CityScan and CompAQS Air Quality Monitors

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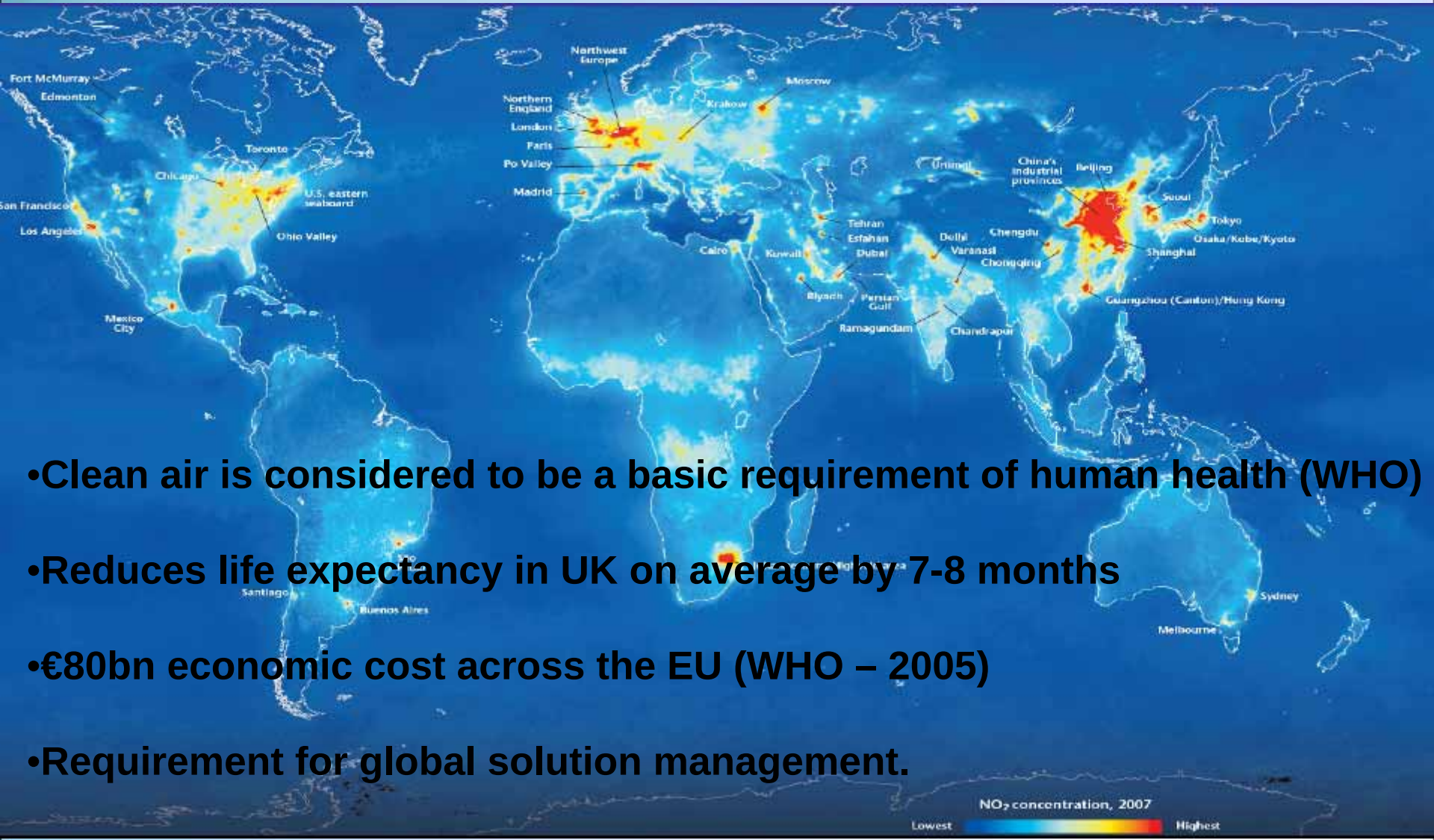
Motivations



- Clean air is considered to be a basic requirement of human health (WHO)
- Reduces life expectancy in UK on average by 7-8 months
- €80bn economic cost across the EU (WHO – 2005)
- Requirement for global solution management.

