TEAGASC RESEARCH INSIGHTS
LEADING RESEARCH FOR TOMORROW'S AGRI-FOOD SYSTEMS

Watching grass grow

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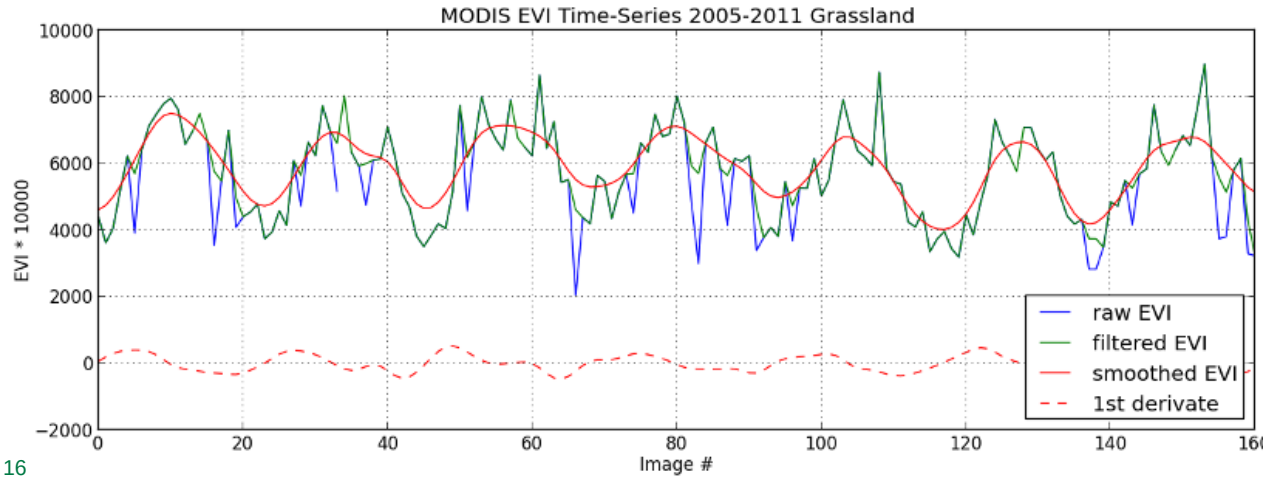
Grassland Monitoring Approaches

- Traditional methods
  - Visual assessment
  - Cut and dry
  - Rising platemeter and PastureBase
  - Field spectrometry
- Remote sensing methods
  - Optical remote sensing
  - Microwave remote sensing
  - UAV

Ali, I., Cawkwell, F., Dwyer, E., Barrett, B., and Green, S. , “Satellite remote sensing of grasslands: from observation to management—a review”, 2016.



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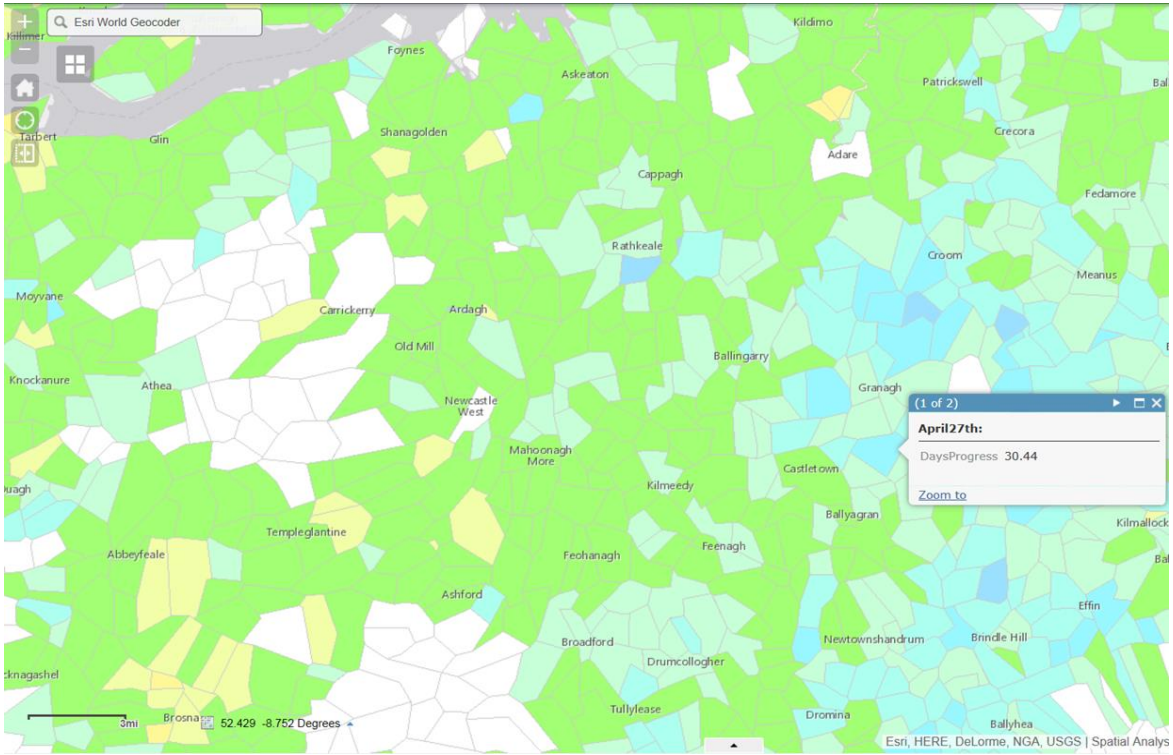
Comparing current grass growth with the satellite record

