

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

Shobitha Shetty^{1,2}, Philipp Schneider¹, Kerstin Stebel¹, Arve Kylling¹, Paul Hamer¹, Terje Koren Berntsen²

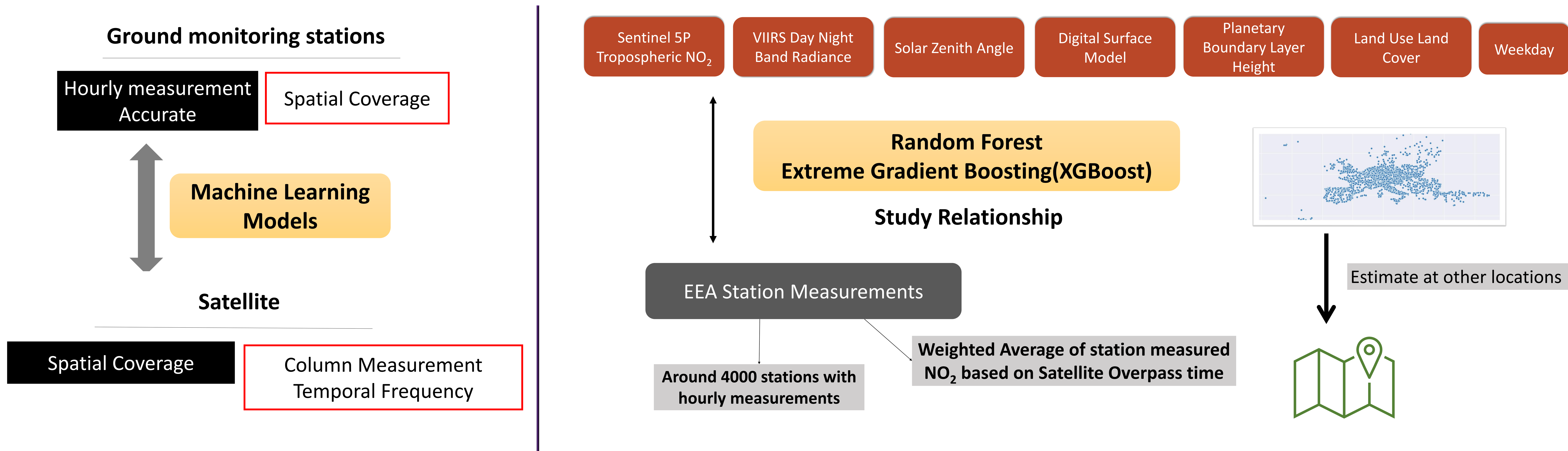
¹NILU - Norwegian Institute for Air Research, Kjeller, Norway; ²Department of Geosciences, University of Oslo, Oslo, Norway

