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Demonstrating Multi-View Spectroscopy for Greenhouse Gas Remote Sensing using GHOST

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GHOST GREENHOUSE GAS OBSERVATIONS OF THE STRATOSPHERE AND TROPOSPHERE
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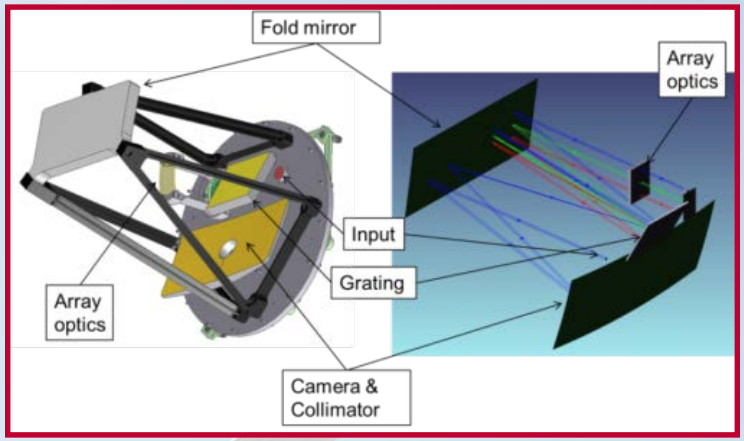
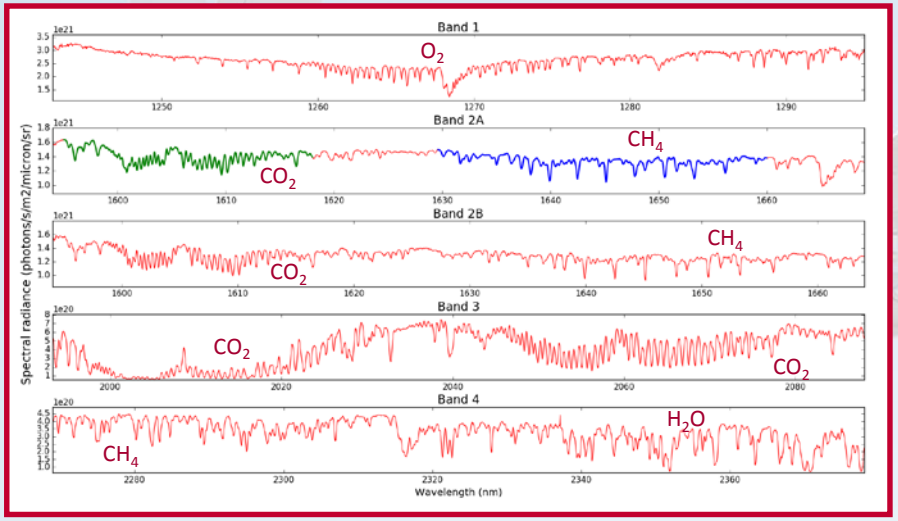
GHOST: GreenHouse gas Observations in the Stratosphere and Troposphere

- Novel UK-developed airborne shortwave infrared grating spectrometer for greenhouse gas remote sensing
- Four SWIR spectral bands observed using a single diffraction grating and detector array with spectral resolution between 0.1 and 0.3 nm (band dependent)
- In addition to GHG bands GHOST measures the 1.27 μm O_2 band to provide information about optical path of observation