Looking over 15 years of satellite data allows us to calculate average condition at any point in the year.

Once we know the average we can calculate how current conditions deviate from it.

We produced an online service that showed how many days ahead or behind growth was at a townland scale on a weekly basis



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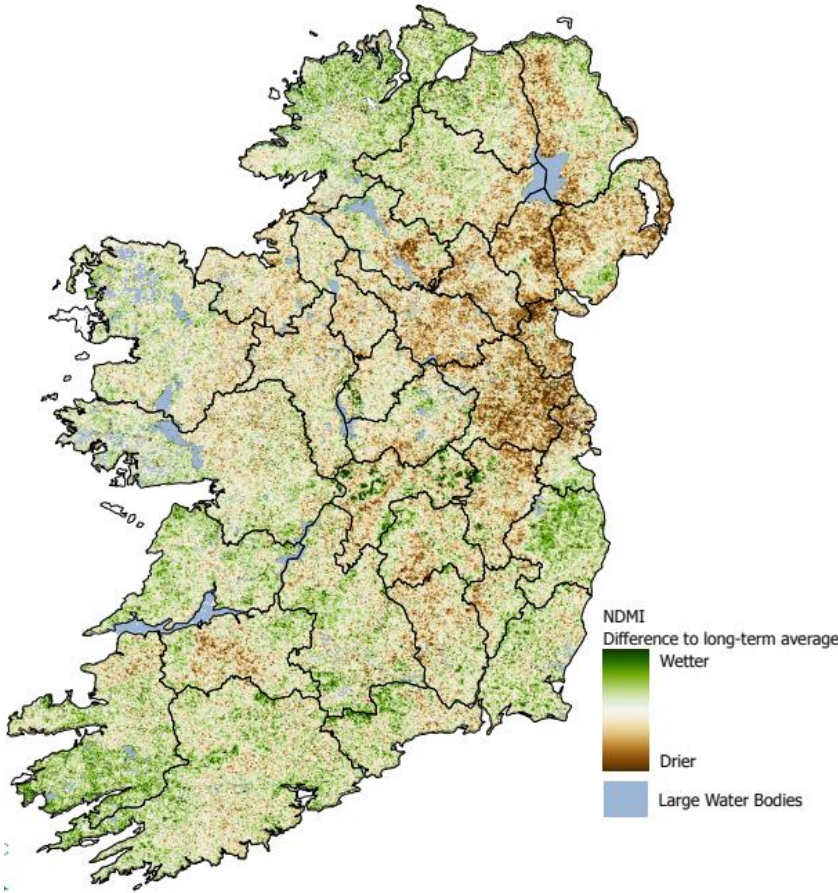
Looking at weather's impact on grass growth

Satellites observe the effect of stress on plants very well and this is the basis of many precision agriculture applications. Here we observe the stress of the dry spell in May last year using the Normalised Difference Moisture Index derived from the satellite data.

