

Validation of IASI radiances from the JAIVEx campaign

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with acknowledgements to Fiona Hilton, Nigel Atkinson,
Jonathan Taylor and Sid Clough (Met Office), Andrew Collard
(ECMWF), the US JAIVEx science team and EUMETSAT

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JAIVEx overview

- Joint Airborne IASI Validation Experiment (JAIVEx) was based in Houston in April-May 2007, combining measurements from FAAM BAe 146 and NASA WB-57 (interferometers, *in situ* and dropsondes) in conjunction with MetOp overpasses



- Eight dedicated MetOp flights, four over Gulf of Mexico and four over Atmospheric Radiation Measurement program site in Oklahoma
- Initial work concentrates on one ocean and one land flight in clear skies

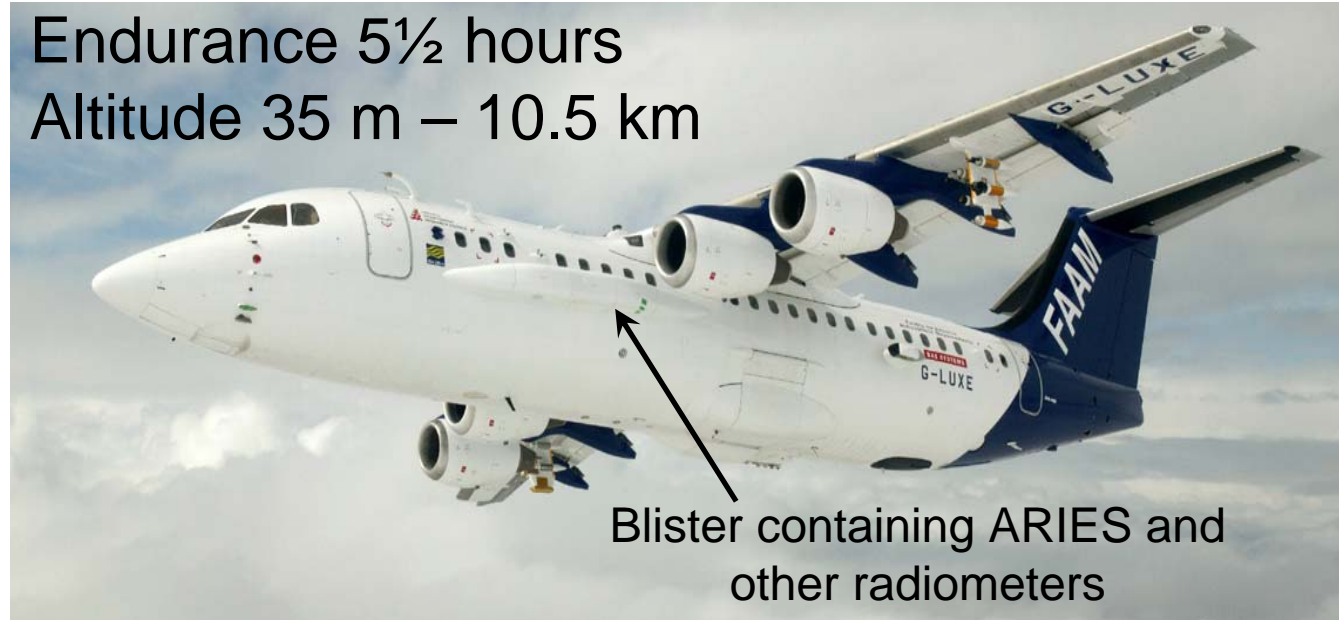


Met Office

FAAM BAe 146-301 capability

Endurance 5½ hours

Altitude 35 m – 10.5 km



- Dropsondes
- Core chemistry (ozone and CO)
- Temperature and humidity probes
- Multi-spectral

shortwave radiometer

- Microwave radiometers
- Particulates (aerosols and cloud particles)
- Winds (and more...)

ARIES interferometer (Bomem MR200)

Spectral range 550-3000 cm^{-1}

HgCdTe and InSb detectors

Max. resolution 1 cm^{-1} (0.5 cm^{-1} sampling)

Multiple viewing geometries (up and down)

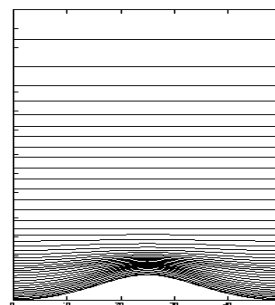
Field of view 44 mrad (full angle)

Observations versus simulations

Methodology for case studies

- For case study select dropsondes released closely in time and space with clear-sky IASI FOVs
- Construct profiles of temperature and humidity etc. for input to line-by-line radiation code; top-up above aircraft profile with NWP model fields
- Output line-by-line infrared simulated spectra for ARIES and IASI
- Compare observed spectra with simulated ones

top of atmosphere (IASI)



Model fields from
Met Office UM
and ECMWF
analyses

BAe 146 max alt. (ARIES)



Atmospheric
profiles from
dropsondes and
FAAM 146 *in situ*
measurements

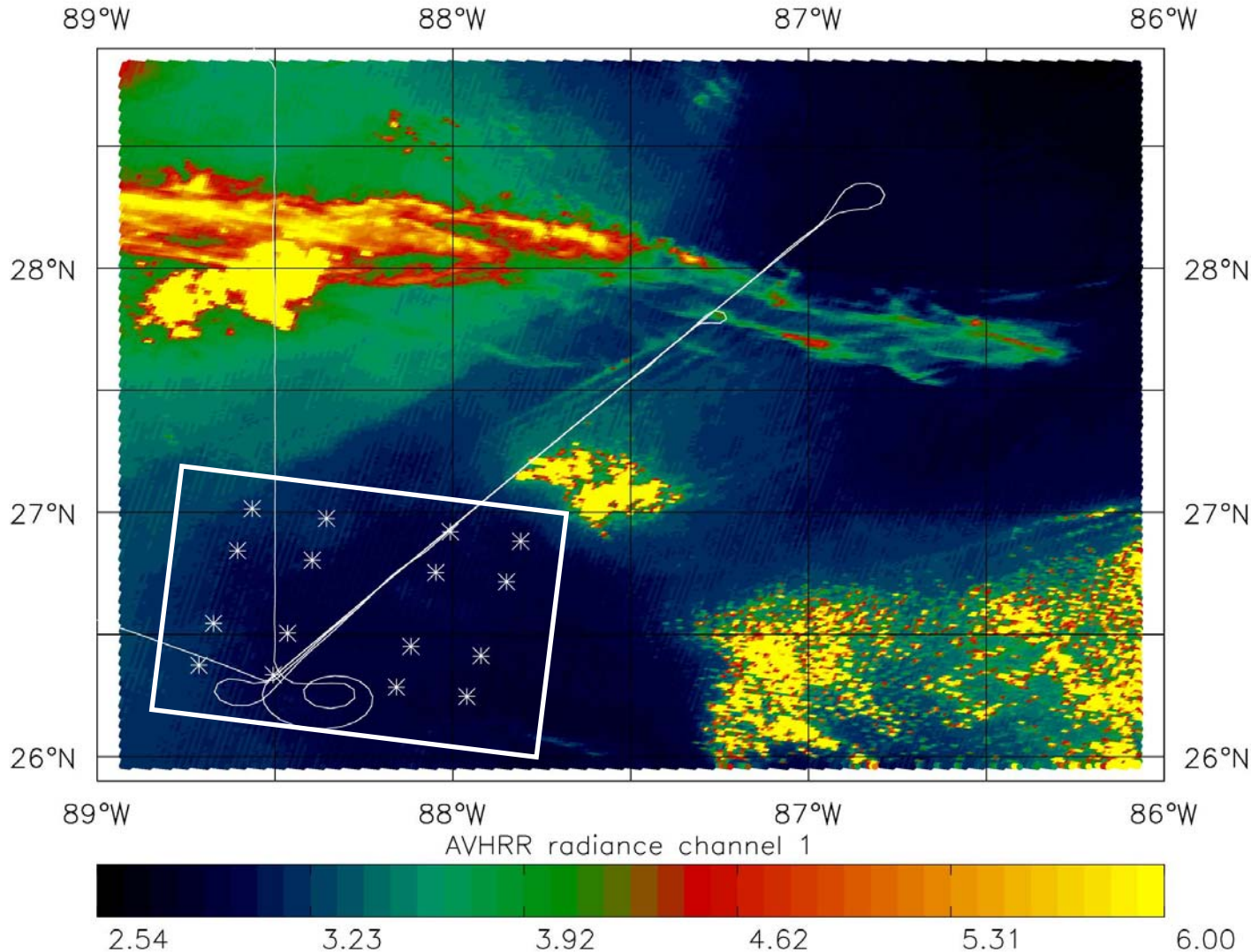
Skin temperature (runs at 35 m)





