BLIND PREDICTION TEST FOR ODOR CONCENTRATION WITH AN ELECTRONIC NOSE: A REAL CASE OF STUDY

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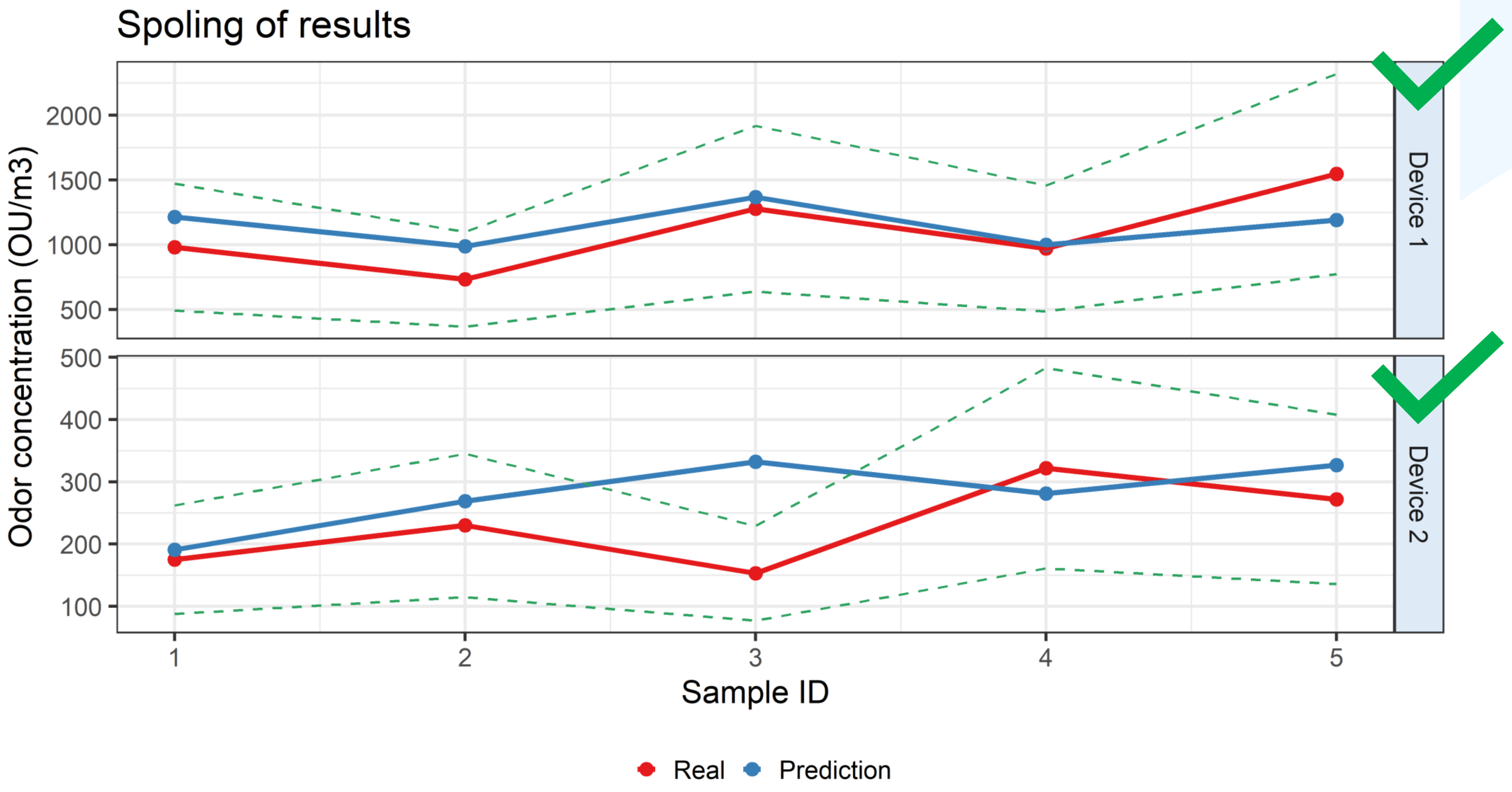
Teaser (TL; NR)

