Update on the ERS, Envisat and selected TPM datasets

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reminder: product evolution?

mission feedback
- science community input
- comparison with independent products
- evolution of protocols (qa4eo)

improved products
- reprocessing results from improved calibration and algorithms
- interface to collaborative algorithms

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calibration strategy
- pre-launch (phase a-d)
- satellite commissioning (phase e1)
- operations (phase e2)
- post-operations (phase f)

“In-situ” component
- collection of data against well-defined requirements
- inter-calibration of in-situ systems
- data collection following community accepted protocols
- maintenance of cal/val information and data portals

Tools
- diagnostic data-sets (dds)
- cal/val tools
- algorithm breadboards
- radiative transfer models

Product & Algorithm Validation
- Atmospheric & bio-optical algorithm validation and development (SIMBios PIs and project staff)
- Match-up analysis, satellite QC, time series evaluation, etc.

Mission Feedback
- Science community input
- Comparison with independent products
- Evolution of protocols (QA4EO)

Improved Products
- Reprocessing resulting from improved calibration and algorithms
- Interface to collaborative algorithms

Calibration Strategy
- Pre-launch (Phase A-D)
- Satellite Commissioning (Phase E1)
- Operations (Phase E2)
- Post-Operations (Phase F)

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Product Validation
- Algorithm development and Validation
- Operational QC on products
- Match-up, long-loop evaluation, Sat-Sat
ERS, Envisat, and many TPMs of interest to CCI, are either in Phase “F” or in the LTDP (i.e. cessation of operations + 5y)

Focus of the SPPA activities, esp. since 2012, is on consolidation and harmonisation of the level-1 and level-2 mission datasets

- Level-1 for example housekeeping of ADFs, recalibration/characterisation
- Level-2 for example applying consistent processors across missions

Communications over the last 3 years with select CCI teams on ESA and TPM data findings/issues:

- Formally through ocean cover, land cover and cloud
- Informally through the Quality Working Groups (QWGs)
- In addition SPPA staff attended more than a dozen CCI project meetings (in addition to the colocations)
Full Resolution Swath (FRS) L1 bulk processing → completed in mid 2013 and available through ftp at the UK-PAC

Full Resolution Swath (FR) L2 bulk processing has been on-going since October 2013 → complete dataset expected by April 2014

Documentation and Validation report is online:

- [https://earth.esa.int/handbooks/meris/](https://earth.esa.int/handbooks/meris/)
- [http://earth.eo.esa.int/pcs/envisat/meris/documentation/](http://earth.eo.esa.int/pcs/envisat/meris/documentation/)
OLC off period: 13th December 2004 and 9th October 2006

- The Level 0 RR were corrected
- The RR L1 and L2 were reprocessed accordingly (3rd reprocessing configuration)
- The FR L0 are not yet reprocessed (to be tackled in the 4th reprocessing)

The impact on an individual scene is not significant, but it is significant on level-3!
The 4th reprocessing objectives for 2014-2016 are:

- Level 1: Ortho-geolocation, radiometric model update, spectral model update, camera interface, BRDF model update (tbc), straylight improvement (tbc), flags (including Land/Sea mask from Sentinel-3), OCL correction for FR

- Level 2: Alignment with OLCI, uncertainties per pixel, classification, water vapour (1D-VAR), aerosol model (tbc)

- Sentinel Like format (NetCDF)

- Availability of new MERIS datasets planned for late 2016
The third (A)ATSR reprocessing was performed in 2013. Complete mission datasets have been made available for AATSR, ATSR-2 and ATSR-1 (at UK-PAC ftp or CEMS).

A full set of L1B and L2 products have been generated, including commissioning phase data (available in a segregated section of the archive).

New L2P/L3U products based on the UK AATSR Reprocessing for Climate - ARC processor, i.e. Including Bayesian cloud detection, ARC SST algorithm and uncertainty model, and LST (U. Leicester).

Improvements have been extensively validated by ESL/QWG/IDEAS.
An improved and consistent calibration was implemented for the reflectance channels:

- Globally reprocessed (A)ATSR calibration is self-consistent at 1% level.
- Long-term stability of calibration is at 1% level.
- AATSR shows some improvement over outgassing periods.