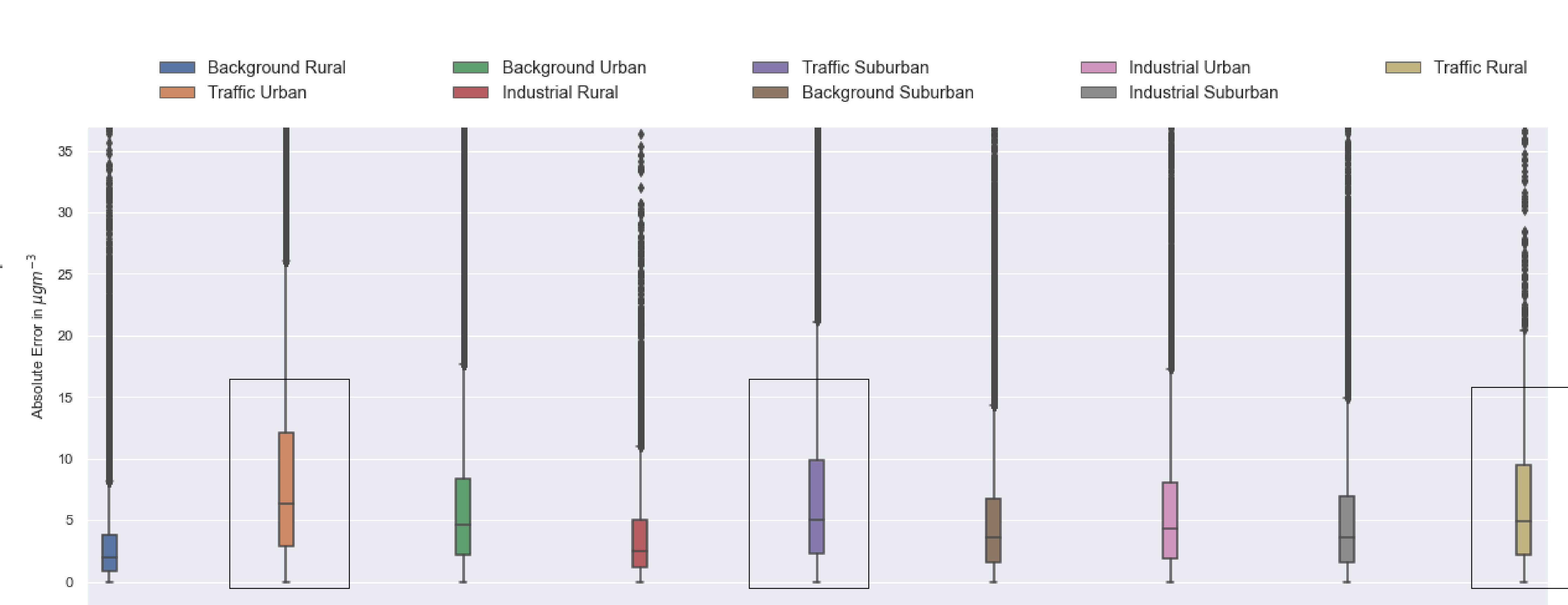
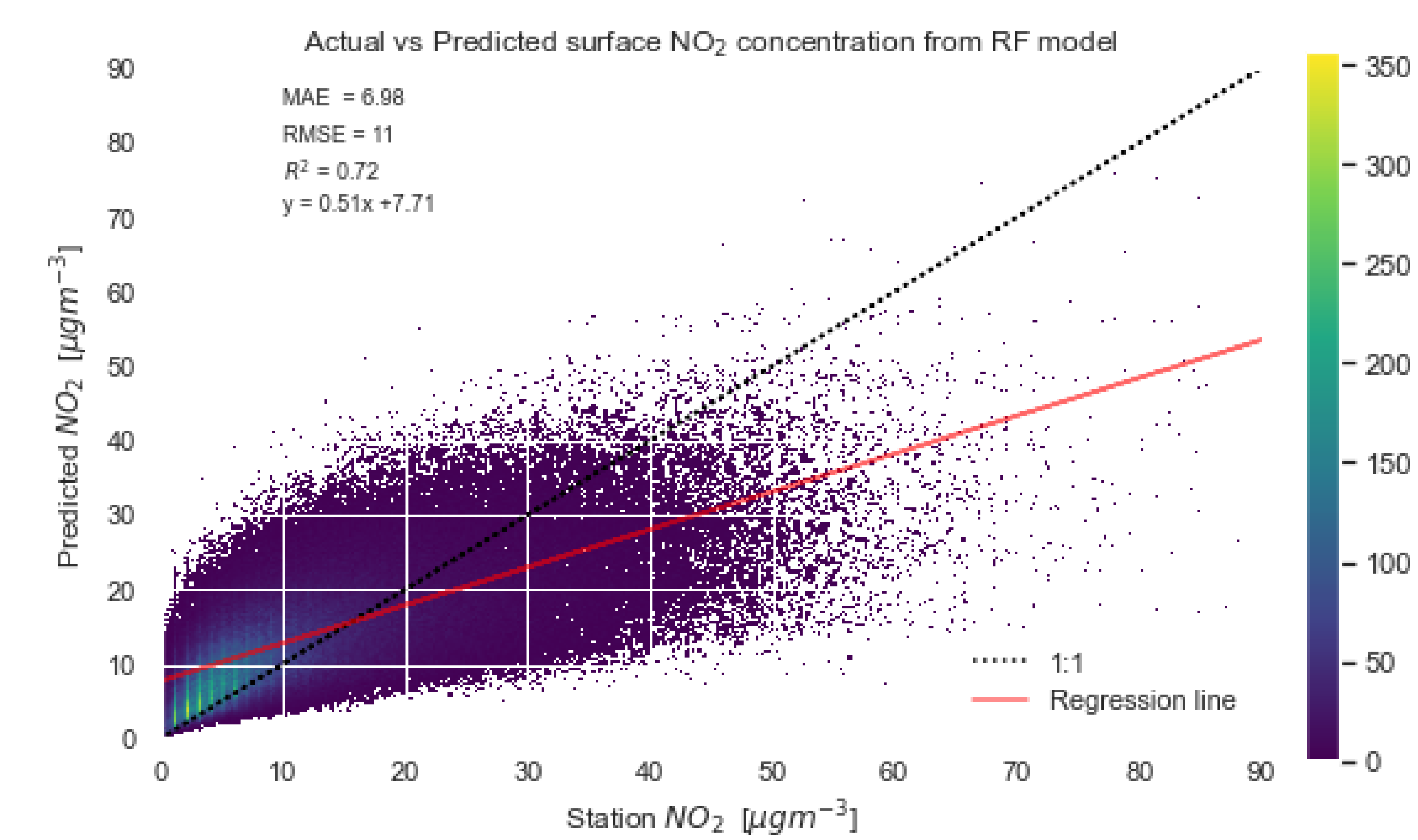
