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
- Regional ATOVS Retransmission Services
- NPP and NPOESS

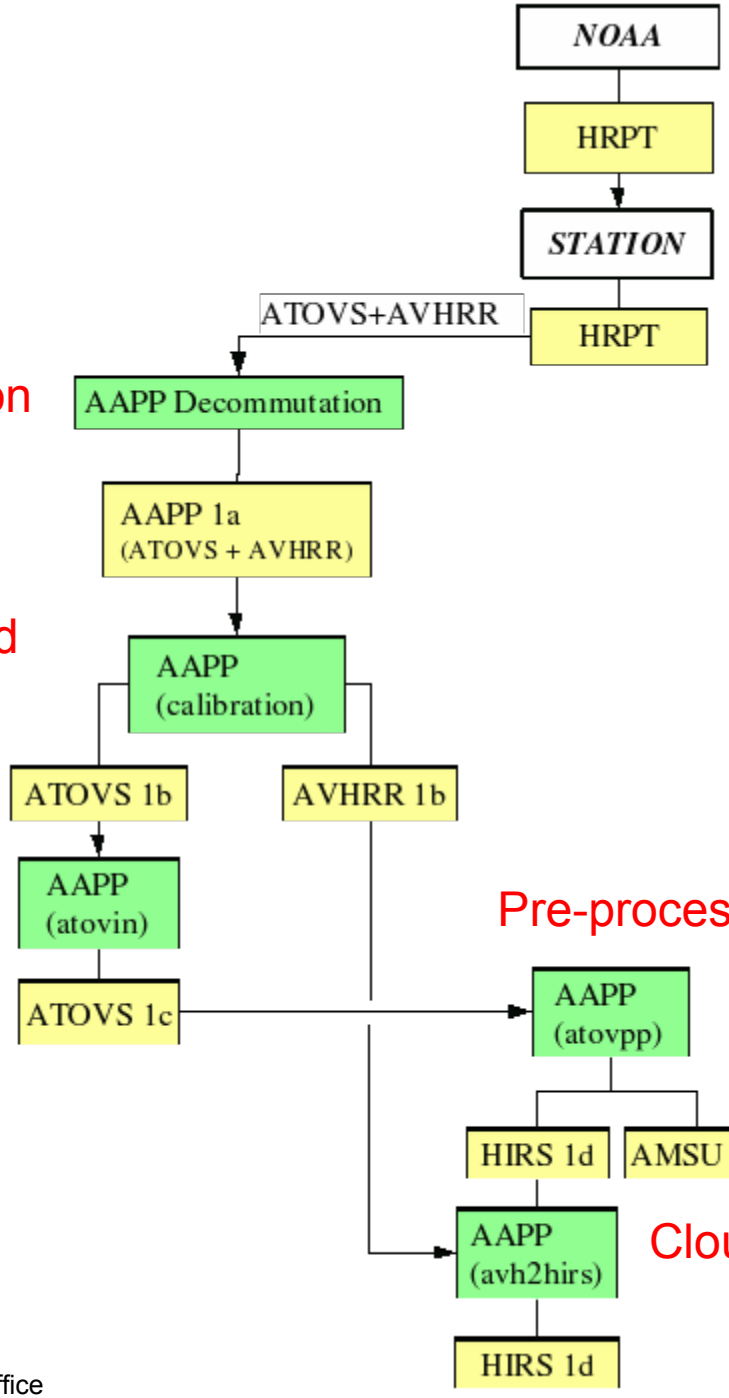
AAPP package

- 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

Pre-processing

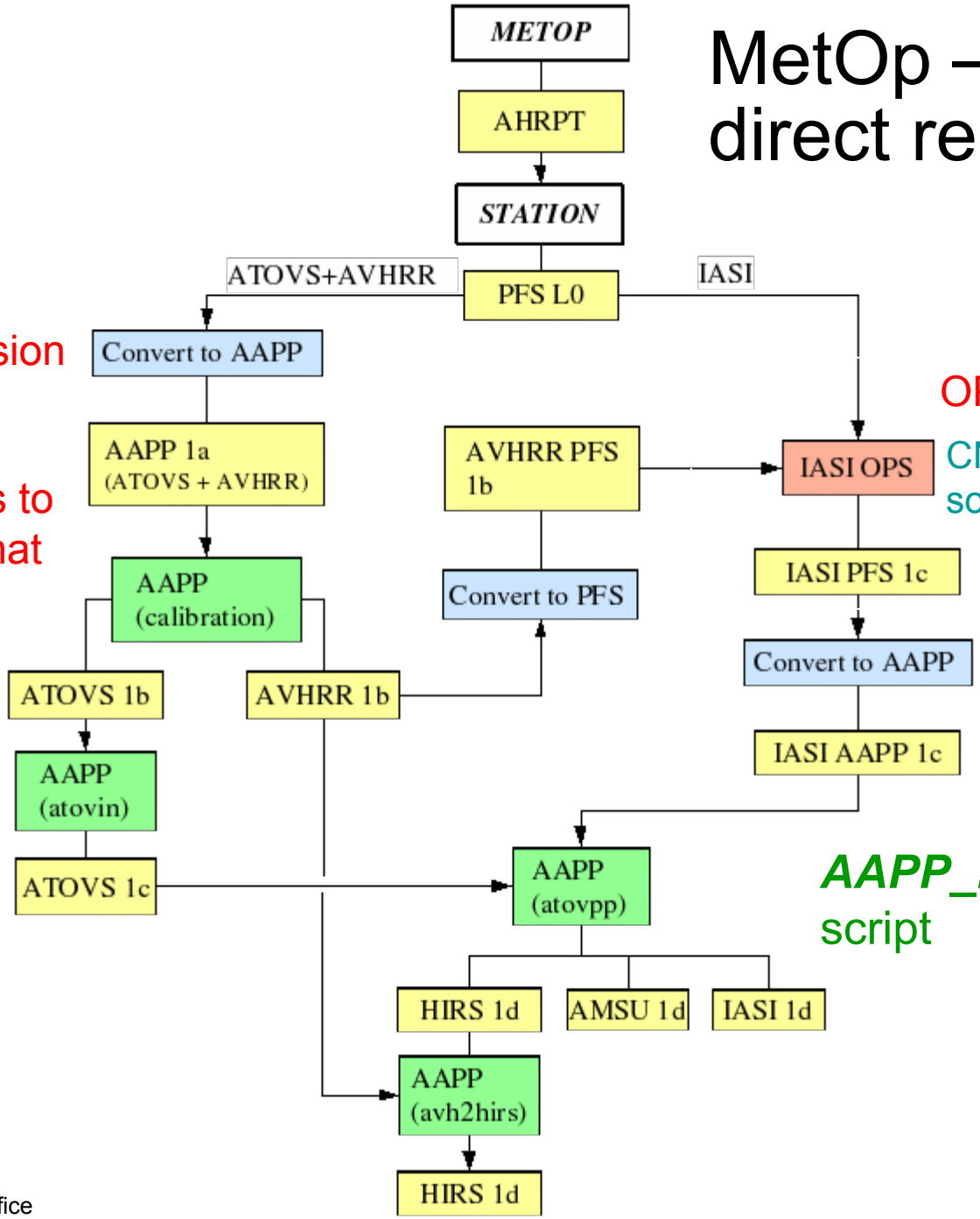
Cloud mask

AAPP_RUN_NOAA
script

MetOp – direct readout

Format conversion tools

Note: station has to deliver EPS format



OPS-LRS

CNES/Thales software