Gulf of Mexico, 30 April 2007

AVHRR channel 1 on MetOp

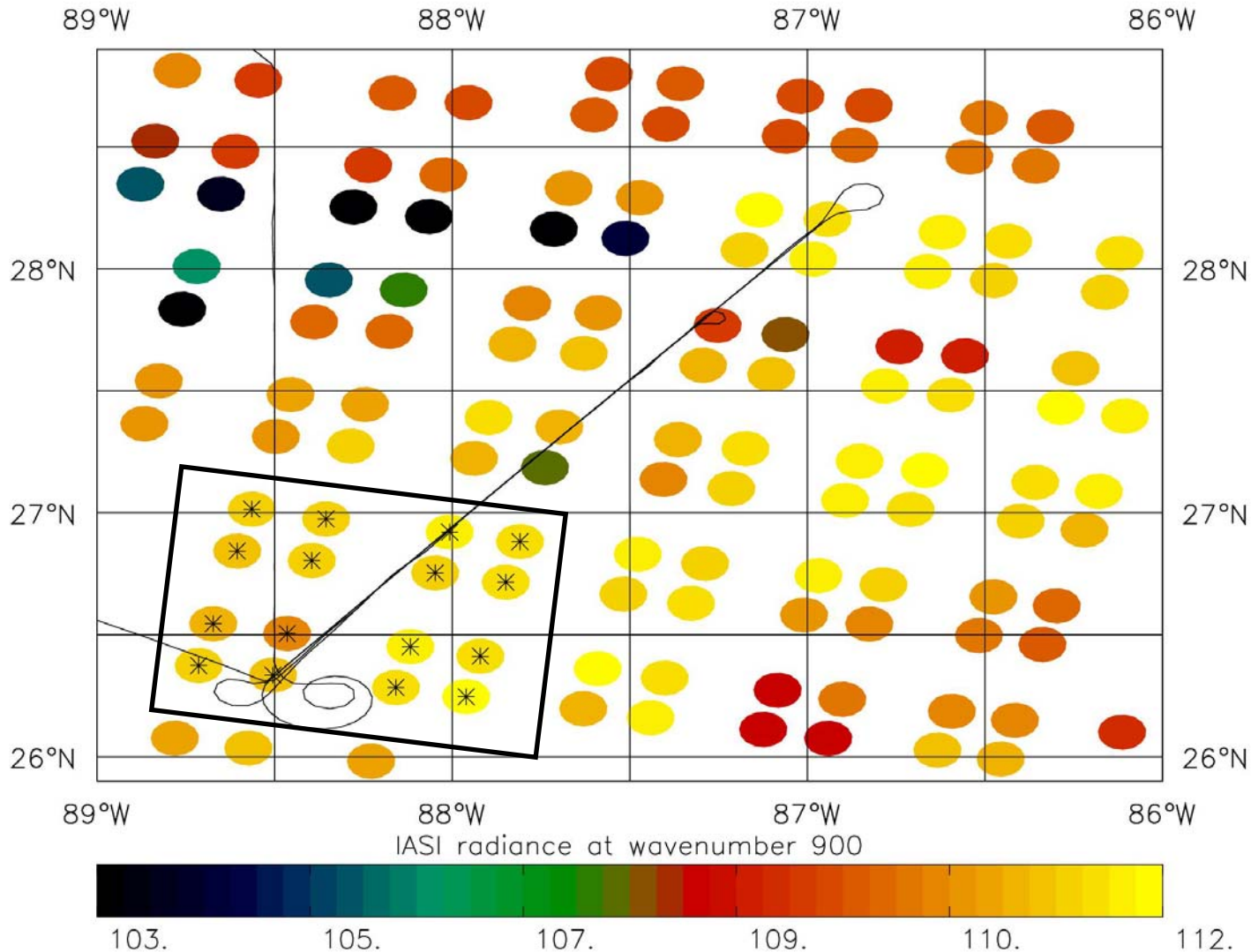


- Southern section of FAAM 146 flight track is clear sky
- 16 clear FOVs selected
- Bright clouds contrast against dark ocean
- Collocated ARIES and dropsondes



Gulf of Mexico, 30 April 2007

IASI window channel on MetOp

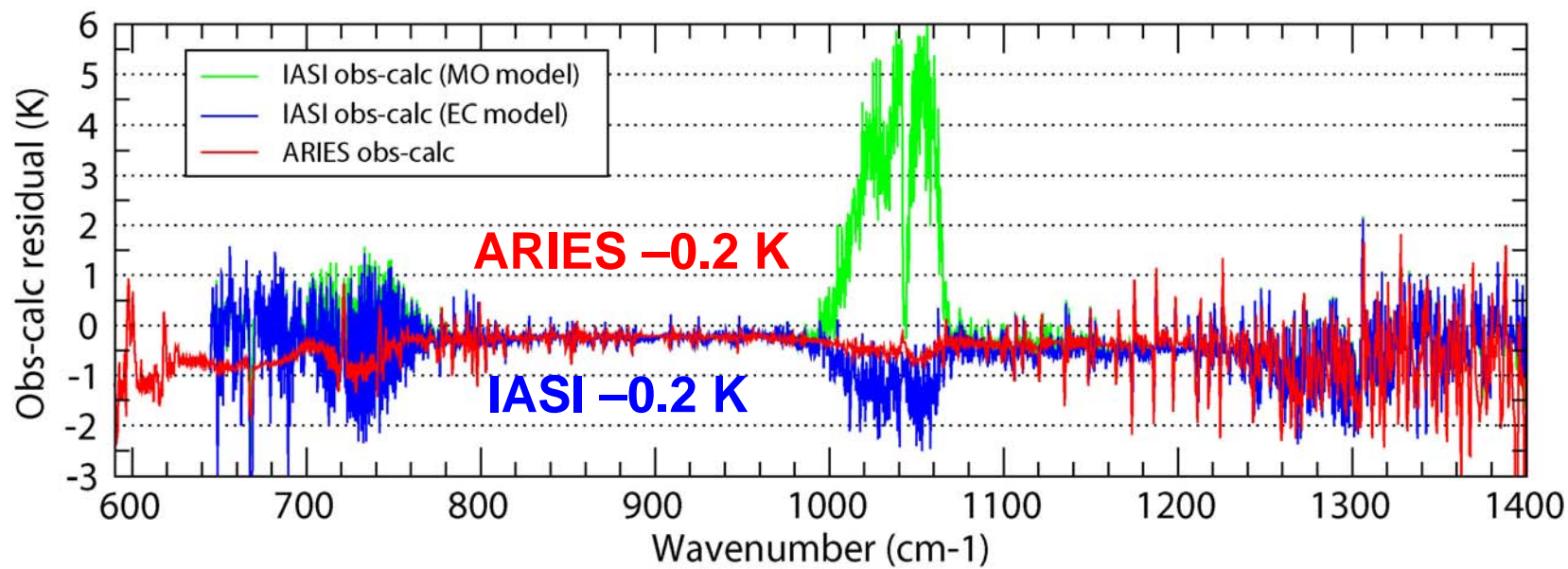
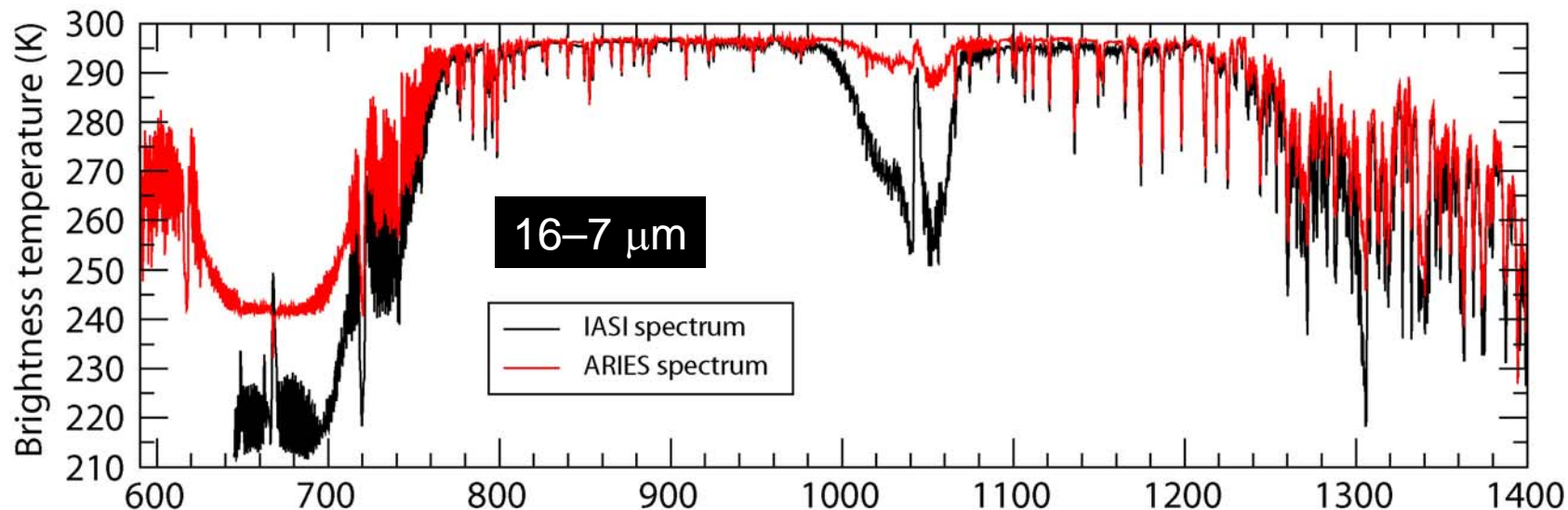


- Southern section of FAAM 146 flight track is clear sky
- 16 clear FOVs selected
- Colder cloud tops contrast against warmer ocean (but have gradients in SST)



Gulf of Mexico, 30 April 2007 (longwave)