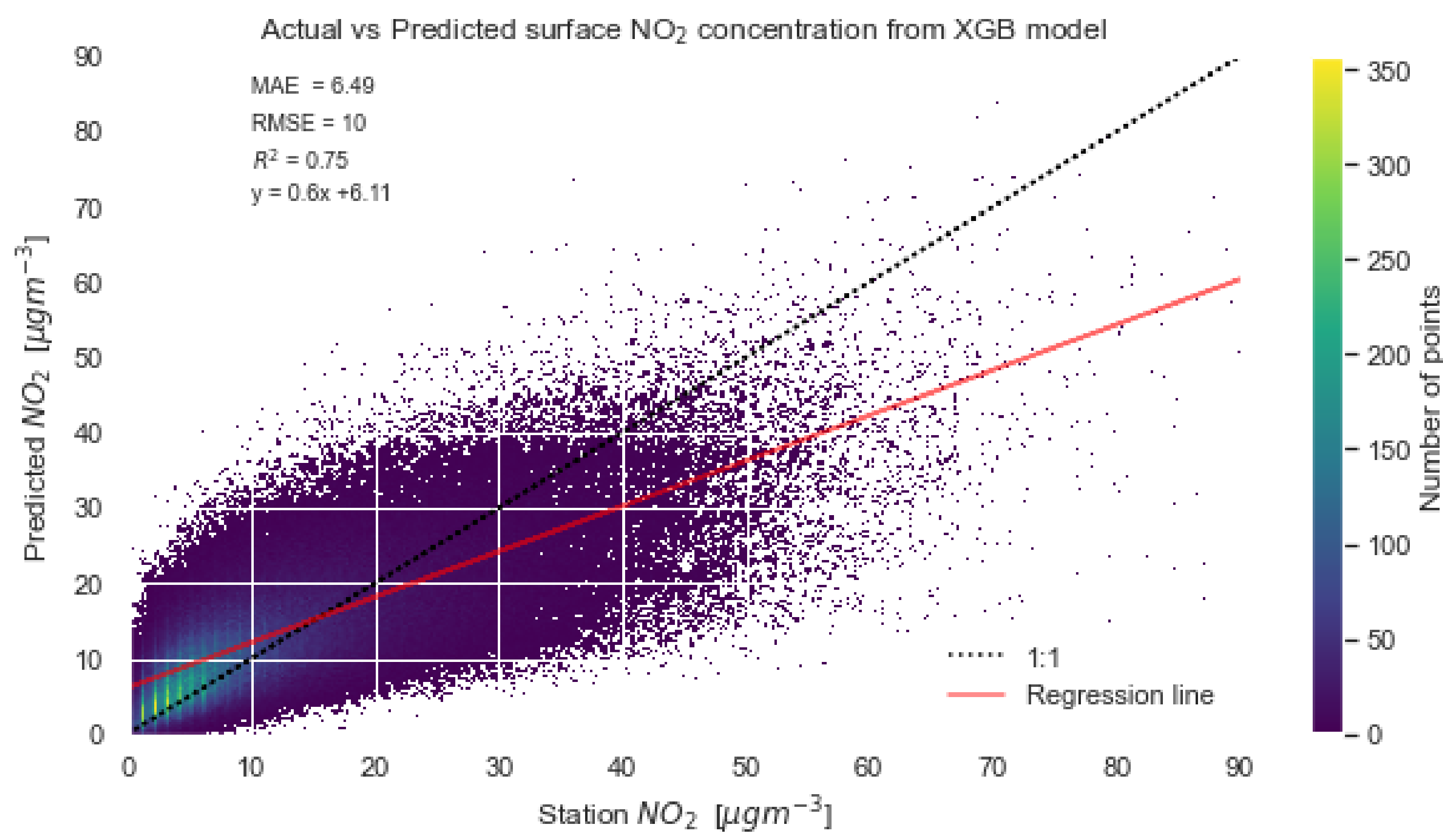