Blind prediction in a wastewater plant



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Context and goals

Case of study: Wastewater Plant

Context

- Control emissions from deodorization process in 2 sites
- Unstable environmental conditions (channeled sources)
- Emissive pollution, particularly odors and gases
- Toxic gases: Hydrogen Sulfide , Ammonia
- Compliance to regular monitoring audits by local authorities
- Training of the electronic noses took place over a period of 4 months including 5 training campaigns, validation and blind samples assessment

Case of study: Wastewater Plant

? Challenge

- Continuous monitoring of odor unit using dynamic olfactometry (EN13725:2003)
- Real-time analysis for quantification of odors and gases to comply with authorities requests
- Prevent local complaints of odors with survey of deodorization processes
- Blind prediction of odor unit should reach 80% of success with olfactometry scores

Material and method

Site 1

Sludge treatment unit.

Quantification of odor emissions after deodorisation process, at dispersion stack

Thermal dewatering of sludge generates odors.

Gases form polluted air are captured, then cleaned through the process.

Site 2

Deodorization unit (nitrification/denitrification sector).

Gases from polluted air are captured, then filtered through the deodorisation unit.

Ellona Dryer solution

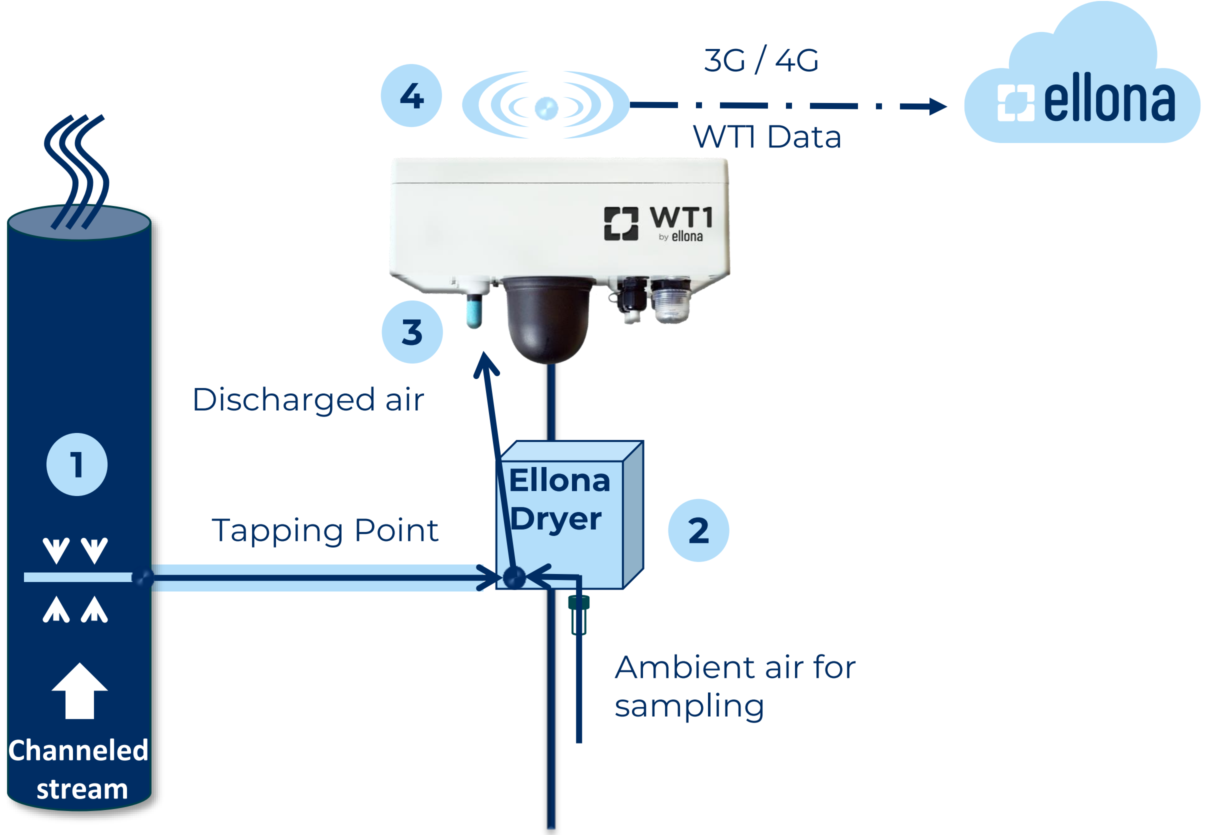
For diffusive source monitoring

1 **Air Sampling**

2 **Air drying**

3 **Air Analysis**

4 **Data communication**



WATCH TOWER 1 (WT1)

Size: 26 x 16 x 16 cm

Weight: 3 kg

Monitoring & Recognition of outdoor environment

VOC

Gas
(up to 8 gases)

Particulate Matters
(PM1, 2.5, 10)

Odors
(recognition)

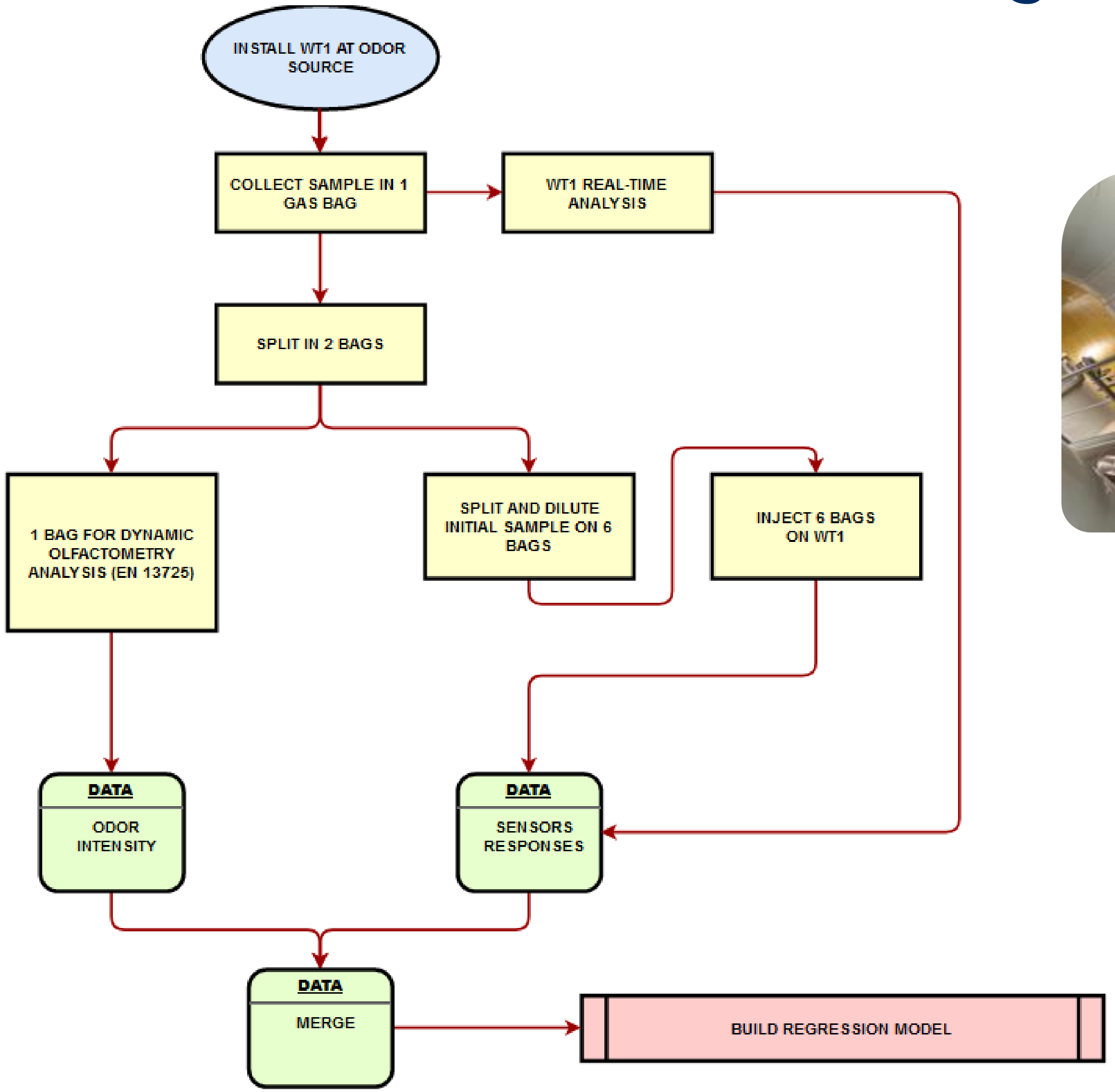
Noise
(intensity, recognition)