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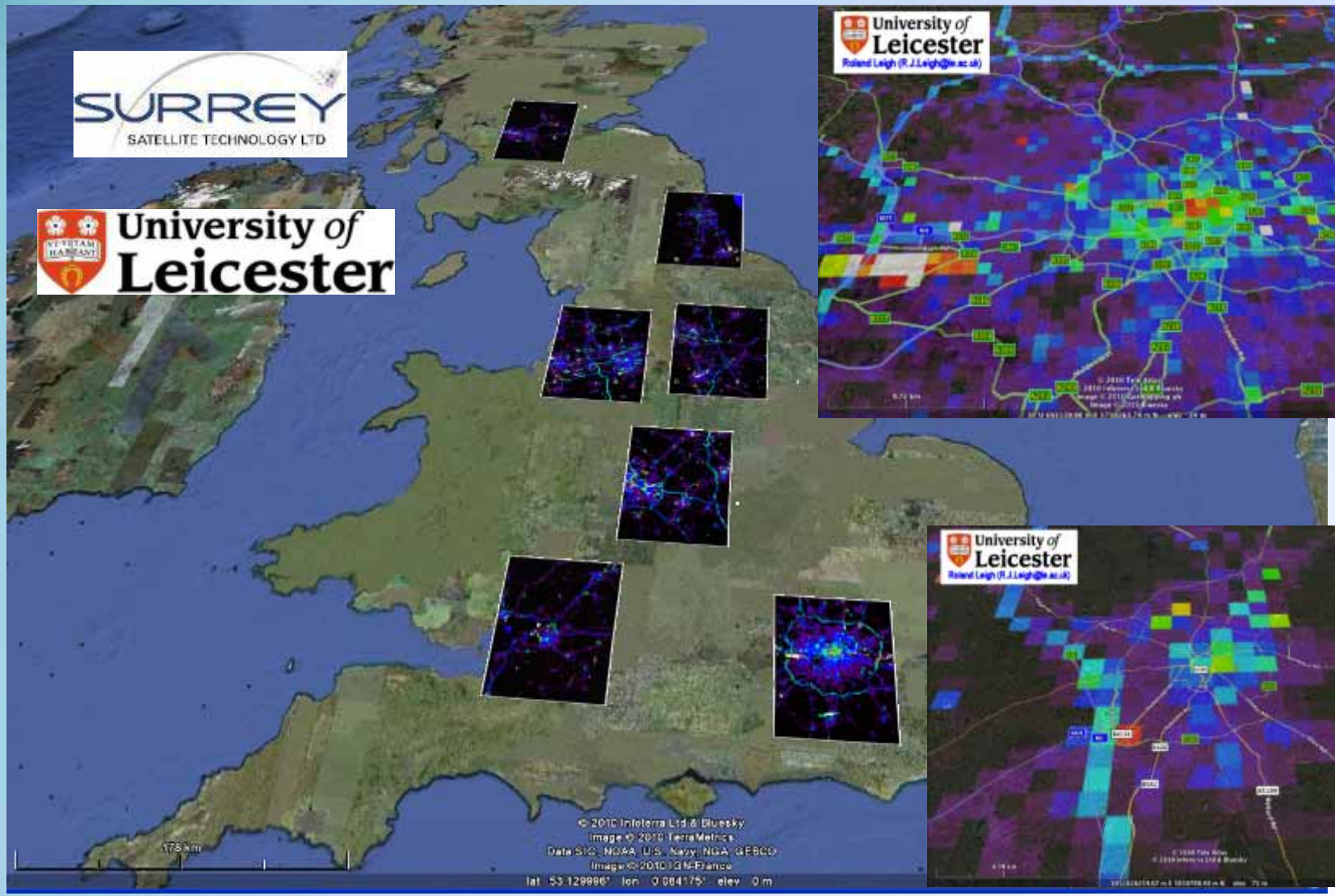

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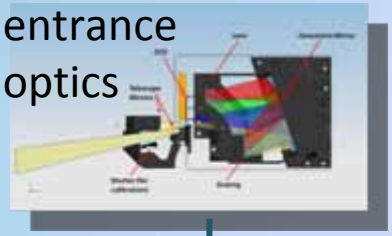
CompAQS timeline