AAPP_RUN_METOP script

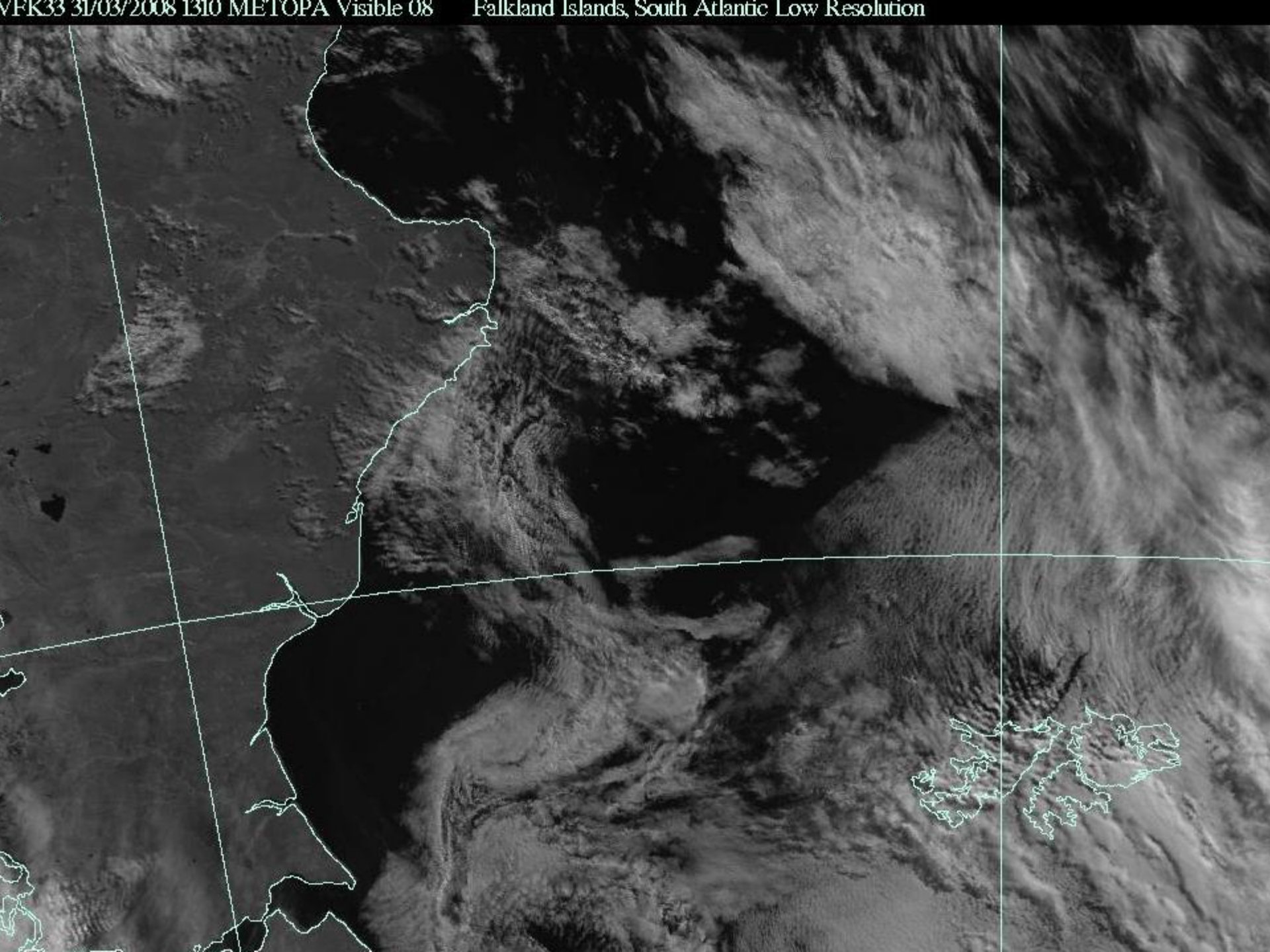
MetOp HRPT failure

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


VFK33 31/03/2008 1310 METOPA Visible 08 Falkland Islands, South Atlantic Low Resolution

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
- Decommutation 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: **y**
  2. Form covariance matrix for each spectrum: $\mathbf{y}\mathbf{y}^{\mathrm{T}}$
