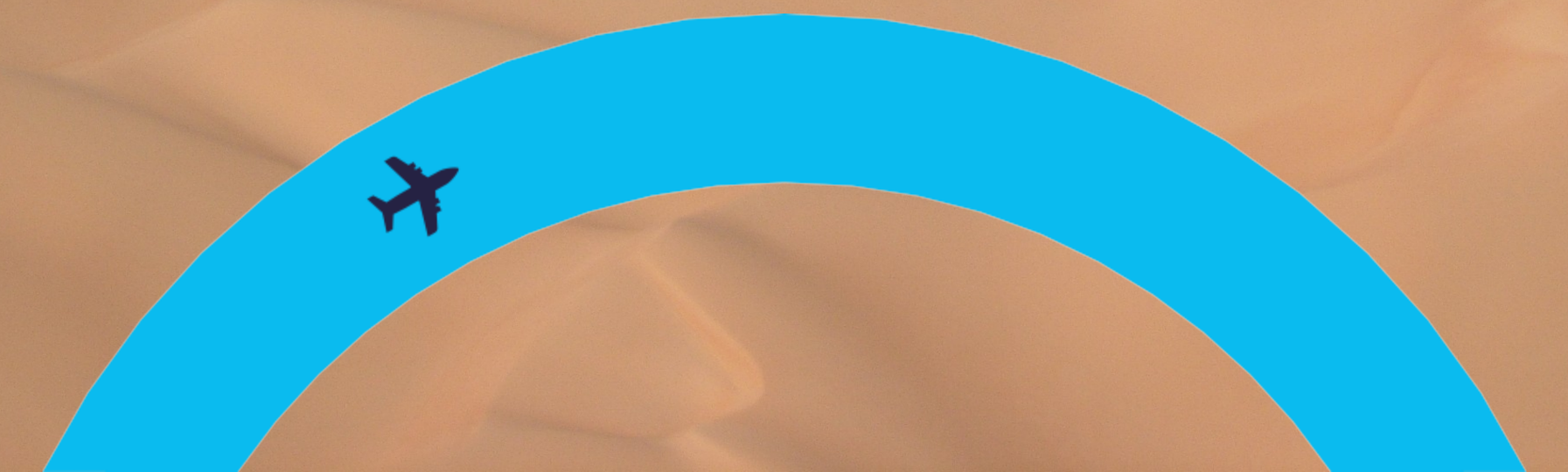
FAAM

AIRBORNE
LABORATORY

Operational and Measurement Capability

Alan Woolley



FAAM In The Air

- **Operating Altitude Range**
- 50ft to 35,000ft
- **Endurance**
- up to 6 hours (12.2 Tonnes fuel)
- **Science speed**
- 100 ms^{-1} (~200 knots)
- **Seats (inc Crew)**
- 21
- **Science Payload**
- Approx 4 tonnes