D.Lobb , Applied Optics 1994

‘94

CompAQS phase 2, Imaging entrance optics



‘07

CompAQS phase 1

‘08

‘09

PhD funded by NCEO and the Env Agency, Exploitation of the CompAQS spectrometer-CityScan

Design and Development of 2/3 CityScan instruments, with tomographic retrievals

‘10

‘11

First CityScan Deployments

CityScan deployments ClearfLo

‘12

’14/ 15

CompAQS launch?

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CompAQS Heritage

- In 1994 Dan Lobb (SSTL) proposed a spectrometer optimised for DOAS retrievals.

Theory of concentric designs for grating spectrometers

D. R. Lobb

A concentric optical design for a grating spectrometer is described. General aberration theory is given for a family of designs of similar form, showing close similarities with the theory for conventional concentric imagers used in microlithography. Control of stray radiation in the concentric grating spectrometer is discussed.

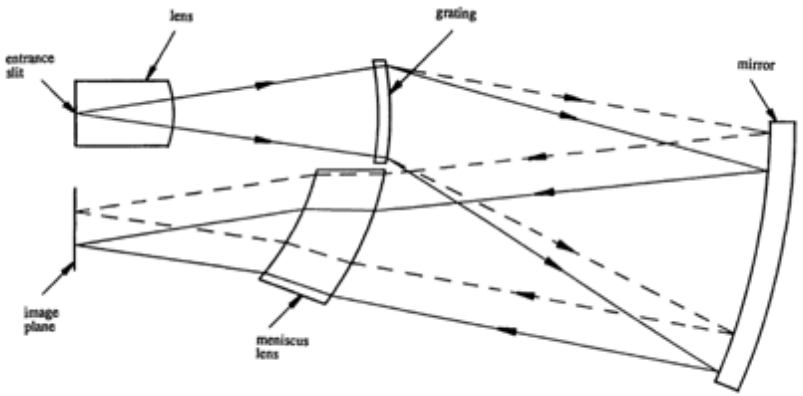

Fig. 5. Transmitting grating system.

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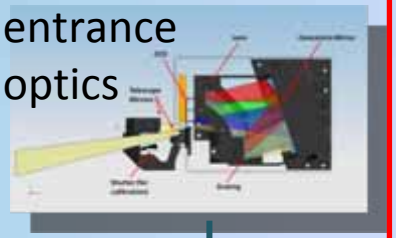

