



AAPP developments and experiences with processing MetOp data

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Contents

- AAPP version 6 and OPS-LRS
- Processing MetOp local and global data
- IASI Principal Components
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- NPP and NPOESS



AAPP package



- Maintained by NWP SAF. 212 registered users of AAPP v6
- To obtain AAPP go to www.nwpsaf.org and fill in the request form
- Versions released since ITSC-15
 - 6.1 12 Oct 2006
 - 6.2 10 Nov 2006
 - 6.3 01 Feb 2007
 - 6.4 22 May 2007
 - 6.5 20 Sep 2007
 - 6.6 07 Feb 2008
 - OPS-LRS v3-5 12 Oct 2006
 - OPS-LRS v3-6 22 May 2007
 - OPS-LRS v4-0 07 Feb 2008



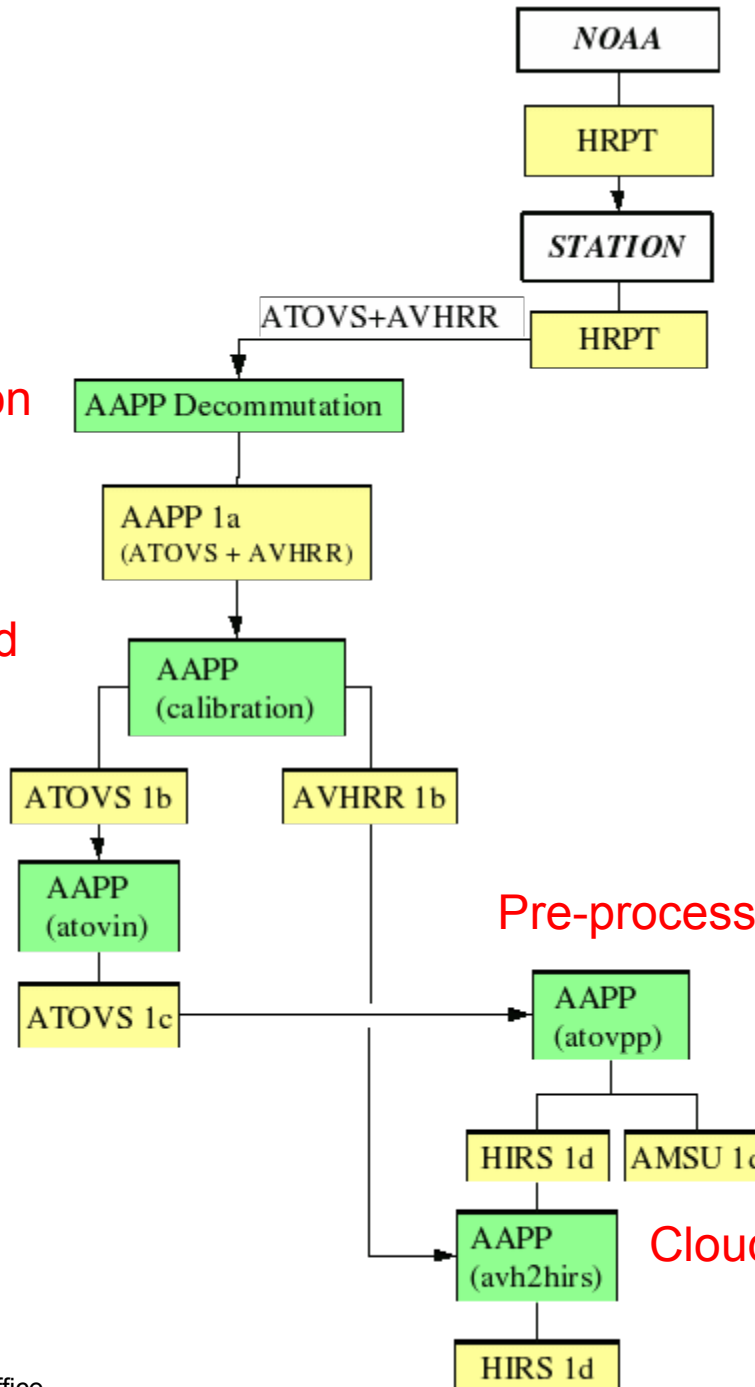
AAPP capabilities

- Data coverage
 - Local direct readout (HRPT / AHRPT)
 - Regional (EARS / RARS)
 - Global (from NESDIS or EUMETSAT)
- Satellites
 - NOAA-15, 16, 17, 18, MetOp-A, FY-1D
- Instruments
 - AMSU, MHS, HIRS, IASI, AVHRR