Temperature

Humidity

Atmospheric pressure

Training method



Collection

Injection

Analysis

Calibration: olfactometry

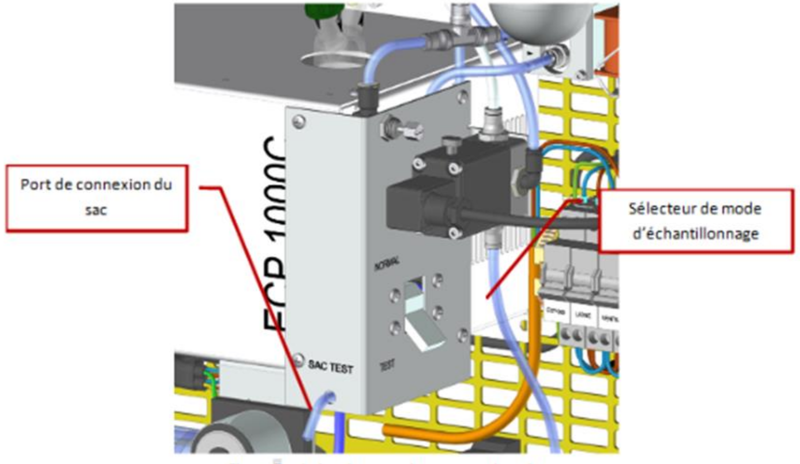
- Period of sampling considering source variation: 4 months
- 5 training campaigns to build and validate the prediction of odor intensity model

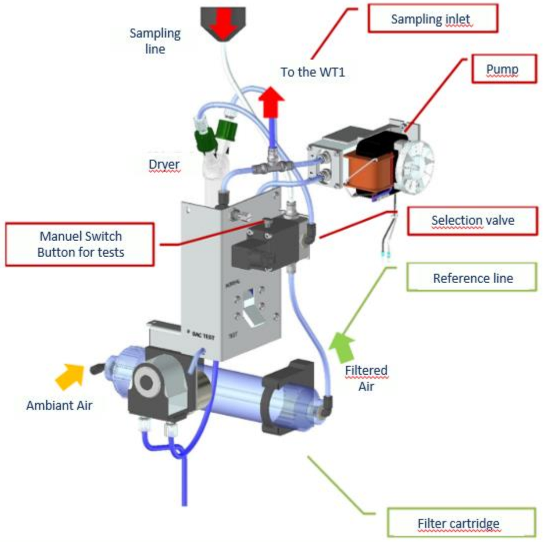
Material

- Nalophan bags from 60 L to 130 L
- Sampling ‘lung’ for training bags dedicated to olfactometry (EN13725) and dilution for WT1

