Methane Retrievals in the Thermal Infrared from IASI

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RAL IASI Methane Retrieval Scheme

- Optimal estimation retrieval scheme
  - Simple a priori methane field
  - Temperature and humidity profiles from ECMWF reanalysis
  - Surface spectral emissivity from University of Wisconsin
- Fits the TIR spectral range 1232-1290 cm\(^{-1}\) (RMS of 0.1 K)
  - Scheme extracts two independent pieces of information on the methane profile
- Column-averaged methane of precision 20-40 ppbv
- \(\text{H}_2\text{O}, \text{HDO, } T_{\text{surf}}, \text{cloud fraction, cloud altitude & scale factors for two systematic fit residuals co-retrieved with methane}\)
- Retrieval of effective cloud parameters achieved by fitting \(\text{N}_2\text{O}\), which has a well known distribution
  - Corrects for the effect of optically thin cloud not screened out by initial cloud filtering
- Scheme has been extensively compared to GOSAT, GEOSchem, TOMCAT, MACC and TCCON
- Paper in preparation for AMT (R.Siddans et al.)
RAL IASI Global Methane Dataset

Key features:

• Processed all available days
• Processed one in four IASI detectors (least cloudy only)
• Archived with CEDA and publically available: http://catalogue.ceda.ac.uk/uuid/510b22c6d12e4635b604c172b583167e
IASI CH4 vs MACC-II GHG Inversion

IASI

MACC
TCCON Comparison (2013)

MACC with AK’s

IASI a priori

TCCON Sites

IASI

IASI (corrected)
IASI/MHS/AMSU T, q and Emissivity

- RAL has enhanced EUMETSAT’s operational IASI OEM retrieval
  - Combines IASI with collocated microwave data from MHS and AMSU
  - Named the Infrared Microwave Sounder (IMS) retrieval

- IMS retrieved T, q and emissivity are being used as input to the IASI methane retrieval

- Eliminates errors encountered through use of interpolated ECMWF reanalyses (ERA-Interim) data and modelled surface spectral emissivity from the University of Wisconsin database.
**IASI/MHS/AMSU T, q and Emissivity**

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**Standard – June 2014 (QC=5)**

**Mean day retrieved**

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**IMS – June 2014 (QC=5)**

**Mean day retrieved**

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*IWGGMS-12, 7th – 9th June 2016, Kyoto, Japan.*
MACC CH4 – IASI CH4 (MAM 2014)

- MACC CH4 minus IASI CH4 (standard and IMS)
- Land-sea difference reduced in IASI CH4 (IMS) comparison
- Overall differences significantly reduced
- Remaining structure over ocean possibly related to N2O
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Regional Comparison: The Americas

Standard IASI Methane Retrieval
June 2014 (QC=0)

XCH4 (Day)  Actual – ECMWF Altitude

XCH4 [ppmv]  Altitude difference [km]
Regional Comparison: The Americas

**Standard**
June 2014 (QC=0)

**IMS**
June 2014 (QC=0)

**XCH4 (Day)**
Regional Comparison: East Asia

**Standard IASI Methane Retrieval**
June 2014 (QC=0)

**XCH4 (Day)**

**Actual – ECMWF Altitude**

[Image of map showing XCH4 (Day) and Actual – ECMWF Altitude]
Regional Comparison: East Asia

Standard
June 2014 (QC=0)

IMS
June 2014 (QC=0)

XCH4 (Day)

XCH4 (Day)
Near-Real Time (NRT) Retrievals

MetOp NRT IASI methane chain established on JASMIN-CEMS in March 2016

- High-resolution met forecast data from ECMWF & IASI L1 data via Eumetcast
- Event detection, support to field campaigns
Summary & Future Work

IASI TIR OE Retrieval Scheme

- 8 year IASI MetOp-A methane dataset available via CEDA (http://catalogue.ceda.ac.uk/uuid/510b22c6d12e4635b604c172b583167e)
- Algorithm and validation paper to be published shortly (R.Siddans et al.)

IASI/MHS/AMSU L2 Temperature, Humidity and Emissivity

- Co-located IASI/MHS/AMSU retrieved T, q and emissivity used as input to IASI methane retrieval
  - Improves on use of ECMWF T, q and UoW surface spectral emissivity database

Near-Real Time MetOp Chain

- IASI CH4 processor incorporated into RAL’s MetOp NRT chain on JASMIN-CEMS
  - Event detection, support to field campaigns
  - Monitoring trials in ECMWF/Copernicus Atmosphere Monitoring Service

Development of 3.7 micron Retrievals

- To improve near-surface sensitivity with the solar reflected term

Sentinel-5P (SWIR) & Suomi-NPP CrIS (TIR)

- S5P scheduled to launch in 2016
  - Fully exploit co-located TIR and SWIR observations for height-resolved methane profiles
Thank you for listening

www.ralspace.stfc.ac.uk/remotesensing

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