  3. Sum covariances: $\mathbf{Y}\mathbf{Y}^{\mathrm{T}}$ (no limit to number of spectra!)
  4. Generate eigenvectors, **U**, using PCA:

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

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

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

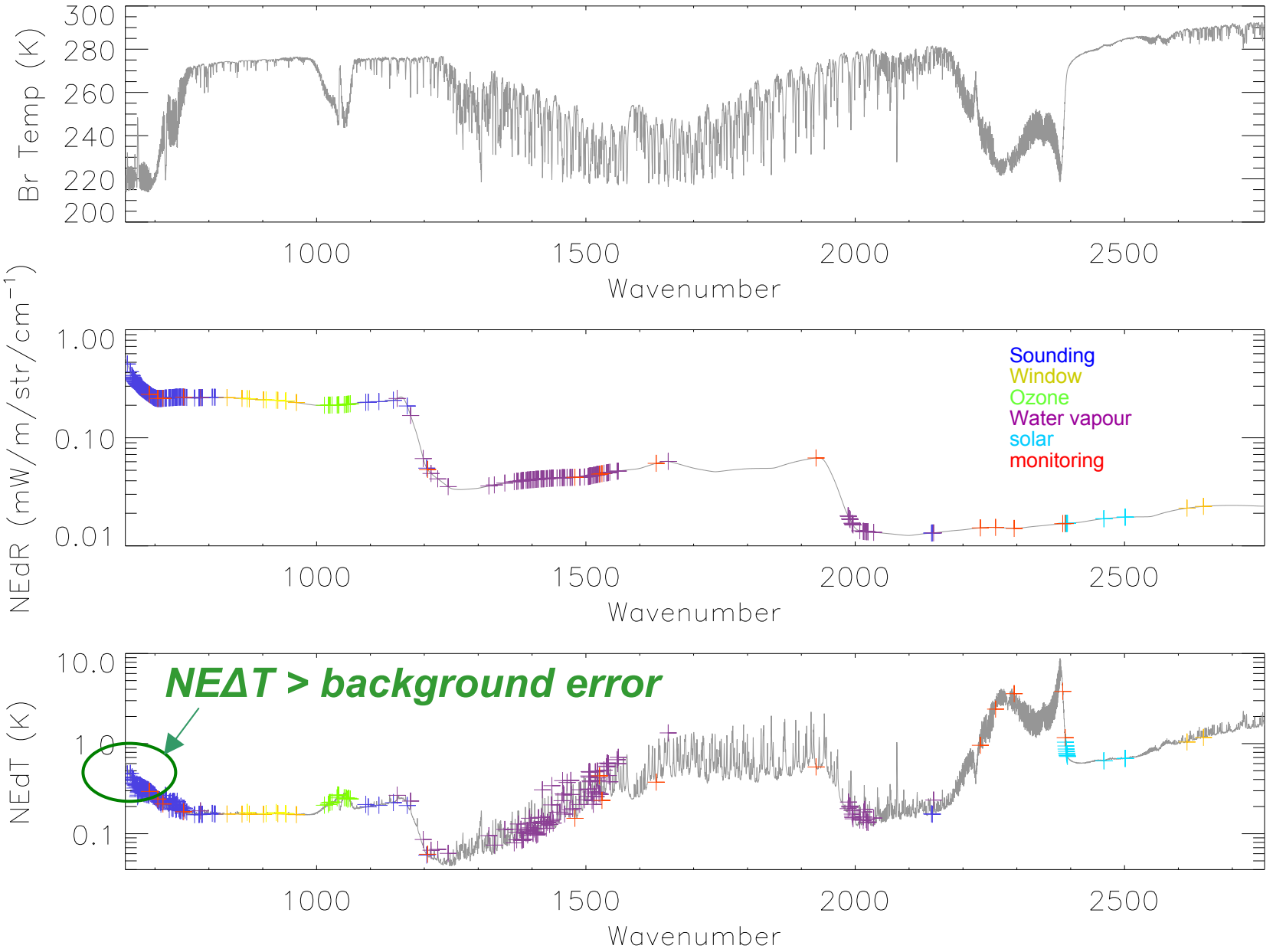
- Finally, reconstruct radiances if required (external to AAPP)