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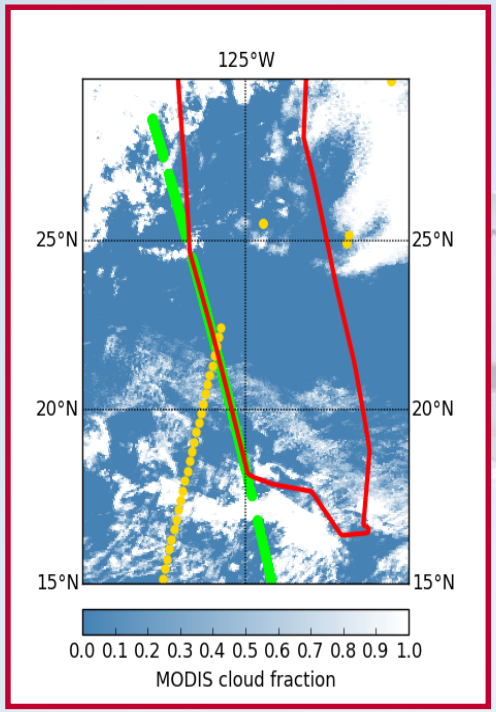
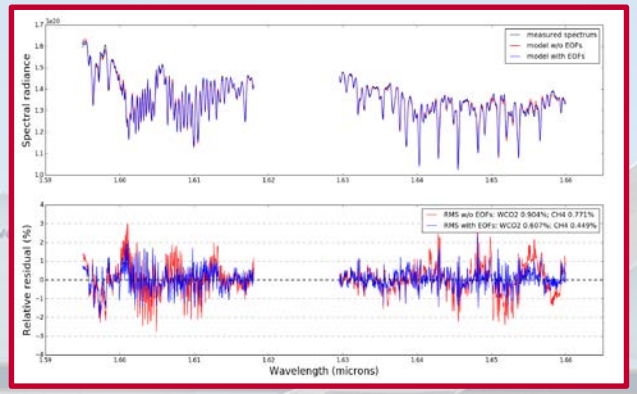
- Maiden flights on the NASA Global Hawk UAV in February and March 2015 – validation opportunities with OCO-2 and GOSAT (also Sentinel-5P TROPOMI after October 2017 launch – see table)
- Further flights on the NERC Airborne Research and Survey Facility in April and May 2015 targeting emissions hotspots
- Instrument description, calibration and first results about to be submitted to Atmospheric Measurement Techniques





Instrument/channel	Range (nm)	Resolution (nm)	Sampling (nm)	Target species
TROPOMI/SWIR	2305 – 2385	0.25	0.1	CH_4 CO H_2O HDO
OCO-2/WCO2	1590.6 – 1621.8	0.071 – 0.098	0.03	CO_2
OCO-2/SCO2	2043.1 – 2083.4	0.087 – 0.127	0.04	CO_2
GHOST/Band 2A	1594.0 – 1670.1	0.21 – 0.24	0.038	CO_2 CH_4
GHOST/Band 3	1993.4 – 2088.7	0.33 – 0.34	0.048	CO_2
GHOST/Band 4	2269.1 – 2378.1	0.26 – 0.28	0.055	CH_4 CO H_2O HDO

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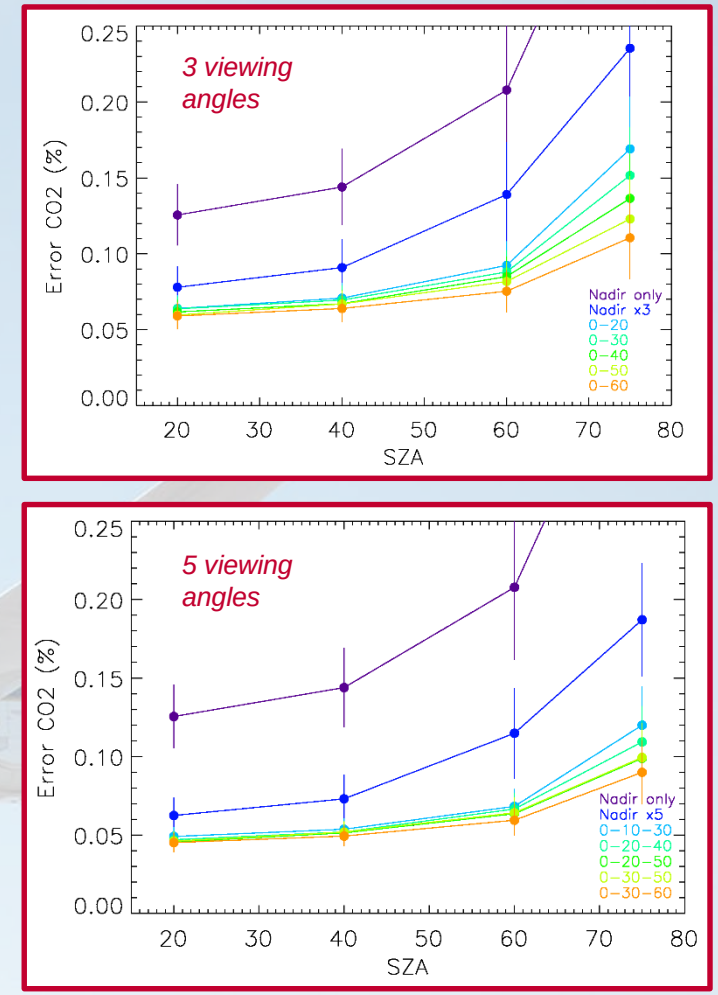
Motivation for multi-view spectroscopy