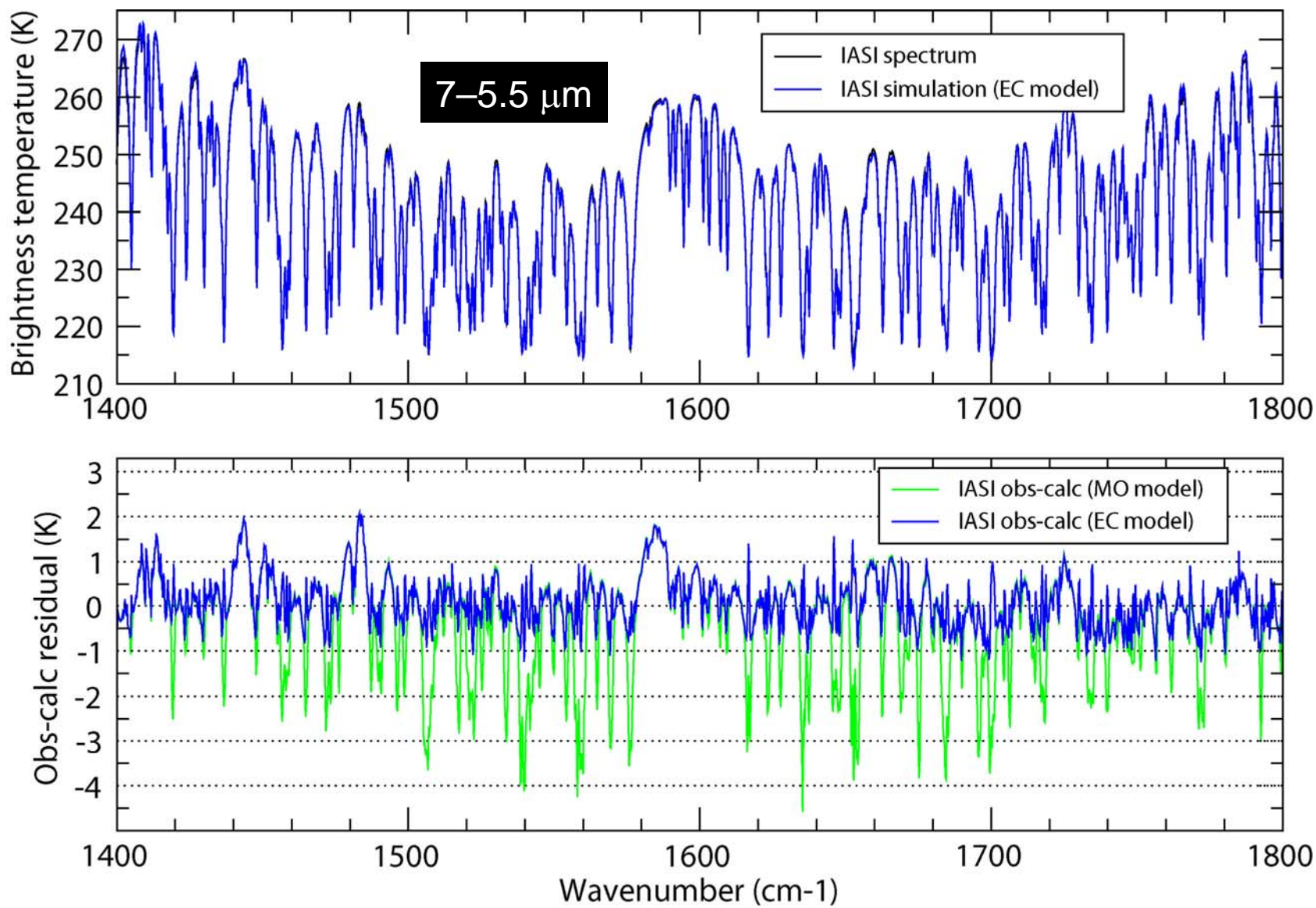
IASI and ARIES spectra compared with model simulations





Gulf of Mexico, 30 April 2007 (water band)

IASI spectra compared with model simulations

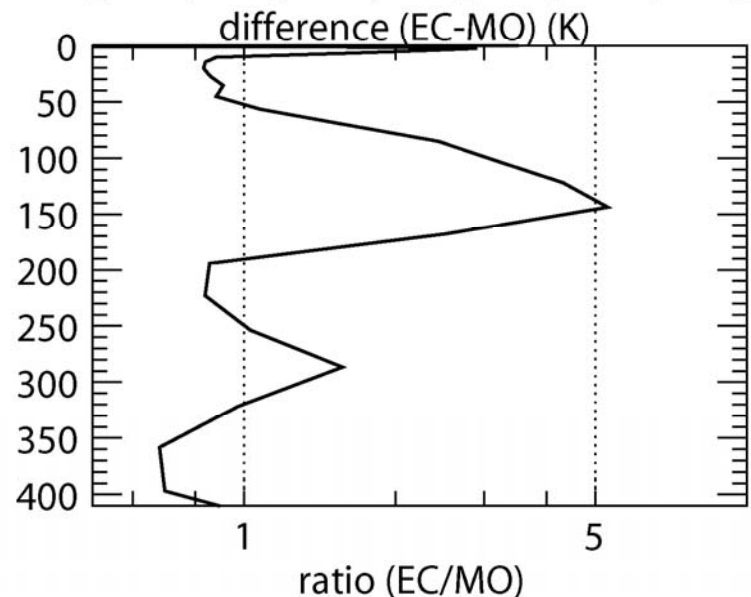
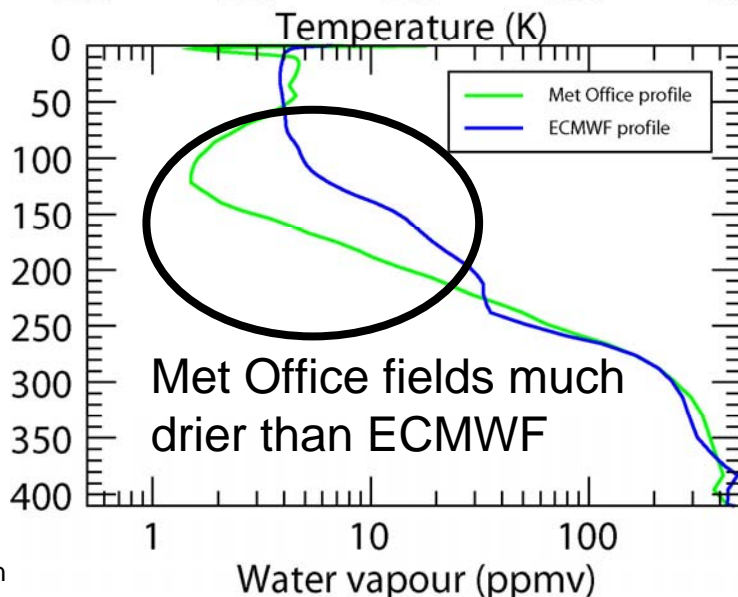
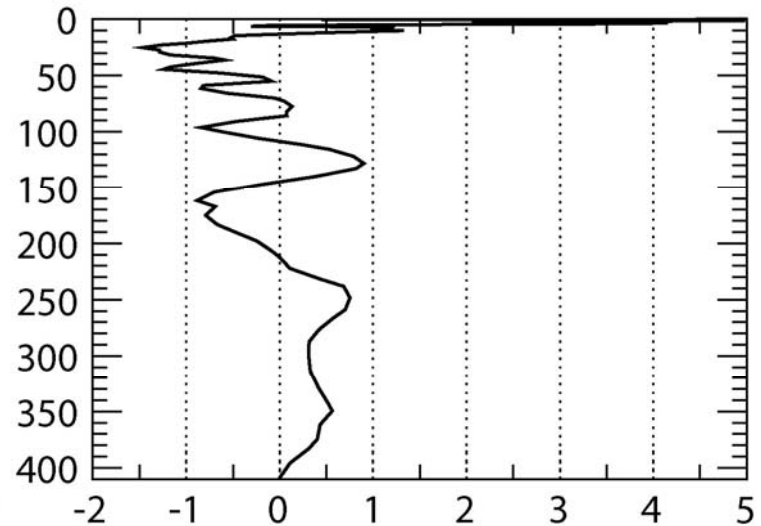
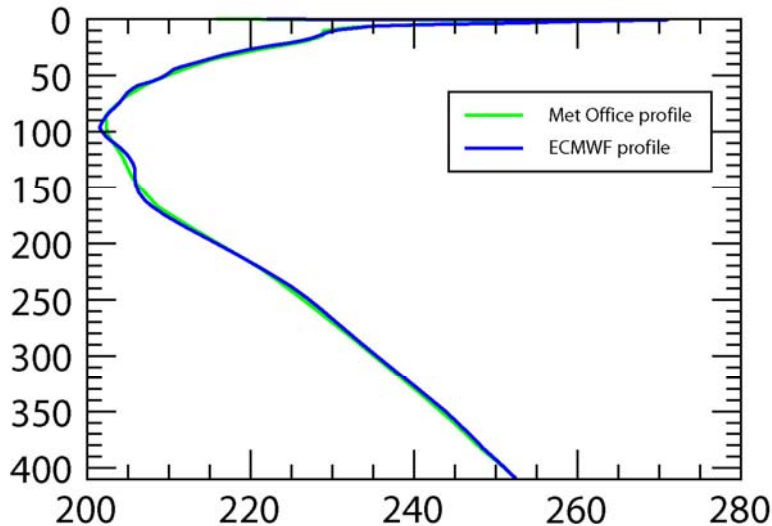




