National Centre for Atmospheric Science

NATURAL ENVIRONMENT RESEARCH COUNCIL

Facility for Ground based Atmospheric Measurements

"Advancing our understanding of the atmosphere through observations"

Facility for Ground based Atmospheric Measurement

Welcome to the Facility for Ground based Atmospheric Measurements (FGAM)

Prof. Alan Blyth - Head of the Facility for Ground based Atmospheric Measurements

FGAM provides National Capability within the National Centre for Atmospheric Science (NCAS) for the study of atmospheric processes. It comprises four integrated sections whose common goal is to advance knowledge of atmospheric science through observations. These are:

- Field Measurements
- Airborne observations
- Long-term Observatories
- Laboratory studies

For more information about FGAM activities and research visit our website: www.ncas.ac.uk/fgam

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Observatories

FGAM has association with seven atmospheric observatories, each with the overarching goal of advancing the understanding of atmospheric processes. Each observatory provides insight into specific atmospheric phenomena, several making long-term measurements. The observatories are owned and often operated by other organisations and FGAM plays a variety of roles in their running.

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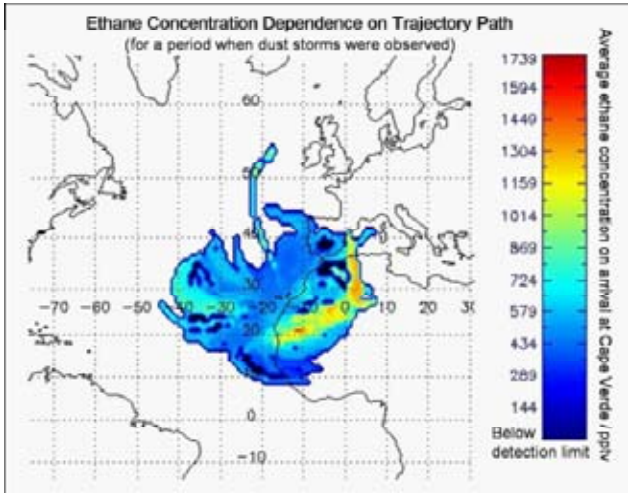
The Cape Verde Atmospheric Observatory

CVAO

Cape Verde goes Global! In 2009 the observatory achieved Global status within the World Meteorological Organisation – Global Atmospheric Watch (WMO-GAW) network, becoming one of only twenty six atmospheric observatories in this classification in the world. Data from the observatory is made available to the international community

The CVAO exists to advance understanding of climatically significant interactions between the atmosphere and ocean. It is one of only a handful of atmospheric observatories situated in the tropics, a region of key importance to atmospheric chemistry. It also provides a regional focal point and long-term data context for the many short-term field campaigns it has hosted

Measurements of a wide range of reactive gases (including O3, oxides of nitrogen, volatile organic compounds and halocarbons) commenced in October 2006 with further composition observations being later added by international partners.



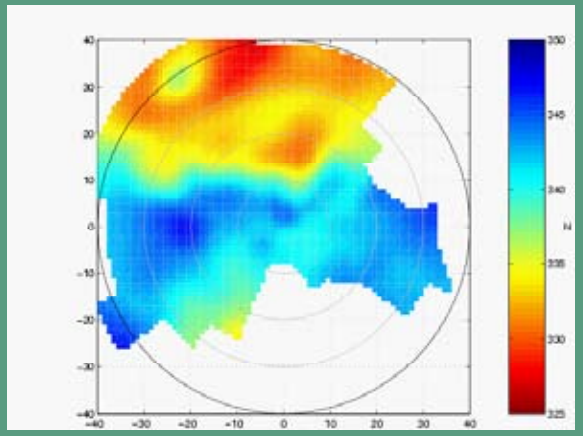
In-situ observations at the Cape Verde Atmospheric Observatory coupled with back trajectory analyses have been used to identify dominant source regions for each species