Lab analysis

Calibration stage : injection in WT1

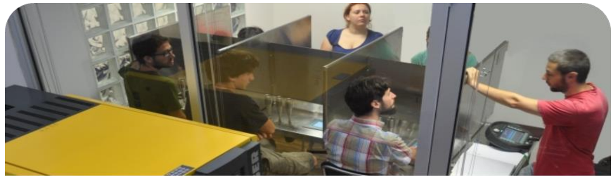


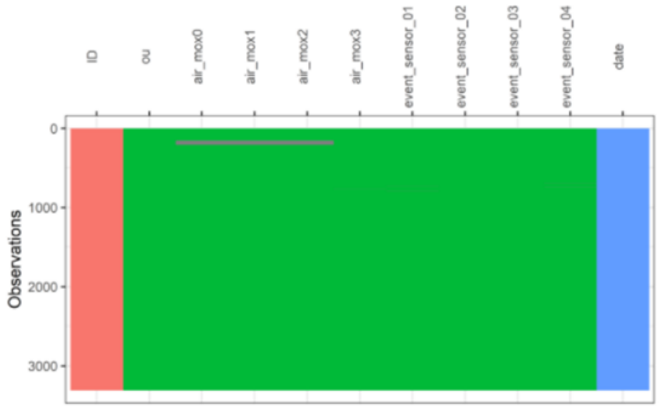


Data pipeline

Sensors' responses

Label (OU/m^3)


Lab analysis



Matrix of 3308 samples for 2 sites

Partial Least Squares (PLS) regression

Principle: regression technique

Application: Get odor intensity (following EN13725 standard) from a set of sensors values

