CPH Sense : Air Quality Node

CPH Sense : Offers fully calibrated, high sensitivity **sensing as a service** for gases and particles with an integrated cloud based data analytics platform.

Power rating
110 - 230 VAC, 50/60 Hz single phase
Power consumption : 5 W during sensing
Approx 0.15 W in standby

Environmental rating
Outer casing : IP54 rating - designed for air intake and water splash / rain protection.

Data Connectivity :
Option 1: (standard)
Dual-Band UMTS/HSDPA 850/1900MHz Quad-Band GSM/GPRS/ EDGE 850/900/1800/1900MHz

Option 2: (custom build request)
Wifi - 802.11 a/b/g

Standard Sensors:
NO2 : 0 - 1000 ppb (tuned for low ppb 0-200 levels if required)
CO : 0 - 10000 ppb
SO2 : 0 -10000 ppb
Particle Sensor : PM 1, PM 2.5, PM 10.
Temperature, (-30 to +50)
Relative Humidity : (10- 90%)

Possible Sensors (custom implementation):
CO2
H2S
NO
O3 - Derivative from analytics
CH4
Decibel Meter : 20-120 dBA (20 Hz – 20 kHz)
UV radiation

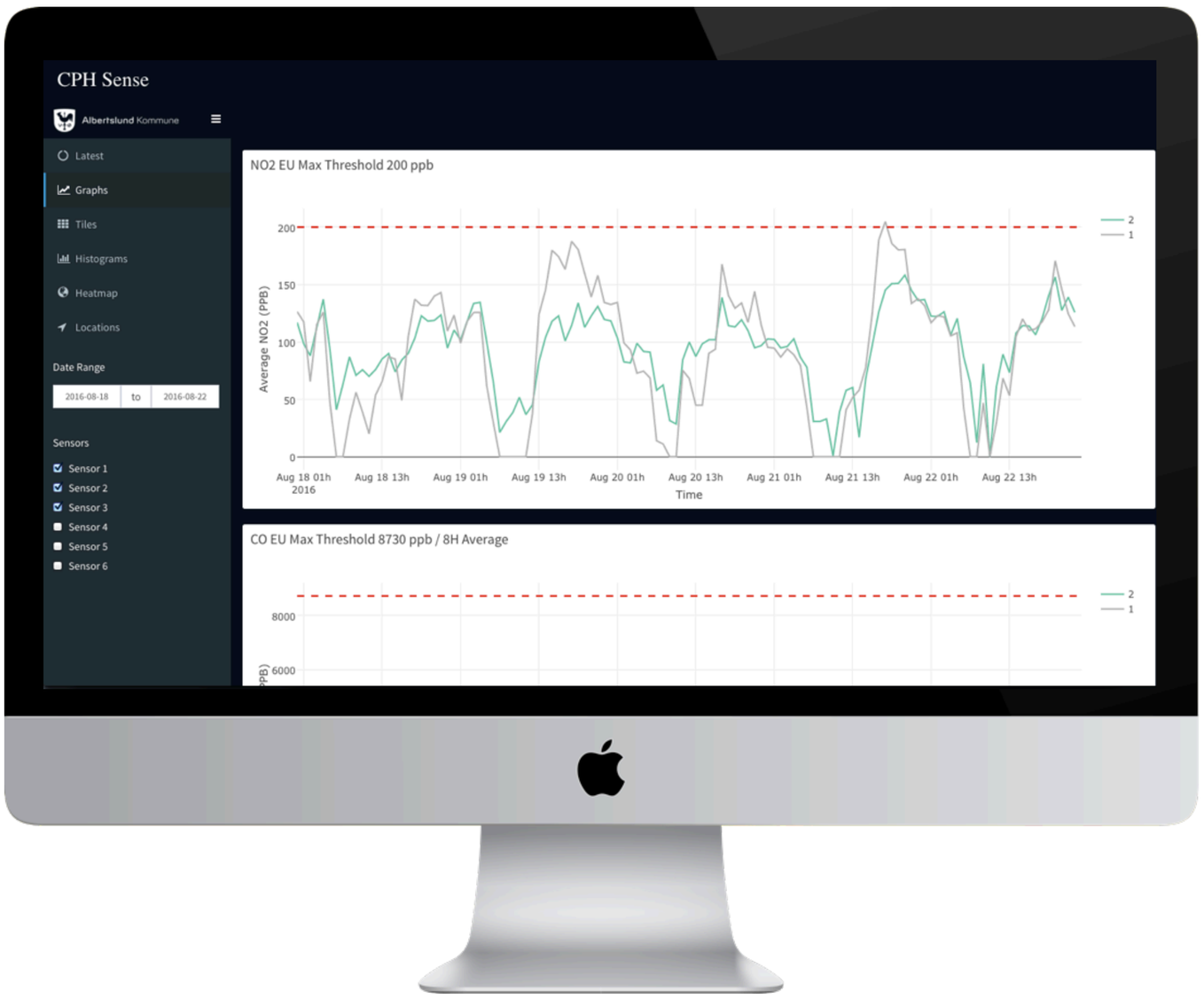
Accessories optional
GPS Location
Li-Poly Battery for non continuous power (900 mAh)
Solar charging kit.

