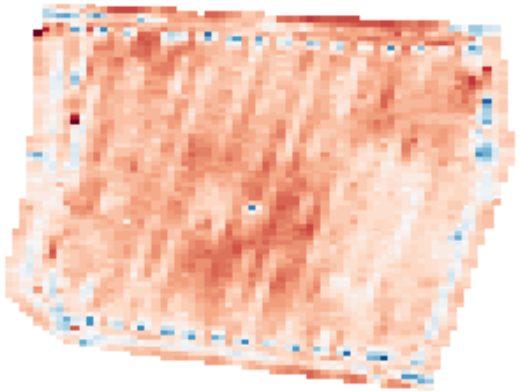
Ground truth measured 17th August
Mean: 12.85



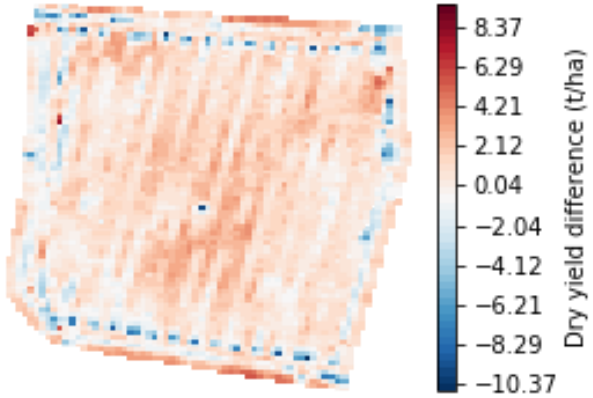
Difference the 10th April model
Mean: 1.94



Difference the 10th May model
Mean: 1.96



Difference the 15th June
Mean: 0.69



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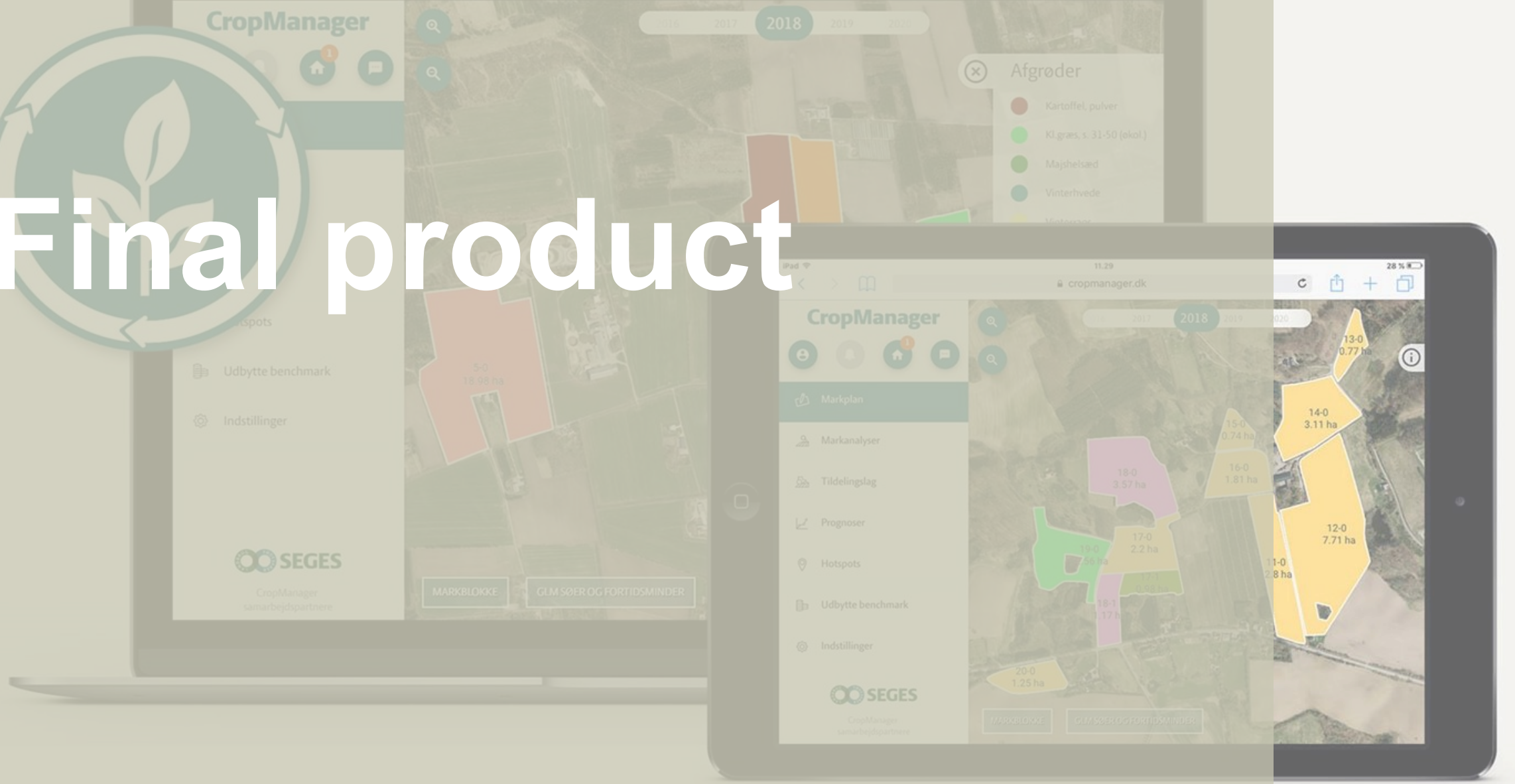
Final product



