

In May 2013 an international research campaign will take place based in the south-western United States. The goal is to test the performance of EUMETSAT's MetOp-B satellite, in particular the second IASI hyperspectral sounder. Two research aircraft will fly coordinated sorties in conjunction with satellite overpasses to gather information about the state of the atmosphere and validate the performance of IASI. The campaign will also target cross-calibrations of MetOp instruments with those on Suomi NPP. At NWP centres IASI observations have been used successfully to improve forecast skill, and the campaign dataset will be analysed to develop algorithms for the use of hyperspectral data in the future.

## International measurement campaign



Above: NASA's ER-2 high-altitude aircraft in flight. Credit: NASA photo EC99-45225-2 by Jim Ross, October 1999.

The Semi-Arid Land Surface Temperature and IASI Calibration Experiment (SALSTICE) will take place in the south-western USA in May 2013. The campaign will bring together the UK's FAAM BAe 146-301 aircraft, capable of flying between 15 m over ocean up to 10.5 km altitude, and NASA's ER-2 high-altitude aircraft flying at approximately 20 km. Combined, the aircraft are equipped with state-of-the-art instruments for measuring:

- Infrared radiances using interferometers of a similar specification to IASI
- Temperature, humidity and trace gases at different altitudes
- Cloud and aerosol particles (size and concentration)
- Lidar backscatter returns for cloud and aerosol remote sensing

Every joint flight of the two aircraft will be carefully planned to coincide with satellite overpasses, so that the aircraft and satellite measurements are spatially and temporally co-located. Flights will be conducted in variety of conditions: clear sky over ocean and land, in the presence of cloud and aerosol, and at night as well as during daytime.



Above: The Facility for Airborne Atmospheric Measurements (FAAM) BAe 146-301 research aircraft. FAAM is a collaboration between the Met Office and the Natural Environment Research Council (NERC).

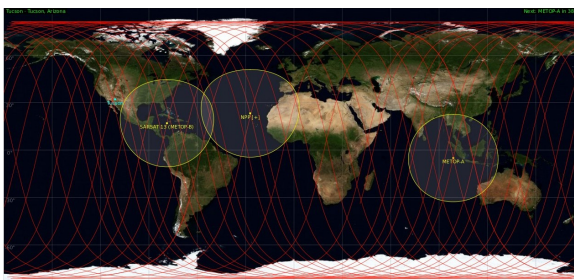
Right: Vaisala RD94 dropsonde, measuring atmospheric profiles of pressure, temperature, relative humidity and wind.



## IASI-B calibration/validation

The second IASI hyperspectral sounder was launched on EUMETSAT's MetOp-B satellite in September 2012. The optimal use of satellite radiances at NWP centres such as the Met Office depends on a good knowledge of instrument error characteristics. The calibration/validation (cal/val) of IASI-B will be tested using a comprehensive set of observations:

- Direct radiance comparisons of IASI radiances with aircraft interferometers in spectral intervals where the atmospheric optical depth is small
- Forward modelling of IASI radiances using co-located atmospheric profiles and surface properties as input to a line-by-line radiative transfer code
- Cross-comparisons of radiances from IASI-A, IASI-B and CrIS on Suomi NPP by targeting multiple overpasses, with aircraft interferometer data used as reference standards to obtain double-differences (e.g. IASI-A/B difference)



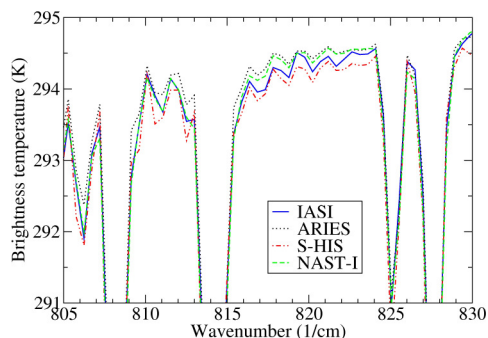
Left: Example orbital tracks for MetOp-A, MetOp-B and Suomi NPP meteorological polar orbiting satellites. From base locations in the southwestern USA intensive observation periods will target overpasses in order to gather a comprehensive dataset, comprising radiance observations from aircraft and satellite together with geophysical validation data.

Overpass visualisation produced using Gpredict real-time satellite tracking and orbit prediction software (Alexandru Csete).

## Key science aims

### IASI-B data quality assessment

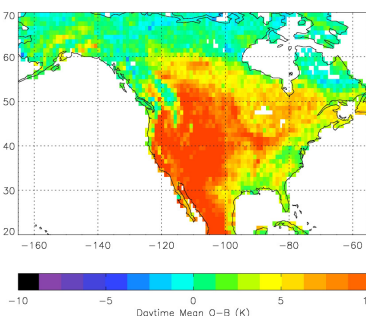
For optimal use of IASI data it is important to confirm high standards of radiometric accuracy and frequency calibration. Direct radiance comparisons with airborne interferometers establish a traceable calibration chain and an upper limit on the magnitude of instrument radiance biases.



Above: Example of cross-instrument calibration from JAIVEx campaign in 2007, for IASI-A, showing calibration differences within IASI design specification.

### Investigation of model biases

IASI retrievals at the Met Office within an NWP 1d-Var framework (Ed Pavelin) allow the estimation of surface temperature and emissivity characteristics. Comparisons with NWP background fields of land surface temperature show very large biases for some locations (e.g. arid southern USA), particularly in daytime. Surface observations of radiative and turbulent fluxes will be used alongside aircraft data to investigate the physical basis of this discrepancy.



Above: Met Office retrieved land surface temperature from IASI minus NWP background, for May 2012. Figure by Brett Candy.

### Test bed dataset

The SALSTICE campaign will produce a quality-controlled dataset of observations which will be made available to the scientific community for IASI-related research. Importantly, aircraft and satellite radiances will be matched with coincident measurements of the atmospheric state and surface properties. The dataset will be a valuable resource for testing state-of-the-art hyperspectral retrieval algorithms.

Right: Aircraft dropsonde profiles offer accurate temperature and humidity profiling within the satellite field of regard. Profiles such as these from the JAIVEx campaign capture spatial and temporal variability.