Sensing frequency :
Adjustable between 3 minutes to several hours / days. 1sec / 125 mSec for sound level.

Dimensions : 390 mm x 108 mm x 105 mm
Weight : 3.1 - 4.2 Kgs (Depending on sensor configuration)

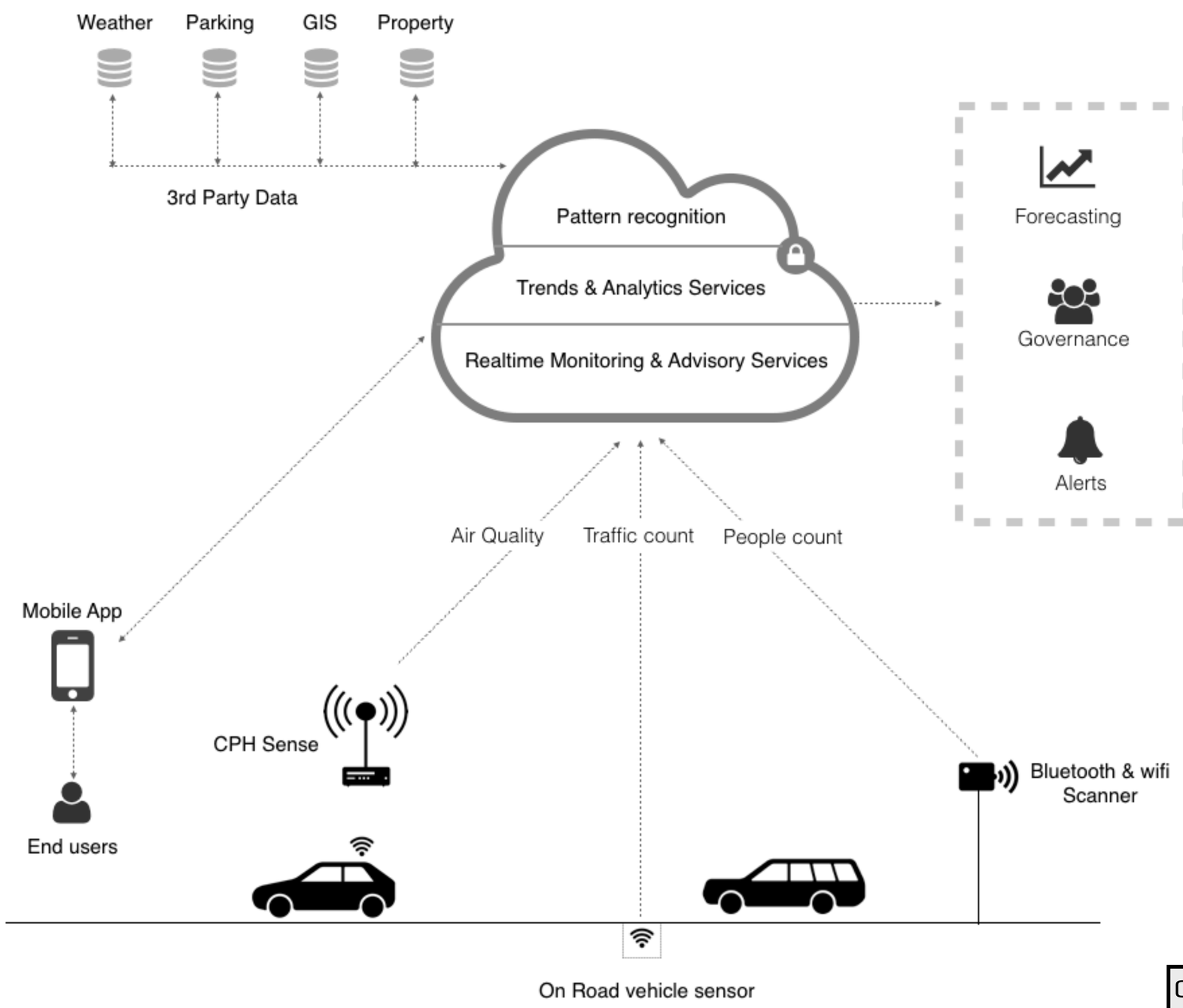
Calibration : CPH sense comes fully calibrated with certified gases. We also run real time compensations for drift and high sensing resolution via our cloud services in real time.