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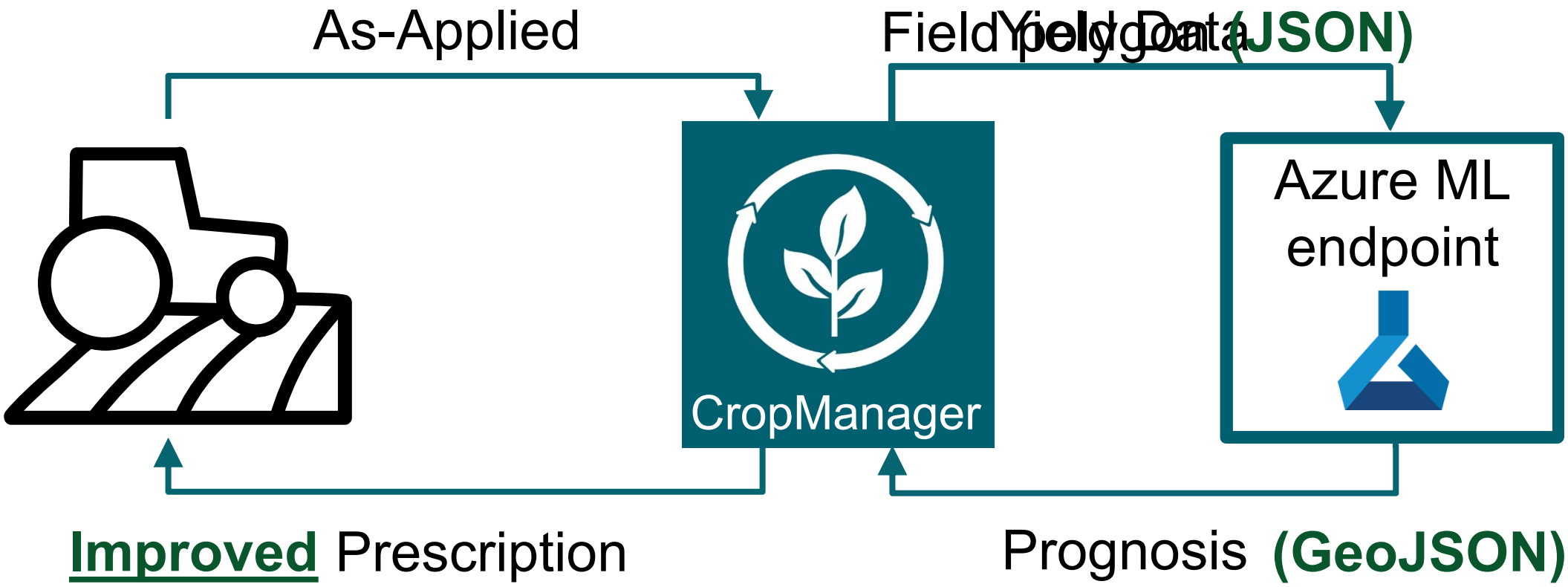
As-Applied
Field Yield Data
Field Yield Data (JSON)
CropManager
Azure ML endpoint
Improved Prescription
Prognosis (GeoJSON)

