Further development of the ATOVS and AVHRR Processing Package (AAPP)

including an initial assessment of EARS radiances

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Contents

- Status of AAPP version 4

- Developments for NOAA-N,N' (version 5) and METOP

- Use of data from EUMETSAT ATOVS Retransmission Service (EARS)

AAPP Version 4 changes

1) Improved documentation
   - Scientific description (pdf)
   - Software description (pdf)
   - Data formats document (pdf)
   - AAPP Overview (pdf)
   - Installation guide (html)

2) Fortran 90 compatible
   - Compiles under selected F90 and F77 compilers, with no significant differences in output

3) Moon in AMSU-A space view
   - Detects and corrects moon contamination in AMSU-A space view (at 1b -> 1c stage)
   - Method used at Met Office for some time
   - Interpolate gain
   - Different from method to be implemented by NESDIS at 1b level (correction based on antenna patterns), but no conflict

AAPP Version 4 changes (cont.)

4) Antenna efficiencies

- `atovin/infdf.F` modified to allow different antenna efficiencies for different satellites

5) 'Bug' in surfelev.F

- Old code gave different answers for f77 & f90 compilers

Status:

- Valuable comments received from beta-testers at KNMI and Wisconsin

- Version 4 being distributed by EUMETSAT October 2003

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Developments for NOAA-N, N'

NOAA-N launch expected summer 2004

Changes will be incorporated into AAPP version 5, to be released following NOAA-N launch

- Main differences from NOAA-KLM:
  - MHS instead of AMSU-B
  - HIRS/4 instead of HIRS/3
- Progress so far:
  - Code changes for MHS complete; being tested using NOAA-N thermal vacuum data

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MHS

Main differences between MHS and AMSU-B:

- Channel 20: 190.31 GHz instead of 183.31±7
- Channel 17: 157 GHz instead of 150
- Channels 18 & 19: H polarization at nadir instead of V
- Spare local oscillators (LO-A, LO-B), characterized separately
- Spare processing electronics (PIE-A / PIE-B)
- Method of computing on-board target temperature (using 3 precision resistors)

In AAPP:

