Time Series Forecast of Environment Factors to Support Prediction of Methane (CH4)

ML1470

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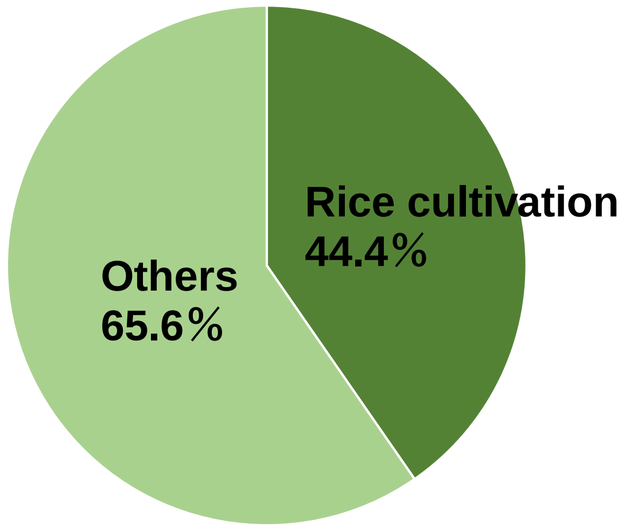
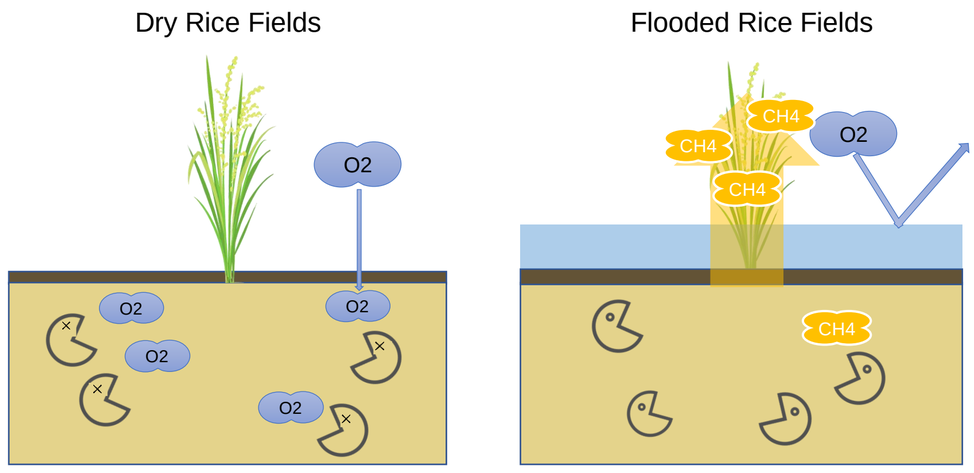
Introduction

Methane-producing bacteria lurk in the soil of rice paddies and feed on organic matter such as rice straw to produce methane. Rice cultivation produces 45% of the methane emitted by human activities in Japan. In addition, Greenhouse effect of Methane (CH4) is approximately twenty-four times as big as that of carbon dioxide and leads to “Global Warming”. An early alarm of methane occurrence is helpful to guide human action in reducing methane.