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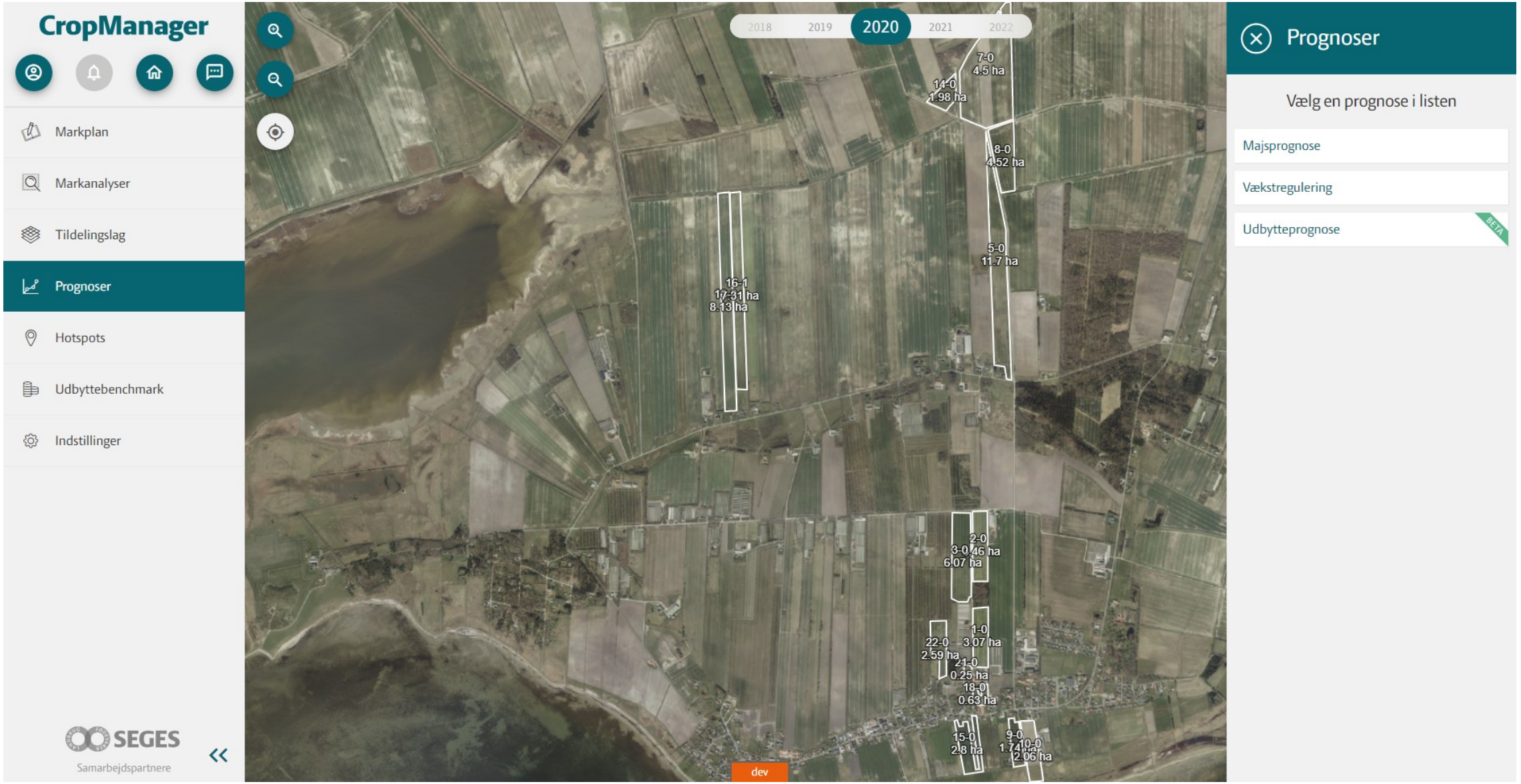

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CropManager
Markplan
Markanalyser
Tildelingslag
Prognoser
Hotspots
Udbyttebenchmark
Indstillinger
SEGES
Samarbejdspartnere
2018
2019
2020
2021
2022
16-1
16-0
8-0
15-0
9-0
dev
Forventet udbytte
Vælg den mark på kortet, du ønsker at se forventet udbytte for