FAAM On-board Measurements

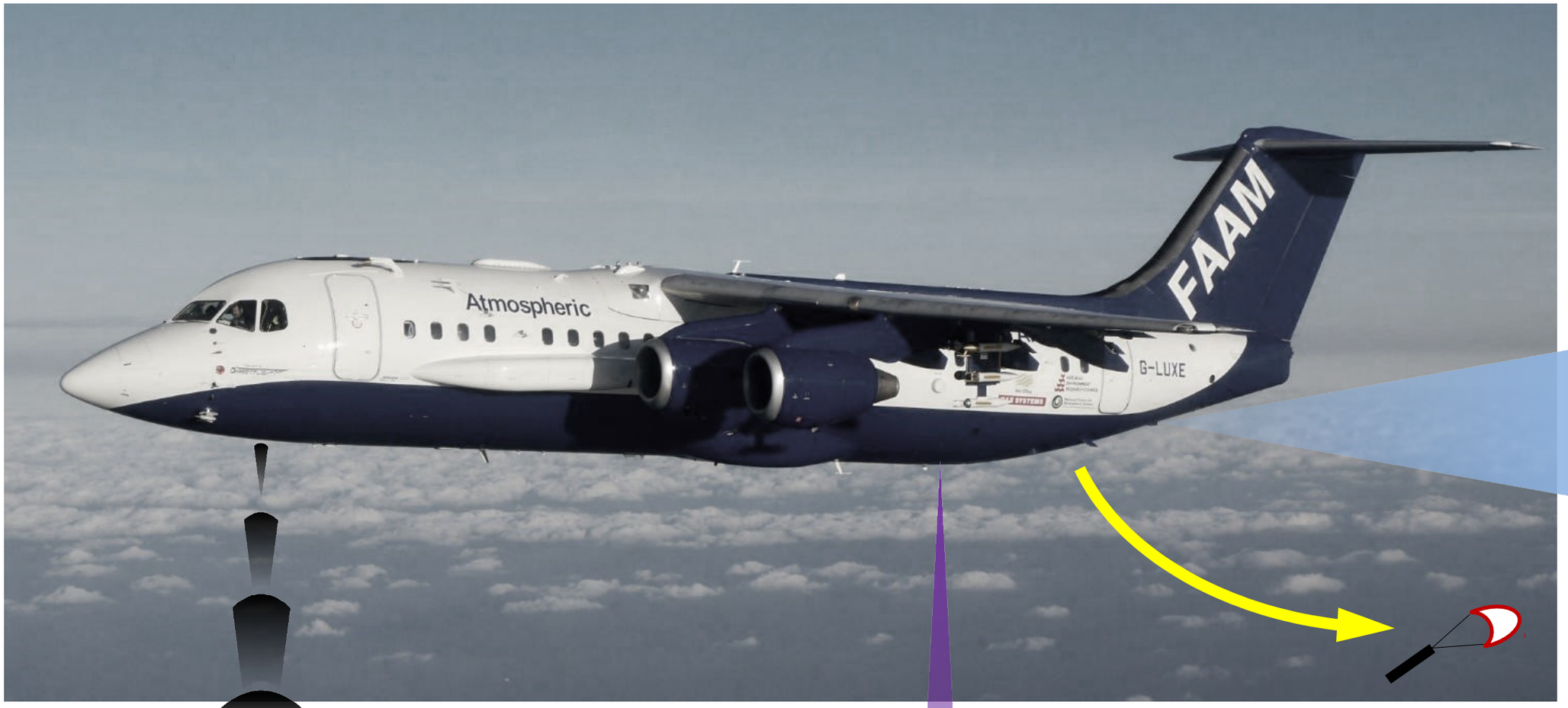
- Primary flight instrumentation (IAS, TAS, Radalt, GPS positions, heading, pitch, roll)
- Temperature, humidity, turbulence, bulk wind, atmospheric soundings using dropsonde launches
- In-house (core) cloud microphysics, aerosol and greenhouse gas and chemistry measurements
- (FAAM Website www.faam.ac.uk/the-aircraft/instrumentation/)

- Non-core, available instrument groups
  - Aerosol: size, composition, number
  - Cloud microphysics: particle size, number, phase, morphology
  - Chemistry: range of climate gases, VOCs, reactive and air pollutant gases. Ability to sample in real-time and also collect for later analysis
  - Remote sensing: Aerosol Lidar, Radiometry both broadband and wavelength-resolved across the microwave, IR, visible and UV regions