NOAA satellites – direct readout

Decommutation

Calibration and navigation



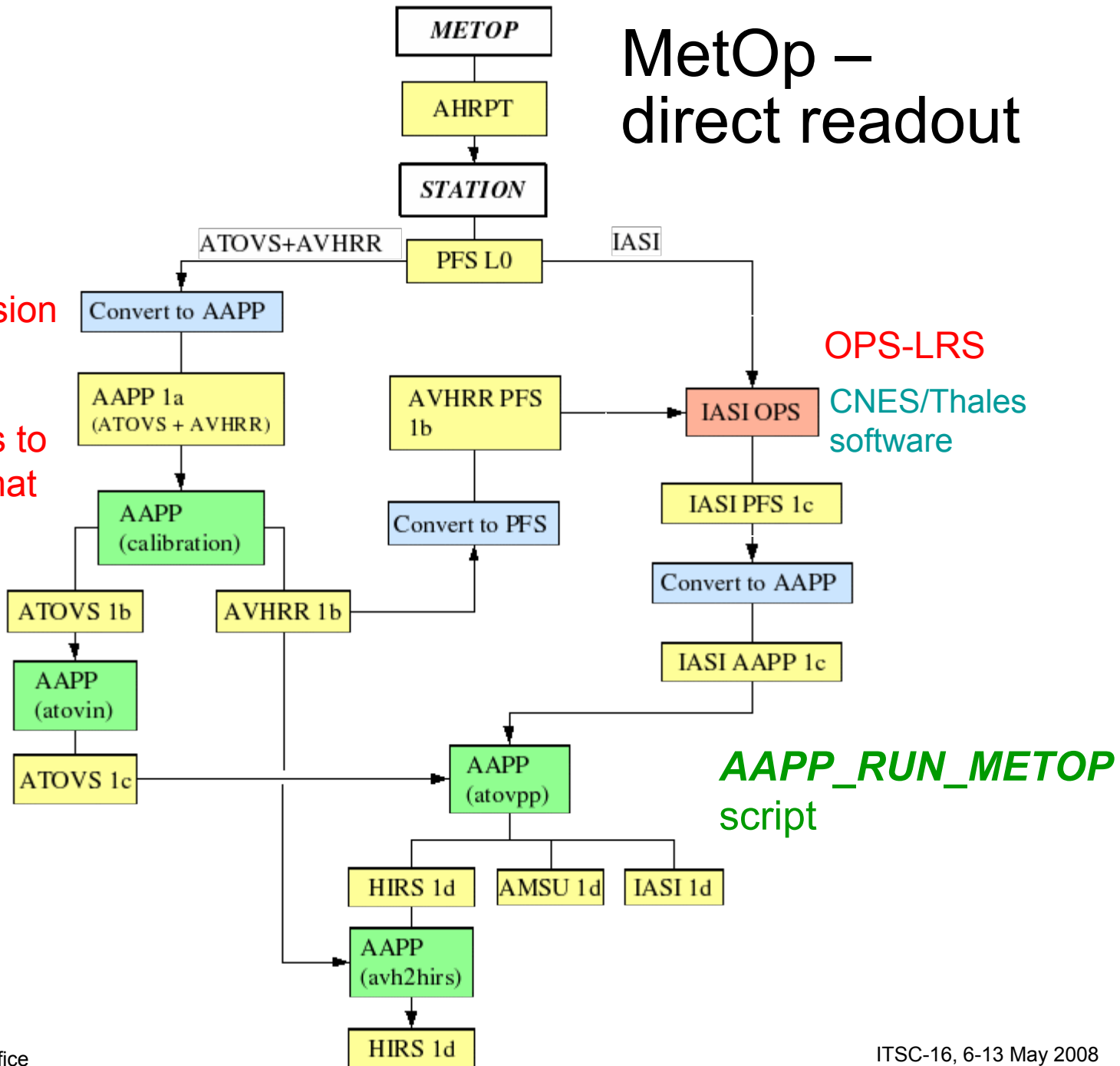
AAPP_RUN_NOAA
script

Pre-processing

Cloud mask



MetOp – direct readout



Format conversion tools

Note: station has to deliver EPS format

OPS-LRS
CNES/Thales software

AAPP_RUN_METOP script



MetOp HRPT failure

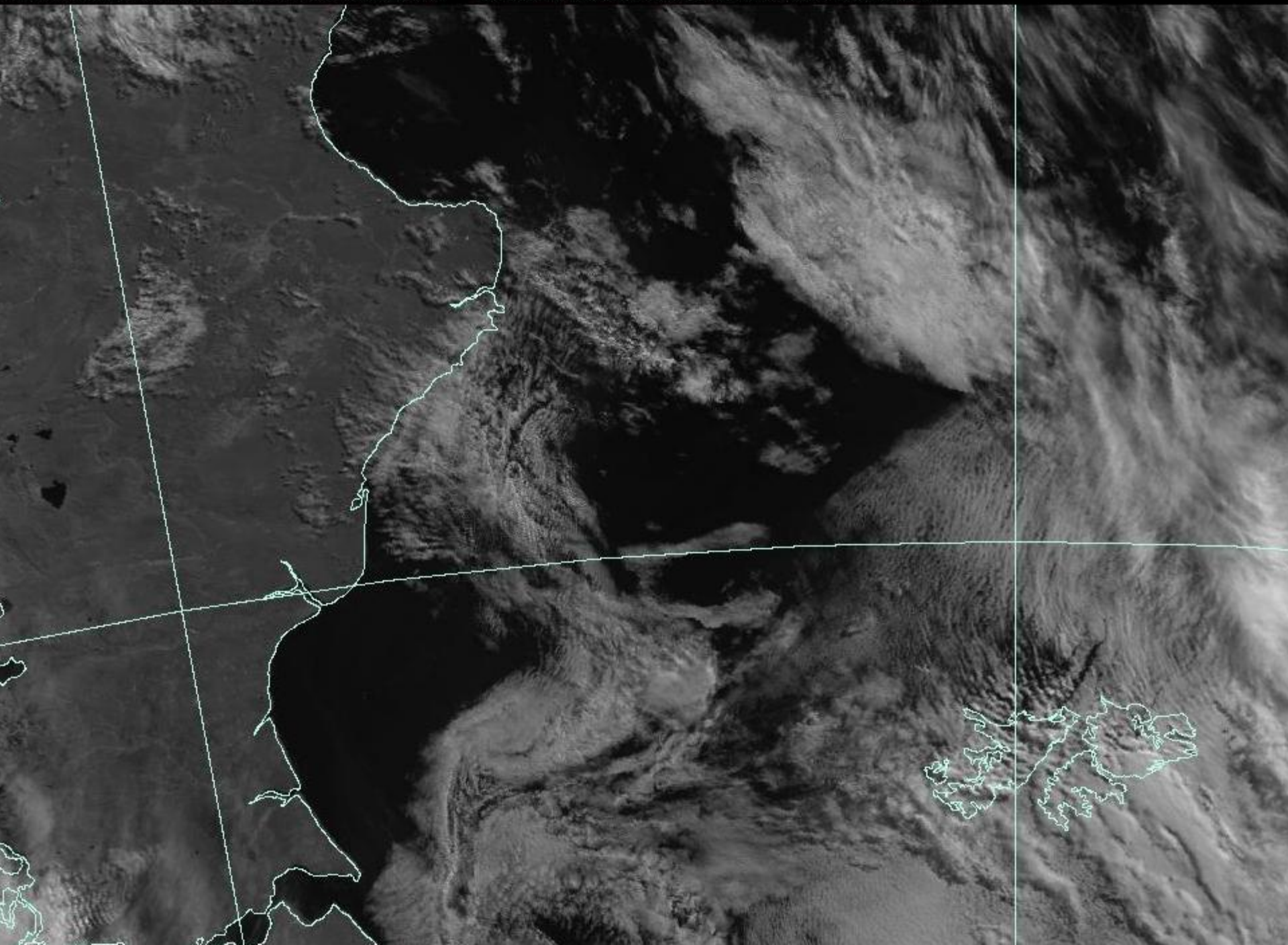
AAPP for MetOp AHRPT (including OPS-LRS) was running successfully at Met Office, Météo-France and elsewhere, until

- MetOp A-HRPT primary transmitter failed in July 2007
- Secondary transmitter *may* be activated in the future
- So we encourage prospective users of OPS-LRS to keep their software up to date
- OPS-LRS may be used within EUMETSAT as part of a fast-track IASI processing facility



MetOp global data

- Received via EUMETCast, timeliness ~1.5 to 2 hours
- AMSU, MHS, HIRS, IASI in BUFR format, AVHRR in PFS
- AMSU and MHS mapped to HIRS/IASI grids using *atovpp*, and used in NWP
- AVHRR imagery generated for areas such as the Falkland Islands
 - PFS converted to traditional AAPP 1b format using AAPP tool





Processing of FY-1D in AAPP (v6.6)

- FY-1D is early morning satellite, similar orbit to NOAA-15
- CHRPT is similar to NOAA HRPT
- MVISR imager has channels similar to AVHRR
- Decommuration and calibration modules added to AAPP, for the 5 AVHRR-like channels
- New script AAPP_RUN_FY1
- Accuracy (radiometric / navigation) not as good as NOAA satellites, but useful imagery (except channel 3 is noisy)
- No plans yet for FY-3



IASI Principal Components

- Latest update used 6 month training set (July-Dec 2007)
- ECMWF software package used to generate eigenvectors – NWP SAF deliverable
 1. Noise-normalise the radiance spectra and subtract mean: \mathbf{y}
 2. Form covariance matrix for each spectrum: $\mathbf{y}\mathbf{y}^T$
 3. Sum covariances: $\mathbf{Y}\mathbf{Y}^T$ (no limit to number of spectra!)
 4. Generate eigenvectors, \mathbf{U} , using PCA:

$$\mathbf{Y}\mathbf{Y}^T/n = \mathbf{U}\mathbf{w}\mathbf{U}^T$$

- For real-time spectra, compute the scores (in AAPP)

