Ktirio Dashboard

Features and enhancements

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Context

- Energy
- Air Quality
- Environmental indoor comfort

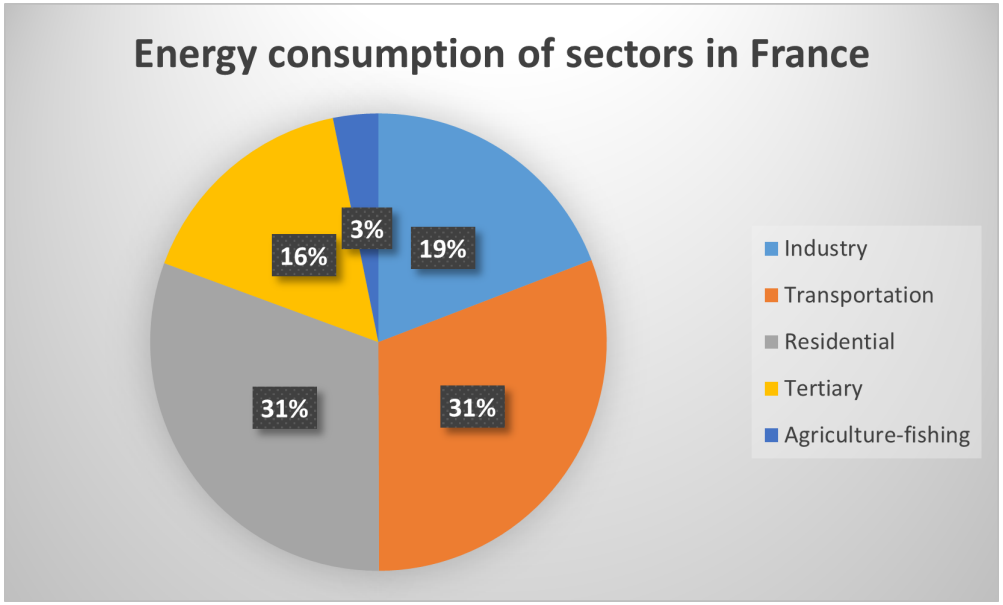


Figure 1: Energetic consumption of France by sector.

Ktirio Project

Focuses on developing an online platform of services for building energy simulation.

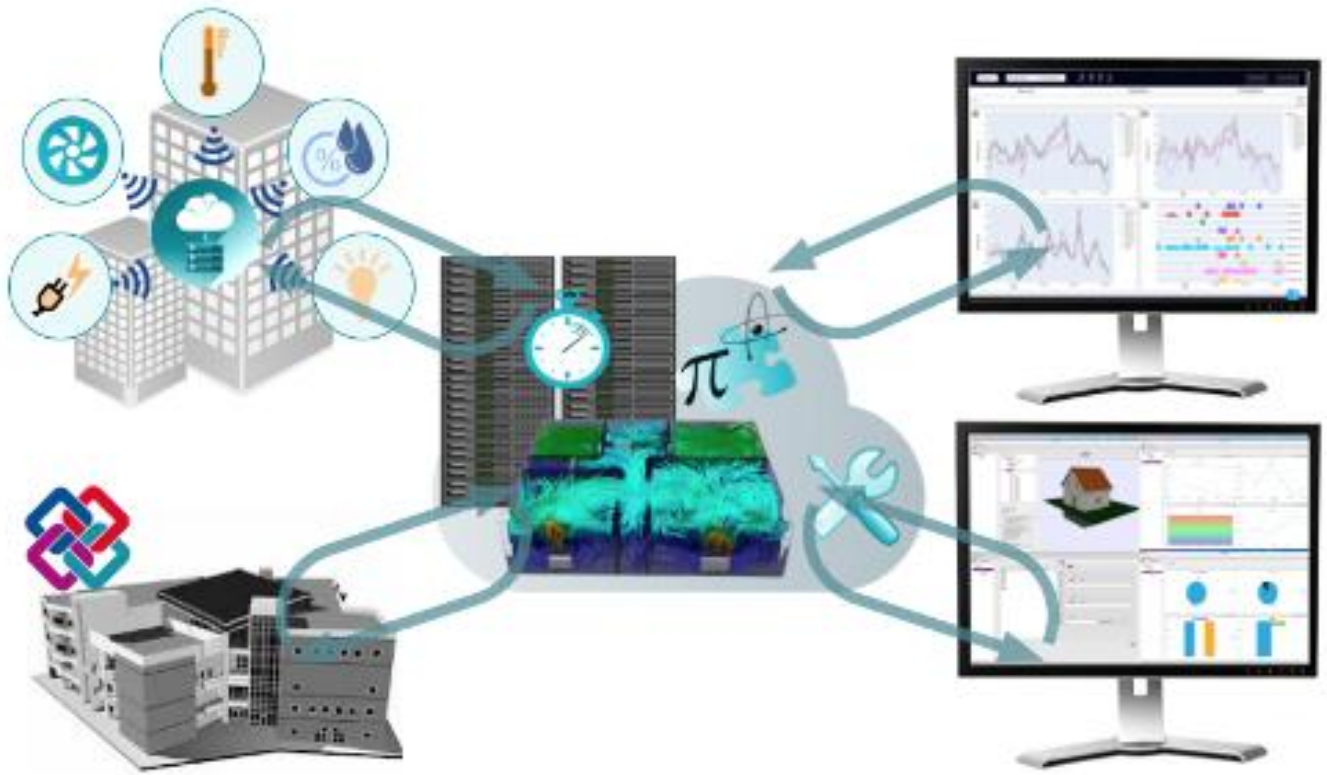


Figure 2: Ktirio service platform, from *insmi.cnrs.fr*

Previous work

Extension of the work done during the Master's project.

Previous features

- Request historic values of temperature, humidity and Open/Close sensors.
- Plot historic interactive data.
- Dynamic statistical treatment.
- Customizable comfort indicators.
- Uploading external weather data.

Previous work

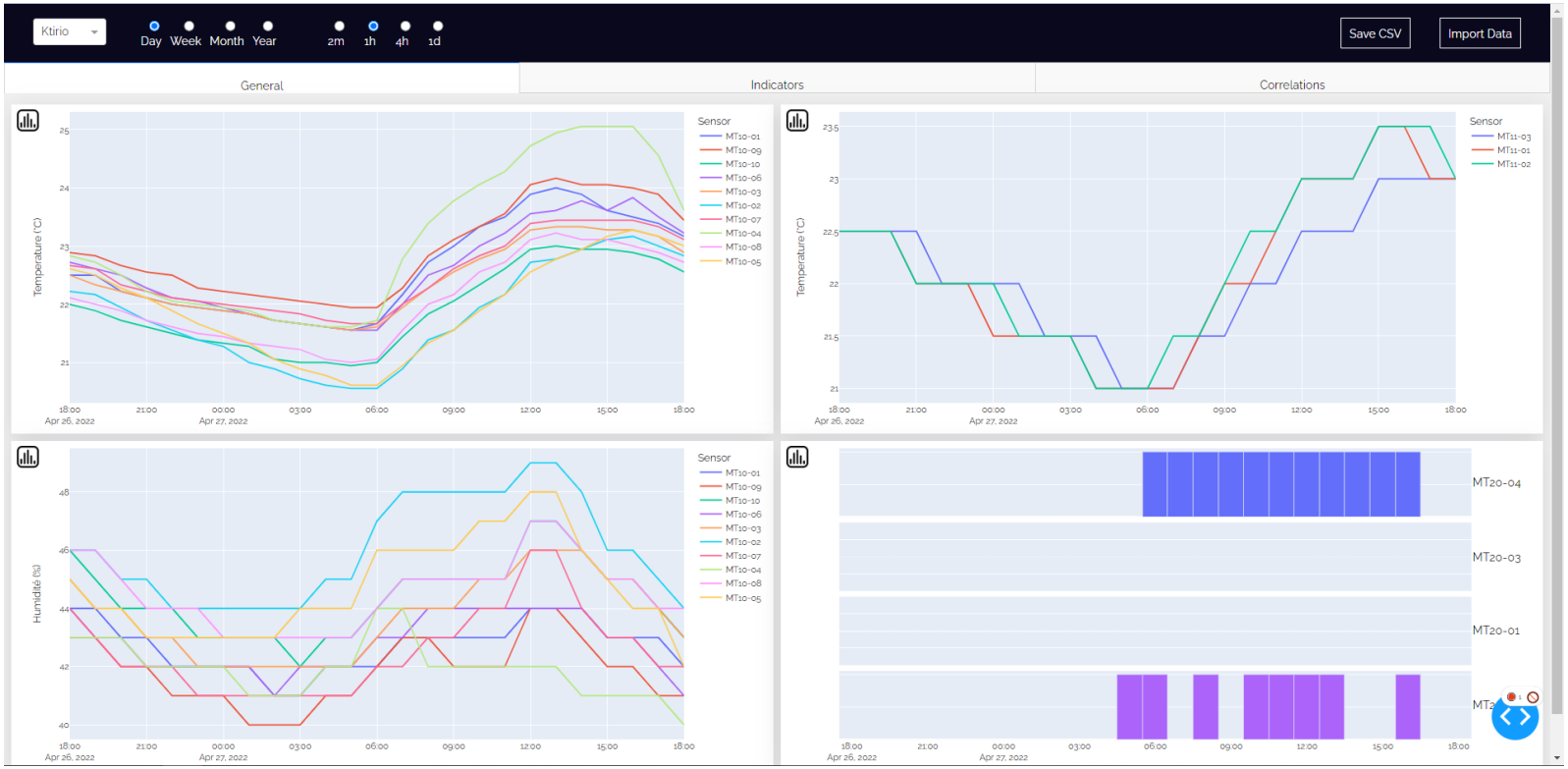


Figure 3: State of the dasbhoard at the end of the Master's project.

