MONITORING WEATHER AND CLIMATE FROM SPACE

Evolution of the EUMETSAT Advanced Retransmission Service (EARS)

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EUMETSAT
EUMETSAT Advanced Retransmission Service (EARS)

Objective
To provide Users with high timeliness regional data from Polar Orbiting Meteorological Satellites in support of Numerical Weather Prediction (NWP) and Nowcasting (NWC).

Principle
Achieved through a network of Direct Broadcast stations receiving, processing and distributing data to Users in near real time.
Past Evolution 2002-2014

- **ATOVS**
- **AVHRR**
- **ASCAT**
- **IASI**
- **CrIS**
- **ATMS**
- **NWC**
- **VIIRS**

**Services**
- **SNPP** X-Band 15 Mbs
- **FY-3C** L/ X-Bd 18 Mbs

**Satellites**
- **POES** L-Band 665 kbs
- **Metop** L-Band 3.5 Mbs

**Networks**
- **Network** 125 kbs
- **Network** 1 Mbs
- **Network** 2 Mbs
- **Network** 6 Mbs
## EARS - Services in Numbers

<table>
<thead>
<tr>
<th>Service</th>
<th>Daily Data Volume (MB)</th>
<th>Daily Data Volume (%)</th>
<th>Number of Registered Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARS-ATOVES</td>
<td>624</td>
<td>5%</td>
<td>1088</td>
</tr>
<tr>
<td>EARS-AVHRR</td>
<td>1341</td>
<td>11%</td>
<td>1435</td>
</tr>
<tr>
<td>EARS-ASCAT</td>
<td>129</td>
<td>1%</td>
<td>758</td>
</tr>
<tr>
<td>EARS-IASI</td>
<td>132</td>
<td>1%</td>
<td>241</td>
</tr>
<tr>
<td>EARS-NWC</td>
<td>1040</td>
<td>8%</td>
<td>202</td>
</tr>
<tr>
<td>EARS-ATMS</td>
<td>96</td>
<td>1%</td>
<td>188</td>
</tr>
<tr>
<td>EARS-CrIS</td>
<td>520</td>
<td>4%</td>
<td>187</td>
</tr>
<tr>
<td>EARS-VIIRS</td>
<td>8610</td>
<td>69%</td>
<td>146</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12492</strong></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>
EARS – Acquired Passes Per Day

Passes per Day

- EARS-ATOVS
- EARS-AWIRR
- EARS-ASCAT
- EARS-IASI
- EARS-NWC
- EARS-ATMS
- EARS-CIIS
- EARS-VIIRS
## International Cooperation (1/3)
### Processing Packages

<table>
<thead>
<tr>
<th>Package</th>
<th>Service</th>
<th>Level</th>
<th>Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAPP</td>
<td>ATOVS, AVHRR</td>
<td>Level-1</td>
<td>NWP SAF</td>
</tr>
<tr>
<td>OPS-LRS</td>
<td>IASI</td>
<td>Level-1</td>
<td>NWP SAF</td>
</tr>
<tr>
<td>RT-STPS</td>
<td>ATMS, CrIS, VIIRS</td>
<td>Level-0</td>
<td>NASA DRL</td>
</tr>
<tr>
<td>CSPP</td>
<td>ATMS, CrIS, VIIRS</td>
<td>Level-1</td>
<td>SSEC, UW-Madison</td>
</tr>
<tr>
<td>ASCAT PPF</td>
<td>ASCAT</td>
<td>Level-1 and -2</td>
<td>EUMETSAT, KNMI</td>
</tr>
<tr>
<td>PPS</td>
<td>NWC</td>
<td>Level-2</td>
<td>NWC SAF</td>
</tr>
<tr>
<td>FY3L1PP</td>
<td>VASS, MERSI</td>
<td>Level-1</td>
<td>CMA</td>
</tr>
</tbody>
</table>

**SAF**  Satellite Application Facility
International Cooperation (2/3)
DB Station Operators

- Centre de Météorologie Spatiale – Météo-France (CMS)
- Danish Meteorological Institute (DMI)
- Hellenic National Meteorological Service (HNMS)
- Instituto Nacional de Téchnica Aerospacial (INTA)
- Kongsberg Satellite Services (KSAT)
- Meteorological Service of Canada (MSC)/Canadian Meteorological Centre (CMC)
- National Oceanic and Atmospheric Administration (NOAA)
- Directorate General of Meteorology and Air Navigation, Civil Aviation Affairs, Ministry of Transport and Communications, Sultanate of Oman (DGMAN)
- Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET)
International Cooperation (3/3)
Coordination and Guidelines

• **CGMS** – The Coordination Group for Meteorological Satellites ([www.cgms-info.org](http://www.cgms-info.org)):
  - Membership covers operators of meteorological and related R&D satellites and WMO;
  - Coordination includes: DB specifications, Satellite Orbits, Availability of Product Processing packages;

• **WMO** ([www.wmo.int/pages/prog/sat/rars_en.php](http://www.wmo.int/pages/prog/sat/rars_en.php))
  - Coordination and guidelines for Regional ATOVS Retransmission Services (**RARS**), covering North and South America, Europe and Asia Pacific;
  - Recently Extended to X-band reception and new satellites under the name Direct Broadcast Network (**DBNet**).
Future Evolution 2015-2025

- **VIIRS**
  - Day
  - Night

- **VAAS**

- **MERSI**

- **HI RAS (TBC)**

- **WIND RAD (TBC)**

- **EPS-SG Reg. Mission**

- **FY-3D**
  - L/X-Band
  - 45 Mbs

- **FY-3E**
  - X-Band
  - >45 Mbs

- **JSPP-1**
  - X-Band
  - 15 Mbs

- **NWC VIIRS**

- **Network**
  - 10 Mbs

- **Network**
  - 100 Mbs

- **Metop SG A1**
  - X-Band
  - 80 Mbs

- **Metop SG B1**
  - X-Band
  - 80 Mbs

- **Services**

- **Supported Satellites**
Extending EARS-VIIRS with the Day/Night Band (1/3)

• The EARS-VIIRS Service is currently providing the 16 VIIRS Moderate resolution channels (M-Band).

