The London Greenhouse Gas Monitoring Network

An overview of the Field Spectroscopy Facility's support for monitoring London GHG emissions

Field Spectroscopy Facility
Natural Environment Research Council

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

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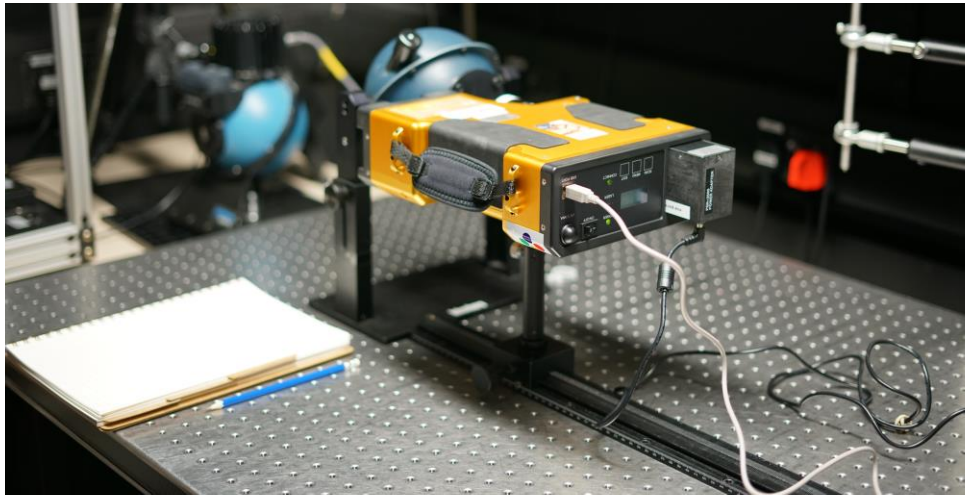
NERC SCIENCE OF THE ENVIRONMENT