- Decode MHS data in HRPT data stream
  - MIU (MHS Interface Unit) on NOAA spacecraft outputs MHS data into HRPT words previously used for AMSU-B
- New 1b definition (`mhs1b.h`) and calibration program (`mhscl`)
- Otherwise, differences can be accommodated within existing structure. No changes at level 1c or beyond (use `amb1c.h`).
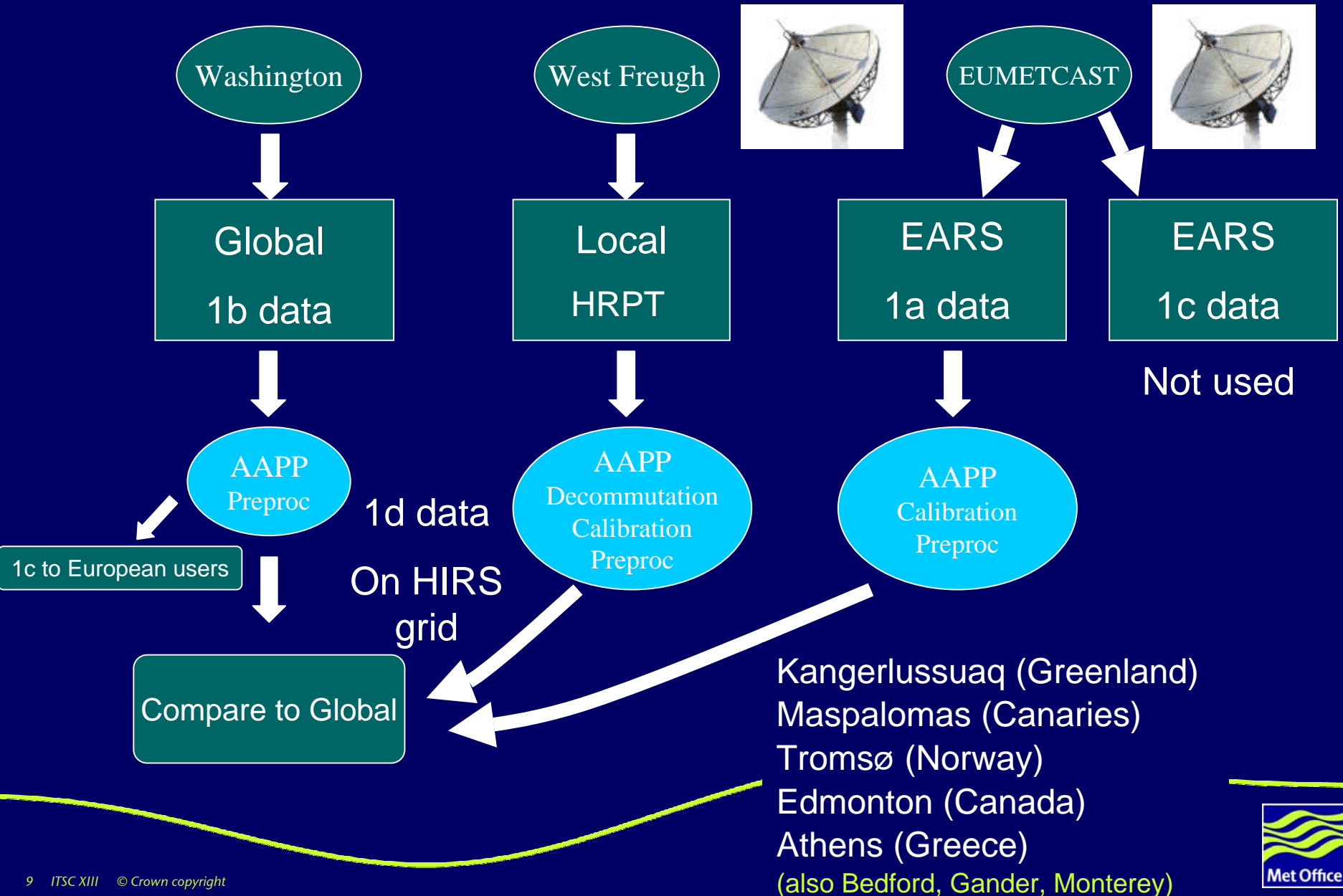
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Other changes for Version 5

- Implement new HIRS calibration algorithm (v4.0) as an option

- Minor additions to AMSU-A 1b format (following NOAA recommendations)

- Improved navigation (2-line elements with SGP4)

- Moon detection in AMSU-B / MHS space view
  - Similar to that already implemented for AMSU-A, but at `amsubcl / mhscl` stage
  - Reject space view samples too close to predicted position of moon (up to 3 of the 4 samples)
  - Same method will be used by NESDIS (performs better than current NESDIS method)

