The Airborne Research & Survey Facility (ARSF) provides:

- High-quality cost-effective remotely-sensed and in-situ data
- Multidisciplinary capability
- Core optical and digital sensor suite and atmospheric capability
- Dedicated data post-processing facility
- International capability and operational flexibility

Serving UK environmental science
A tool for developing and validating Earth system models
http://arsf.nerc.ac.uk/
Rapid economic and population growth are putting increasing pressure on natural resources, and human activities are causing unprecedented environmental changes and contributing to climate change.

The planet is made up of many components, the interactions of which create and maintain the conditions which support life. We need knowledge of how these components interact to measure, predict and manage the effects on our environment. Airborne remote-sensing techniques are key components in developing and validating Earth system models and satellite data.

The ARSF provides a high-quality and cost-effective way of sustained observation of terrestrial, freshwater, marine, cryospheric and atmospheric environments.

It does this using a research aircraft equipped with a suite of state-of-the-art digital and analogue remote-sensing systems. These can be supplemented with user-supplied instruments.

The facility is underpinned by a ground-based data-processing system. This provides users with a variety of products ranging from radiometrically-calibrated data to fully geometrically-rectified images which allow direct comparison of multi-temporal surveys.

International operations
The facility has supported atmospheric campaigns as far afield as northern Australia and Chile, Earth science in Ethiopia, and glaciology in Greenland.

Next Generation Science for Planet Earth

The ARSF and the NERC science strategy
The ARSF contributes to the seven science themes identified in the NERC Science Strategy 2007-2012

- Climate system
- Biodiversity
- Sustainable use of natural resources
- Earth system science
- Natural hazards
- Environment, pollution and human health
- Technologies
What can the ARSF offer you?

**SATELLITE VALIDATION**

*Network for Calibration and Validation of Earth Observation Data*

This NERC-baseline-funded project drew together a network of scientists, engineers and applications specialists to investigate the calibration and validation of remotely sensed satellite datasets. The ARSF aircraft operated in parallel with the Environment Agency’s aircraft, the CHRIS/PROBA satellite overpasses and field measurements to provide a coordinated resource to establish benchmark methods and algorithms, facilitating access for the remote-sensing community.

**Operational flexibility**

Rapid operational deployment and self-sufficient campaigns.

**Repeatability**

Observations can be made at user-specified spatial, temporal and spectral resolutions.

**Dedicated processing system**

The ARSF Data Processing Node (ARSF-DAN) delivers post-processed data (radiometrically-calibrated and georectified) within three to four weeks of receipt of the raw data (and within days for special requirements). A team of experts provides user support via the web and a helpdesk.

**Synergy with other facilities**

The ARSF has flown in concert with other research facilities such as the UK’s Facility for Airborne Atmospheric Measurements (FAAM), SAFIRE (France), NLR (Netherlands), DLR (Germany) and is a founding member of the European Fleet for Airborne Research (EUFAR).

**Instrumentation**

The facility is equipped with a range of hyperspectral sensors, a scanning Lidar system and digital and analogue cameras coupled to a GPS-based navigation system. In addition, meteorological instruments can be accommodated internally and externally.

**New instruments**

Novel instruments can easily be accommodated for testing or developing.
Investigation of contemporary rates and cause of volume loss from glaciers in south-east Greenland

As part of International Polar Year, ARSF collected airborne LiDAR and aerial photography over the Helheim and Kangerlussuaq Glaciers in east Greenland. In recent years these glaciers have been thinning at rates of over ten metres a year, and accelerate and decelerate dramatically.

Quantitative assessment of optically-derived properties from CASI and ATM for optical modelling in the Venice Lagoon

Researchers used hyperspectral CASI2 and multispectral ATM data to measure colour-dissolved organic matter, chlorophyll and suspended particulate matter in complex optical Case 2 waters of the Venice Lagoon (below).

The Afar region in northern Ethiopia sits on a tectonic triple junction between the Arabian, Nubian (African) and Somalian plates. Research was supported by the ARSF in 2008 and 2009.

Hedgerows and woodland in Buckingham derived from an orthorectified photograph and processed Lidar returns of the same area.

Cyanobacteria concentrations in Esthwaite Water derived from multispectral data.

Map of the intertidal distribution of radionuclide concentrations in the Ribble Estuary using multispectral data.
Technical information

Aircraft
Dornier 228-101, unpressurised twin-turboprop; cabin volume 14 cubic metres; crew two pilots and accommodation up to four operator/observers; up to six hours endurance at a science altitude of 20,000 feet.

Airframe modifications
Experimental power DC 28V/225A and AC via inverter 220V/50Hzx9200VA, one cabin floor opening 2060mm x 515mm and one circular opening 425mm diameter; one cabin roof opening 400mm diameter and two 150mm diameter; external hardpoints on fuselage sides and bottom; underwing pylons/PMS pods; internal 19" racking.

Atmospheric equipment
Aventech AIMMS-20: 3D winds, turbulence, barometric pressure, temperature and humidity.

Isokinetic air intake: fully characterised; mounted above cockpit; associated internal piping.

Underwing pylons/PMS pods: one pylon under each wing with two PMS pods on each; associated power/data cabling; PMS canisters user-provided or on loan from FAAM.

Specim hyperspectral imaging system
**Eagle VNIR**: spectral range 400-970nm, resolution 2.6nm; 244 bands; 1024 pixels; image rate 50/sec @ 244 bands & 80/sec @ 60 bands; spatial resolution 0.7m @ 1000m; FoV 38 deg.

**Hawk SWIR**: spectral range 960-2450nm, resolution 6nm; 254 bands; 1024 pixels; image rate 50/sec @ 244 bands & 80/sec @ 60 bands; spatial resolution 0.7m @ 1000m; FoV 24 deg.

Leica Geosystems imaging system
**Leica ALS50-11 Lidar system**: (for 1000m flying height/140kt speed) 150kHz single and multiple pulse in air; max scan rate 90Hz; FoV 40-75deg; 1.8 points per sq metre; average point spacing at nadir 0.8m; XY accuracy 0.1m and Z accuracy 0.08m; swath width 728m.

**Leica RCD105 Digital Camera**: 39Mp, FoV 40 deg; mid-frame georeferencing via Applanix navigation system.

**WILD RC-10 Metric Survey Camera**: available on request; FoV 74 deg; georeferenced via mid-frame navigation input; images scanned @ 1200 dots/inch with embedded tag data.
NERC Swindon Office
Peter Purcell
Head of Airborne Research Facilities
Polaris House, North Star Avenue,
Swindon, Wilts SN2 1EU, UK
Tel: +44 (0)1793 411649
Fax: +44 (0)1793 411610
Email: pp@nerc.ac.uk

ARSF operations office
Firfax Building, Meteor Business Park,
Cheltenham Rd East, Gloucester
GL2 9QL, UK
Tel: +44 (0)1452 859945
Fax: +44 (0)1452 713219
Mobile: +44 (0)7919 697851

Contacts

Carl Joseph
Chief pilot and operations manager
Email: cjos@nerc.ac.uk

Gary Llewellyn
Science/operations coordinator
Email: gaew@nerc.ac.uk

Phil Goy
Instrument specialist
Email: pagoy@nerc.ac.uk

David Davies
Co-pilot and electronics officer
Email: davd@nerc.ac.uk

James Johnson
Instrument operator/data coordinator
Email: jahn@nerc.ac.uk

ARSF Data Analysis Node (ARSF-DAN)
Plymouth Marine Laboratory
Prospect Place
The Hoe
Plymouth PL1 3DH
Tel: 01752 633432
Email: arsf-processing@pml.ac.uk