Conclusions on Reconstructed Radiances

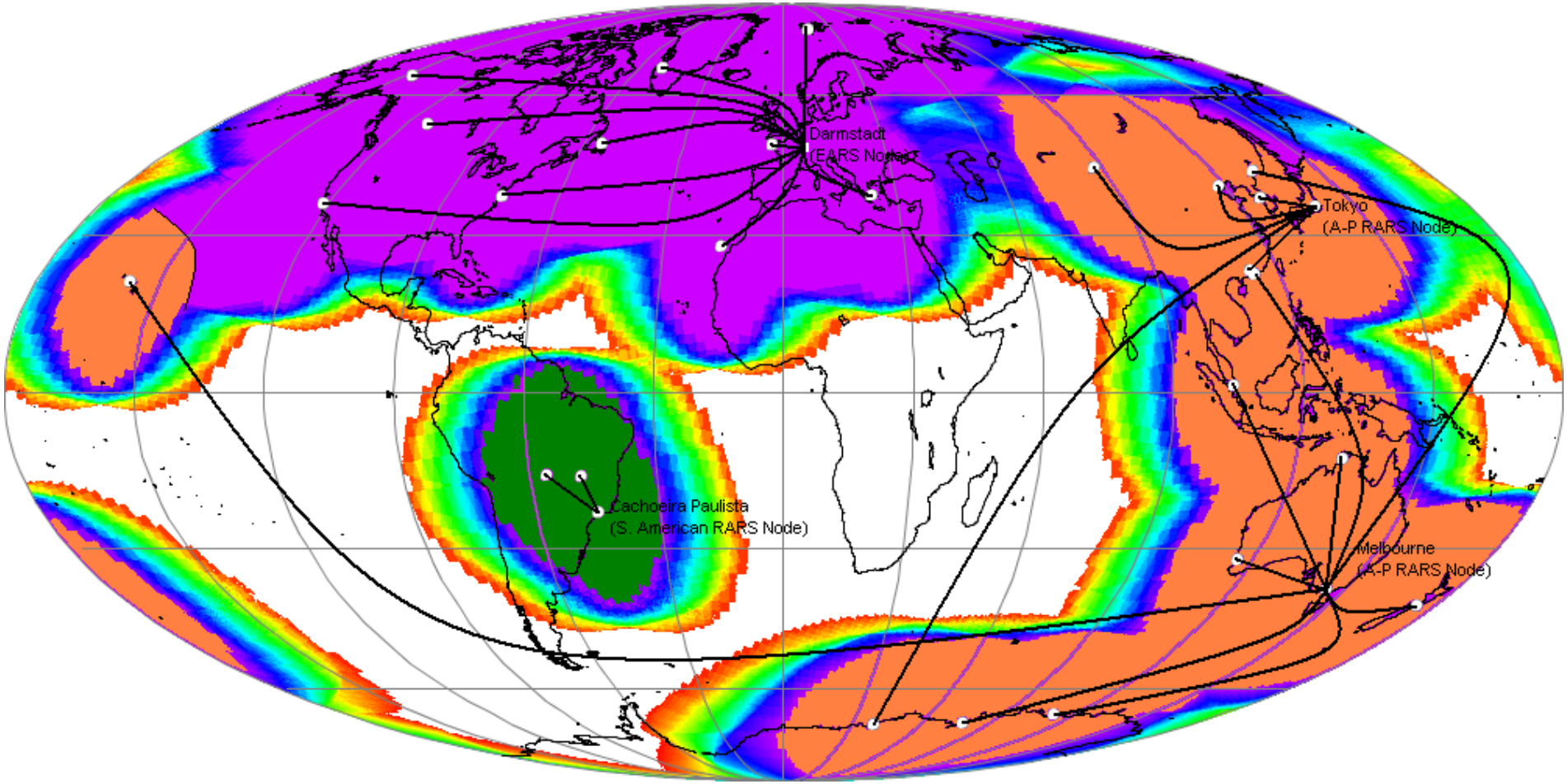
- 125 to 150 PCs is about the optimum for global training set – removes most of the random noise. Noise reduction factor ≈ sqrt(150/8461) = 0.13
  - **See poster by Elliott, Hultberg and Schlüssel**
- Don't use too many PCs – or you will add noise
- Can do the three spectral bands separately, but require 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)



