

**“This instrument has the potential to revolutionise the way pollution is monitored in urban areas.”**

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## UV/VIS spectrometer for space missions has been developed to provide ground-based systems for gas analysis

### Industry

Environmental sensing

### Challenges

Provide air monitoring instrument for urban areas  
Provide a compact instrument for differential optical absorption spectroscopy (DOAS) space mission applications

### Solution

Provision of accurate hemispherical air quality signatures  
Constant measuring of NO<sub>2</sub> and Aerosol at 6 minute intervals

### Benefits

Ability to better manage urban air quality  
Early warning of dangerous pollution levels

### Summary

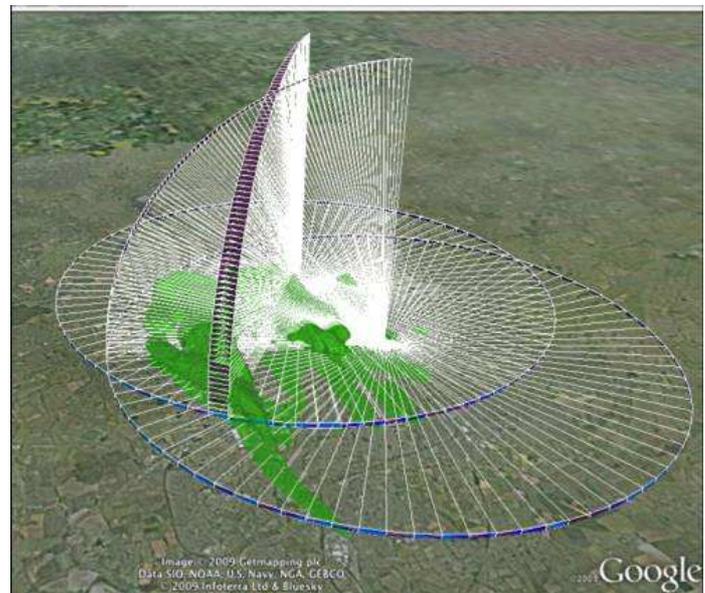
This compact and novel optical system known as CompAQS uses ultraviolet-visible (UV/VIS) spectrophotometric techniques to measure air quality from space. It was one of the original projects to be spun out of the Centre for Earth Observation Instrumentation (CEOI), when it was created in 2007.

The CEOI has a vision to develop and strengthen UK expertise and capabilities in EO instruments and to help position the UK to win leading roles in future international space programmes. It was created as a result of joint support from the Natural Environment Research Council (NERC), the Technology Strategy Board (TSB) and industry. It is funded through the UK Space Agency with the aim to develop key capabilities through the teaming of scientists and industrialists.

Space instrumentation makes valuable contributions in air quality monitoring, which is a vital goal for human health and for our understanding of climate change.

### Challenge

The project was originally conceived to provide an exceptionally compact instrument for differential optical absorption spectroscopy (DOAS) applications from space missions in a range of orbits. A similar instrument for ground-based deployment has evolved from this design.



Gas Tomography – using multiple CityScan instruments to derive concentrations of nitrogen dioxide in lofted plumes. By scanning all the available field of view, CityScan allows a full 3D picture to be built of the distribution of the pollution.

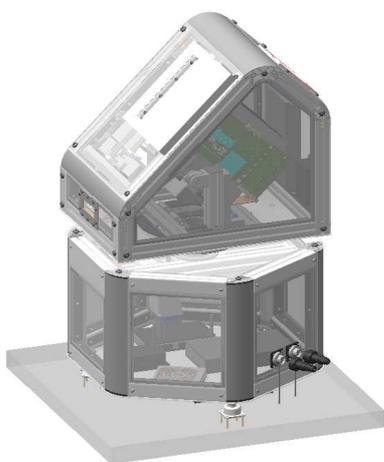
Standard urban air quality monitoring systems are limited in that they can only sample at a particular point. The information that can currently be gained from such instruments is therefore limited.

## Solution

Following specification, design, procurement and build phases, the CompAQS instrument was characterised at the University of Leicester. Using designs from Surrey Satellite Technology Ltd (SSTL), a demonstrator was constructed and tested at the University of Leicester's Space Research Centre.

To increase the likelihood of receiving additional funding and to explore economic opportunities of the research, the project needed to demonstrate additional applications for the CompAQS technology. With the help of Qi3 in Cambridge, a technology commercialisation company, a Technology Market Evaluation was carried out. This focused on the potential of the CompAQS technology in other applications. Qi3 also helped facilitate further publicity for the project via events and networks such as the Sensors & Instrumentation Knowledge Transfer Network.

This evaluation helped identify other applications such as environmental monitoring, defence & security and analytical instrumentation. These included, high performance military systems used for surveillance and monitoring, as well as uses in the detection of human habitation within difficult and hostile terrain to aid in the detection of potential terrorist threats. Importantly, it also helped secure further funding from NERC which led to the development of the CityScan concept for urban air monitoring. This resulted in construction of two fully-operational ground-based CompAQS spectrometer systems for the retrieval of nitrogen dioxide and aerosol concentrations.



The Cityscan spectrometer will monitor urban air quality with a rotating turret design

The project is also being applied within the ESA Integrated Applications Programme within the context of Integrated Traffic management and Air Quality and in partnership with Infoterra UK Ltd, Leicester City Council and DeMontfort University, this new project aims to demonstrate the capabilities of both CompAQS and CityScan.

Local authorities will be able to see the extent of the information that can be provided from the instruments and also how these air quality measurements will enable them to better manage the urban environment.

In environmental monitoring generally, the instrument was also deemed to have potential within the areas of oil & gas refineries, chemical plants, mining, waste management and aerospace emissions. A number of companies and industrial contacts were also identified and potential partnerships and collaborations are currently being progressed by the project team.

## Benefits

The CityScan rooftop instruments will make measurements of Nitrogen Dioxide and Aerosol in 180,000 different directions, every six minutes. It will provide a more accurate hemispherical picture of what is present in the urban airspace at any given time. By revolutionising the way pollution is monitored in urban areas in this way, these instruments will enable local authorities to better manage the urban environment.

The CompAQS project has also been hugely successful in bringing together a very successful academic and industrial team and helped strengthen the UK capability in UV/Visible spectroscopy.

## Contact point for further information:

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