FAAM Atmospheric Research Aircraft Remote Sensing

All-sky radiant flux

NIR spectrometer



Video

Dropsondes

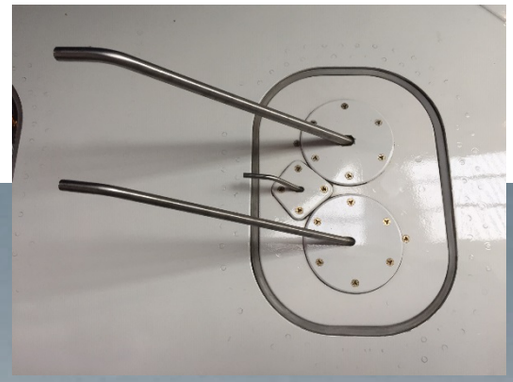
Radar Altimeter

FIR spectrometer

Aerosol lidar

FAAM Atmospheric Research Aircraft In-situ Measurements

Water content
Temperature

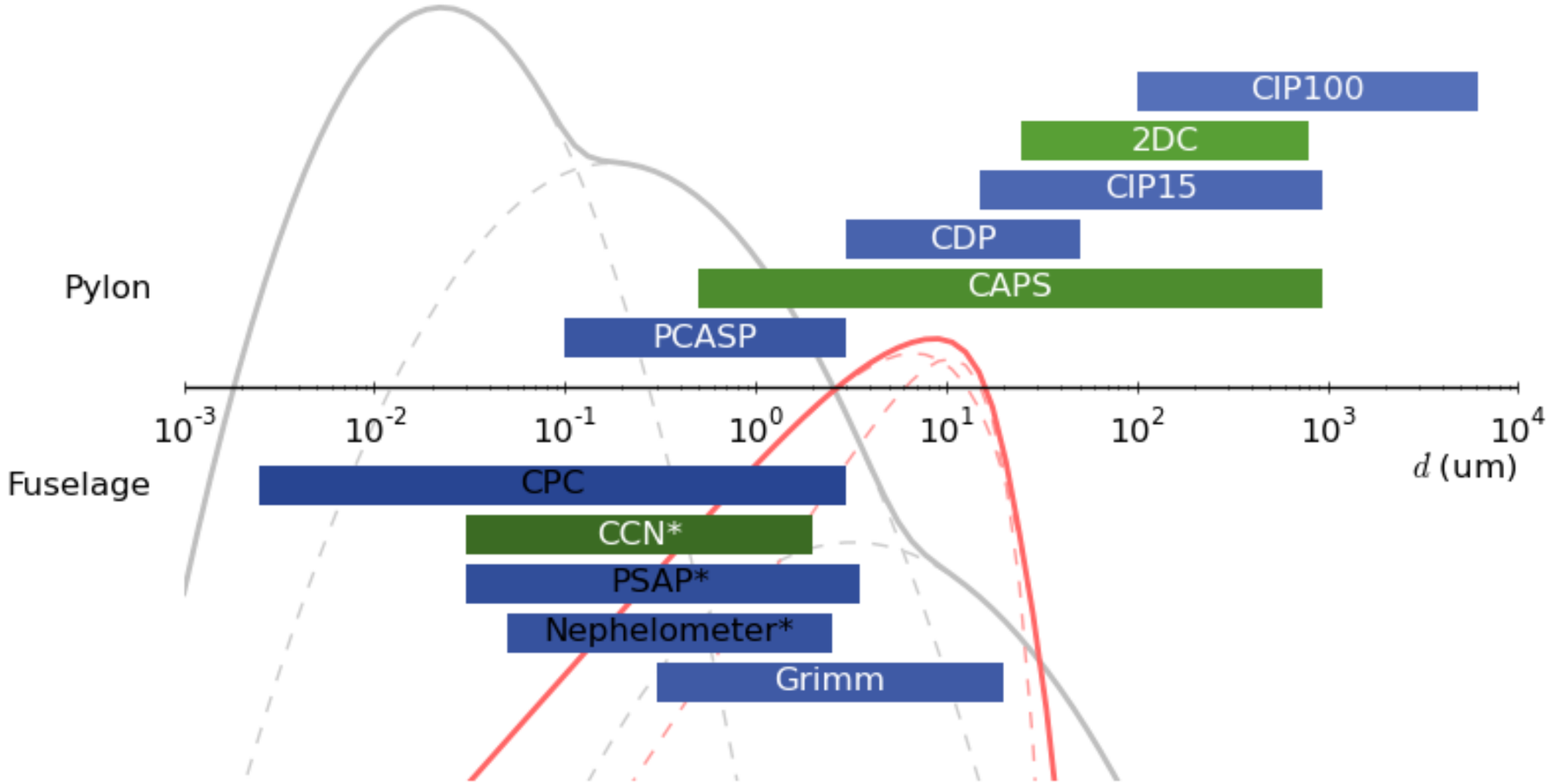


