XAI on Time Series Forecasting

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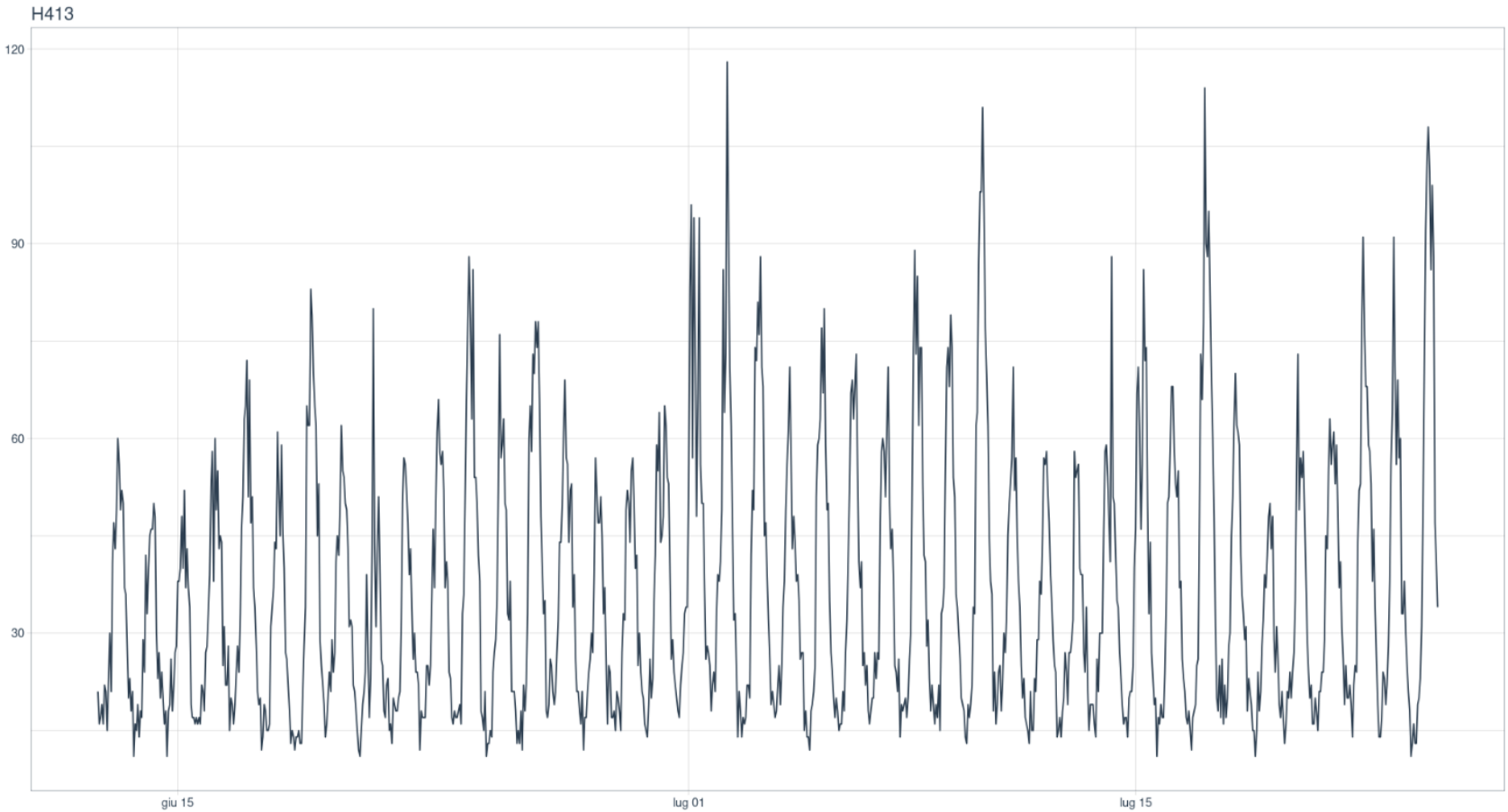
Contents