CPH Sense : Cloud Specifications



CPH Sense connects to a fully managed cloud solution to harvest data, run analytics and download data to various other applications. The solution is truly plug'n'play - you just need to setup the hardware on location and then login via your credentials to instantly start measuring air quality in your area.

CPH Sense is smart city ready - with full inbound and outbound integration to various data sources, use cases, advanced rule engine and data integration via a REST-API.



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CPH Sense

Ambient sensing for smart cities

Sensor Data Quality V2.0

leapcraft

CPH Sense :

Low cost rugged sensor

Senses various gas and particles

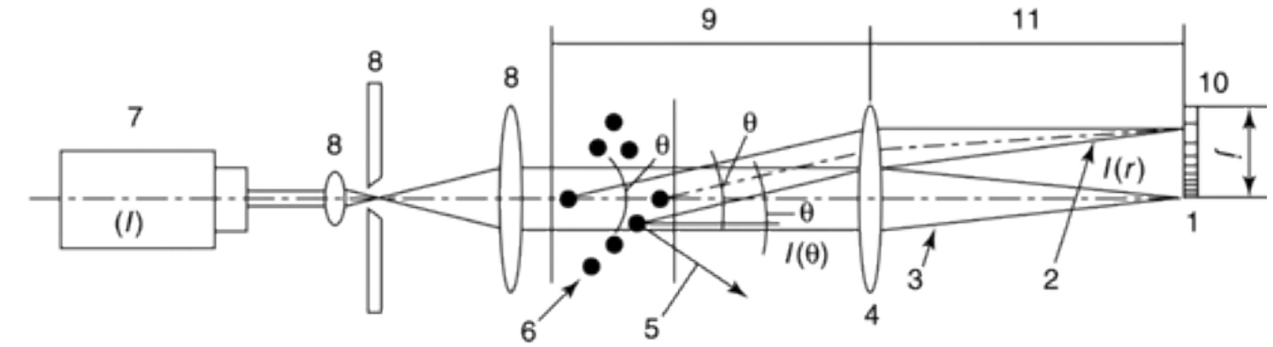
NO2, NO, O3, SO2, CO, PM1, PM2.5, PM10

Power from Lamp posts / solar panel

3G connectivity - plug 'n' play

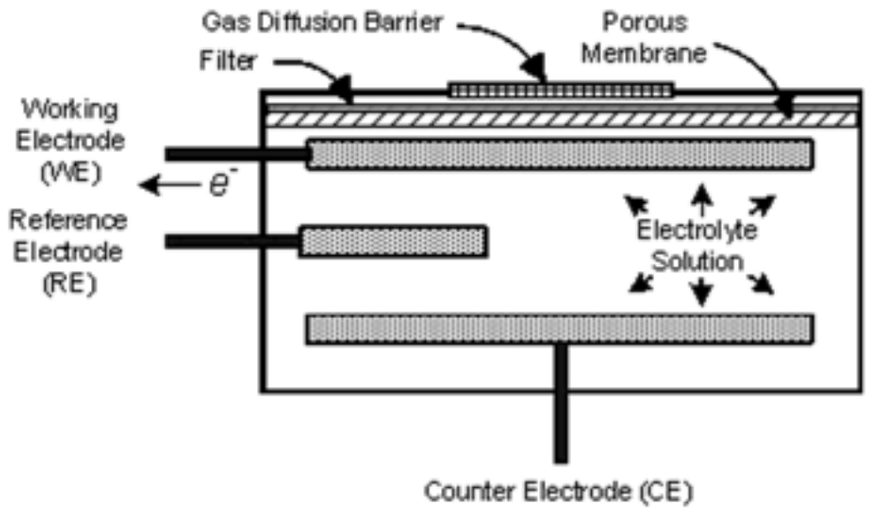
HIGH FOCUS ON ACCURACY at LOW COST

CPHSense as a system is tuned for matching the accuracy of more expensive and sophisticated setups. We do this with our proprietary performance optimization of laser diffraction and electrochemical cells via precision electronics and advanced digital signal processing (DSP) combined with compensation algorithms running on the cloud.



1. Obscuration detector
2. Scattered beam
3. Direct beam
4. Fourier lens
5. Scattered light not collected by lens (4)
6. Particle ensemble
7. Light source laser
8. Beam processing unit
9. Working distance of lens (4)
10. Multi-element detector
11. Focal distance of lens (4)

Laser Diffraction for particle counting



1. Basic Electro-chemical sensor with filter

Electrochemical cells for gases

http://www.pharmacopeia.cn/v29240/usp29nf24s0_c429.html

Data Quality Process

The devices themselves send data every two minutes and they are compensated and averaged according to the granularity requirement at the server side. The sensor devices are constructed of high quality low noise electronics with its own battery backup and shielding to minimize external EMF influence. Each device has an inbuilt memory that stores the custom calibration values and the amplifier scaling for the desired sensitivity. All data is sent in real time to a cloud infrastructure where the data is backed up, analyzed and presented.