Aerosol and chemistry inlets

Photos: A. Wellpott, D. Pasternak

Cloud and aerosol particles

FAAM Atmospheric Research Aircraft Particle Measurements



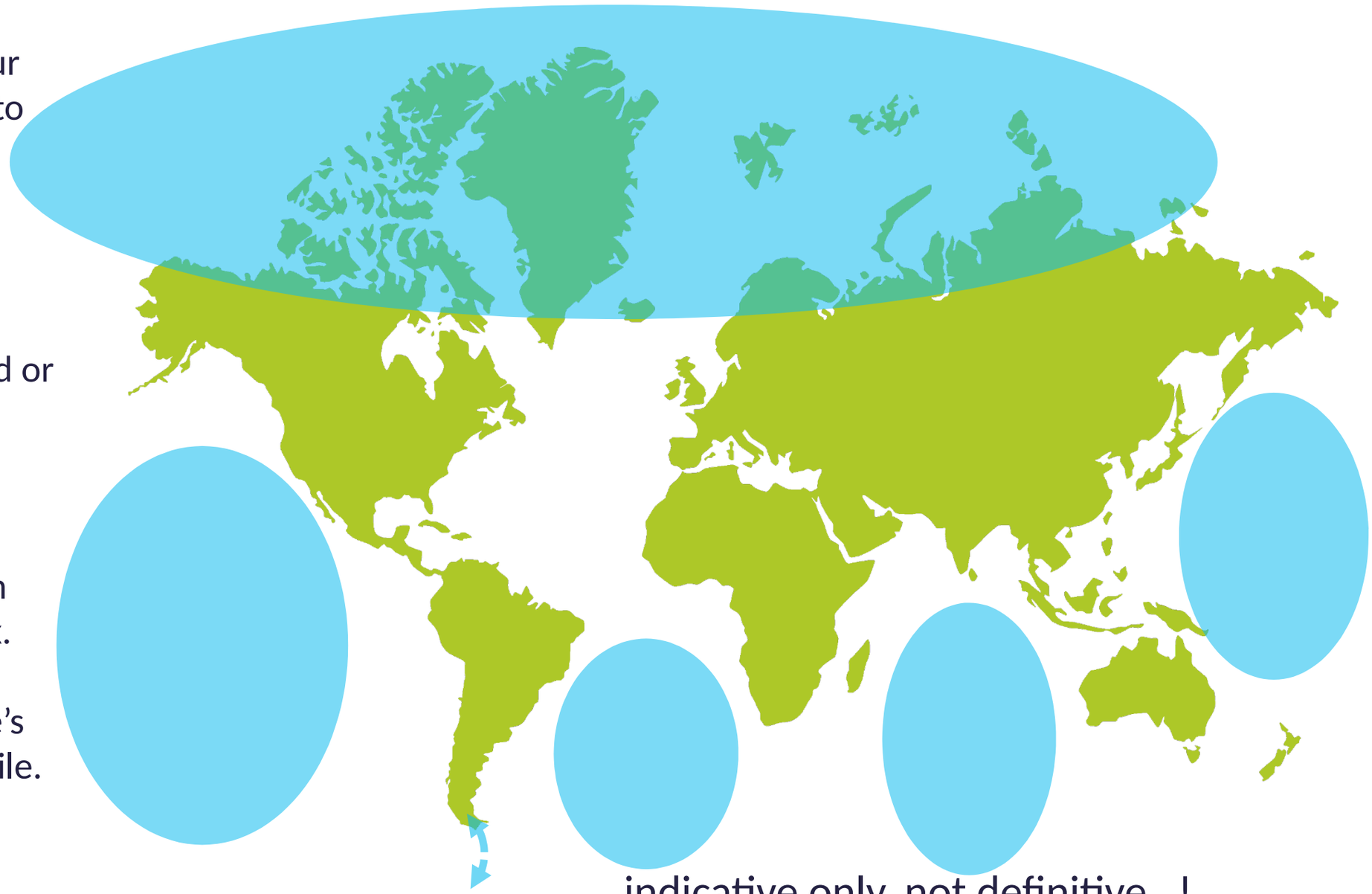
FAAM Atmospheric Research Aircraft Instrument Configuration

Cabin is fitted with rack-based instruments that are tailored to each specific scientific campaign.