1. Data

M4 Competition



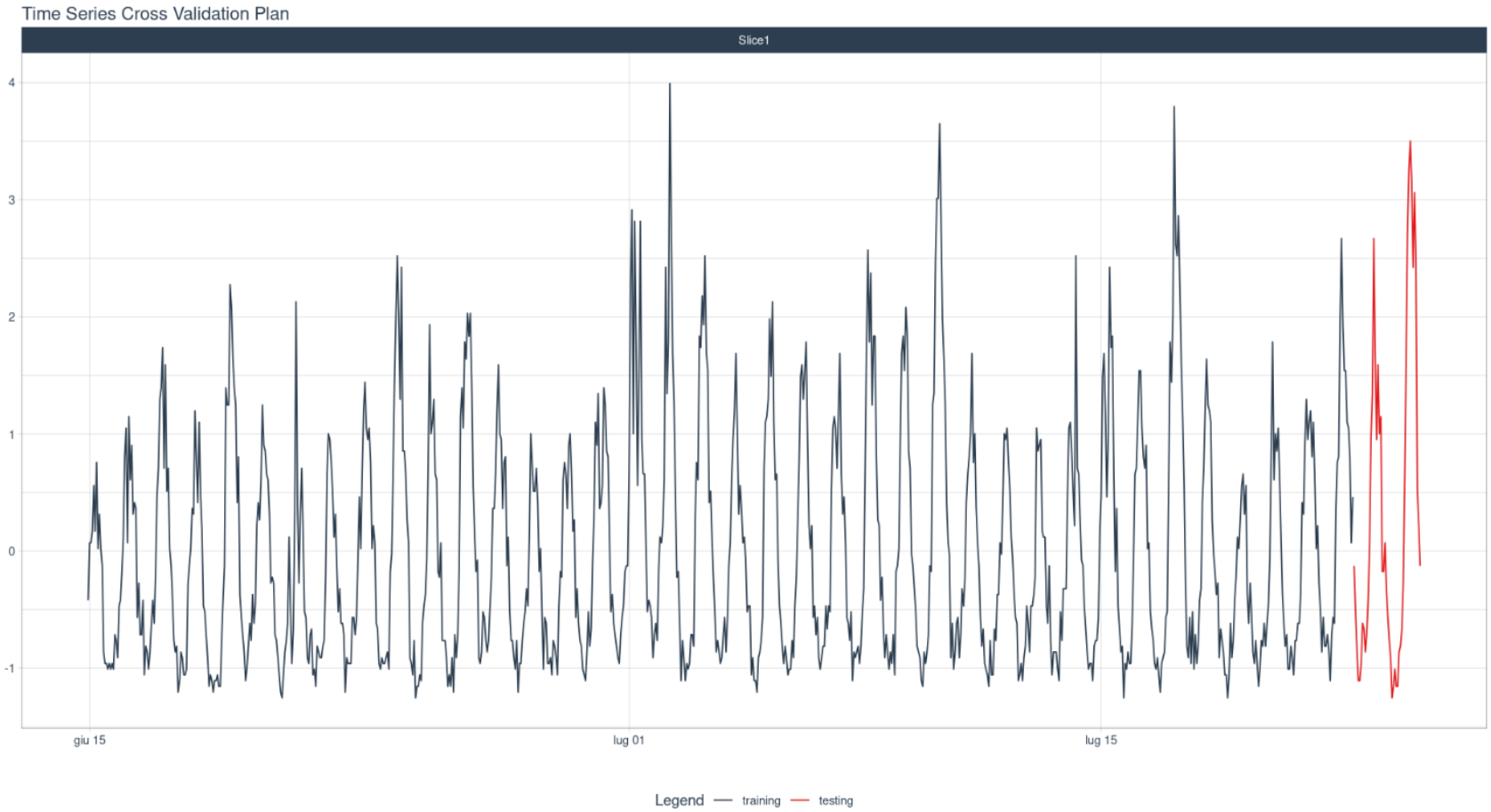
Feature Engineering

In order to be able to use data in a machine learning model, we need to create features that can be used as predictors.

This step is extremely relevant in time series data, since we need to create **features that are able to capture the time dynamics of the data**.

Here, I used lags, rolling features, calendar features and fourier series, obtaining a total of **24 features**.

Train-Test Split



2. Modelling

AutoML with H2O

h2o automatically estimates and tests **6 different ML algorithms**:

