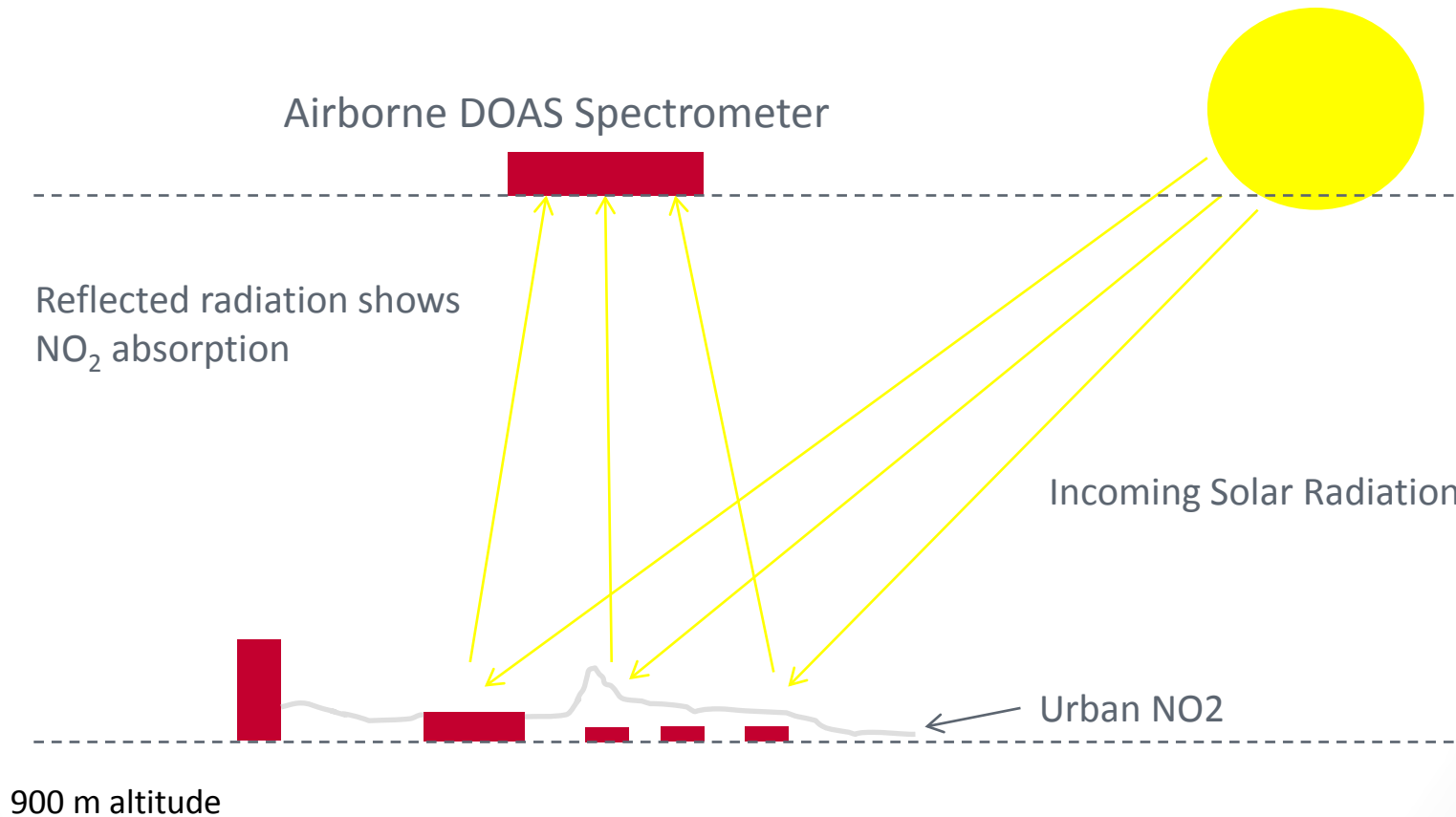


NO₂ Sensing from Airborne Platforms

Roland Leigh & Martin Thompson

Measurement technique



Why build a new spectrometer for Air Quality?