Met Office

Model fields for the Gulf, 30 April 2007

Met Office global model forecast from previous run (Fiona Hilton),
ECMWF 6-hourly analysis (Andrew Collard)

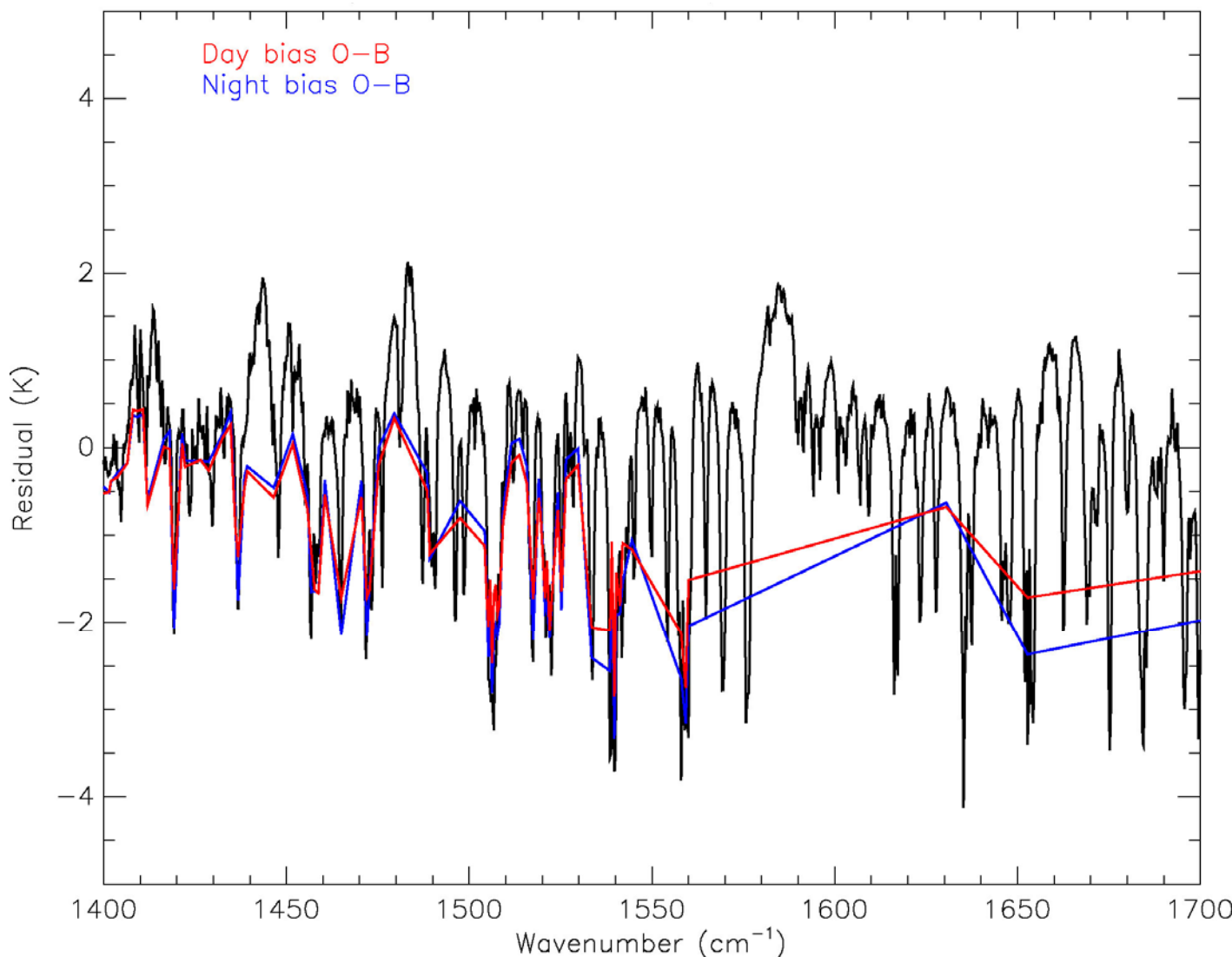


Case study versus operational biases

Observed-background global IASI channel biases (Fiona Hilton)

JAIVEX case 20070430 vs Met Office day/night biases

- Spectral signature of biases in striking agreement
- Bias correction eliminates majority of negative residuals in assimilation



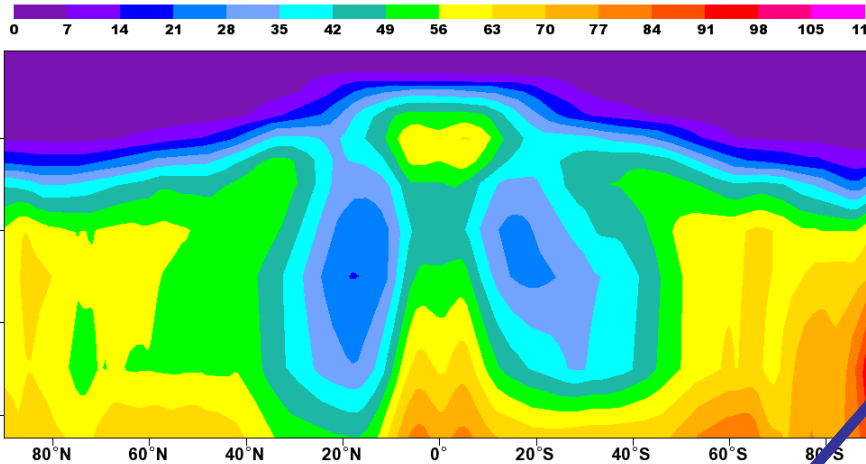


Met Office and ECMWF humidity fields

(monthly zonal means for April 2007, Sid Clough)

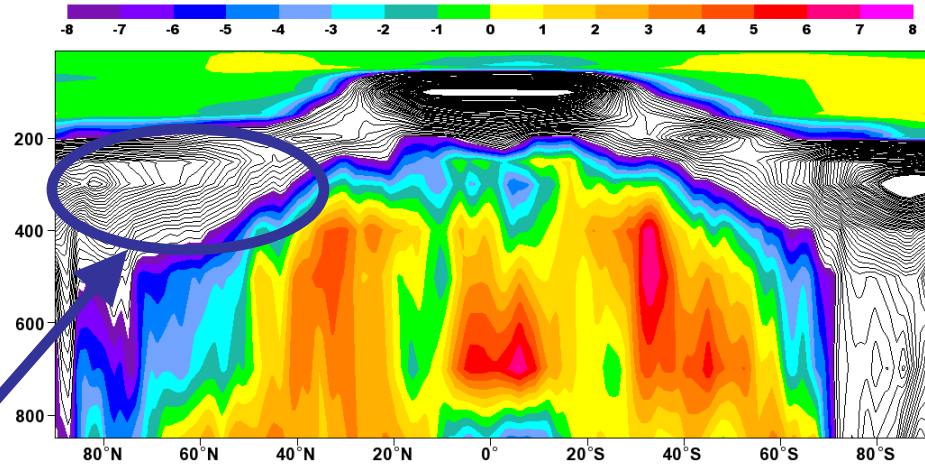
April 2007 at T+96

Zonal mean of Forecast Mean Relative Humidity WRT Ice
Model : UKMO / min: 0 max: 97 mean: 43.4