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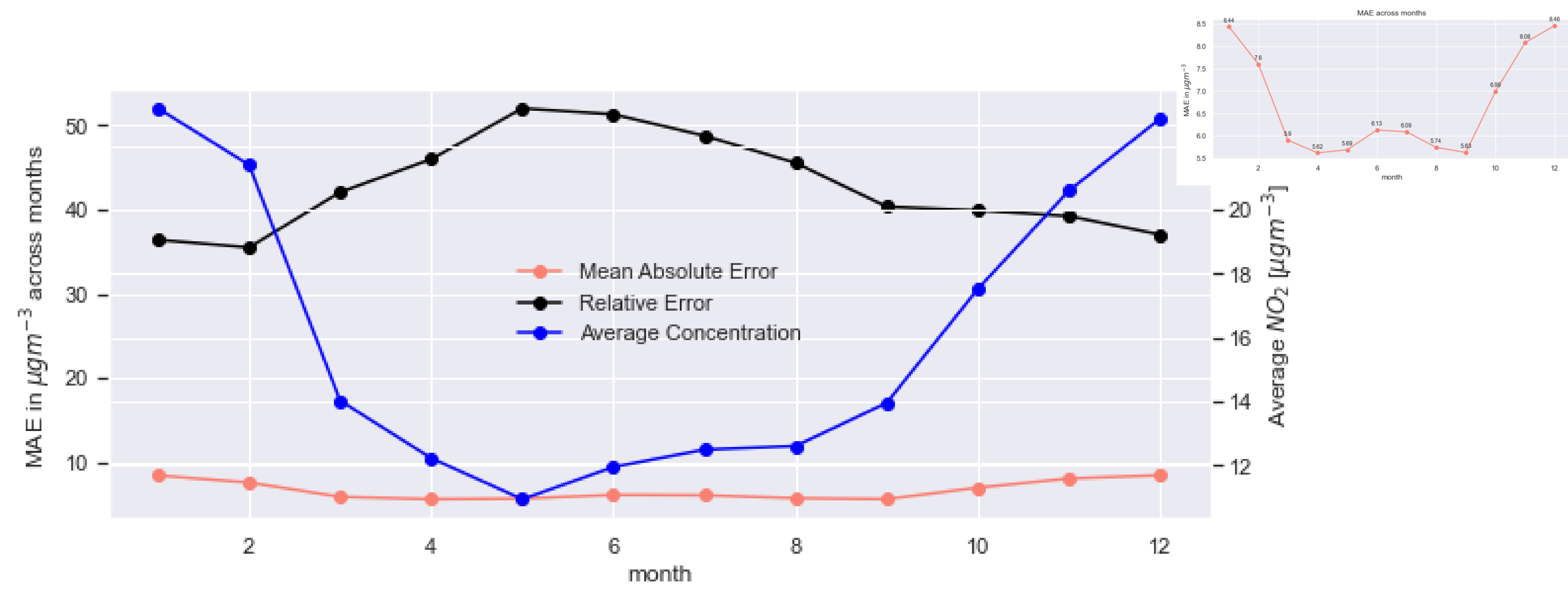
- 16 of the EU Member States and three other reporting countries had concentrations above the annual limit value (European Environmental Agency, 2020)
- Important to monitor and observe surface NO₂ concentrations over larger regions
 - Different measurement or estimation sources exist - Chemical transport models, Monitoring Stations, Low-Cost Sensors, Satellites