FAAM Global Access – Limitations

- **Arctic**
- Availability of main/diversion airfields limits our operating areas to some extent
- **Oceanic**
- 500-600nm max range from island or coastal airfields
- **Antarctica**
- Closest approach would be approx. 00 miles away, route over Drake's Passage from Chile.

Areas shaded blue signify geographical limitations of varying degrees



…indicative only, not definitive…!

1500+ Flights, 2 Million Miles To Date

Icelandic volcano

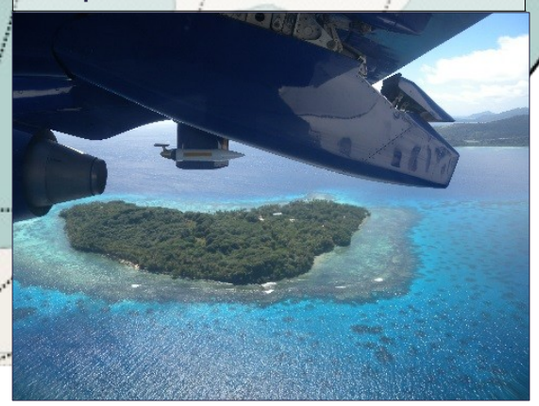
Arctic methane emission

Biomass burning in Brazil

Clouds and Climate over the Pacific

Monsoon Processes In India

Chemical Transport and Convection Processes in the Tropics



Example: FENNEC 2011-12 Deployment and Science Aims

Period of Operations:
April 2011, June 2011, June 2012

Total Sorties:
38 Science flights across 3 operational periods

Total Flight Time:
c. 130 Hours

Fennec -The Saharan Climate System was a NERC consortium project 2010-2012 lead by the University of Oxford and involving the Universities of Leeds, Reading, Sussex and the Met Office.

The aim of Fennec was to quantify and model boundary layer and aerosol processes over the Saharan 'heat low' region, the greatest dust region during summer. This is the most ambitious project ever to observe the Saharan climate system and the role of dust aerosols, involving a unique surface and aircraft field campaign with the FAAM BAe-146.

https://www.atmos-chem-phys.net/15/8479/2015/

FAAM: Fennec Programme in the Central Sahara - YouTube
https://www.youtube.com/watch?v=r0nre1Zs-R4

11 Feb 2013 - Uploaded by National Centre for Atmospheric Science
Fennec is a large-scale, international, multi-institutional, multi-platform, ... It is an ambitious atmospheric ...

Example: ICE-D 2015
Deployment and Science Aims

Period of Operations:
August 4th -27th 2015

Total Sorties:
15 Science flights in 24 operational days

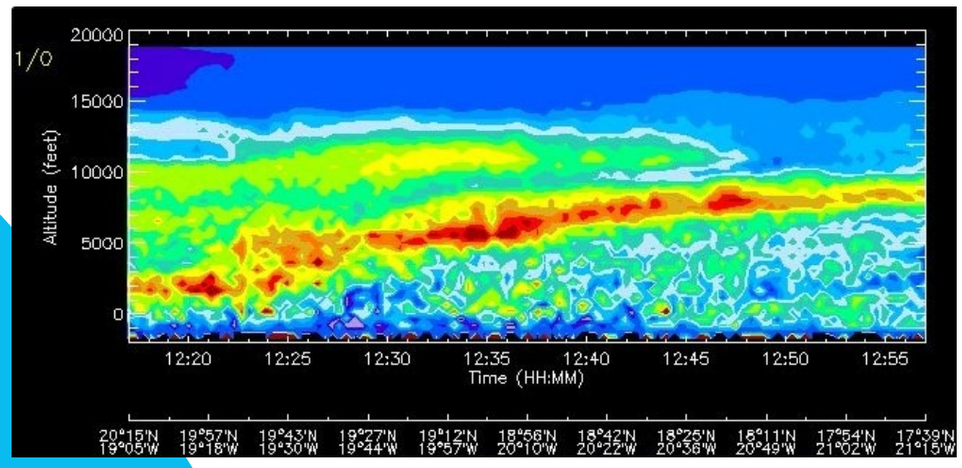
Total Flight Time:
84 hours and 25 minutes. (Incl. Transit)

