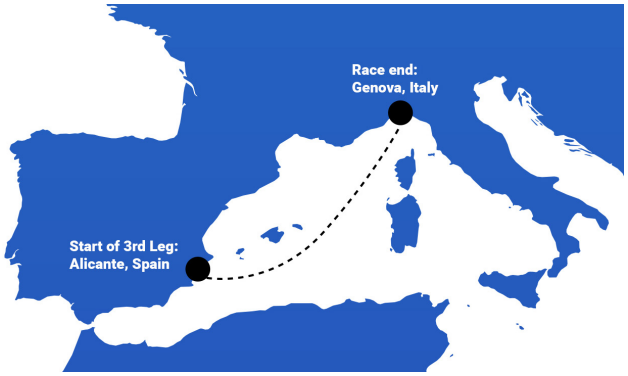
EARTHSENSE

The Ocean Race Europe

Leg 3 | 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?

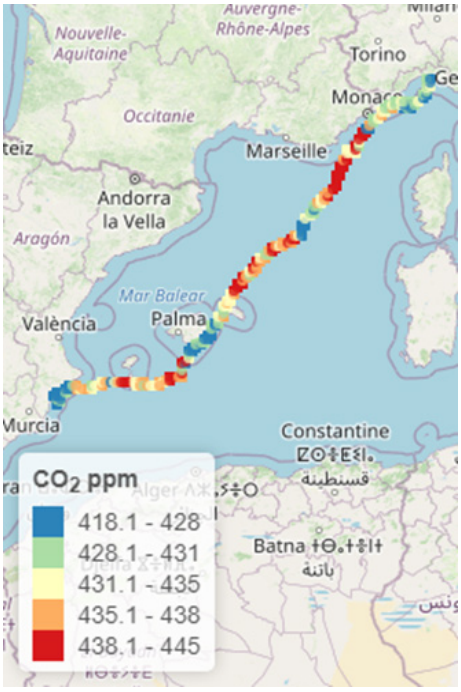
Electrochemical sensors (EC) are used in the Zephyr® monitor for the measurement of trace gas pollutants. An optical particle counter (OPC) is used in the Zephyr® to categorise and measure particule of sizes between 0.3 – 10 µm in diameter.

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

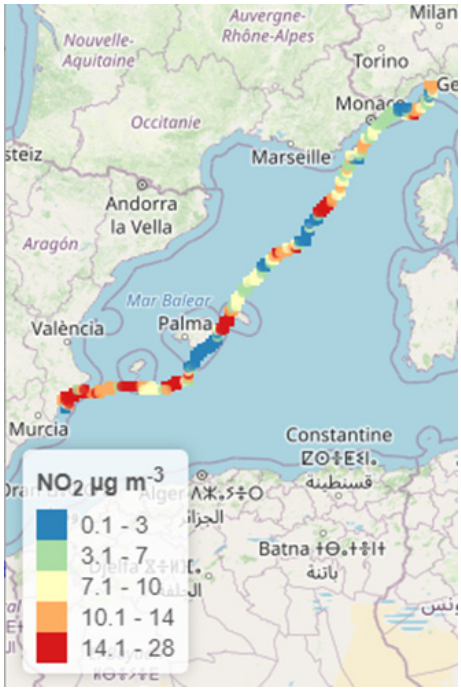
Leg 3 Pollution Overview

From: Alicante, Spain - 13/06/2021
To: Genova, Italy - 17/06/2021

Measured CO_2 Concentrations



Measured NO_2 Concentrations



Measured O_3 Concentrations

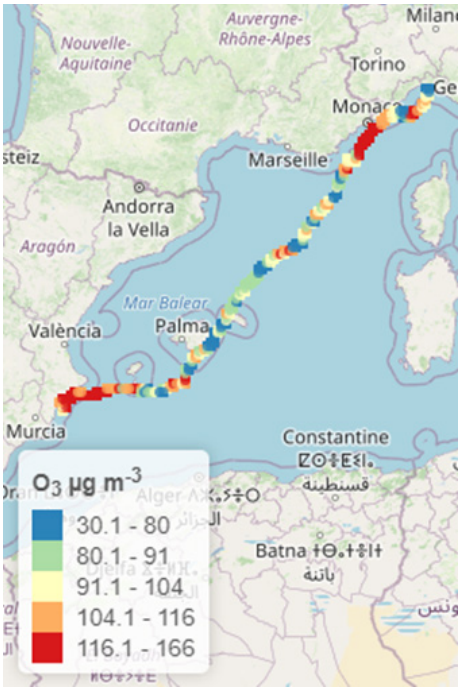


Figure 1: Real-time concentrations of CO_2, NO_2 and O_3 measured during the Ocean Race Europe by the Zephyr® Air Quality Monitor on the Mirpuri Foundation Racing Team VO65 boat from 13/06/2021 - 17/06/2021.