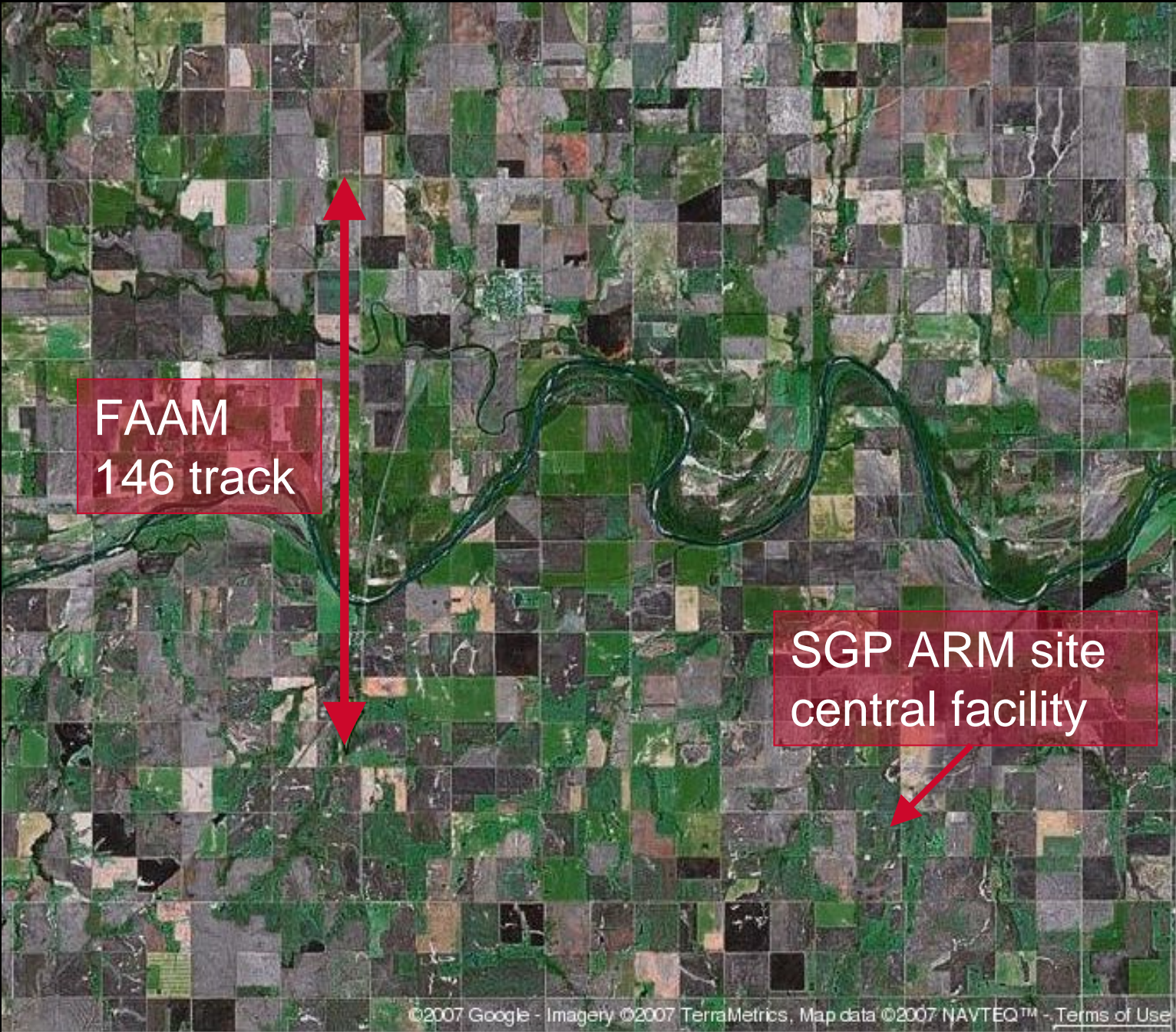


April 2007 at T+96

Zonal mean of Forecast Mean Relative Humidity WRT Ice
Model : UKMO-ECMWF Difference / min: -68.6 max: 9.87 mean: -5.57



Tropopause level humidity values are consistently moister for ECMWF at high latitudes, increasingly at lower levels during the forecast period

A satellite map showing a river system. A red double-headed arrow is positioned vertically on the left side of the river. A red arrow points from the 'SGP ARM site central facility' label to a specific location in the lower right quadrant of the map. The map is composed of a grid of small, overlapping satellite images, giving it a mosaic appearance. The river is dark and winding, flowing from the top left towards the bottom right.

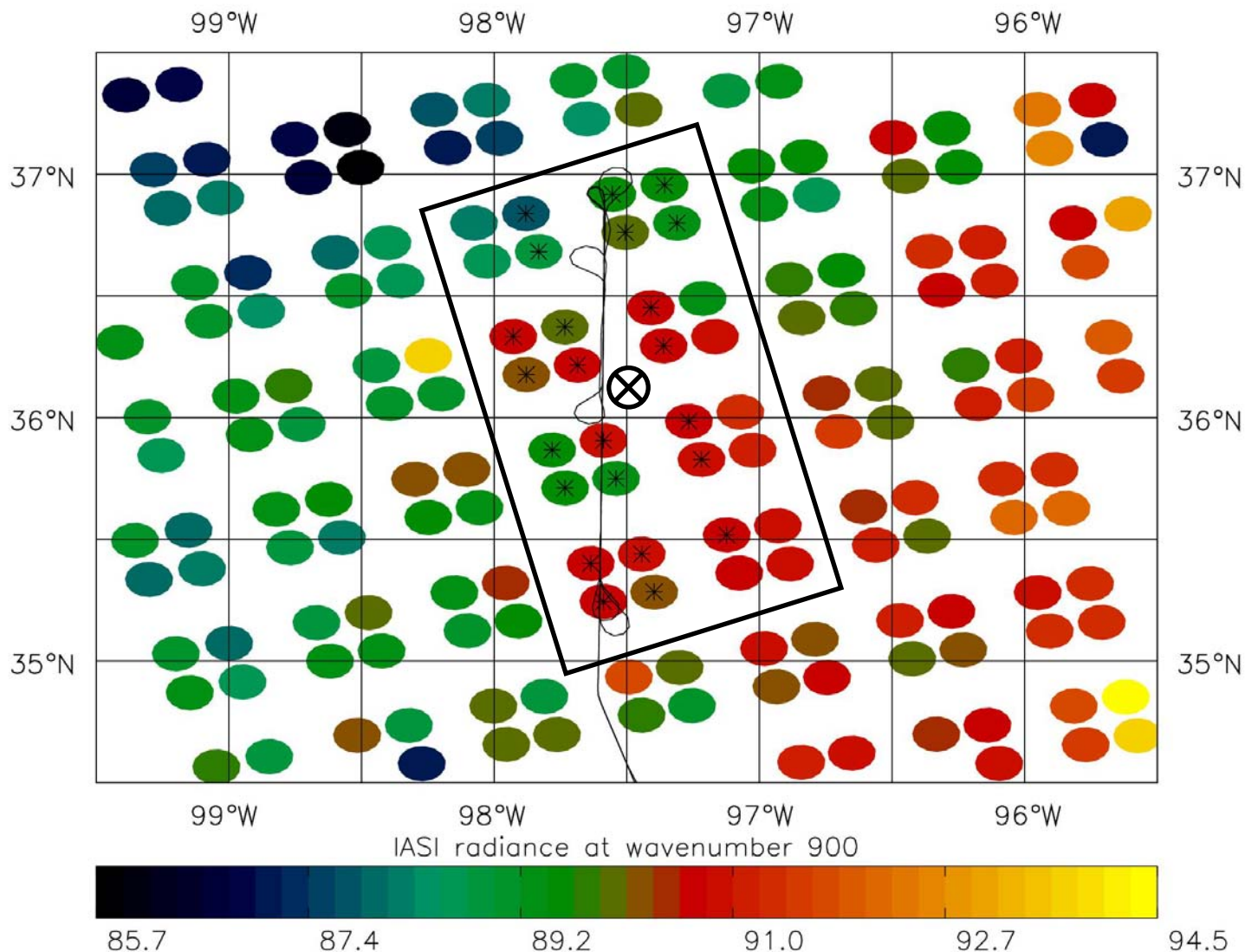
FAAM
146 track

SGP ARM site
central facility



Oklahoma, 19 April 2007

IASI fields of view

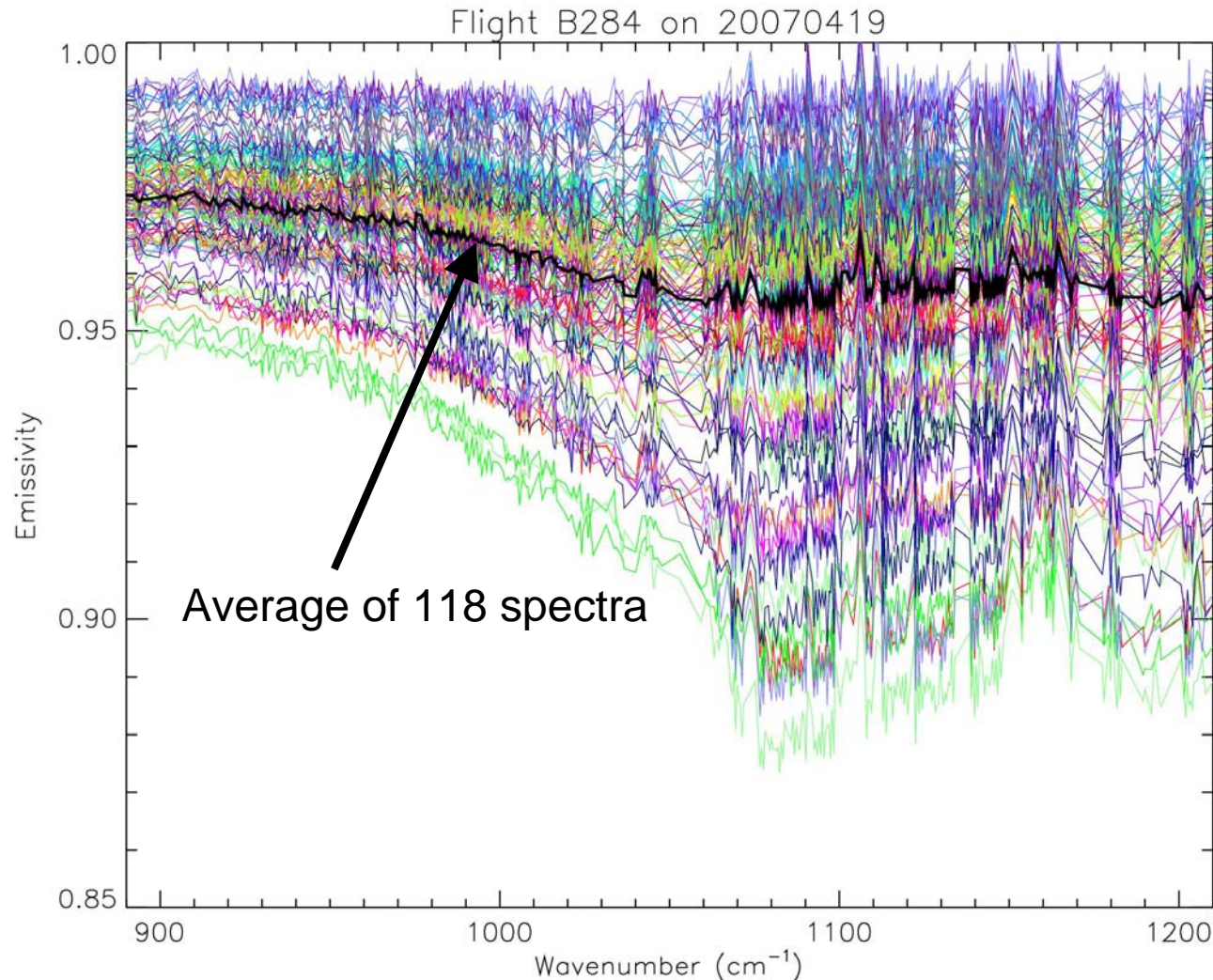


- IASI FOVs at 900 cm^{-1} show variation in surface emission (clear sky case)