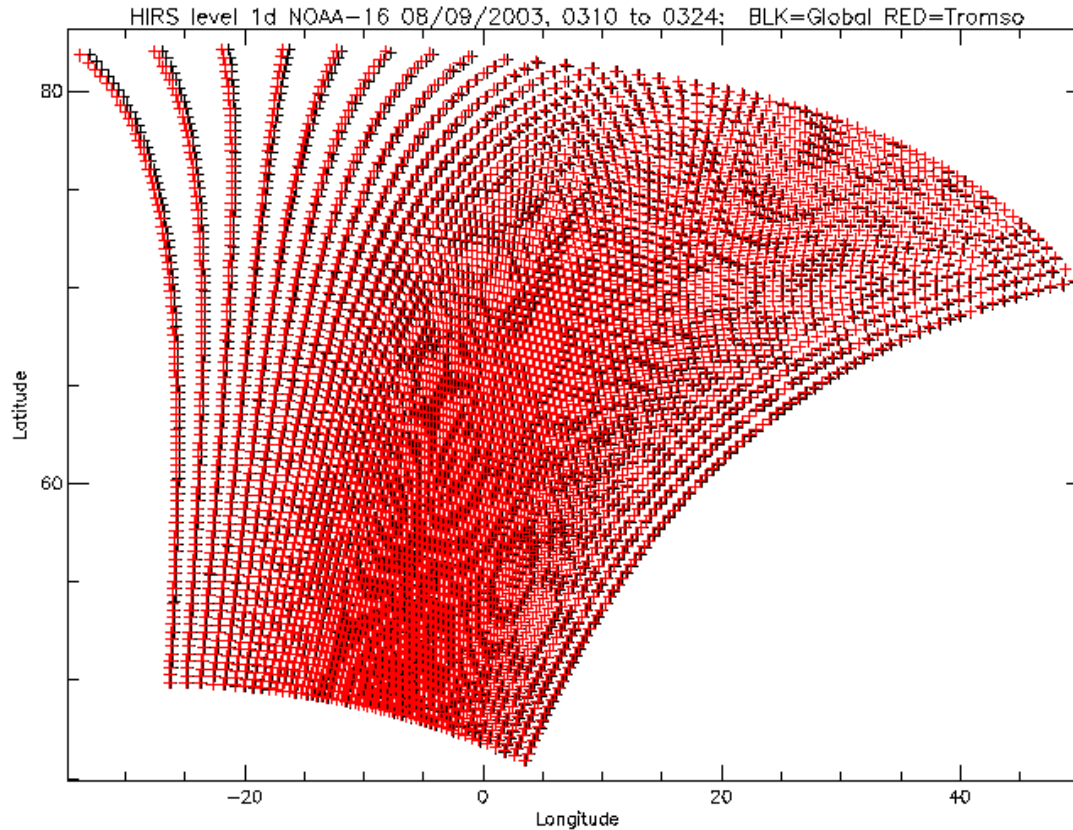Met Office

Developments for METOP direct broadcast

- NWP SAF working with EUMETSAT on development of AAPP for the METOP era

- Instruments supported: ATOVS + IASI

- EPS user terminals:
  - Supplied by EUMETSAT
  - Software (written by industry) to receive direct broadcast
  - Interface for AAPP will be EUMETSAT level 0 (i.e. the EUMETSAT equivalent of NOAA level 1a)
  - SPOT-5 orbital prediction model to be used
  - The 'Admin' message will contain information related to navigation, spacecraft manoeuvres, etc.

- IASI code being developed by CNES

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EARS Data Acquisition and comparison

```
Washington          West Freugh                      EUMETCAST

     ↓                   ↓                         ↓          ↓

  Global              Local                     EARS        EARS
  1b data             HRPT                      1a data     1c data

     ↓                   ↓                         ↓          Not used

  AAPP                AAPP                      AAPP
  Preproc             Decommutation             Calibration
                      Calibration               Preproc
   ↓  ↘               Preproc
```

1d data

On HIRS grid

1c to European users

Compare to Global

Kangerlussuaq (Greenland)
Maspalomas (Canaries)
Tromsø (Norway)
Edmonton (Canada)
Athens (Greece)
(also Bedford, Gander, Monterey)

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Mapping Compared to Global

Tromsø Data

HIRS level 1d NOAA-16 08/09/2003, 0310 to 0324; BLK=Global RED=Tromso

Black=Global

Red=EARS

Latitude

Longitude

Reasons for mapping differences

- **Orbit prediction**
  - Met Office: TBUS received daily via GTS
  - EARS 1c: TBUS info from NOAA web site
    http://noaasis.noaa.gov/NOAASIS/ml/navigation.html
  - NESDIS global: more sophisticated US military data

- **Re-mapping to HIRS**
  - NOAA-16 & NOAA-17 HIRS misaligned
  - NESDIS assume 1.8 deg for both
  - AAPP assumes 2.0° & 1.7° respectively, based on comparisons with AVHRR (hard-coded in `include/timang.h`)