The rate of methane emitted from human activities in Japan

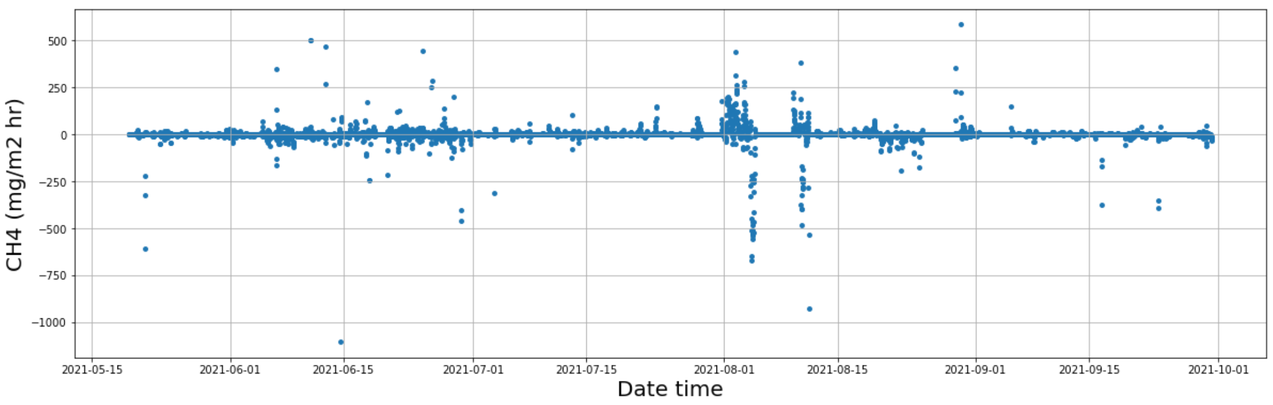


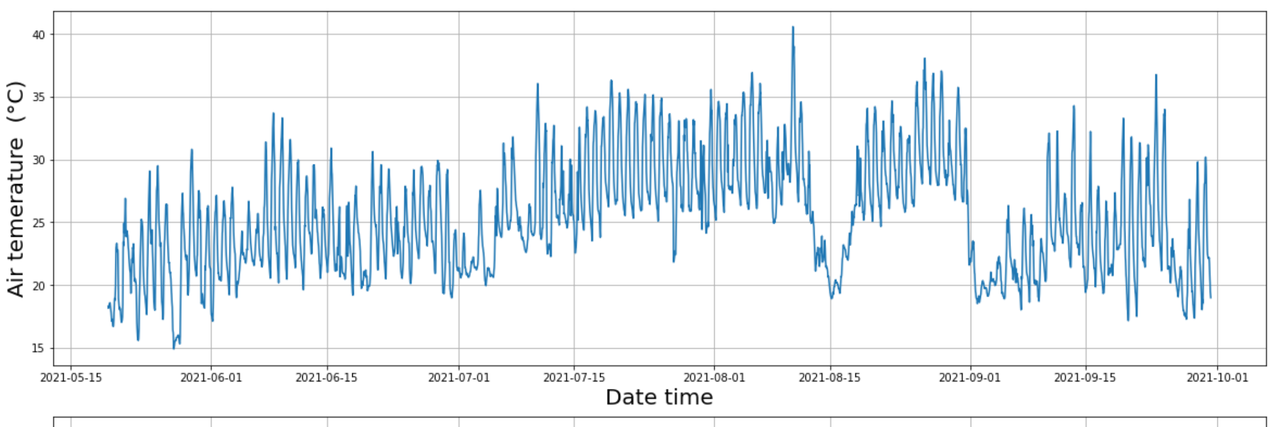
The principle of methane emission in paddy field

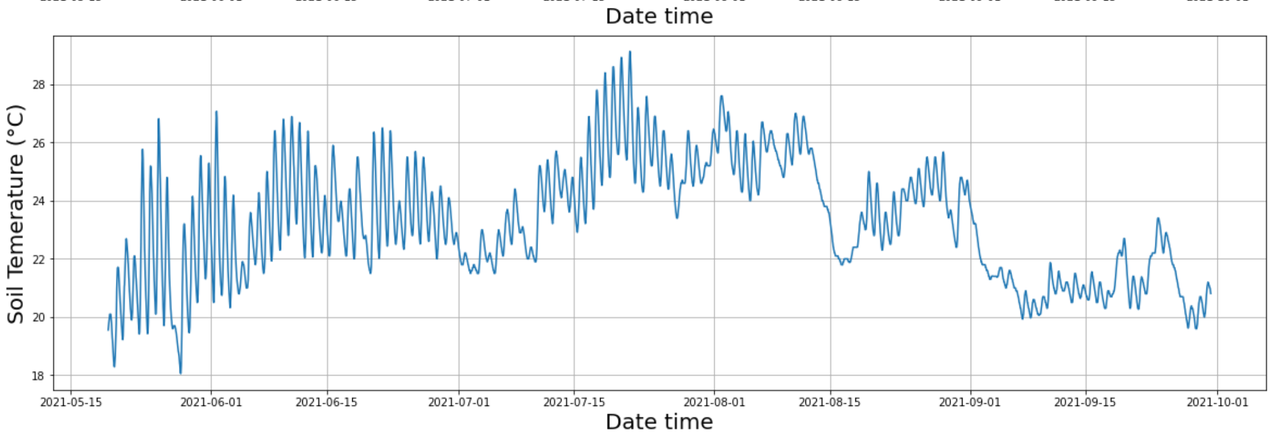
Dataset and Method

CH4 occurrence is rather irregular and impacted by meteorological and soil factors. Forecast of future CH4 occurrence is challenging with unknown future readings of those factors. Air temperature (AT) and soil temperature (ST) have been confirmed highly relevant among influence factors to CH4, and more importantly their future values can be possibly forecasted through time series forecasting. We analyzed the trends of AT and ST observed in rice paddies using Auto-Regressive models to predict their future values. The predicted results will then be fed into regression models to predict future methane.