The Chilbolton Facility for Atmospheric and Radar Research

CFARR

NERC-CFARR hosts an extensive set of ground-based remote-sensing and in-situ instruments used for atmospheric science research. The most prominent feature of the site and the historical reason for its existence is the 3 GHz Chilbolton Advanced Meteorological Radar (CAMRa), the largest fully steerable meteorological radar in the world. The large antenna (25m diameter) gives it an extremely narrow beam of only 0.25 degrees. The 1275 MHz ACROBAT (Advanced Clear-air Radar for Observing the Boundary layer And Troposphere) radar is also on the dish.

A variety of other radars, lidars, balloons and meteorological instruments operate at the site. Measurements of aerosol optical depth are supplied to NASA-AERONET. In addition to the ongoing long-term research activities CFARR frequently hosts national and international field campaigns. The Met Office have recently installed a wind profiling radar at the facility.



The FGAM radar (ACROBAT) has been used to derive fields of refractivity using the phase of ground returns. A change of 1 refractivity unit (N) roughly corresponds to a 1% change in relative humidity. The example shows a snapshot of the passage of a cool, moist sea-breeze front from the south within 40km of the radar. High refractivity values correspond to cool, moist air while low values indicate warm, dry air. This technique has also been developed for use on the operational Met Office weather radar network with the goal of improving the weather forecasts of convective storms.

The Salford Urban Built Environmental Research Base

SUBERB

SUBERB is a meteorological research station based at Basell Polyolefins UK Ltd, Urmston, Manchester. The field site was set up in 2006 to make long-term meteorological measurements of temperature, moisture and the turbulent structure of the urban atmospheric boundary layer. The site is also regularly used for short timescale studies including testing of new instrumentation.

The Cardington field site

The boundary-layer observation facility at Cardington, Bedfordshire is a Met Office owned and run site involved in research aimed at improving numerical weather prediction models. The facility collaborates with FGAM on a range of atmospheric research topics, and currently hosts the FGAM UHF wind profiler

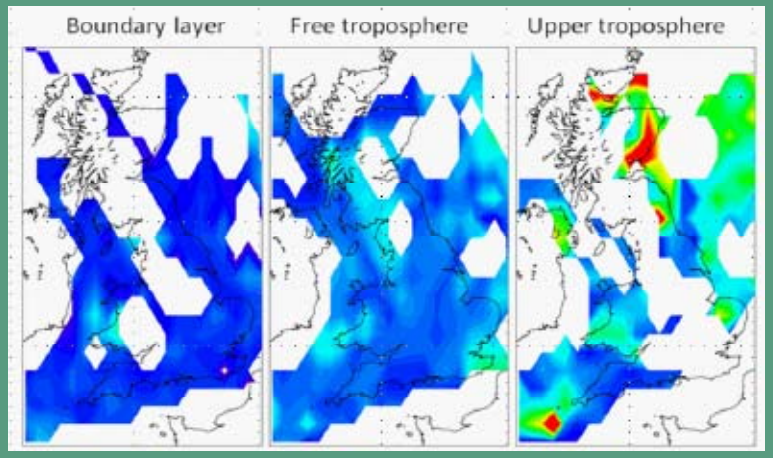
The NERC MST radar facility

The NERC MST radar facility is located at Capel Dewi 6 km east of Aberystwyth in west Wales and is operated by the Rutherford Appleton Laboratory. As well as the MST radar, the Facility runs a surface meteorological station and lidar ceilometer. The FGAM-Elight mobile boundary layer ozone/aerosol profiler and fixed lidars also operate there. The site is secure and has ample space and power for visiting instruments. It is therefore well suited for field campaigns