The CPH sense cloud infrastructure also runs compensation for relative humidity and temperature shift as a continuous background process to ensure good data quality. Electrochemical cells are prone to influence by humidity and drastic temperature changes, thus we put significant effort to run compensation algorithms.

CUSTOM CALIBRATION

CPHSense offers high quality benchmarking and custom calibration profiles for each sensor. We feed digitally controlled gas values and use Chemiluminescence & FTIR instruments for reference data. All calibration values are hard coded into each sensor board.

Calibration Process

The sensors are placed in a Non-reactive chamber connected with gas-mixing equipment along with reference instrumentation. In addition, the gases utilized by the gas-mixers were verified to be certified. The first step in the process of calibration was 'Zero Air' or 0% Full Scale (FS). Once the Zero-air calibration was performed, the gas-mixer was utilized to generate mixtures depending on the sensor under calibration.

For Carbon Monoxide (CO) sensors, three tests were carried out at 0%, 25% FS and 50% FS.
For Nitrogen Dioxide (NO2), two sensor tests were carried out at 0%, 5% and 25% FS which was similarly the same mixture concentration for Sulphur Dioxide (SO2).

The mixture was validated using the reference instrumentation available at Force Technologies (Danish government approved labs) with their quality assurance process. With the response from the sensors, a calibration function was built to get the corresponding concentration value from the raw digital/analog value. The sensors have been proven to provide high degree of linearity in lab tests.

For example, the NO2 sensors have the following characteristics according to the specification sheet:

Response time t90 (s) from zero to 2 PPM NO2 < 60
Noise ±2 standard deviations (PPB equivalent) : 15
Linearity PPB error at full scale, linear at zero and 5 PPM NO2 : < ±0.5