$$\mathbf{c} = \mathbf{U}^T\mathbf{y}$$

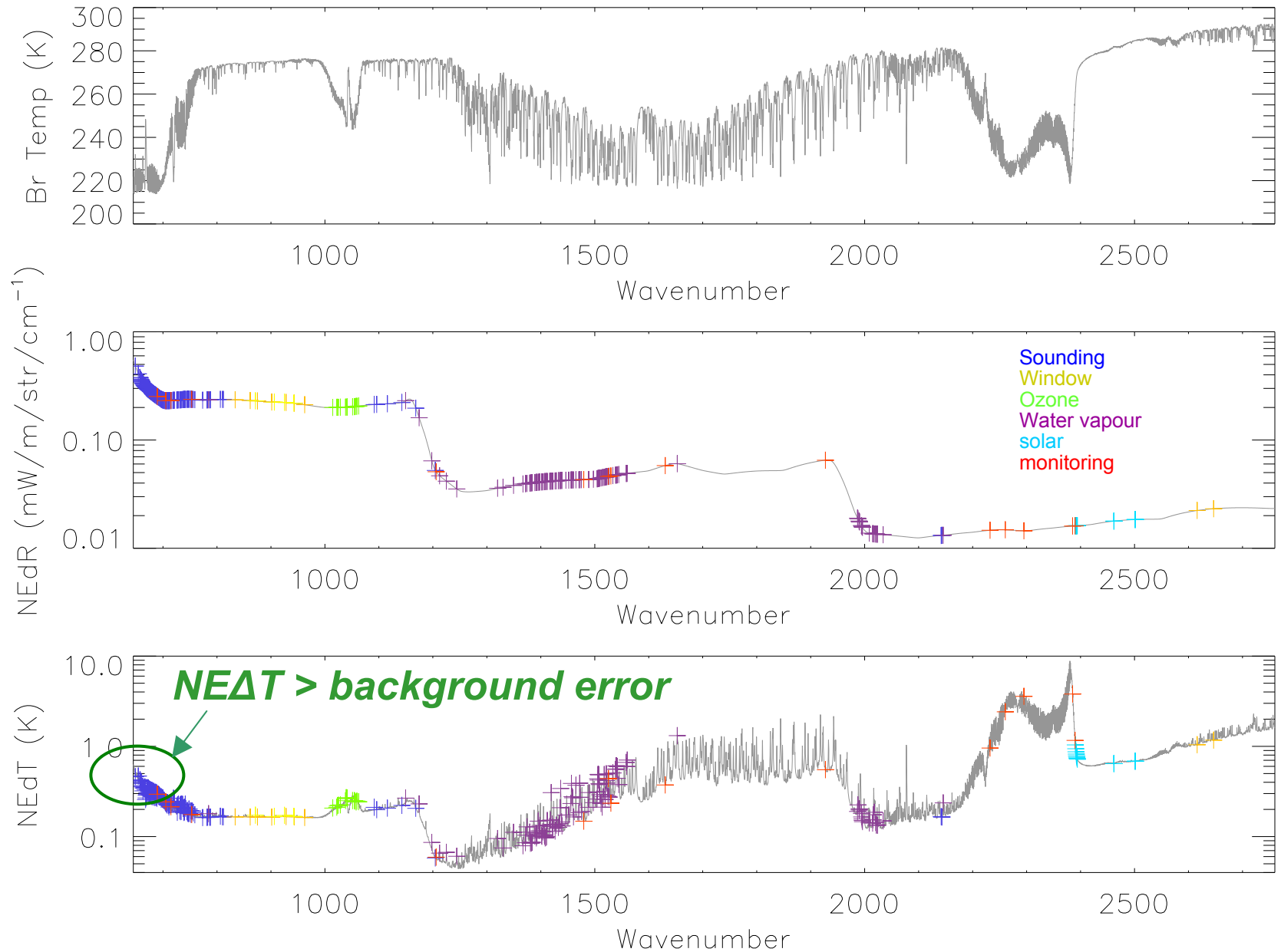
- Finally, reconstruct radiances if required (external to AAPP)

Conclusions on Reconstructed Radiances

- 125 to 150 PCs is about the optimum for global training set – removes most of the random noise. Noise reduction factor $\approx \sqrt{150/8461} = 0.13$
 - See poster by Elliott, Hultberg and Schlüssel
- Don't use too many PCs – or you will add noise
- Can do the three spectral bands separately, but require more PCs (~180). EUMETSAT planning to do this.
- Ideally, should take account of off-diagonal noise covariance (AAPP de-apodises by default). But most IASI users don't bother.