25 dropsondes

Studied influence of Saharan desert dust on clouds in combination with ground team and deployment of NCAS X-band radar. Dust important in the formation of clouds, and its presence can modify how a cloud behaves. Dust acts as an ice nuclei as well as cloud condensation nuclei.

In-situ measurements of the dust aerosol and cloud properties. Extensive aerosol measurements were made on the ground by the University of Manchester laboratory. The NCAS X-band radar identified cloud regions for the aircraft to sample, observing their evolution and the development of precipitation with varying concentrations of Saharan dust.

https://www.atmos-chem-phys.net/18/3817/2018/



Example: CLARIFY-2017 Ascension Island Deployment & Science Aims

Period of Operations:
August 16th 2017 –
September 7th 2017

Total Sorties:
28 Science flights in 23 operational days

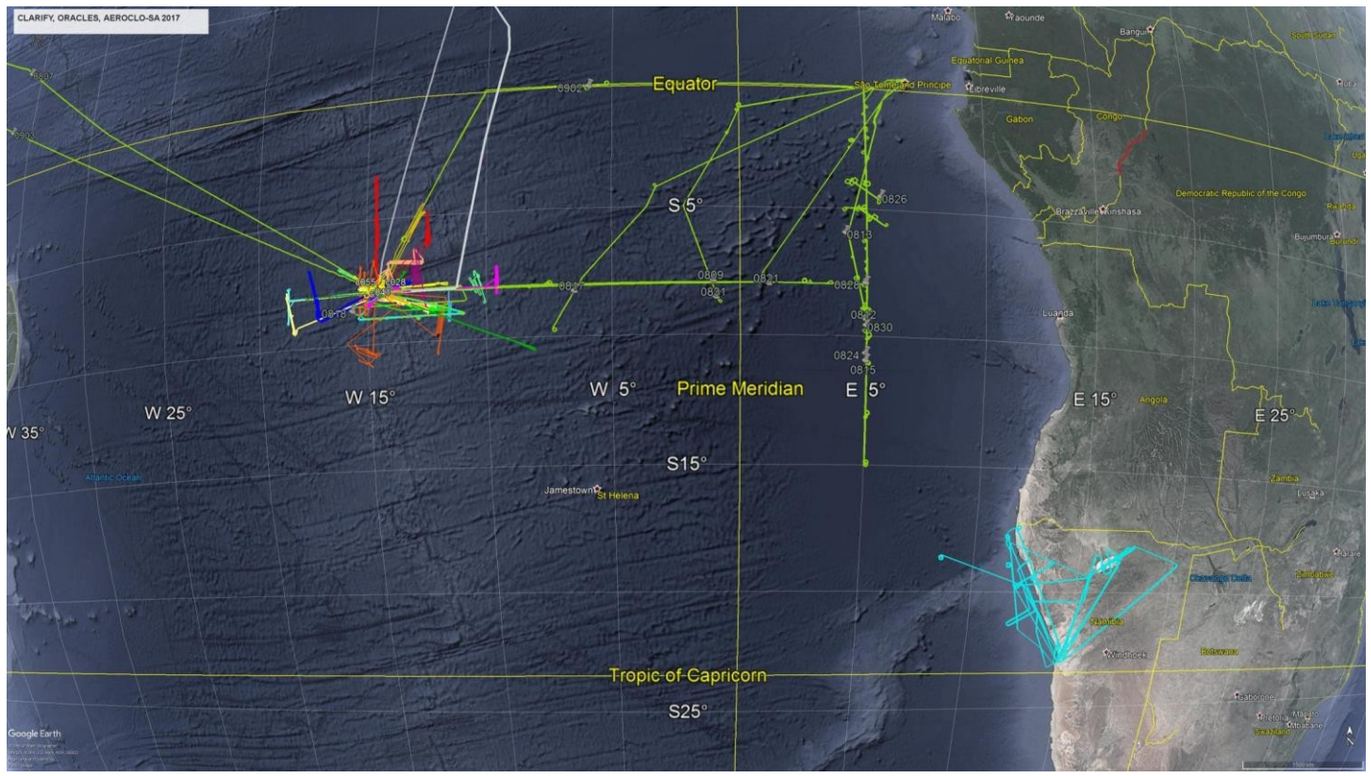
Total Flight Time:
98 hours and 43 minutes.