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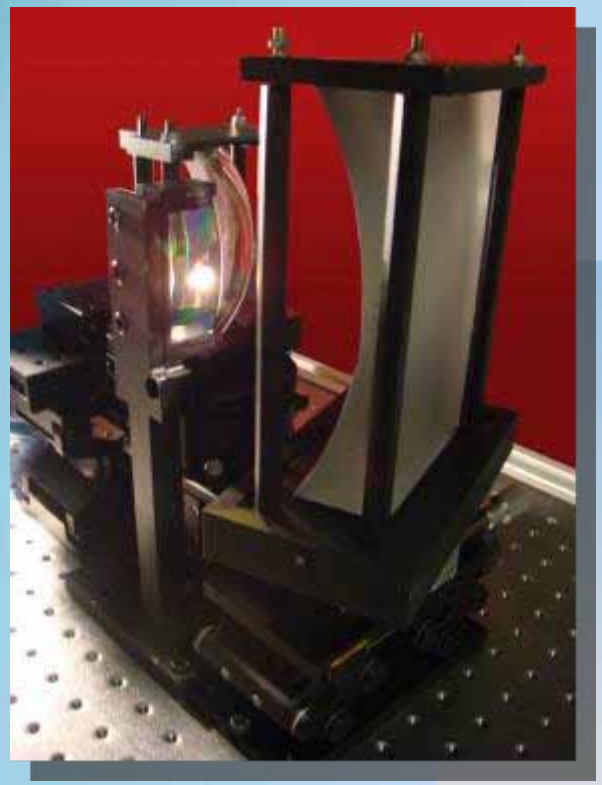
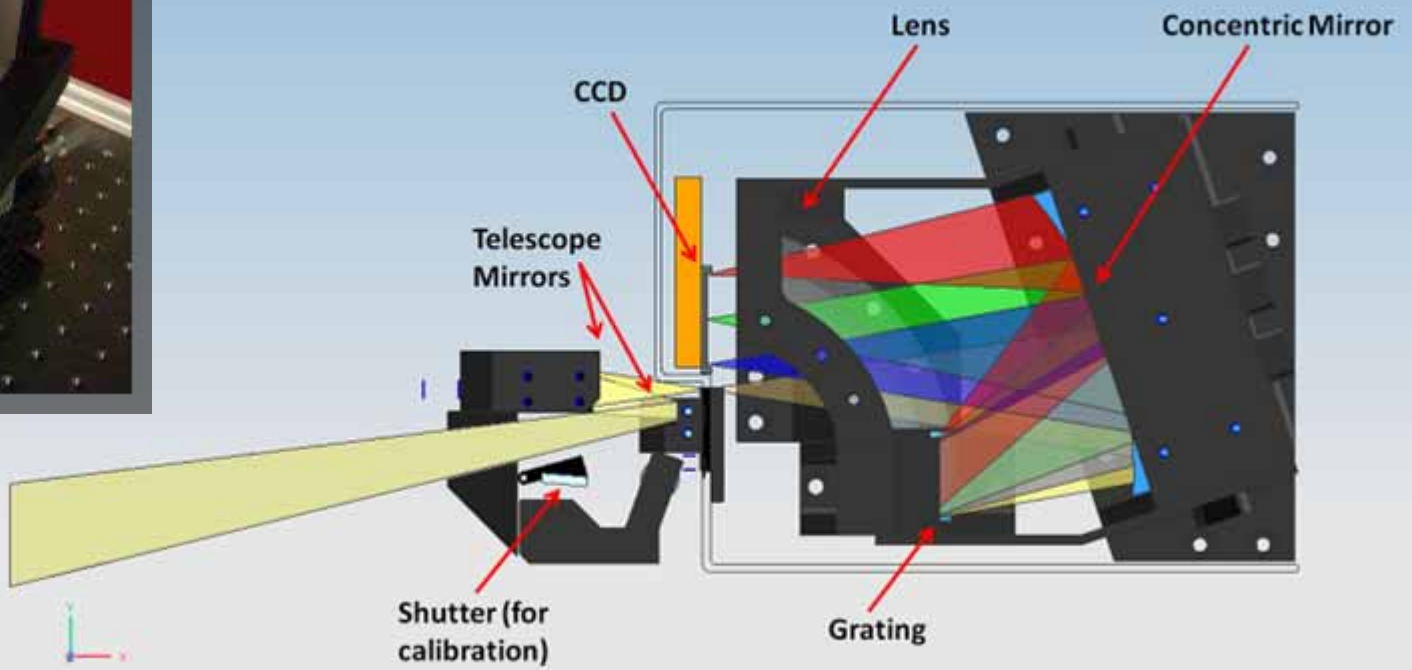
CompAQS (Phase1 & 2) to CityScan



- CompAQS demonstrator 2007-9
- CityScan 2011



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First Spectrometer Results

Atmos. Meas. Tech., 2, 789–800, 2009
www.atmos-meas-tech.net/2/789/2009/

Atmospheric Measurement Techniques

Assessment of the performance of a compact concentric spectrometer system for Atmospheric Differential Optical Absorption Spectroscopy

C. Whyte[1], R. J. Leigh[1], D. Lobb[2], T. Williams[2], J. J. Remedios[1], M. Cutter[2], and P. S. Monks[3]

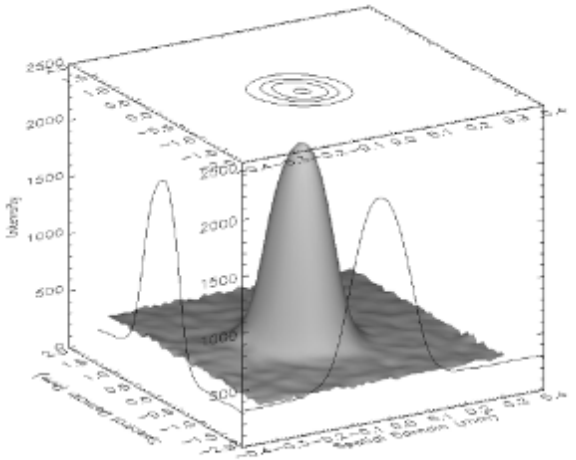


Fig. 9. A 3-D representation of the spatially resolved 404.66 nm mercury emission.