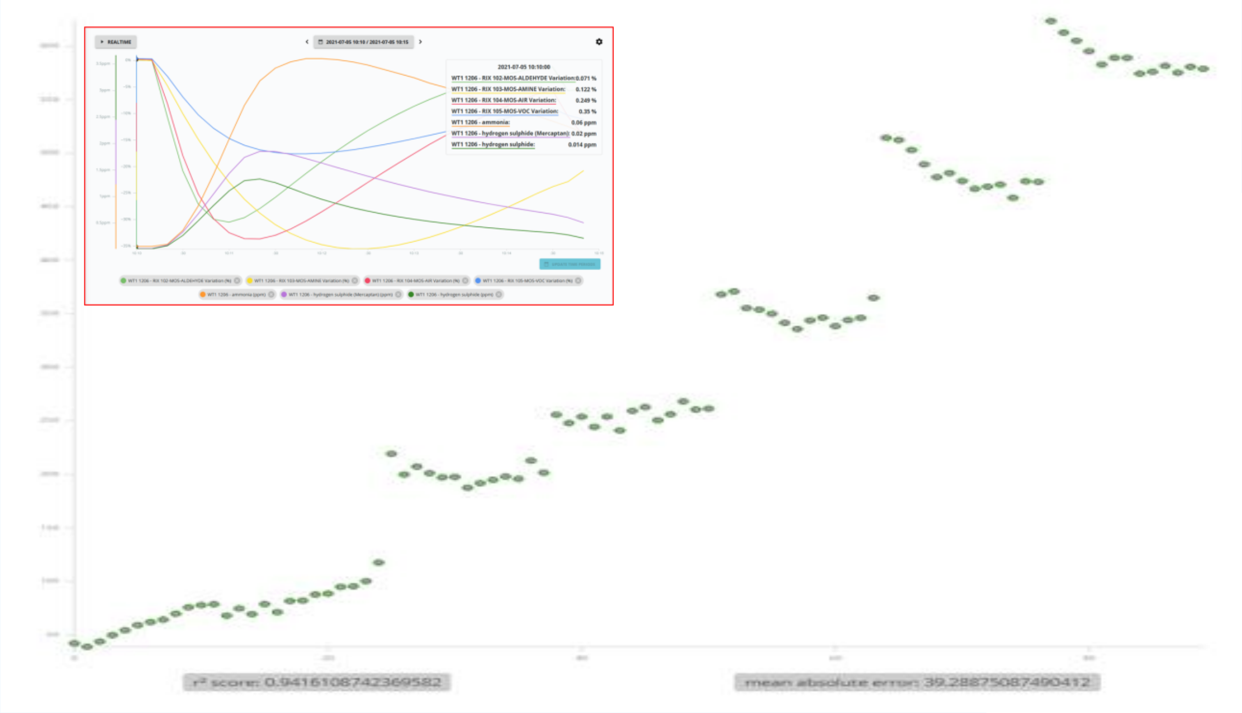
DATA COLLECTION → **DATA** PREPARATION → **DATA** MODELLING

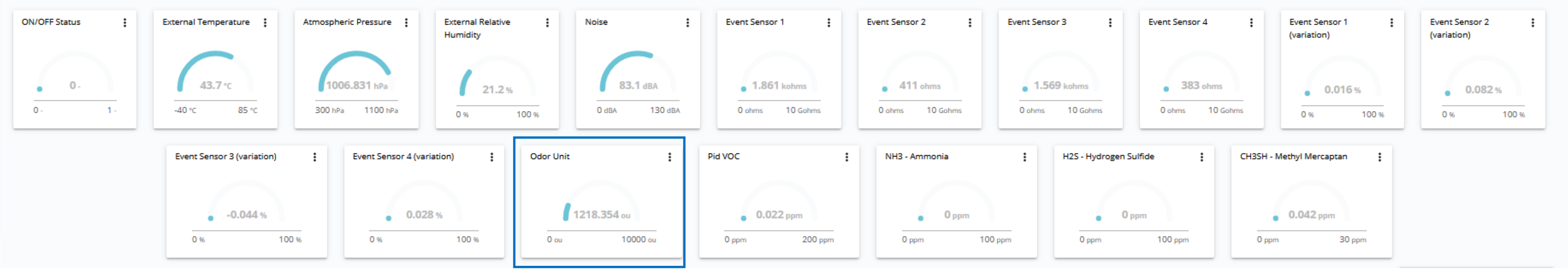
Results

Regression model

1. Data collected during the olfactometry study is used to calculate the model which «translates» sensor data into odour units suited to each site

2. Model is then integrated into the analyser control software as an additional sensor : OU/m³ value can be followed in real time





Blind prediction: score

Odor concentration forecasting lead to successful prediction with 90% of correct identification

Blind analysis Odor concentration UO_E/m^3

Validation results

Blind test

Sample ID	Real concentration	Low limit	High limit	Model prediction	Validation
Device 1					
1	981	491	1471	1215	OK
2	733	367	1099	987	OK
3	1278	639	1917	1369	OK
4	972	486	1458	1000	OK
5	1547	774	2320	1191	OK
Device 2					
1	175	88	262	191	OK
2	230	115	345	269	OK
3	153	77	229	332	NOK
4	322	161	483	281	OK
5	272	136	408	327	OK

Online measurements

Example of Odour concentration with alarm level limits (low , medium, critical)

Conclusions

Source Monitoring

Online control

Real time monitoring thanks to the efficient and accurate modelization with olfactometry data

Real time alerts

Customize threshold

Alert for gases and odor intensity can be adjusted in order to warn the environmental director of any anomaly on the deodorization process