Objective

Add and improve features to the dashboard that will:

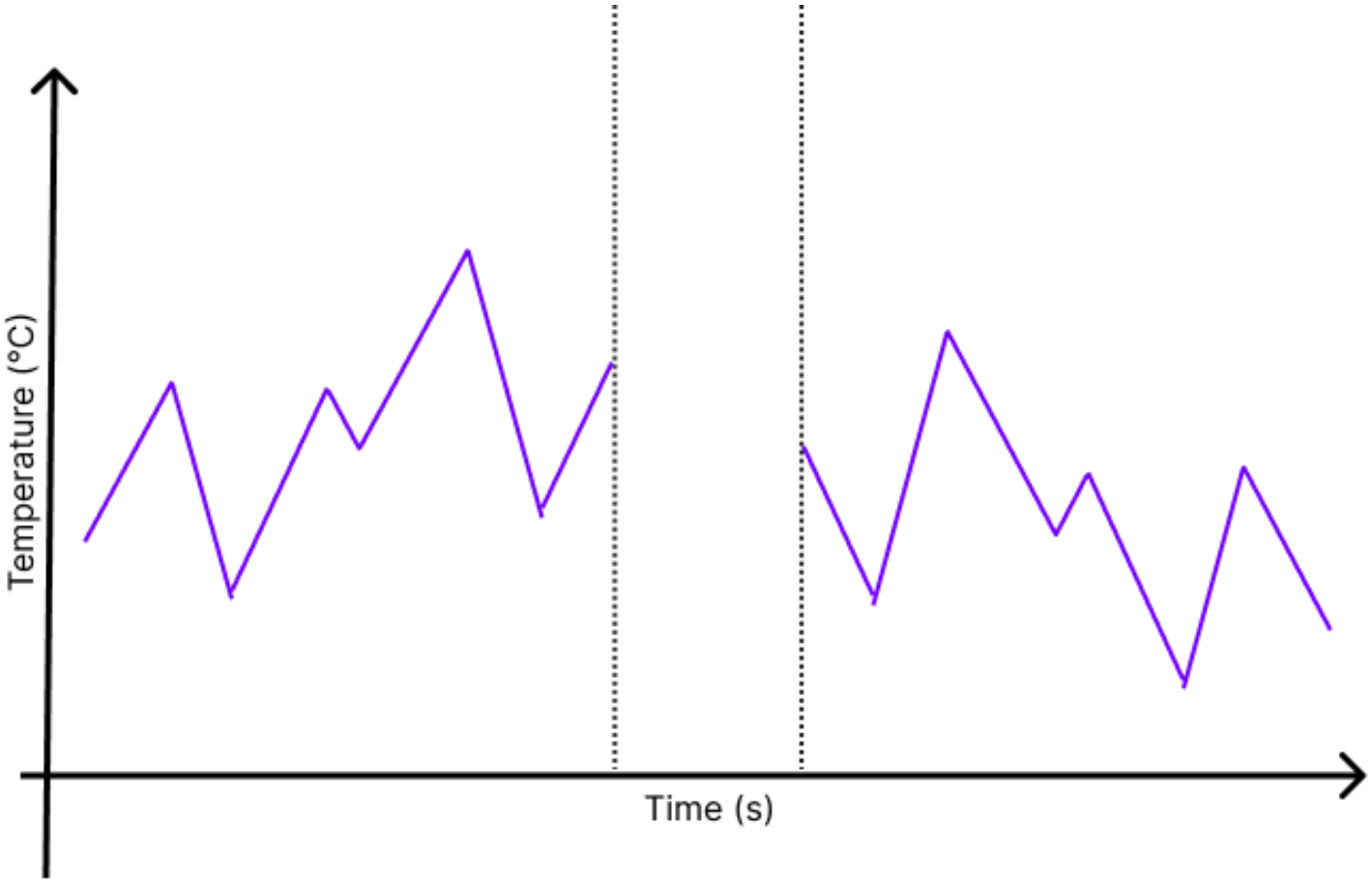
- Upgrade the performance and enhance the UX.
- Make the dashboard customizable.
- Complete missing information.
- Add new sensors/sensor models.
- Add indicators for a better understanding of the building.

Outline

- Data Imputation
- Database construction
- Dashboard Personalization
- Indoor Environmental Qualiy
- Building geometry
- Deployment

Data Imputation

Concept



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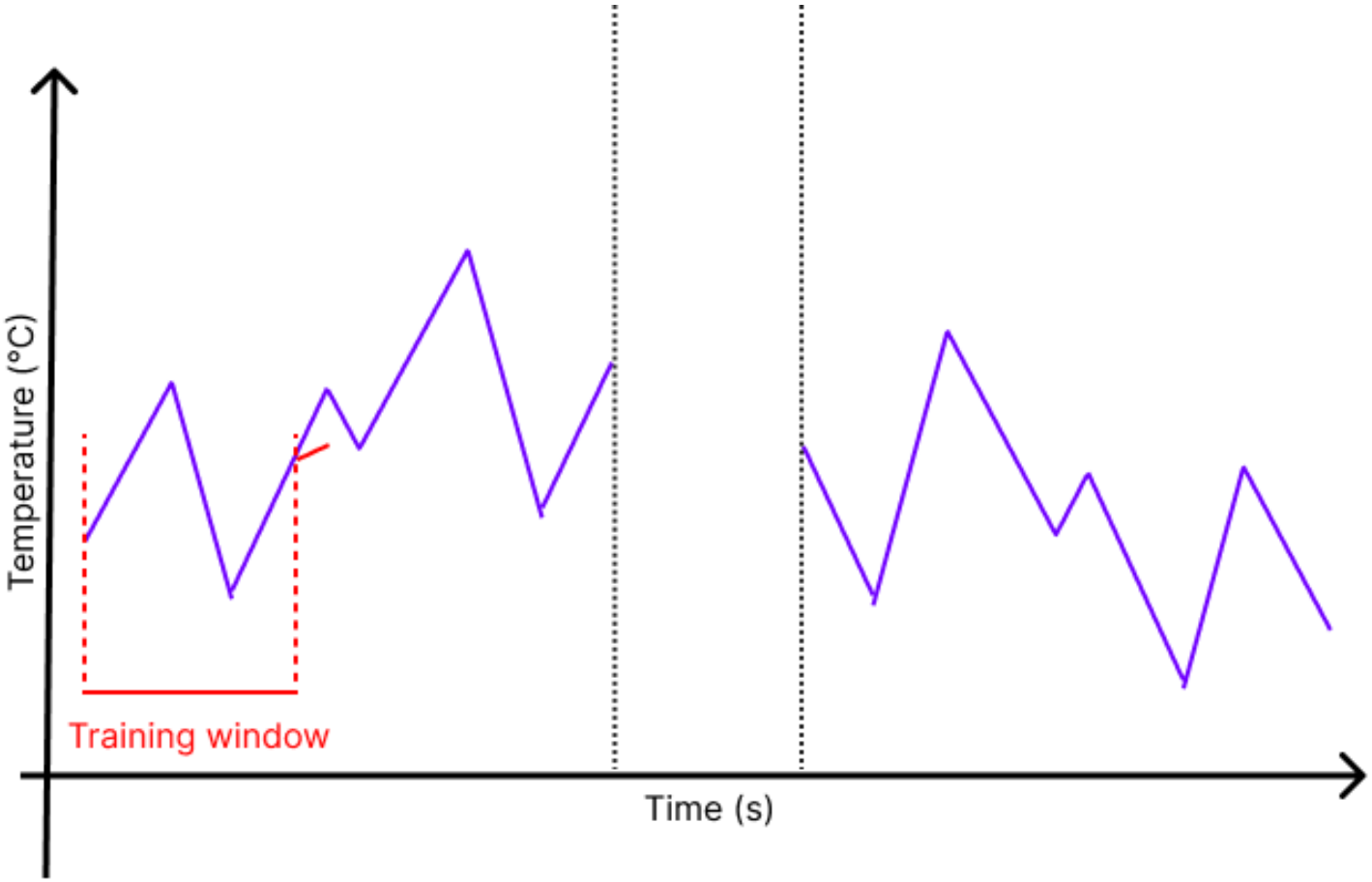

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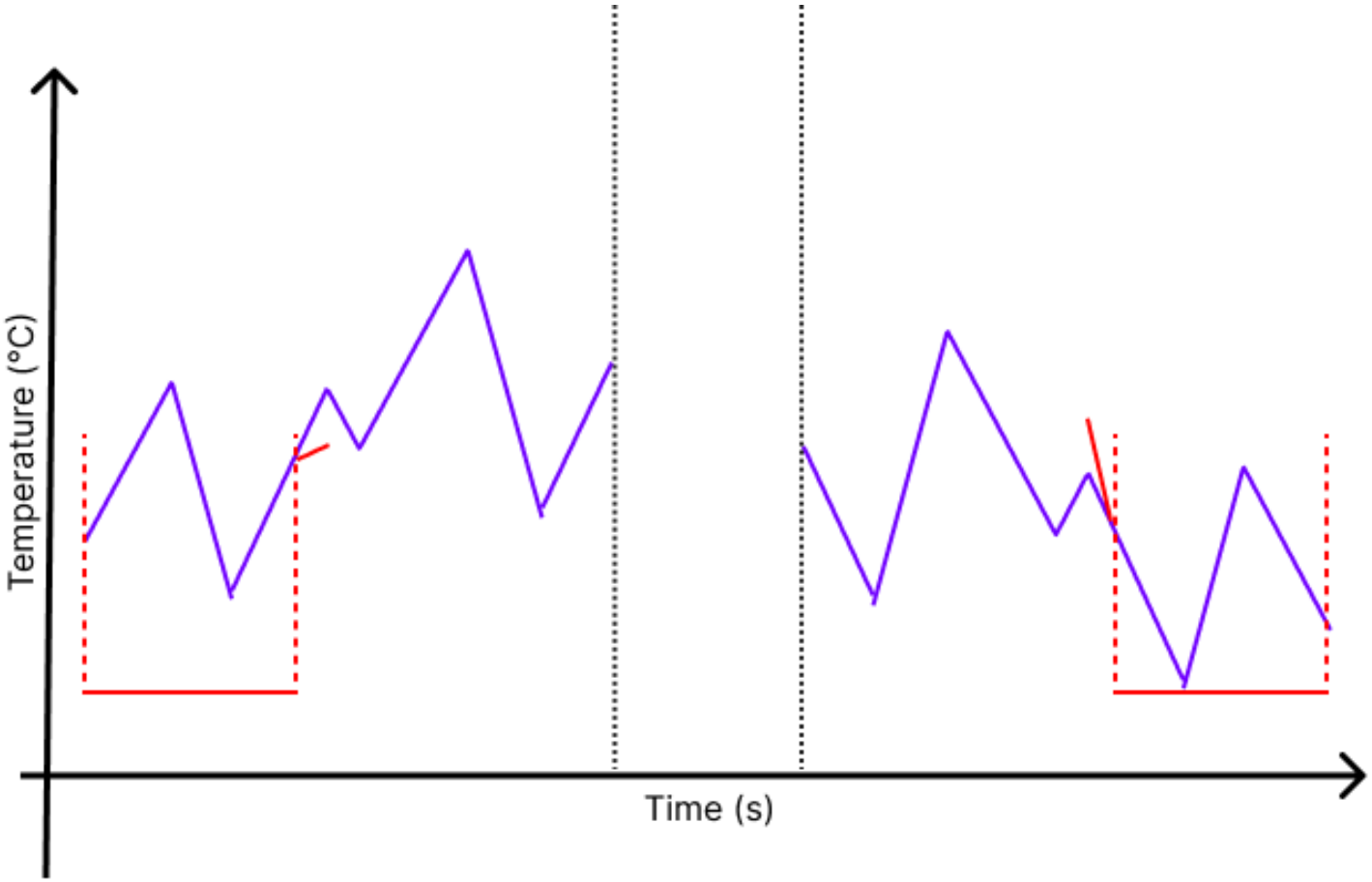