The brown areas in the North East were those areas under most stress form the dry spell



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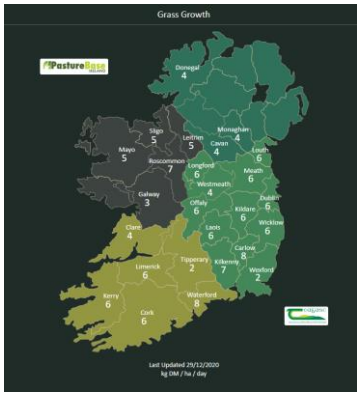
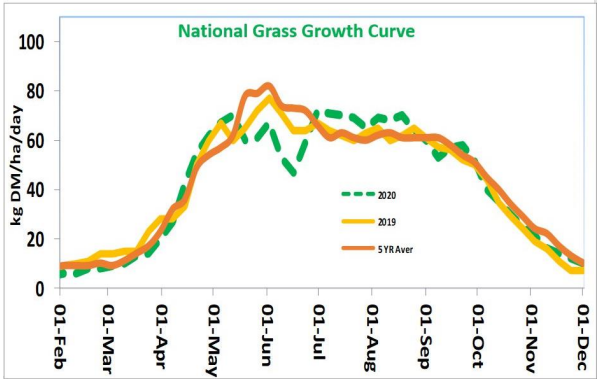
Models to Estimate Biomass Remotely at a national scale

Vegetation index based regression models

Biophysical models

Machine Learning Approaches





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Ali, I., Cawkwell, F., Dwyer, E., and Green, S., "Modeling managed grassland biomass estimation by using multitemporal remote sensing data—A machine learning approach", 2016