Comparison of Measured NO_2, CO_2 & O_3 Concentrations during Leg 3 - Alicante to Genova

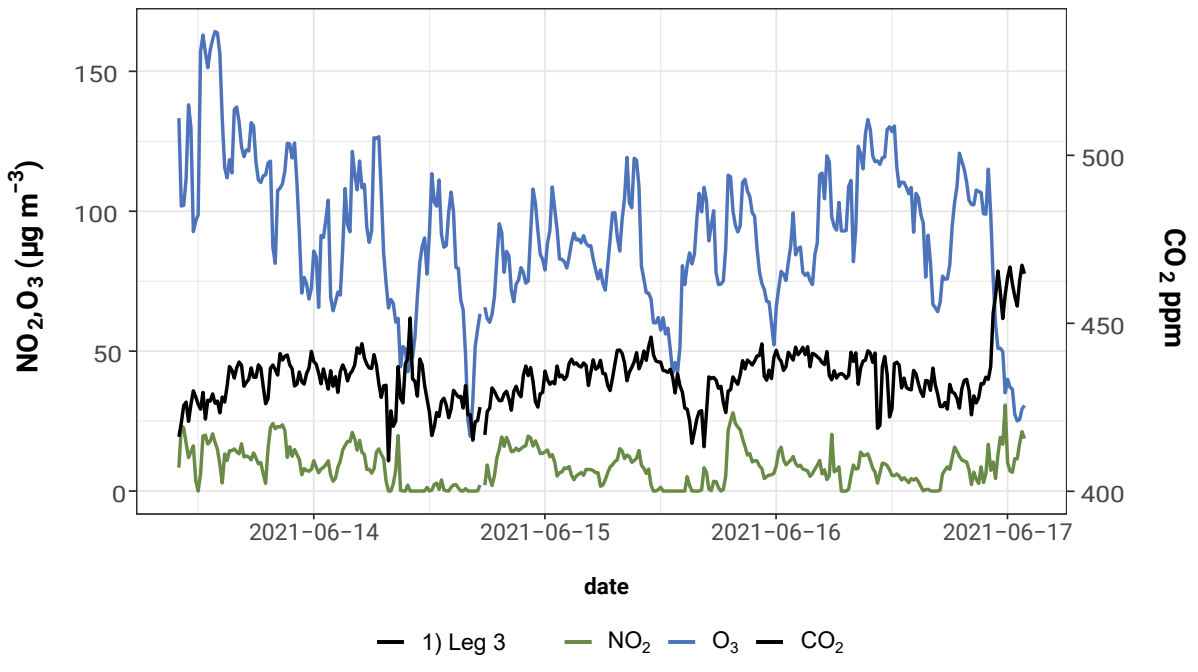


Figure 2: Real-time concentrations comparison of CO_2, NO_2 and O_3 measured during the Ocean Race Europe by the Zephyr® Air Quality Monitor on the Mirpuri Foundation Racing Team VO65 boat from 13/06/2021 - 17/06/2021.

What Does This Mean?

Leg 3 of the Ocean Race Europe got off to a slow start with light winds and clear skies over the Mediterranean Sea.

Tropospheric ozone is a pollutant that is formed in sunny conditions by chemical reaction from emissions typical from fossil fuel sources , and causes one million premature deaths each year[1]. Ozone also reduces global crop yields by as much as 15% for wheat producing areas in China and India.

High levels of ozone in the Mediterranean Sea during summer months is common – the Zephyr® on board the Mirpuri Foundation Racing Team's VO65 captured measurements to evidence this. During leg 3, an ozone episode over eastern Europe was affecting millions of people with concentrations in excess of safe limits. Due to the prevailing weather conditions, the Mediterraean Sea had consistently higher levels of ozone compared with western Europe for the duration of the race. For 17 hours of leg 3 (20%), ambient ozone breached the limits set by the World Health Organisation for the protection of human health .

Carbon dioxide (CO_2) is a major greenhouse gas that is significantly contributing to increases in temperatures globally, resulting in severe and rapid changes to environments, such as retreating ice caps, and making some coastlines and small islands uninhabitable.

CO_2 concentrations were steady for the most part of leg 3, with the exception of the final sprint to Genova. During this period, there was a headwind, suggesting local emission sources such as the Port of Genova may have contributed the elevated concentrations. Genova, in northern Italy is flanked by the Alps, in the Po Valley region. This region has long been a debate amongst the scientific community as a geographical feature where the relief often traps air pollution, resulting in poorer air quality for this region, despite its relatively insignificant contributions to regional emissions.

Resources:

https://www.ceh.ac.uk/press/new-research-could-help-farmers-mitigate-impact-ozone-pollution-crop-yields

https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

https://ehp.niehs.nih.gov/doi/10.1289/EHP1390

http://macc-raq-op.meteo.fr/index.php?category=ensemble&subensemble=hourly_ensemble&date=LAST&calculation-model=ENSEMBLE&species=o3&level=SFC&offset=000

> **For 20% of the leg 3 race, ambient ozone breached the limits set by the World Health Organisation.**