This presentation covers the following areas

- OBR – facilities and staff
- OBR Impact
  - NWP
  - Defence
  - Customers - CAA
- Future science strategy
- The future provision of airborne atmospheric research capability
The OBR Facilities
Plus 48 staff at 3 locations
Impact on NWP
The Satellite Remote Sensing Challenge...

- IASI Sounder on Metop has 8461 spectral channels
- IASI – NG on post EPS will have ~16000 channels
- MTG-IRS will have ~4000 channels
- Clouds and surfaces have spectrally variant properties
- Computing these complex radiances was slow
- Current data assimilation techniques are not fast enough to deal with these complexities, so we assimilate a sub-set of the radiances (through scene selection and channel selection)
PCs allow you to represent full spectral information in a compact manner.

Original Spectrum

Reconstructed Spectrum using 9 PCs

Radiance residual

700 cm\(^{-1}\) 1300 cm\(^{-1}\)
Havemann-Taylor Fast Radiative Transfer Code

- Predicts principal components from the atmospheric profile and full spectral emissivity of the surface
- Has exact treatment of scattering by clouds and aerosols
- Works from visible through to far infrared (simultaneously with no spectral gaps)
- Is extremely fast
- Potentially allows assimilation of all sounder data in presence of clouds and over any surface
IASI 1d-Var clear-sky RH retrievals
Case Study ONE (2\textsuperscript{nd} March 2010)
HT-FRTC – next steps

- Plan to implement a version of HT-FRTC in to the RTTOV operational RT code during next year
- This will allow initial trials of using PC radiative transfer in the assimilation of hyperspectral sounder data.
- Collaborating with Univ of Manchester in retrieval of trace species using HT-FRTC
- Implementing a version of HT-FRTC in the UM satellite simulator (COSP) which will allow simulation of full IASI spectra from UM model fields.
• Improve forecast of Sc: in particular its break-up (or not) over land as the BL warms

• Experiments attempted to examine pseudo-Lagrangian evolution of Stratocumulus clouds as they advected over East Anglia

• Continuous measurement sites at Weybourne, Denver Sluice, Cardington (lidar, microwave, CBR)

• IOP-based: radiosondes, Cardington TB and FAAM BAe-146
Tethered balloon system

Met Office

1800Cuft, ≈ 6000ft ceiling

Fit during COALESC:

• Turbulence probe

• DMT cloud droplet probe
Flight B858, 16th March 2011
Cloud thickness with time (from sondes and TB)

2nd March 2011

Thinning cloud layer (break-up at Denver and Cardington)

16th March 2011

Steady cloud layer (no break-up)
Mean LWC profiles (above CBR cloud base)
Supporting the Defence Customer
Validating the performance of the dust model in the Middle East
Fast Hyper-spectral Scene Identification – using HT-FRTC
Studies of the eruption of Eyjafjallajökull in 2010
FAAM LIDAR from 6 flights (4\textsuperscript{th}-18\textsuperscript{th} May)

LIDAR column load, overlaid on dust RGB images derived from SEVIRI

Thanks to Kate Turnbull & Franco Marenco

LIDAR retrieved mass concentration
Variability of FAAM size distributions

- B526: 4\textsuperscript{th} May (Irish sea)
- B527: 5\textsuperscript{th} May (Irish sea)
- B528: 14\textsuperscript{th} May (59N, 6W)
- B530: 17\textsuperscript{th} May (N.Sea ~ 54N, 2E)
NAME vs satellite and CAS for 14th May at 12:00

Possible overestimation due to ice!
NAME vertical profiles at 12:00 on 14th May

Latitudes: 59.58°N  59.81°N  60.05°N

FAAM CAS profile at 12:40 @ ~ 60N, 7W

Thanks to Ben Devenish
Case study
17 May 2010

FAAM aircraft track and ash mass concentration

Satellite spectral Infra-red ash diagnostic

NAME Ash forecast 1200UTC

Thanks to Stuart Newman
Raw LIDAR data from flight B530

Symmetry due to aircraft turn

Thanks to Franco Marenco
B530 – profile 1 (~14:45)
54.0°N 001.6°E

AEROSOL MASS > 500 μg m⁻³ between 3.5-6.5 km

Thanks to Kate Turnbull
IR spectra from ARIES (Airborne Infra-red Interferometer Evaluation System) and forward radiative transfer modelling

ARIES measurements

HTFRTC forward simulations (lidar extinction)

Irish sea, lidar O.D. = 0.06
North sea, lidar O.D. = 0.28
North sea, lidar O.D. = 0.61

Clear sky simulation
Irish sea, lidar O.D. = 0.06
North sea, lidar O.D. = 0.28
North sea, lidar O.D. = 0.61

ARIES used to detect ash and constrain particle physical / optical properties

Thanks to Stuart Newman & Stephan Haveman
17 May

SEVIRI multichannel imager on board the METEOSAT satellite
Cabin installation
Future Science Strategy
Future Science Strategy

- Enhancing the benefit from future satellite systems:
  - Use of more IR sounder data – over land, in presence of clouds
  - Use of microwave sounder data over sea ice/snow
  - Sub-mm microwave radiometry (see later slide)

- Aerosols
  - Representation of biomass burning in the UM and validation of source strengths
  - Development of UKCA aerosol model
  - Indirect effects of aerosols on clouds
Future Science Strategy

• Cloud microphysical processes:
  • Prediction and radiative properties of contrails
  • Constraining the uncertainty in cloud microphysical processes
  • Stratocumulus and shallow convection around the UK

• Radiative transfer and Defence:
  • Enhancements to TDAs – cold climates, target detection, land target modelling, 3d-radiative transfer for crew training/mission planning
  • Improvements in water vapour continuum and new fast radiative transfer techniques
# International Sub-mm Airborne Radiometer - Channels

**ESA funded**

**Met Office funded**

**EUFAR funded**

Existing capability MARSS and Deimos instruments give:

- 24, 50, 89, 157
- and 183GHz

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<th>Channels (GHz)</th>
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<th>Feature</th>
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Future Provision of Airborne Atmospheric Research Capability
• FAAM review clearly indicated the scientific requirement for a large research aircraft

• Met Office are supportive of future provision of the FAAM BAe146 beyond Jan 2015
  • It remains a high priority activity for the Met Office
  • Need to manage costs through partnership with NERC and ensure best value for money

• See the Joint Weather Climate Research Programme – Joint Facilities Group as the prime mechanism for delivering the business case options for future provision of the BAe146
Summary

- Preparing for future satellite instruments
- Studying Stratocumulus break-up around the UK
- Developing products for the Defence Customer
Summary

• Key observations of volcano in 2010

• Delivering the Met Office Civil Contingency Aircraft

• Developing innovative new instrumentation - ISMAR
Summary

- The NERC/NCAS partnership is critical to the success of FAAM
- There is a vast amount of good science to be done!
- The Met Office is keen to find a solution for the future of FAAM beyond 2015
Questions and answers
BAe146 Impact and Scientific Reputation

- Peer reviewed publications
  - 2006 – 2010 (5yrs) = 122 publications with FAAM data
  - H-index = 22 (i.e. 22 papers with 22 or more citations)
  - Total no. of citations = 1776
  - Compare with Met Office C130 H-index = 42 (253 papers)
  - Met Office C130 was the world leader in publications and citations measured against all research aircraft (including USA).