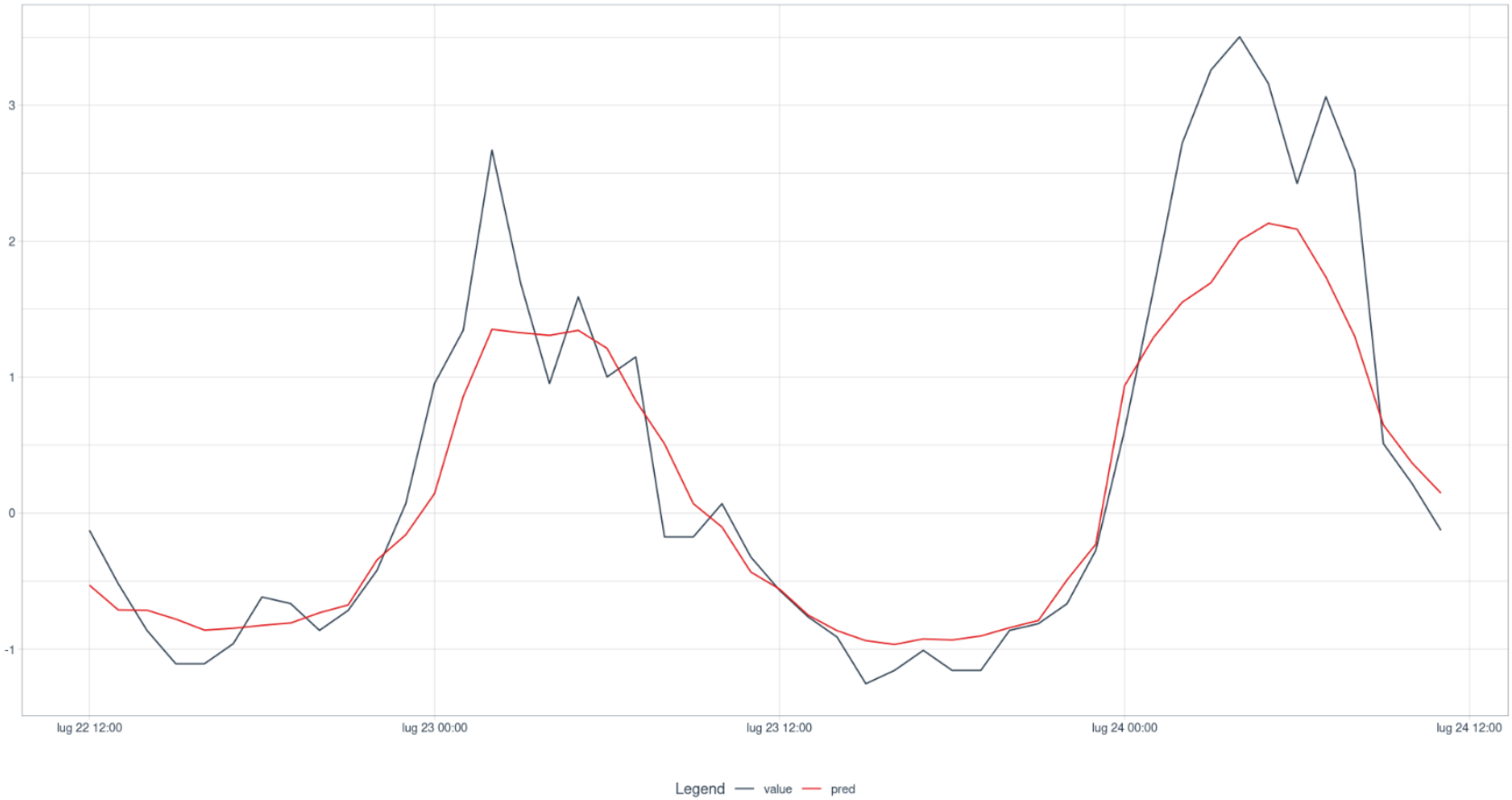
- DRF (This includes both the Distributed Random Forest (DRF) and Extremely Randomized Trees (XRT) models)
- GLM (Generalized Linear Model with regularization)
- XGBoost (XGBoost GBM)
- GBM (H2O GBM)
- DeepLearning (Fully-connected multi-layer artificial neural network)
- StackedEnsemble (Stacked Ensembles, includes an ensemble of all the base models and ensembles using subsets of the base models)

AutoML with H2O

```
model_h2o_automl <- h2o.automl(
    y = target, x = x_vars,
    training_frame = train_h2o,
    max_runtime_secs = 120,
    max_runtime_secs_per_model = 30,
    max_models = 50,
    nfolds = 5,
    sort_metric = "rmse",
    verbosity = NULL,
    seed = 123
)
```

Best Model

The best model ends up to be a GBM.



3. XAI

XAI in Time Series

In the context of time series forecasting, being able to understand the model's predictions is of paramount importance for 3 main reasons:

1. **Trust**: to be able to trust the model's predictions, especially when it is used to make important future decisions.
2. **Improvement**: to be able to understand the model's weaknesses to improve it.
3. **Combine**: usually model's predictions are combined with human judgement, so understanding what causes such predictions is crucial for business experts to adjust their forecasts.