45 dropsondes

1. Measure and understand the physical, chemical and optical properties of biomass burning aerosol over the SE Atlantic

2. Measure and understand the physical properties of boundary layer clouds and their environment. Improve the representation of these clouds in a range of models

3. Evaluate and improve the representation of aerosol interactions with cloud and radiative effects over the SE Atlantic at a range of model scales and resolutions

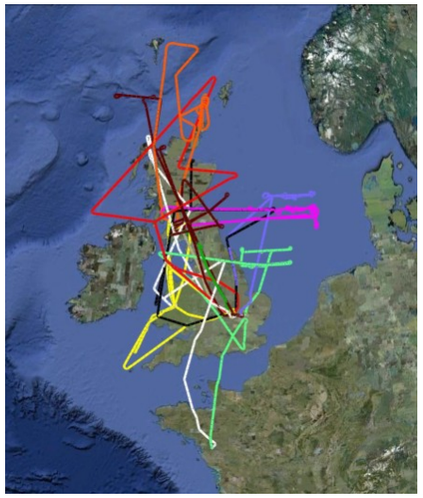


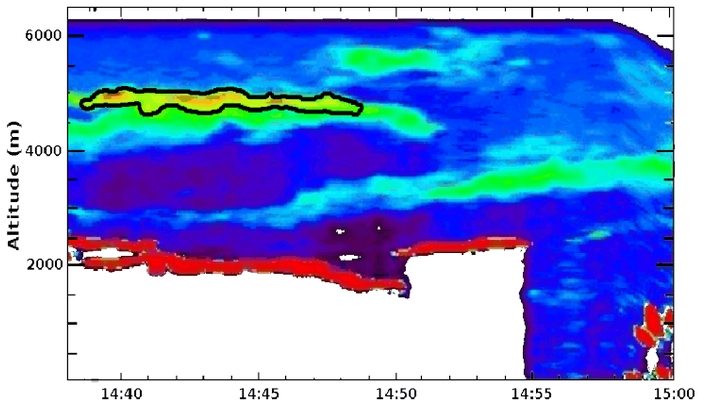
Example: Eyjafjallajökull Deployment & Science Aims

Period of Operations:
April-May 2010

Total Sorties:
12 Science flights

Total Flight Time:
c. 60 Hours





12 flights targeting volcanic ash clouds around the UK. Observed ash layers between altitudes of 2–8 km with peak mass concentrations typically between 200–2000µg/m3, as estimated from a Cloud and Aerosol Spectrometer (CAS). A peak value of 2000–5000 µg/m3 was observed over Scotland on 14 May 2010, although with considerable uncertainty due to the possible contamination by ice.

Aerosol size distributions within ash clouds showed a fine mode (0.1–0.6 µm) associated with sulphuric acid and/or sulphate, and a coarse mode (0.6–35 µm) associated with ash. The ash mass was dominated by particles in the size range 1–10 µm (volume-equivalent diameter), with a peak typically around 3–5µm. Electron-microscope images and scattering patterns from the SID-2H (Small Ice Detector) probe showed the highly irregular shape of the ash particles.

https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2011JD016760

Volcanic Ash Plume Sensing, US 9,079,670 B2, July 2015

FAAM User Guide / Contacts

User Application Procedures:
https://old.faam.ac.uk/index.php/faam-documents/faam-handbook/3051-faam-access-procs-new-v0-2

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