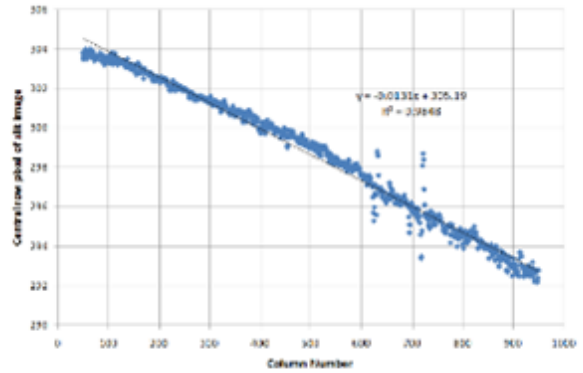


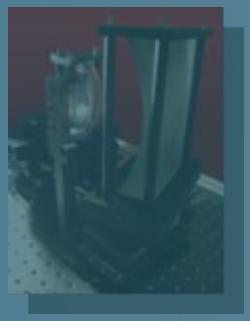
Fig. 10. A measurement of the "smile" in the CompAQS spectrometer system. The overall slope of the plot is due to a minor rotation of the CCD detector with respect to the focal plane. Sub-pixel values were obtained using a combined smoothing/spline interpolation routine. Features around column 620 and 710 result from artefacts on the CCD surface, and not deviation of the image.

CompAQS timeline

D.Lobb , Applied Optics 1994

CompAQS phase 2, Imaging entrance optics

CompAQS phase 1



Design and Development of 2/3 CityScan instruments, with tomographic retrievals

CityScan deployments ClearfLo

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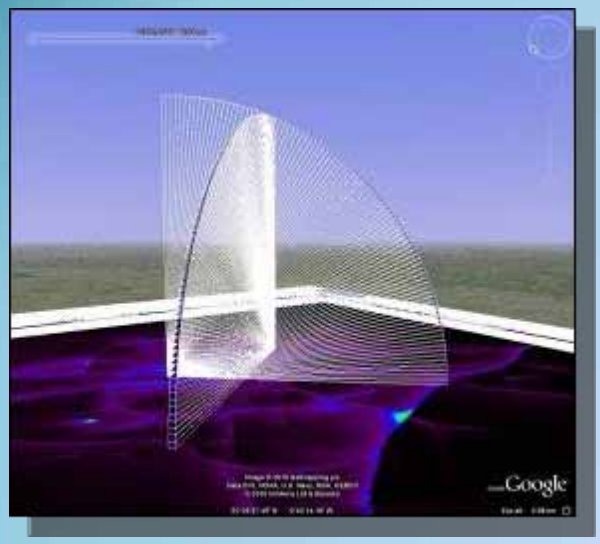