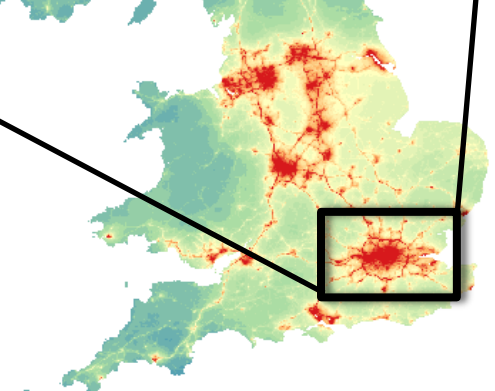
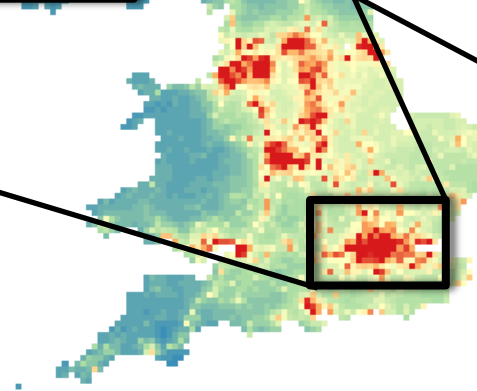
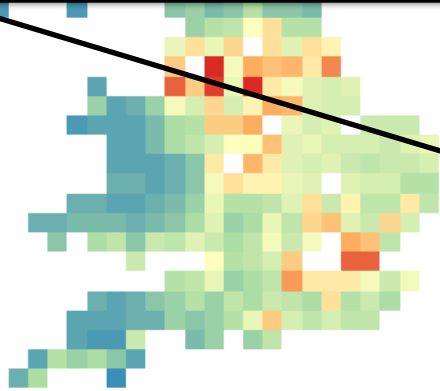
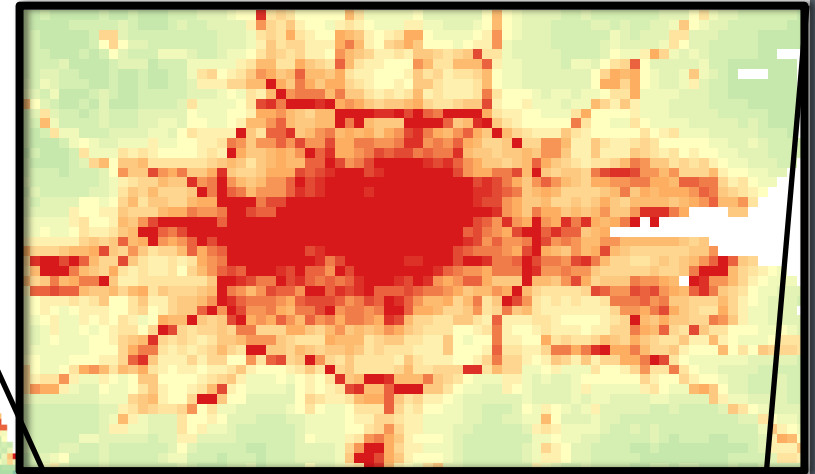
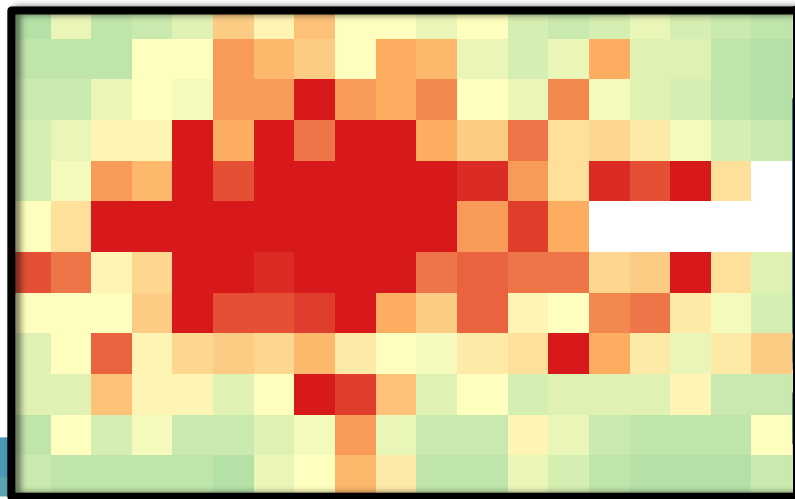
23 km?



7 km?



1 km?

