

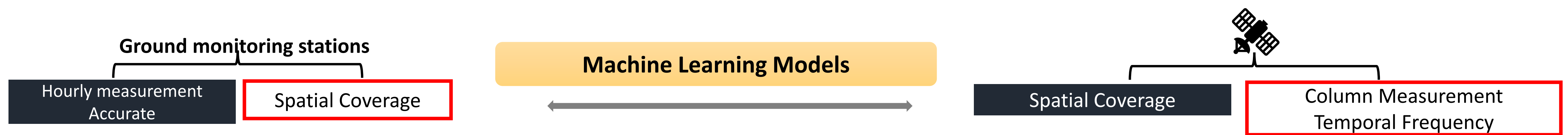
Combining Sentinel-5P and Ground Measurements to estimate surface NO₂ Concentrations over Europe Using Machine Learning Models

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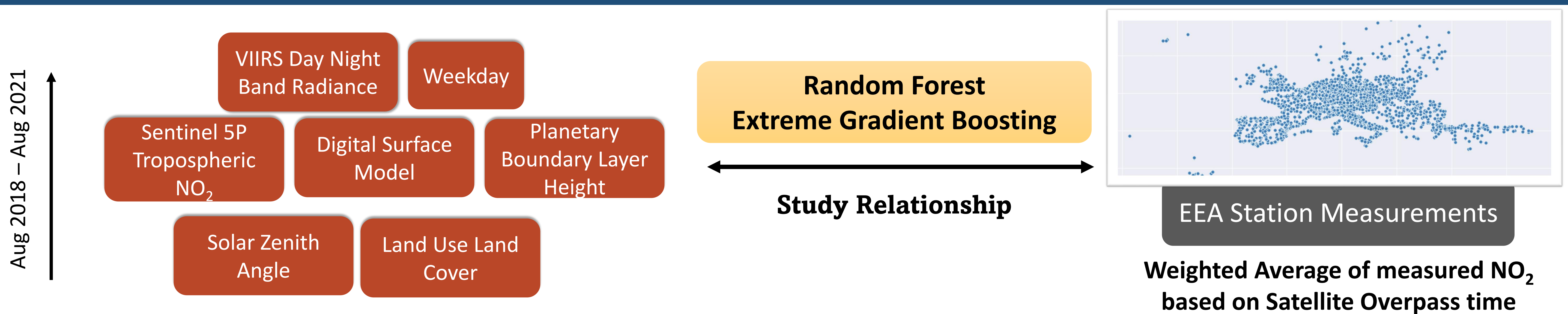
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OBJECTIVE

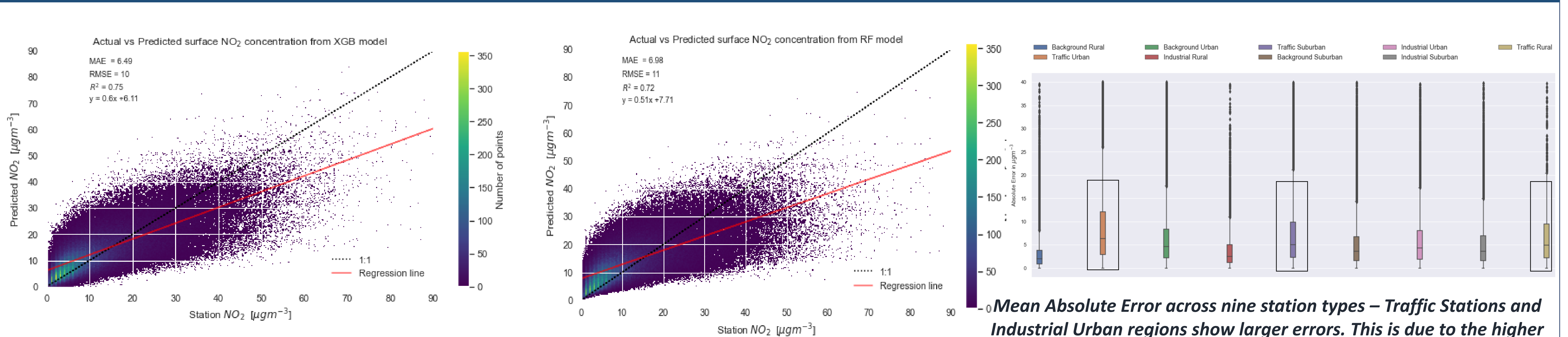
Following a top-down approach for estimating surface NO₂ concentrations using Machine Learning models such as Random Forest and Extreme Gradient Boosting (XGBoost) by combining Sentinel 5P Tropospheric columnar NO₂ data with ground measurements and other datasets.