Process monitoring

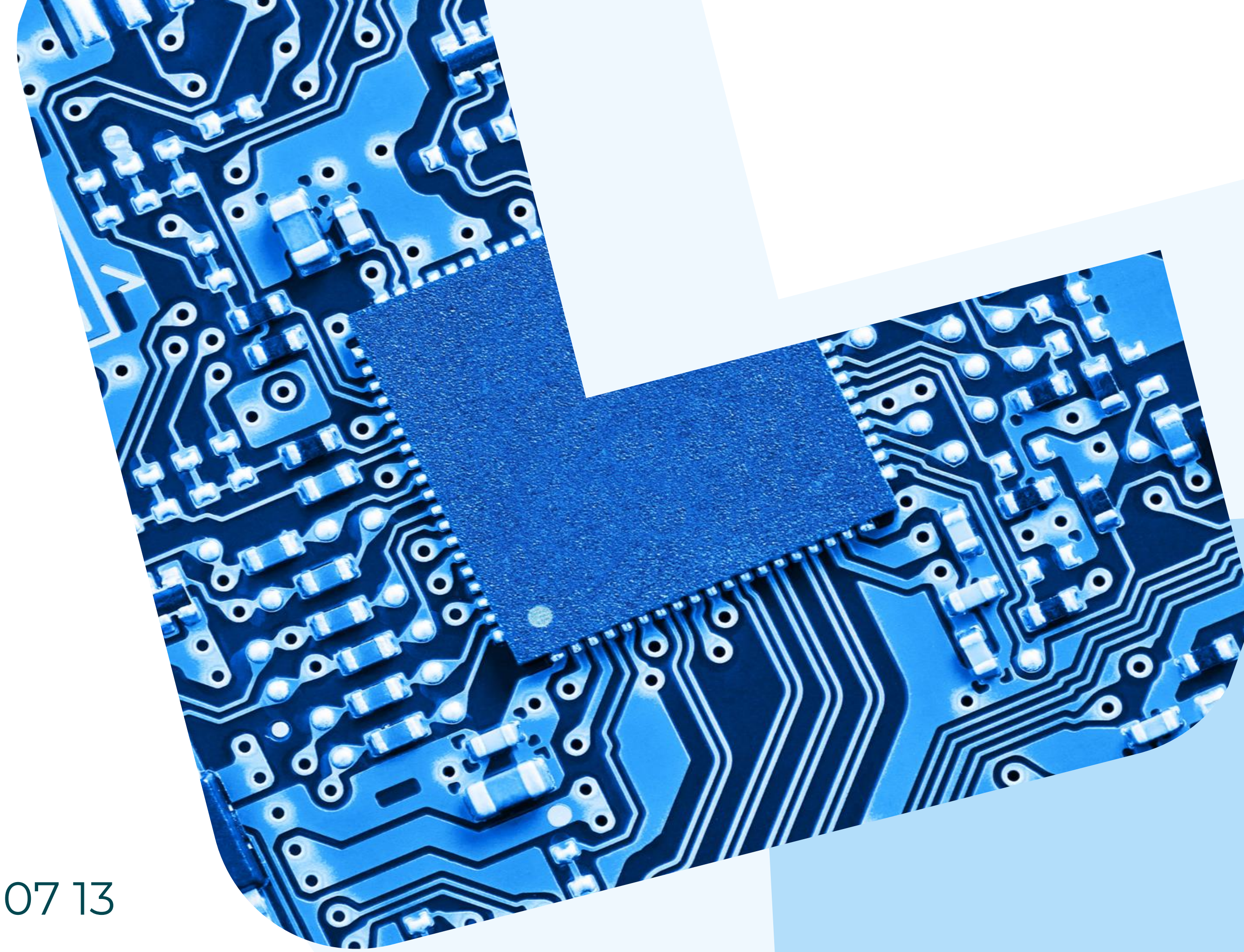
Operations follow up

Upstream and downstream installation can be controlled to have an optimal deodorization process and consistency of emissions

Enrich odor unit model overtime

Limit periodic checks

The model for odor unit prediction can be enriched and checked with periodic olfactometry campaigns



Thank you

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