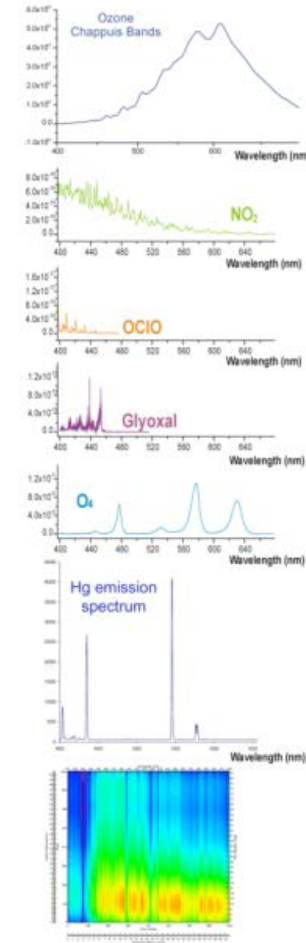
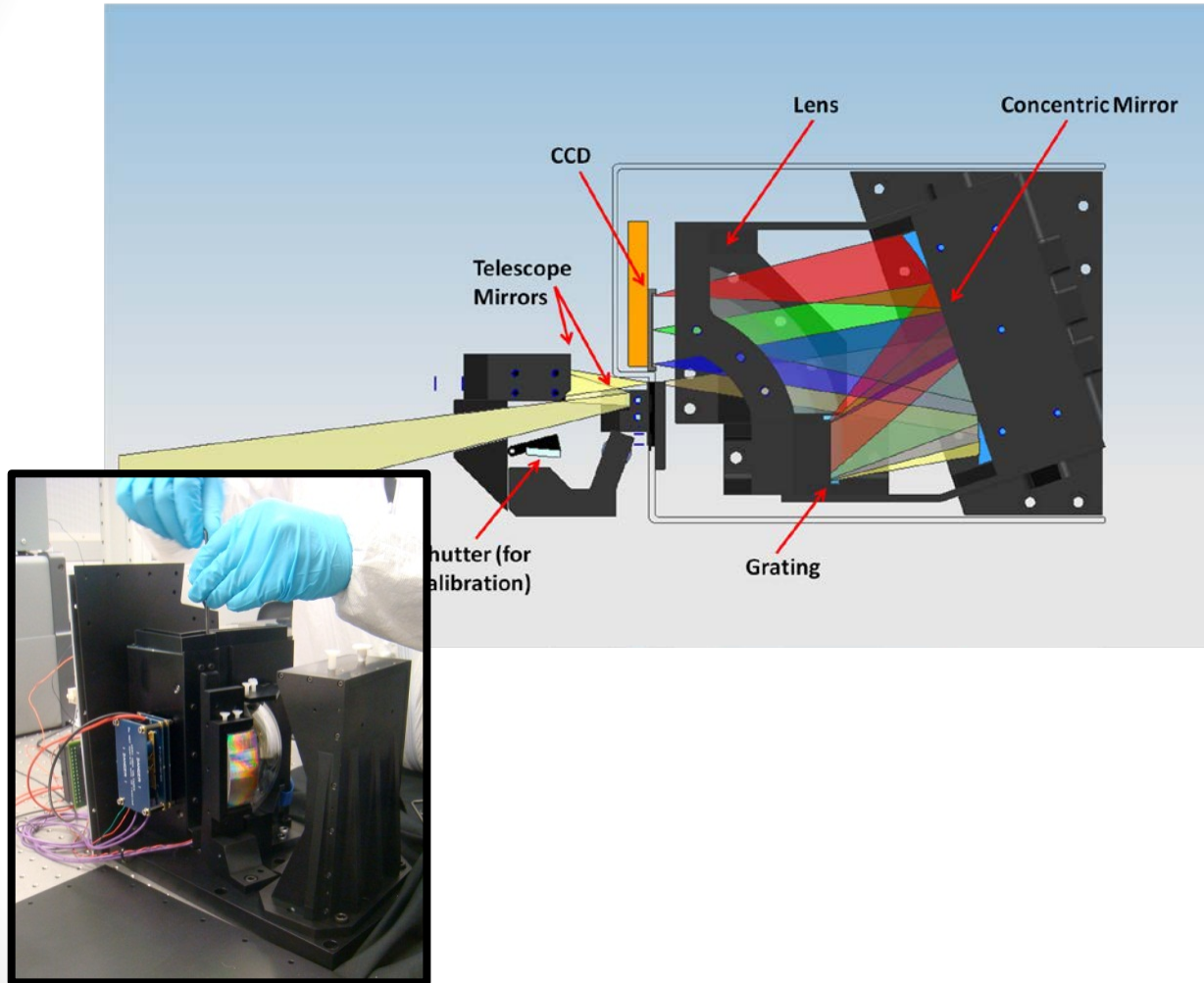


OMI

Sentinel 5 Precursor

CompAQS

CompAQS



The Airborne demonstrator

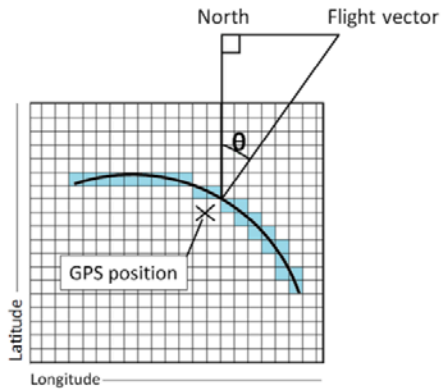


Fig. 2. Schematic of the gridding process, showing the GPS location relative to the CompAQS field of view (curvature exaggerated for display purposes) shown as the black curve.