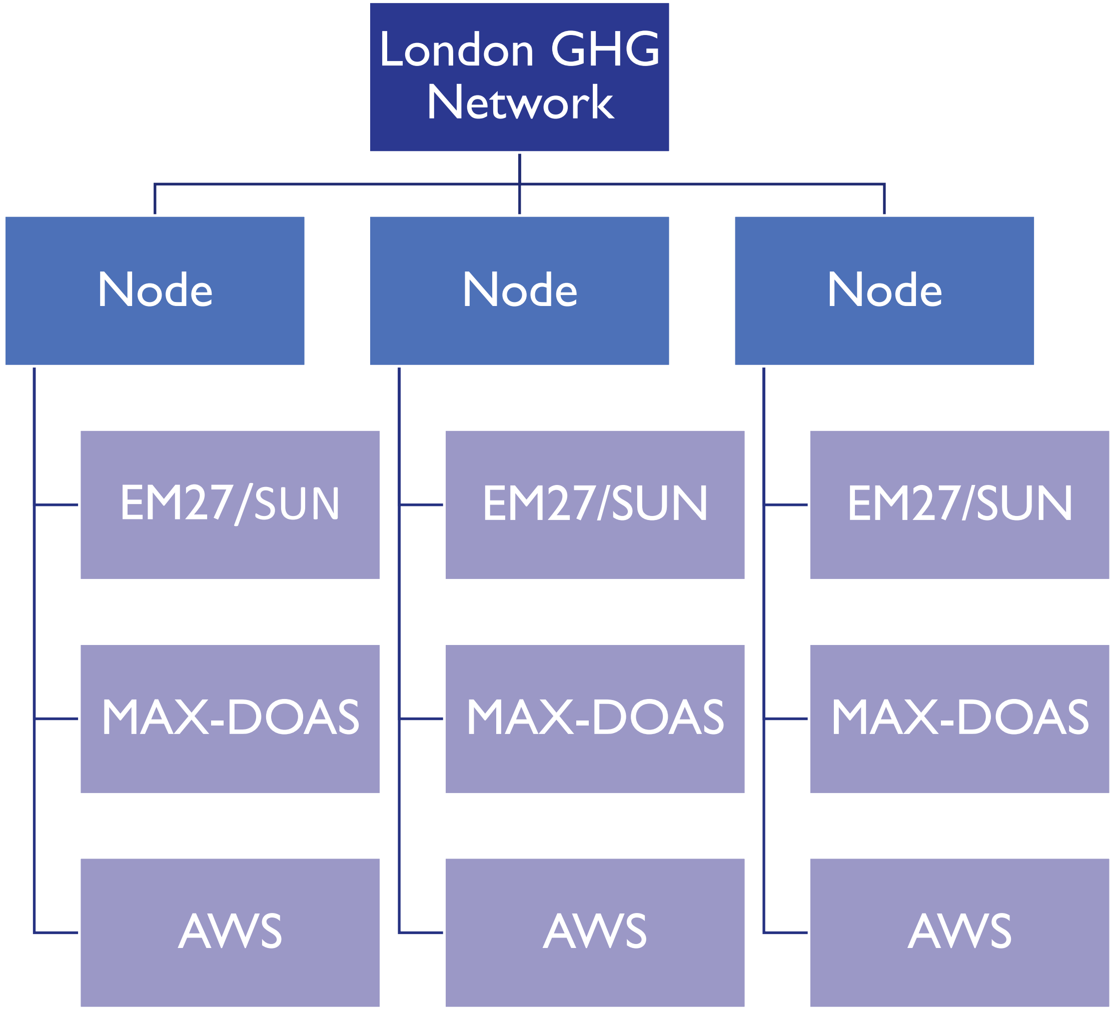
Introduction to FSF

- The NERC Field Spectroscopy Facility maintains and provides a pool of state-of-the-art spectroscopy instruments for use by the UK research community.
- We provide training and user support in use of our instruments, and promote good practice in the application of field spectroscopy
- We help to develop instrumentation for specific research questions, and to improve data collection.
- Our state of the art optical lab allows us to calibrate, characterise and validate EO sensors



FSF 2019 Transformational Capital Bid

- **Rationale** – "Significant temporal and spatial variability in GHG emissions at mega-urban sites, resulting in a clear need for multiple and long term instrumentation to capture variability"
- **Proposal** – to provide to the UK research community a network of autonomous, GHG measuring instruments, to be deployed in London as three discrete "nodes".
- Initial deployment – Summer 2020, revised Autumn 2020. Co-ordination with satellite missions (GOSAT, TROPOMI-5)



Bruker EM27/SUN Spectrometer

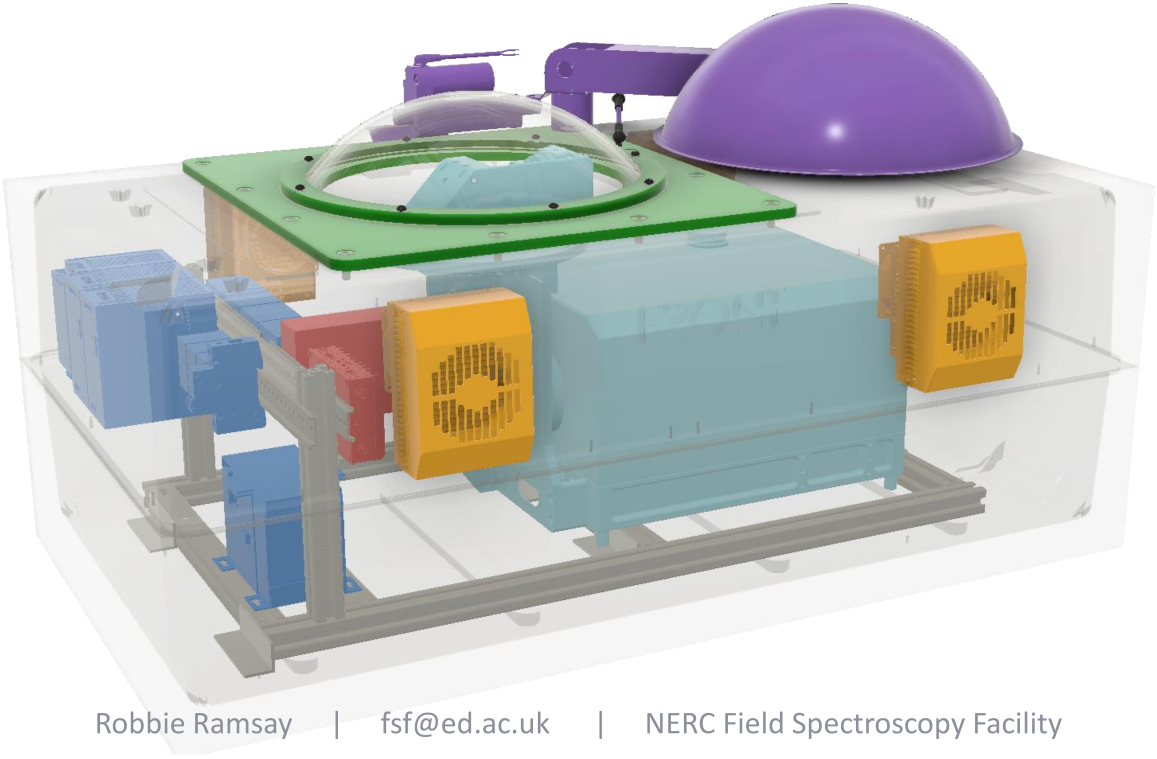
- **Species measured** – CO_2, CH_4, CO
- Fourier Transform spectrometer: in standard operation, 10 interferograms are co-added per observation resulting in temporal frequency of approximately 1 minute
- Measures atmospheric absorption spectrum using direct sunlight as the light source: automatic solar tracker uses camera-based feedback system
- Two detectors at 0.5 cm-1spectral resolution
  - 5000 to 14500 cm^{-1} (0.69 to 2.0 μm): InGaAsdetector
  - 4000 to 5500 cm^{-1} (1.8 to 2.5 μm): for carbon monoxide, extended range InGaAsdetector with Ge filter
- Internal calibration source
- Portable and robust instrument
- Provides access to **COCCON** (Collaborative Carbon Column Observing Network, Frey et al. 2019 AMT), an international network of over 100 instruments

