EARTHSENSE

The Ocean Race Europe

Leg 2 | Air Quality Report

Mirpuri Foundation Racing Team

About Air Pollution

Air pollution is a leading health emergency, with a global economic cost of $5 trillion (World Bank), cutting lives short. Poor air quality is an unfortunate truth of towns and cities around the world.

Road transport contributes the greatest fraction of emissions of nitrogen dioxide (NO_2) in urban areas, and an inadequate road network that cannot allow easy flow of vehicles may amplify emissions, further diminishing local air quality.

Such hotspots may breach legal limits for NO_2, meaning the air is unhealthy for those living, working and passing through such areas. These challenges extend beyond road networks as the world's oceans produces oxygen we breathe and absorbs a third of greenhouse gases and air pollution, regulating CO_2 and other man made pollutants. Due to a recent increase in emissions, these natural sinks have become insufficient in maintaining an equilibrium and the ocean's acidity has risen, harming underwater species, waterways and economies.

Zephyr® Air Quality Monitor

The Zephyr® measures several harmful pollutants that are of interest at outdoor environments. Its small form-factor makes the monitor easy to deploy on street furniture and can be powered from an internal battery, mains power or a solar panel.

The capacity to deploy a high-density Zephyr® network whilst recording on up to 10 second intervals with 15-minute latency gives the opportunity for near-real time (NRT) air pollution data to be used for decision making to better manage health effects in towns, cities.

The Zephyr® monitor measures a variety of harmful gases including nitrogen dioxide (NO_2), ozone (O_3), nitric oxide (NO), Carbon Diozide (CO_2) and fine particle matter, PM_1, $PM_{2.5}$ and PM_{10} as standard, with the option of including hardware capacity to also measure carbon monoxide (CO) and sulphur dioxide (SO_2).

How are Gas & Particle Concentrations Measured?

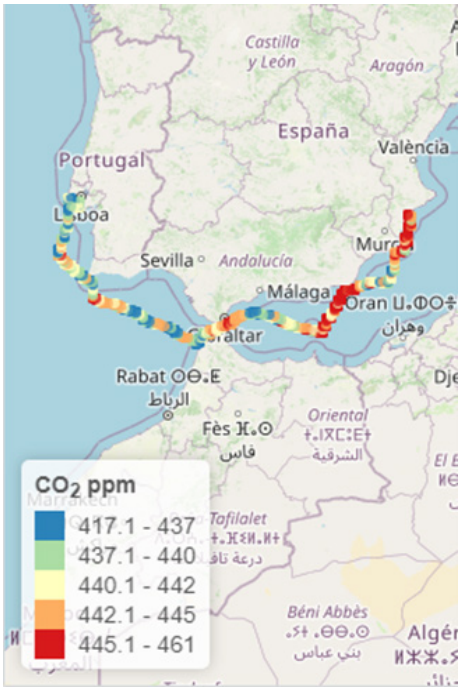
Electrochemical sensors (EC) are used in the Zephyr® monitor for the measurement of trace gas pollutants. An optical particle counter (OPC) is used in the Zephyr® to categorise and measure particule of sizes between 0.3 – 10 µm in diameter.

From this, mass concentrations are estimated to PM_1, $PM_{2.5}$ and PM_{10}.

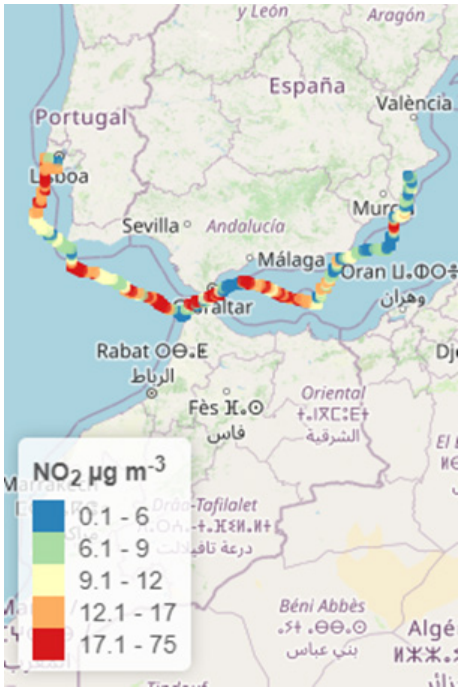
Leg 2 Pollution Overview

From: Cascais, Portugal - 06/06/2021
To: Alicante, Spain - 09/06/2021

Measured CO_2 Concentrations



Measured NO_2 Concentrations



Measured O_3 Concentrations

Figure 1: Real-time concentrations of CO_2, NO2 and O_3 measured during the Ocean Race Europe by the Zephyr® Air Quality Monitor on the Mirpuri Foundation Racing Team VO65 boat from 06/06/2021 - 09/06/2021.