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Brightness Temperature Comparison

AMSU-15

Global -Tromsø   Global -Local
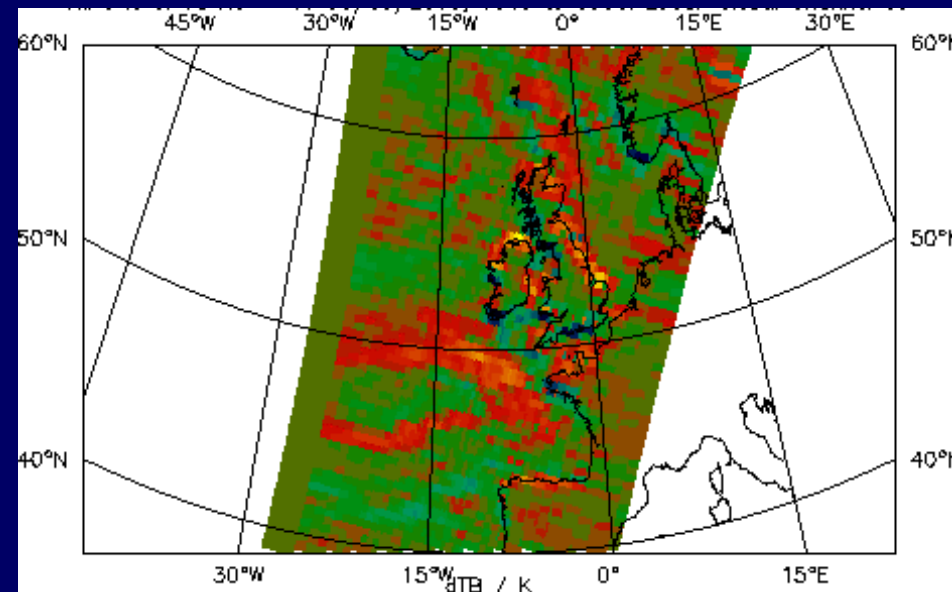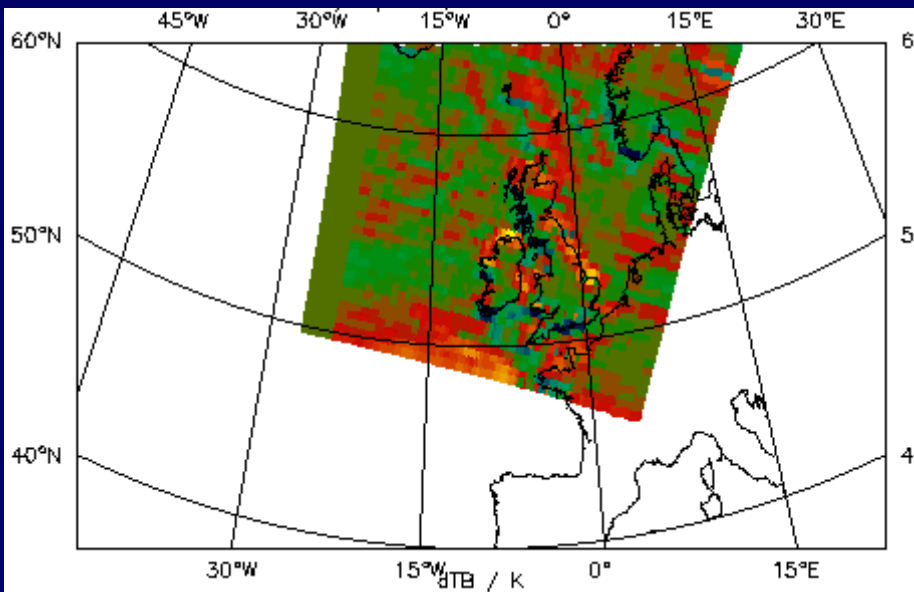
Reasons for brightness temperature differences

- **Re-mapping to HIRS grid**
  - AMSU brightness temperatures are consistent to 0.01K at level 1c