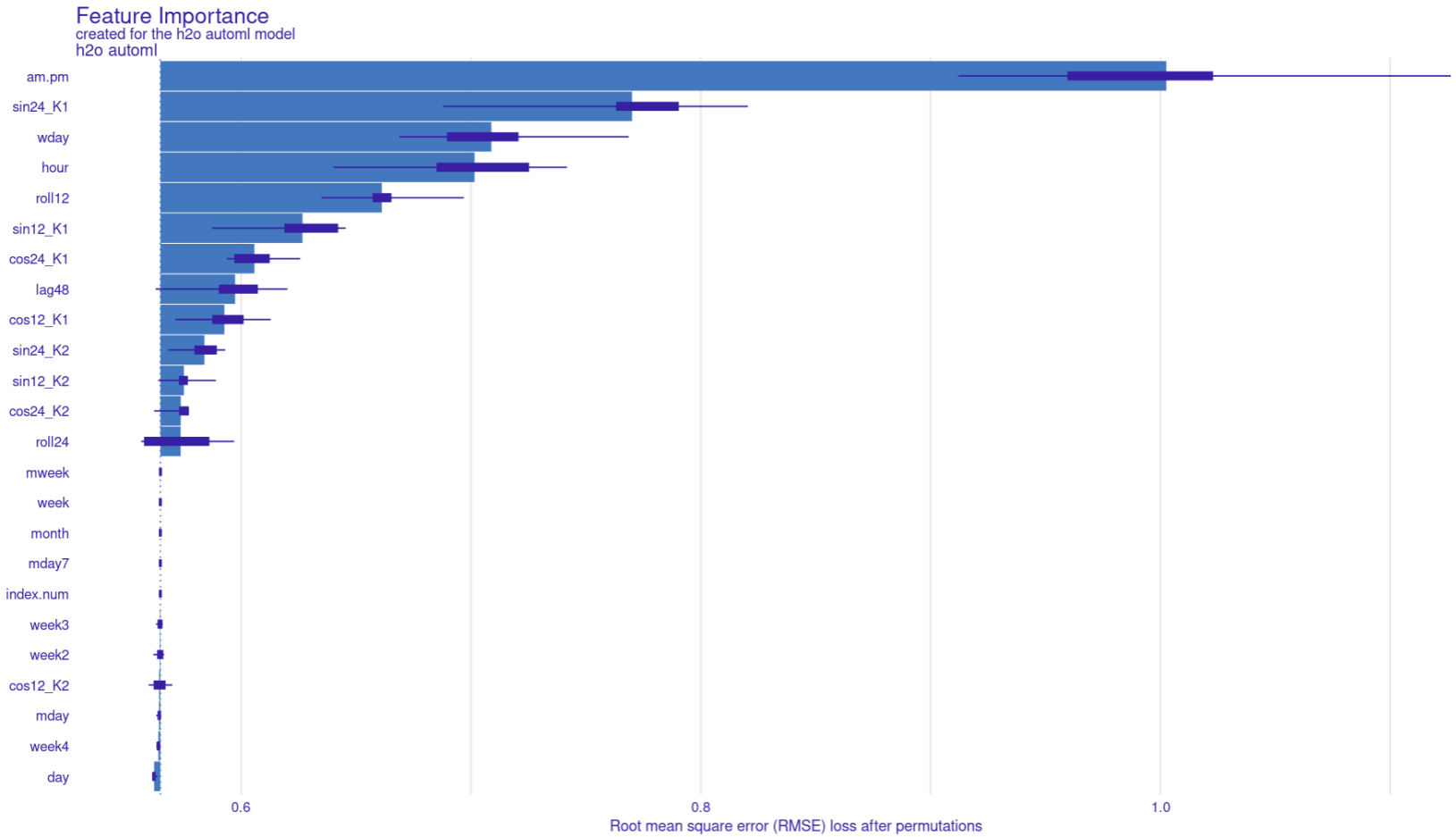
DALEX

To perform a XAI analysis on the automatic black-box model the **DALEX** package, from Dr. Why AI, is used.

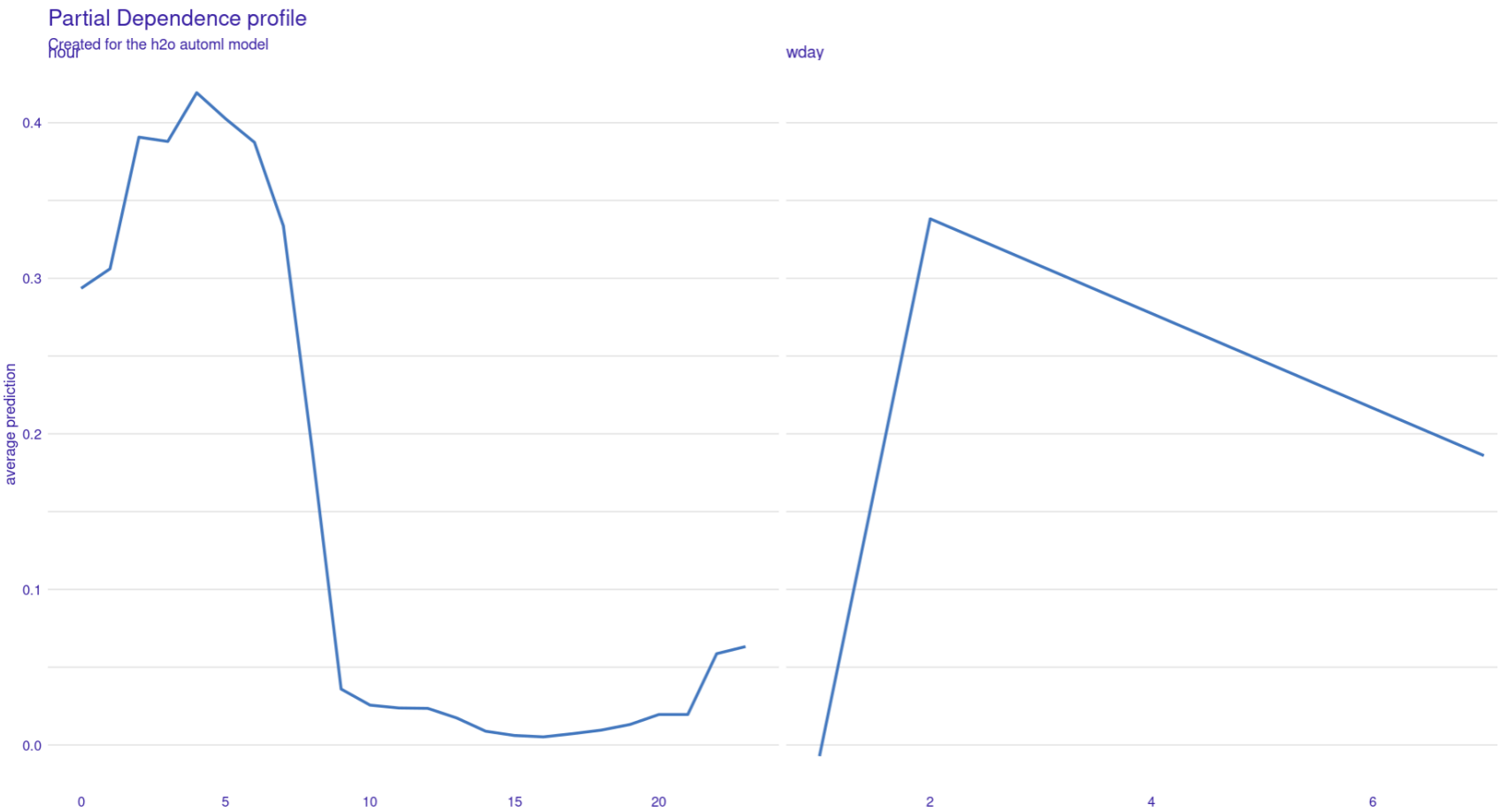
DALEX is a XAI framework which allows to easily adopt several model agnostic explainability techniques, such as:

- Feature Importance
- Partial Dependence
- Break Down
- Shapley Values
- LIME
- Ceteris Paribus and
- Stability Analysis.