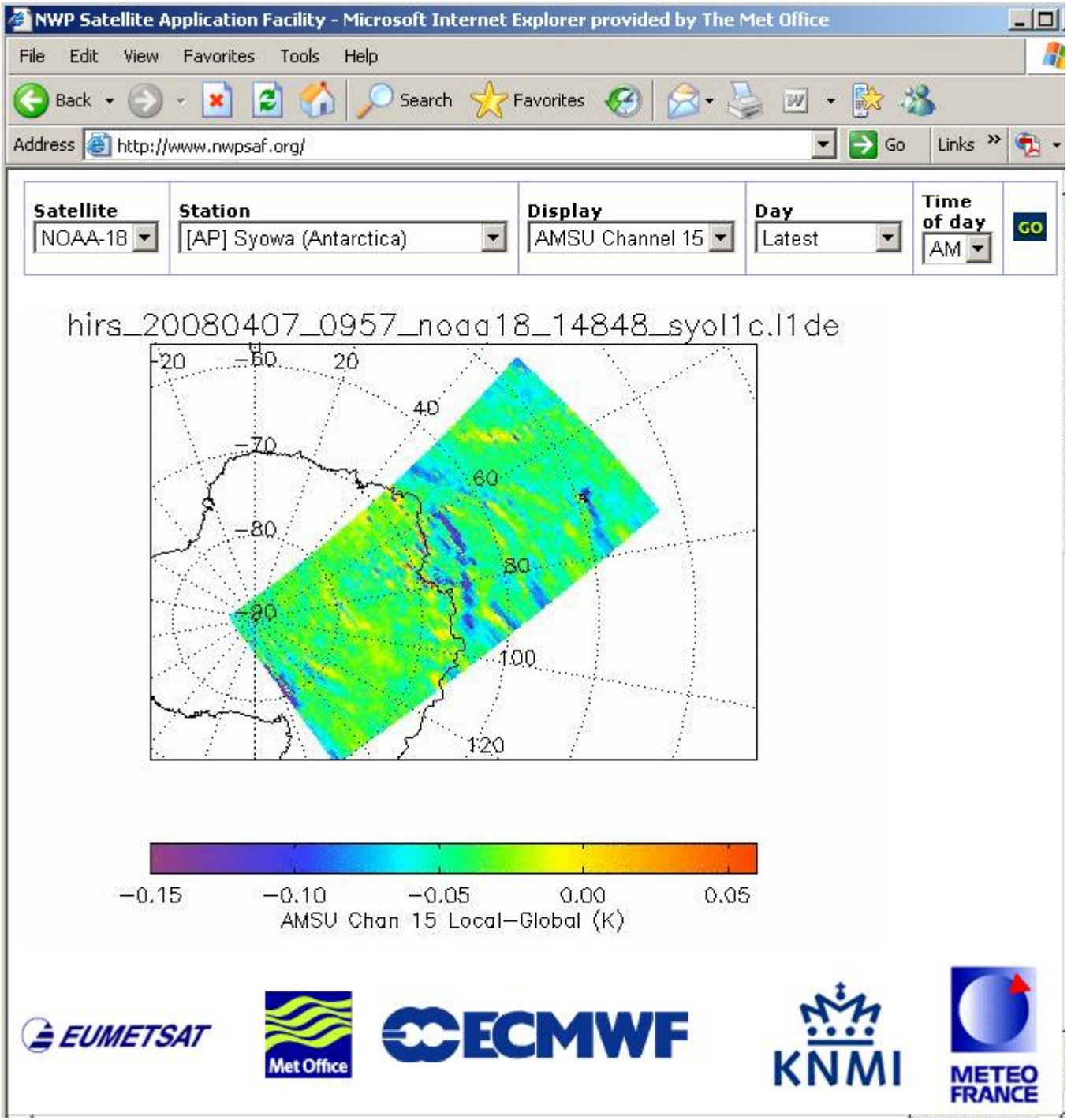
RARS networks at end 2007 (from WMO web page)