The following figure shows the CH4, AT, and ST data sets used in this study.

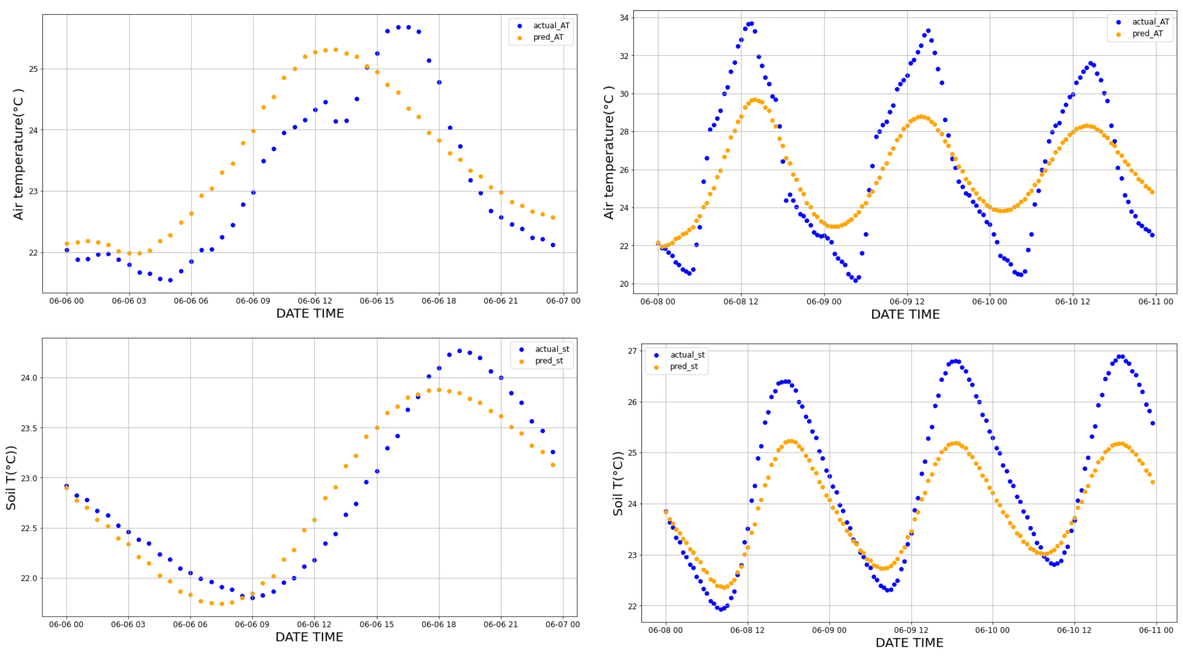






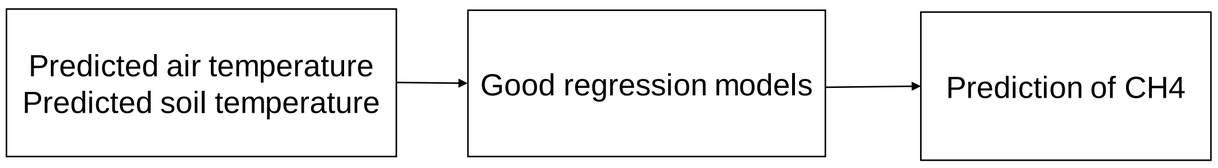
Result

Experiments were done using datasets collected in a rice paddy at Tokyo University of Agriculture and Technology, Japan, during May to September 2021. As preliminary results, we achieved forecast accuracies with an average error at ±2.48°C for AT and ±0.71°C for ST for 1-day continuous period, and ±2.97°C for AT and ±0.97°C for ST for 3-day continuous period.



Future works

More investigation in time series models is being carried out for better forecast accuracy. With the support of time series forecasting on meteorological and soil data, and good regression models, forecast of CH4 can be achieved.



Reference

[1] Y. Morishita, R. Kishaba, L. Ding, K. Noborio & S. Phungern, “A New Approach of Data and Knowledge based Prediction for Green House Gas “Methane” in Paddy Field, the 3rd International Conference on Machine Learning and Intelligent Systems (MLIS2021), ML1348, Xiamen, China, Nov. 8th-11th, **2021**.