The FAAM aircraft as a long-term observatory

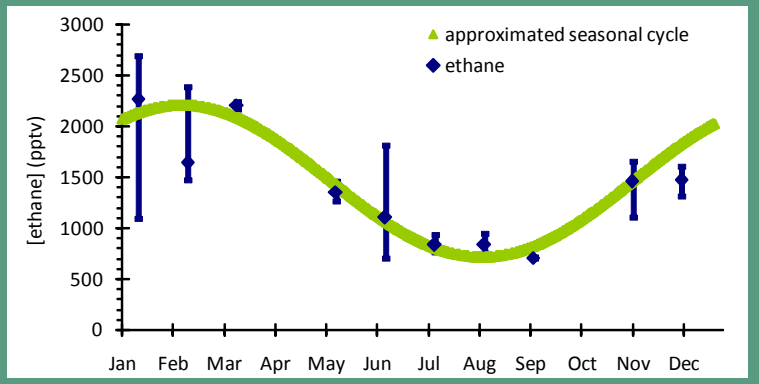
The region of the atmosphere from the surface through to the lower stratosphere is currently difficult to probe from space. Although satellites give good global coverage they are less quantitative than in-situ measurements and there can be problems with cloud coverage and the effect of aerosols. The availability of high quality and high resolution aircraft observations are of great value to improve our knowledge of atmospheric dynamics and composition, for validation of satellite measurements and to provide the necessary data for transport models which are not available from satellites.

The FAAM BAe-146 Atmospheric Research Aircraft has been operating for over 5 years and has built up a database of over 500 flights from case study research with individual flights being specific to funded experiments. Data have been compiled from ALL UK flights to produce long-term datasets.



FAAM ozone data have been averaged into 0.5 ° resolution sectors and divided into three vertical regions of the atmosphere to evaluate differences in composition in both vertical and horizontal dimensions.

Observations of ethane mixing ratios from the free troposphere during UK flights between May 2005 – March 2010 have revealed a well-defined seasonal cycle