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ML DevOps

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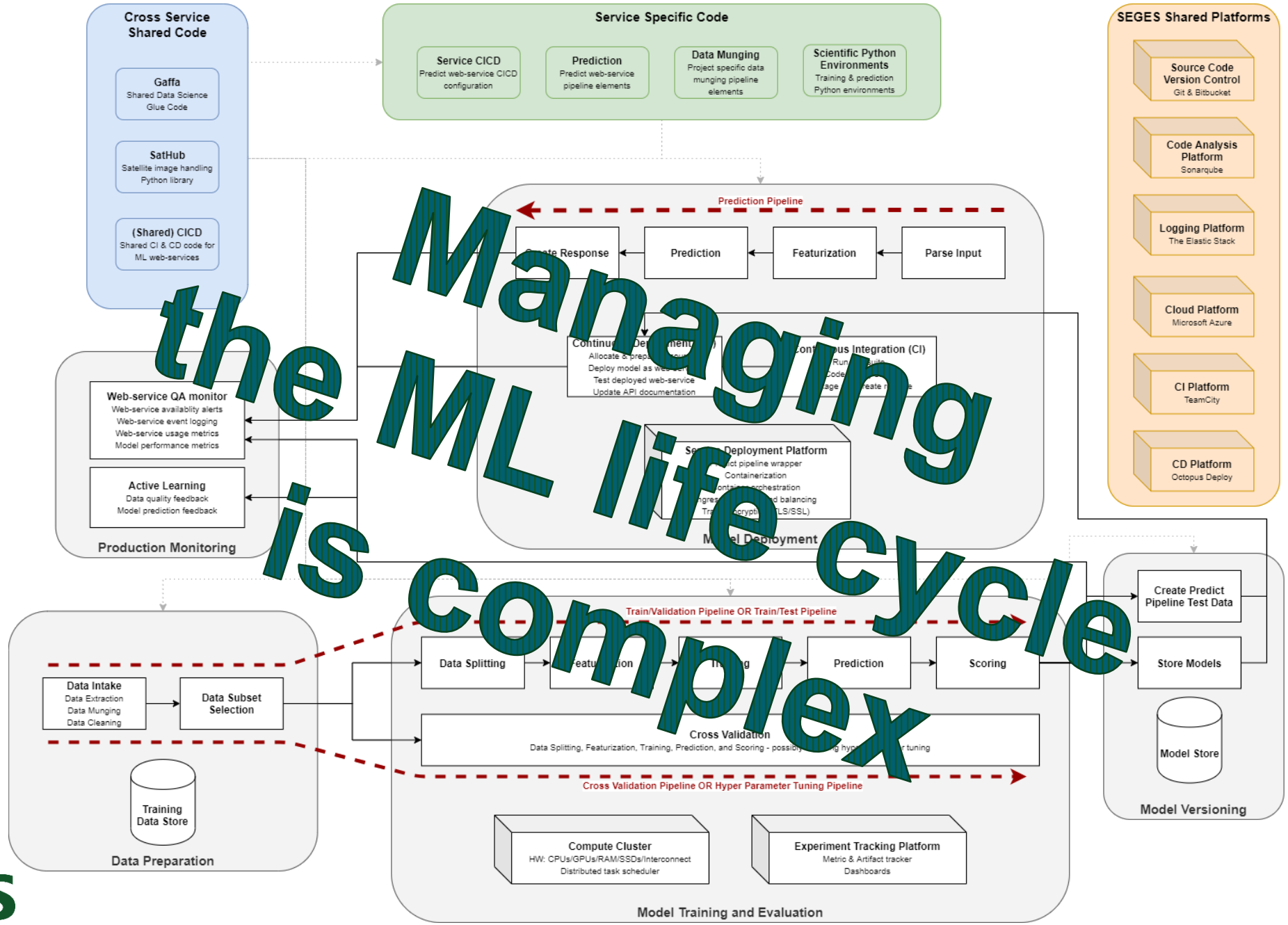