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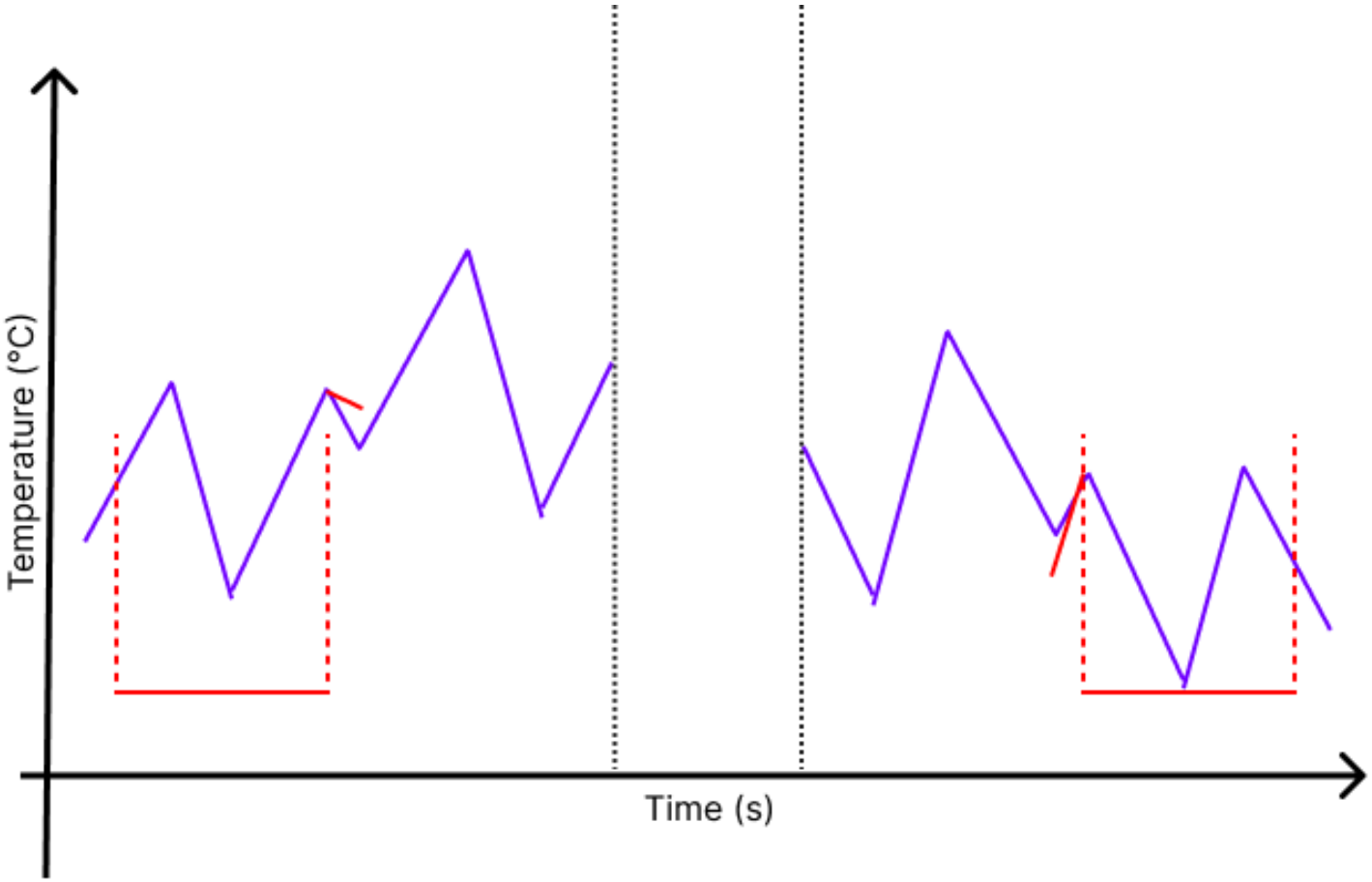

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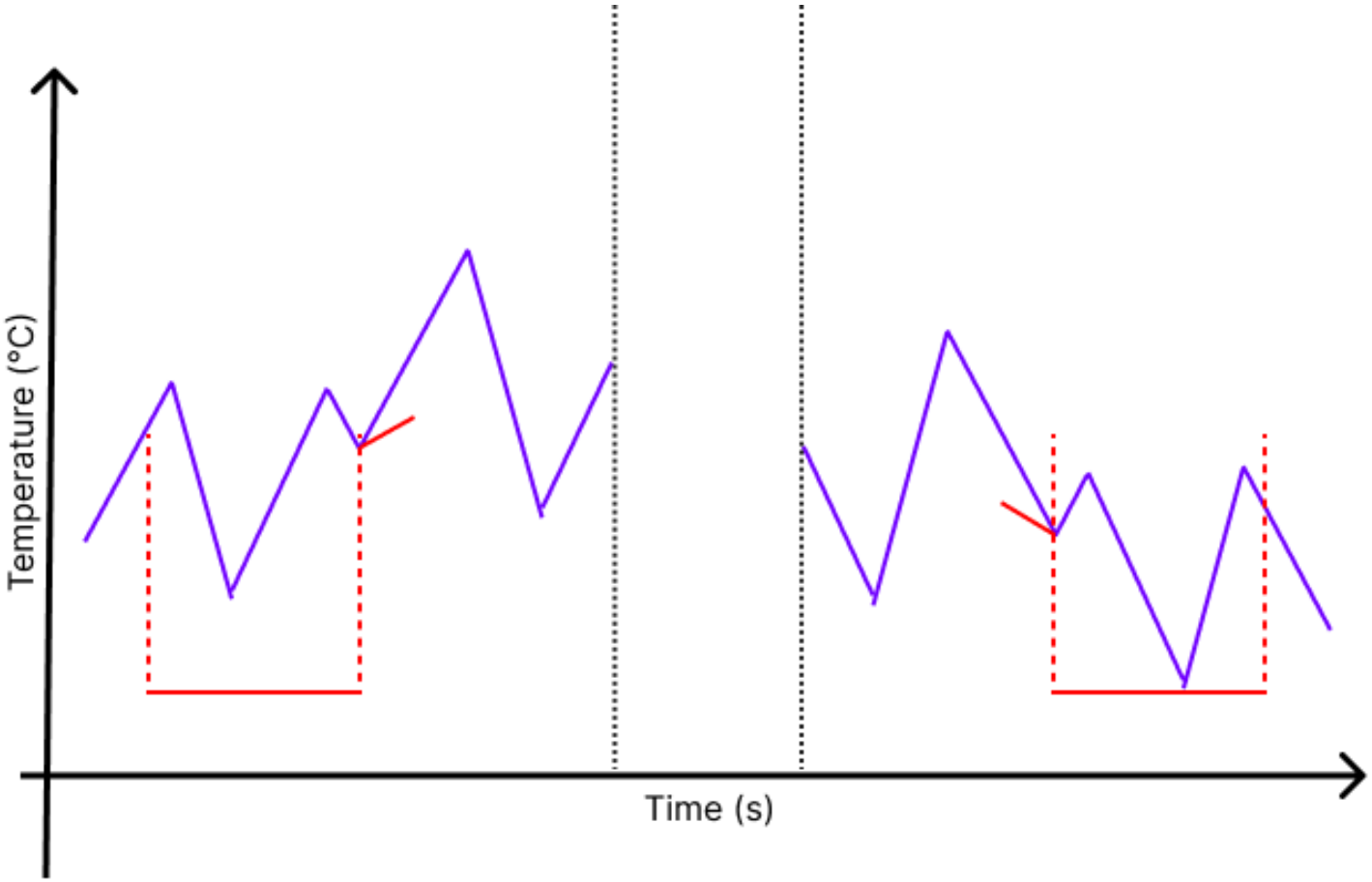