RARS

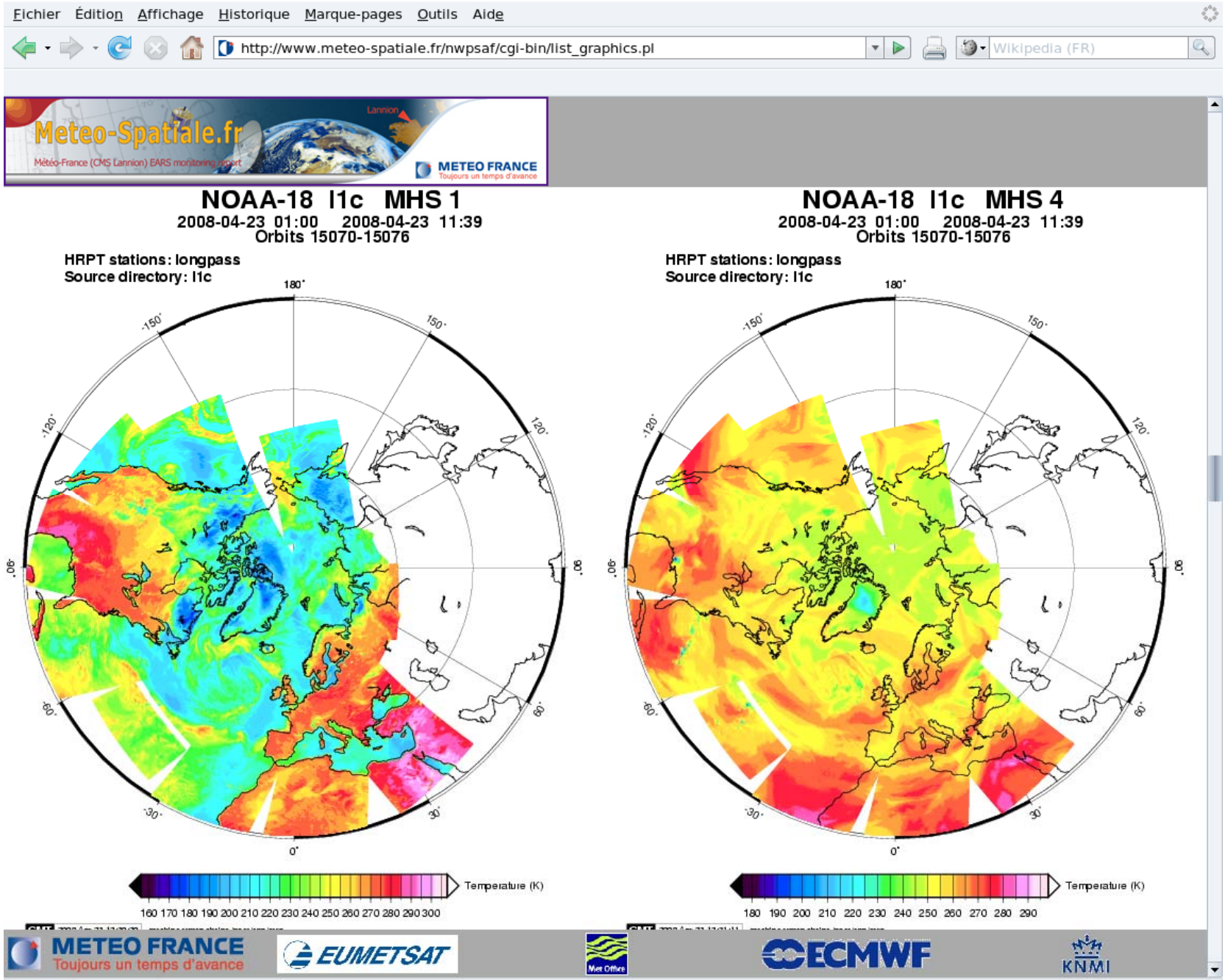
- Aim is to re-broadcast ATOVS data with a timeliness of 30 minutes
- Data distributed via GTS and/or FTP
- *AAPP used at each reception station*
- NWP SAF monitors the data quality, by comparison with global data (from NOAA and EUMETSAT)
- See Brett Candy's poster for forecast impact
- More stations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

