AAPP status report and review of developments for NOAA-N and METOP

Nigel Atkinson

30th May 2005

Acknowledgements: Steve English, Amy Doherty (Met Office)
Pascal Brunel, Tiphaine Labrot, Philippe Marguinaud (Météo-France)
Aarno Korpela (NIWA)
Status of AAPP version 4

Developments for AAPP version 5

Plans for METOP and AAPP version 6

Plans for NPP and NPOESS
AAPP – a reminder

- Pre-processing package for polar orbiter data
- Maintained by EUMETSAT Satellite Applications Facility for Numerical Weather Prediction (NWP-SAF)
- Lead institute - Met Office
- ~200 licensed users worldwide
- Runs on a range of Unix and Linux computer platforms
Current status

Updates to AAPP v4.0

- **Update 4.4, 31/8/04:**
  1) Linux compatibility (also Windows via MS Services For Unix)
  2) Improved robustness in decommutation
  3) Utility to compare output files from different platforms (*atovsCompare*)
  4) Big/little-endian conversions
  5) Processing of NOAA-17 to level 1d
  6) 1d flag for fewer co-locations than expected in re-mapping AMSU-A to HIRS

- **Update 4.5, 03/02/05:**
  - Updated AMSU-B calibration parameters file (gross limits)

- See also list of bugs on web page
- New NESDIS 1b formats (from 28/4/05) are compatible with AAPP-4
Administrative changes

- Now distributed by NWP-SAF (previously by EUMETSAT)
- Enquiries and licensing handled by NAP-SAF helpdesk
- AAPP web site is via http://www.metoffice.com/research/interproj/nwpsaf/
- FTP server for update versions: thorn.metoffice.gov.uk (command line ftp only)
- User email forum is still operated by EUMETSAT
  - L-aapp@listserv.eumetsat.int (note recent address change)
  - Subscribe via listserv@listserv.eumetsat.int
- Separate registered user email list held at Met Office
Includes the following enhancements:

- NOAA-N capability (including MHS)
- New HIRS calibration method (based on NOAA v4)
- Updated navigation – ability to use 2-line elements
- Allow for moon contamination in AMSU-B and MHS
- Added NWC-SAF scattering index (Bennartz) to AMSU-B level 1d
- Use of instrument-specific scan characteristics, and removal of many hard-coded parameters

- V5.01 distributed to beta testers 28/4/05

- To be released as V5.1 following validation with NOAA-N data (approx 2 months after launch)
NOAA-N capability

- New calibration module *mhscl*
- New MHS 1b format (same as NOAA format)
- 1c format same as AMSU-B – with different instrument identifier
- Allow for non-ideal antenna reflectivity (small scan dependence)
- No change at level 1d
HIRS calibration

- Based on NOAA ‘version 4’ algorithm
- Can be used with HIRS/3 and HIRS/4
- Accumulate statistics of slope/offset and telescope temperature from previous overpasses
- Should improve results in partial super-swaths

![Graph showing Channel 19 counts at zero K (v4) vs. scan line with different line styles for AAPP v4, AAPP lin, and NESDIS]
In previous versions of AAPP, moon-contaminated AMSU-B scans were discarded by QC.

For V5, use astronomical formula to predict which (if any) of the 4 space view samples are contaminated.

Same method now used by NESDIS.
Moon in AMSU-B

Worst case: 3 samples out of 4 see moon,
But $a1$ coefficient still computed OK.

~4 minutes of data affected
2-line elements

- Alternative to TBUS
- Improved navigation accuracy for AVHRR
- Data available from [http://www.space-track.org](http://www.space-track.org) (need to register)
- AAPP-5 contains script for automatic download (using `wget`)

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Method</th>
<th>bias</th>
<th>sigma</th>
<th>r.m.s</th>
</tr>
</thead>
<tbody>
<tr>
<td>noaa16</td>
<td>tbus</td>
<td>-2.92</td>
<td>1.25</td>
<td>3.17</td>
</tr>
<tr>
<td></td>
<td>2line</td>
<td>-0.05</td>
<td>0.76</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>argos</td>
<td>0.61</td>
<td>0.80</td>
<td>1.01</td>
</tr>
<tr>
<td>noaa17</td>
<td>tbus</td>
<td>4.70</td>
<td>1.95</td>
<td>5.09</td>
</tr>
<tr>
<td></td>
<td>2line</td>
<td>-0.06</td>
<td>0.66</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>argos</td>
<td>0.78</td>
<td>1.00</td>
<td>1.27</td>
</tr>
</tbody>
</table>

Extrapolation error in km per day, from 2003/09/22 to 2004/03/15
How to get AAPP V5.1

- Availability will be announced via l-aapp@listserv.eumetsat.int and http://www.metoffice.com/research/interproj/nwpsaf/
- Users will need to register via NWP-SAF web page
- Distribution will be on CD-ROM, as for previous releases
Requirements for METOP:

IASI data processing overview

As presented to EUMETSAT Science Working Group
Pre-processing at the NWP centre:

Optional steps:
- Gross quality control
- Identify surface type and altitude
- IASI (+AVHRR) cloud tests
- Map AMSU-A and MHS to IASI
- Eigenvector compression
- Truncated eigenvector decompression ("reconstructed radiances")
- **Data subset selections:**
  - Selected fields of view
    - Fixed grid
    - Warmest fov
    - Cloud free fovs
  - Channel or eigenvector coefficient selection
- Data formatting (e.g. BUFR)

“Level 1d” stored in observations database

Local pre-processing
At NWP centres
AAPP Version 6 - METOP

EUMETCAST
Global ATOVS + EARS
or GTN

METOP AHRPT
(CCSDS packets)

ATOVS

BUFR decode

ATOVS 1a/b

AAPP

ATOVS 1c

ATOVS 1d

ATOVS/IASI 1d

IASI ‘level 0’

OPS
(CNES)

IASI 1c

EUMETCAST
Global IASI
or GTN

X-band

NB: IASI 1c = calibrated, corrected & Gaussian apodised

User options (flexible):
• AMSU mapped to IASI
• Spatial thinning
• Reduced channel set and/or
• Eigenvector scores
Met Office plans for IASI

- Cannot store all IASI channels (or process in NWP)
- Plan to store ~300 channels initially
  - Channel selection work in progress
- Also ~300 Eigenvector scores (sig/noise) \( c = U^T N y \)
  - 8641 point radiance spectrum \( y \)
  - Eigenvectors \( U \) to be computed off-line from training dataset (self apodised, noise normalised)
  - \( N \) does the noise normalisation for \( y \) (NE\( \Delta R \) + de-apodisation)
- Initially spatially thinned to 1 spot in 4 (1 detector per scan pos)
- Data rate factor 30 less than raw IASI, but still ~10 times that of ATOVS 1d!
- An internal BUFR format has been devised for IASI (+ AMSU) level 1d
X-band reception System at Exeter
NPP and NPOESS

- AAPP development effort will concentrate on METOP, but would like to process NPP
- New instruments – CrIS, ATMS, VIIRS
- X-band direct broadcast – interface AAPP with output from NASA’s direct broadcast software?
- Global data distribution via NOAA? Details not yet clear
- Need information on formats ASAP
Conclusions

- AAPP is used worldwide to pre-process direct-readout and global polar orbiter data
- Available via NWP-SAF web site
- Version 5 is being beta-tested and will be released ~2 months after launch of NOAA-N
- Preparations well underway for METOP-compatible version, including IASI
- Plan to extend for NPP and NPOESS – but need detailed information on instruments and formats as soon as possible

*Thanks to CMS (Météo-France) for their contributions to AAPP development*