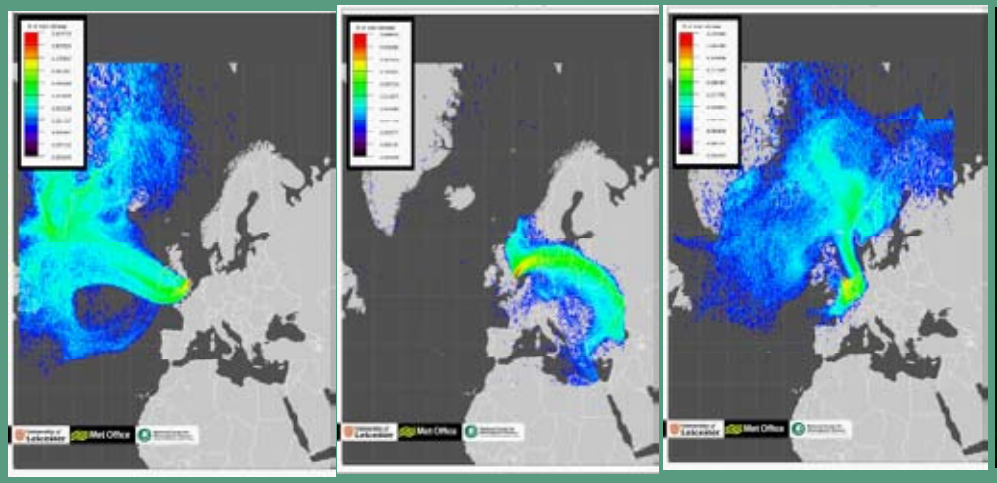


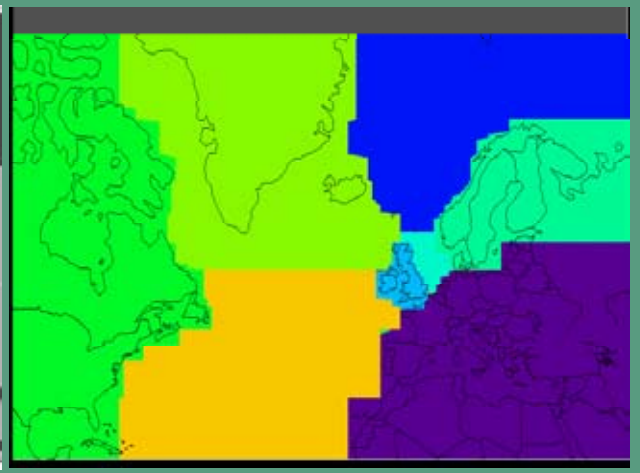
The Weybourne Atmospheric Observatory

WAO

Situated on the North Norfolk coastline, WAO has been in operation since 1993. It is ideally positioned to make long-term measurements of a wide range of atmospheric phenomena including; ocean-atmosphere exchange; UK and European air quality; long-range transport and transformation of pollutants; shipping emissions; and the chemical drivers of global climate change. It has also hosted many short-term field campaigns with UK and international collaborators.

A wide range of composition and meteorological observations are made at the observatory which has a dedicated website http://weybourne.uea.ac.uk/ providing near real-time information about the state of the atmosphere and a web cam gives visual information about current weather conditions.





Back trajectory analyses of the air arriving at the Weybourne Atmospheric observatory allows the observations to be filtered according source origin.

Field measurements

FGAM operate a suite of atmospheric monitoring instrumentation that provide a wide range of meteorology, dynamics, aerosol and gas-phase measurements. The instruments are readily deployable, enabling observations around the globe often in taxing and difficult environments. They are generally operated during intensive field campaigns which aim to address a set of questions about specific atmospheric processes. Several instruments require minimal user intervention and have run for longer periods at atmospheric observatories to provide additional measurements.

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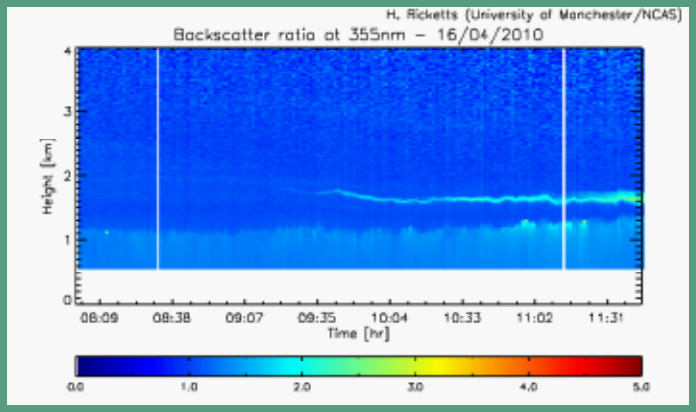
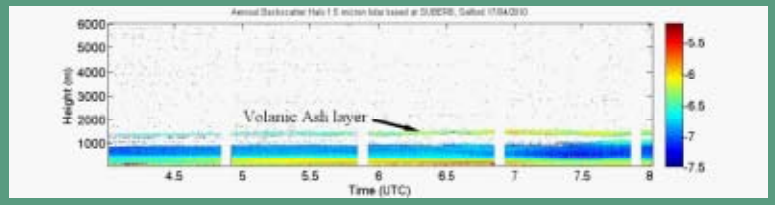


Eruptions at Eyjafjallajökull in Iceland pumped volcanic ash into the atmosphere which was transported toward the UK. FGAM instrument scientists were able to rapidly respond and make observations, mainly using lidars, of volcanic ash in the atmosphere above the UK.



The FGAM FAGE instruments which measure OH and HO2 have been developed to allow detection of iodine monoxide (IO) which can play an important role in the chemistry of marine air. The ground-based instrument made the first ever measurements of IO in Roscoff in 2006 as part of the RHaMBLe project, whilst the aircraft instrument made the first ever ship-borne measurements of IO in 2007.