Current work with EM27/SUN – Part One

- 3 × EM27/SUN spectrometers purchased in September 2019, delivered in January 2020.
- In March 2020, performed observations using the spectrometers with and without a sample of proposed dome material in line of sight of solar tracker
- Slight refraction noted, however, will introduce only minimal impact to gas retrievals that can be corrected
- Conducted a side-by-side intercomparison of instrument performance

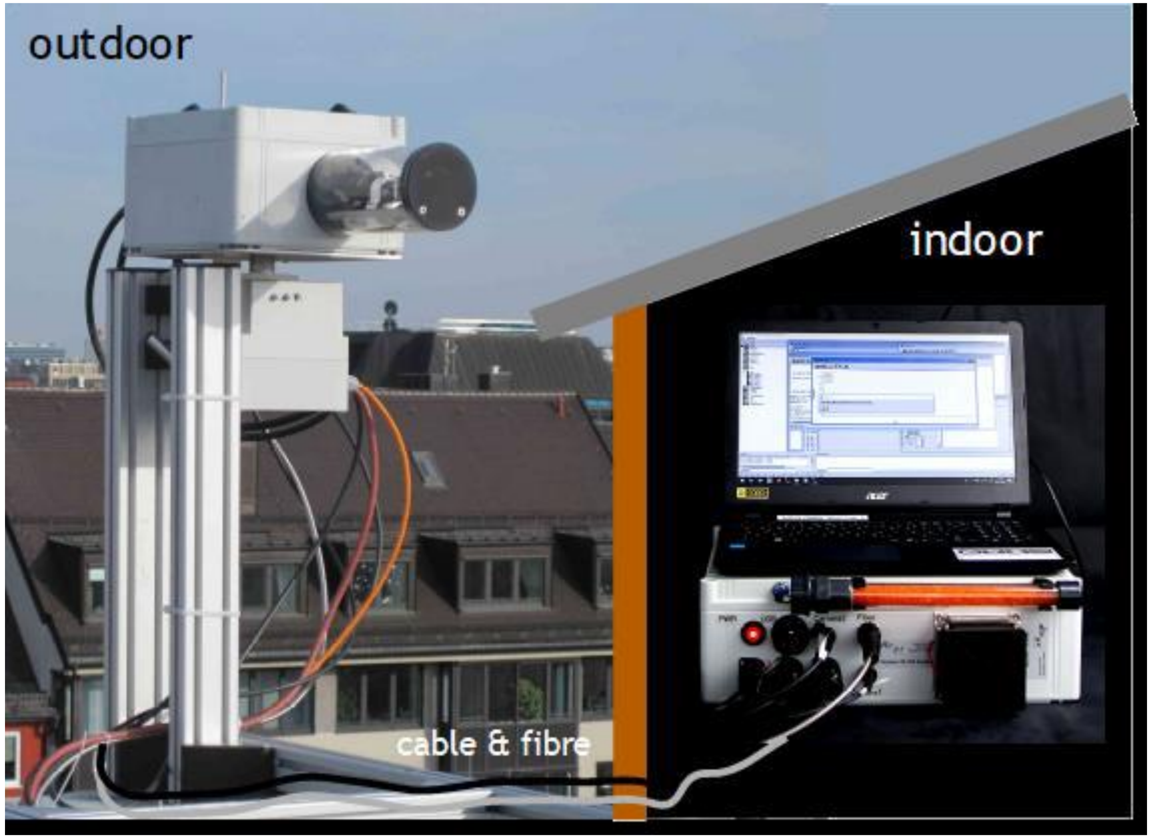
Current work with EM27/SUN – Part Two

- Three enclosures for the EM27/SUN to allow continuous, autonomous operation in all conditions are currently being built in Edinburgh.
- Original concept by Heinle and Chen, AMT 2018 (TU Munich); design by Jerome Woodwark (University of Edinburgh).
- By including a dome, solar tracker mirrors are shielded from potential contamination, outweighing drawback of glass dome refraction on retrieval of gas profiles.