BENCHMARKING STUDY

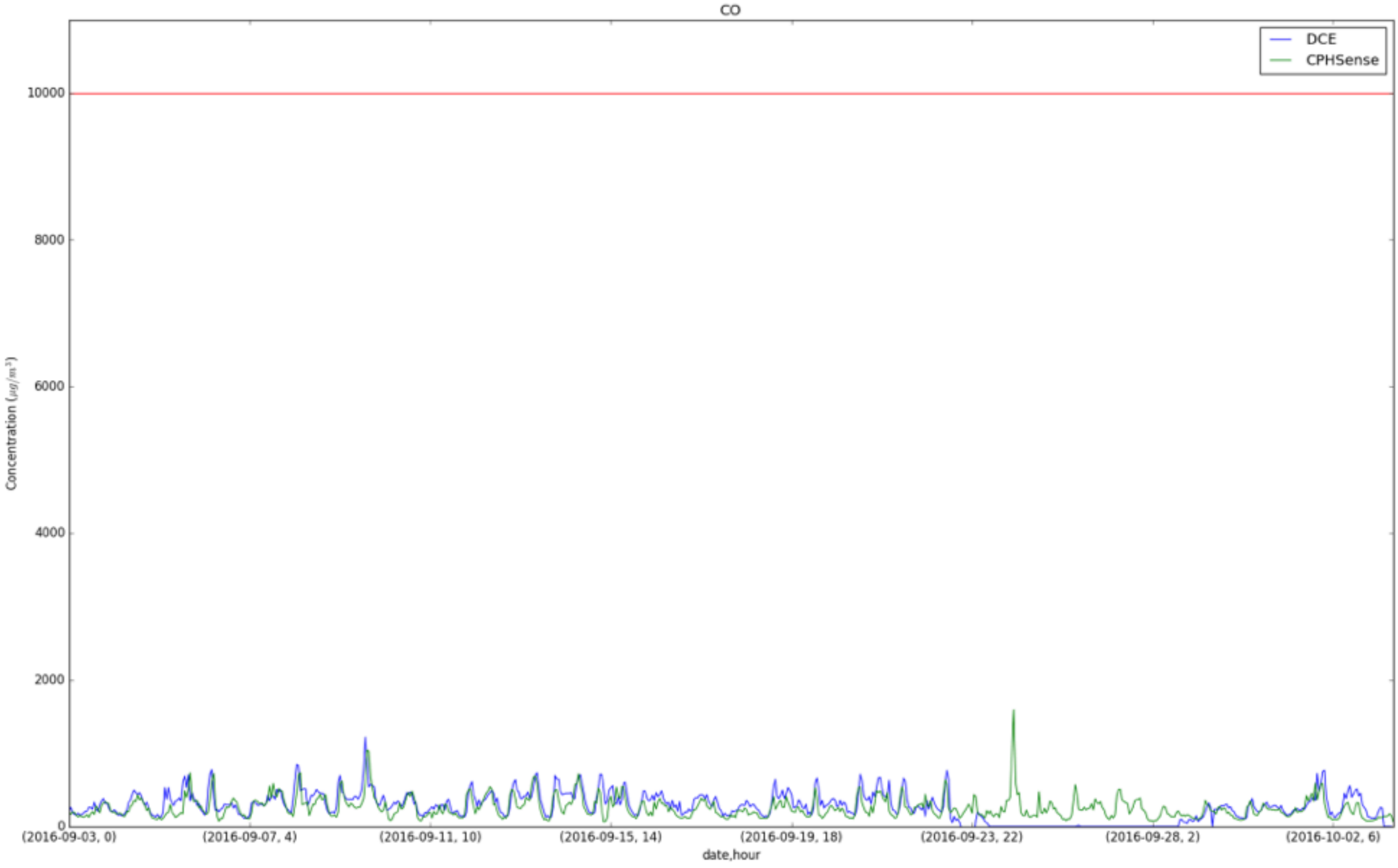
CPHSense was benchmarked against state of the art equipment. We run continuos (hourly) benchmarking by placing our equipment next to Danish National reference station.