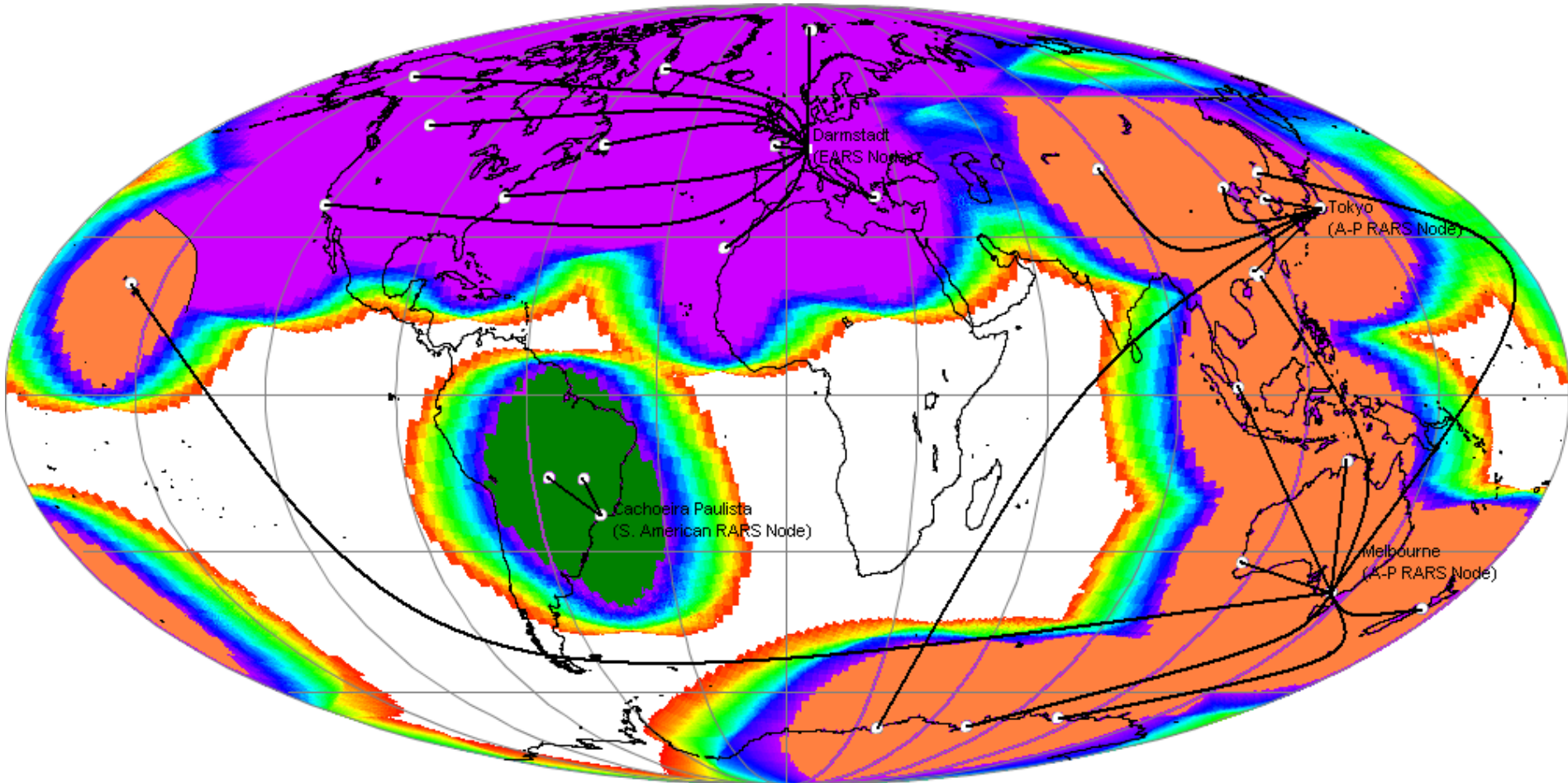
Question: In which spectral region is the noise reduction most significant for NWP?

Answer: For the high-peaking T sounding channels around 650 cm^{-1} . These have low BT and high instrument noise but low background error. (See Fiona Hilton's talk)





Regional ATOVS Retransmission Services (RARS)



RARS networks at end 2007 (from WMO web page)



RARS

- Aim is to re-broadcast ATOVS data with a timeliness of 30 minutes
- Data distributed via GTS and/or FTP
- *AAPP used at each reception station*
- NWP SAF monitors the data quality, by comparison with global data (from NOAA and EUMETSAT)
- **See Brett Candy's poster for forecast impact**
- More stations expected during 2008 (Argentina, Tahiti, Honolulu, etc.)



NWP SAF RARS monitoring

www.nwpsaf.org

NWP Satellite Application Facility - Microsoft Internet Explorer provided by The Met Office

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Home Mail Print Word Star People

Address <http://www.nwpsaf.org/> Go Links

Satellite NOAA-18	Station [AP] Syowa (Antarctica)	Display AMSU Channel 15	Day Latest	Time of day AM	GO
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hirs_20080407_0957_noaa18_14848_syol1c.l1 de

-0.15 -0.10 -0.05 0.00 0.05
AMSU Chan 15 Local-Global (K)