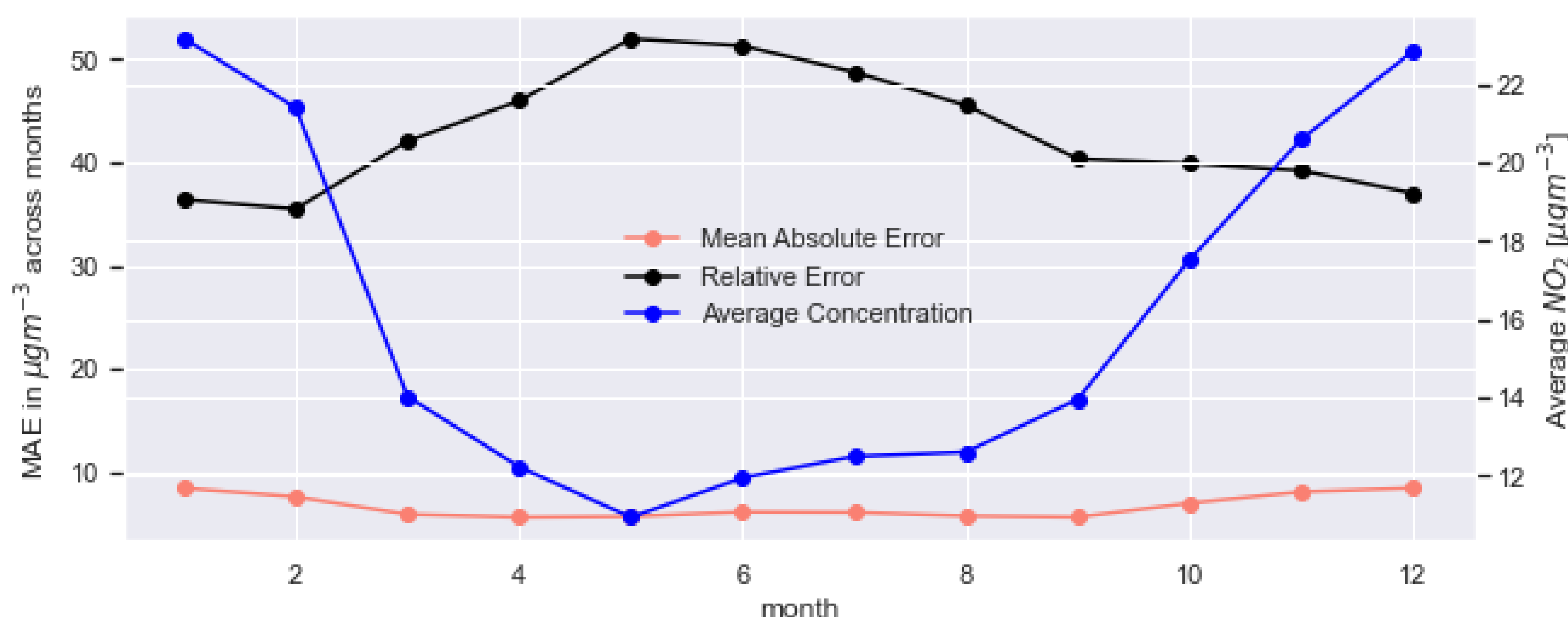
METHODOLOGY



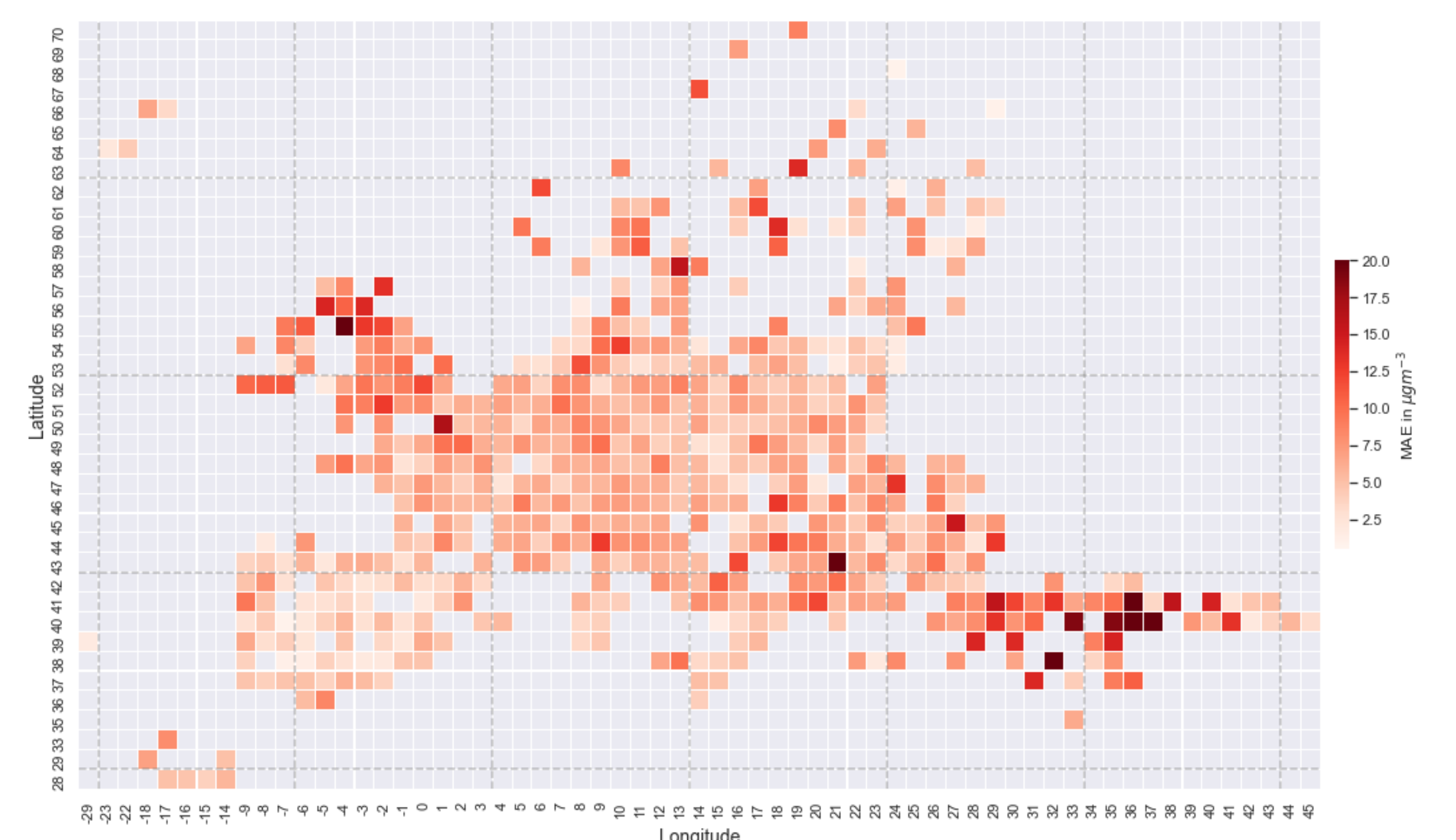
Results



Correlation of NO₂ estimated using Machine Learning models with station measured NO₂. Both the models show similar estimation performance, with comparatively lower errors from XGBoost. Additionally, XGBoost is computationally faster than Random Forest



Predicted error distribution analysis across months against the monthly EEA station average concentration. Model shows relatively good performance in Winter months. Though summer months observe smaller absolute errors from the model, relative errors are higher due to low NO₂ concentration



Error distribution at stations within 10km grid. Low error predictions mostly observed towards central and southern Europe. We can also observe less spread of monitoring stations towards the North

Conclusions

- Machine Learning Models such as Random Forest and XGBoost can estimate surface NO₂ concentration from Sentinel-5P satellite observations with mean absolute error of ~6-7 μg/m³ over larger regions, such as Europe.
- The model estimated surface NO₂ shows correlation of 0.72-0.75 with the ground measurements of EEA stations.
- Model predictions can be further improved by using meteorological variables such as wind speed and temperature.

References

European Environmental Agency. (2020). Air Quality in Europe - 2020 report. 10.2800/786656.