- **HIRS calibration**
  - Partial super-swaths at start and end of overpass
  - Combine EARS 1a datasets before calibrating?
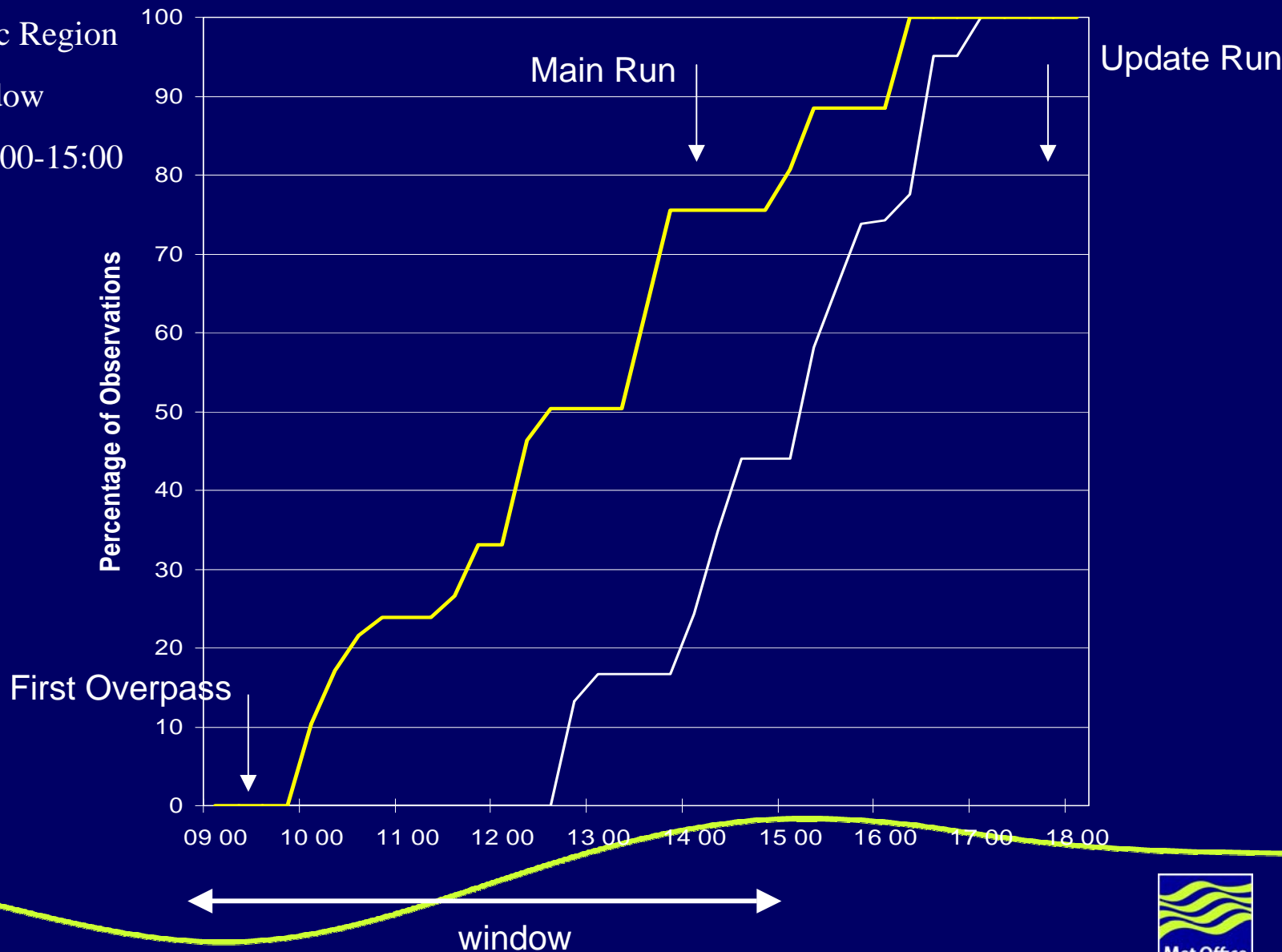 - New NOAA HIRS calibration method (v4.0) may help. Météo-France updating calibration algorithm for AAPP.