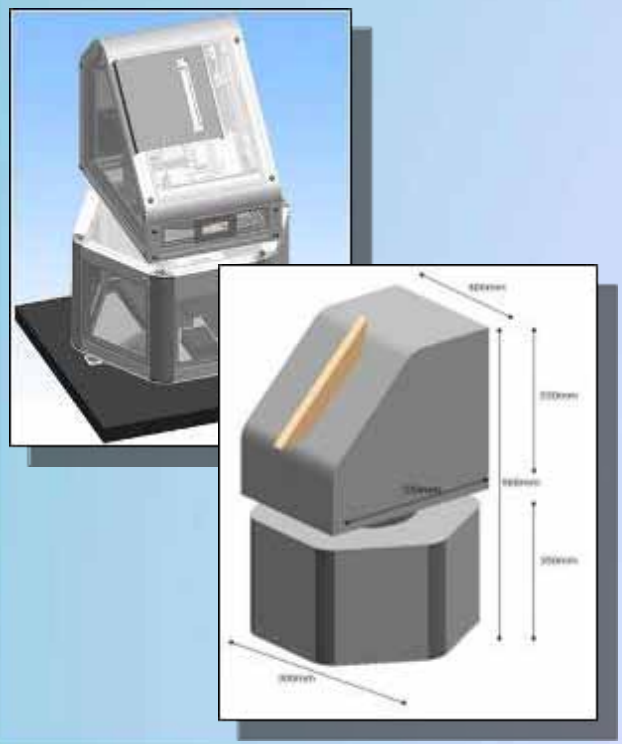

CityScan

- Utilising the CompAQS spectrometer.
- Provides a weatherproof, thermally controlled housing which rotates in a full 360˚ every 6 minutes.
- The CompAQS spectrometer provides a 95˚ FOV which in combination with the rotation provided by CityScan gives a full hemispherical imager.
- Intersecting FOVs of multiple instruments offer the potential of gas tomography on a city-wide scale.