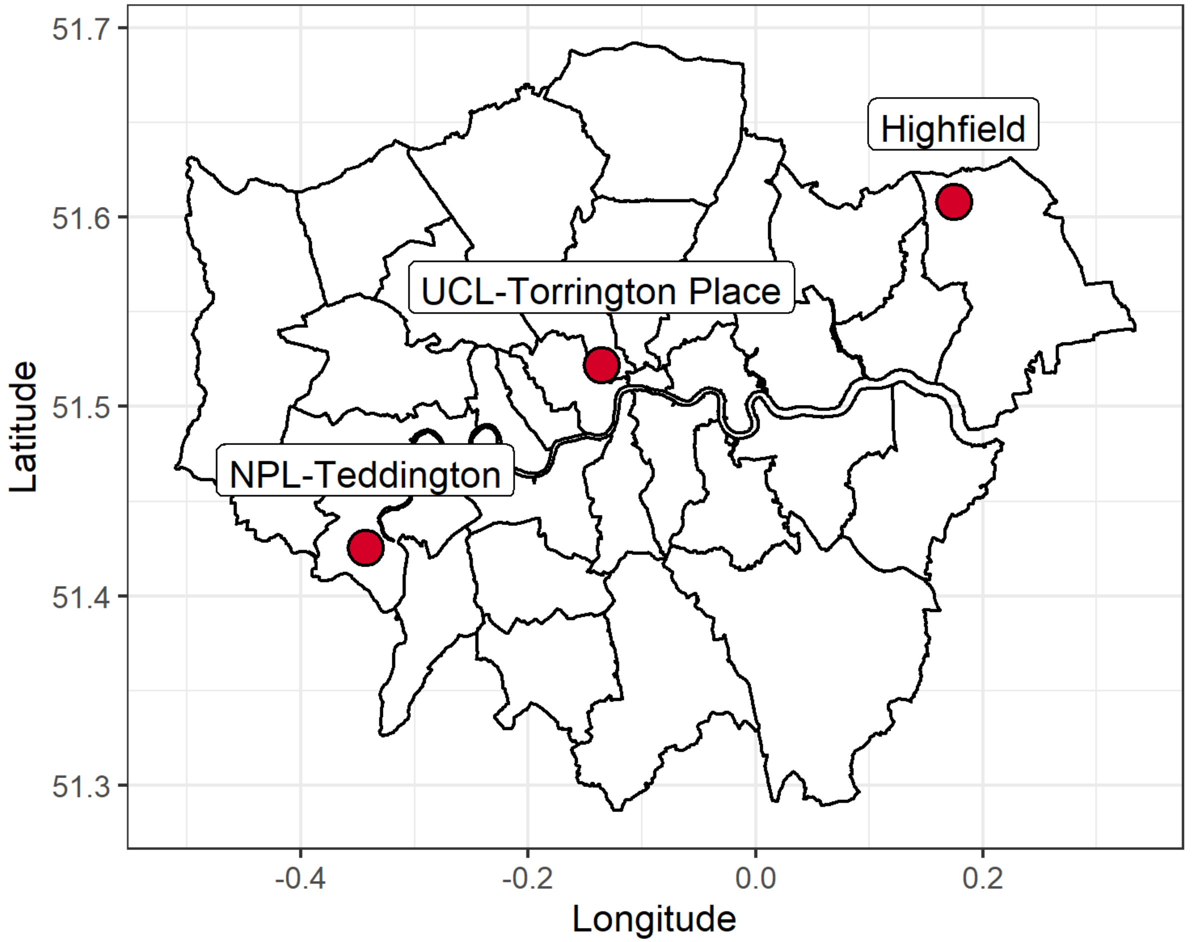
AirYX MAX-DOAS

- **M**ulti **AX**is **D**ifferntial **O**ptical **A**bsorption **S**pectroscopy
- **Species measured –** NO_2, O_3, CHOCHO, HCHO, HONO, halogen oxides
- Simultaneous measurements of these trace gases with GHG measurements will enhance research into links between GHG emissions and air quality.
- Two detector units:
  - UV-VIS: 290 – 450 nm, FWHM 0.60 nm
  - VIS: 430 – 565 nm, FWHM 0.60 nm
- 2D MAX-DOAS system: scanning in both elevation and azimuth, allowing for measurements of three dimensional distributions of trace gases
- **Progress** – tendering process from January to March 2020. 3 × spectrometers purchased in March 2020. Delivery expected September 2020.