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Arrival Times of Data

Global 109229 obs —— EARS 93979 Obs
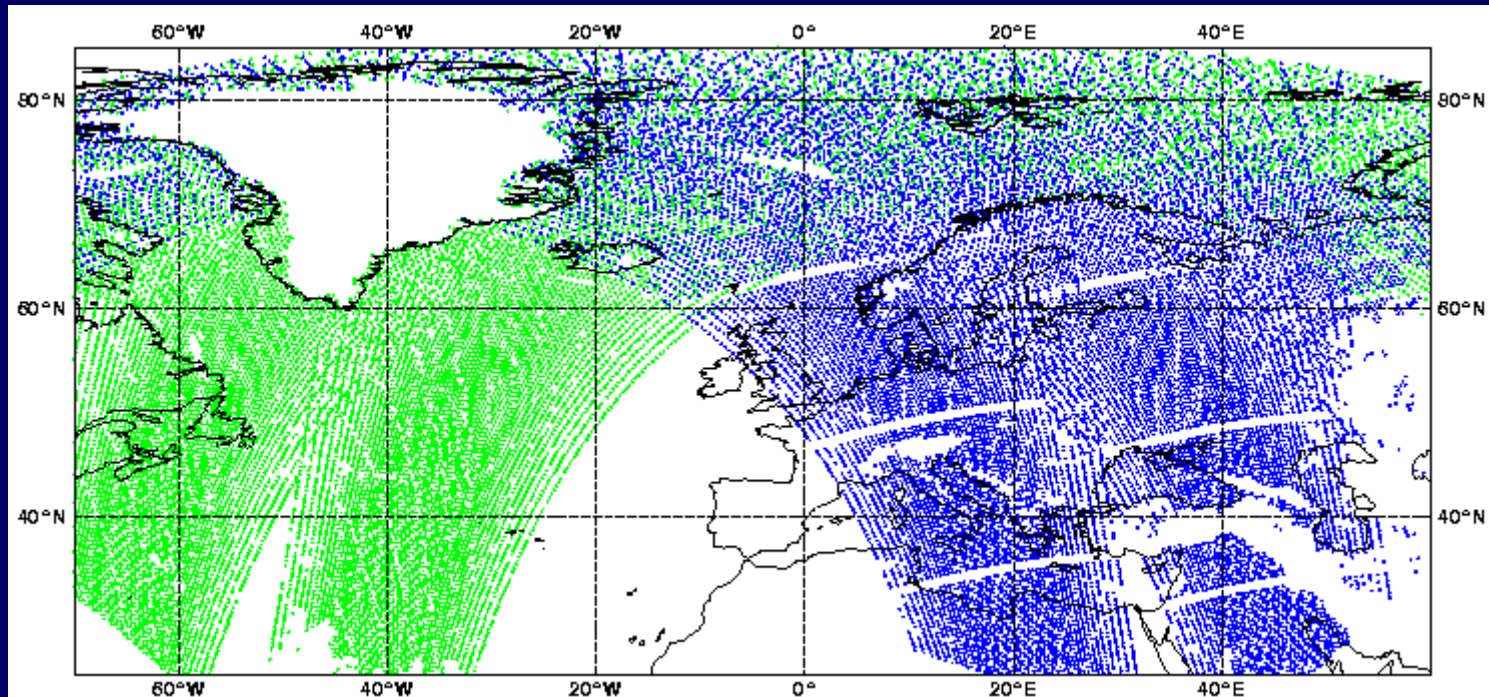
- North Atlantic Region
- six-hour window