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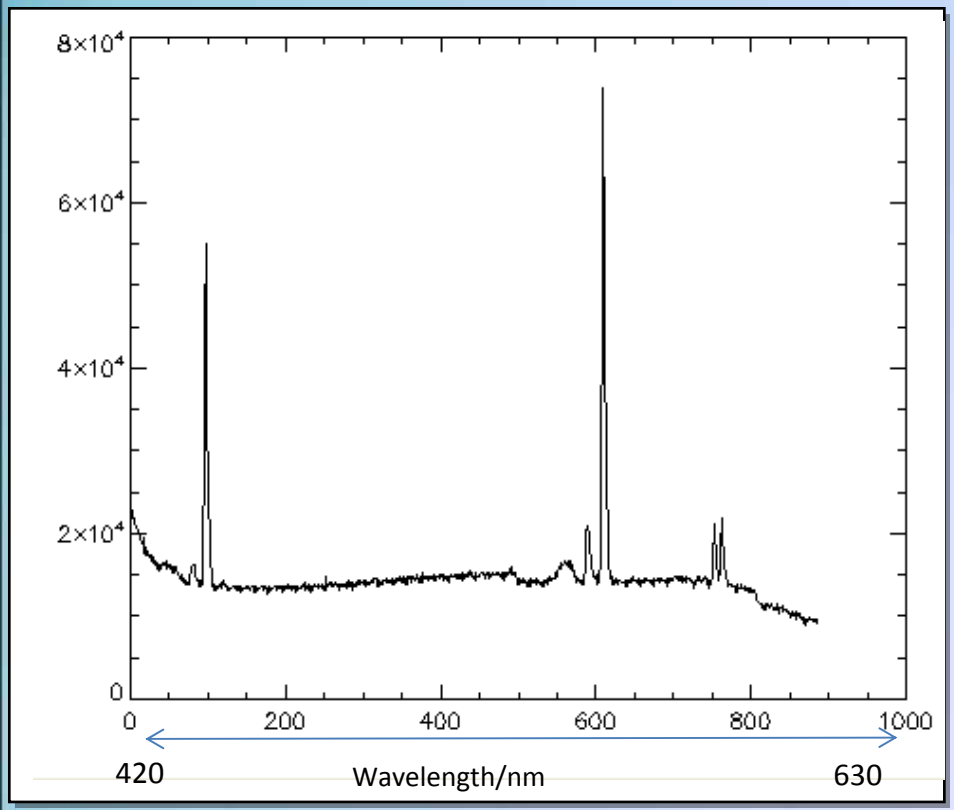
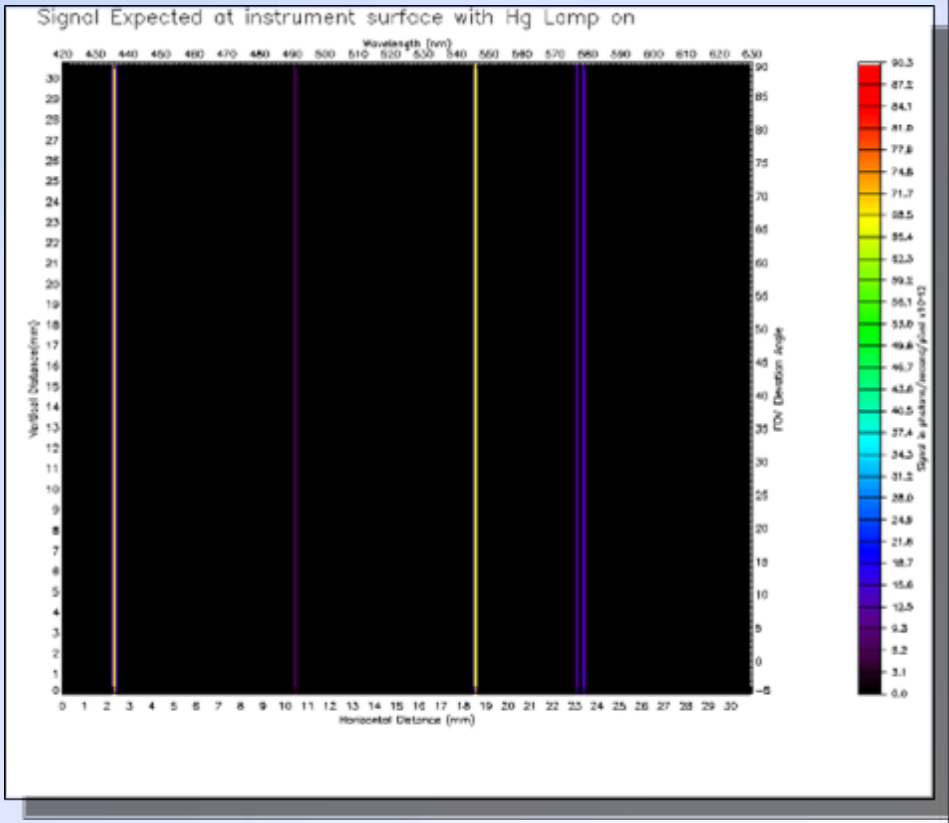
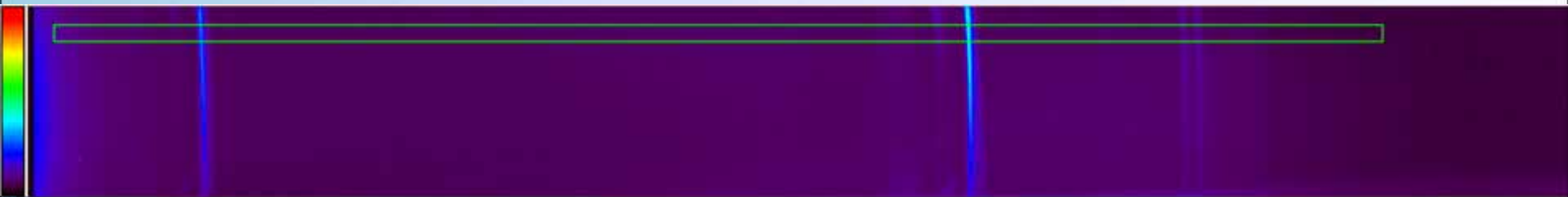
Instrument Characterisation







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Leicester Deployment

- Deployment as part of the ESA-funded project, iTRAQ- CityScan to provide NRT NO_2 data.
- Two instruments located in Leicester with intersecting fields of view over the region of interest.

Latest results

- V1. Retrieval scheme for CompAQS now complete.
- Work in progress to optimise both the instrument and the algorithms to produce better quality NO_2 mapping.
  - (Rationalisation of focal plane readout, instrument characterisation, post-processing, radiative transfer, NRT data feeds, etc).
  - First imaging data due by end Sept 2011.
  - DOAS residuals down to 1.2×10^{-3} RMS (target 1×10^{-3})
  - ILS measured at 0.72 nm
- Temperature stabilisation..
- Data capture (50k images).
- Data feed from rooftop to server.. Automated processing.

