EARTHSENSE

TRUSTED AIR QUALITY INSIGHT

Zephyr Air Quality Monitor

Dec 2020

Near-Reference Air Quality Sensor

The Zephyr is a compact ambient air pollution sensor that accurately measures gases and particulate matter that can be harmful to human health. The device provides detailed air quality measurements, in real-time, helping users in multiple scenarios:

- Identify pollution hot spots, such as busy road junctions.
- Establish baseline ambient air quality conditions prior to building developments.
- Study nuisance effects of local emission sources, such as demolition and construction activities.
- Evaluate the effectiveness of pollution lowering initiatives, such as filtration or green walls.
- Establish city-wide sensor networks creating smart connected spaces.
- Automatically control of traffic flow through integration with traffic signalling.

The standard Zephyr configuration provides measurements for:

- Nitrogen Dioxide (NO_2)
- Nitric Oxide (NO
- Ozone (O_3)
- Particulates (PM_1, $PM_{2.5}$ and PM_{10}).
- Meteorological conditions – Temperature, Pressure & Humidity

The enhanced configuration adds:

- Carbon Monoxide (CO)
- Sulphur Dioxide (SO_2)
- Hydrogen Sulphide (H_2S)

Further optional measurements now include Carbon Dioxide (CO_2) and Total Volatile Organic Compounds (TVOCs). Third party devices such as wind anemometers can also be integrated.

Figure 1. Zephyr Air Quality Monitor

Operation and Installation

The Zephyr sensors respond to the target pollutants and raw data from the sensors is stored onboard the device. Intermittently raw data is transmitted to EarthSense's server via cellular networks. The raw values are converted to pollutant concentrations and made available through a web-based application MyAir®.

Typically, Zephyrs are set take measurements every 10seconds and transmit these every 15minutes providing near real-time Air Quality visibility.

The Zephyr can be used for both static and mobile measurements. The internal battery provides between 2 to 4 days power back up (depending on configuration). Long-term power is supplied by either a solar panel or a mains power supply unit (PSU). EarthSense can provide both internal and external PSUs.

Static Measurements

The Zephyr can be installed on pole structures with two jubilee clips (supplied). This makes it very simple to install on street furniture such as lamp posts.

If a solar panel is to be used, this can also be installed with two further jubilee clips. Typically, the solar panel is mounted above Zephyr facing Southwards.

Once installed and powered on, EarthSense will remotely commission the instrument and verify when data is ready to use.

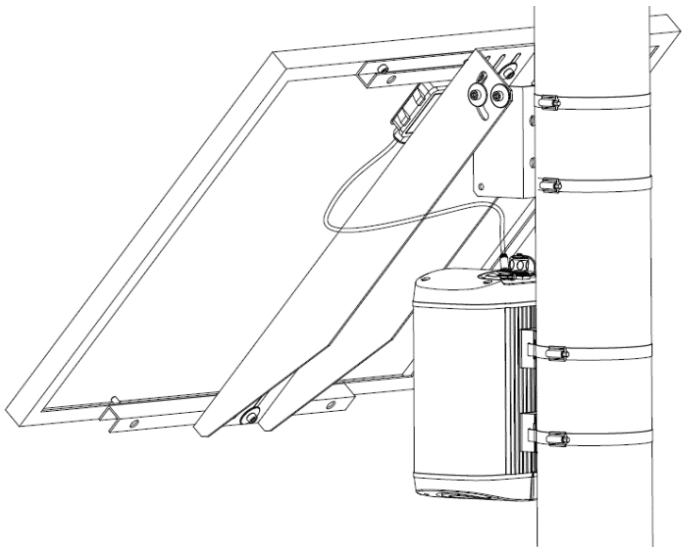

Figure 2. Zephyr installed on lamppost with solar panel.