EUMETSAT Met Office ECMWF KNMI METEO FRANCE

EARS monitoring at Météo-France

Fichier Édition Affichage Historique Marque-pages Outils Aide

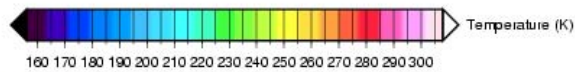
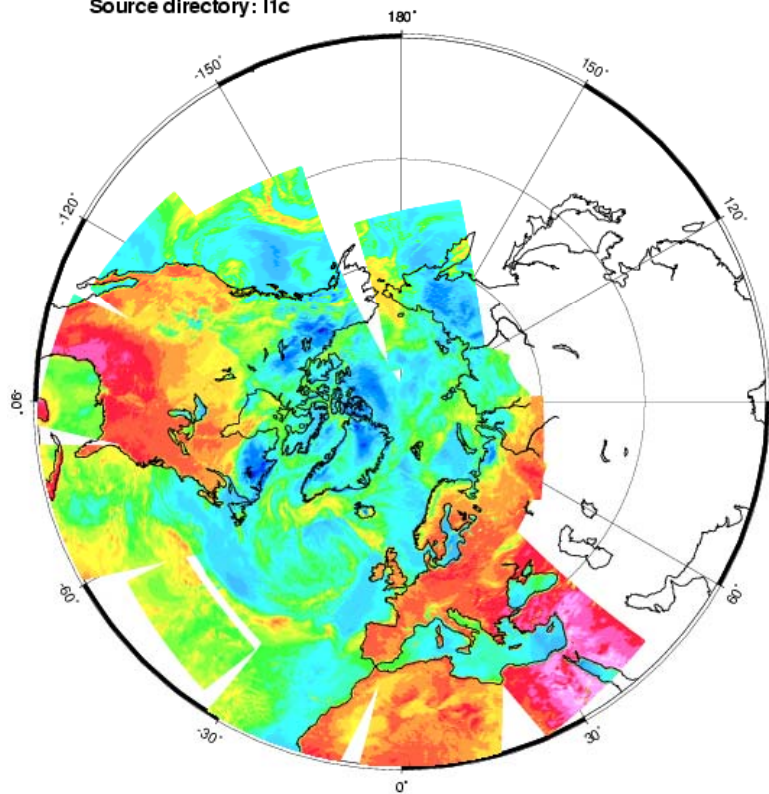
http://www.meteo-spatiale.fr/nwpsaf/cgi-bin/list_graphics.pl



NOAA-18 I1c MHS 1

2008-04-23 01:00 2008-04-23 11:39
Orbits 15070-15076

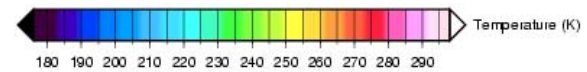
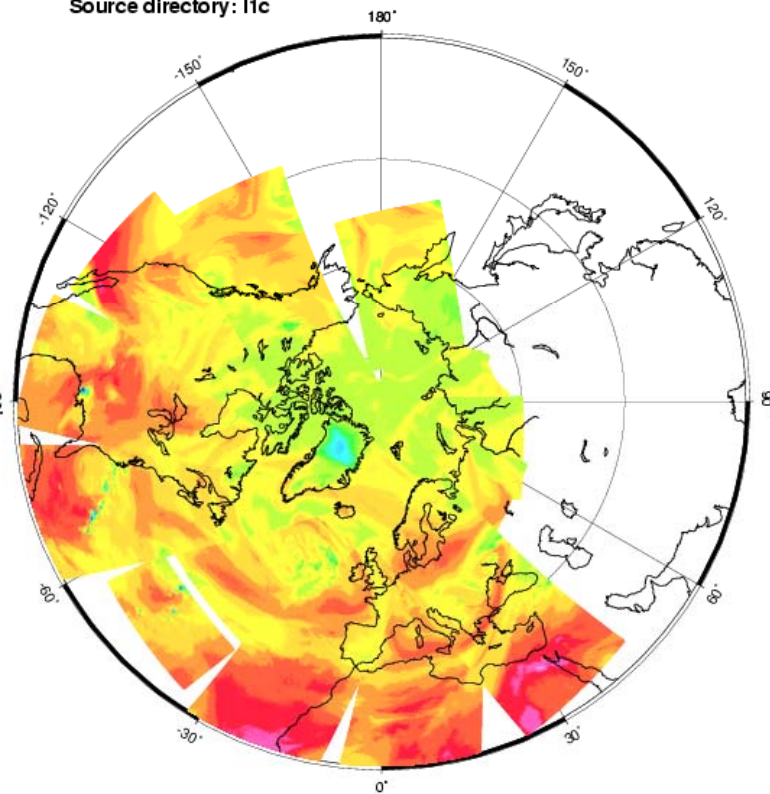
HRPT stations: longpass
Source directory: I1c