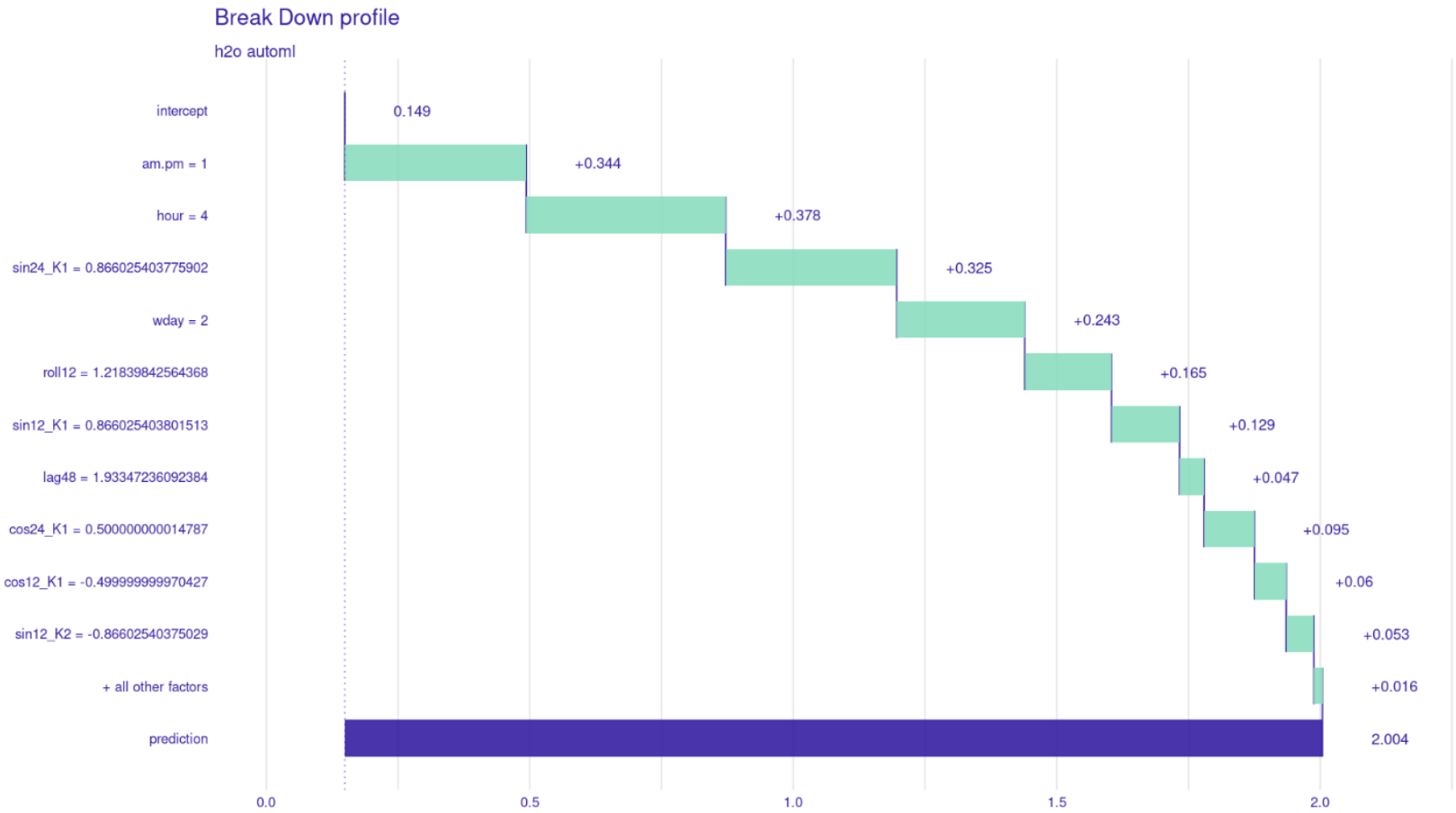
Global - Feature Importance



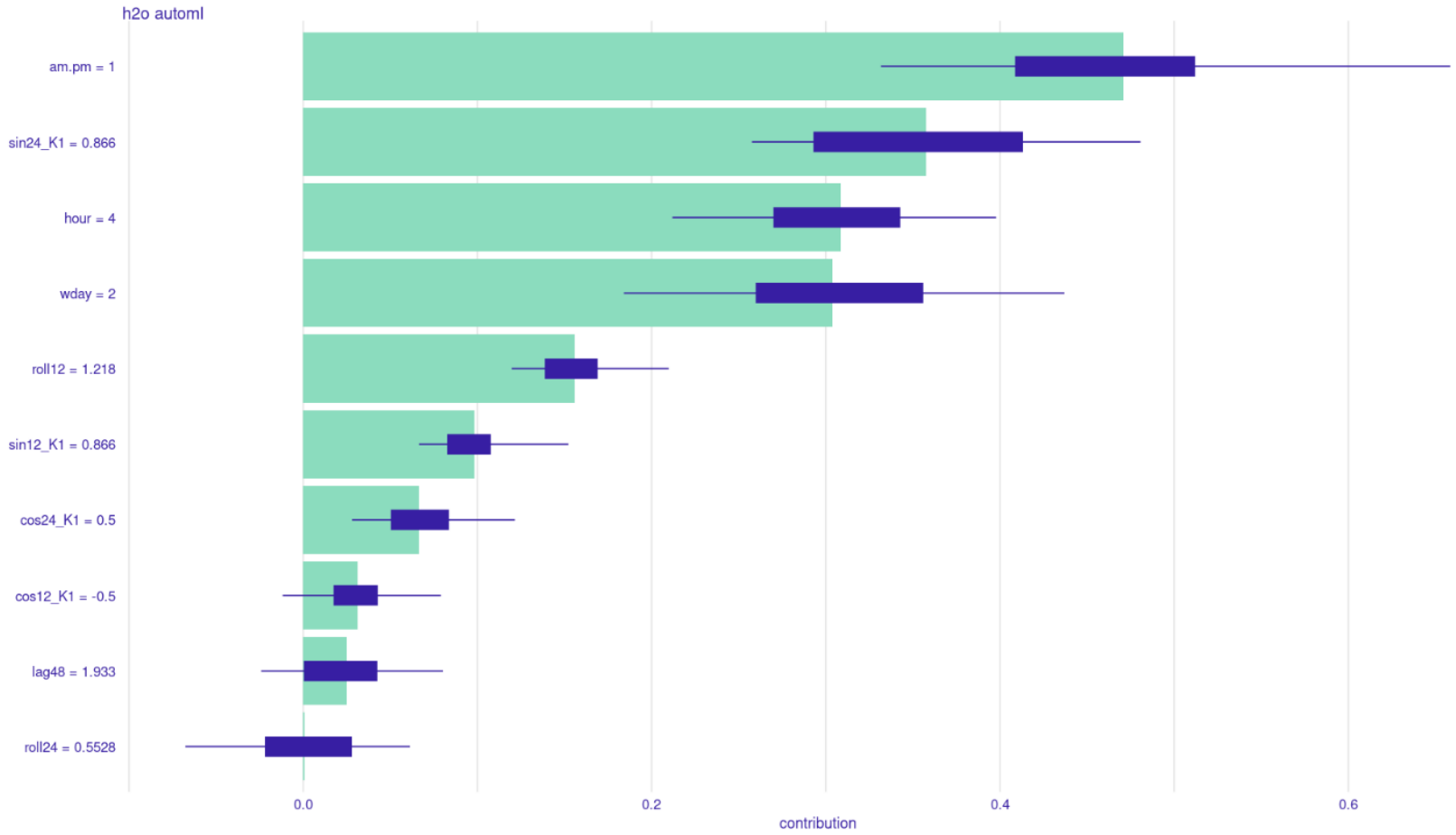
Global - Partial Dependence



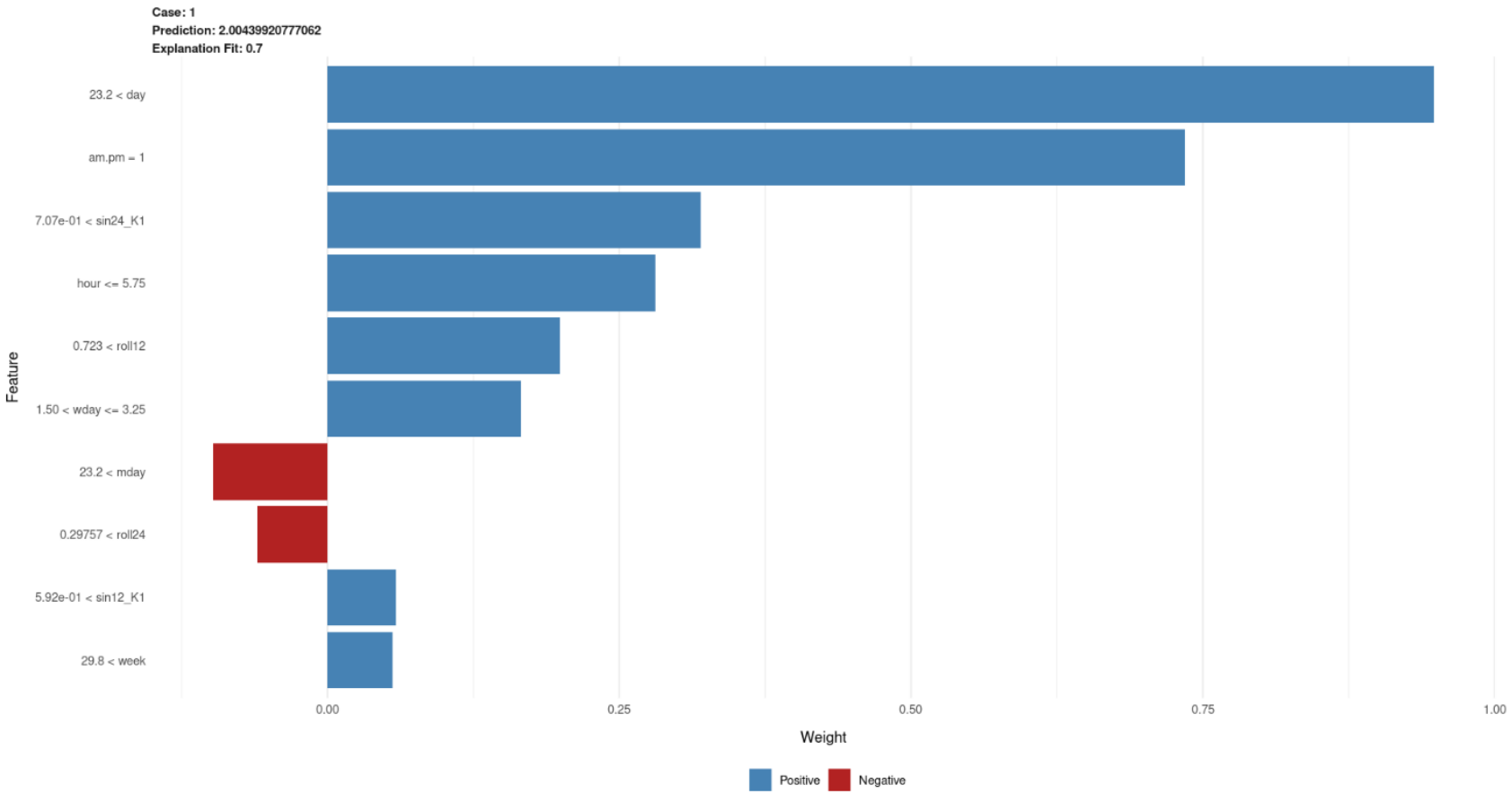