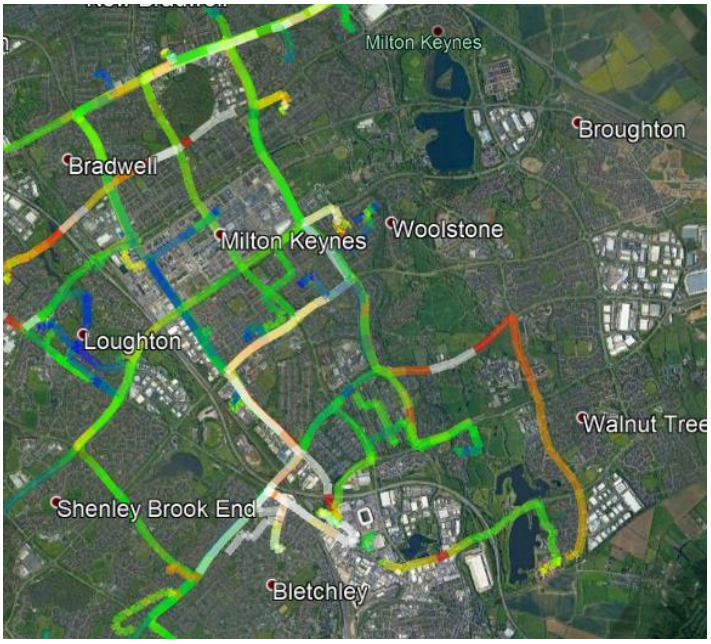

Figure 3. Mobile AQ measurements taken with Zephyr

Mobile Measurements

The onboard GPS systems provides accurate location data, meaning the Zephyr can also be used for mobile measurements.

Additionally, the battery backup makes it possible to perform day long surveys without the need to access a power supply.

To perform area-wide measurements, the zephyr can be fixed to a moving vehicle or even carried by hand.

MyAir provides a data file (KML), which is compatible with google earth. This makes it very simple to create pollution maps of an area such as shown in Figure 3.

Zephyr Calibration

EarthSense aim to provide the best accuracy and traceability that is possible with small form sensors. We operate a certified reference air quality station at our manufacturing facility in Derby, UK. This is maintained by Enviro Technology Services (www.et.co.uk) who service and maintain instruments on the Automatic Urban and Rural Network (AURN) run by DEFRA, as well as supporting many council across the UK

Figure 4. Derby based Reference Air Quality Station and Multiple Zephyrs during FAT test

Every Zephyr sensor cartridge must pass a factory acceptance test (FAT) before being shipped. The FAT includes a colocation with our reference air quality station, and comparisons are made between the Zephyr and MCERTS approved instruments. We believe this to be the best method available to validate and check the quality of Zephyr data.

Every Zephyr cartridge is supplied with a calibration certificate. This includes a time series plot and correlation data from the colocation. Currently this is provided for NO_2, NO, O_3 & $PM_{2.5}$.