Airborne Observations

Many of the FGAM instruments are operated aboard the FAAM 146 aircraft alongside those operated by the Met Office, Individual University groups and FAAM "core" instruments. The aircraft instrumentation can measure aerosol size and composition, cloud and ice microphysics and a range of trace gases and free radicals. Our close working links with the Met Office, FAAM, ARSF and international scientific aircraft operators (established during collaborative projects) makes FGAM ideally placed to coordinate a wide range of activities in the field of airborne observations from project design and data interpretation to instrument development.

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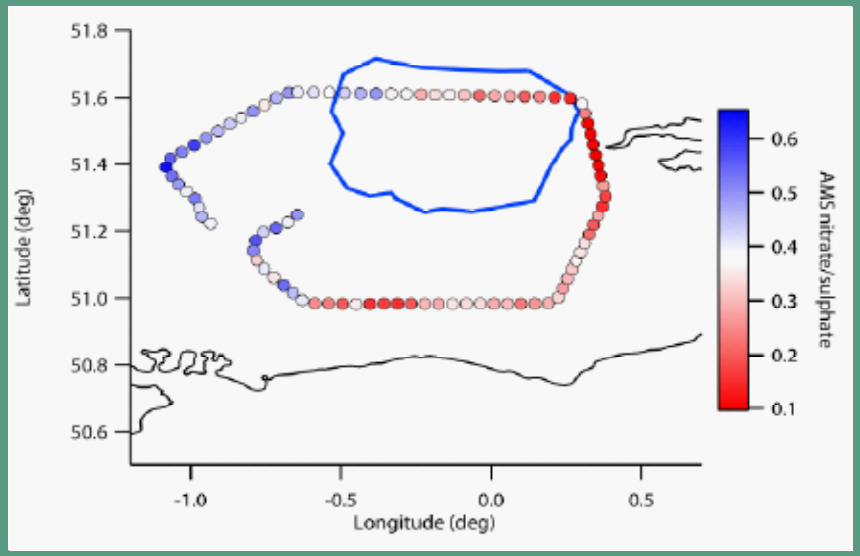
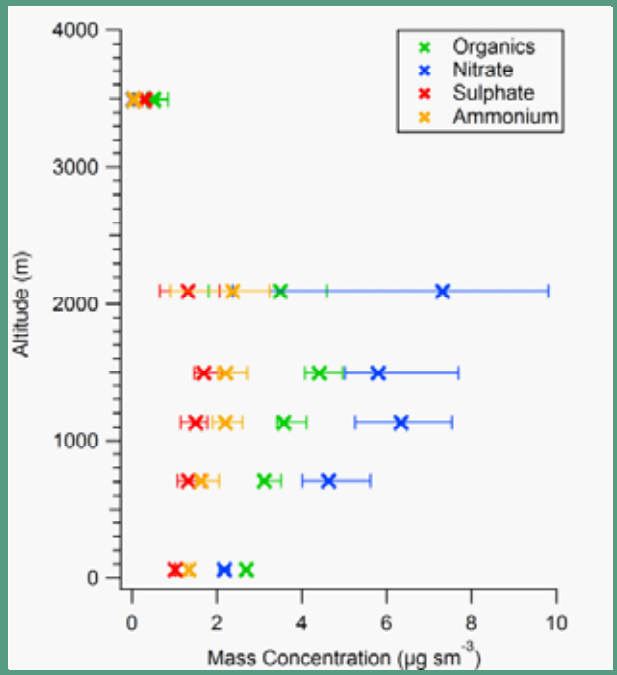


Observations made by the FGAM Aerosol Time-of Flight Mass Spectrometer (ATOFMS) during flight B40 around London reveal significant perturbations to the Nitrate/sulphate ratio caused by the city.

The FGAM Aerosol Mass spectrometer observations made aboard the FAAM 146 aircraft have been collated from numerous flights to reveal their vertical distribution throughout the atmosphere above the UK. The large-scale variations with altitude highlight the importance of high resolution composition observations from aircraft.