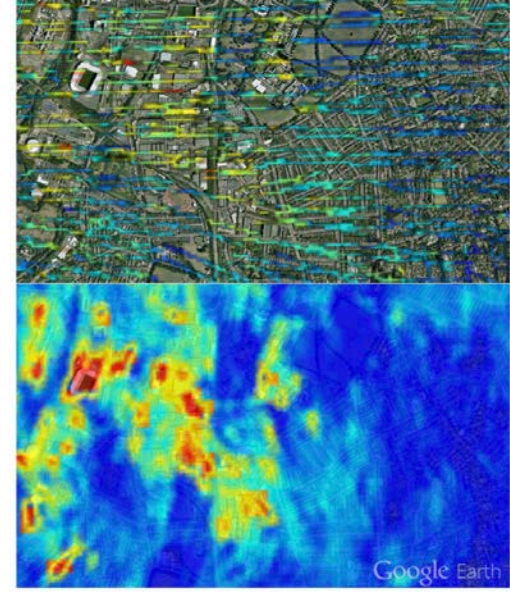


Fig. 4. 20 m resolution surface intensity (442.7 nm) with (bottom) and without (top) along-track linear interpolation and 2×2 grid cell smoothing, colours represent surface intensity, red is brighter,

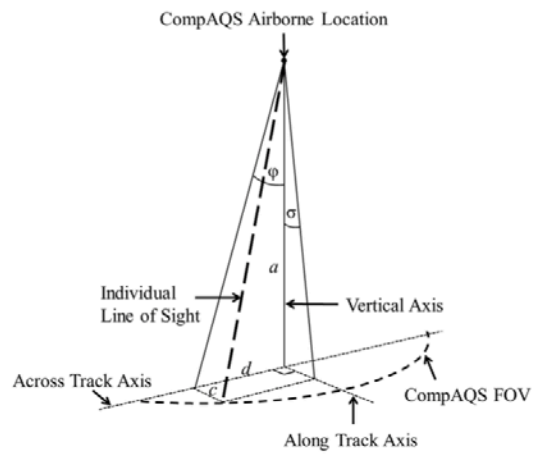
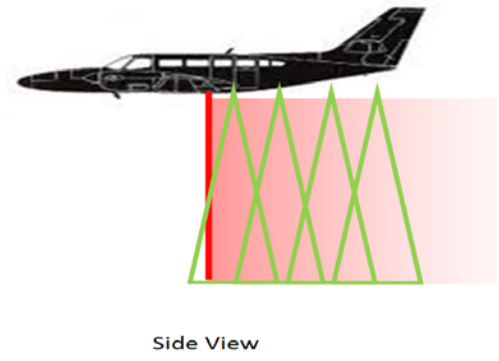
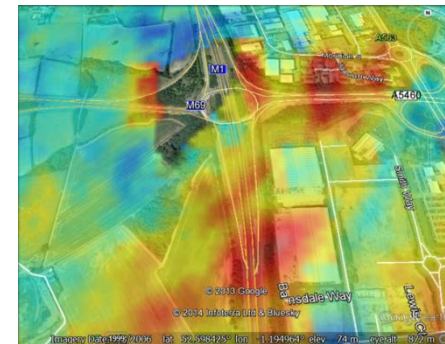
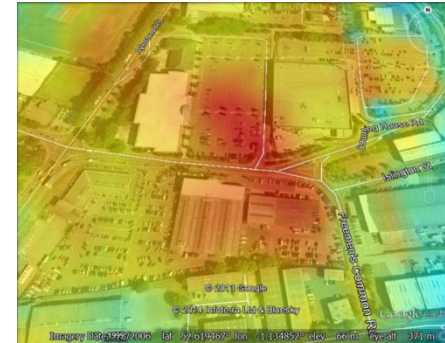
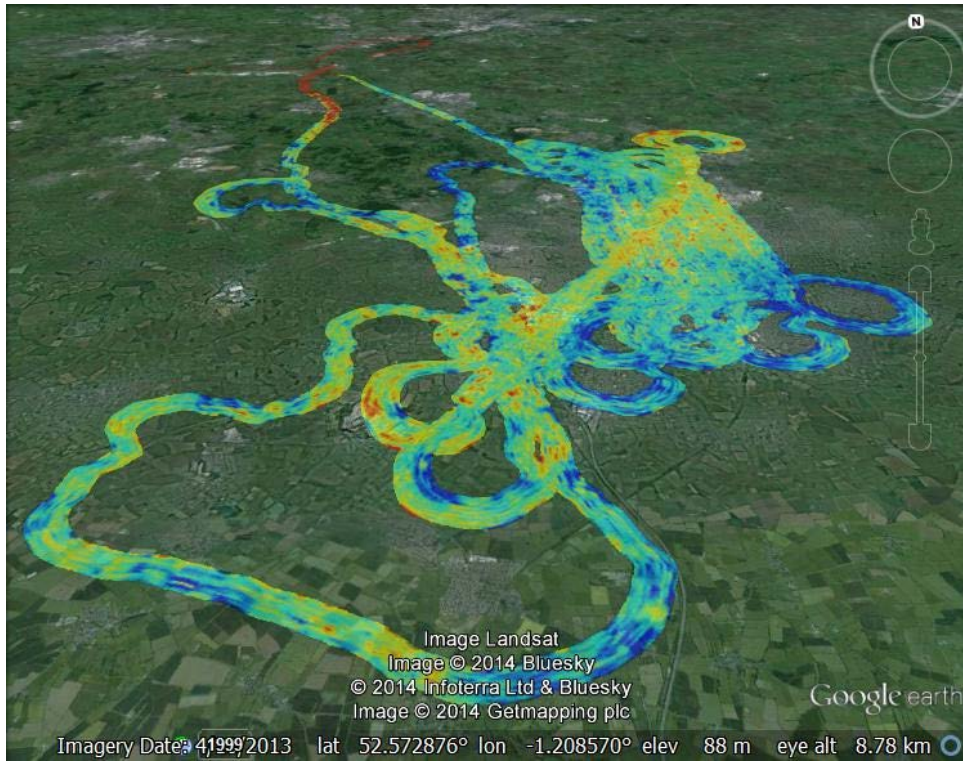


