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The High-resolution Anthropogenic Pollution Imager (HAPI): a closer look into air pollution

Cristina Ruiz Villena (1), Piyal Samara-Ratna (1), Samuel Grocock (1), Samuel Brocksopp (1), Alexander N. H. Lodge (1), Dr. Chris Thomas (1), Robert Brennan-Craddock (2), Michael Walshe (2), Mark Stinchcombe (2), Martin Black (3), Martyn Wells (3), John Murray (3), Naidu Bezawada (3), Chris Miller (3), David Lunney (3), Dr. Claire E. Parfitt (2), and Prof. Roland Leigh (1)

(1) University of Leicester, Physics and Astronomy, Leicester, United Kingdom, (2) Thales Alenia Space UK Ltd, Bristol, United Kingdom, (3) UK Astronomy Technology Centre, Edinburgh, United Kingdom

Air pollution is one of the major environmental issues of our time, causing millions of premature deaths worldwide and billions of pounds in economic losses every year. Nitrogen dioxide (NO_2) is one of the main components of air pollution and a good tracer of the air quality in cities; most of its presence in the troposphere is due to anthropogenic emissions such as those produced in the combustion of fossil fuels. Monitoring NO_2 is key to understanding and tackling the problem of air pollution, and this is done at a global scale using remote sensing instruments on satellites. However, current instruments do not achieve the necessary spatiotemporal resolution to image air pollution at a suburban scale.

We present the High-resolution Anthropogenic Pollution Imager (HAPI), a novel instrument developed by the Air Quality group at the University of Leicester for the remote sensing of NO_2 with high spatial and temporal resolution. HAPI records images at 10 discrete wavelengths in the visible range (400 - 500 nm) and uses a retrieval algorithm based on the well-established Differential Optical Absorption Spectroscopy (DOAS) technique. Discrete-wavelength retrievals of NO_2 are challenging due to the small amount of spectral information available and the fact that it is a weak absorber; however, it allows for simpler instrument designs and the possibility of deploying them on constellations of small satellites.

A HAPI airborne demonstrator has been built with partners at Thales Alenia Space in the UK and the STFC Astronomy Technology Centre to validate the instrument concept. Although the instrument and algorithm performances are yet to be fully assessed, preliminary test results indicate that the instrument is capable of detecting time variations of NO_2 slant column densities in real atmospheric conditions. With further development, HAPI has the potential to allow the monitoring of air quality at a global scale with unprecedented spatial and temporal resolution.