• In response to user request, new extension planned to include VIIRS Day/Night Band.

• The natural data rate of the VIIRS Day/Night Band SDR is 16 Mb/s, which is considered prohibitive for establishing such service.

• Data rate reduced by a combination of:
  • Storing geolocation data on Tie-Point grid only as for VIIRS M-Band Service (CVIIRS tool);
  • Storing Radiance using a tailored HDF5 Floating Point representation:
    • 12 bits Mantissa
    • Size of Exponent chosen dynamically depending on the actual range of radiance values in each granule
    • 1 bit Sign
  • Applying standard compression.
### Communication Bandwidth Reduction:

<table>
<thead>
<tr>
<th></th>
<th>Radiances</th>
<th>Geolocation Data</th>
<th>Total</th>
<th>Fraction of Original</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mb/s</td>
<td>Mb/s</td>
<td>Mb/s</td>
<td></td>
</tr>
<tr>
<td><strong>Original Format</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Compression</td>
<td>1.39</td>
<td>15.02</td>
<td>16.41</td>
<td>100.0%</td>
</tr>
<tr>
<td>Compression</td>
<td>1.05</td>
<td>4.97</td>
<td>6.02</td>
<td>36.7%</td>
</tr>
<tr>
<td><strong>Compact Format</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Compression</td>
<td>0.65</td>
<td>0.15</td>
<td>0.80</td>
<td>4.9%</td>
</tr>
<tr>
<td>Compression</td>
<td>0.53</td>
<td>0.09</td>
<td>0.62</td>
<td>3.8%</td>
</tr>
</tbody>
</table>
Planned activities:

• New features need to be added to the Compact VIIRS SDR product format in order to support the VIIRS DNB.

• CVIIRS tool will be extended to permit users to reconstruct original VIIRS Day/Night Band SDR

• It is expected that the VIIRS Day/Night Band can be included in the EARS-VIIRS service on a trial basis by late 2015 or early 2016.
## New EARS FY-3 Service (1/2)

### Selected FY-3 Instruments:

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<thead>
<tr>
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<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Orbit</td>
<td>10:15</td>
<td>13:40</td>
<td>10:00</td>
<td>14:00</td>
<td>06:00</td>
<td>14:00</td>
<td>06:00</td>
</tr>
<tr>
<td>Microwave Temperature Sounder</td>
<td>FY-3 A</td>
<td>MWTS-I</td>
<td></td>
<td>MWTS-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microwave Humidity Sounder</td>
<td>FY-3 B</td>
<td>MWHS-I</td>
<td>MWHS-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared Atmospheric Sounder</td>
<td>FY-3 C</td>
<td></td>
<td></td>
<td></td>
<td>IRAS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyper Spectral Infrared Atmospheric Sounder</td>
<td>FY-3 D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HIRAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visible and Infrared Radiometer</td>
<td>FY-3 E</td>
<td>VIRR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium Resolution Spectral Imager</td>
<td>FY-3 F</td>
<td>MERSI-I</td>
<td></td>
<td>MERSI-II</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Wind Radar</td>
<td>FY-3 G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wind RAD</td>
<td></td>
<td>Wind RAD</td>
</tr>
</tbody>
</table>

Future Launch Dates and Orbits indicative, to be confirmed by CMA.

- **ATOVS Type Sounders**: AMSU-A, MHS, HIRS, ATMS
- **Hyper Spectral Sounder**: CrIS, IASI
- **Imager**: AVHRR, VIIRS
- **Scatterometer (C+Ku)**: ASCAT (C)
# New EARS FY-3 Service (2/2)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>FY-3 A</th>
<th>FY-3 B</th>
<th>FY-3 C</th>
<th>FY-3 D</th>
<th>FY-3 E</th>
<th>FY-3 F</th>
<th>FY-3 G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave Temperature Sounder</td>
<td>MWTS-I</td>
<td></td>
<td></td>
<td></td>
<td>MWTS-II</td>
<td></td>
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<tr>
<td>Microwave Humidity Sounder</td>
<td>MWHS-I</td>
<td></td>
<td></td>
<td></td>
<td>MWHS-II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrared Atmospheric Sounder</td>
<td>IRAS</td>
<td></td>
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</tr>
<tr>
<td>Hyper Spectral Infrared Atmospheric</td>
<td>HIRAS</td>
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<tr>
<td>Sounder</td>
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</tr>
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<td>Medium Resolution Spectral Imager</td>
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<td></td>
<td></td>
<td></td>
<td>MERSI-II</td>
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<td></td>
</tr>
<tr>
<td>Wind Radar</td>
<td></td>
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<td>Wind RAD</td>
<td></td>
<td>Wind RAD</td>
<td></td>
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</tr>
</tbody>
</table>

Future Launch Dates and Orbits indicative, to be confirmed by CMA.
Extending the X-Band Coverage (2/2)

- NOAA Real Time Network (NOAA/ SSEC)

- Exchange with EUMETSAT is planned to provide additional data to European users, in particular from:
  - Suomi NPP
  - Metop
EARS-VIIRS 10 November 2013
EARS-VIIRS 10 November 2013
Thank you for your attention!