Preliminary Benchmark Studies

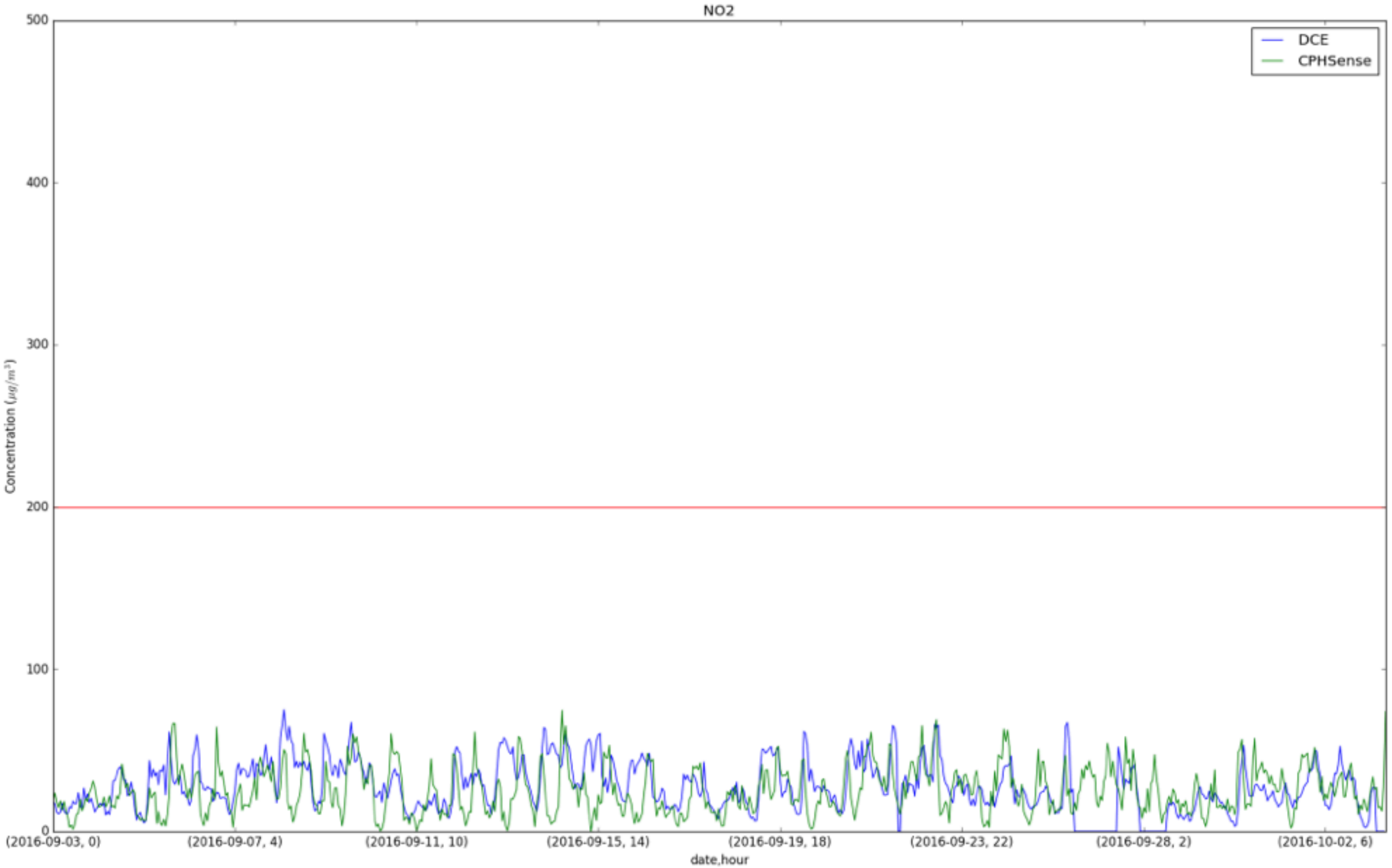
The CPH Sense device has been benchmarked against reference methods as prescribed by the EU Air quality directive in an experiment located at H.C Andersens Boulevard in the City of Copenhagen. The study involved placing the CPH Sensors close to the official monitoring station by the road size at the same height and distance from the road. The two systems though had approximately 20 meters distance between them due to some technical installation limitations at the time of the tests. The tests lasted 1 month of continuous data collection.

The reference monitoring station has equipment based on beta attenuation principle for particle counting and chemiluminescence analyser for NOx. The CPH Sense device is based on Laser diffraction for particle sensing and electrochemical cells for gas sensing. The overall results of the study have proven to quite satisfactory showing good co-relation to the benchmark values. The particle values of PM2.5 and PM 10 have very similar baseline values for 1 hour and 24 hour averages. The CPH sense device was not able to detect certain sudden short term spikes as reported by the reference method once and the reasons are yet to be ascertained. The CO and NO2 values are quite close with the reference methods and the detection levels at ppb levels quite satisfactory (well within the data quality objectives). CO and SO2 have been fairly accurate and follow the trends over the running averages as prescribed by the EU directive 2008/50/EC. NO2 is harder to decipher due to influence of Ozone and the trends do not directly match to the reference methods though the values reported overall fall within the same range of values and maintain an overall trend. Further investigation is required to fully benchmark NOx.