- 23 FOVs selected in close proximity to FAAM 146 flight track and ARM CART site ⊗

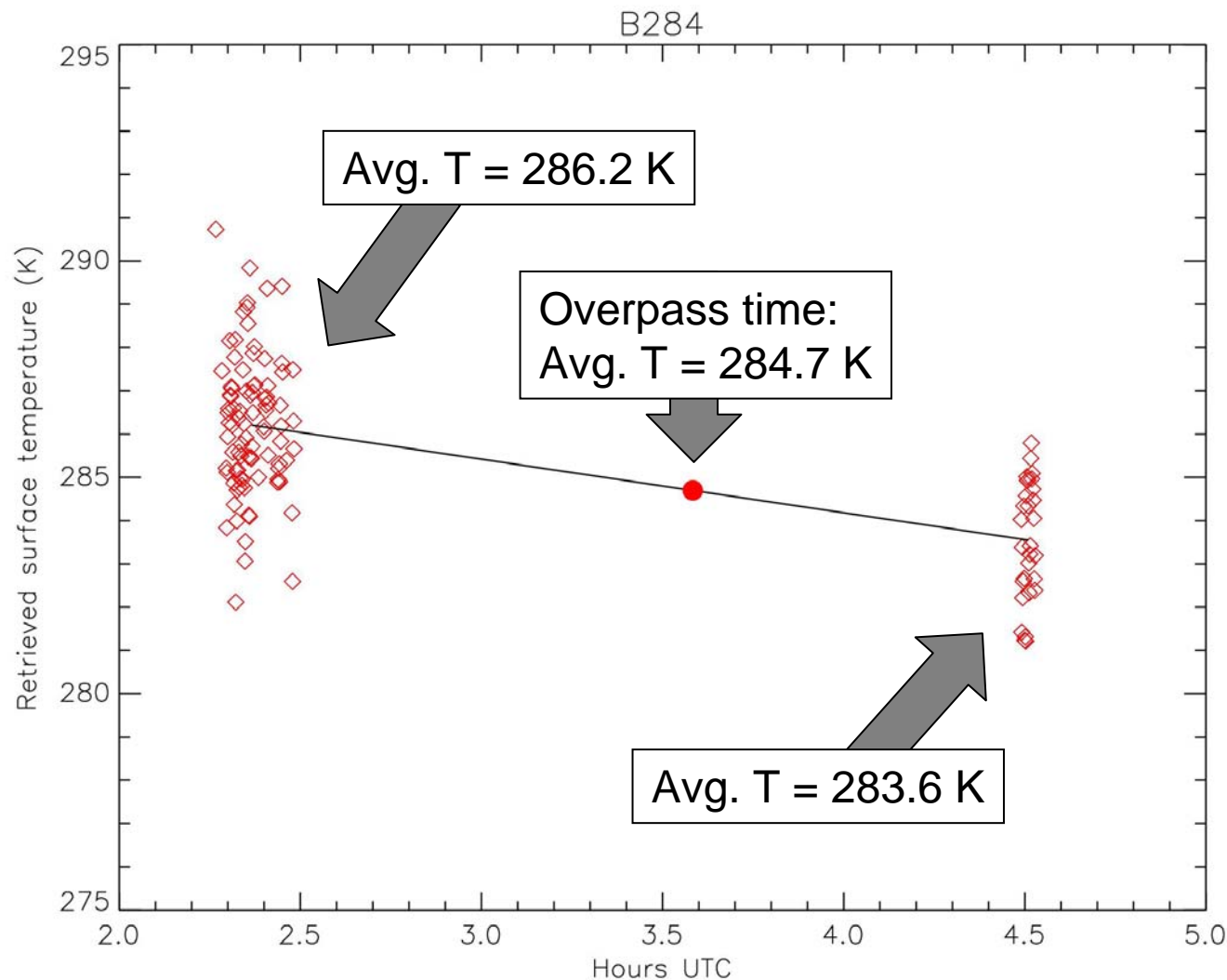
Oklahoma, 19 April 2007 (surface retrievals)

ARIES retrieved surface emissivity from runs at 3000 feet



Oklahoma, 19 April 2007 (surface retrievals)

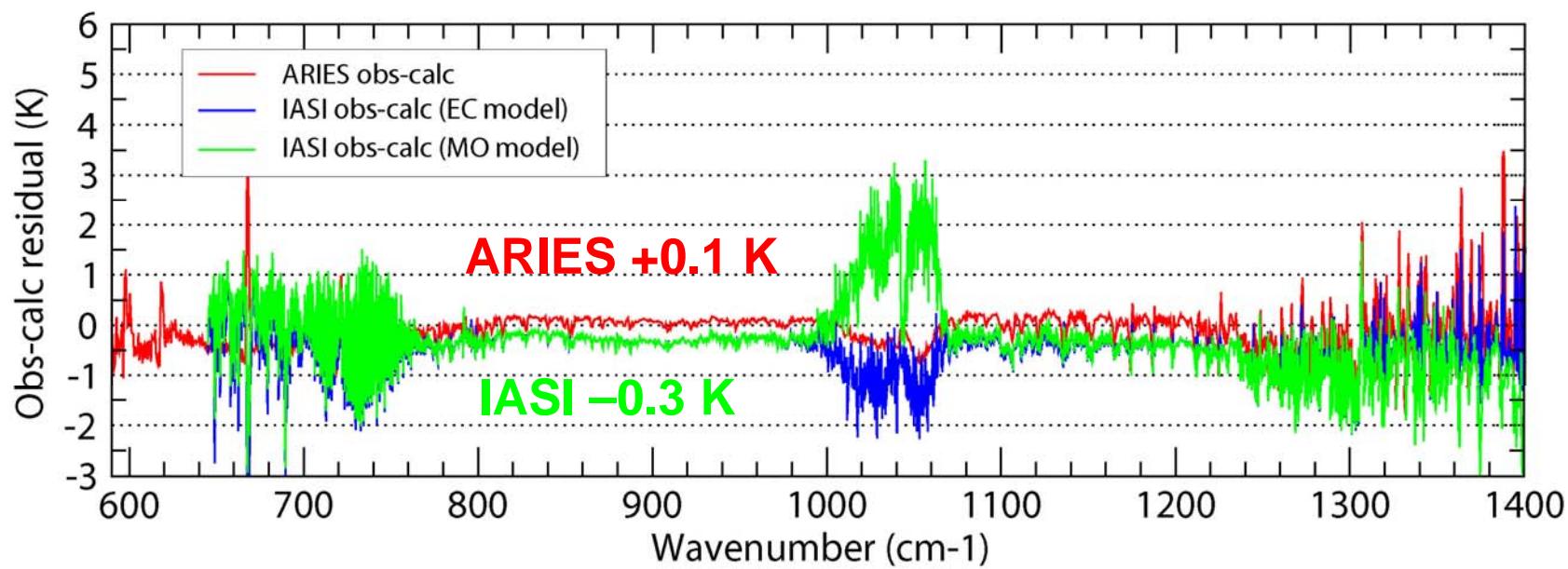
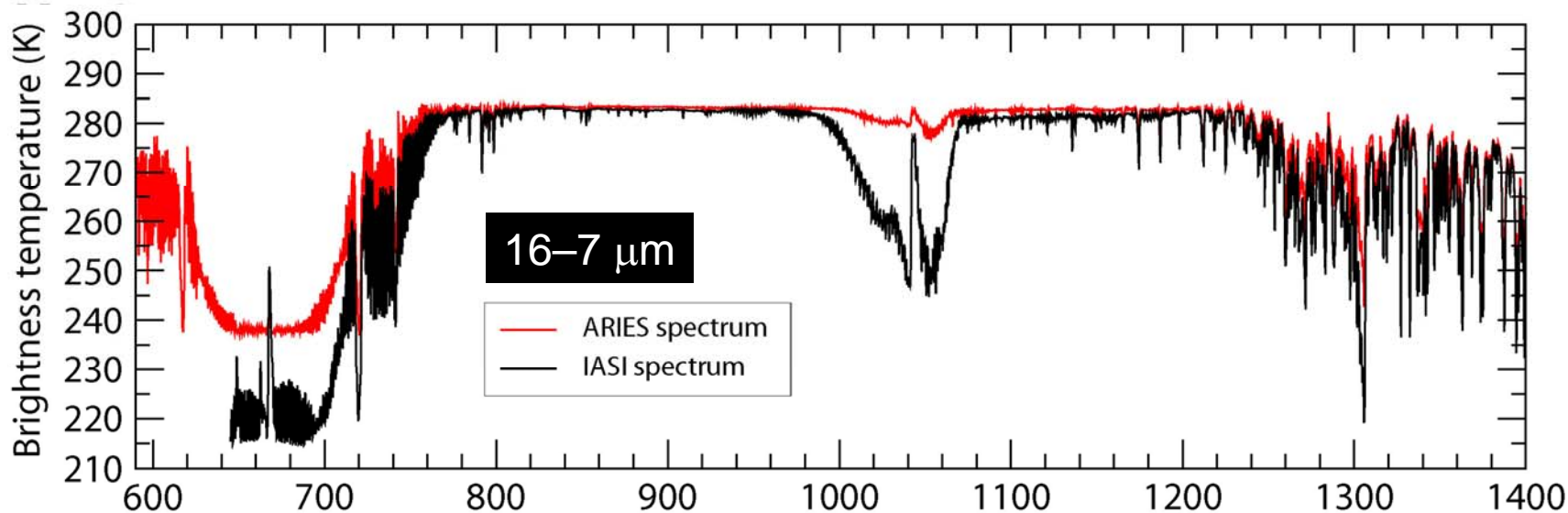
ARIES retrieved surface temperature from runs at 3000 feet