Fig. 3. Schematic demonstrating the dimensions and geometry used to define the terms given in equations 1 to 6.

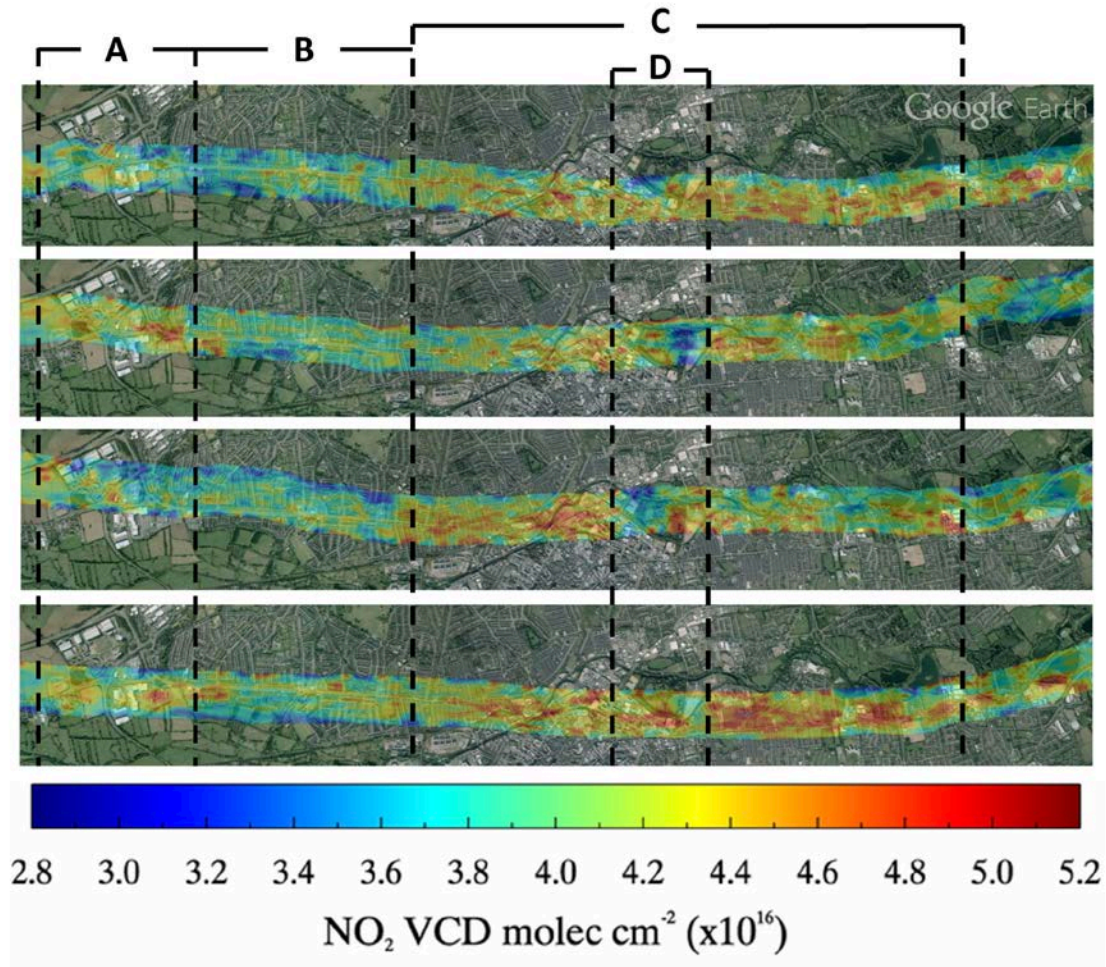


Proof of Concept Flight



28th February 2013 * 12:00-14:30 * ENE wind (8 knots approx.)