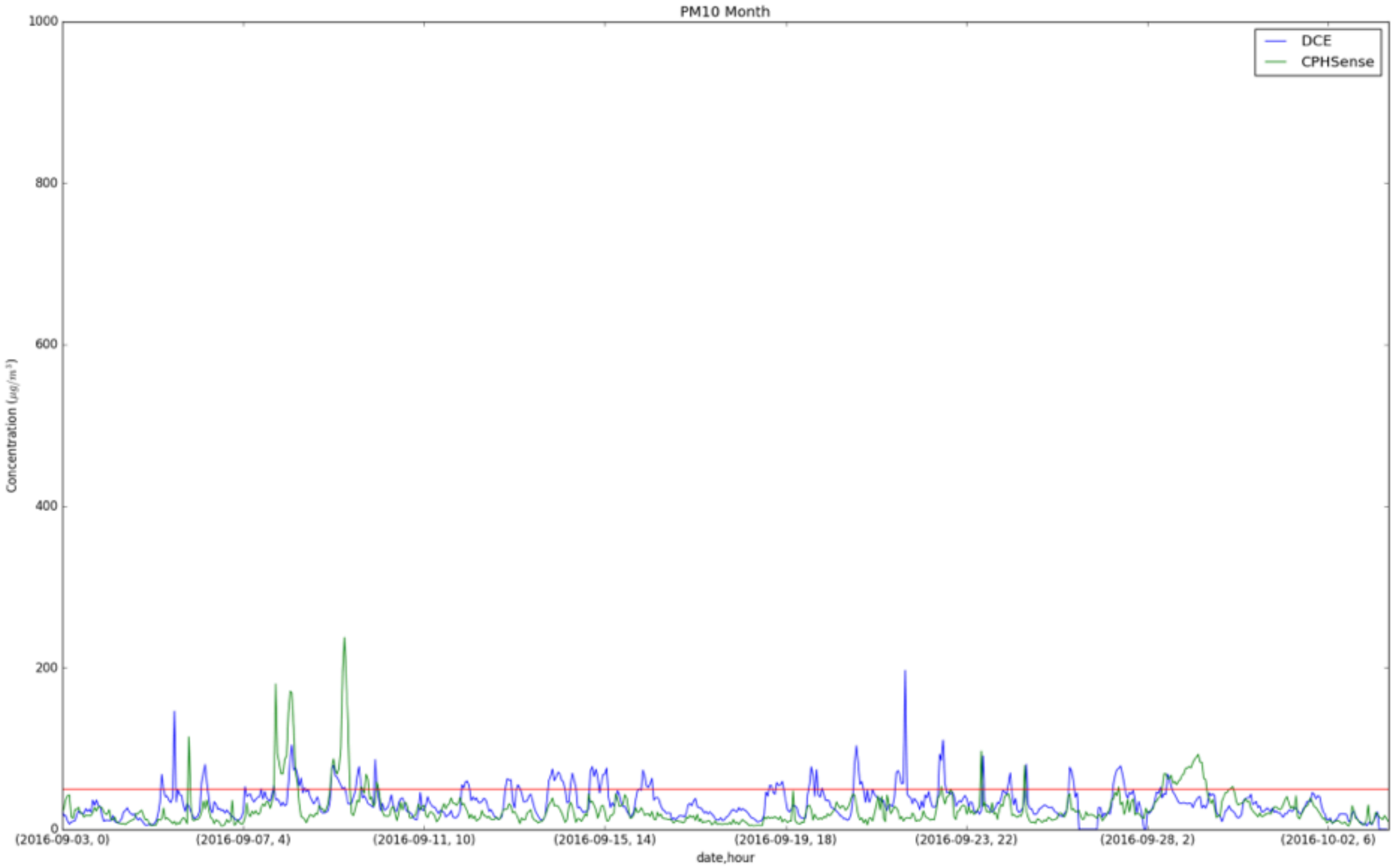
The electrochemical sensors we use show good short term stability for the period tested (June – Sept 2016). However, the long-term stability and drift of the sensors are currently under study. Leapcraft has started a new project in collaboration with Force Technology and Aarhus university – (Nationalt center for Miljø og Energy) to further improve the sensing capability and study the long term feasibility of such techniques in a new study at H.C andersen boulevard and the Copenhagen Airport. A parallel study is being undertaken by Copenhagen University and Airlabs using the CPH Sense device for a deployment in London.