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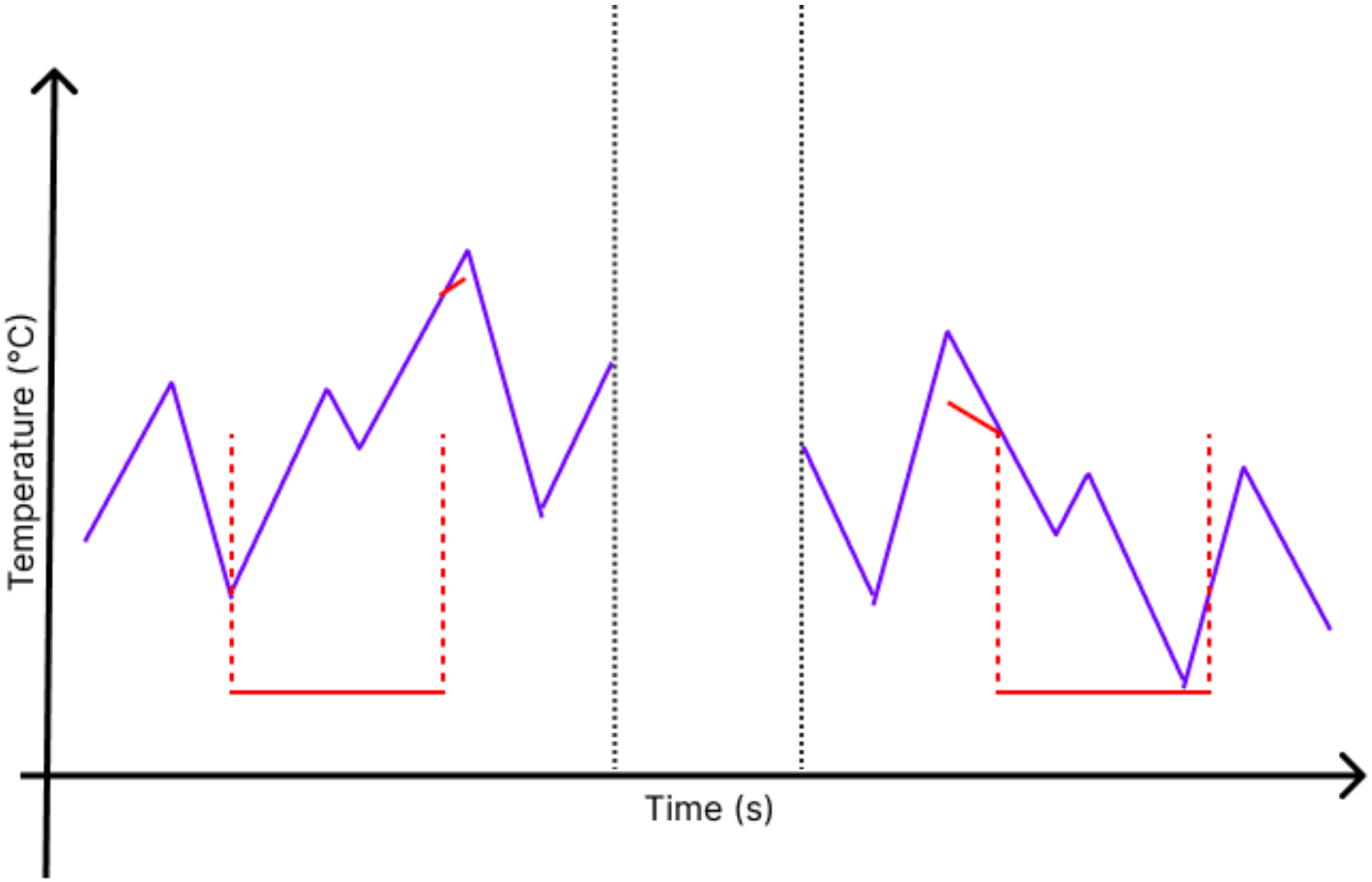

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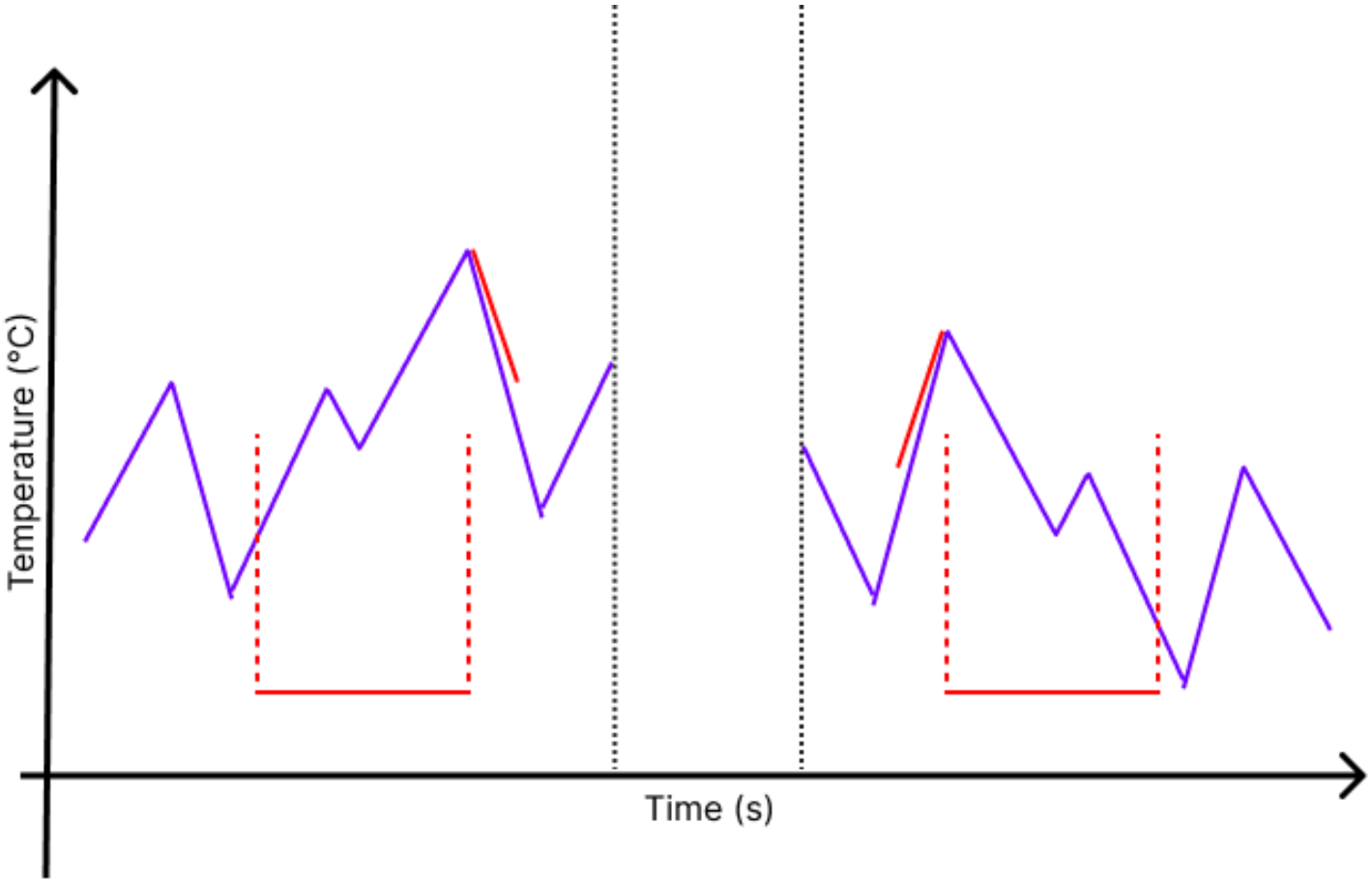

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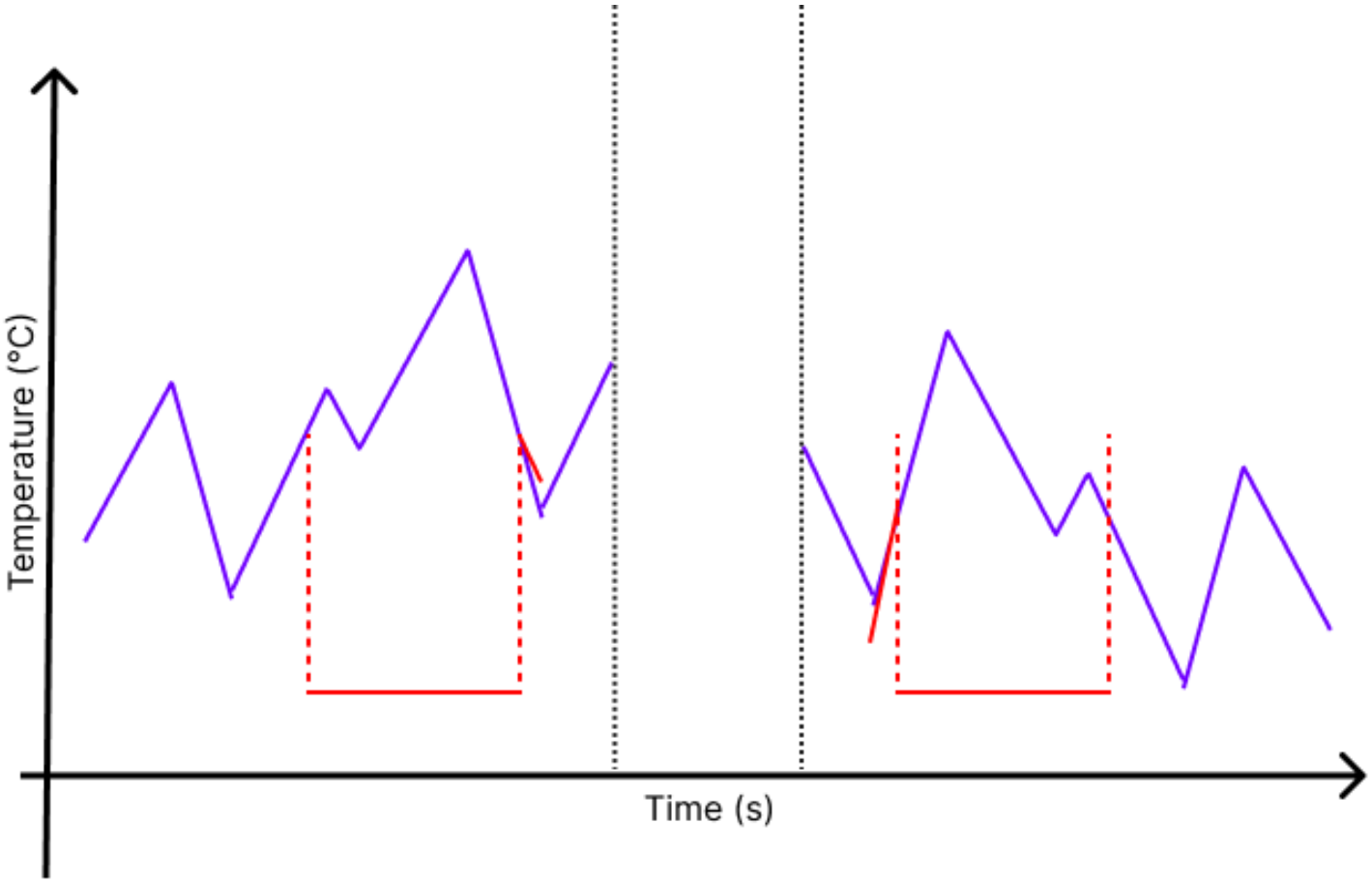