Managing the ML life cycle is complex

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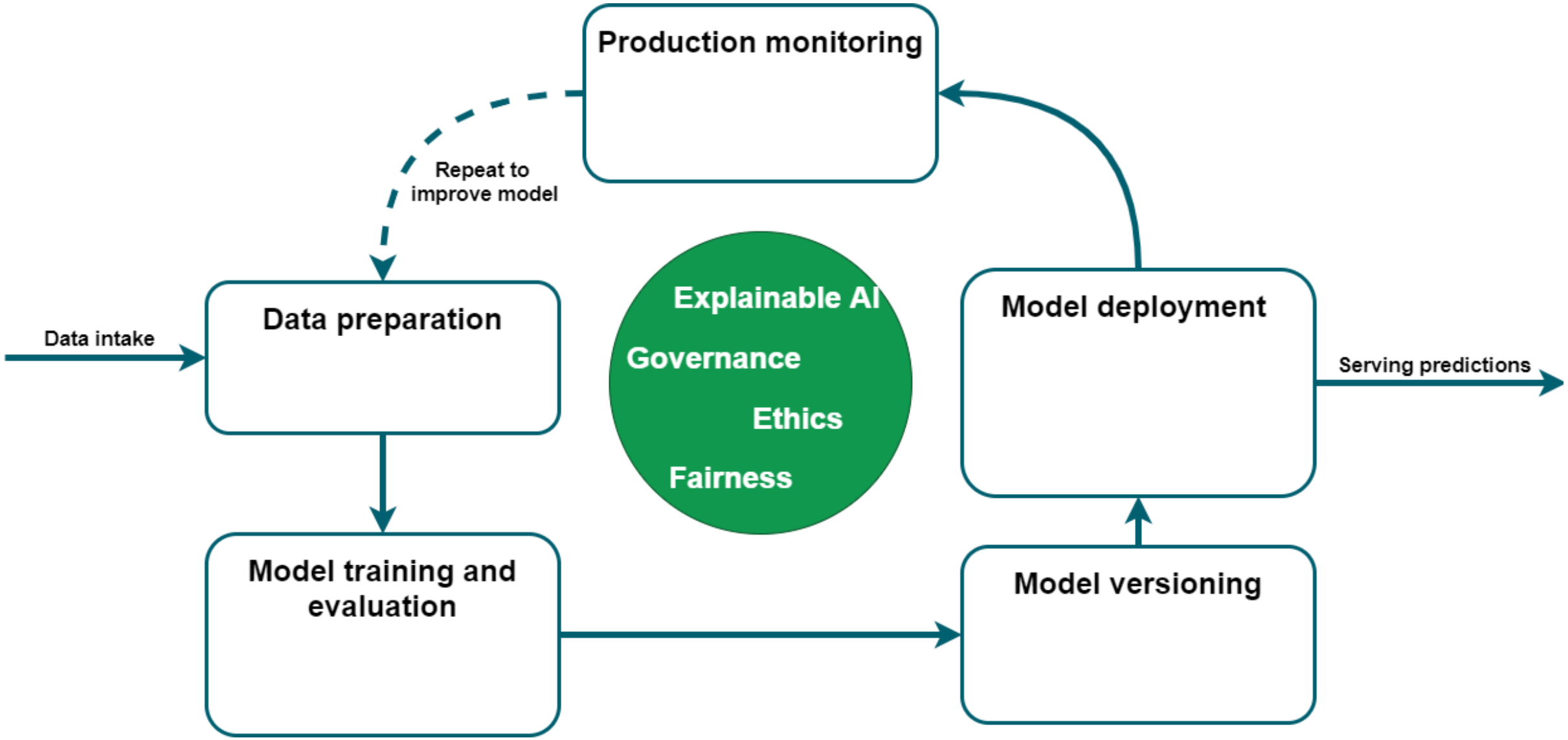
Production monitoring
Repeat to improve model
Data intake
Data preparation
Explainable AI
Governance
Ethics
Fairness
Model deployment
Serving predictions
Model training and evaluation
Model versioning