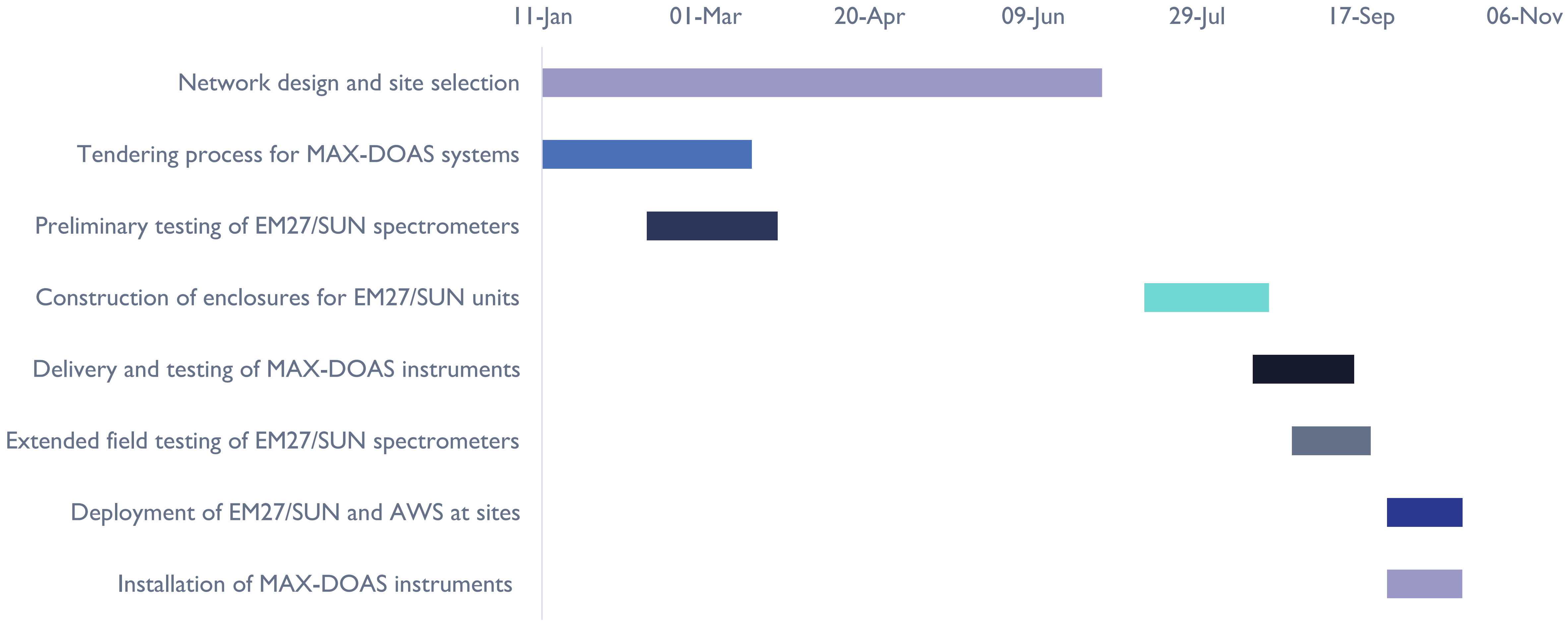


Proposed locations for sites in London

- **Concept** – three "nodes" along a SW-NE transect, following the prevailing wind direction:
- **SW Node** –National Physical Laboratory, Teddington
- **Central Node** –University College London, Torrington Place
- **NE Node** –Highfield Residential Tower
- Discussion with stakeholders still ongoing for NE Node, access issues in light of lockdown for central and SW nodes.



Revised timeline for project



Future projects

- Instruments are portable, robust, and autonomous
- Potential for use in other projects, such as monitoring methane emissions from wetlands, biochar projects etc.
- Minimal set up required, training will be provided by FSF
- Access to instruments can be provided as part of a NERC grant
- Feel free to discuss ideas with us at fsf@ed.ac.uk

Question and Answer Session

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