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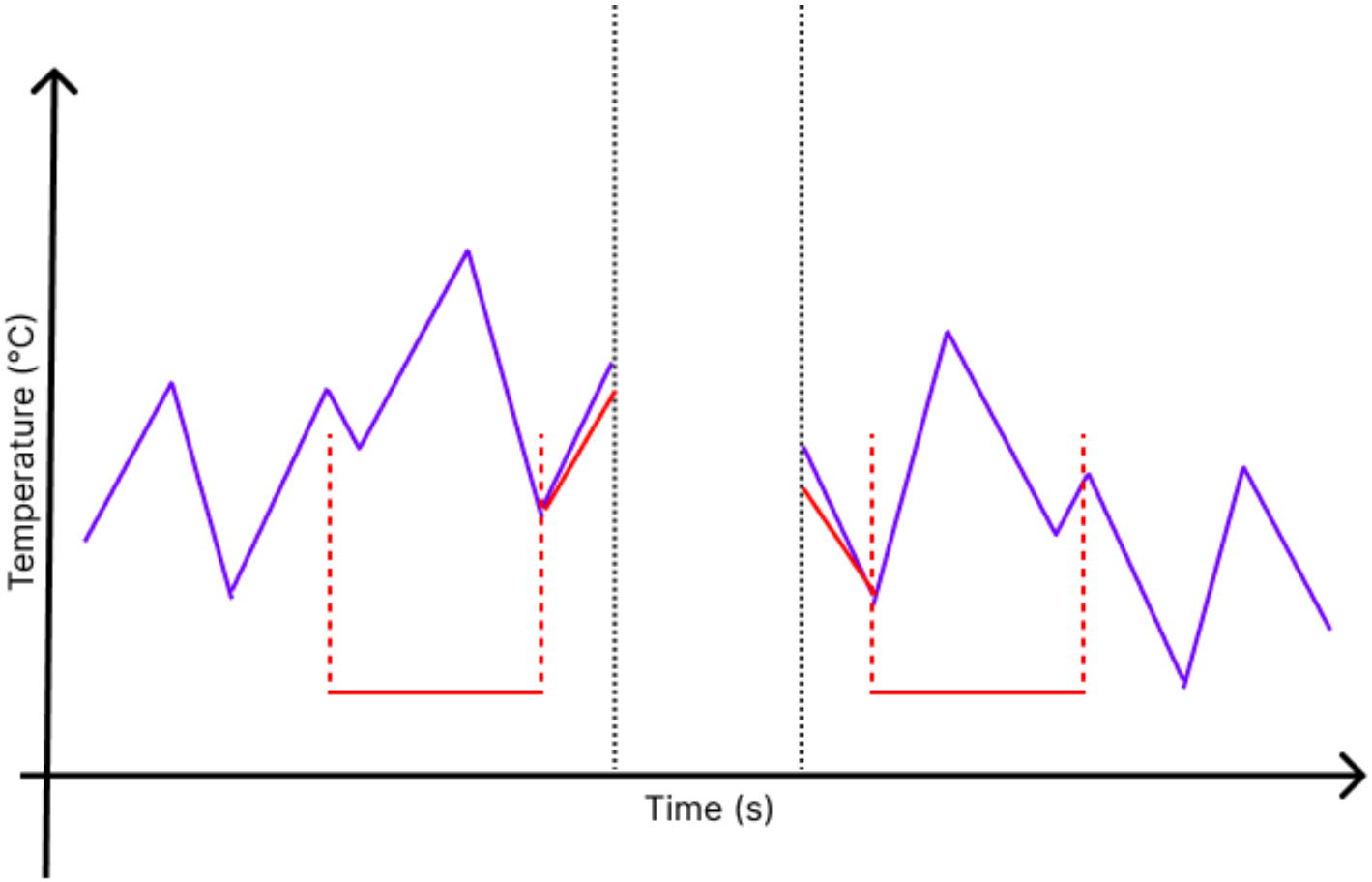

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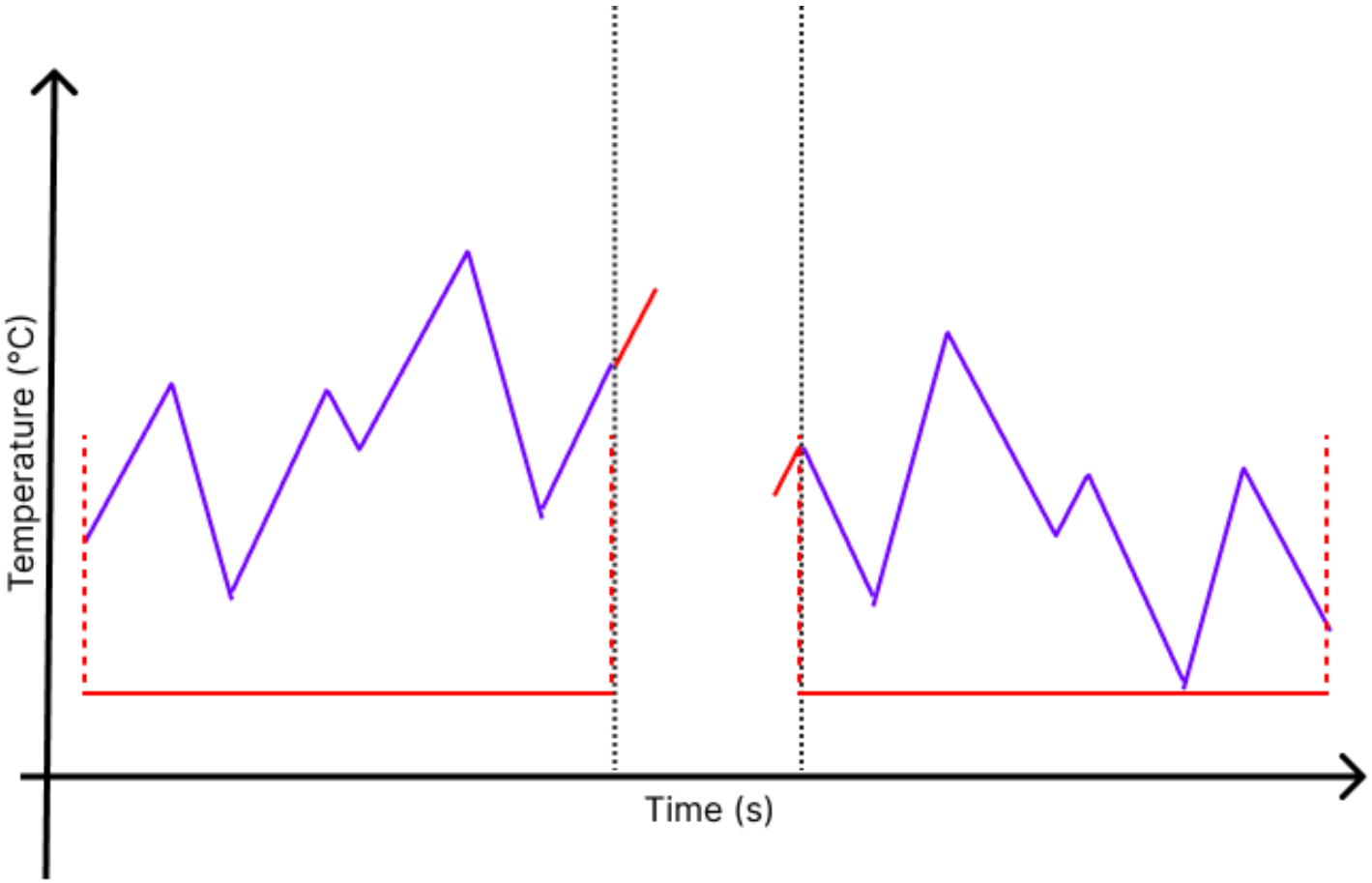

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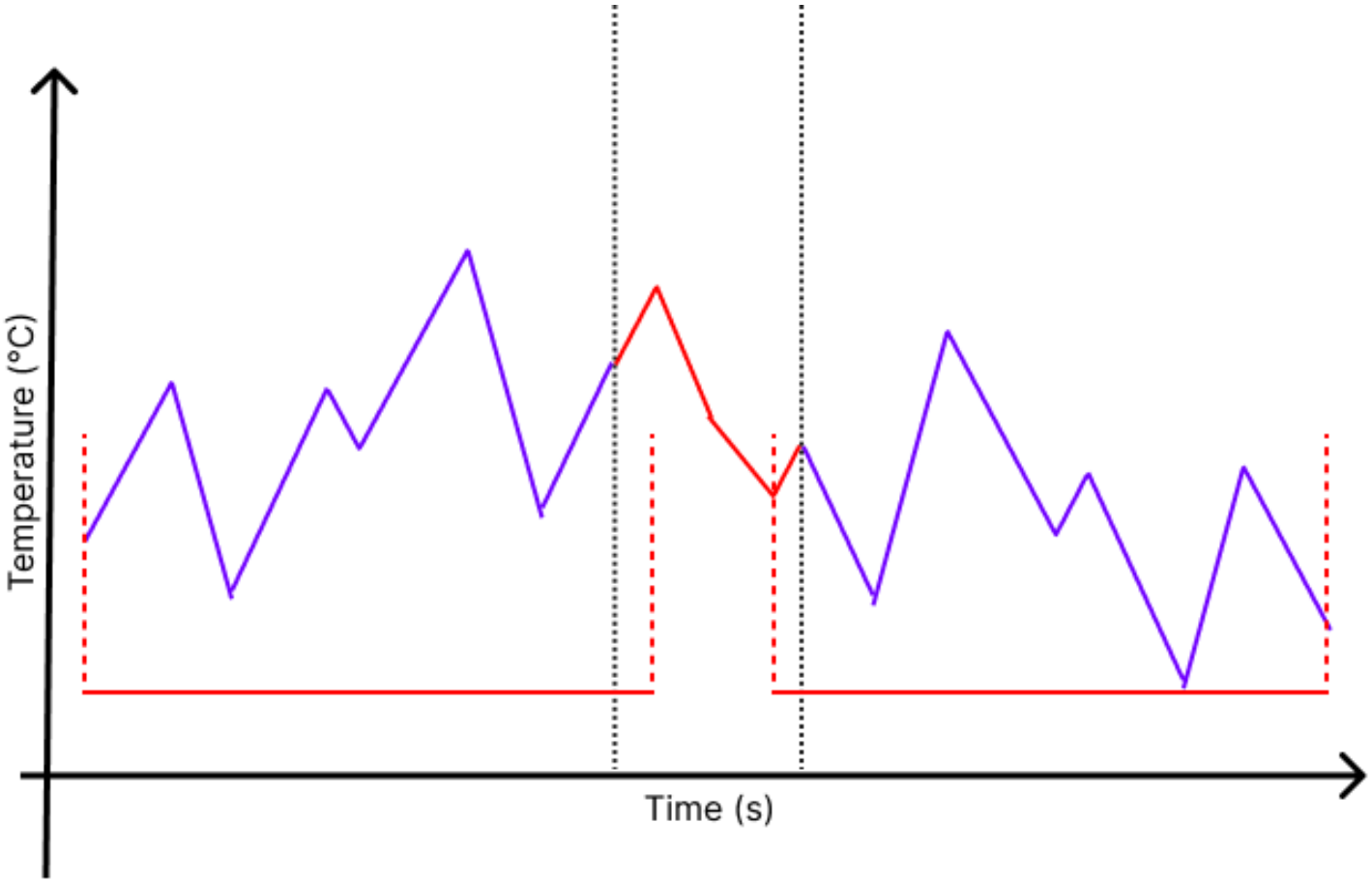