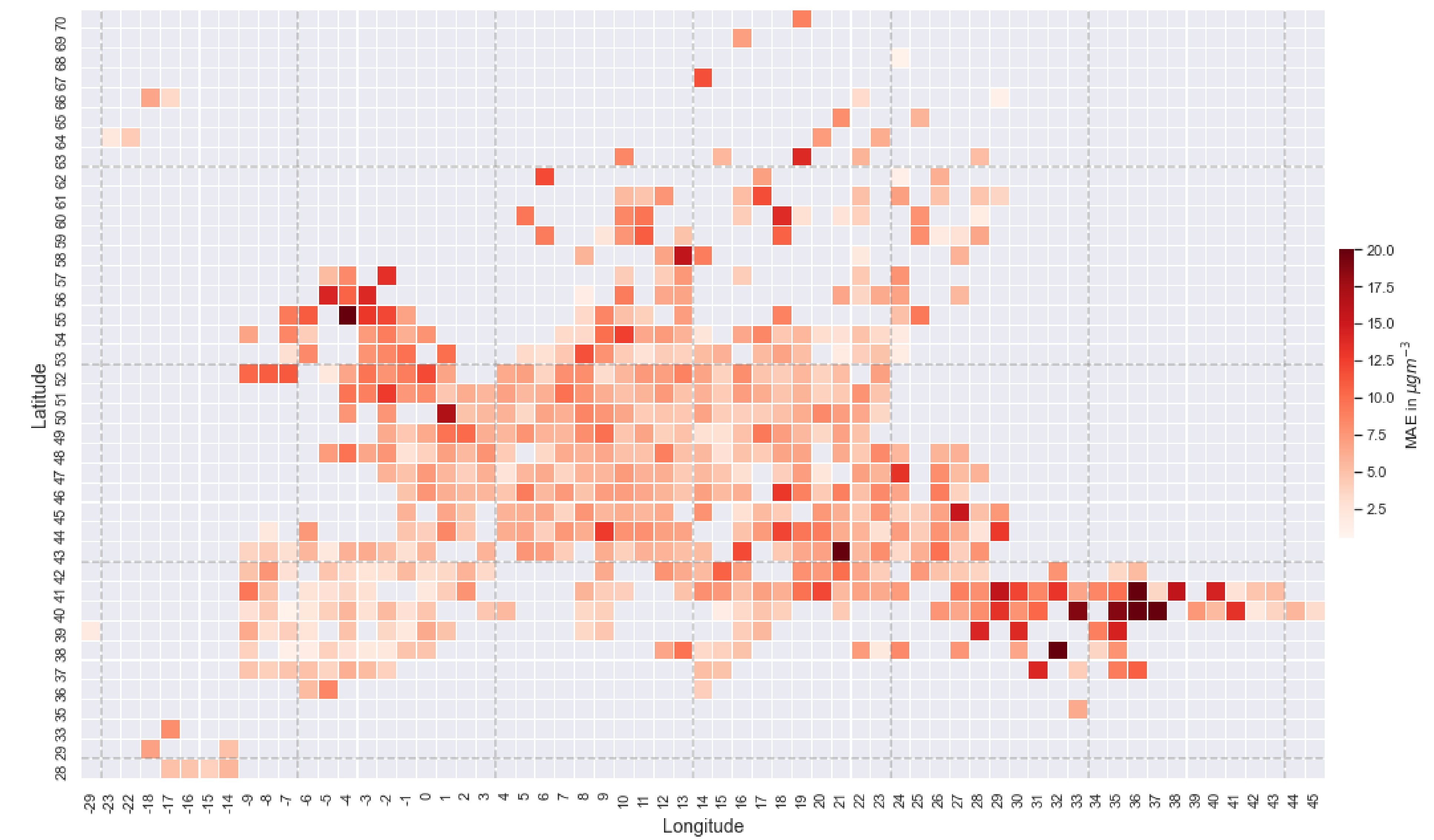


Correlation of NO₂ predicted using ML models with station measured NO₂. Both the models show similar performance, with comparatively lower errors from XGBoost

Mean Absolute Error distribution across 9 station types – Traffic Stations and Industrial Urban regions show comparatively larger error distribution



Error in prediction distributed across months along with the mean NO₂ station concentration



Error distribution gridded across stations

CONCLUSIONS

- Synergy between satellite datasets such as Sentinel-5P and in-situ station dataset has good potential in deriving the surface NO₂ concentration maps
- Machine Learning Models such as Random Forest and XGBoost could 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 NO₂ shows correlation of 0.72-0.75 with the measurements of EEA stations
- Model prediction 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.



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