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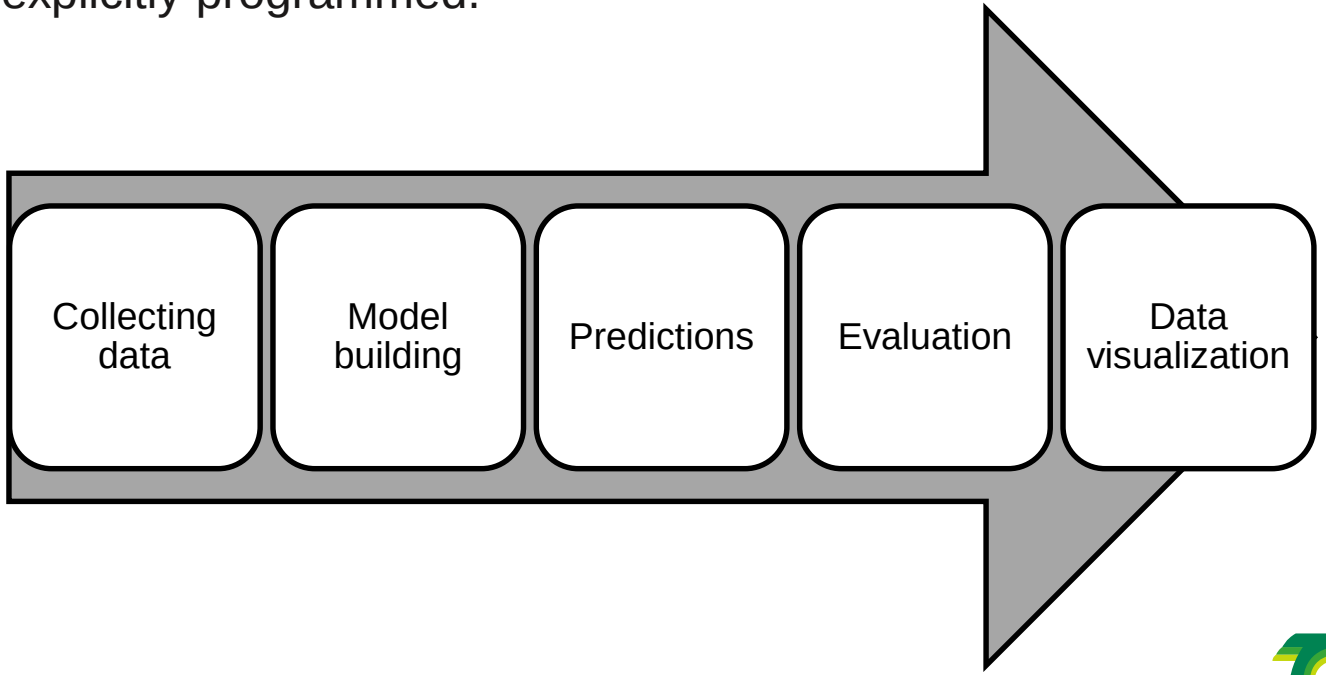
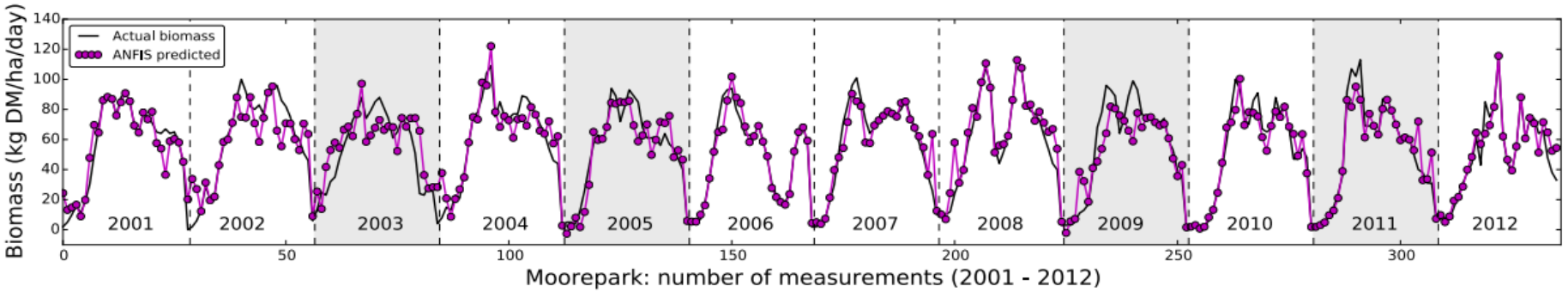
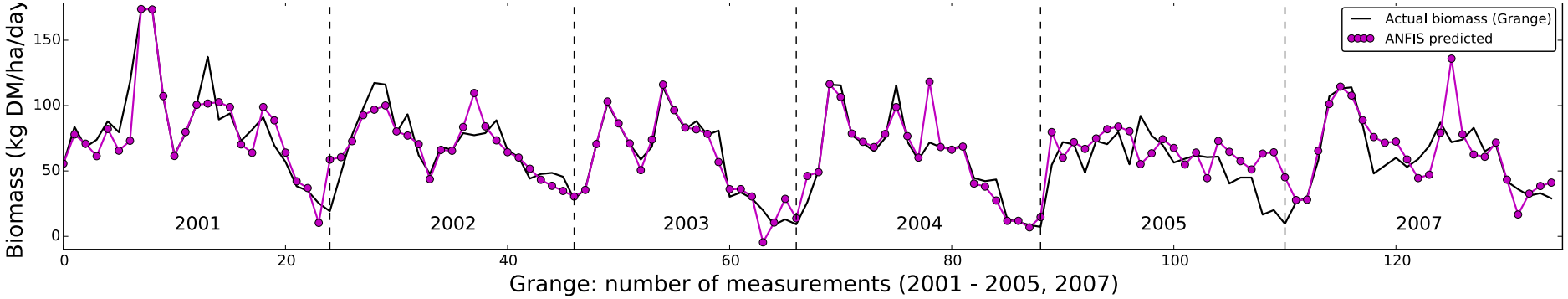
What is Machine Learning?

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.



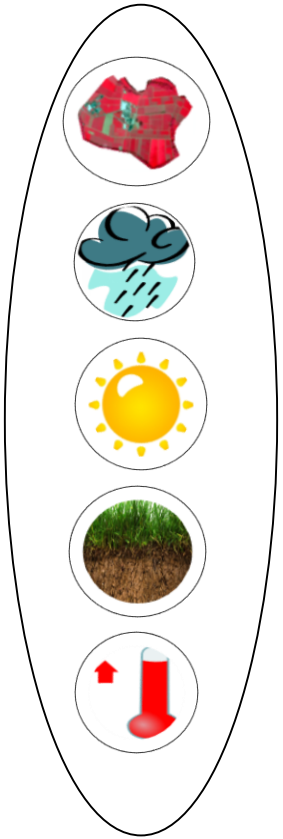
First attempt at Machine learning for time series analysis of grass growth



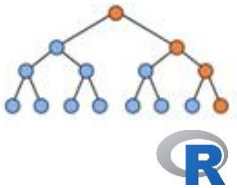


New data and new algorithm

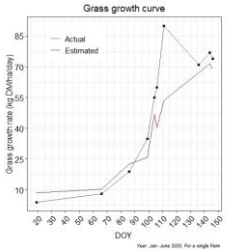
Input data



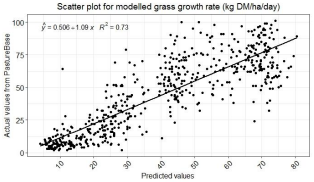
Random forest



Predicted output



Evaluation



Random forest is a supervised learning algorithm. The RF model takes as input data and creates lots of decision trees.