NOAA-18 I1c MHS 4

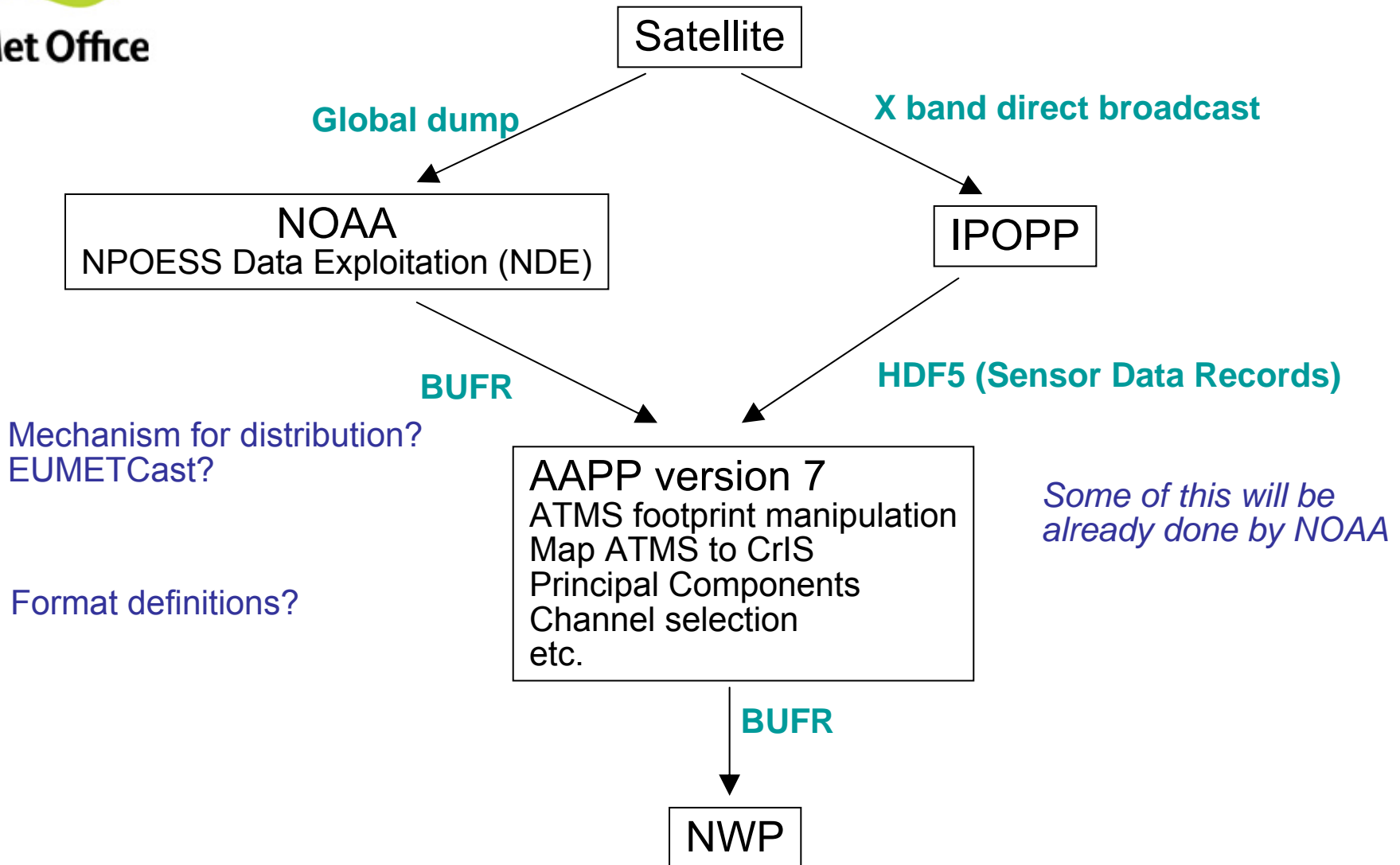
2008-04-23 01:00 2008-04-23 11:39
Orbits 15070-15076

HRPT stations: longpass
Source directory: I1c





NPP – ATMS and CrIS radiances

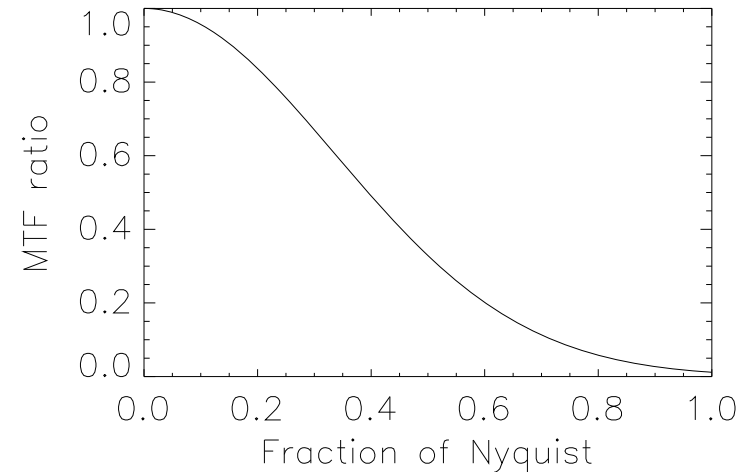
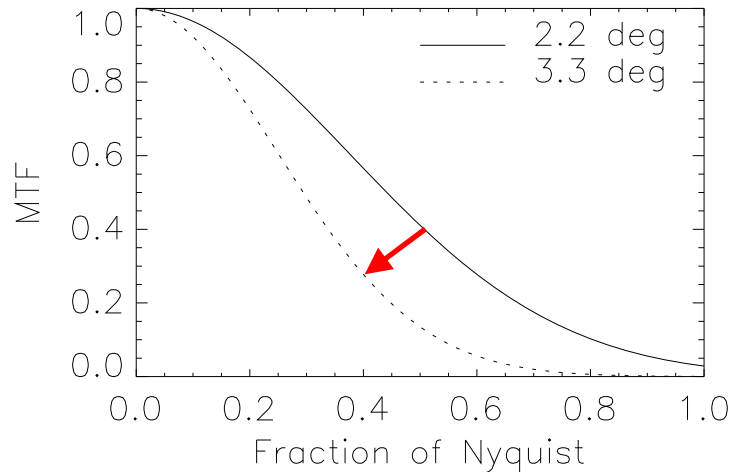