Comparison of Measured NO_2, CO_2 & O_3 Concentrations during Leg 2 - Cascais to Alicante

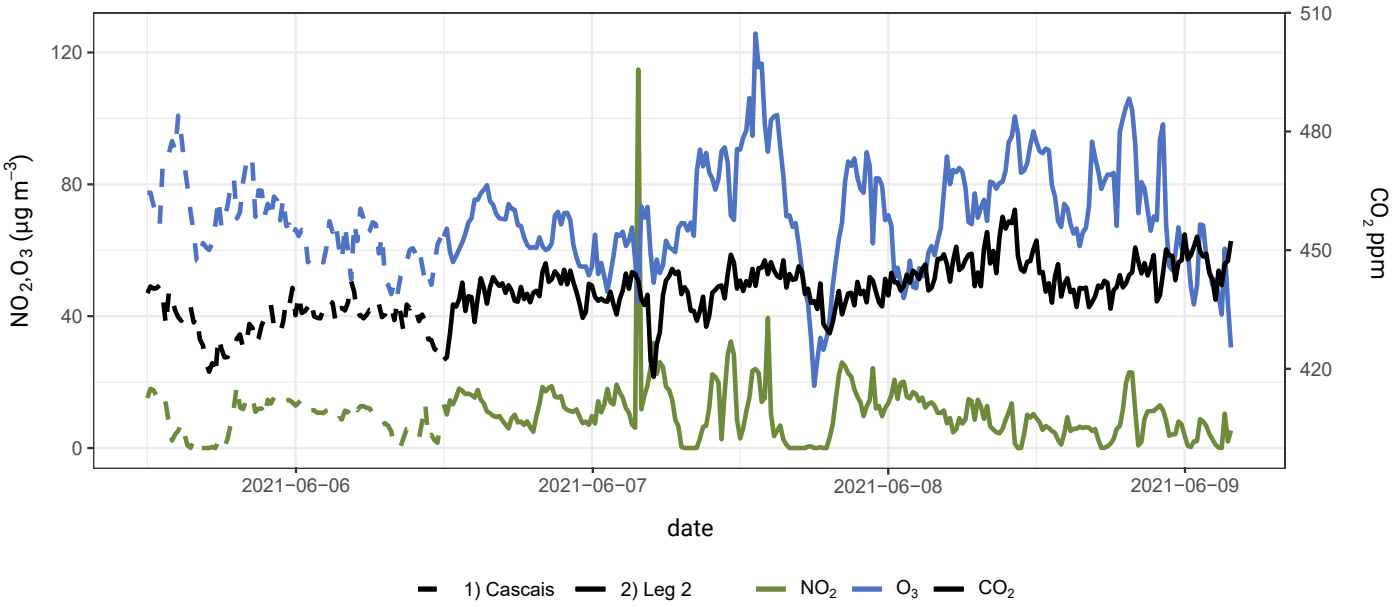


Figure 2: Real-time concentrations comparison of CO_2, NO_2 and O_3 measured during the Ocean Race Europe by the Zephyr® Air Quality Monitor on the Mirpuri Foundation Racing Team VO65 boat from 06/06/2021 - 09/06/2021.

What Does This Mean?

The second leg of the Ocean Race Europe, from Cascais to Alicante, saw a range of pollution environments. Much of the air pollution we experience daily is heavily influenced by meteorology, as winds and convection dilute (or clean) the air. The oceans play an important role in removing pollution from the atmosphere, and by setting up an air pollution monitoring platform on board the Mirpuri Foundation Racing Team's VO65, the team's personal exposure is tracked in real time.

Leg 2 of the Ocean Race Europe cut through many of the world's busiest shipping routes whilst remaining relatively close to mainland Europe. Unfortunately meaning sources of pollution were never far away, and as such clean air could not be guaranteed.

The Atlantic Ocean was found to have the cleanest air to breathe with the lowest concentrations of O_3. The team were exposed to higher concentrations of ozone in the Strait of Gibraltar and the Mediterranean Sea, closer to what may be expected on land. O_3 levels gradually reduce during the night on land, whereas for largely enclosed bodies of water such as the Mediterranean levels often remain high.

At sea, NO_2, a harmful air pollutant that is predominantly sourced from fossil fuel combustion, often coincides with shipping routes. The elevated concentrations of NO_2 are indicative of the pervasive nature of air pollution and man's impact on the health of the natural environment. The Strait of Gibraltar had the highest levels of NO_2 similar to levels on mainland Europe.

> **38% of global CO_2 is dissolved in to the oceans representing a vital sink to regulate natural and man-made sources of CO_2.**

For greenhouse gas CO_2, there was minimal variability through the race. Around 38% of global CO_2 is dissolved in to the oceans *(IPCC, 2018)*, representing a vital sink to regulate the natural and man-made sources of CO_2. The uptake of CO_2 from land systems is greater than that of the ocean, contributing to the elevated levels found at sea.

Air pollution is largely sourced from economic activity, and tracing back the emissions is incredibly complex. Favouring products and industries that show good sustainability credentials can help to reduce the effect we as individuals have on our planet.