Laboratory studies

Laboratory studies of physical and chemical atmospheric processes are important to further our understanding of the atmosphere and the behaviour of pollutants therein. The chamber facilities within FGAM enable the study of dynamical and chemical processes as well as cloud-aerosol interactions. The continuity of staff within the facility means we are ideally placed to perform calibration exercises and ensure accuracy and comparability of measurements is maintained

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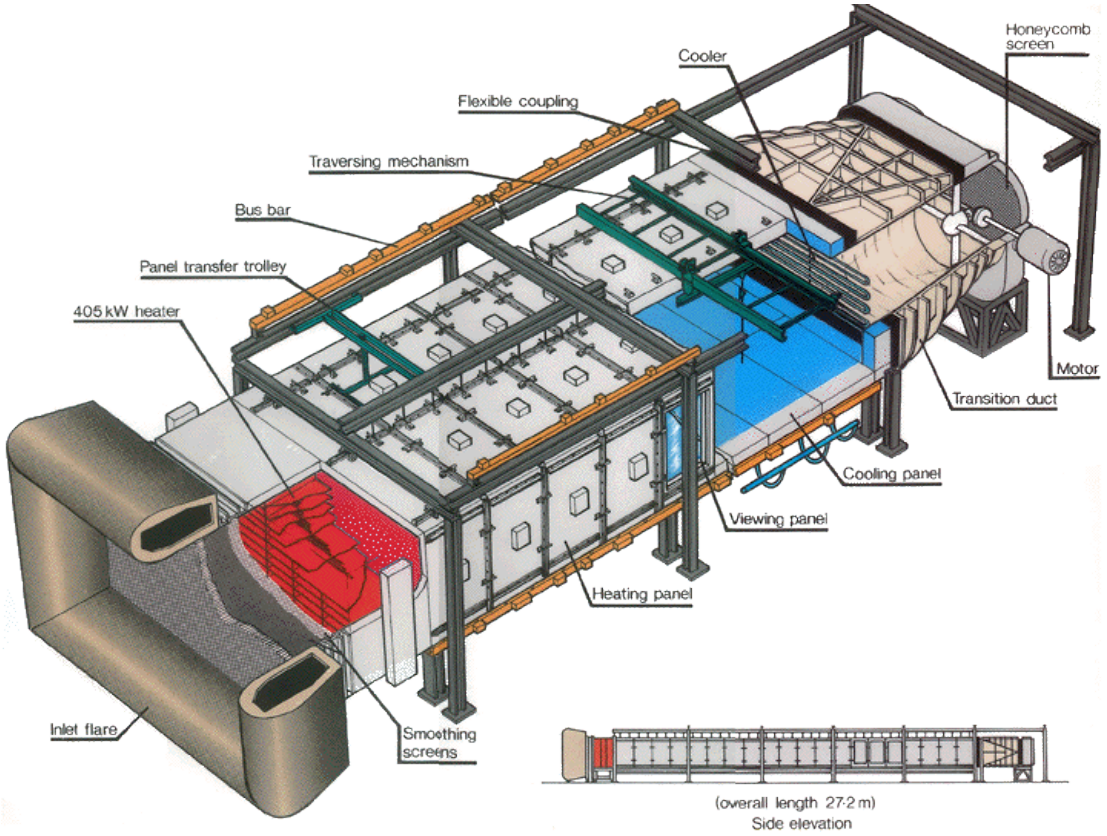
EnFlo meteorological wind tunnel