- Investigated as part of CEOI funded study supporting the Tropical Carbon Mission (a potential ESA Earth Explorer candidate)
- Viewing the same target from multiple angles allows for better characterisation of scattering effects in the atmosphere, e.g. from aerosols and cirrus
  - *Reduced errors in XCO_2 and XCH_4 retrievals*
  - *Improved quantification of emission sources*



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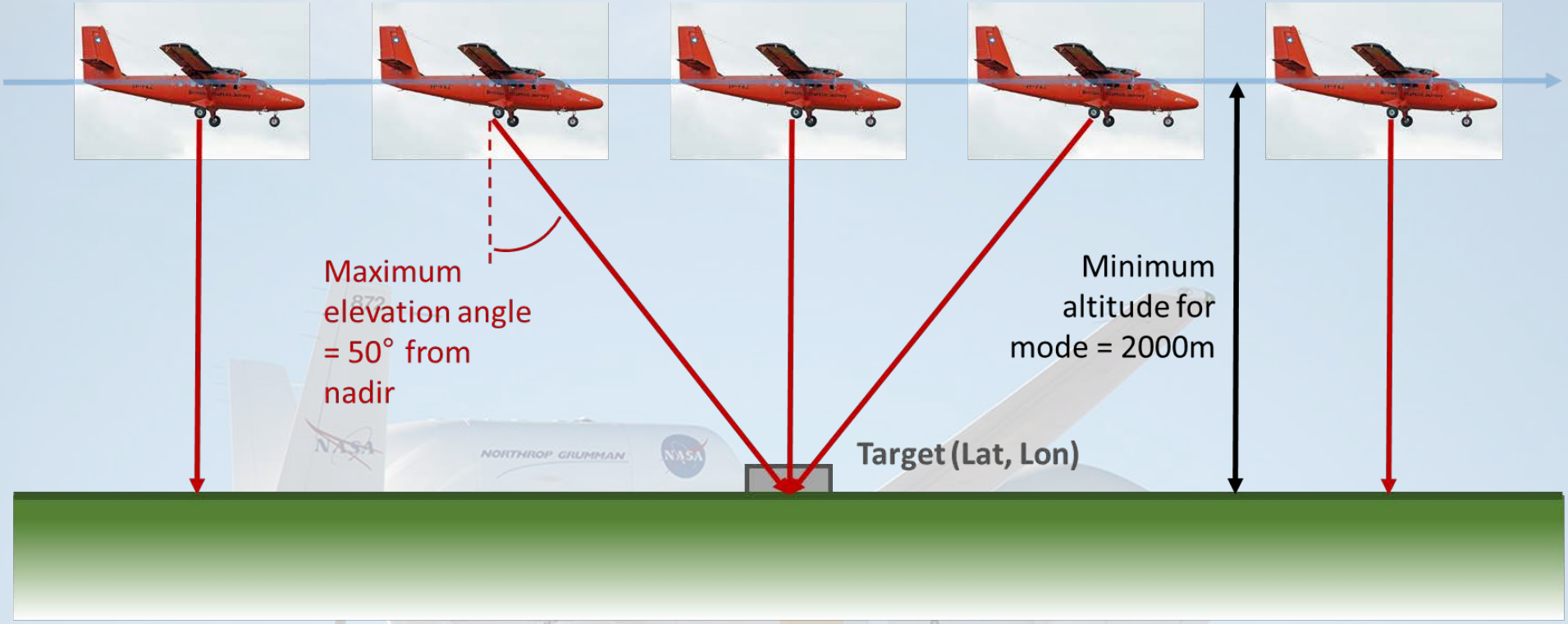
New target tracking mode to demonstrate multi-view observations



- When target co-ordinates are within the gimbal viewing geometry, gimbal continuously tracks the target
- Otherwise, gimbal reverts to nadir pointing

Summary

- New calibration measurements for GHOST – led by RAL Space with assistance from University of Leicester, hosted by STFC ATC
- Update to GHOST instrument software to incorporate a programmable target tracking mode
- Flights in summer 2018 on board the NERC ARF/BAS Twin Otter aircraft
- Update of University of Leicester data analysis software to incorporate simultaneous multi-view observations

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