Flight altitude 900m, Aircraft speed 60 m/s

Repeat Overpasses



Re-Design Requirements

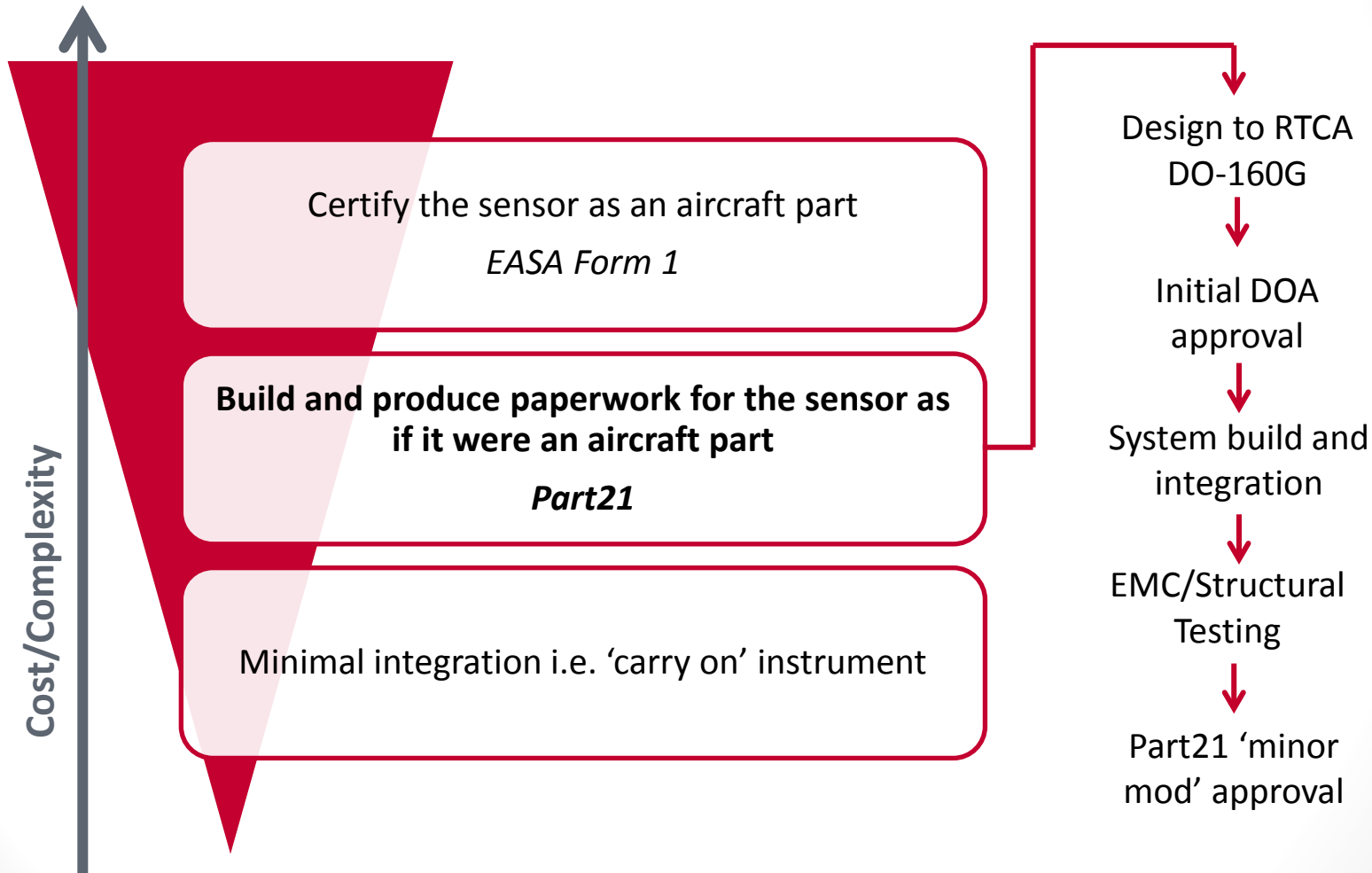
'To bring previous AQM designs up to a TRL 6 (airborne)'