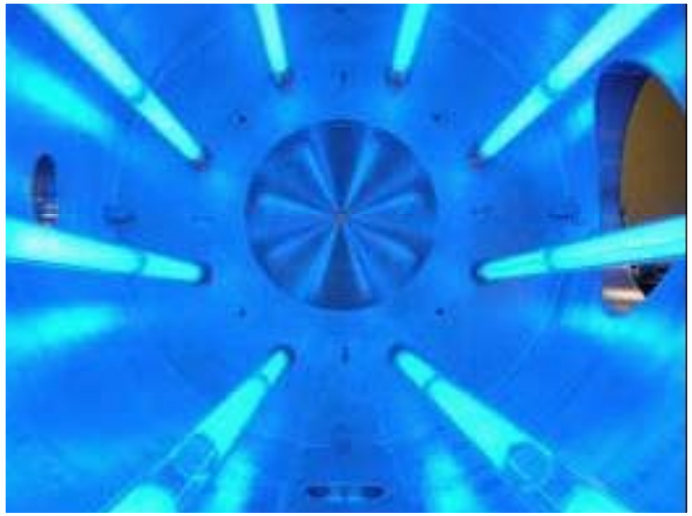
The EnFlo wind tunnel, based at Surrey University, has the capability of setting a vertical temperature profile at the inlet to the working section, and heat or cool the tunnel floor panels so it can be used to simulate the atmospheric boundary layer in neutral, stable and unstable conditions.



Tracer compounds can be released and simultaneously measured at four separate locations along with velocity. A three-dimensional, computer controlled, traversing gear enables unmanned running of the tunnel.

Highly Instrumented Reactor for Atmospheric Chemistry chamber

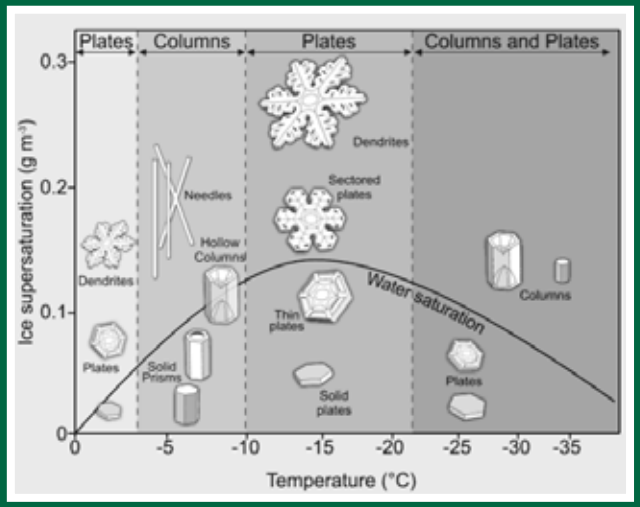
HIRAC



HIRAC is a NERC-funded atmospheric simulation chamber developed with the ability to control temperature, pressure and photolysis rates during experiments. It may be used to test instruments under a range of atmospherically relevant conditions, providing, for example, a calibration facility for FGAM airborne instrumentation at a range of temperatures and pressures consistent with conditions experienced during airborne measurements.

Manchester Ice Cloud chamber

At 10 m tall and spanning three floors, the Manchester Ice Cloud Chamber (MICC) is one of Europe's tallest cloud chambers. It is capable of reaching temperatures as low as -55 °C and is pressure controlled. It is thus able to simulate upper tropospheric conditions. Liquid water, mixed phase, or entirely glaciated clouds can be generated and its large height provides long crystal fall and growth times, and a new opportunity to grow particularly large, mm-sized, ice crystals. Research in the chamber has thus far covered a variety of scientific topics including aggregation, ice crystal light scattering, nucleation of ice particles and thunderstorm electrification.



Ice crystal morphology diagram illustrating the shapes (habit) of ice crystals as a function of both ambient temperature and ice supersaturation."

FGAM scientists (from left to right): John Nicol, Hugo Ricketts, Lisa Whalley, Emily Norton, Barbara Brooks, Jim Hopkins, Fay Davies, Paul Williams, Ruth Purvis, James Dorsey, Sarah Moller, Matt Hobby and Alan Blyth (Other FGAM scientists, not pictured: Brian Bandy, Paul Hayden, Trevor Ingham and Katie Read)

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