ATMS optimisation

- Temp sounding channels are 2.2° beam width, 1.1° sampling
- For global NWP, require low-noise, AMSU-like footprint: 3.3°
- Use Fourier techniques to manipulate the Gaussian beam shape (attenuate high spatial frequencies), then re-sample to desired output grid (e.g. CrIS)
- Noise reduction factor ~ 0.3
- Other applications will wish to retain the 2.2° beam width (e.g. cloud imaging)
- All this will be user-configurable in AAPP v7

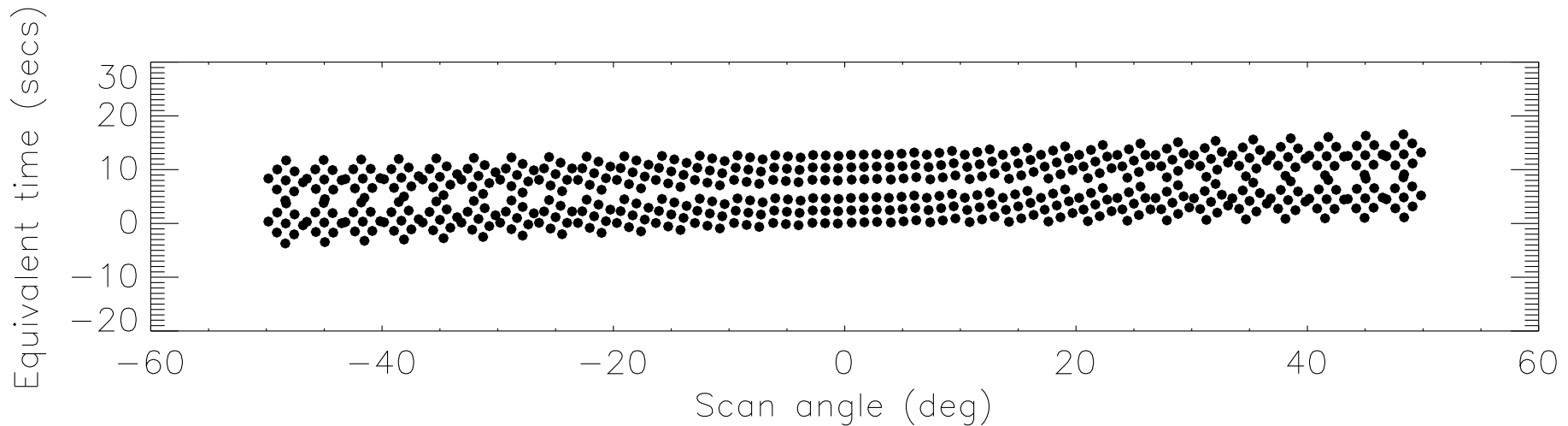
ATMS optimisation (cont.)



- Broaden beam width by multiplication in spatial frequency domain
- Sampling remains at 1.1° in scan angle (cross-track), $8/3$ sec in time (along-track)
- Noise reduction according to RMS of ratio curve (2-D), 0.3 in this case
- Re-sample afterwards



CrIS scan pattern



FOV separation is 1.1° at nadir

9 FOVs per 3.3° step – pattern rotates across the scan

8 seconds per scan



Other AAPP developments

- Preparations for NOAA-N' (Feb 2009 launch)
- New version of MAIA (AVHRR cloud mask) – supporting IASI level 1c cluster analysis
- Any other developments requested by users?



Summary

- AAPP v6 well established for processing MetOp and NOAA satellites
- FY1D imager recently added
- IASI PCs compatible with ECMWF PC package - NWP SAF deliverable
- IASI OPS-LRS users advised to keep their software up to date even though AHRPT is off
- AAPP v6 forms the basis of RARS – Asia Pacific and South American networks are developing
- Preparations underway for NPP – but still hampered by lack of detailed information on data formats



Met Office



Questions and answers

International TOVS Study Conference, 16th, ITSC-16, Angra dos Reis, Brazil, 7-13 May 2008.
Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center,
Cooperative Institute for Meteorological Satellite Studies, 2008.