Data Imputation

Random Forest Model

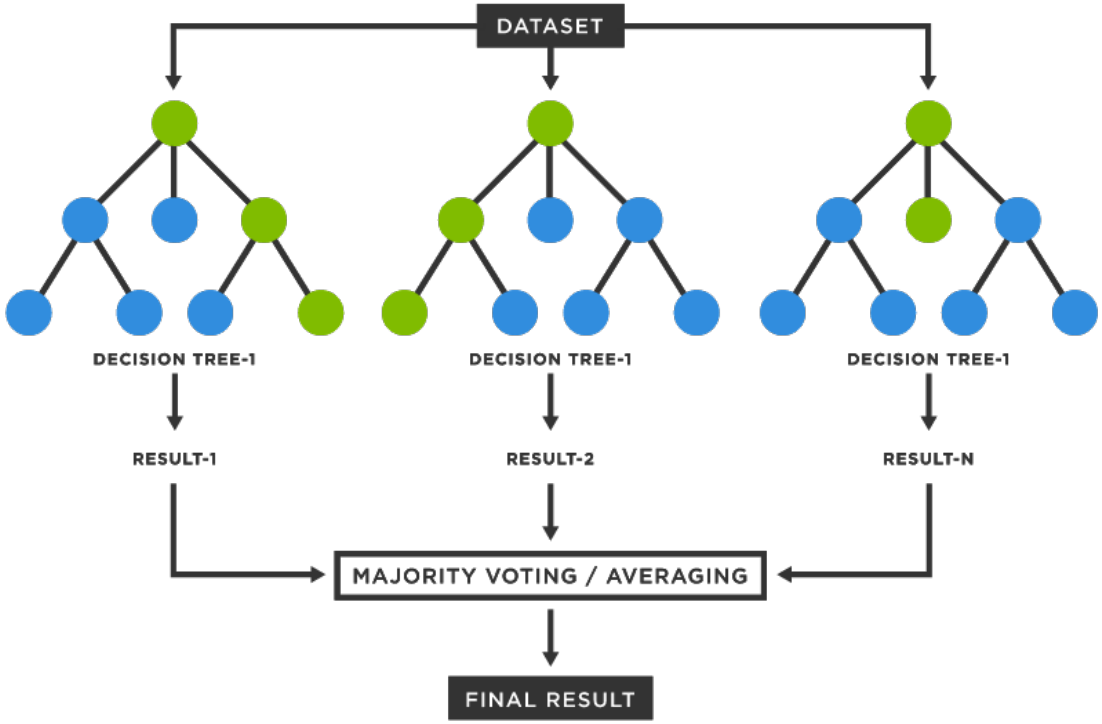


Figure 4: Diagram of the Random Forest model

Data Imputation

Model performance

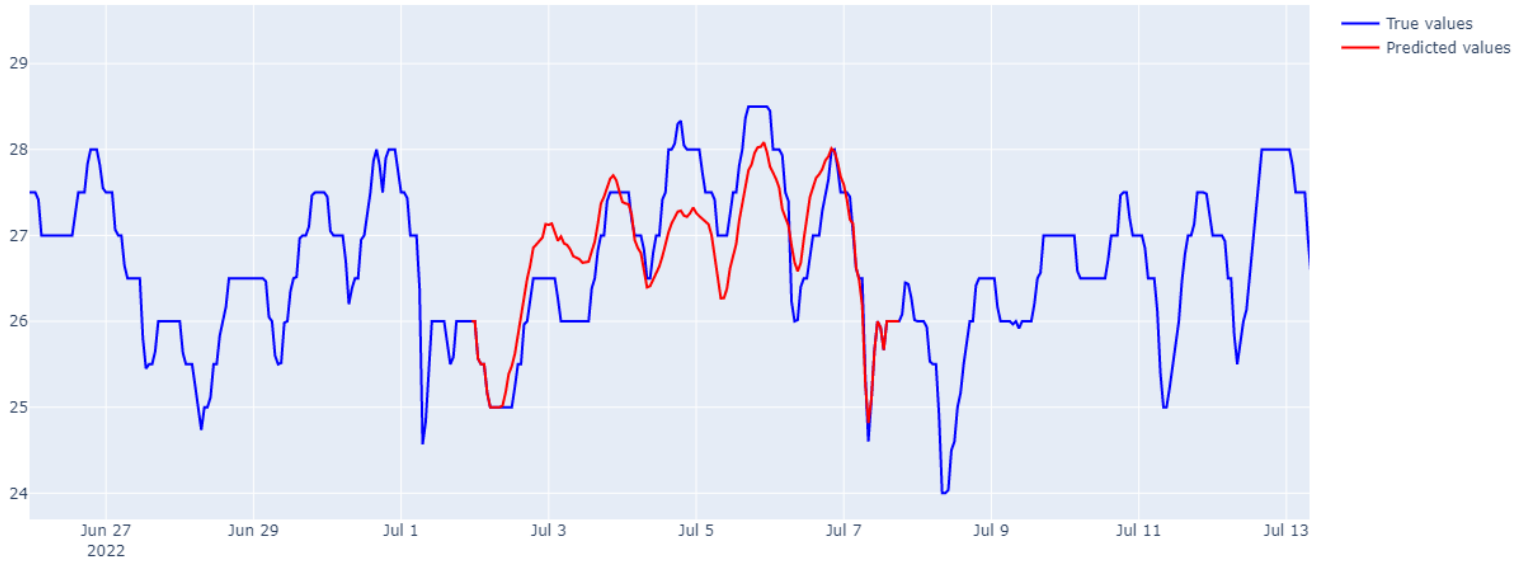


Figure 5: Test for one sensor from Meraki. Resolution = 1 hour.

Data Imputation

Model performance

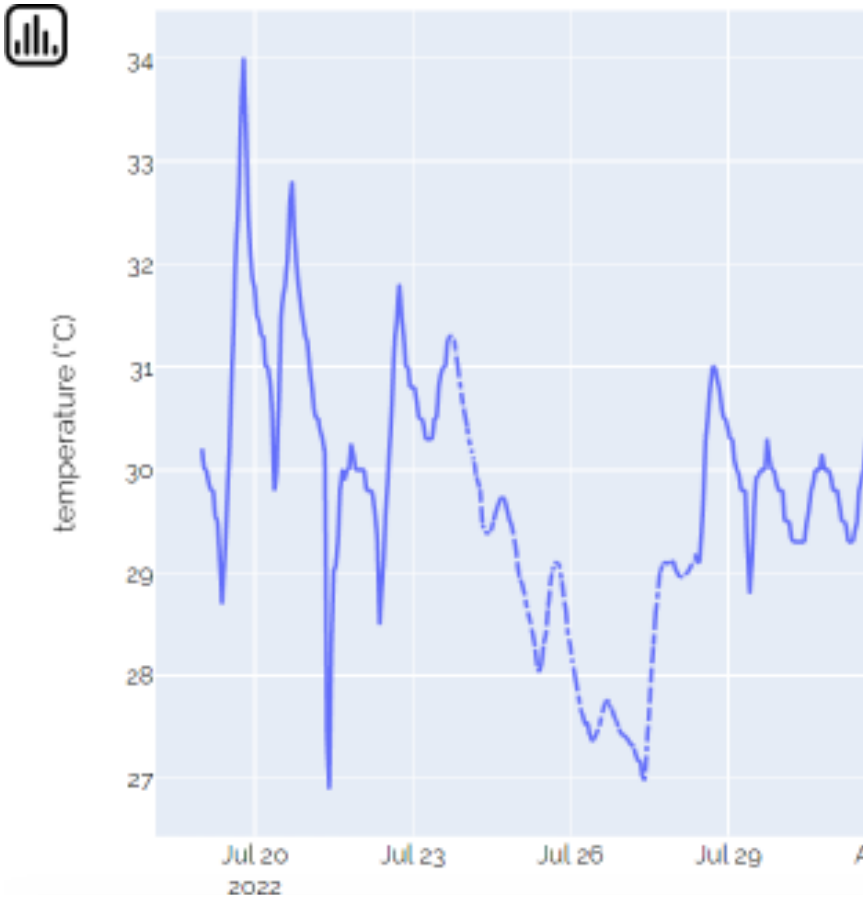


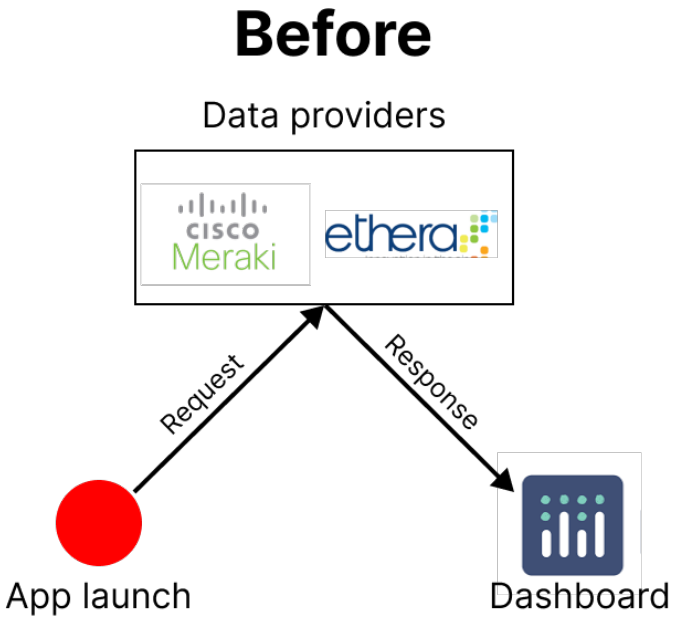
Figure 6: Imputed data for an Ethera sensor. Resolution = 10mins.