*'To enable permanent installation on a fixed wing light aircraft
for repeated surveys'*



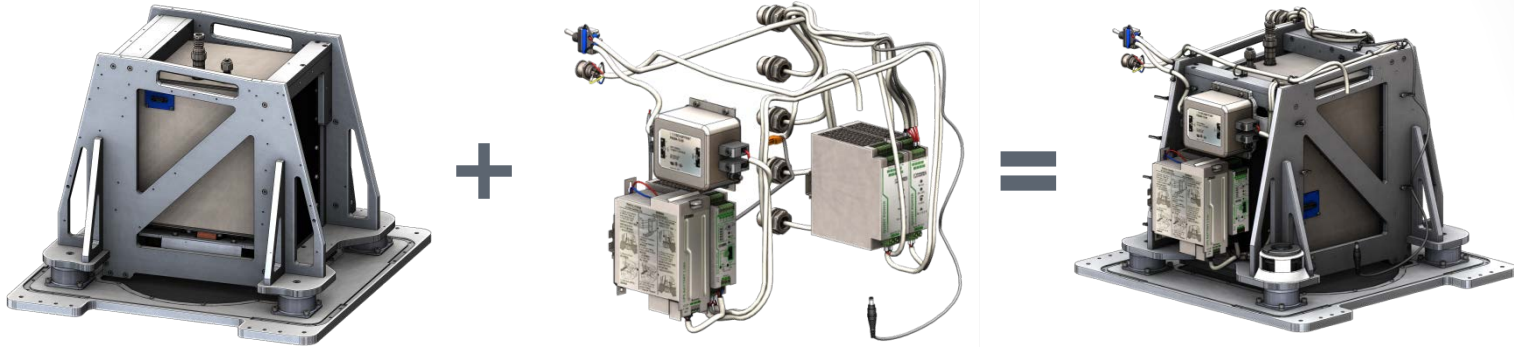
BN-2A Islander

Route to Certification

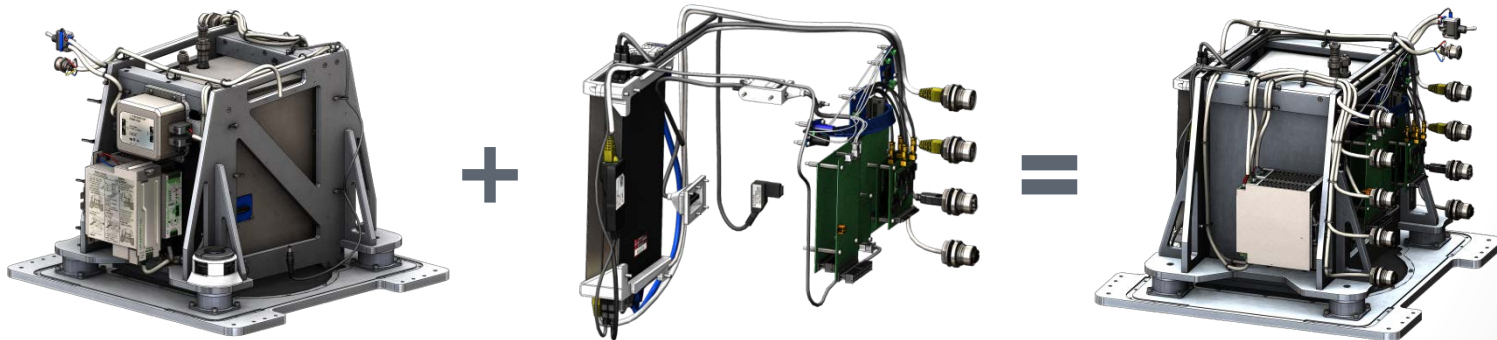


System Integration

Power circuit



Data circuit



Internal Views

CompAQS CCD electronics

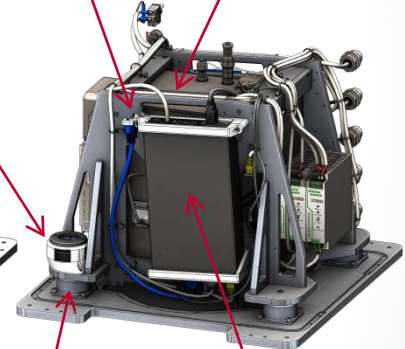
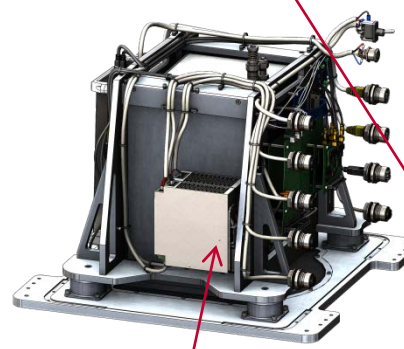
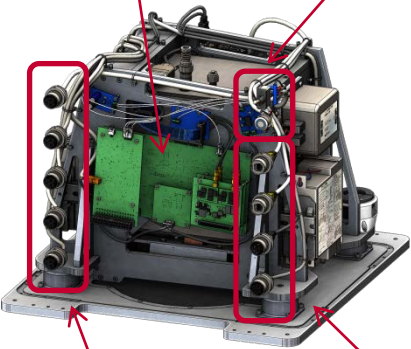
Switches
(rocker – system power, momentary – PC power)