Local - Break Down



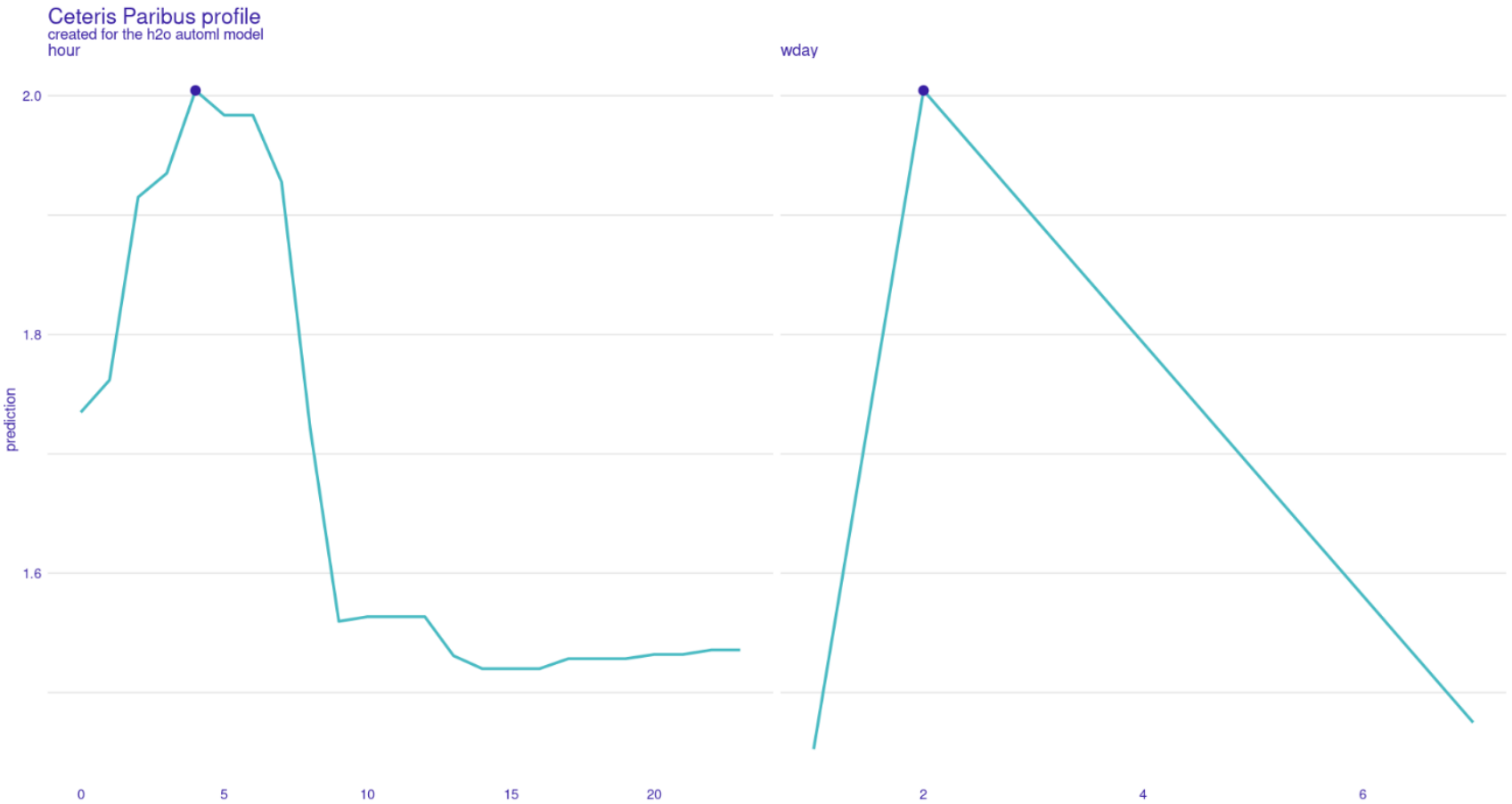
Local - Shapley Values



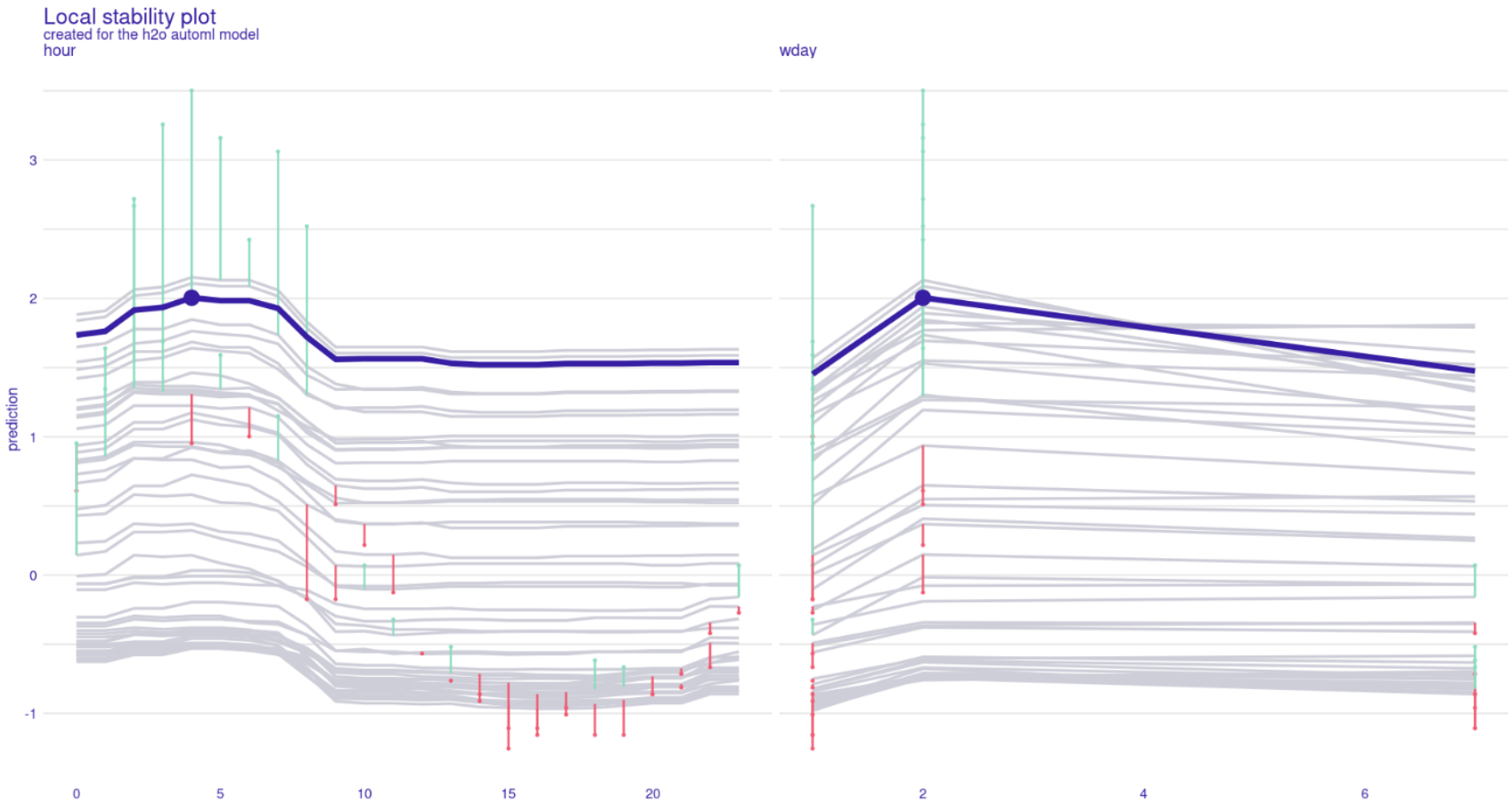
Local - LIME


Case: 1
Prediction: 2.00439920777062
Explanation Fit: 0.7
23.2 < day
am.pm = 1
7.07e-01 < sin24_K1
hour <= 5.75
0.723 < roll12
1.50 < wday <= 3.25
23.2 < mday
0.29757 < roll24
5.92e-01 < sin12_K1
29.8 < week
Feature
0.00
0.25
0.50
0.75
1.00
Weight
Positive
Negative

Local - Ceteris Paribus



Local - Stability Analysis



4. Conclusions

Conclusions

Thank you!