Oklahoma, 19 April 2007 (longwave)

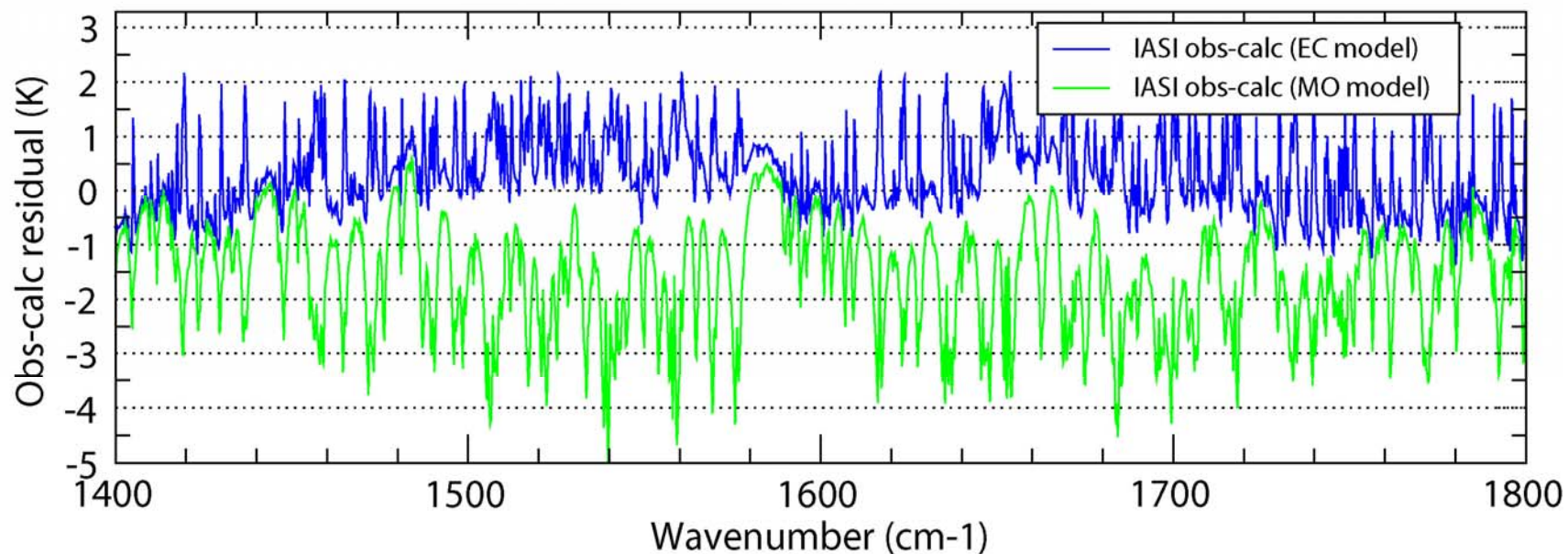
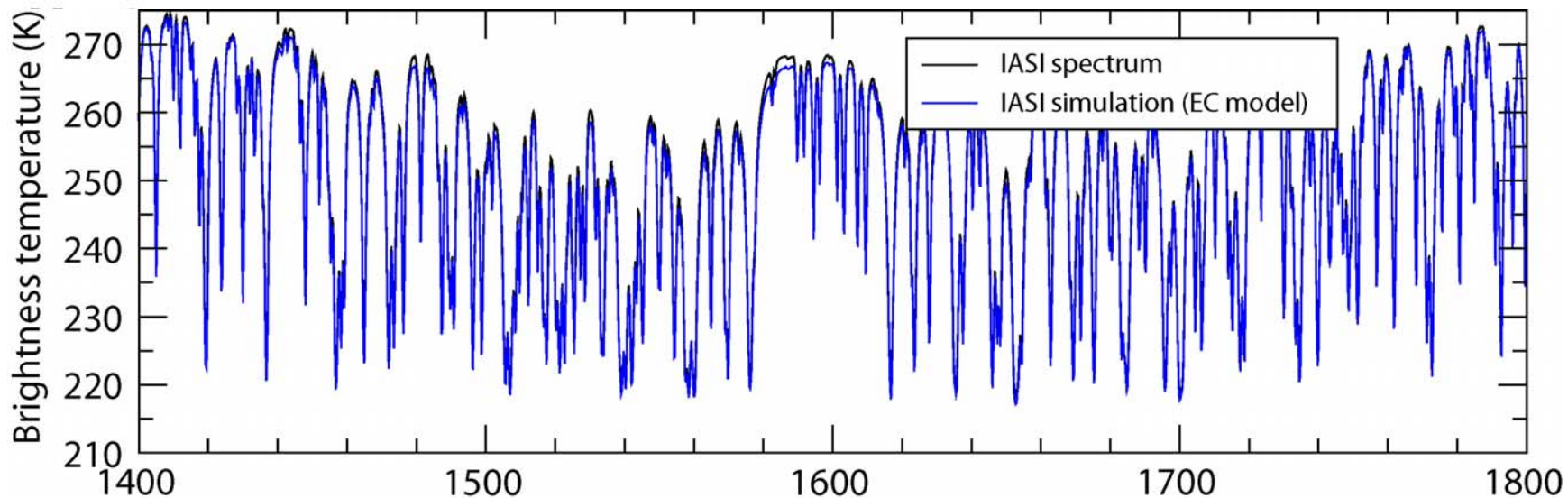
IASI and ARIES spectra compared with model simulations





Oklahoma, 19 April 2007 (water band)

IASI and ARIES spectra compared with model simulations

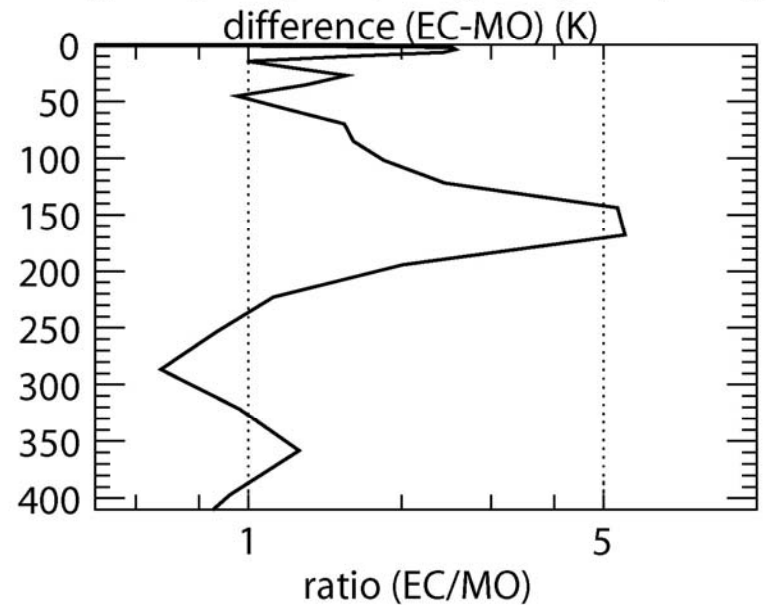
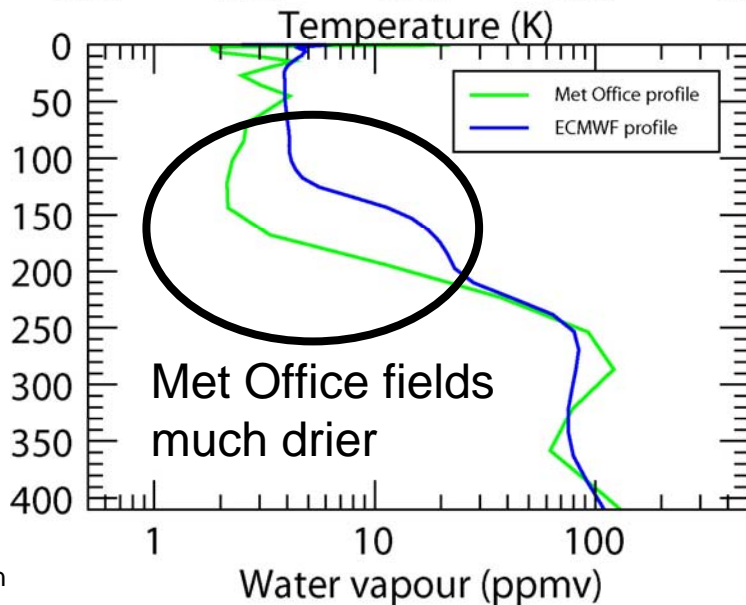
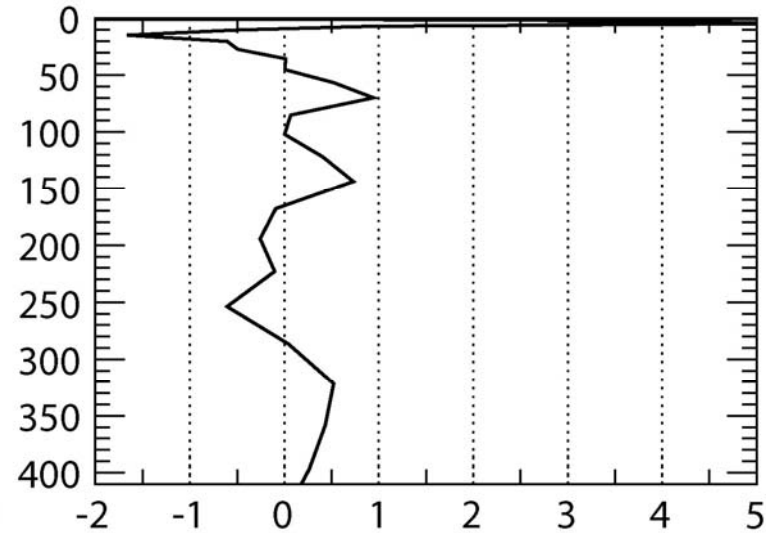
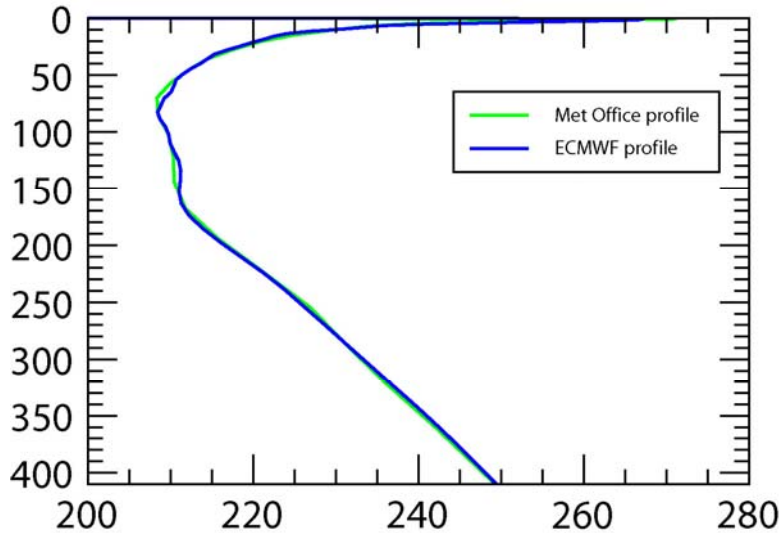