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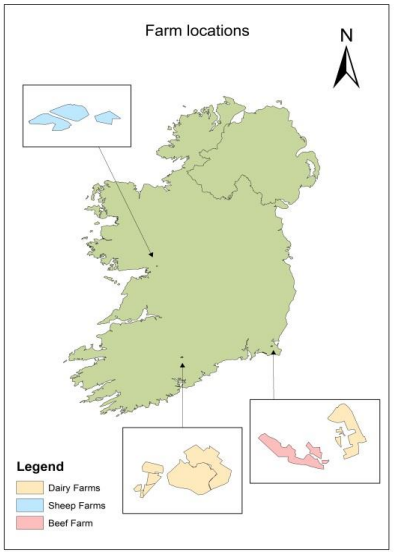
Model transfer to national level

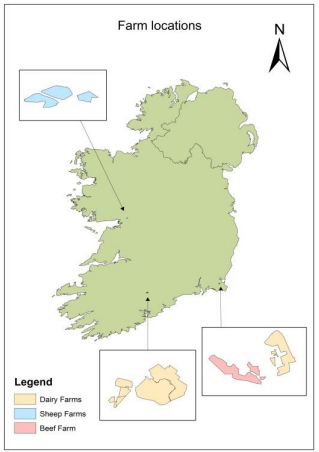
1 site

8 Farms

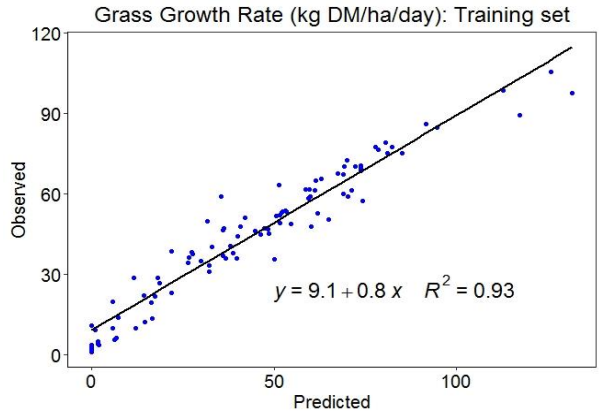


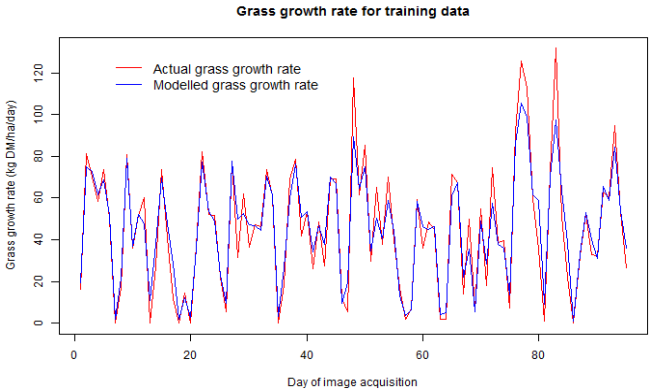
National model:
180 farms

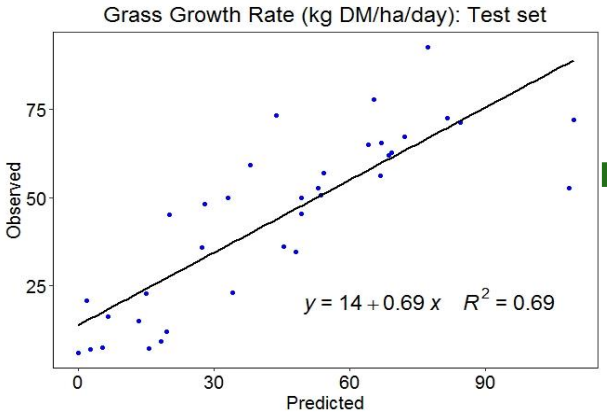
Results