Power filter
(with surge protection)

Desiccant

VGA out

CompAQS



Power Connectors
(28V in, 2x 12V out, 1x 19.5V out, 1x 28V out)

Data Connectors
(Ethernet x2, USB x 1, Serial x1)

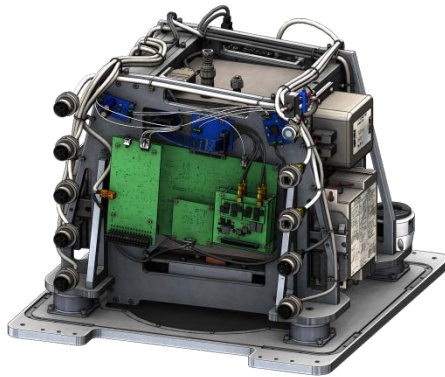
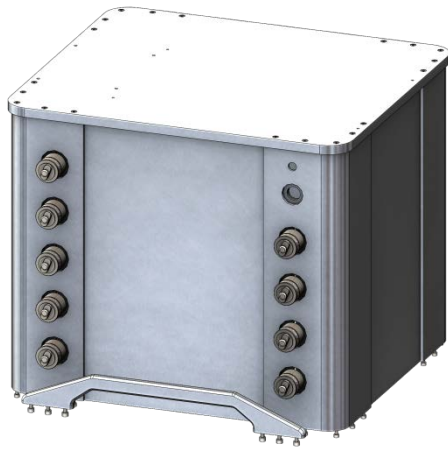
UPS system
(5Ah battery)

DC – DC
Converters

Anti vibration
mounts (x4)

Computer

Final Design



296 mm



78.2 kg

242 mm

204 mm

Testing Requirement

'De-risking crucial areas of risk to the airworthiness of the platform'



Electromagnetic Compatibility

- Susceptibility
- Emissions
- Contracted out to TRaC Malvern

Structural Compatibility

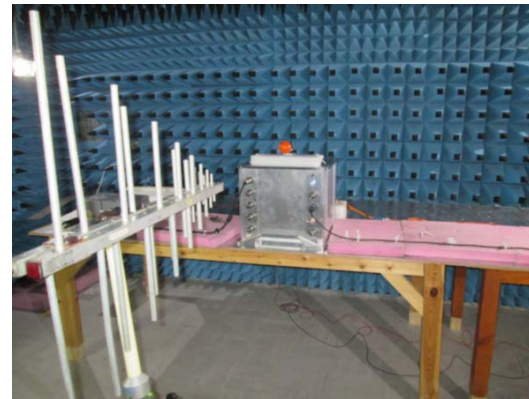
- Operation shocks and crash safety
- Vibration

EMC Testing

- **Section 15** Magnetic Effect
- **Section 21** Emission of Radio Frequency Energy
 - Conducted (CE)
 - Radiated (RE)
- **Section 25** Electrostatic Discharge (ESD)



Voltage Spike Test



Radiated Susceptibility Test,
Frequency Range 200MHz-1GHz

Certification Considerations

- *'Minor'* vs. *'Major'* mods
- Aerial survey aircraft eases integration to aircraft
 - Expectation of impact on platform.
- 2 modes of operation
 - Commissioned flights
 - Drift hole use allows 'piggyback' usage

Work Package	Cost
Design	£ 18 k
Documentation for certification	£ 6 k
EMC Testing	£ 18 k
Certification	£ 10 k
Flight Planning	£ 5 k
Aircraft Operation (on flight – 4 hrs)	£ 6 k
TOTAL	£56 k

Concluding Remarks

- An airborne demonstrator has been developed to prototype demonstration in a relevant environment
- System designed for usability (plug and play)
- Pathway through the certification complexities has been found



- Use of commercial aerial survey aircraft provides increased flight opportunities for longer campaigns

Acknowledgements

*Funded by the **CEOI***

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SSTL (Dan Lobb, Mike Cutter)

Bluesky (James Eddy, Stuart Yorke & Dan Taylor)

RVL (Roger Stockham)

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