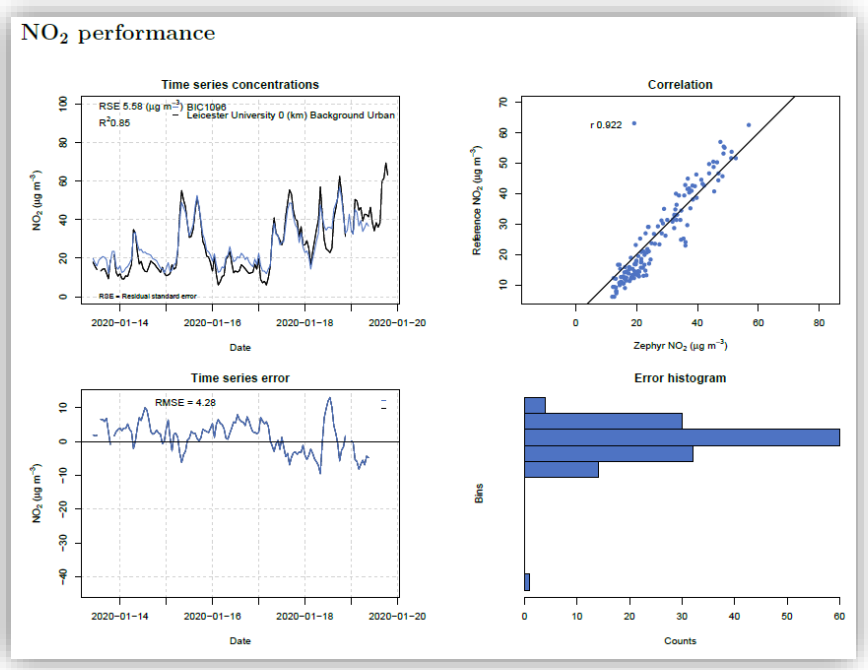

Figure 5. Example data from Colocation as detailed on the Zephyr Calibration Certificate

Service and Maintenance

Within the Zephyr subscription, all primary maintenance and calibration costs are included.

EarthSense check the Zephyr network daily for key performance criteria. These checks include sensor degradation, sensor failures, power failures, unexpected high / low values, and calibration status.

EarthSense will contact the customer if an issue occurs. Remote diagnosis and repair can fix most failures reducing the need to access the instrument. If a failure occurs which requires a physical repair, EarthSense will issue a replacement device which can be used to swap out the faulty instrument, ensuring downtime is kept to a minimum.

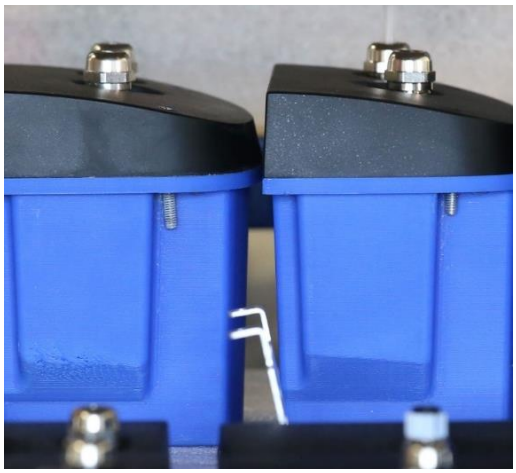

Figure 6. Zephyr Sensor Cartridge

When a new calibration is required, a new cartridge, along with the calibration certificate, will be sent to the customer. The cartridge replacement is very straightforward, with the cartridge simply slotting into one of the two slots available on the Zephyr device. This allows two cartridges to be run in parallel if required to improve data quality assurance.

Data Access via MyAir®

Zephyr data is made available through a web-based application called MyAir. Raw data can be plotted as a time-series graph with options to customise averaging frequencies and the monitoring period. Data is also available for download as a CSV file.