Input data 2017-2018







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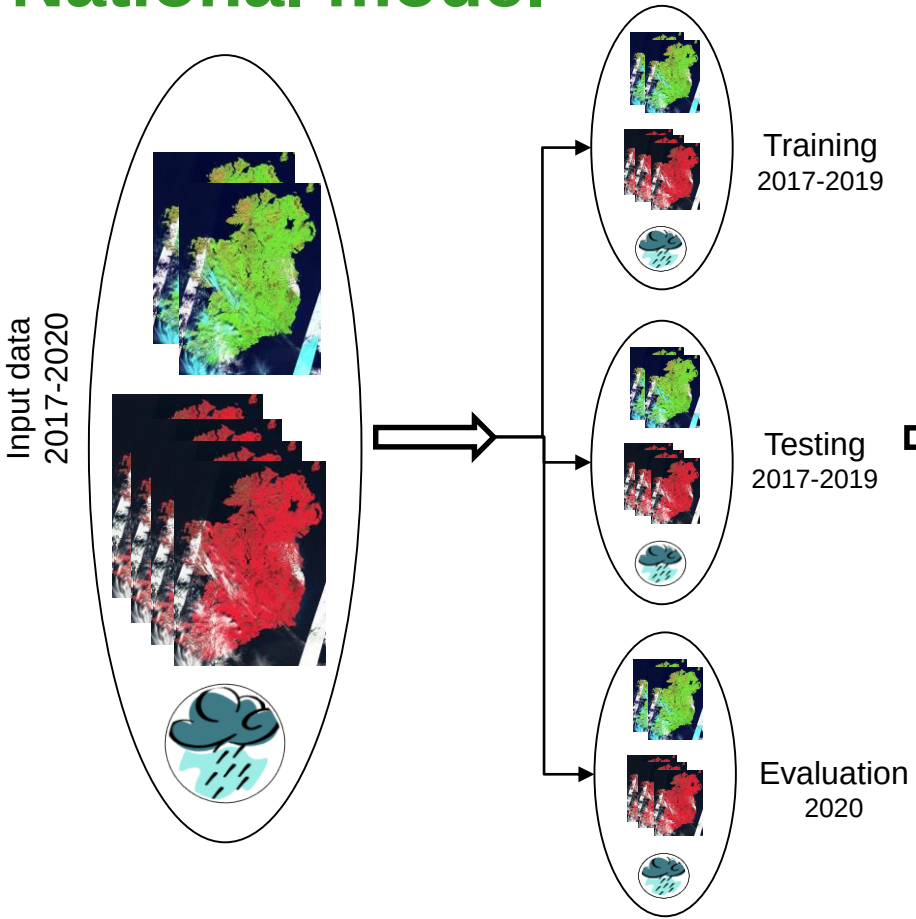
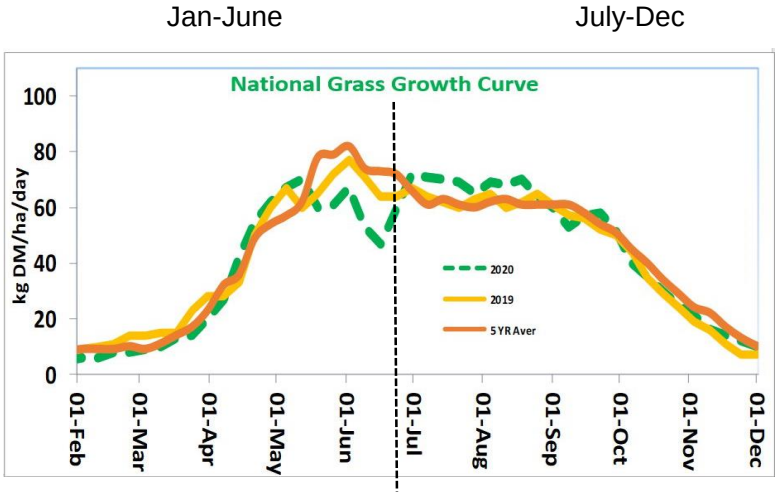
National model



To get a national model, we developed 2 models. One for Jan-June, when the grass growth is high with a peak. Other is for July till Dec, when grass growth is lower