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CompAQS phase 2, Imaging entrance optics

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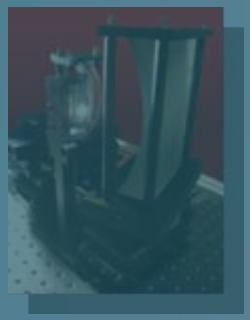
CompAQS phase 1



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CompAQS launch?

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CEOI

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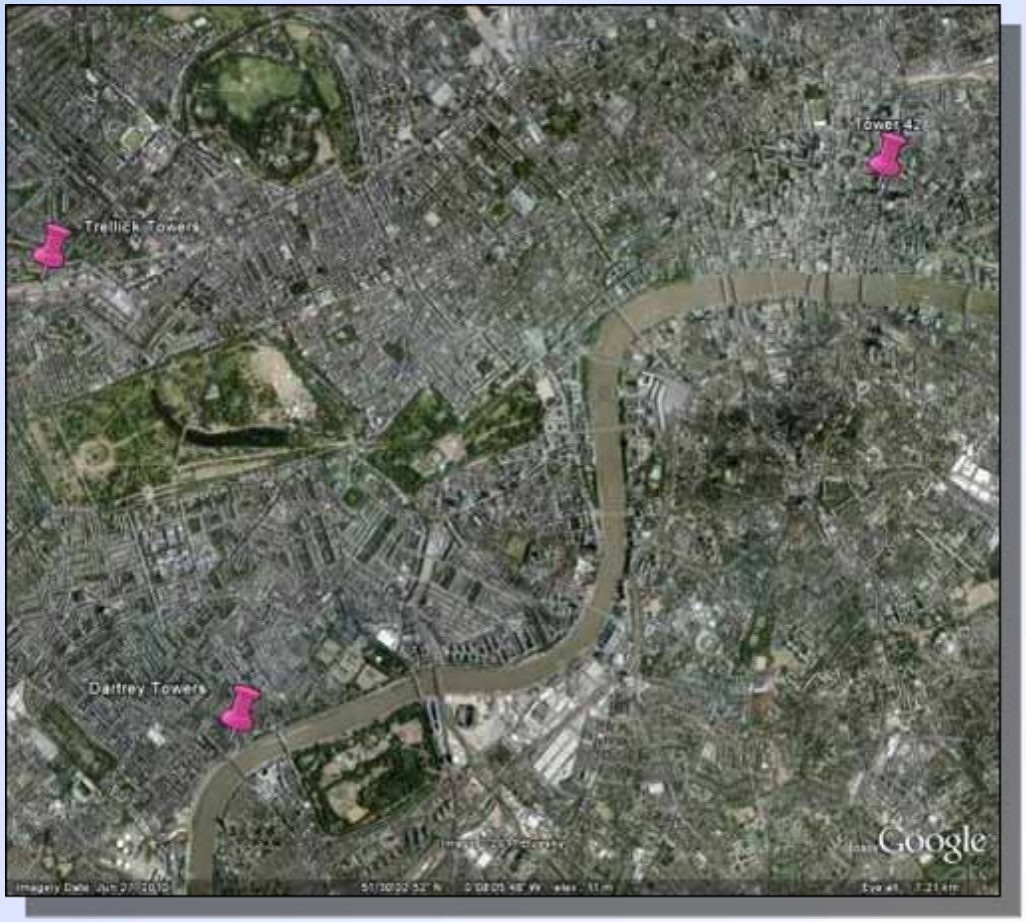
Looking Ahead

- ClearfLo, NERC funded project involving 8 institutions taking measurements at the ground and at elevated sites to give information on the chemistry, meteorology and composition of the London urban boundary layer.
  - Three instruments to be deployed Jan-Feb and July-Aug 2012.
- Optimisation of CompAQS spectrometer design by CEOI-funded CASE studentship with SSTL.
  - Assessment of performance parameters from CityScan instrument.
  - Rationalisation of instrument and algorithms.
  - Design of small satellite payload.



Acknowledgements

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  - R.J. Leigh
  - P.S. Monks
  - J. Lawerence
  - J. Anand
  - Alex Webb (Summer Student)
  - Martin Thompson (Summer Student)