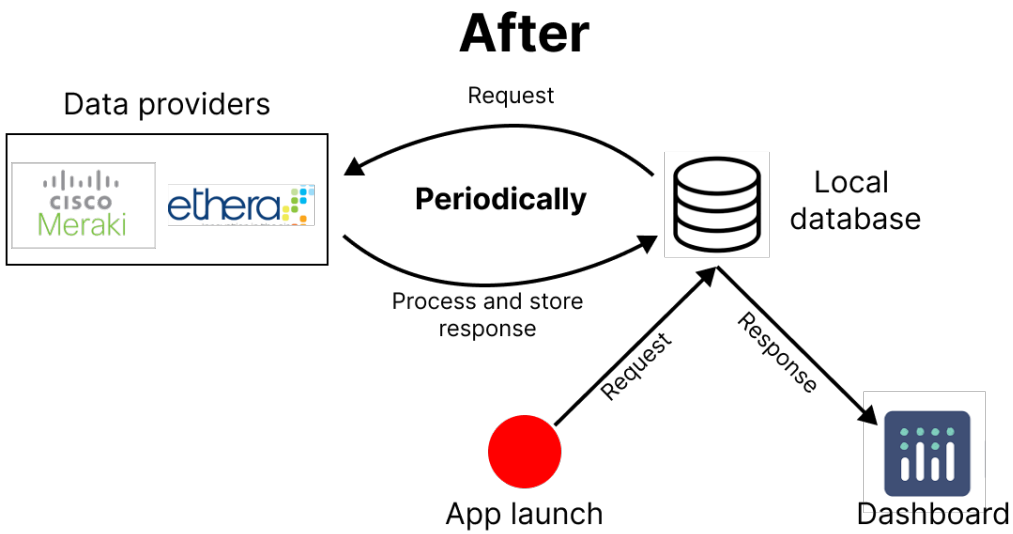
MSE	1 day	5 days	30 days
10min	0.02	1.61	-
1H	0.22	0.6	6.7
1D	0.01	0.12	5.8

Figure 7: MSE averages for 10min, 1h, 1day resolutions by gap length.

Database construction

Data Flow





Database construction

Data structure

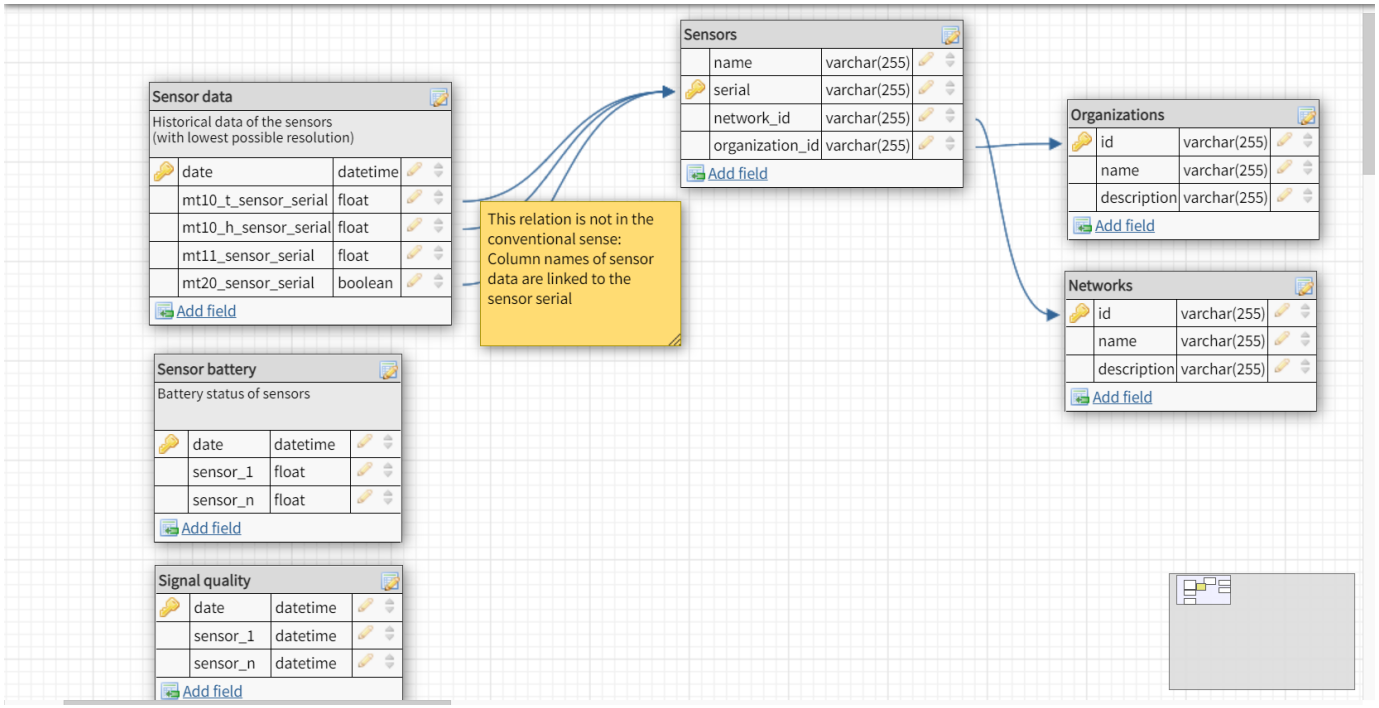


Figure 8: Proposed schema for a MySQL database.

Database construction

Estimating storage size

Assumptions

- 60 sensors.
- 20 year period.
- 2 minute resolution.
- 40 float columns, 20 binary columns.

Results

- Unprocessed information: 946MB.
- Processed information: 24.3% more space (total of 1.2GB).
- Maximum estimated storage size: 10GB.

Database construction

Reconstructing historic data

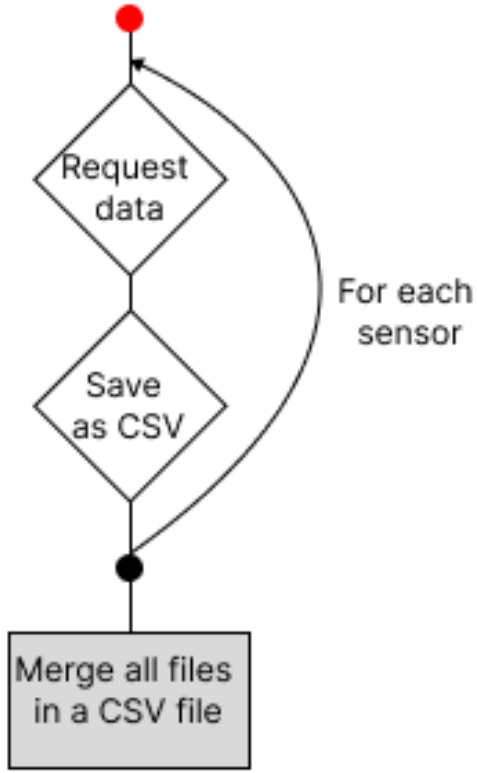


Figure 9: Steps of reconstruction script

Database construction

Data processing and updating

Processing steps

- Reindex the incoming data by multiple frequencies
- Check for missing values on incoming data
- Use existing data to fill missing values

CRON Job

- Request
- Process
- Store

Dashboard Personalization

Make the dashboard's code independent of the requested data.

Improvements

- Facilitate adding new sensor models and metrics.
- Reduce the need for code modifications.
- Provide an easy way of customizing the dashboard.

Dashboard Personalization

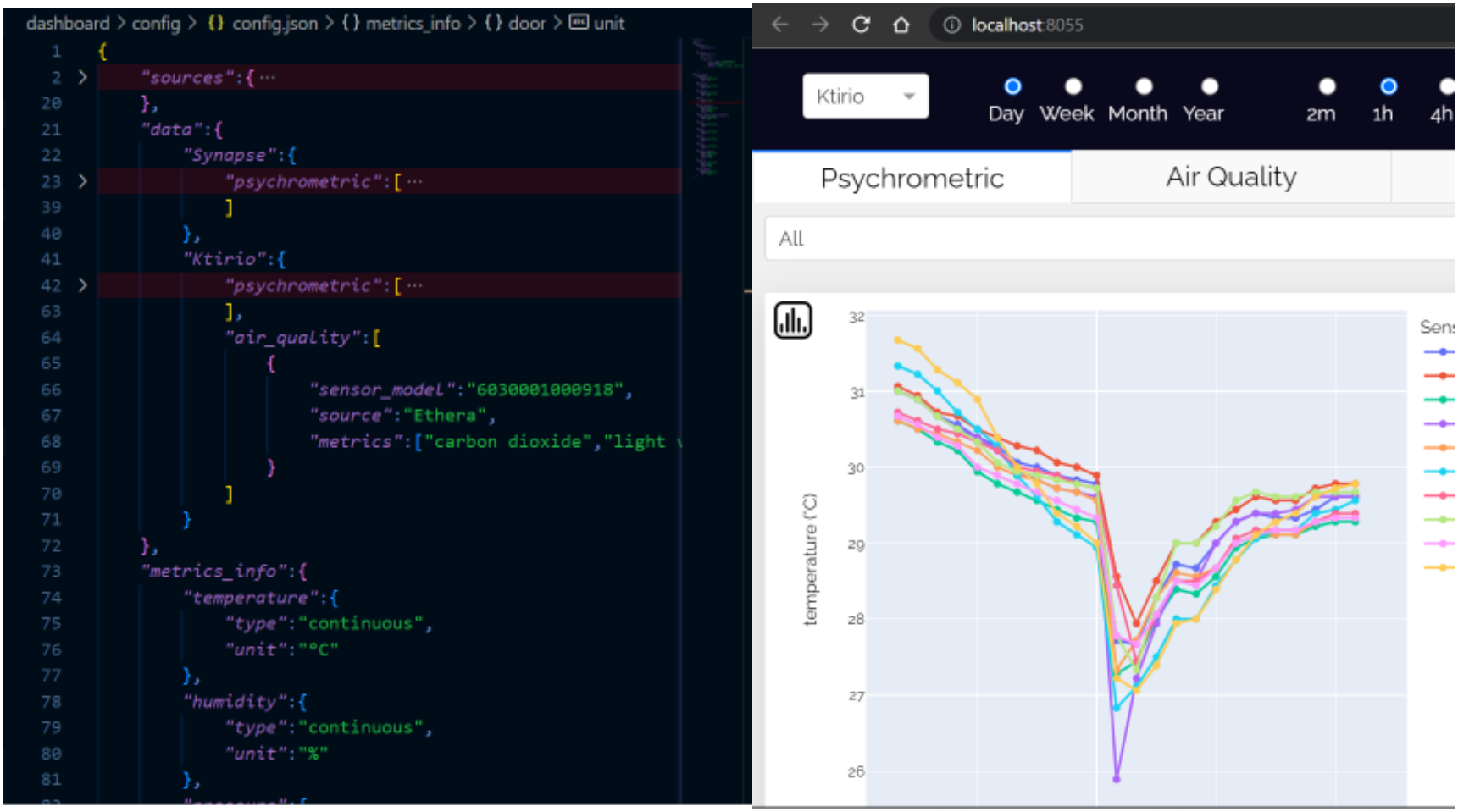


Figure 10: Effects of the configuration file on the dashboard.