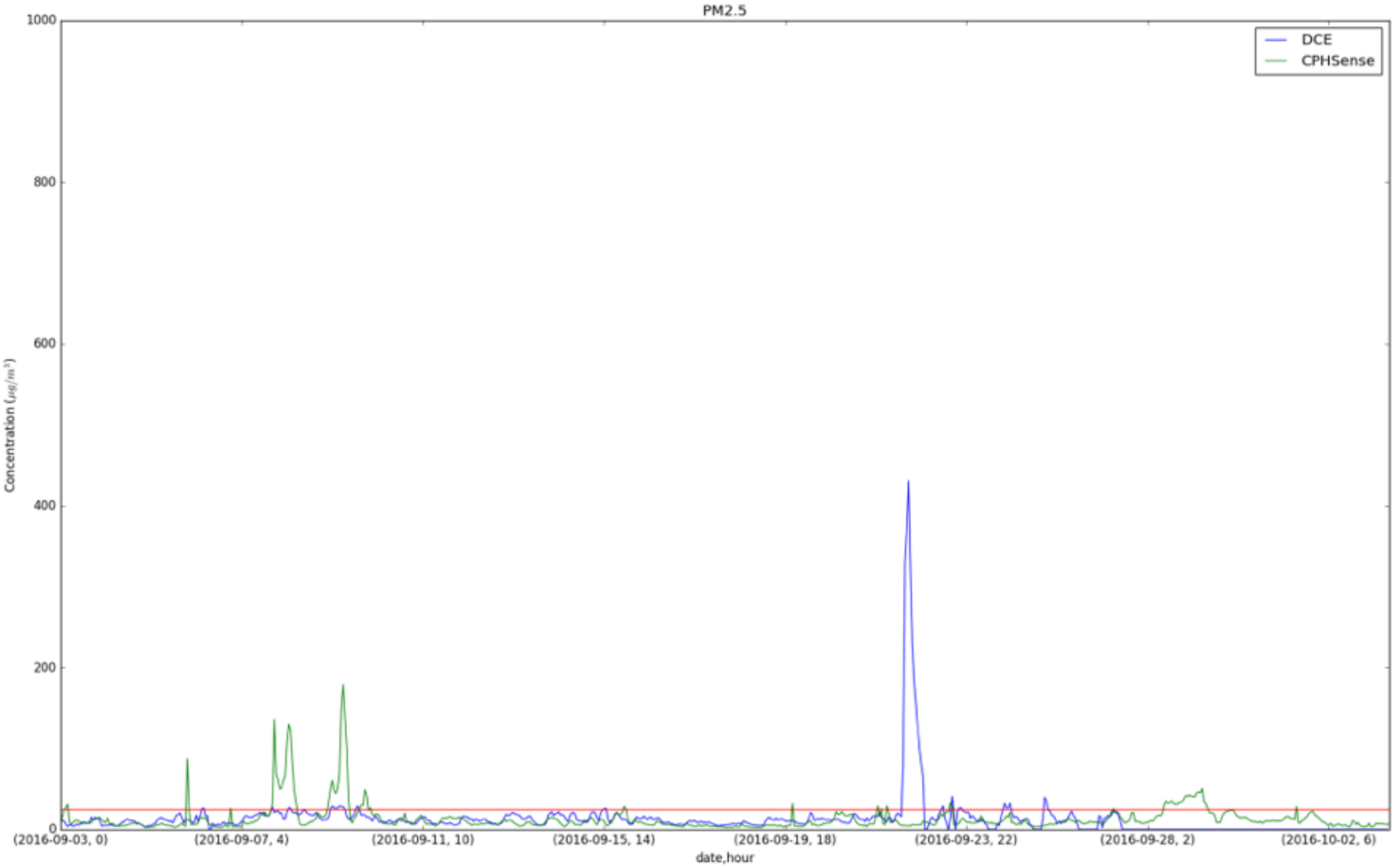
CO level benchmark - Electrochemical cell (CPH Sense) against non-dispersive infrared spectroscopy (DCE)



NO2 level benchmark - Electrochemical cell (CPH Sense) against Chemiluminescence (DCE)



PM10 level benchmark - Laser Scattering (CPH Sense) against Beta attenuation (DCE)



PM2.5 level benchmark - Laser Scattering (CPH Sense) against Beta attenuation (DCE)

Get in touch !

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