NWP SAF RARS monitoring

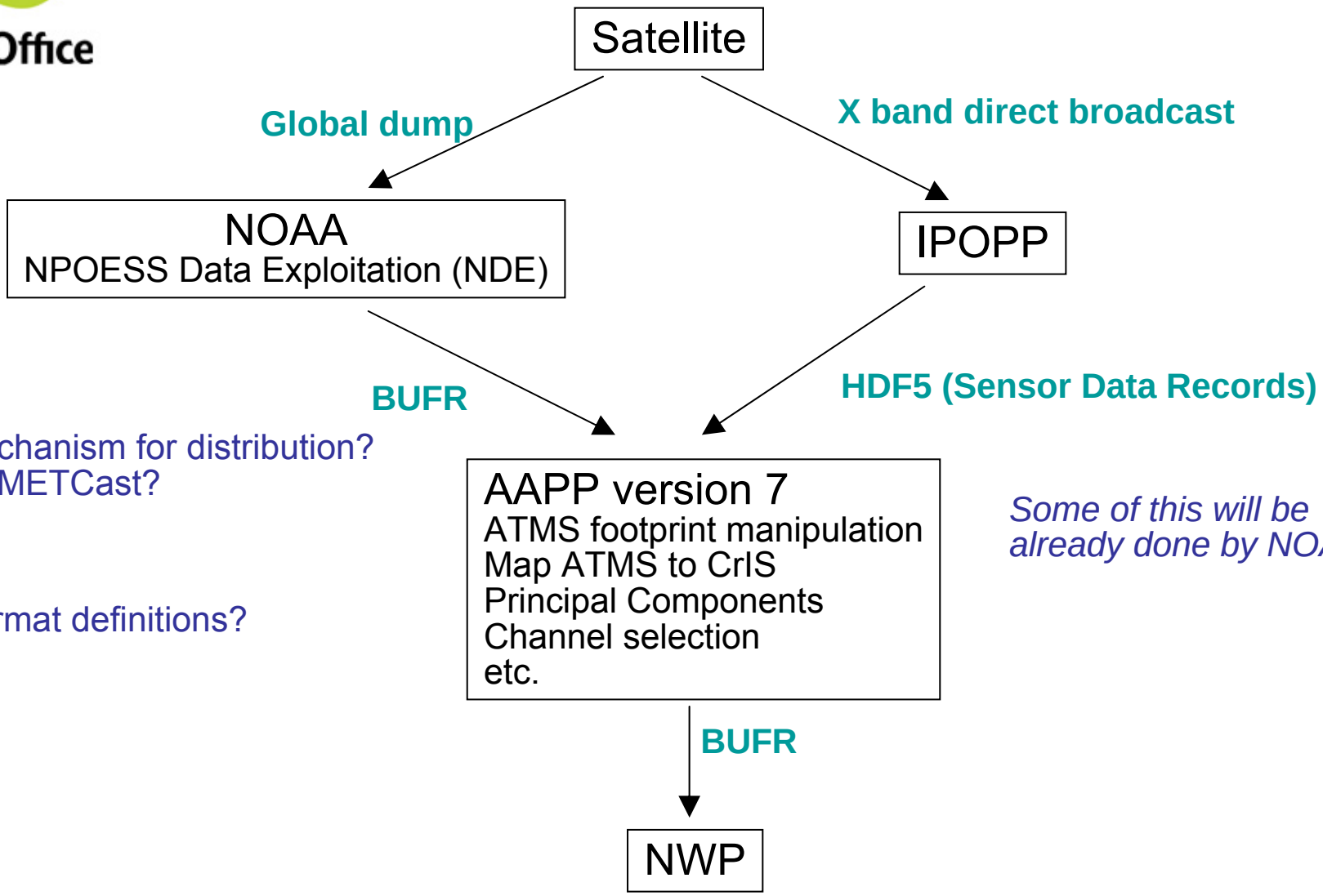
www.nwpsaf.org



EARS monitoring at Météo-France



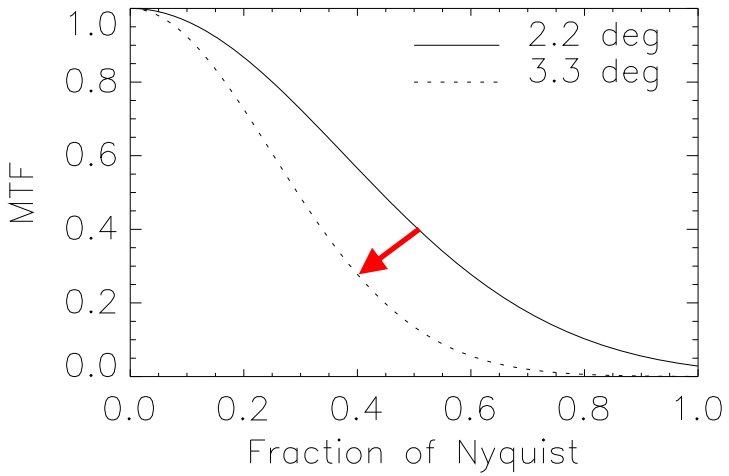
NPP – ATMS and CrIS radiances

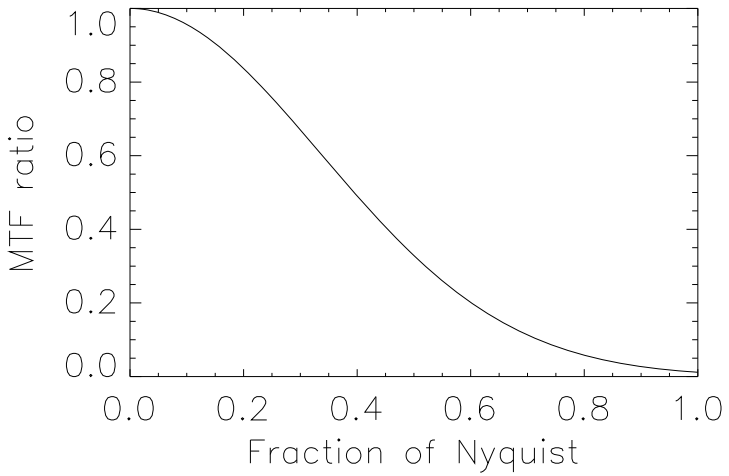


ATMS optimisation

- Temp sounding channels are 2.2º beam width, 1.1º sampling
- For global NWP, require low-noise, AMSU-like footprint: 3.3º
