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The use of machine learning algorithms to identify drivers of atmospheric ammonia concentrations

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Introduction

- Increasing demand for animal products increases animal population and the volume of manure to be managed
- In Northern Ireland, livestock manure accounts for 89% of agricultural NH_3 emissions
- NH_3 impacts human health, air and water quality, and biodiversity; thus the drivers of NH_3 emissions need to be investigated

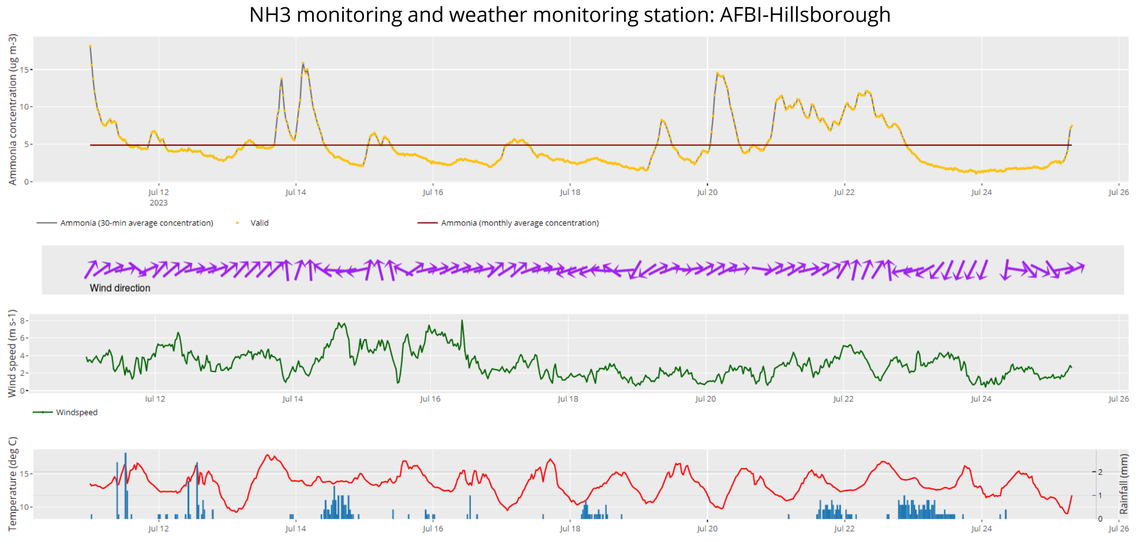
Objective

To investigate the relationships between weather conditions and atmospheric NH_3 concentrations in temperature grassland livestock systems to formulate NH_3 mitigation strategies