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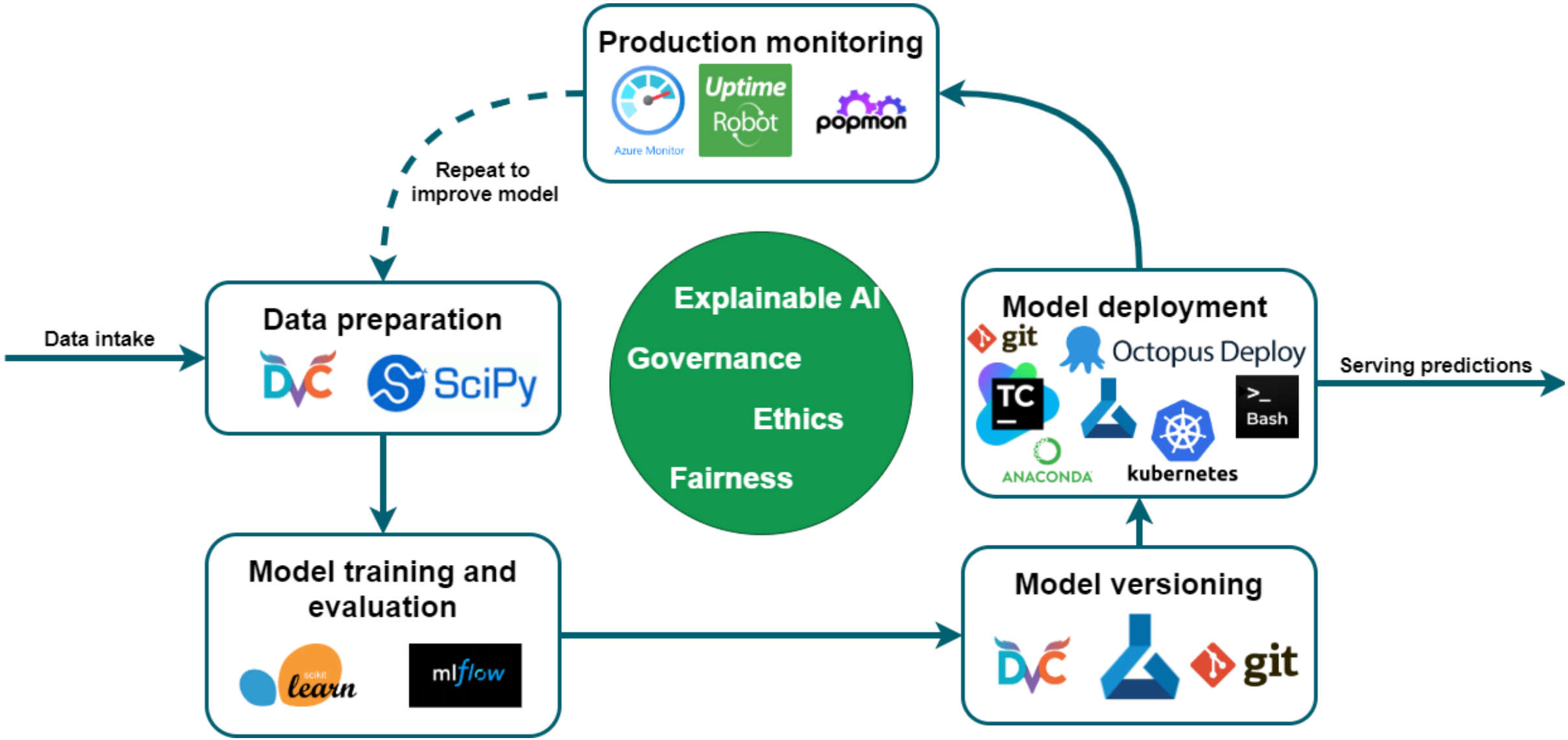

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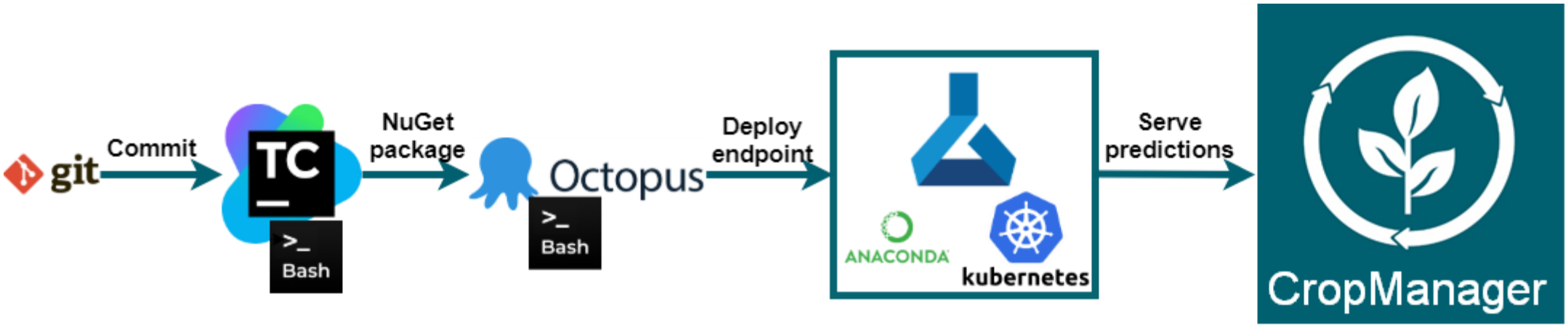
git
Commit
TC
>_
Bash
NuGet
package
Octopus
>_
Bash
Deploy
endpoint
ANACONDA
kubernetes
Serve
predictions
CropManager

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Takeaways

1. Yield map prognosis improves agro management
2. S2 + Gradient Boosting model = MAE of 1.3 ton/ha
3. Yield prognoses in CropManager WebUI
4. ML DevOps is complex – we use SciPy, Git, DVC, MLflow, TeamCity, Octopus, and Azure ML

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Thanks

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