09/09/2003 09:00-15:00

Percentage of Observations

Main Run

Update Run

First Overpass

window

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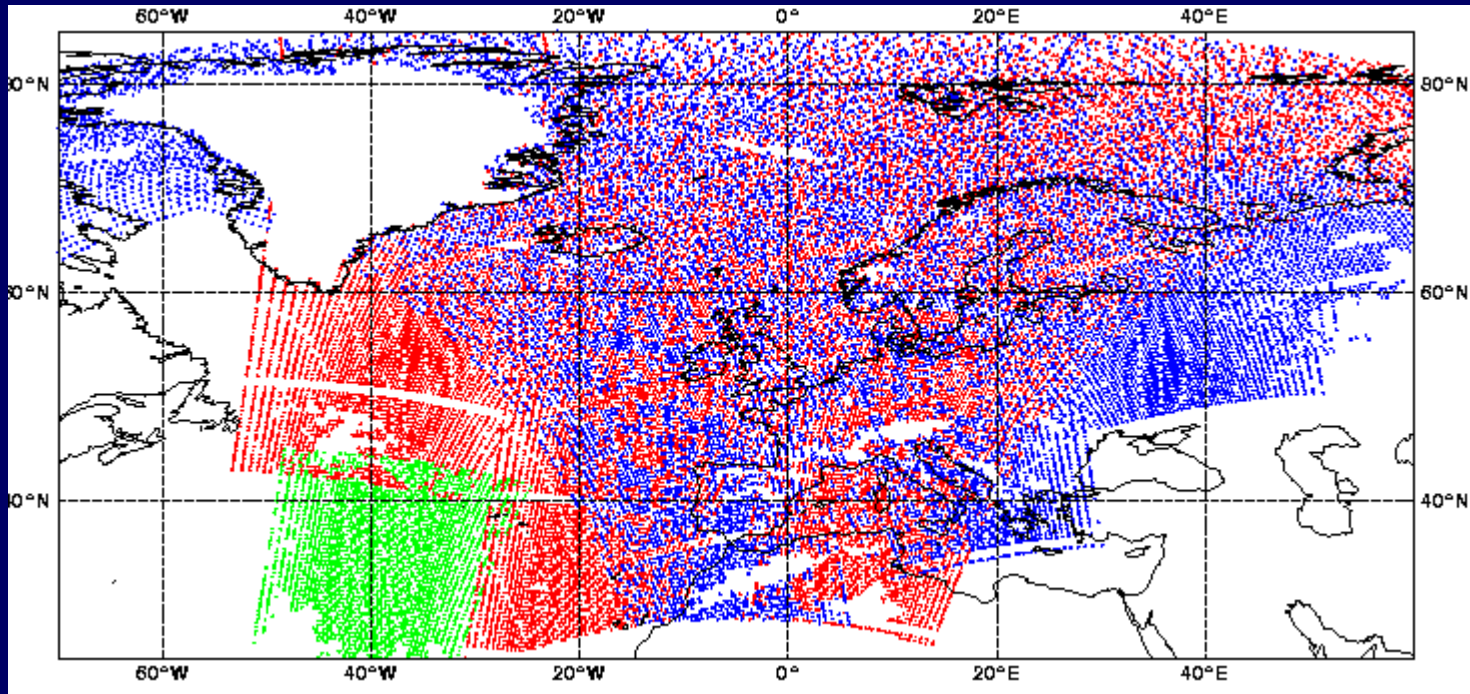# Global AMSU Data Used in the Main Run

six-hour window 09/09/2003 09:00-15:00

Green: NOAA 15   Blue: NOAA 16   Red: NOAA 17

Available EARS AMSU Data

six-hour window 09/09/2003 09:00-15:00

Green: NOAA 15 Blue: NOAA 16 Red: NOAA 17

- Assimilation trials using EARS to commence in autumn 2003

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Conclusions

- AAPP v4 released

- Work underway for NOAA-N and METOP

- EARS comparisons with NESDIS data performed routinely

- Monitoring in the operational system suggests good quality for assimilation & ability to fill in 'blind orbits'

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