- 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 2.2º beam width (e.g. cloud imaging)
- All this will be user-configurable in AAPP v7

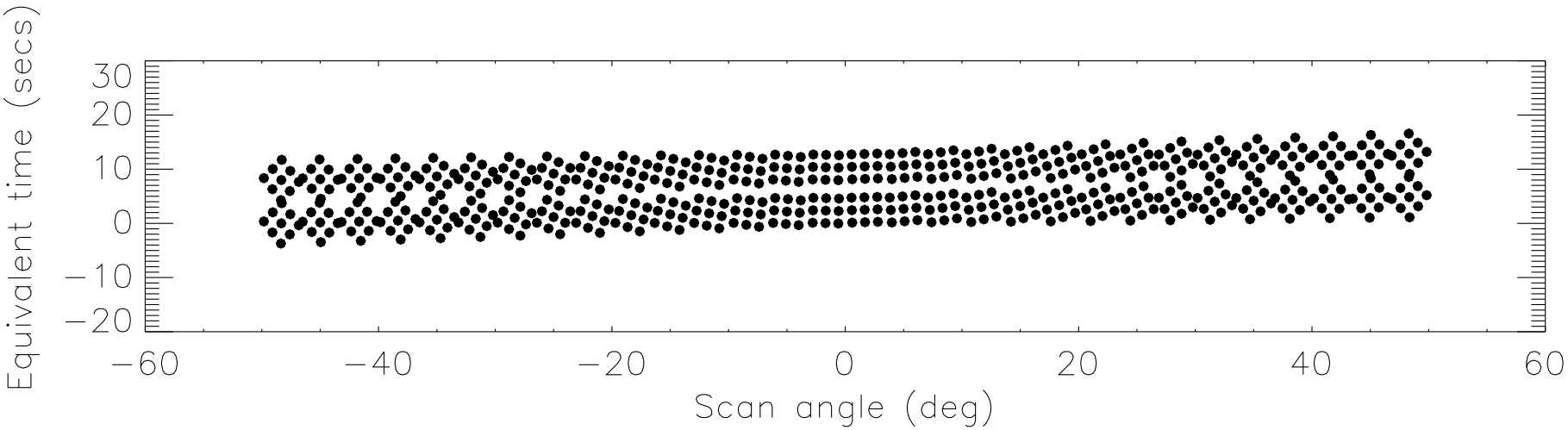
ATMS optimisation (cont.)





- Broaden beam width by multiplication in spatial frequency domain
- Sampling remains at 1.1º 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 1.1º at nadir

9 FOVs per 3.3º 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

Questions and answers