Objective

Asses uncertainty of PMV and PPD models by handling subjective or unknown parameters.

Parameter	ISO7730	ASHRAE55
Metabolic Rate	0.8 - 4	1 - 4
Clothing insulation	0 - 2	0 - 1.5
Relative air speed	0 - 1	0 - 2

Figure 11: Table of unknown parameters and their limits

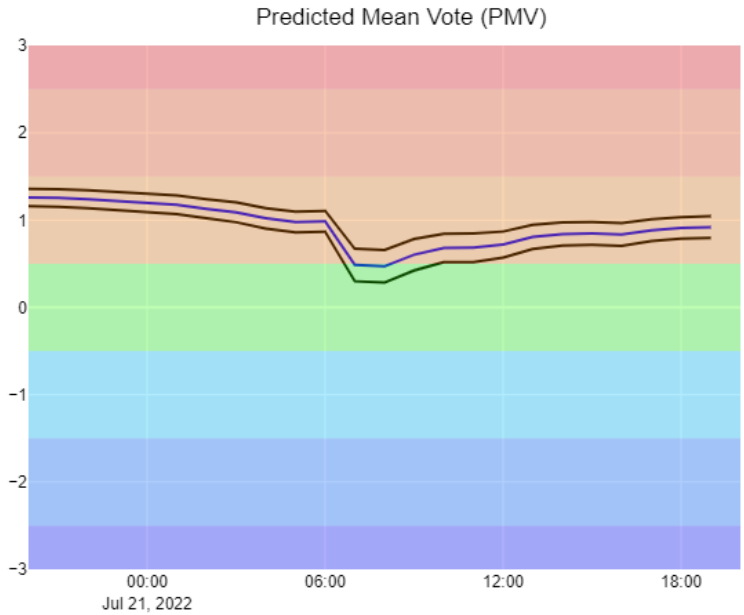


Figure 12: Monte Carlo simulation of the PMV. 95% confidence interval.

CO_2 Dissatisfaction Percentage

$$PD_{CO_2} = 407 \cdot exp(-15.5 \cdot (C_{CO_2} - 380)^{-0.25})$$

Volatile Compounds Dissatisfaction Percentage

$$PD_{TVOC} = 405 \cdot exp(-11.3 \cdot C_{TVOC}{}^{-0.25})$$

Formaldehyde Dissatisfaction Percentage

$$PD_{HCHO} = 100 - 95exp(-0.068log(C_{HCHO}/0.1)^4 - 0.44log(C_{HCHO}/0.1)^2)$$

Total Indoor Air Quality

$$IAQ_{index} = 100 - (W_{CO_2} * PD_{CO_2} + W_{TVOC} * PD_{TVOC} + W_{HCHO} * PD_{HCHO})$$

Indoor Environmental Quality

$$IEQ_{index} = \frac{1}{3}(IAQ_{index} + (100 - PD_{ACC}) + (100 - PD_L))$$

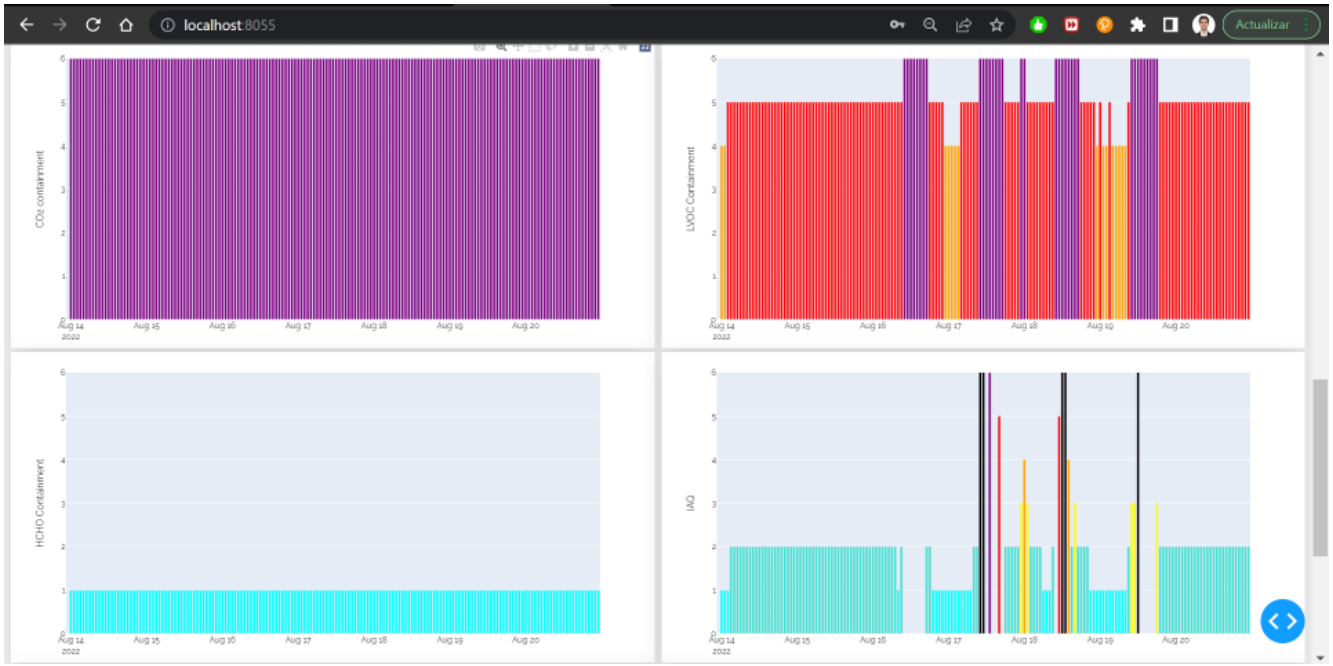


Figure 13: Air Quality indicators in the *Indicators* tab

Building geometry

3D view

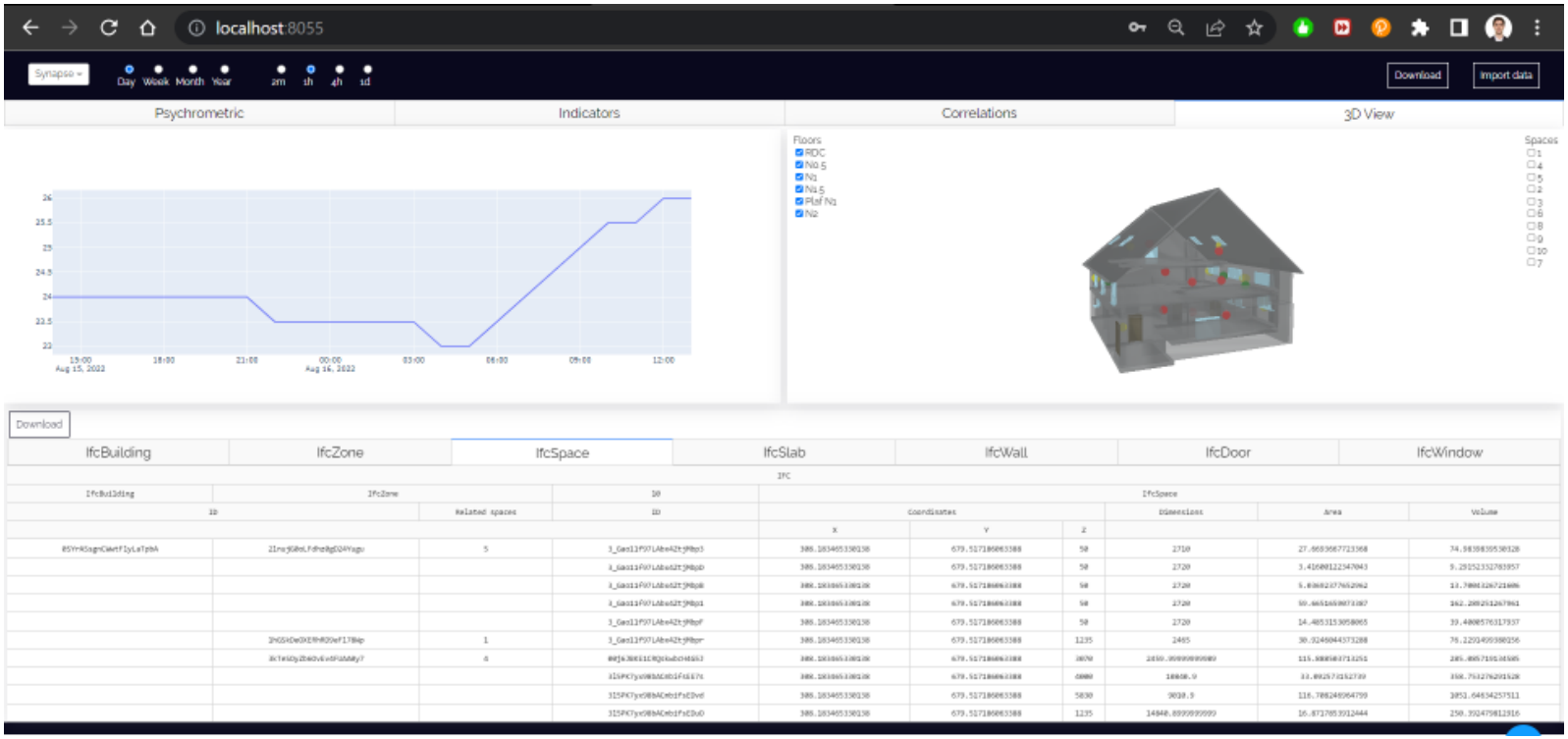


Figure 14: 3D View tab of the dashboard. Synapse Building.

Deployment

The dashboard is now accessible through dashboard.ktirio.fr.