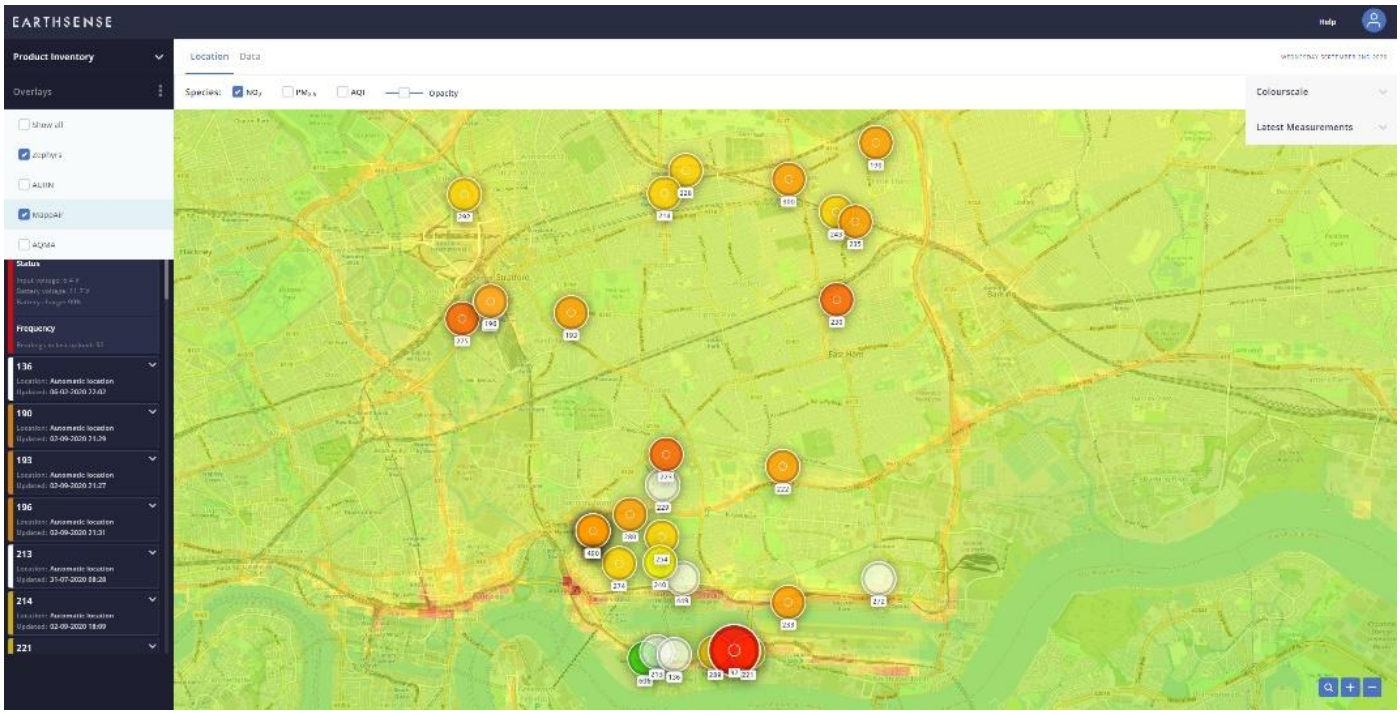

Figure 7. MyAir Screenshot showing Zephyr Network and MappAir Near Real-Time Pollution Overlay

MyAir provides mapping software that plots the Zephyr's geographical location, based upon the current GPS signal. The map also includes monitoring data available from the Automatic Urban and Rural Network (AURN) as provided by DEFRA.

EarthSense's MappAir national pollution model is also incorporated within MyAir and included within the Zephyr subscription. This provides hourly predicted pollution data for NO_2 and PM2.5 at a $100m^2$ resolution across the UK.

Zephyr Pricing

Zephyr is offered on a subscription basis. The first-year subscription includes the main Zephyr device, a calibrated cartridge, UK Internal 13amp Mains PSU, 50w Solar Panel, Jubilee Clips (required for installation), Annual MyAir Subscription, data hosting and GSM data transfer, manufacturer warranty and delivery.

After the first year, there is an ongoing annual fee and this includes: A calibrated cartridge (if required), MyAir Subscription, data hosting and GSM data transfer, manufacturer warranty.

Table 1. Zephyr Pricing Matrix. all prices exc. VAT and local duties. Prices are valid for 30days from delivery of this document.

Measurements		1st Year	Annual Fee
Zephyr Standard	NO_2, NO, O_3 & Particulates (PM10, PM2.5, PM1)	£4,050.00	£2,025.00
Zephyr Enhanced	adds CO, H_2S, SO_2	£5,400.00	£2,700.00
Zephyr Enhanced +	adds CO_2	£5,670.00	£2,835.00
Zephyr Enhanced ++	adds TVOC	£6,750.00	£4,117.50

Discounts are available for multiple units and extended service agreements, please contact us to discuss your requirements.

If you would like to discuss the Zephyr, or other EarthSense services, please contact me on the details below.

Kind regards

David Green

david.green@earthsense.co.uk

EARTHSENSE

David Green
Senior Business Development Manager
+44 (0)116 296 7460
+44 (0)7806 607 823
www.earthsense.co.uk