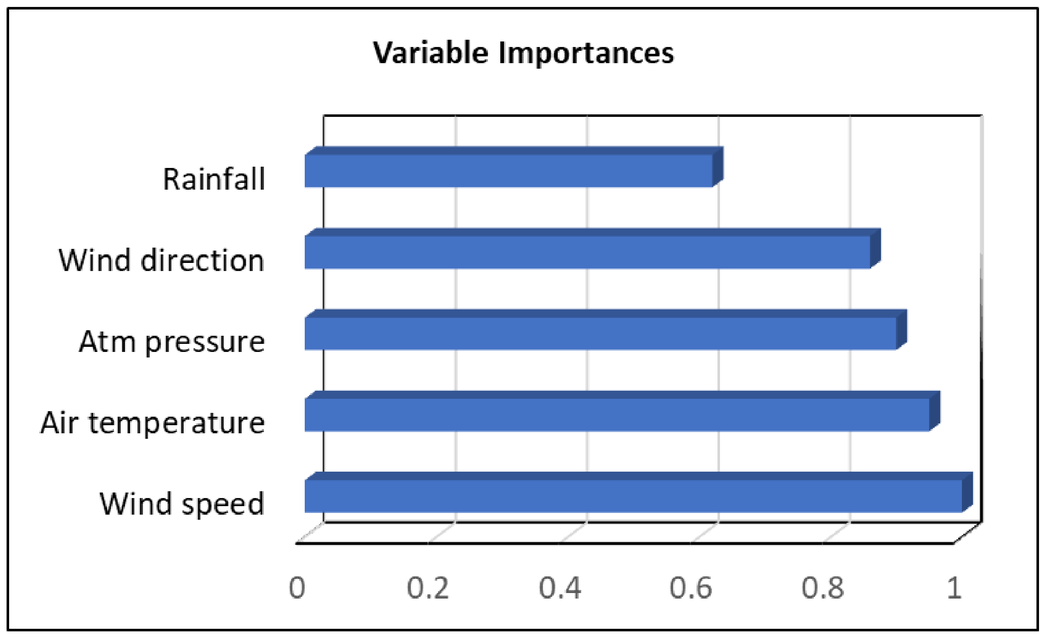
Methodology

- Data used in this study was 30-min averages of NH_3 concentration, air temperature, wind speed, relative humidity, wind direction, rainfall, and atmospheric pressure
- A high-resolution atmospheric NH_3 concentration was monitored at the Agri-Food and Biosciences Institute (AFBI)- Hillsborough Research Farm using Picarro analyser
- Random forest (RF) algorithm available in H_2O Package of R-programming language was used to analyse > 3 years of data (Apr 2019 - Aug 2022)

NH3 monitoring and weather monitoring station: AFBI-Hillsborough

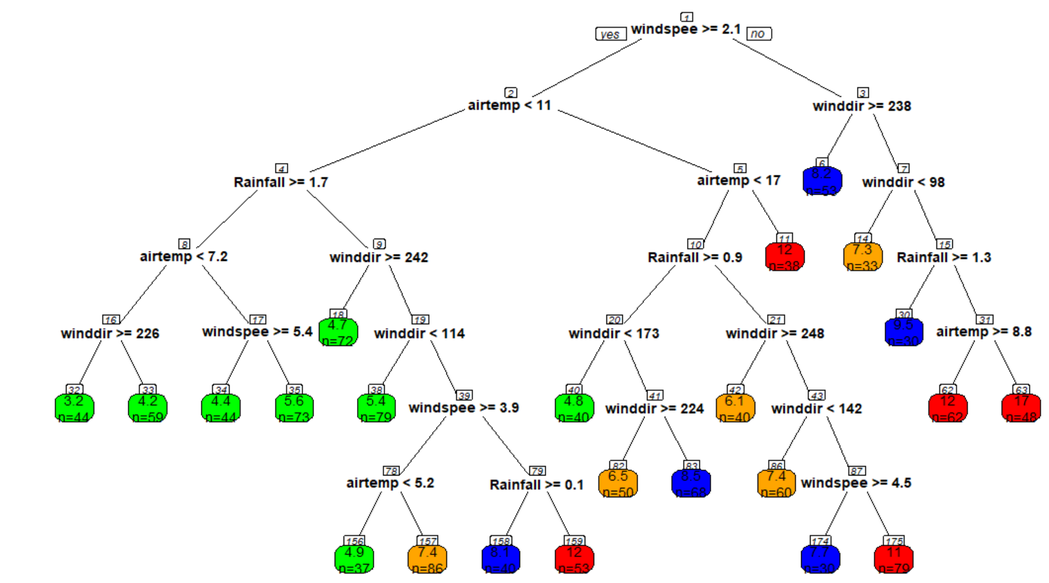


Results



	Continous data	Categorical data*
Model	Regression	Multinomial
R^2	0.19	0.46
MSE	63.8	0.36
RMSE	7.99	0.6

** Data were classified into 3 categories based on quartile distribution: Low (lower 33%), Medium (Middle 67%) and High (upper 33%) emissions*



Conclusions

- NH_3 concentrations are controlled by a complex interaction between farm management activities and environmental parameters
- Wind speed, air temperature, wind direction and rainfall are the important variables for NH_3 concentrations
- Low wind speed, high temperature, and no/low rainfall increase NH_3 concentrations
- Predictability of NH_3 emissions may improve via including field activities such as fertilizer/manure spreading events, but care must be taken while the inclusion of such limited data in RF model as it may remove some continuously measured data