For 180 representative farms

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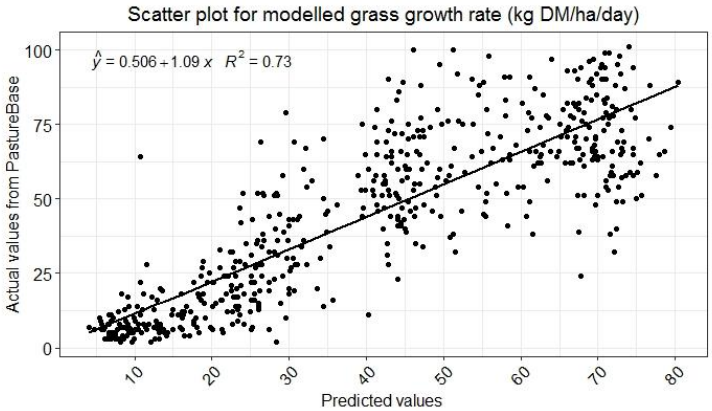
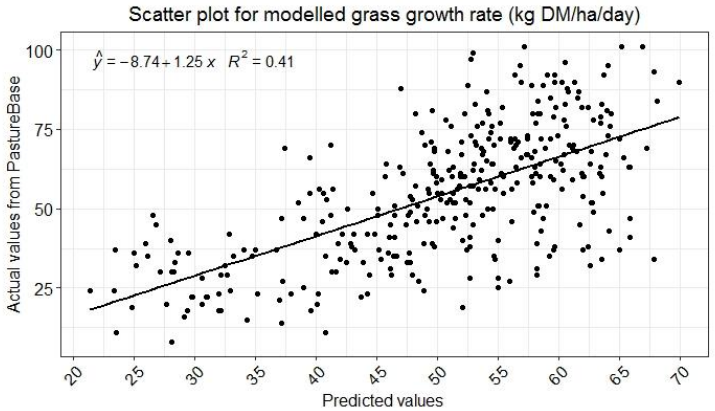
National model results

For 180 Farms

2020





Jan-June

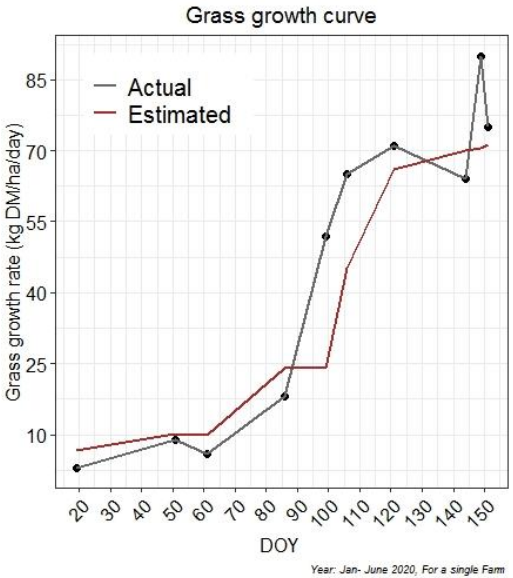
Evaluation data

July-Dec

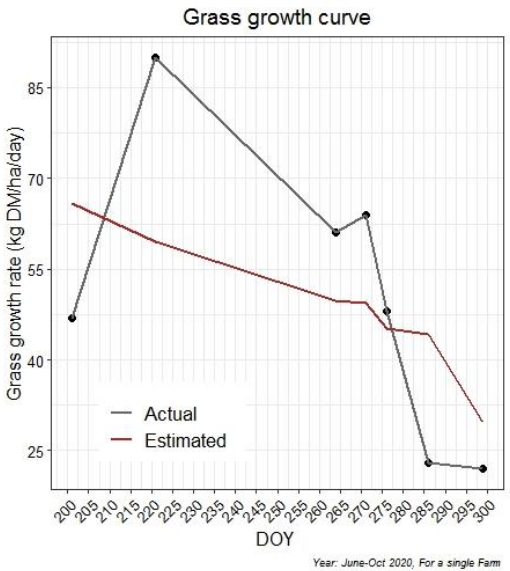
The two models were trained on randomly selected 70% of 2017-2019 data and were tested on 30% of 2017-2019 data and finally evaluated on 2020 data

National model Evaluation

2020 dataset



Jan-June



July-Dec

The trained model (2017-2019) was used to predict for 2020 data which is completely independent of training data.

The grass growth curve obtained from the model is shown for one farm for 2020 data.

Conclusions

- We can successfully map growth rate at farm scale using machine learning and multispectral satellite data
- Satellites give us a national overview of farms
- This model is now in final stages for testing on 2020 data for Munster
- As more satellites come on line with higher resolution for training the machine learning models, we will rely less on the field data

Thank you