Met Office

Model fields for Oklahoma, 19 April 2007

Met Office global model forecast from previous run (Fiona Hilton),
ECMWF 6-hourly analysis (Andrew Collard)



Conclusions

- JAIVEx has proved to be a successful campaign, with a comprehensive dataset of collocated interferometer and *in situ* profile data
- Case studies show good agreement between simulated and observed spectra from IASI, giving confidence in the absolute calibration accuracy of the instrument
- Atmospheric window region residual errors of a few tenths of 1 K – extension to land surface case over Oklahoma ARM site shows good results when retrieved emissivity values are used
- Analysis of the water vapour band centred at 6.7 μm has highlighted discrepancies between tropopause-level humidity fields in the Met Office and ECMWF operational models; spectral residuals are consistent with a dry bias in the Met Office model
- Spectral calibration of IASI shown to be of high quality



Met Office

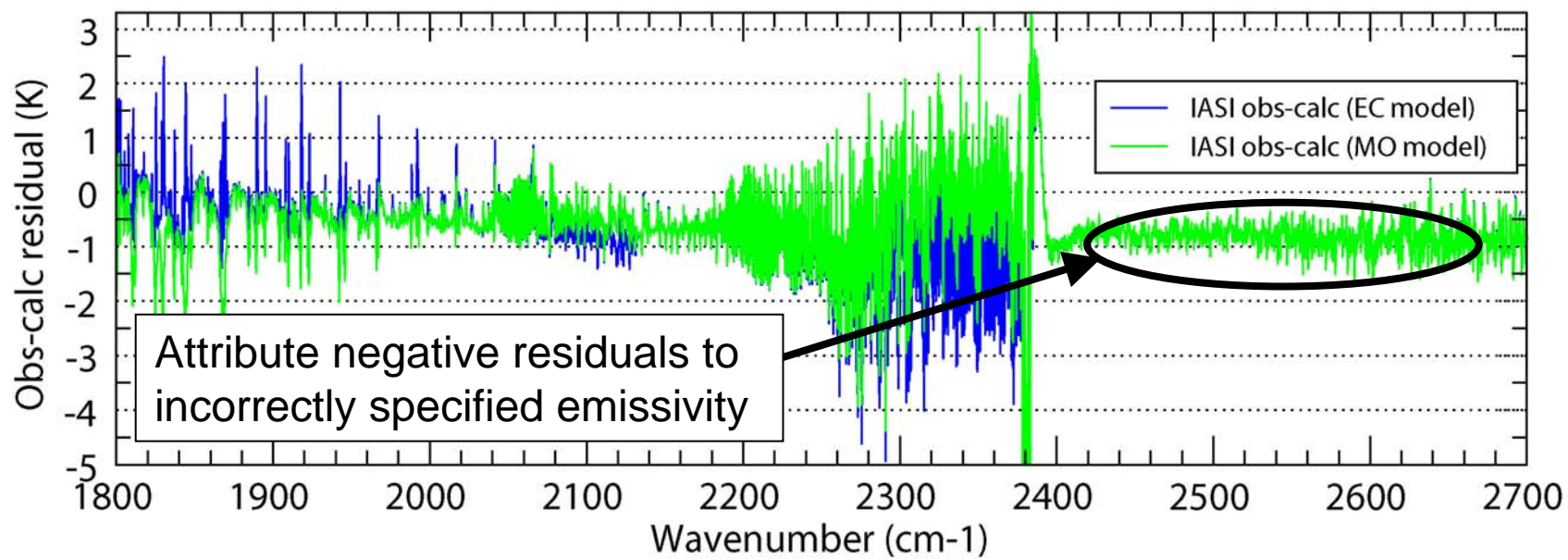
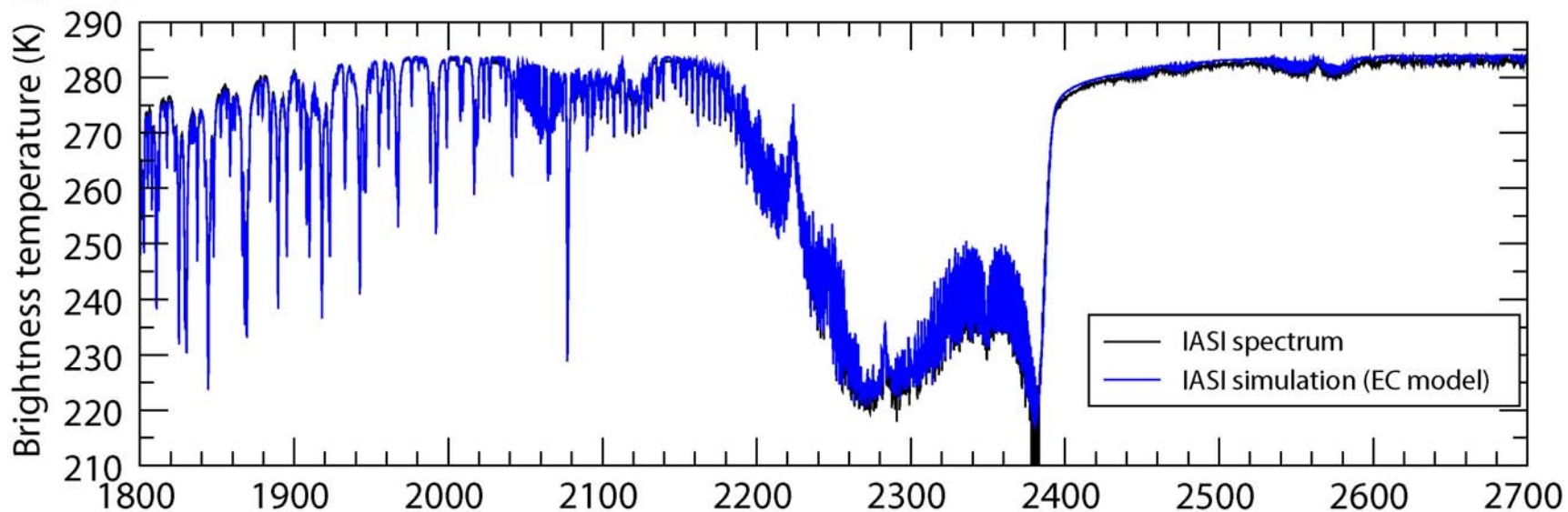
Thankyou

Any questions?



Oklahoma, 19 April 2007 (Band 3)

Night flight with no solar term simplifies modelling



IASI spectral calibration

- Initial IASI Cal/Val flight around UK (2/2/2007) confirmed small shift in IASI frequency scale was required for obs-calc best fit
- Later flights during JAIVEx show modifications to spectral parameters have been successful in eliminating these errors