Note: comparisons with MERIS & MODIS-A show 3% difference.
Improved colocation between nadir and forward channels:

- *The 2 views are now collocated to within 1 pixel.*
- *Visible improvements at edges of land and cloud*

July 29 2002, orbit 02150
Lake Ladoga, Russia

Left: previous data; Right: reprocessed data
Features in reprocessed data show smaller edge differences
Main objective: ATSR-series level-1 data in SLSTR format

Reprocessing by mid-2015 (to L1b) with:
- *Improved geolocation (ortho-geolocation)*
- *Improved cloud masking*
- *Increased swath width to include all (A)ATSR pixels*
- *Uncertainty estimation (noise per scan; QWG discussions ongoing)*

Level-2 highlights:
- *Adopt L2 SST products from SST CCI*
- *Adopt L2 LST products from DUE GlobTemp (including lakes)*

*Note: a SWIR recalibration (ALTS, TZV UK) and a geolocation (GEOCCA, Enveo), both funded by the LTDP, running in parallel addressing issues raised by CCI teams*
REAPER v1 reprocessed ERS-1/2 altimetry dataset covering July 1991 to June 2003 → 22 years of intercalibrated (with Envisat v2.1) and harmonised products

Key improvements:

- Processing baseline based on Envisat’s one
- Improved RA L1B engineering corrections (PTR, IF mask, SPTR)
- Improved MWR L1B Bright Temperature processing
- Improved Orbit solutions based on new models (from ~8 cm rms down to ~2 cm rms)
- Improved RA L2 processing (4 retrackers, new geophysical corrections, inter-missions bias correction, etc.)
- GDR and S-GDR REAPER products in NetCDF V1.6 in line with S-3 SRAL product definition.

To be available at Ifremer ftp server in March/April 2014
ERS-1 REAPER v1: Sea Level Anomaly

SLA estimated over one cycle of ERS-1 data from reference (improved OPR) (left) and REAPER (right) datasets. Intermediate validation result based on COM3 data set (CLS).
Envisat v3 and REAPER v2 (i)

Envisat altimetry v3
- Improved RA L1B engineering corrections (USO, PTR, IF mask)
- Improved MWR L1B processing (side lobe correction)
- Improved orbit information (CNES GDR-E)
- Alignment to Sentinel-3 SRAL processing (inclusion of surface classification, distance to the shore, rain rate, etc.)
- Improved Ice data processing (LEGOS Echo and Geo corrections)
- GDR and S-GDR products in NetCDF in line with S-3 SRAL product definition
- etc.
REAPER v2 project will start by Q4 2014 and will address:

- The complete ERS-1 and ERS-2 mission lifetime (07/1991 → 07/2011)
- Be harmonized with Envisat Altimetry data set V3.0
- Improved data coverage
- Pole-2-pole partitioning
- Includes updates based on REAPER v1 user feedback and CCI

Availability of both products by mid-2015

Note: a MWR recalibration and advanced 1-D Var water vapour implementation for ERS/Envisat ongoing in the frame of LTDP project
Envisat ASAR processor:
  • *Data is processed with PF-ASAR through the entire mission*
  • *Data is systematically reprocessed if ordered through EOLIIi-SA* ([https://earth.esa.int/web/guest/data-access/catalogue-access](https://earth.esa.int/web/guest/data-access/catalogue-access))

ERS SAR processor:
  • *The ERS processor has evolved along the years with the evolution of the ERS PDGS*
  • *The historical VMP processor has been gradually replaced by PGS-ERS (SGI) now under replacement by PF-ERS (Linux)*
  • *PF-ERS re-uses the same processing core as PF-ASAR such that the ESA C-band data is processed in an homogeneous way*

PF-ERS/ASAR processing baseline is stable since several years (multi-mission cost benefits by reducing maintenance costs)
ESA is supporting as Third Party Mission L-Band SAR sensors: **PALSAR, JERS and Seasat**

The processing was until recently made by different processors:
- **PALSAR**: JAXA processor
- **JERS**: Vexel processor (very old)

In the frame of the ALOS ADEN migration project and JERS reprocessing an harmonisation process has been undertaken to unify the processing cores for JERS and PALSAR.

The L-band processing core has been extended for the Seasat reprocessing on the LTDP frame
SCIAMACHY 3rd reprocessing was released in 2012:

- **Level-1**: processor version 7.04-W
- **Level-2**: offline Processor version 5.02-W
- **SPPA/QC related Documentation**
  
http://earth.eo.esa.int/pcs/envisat/sciamachy/documents/

http://earth.eo.esa.int/pcs/envisat/sciamachy/full_mission_dataset/

Next reprocessing with improved algorithm in 2014:

- **Level-1 processor version 8 (Q2 2014)**
- **Level-2 processor version 6 (Q3 2014)**
Major level-1 improvements for v8:

- Scan Mirror Model implementation (scan angle dependent)
- Implementation of a stray light matrix for Channels 3-8
- Memory effect improvement (correction Limb)
- Improved non-linearity correction
- Improved Hot Pixel Correction
- Improved SAA check
- Improved dark calculation
- Improved radiometric correction

<table>
<thead>
<tr>
<th>Item</th>
<th>Change</th>
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<tbody>
<tr>
<td>Stray Light Ch. 3-8</td>
<td>Matrix approach introduced</td>
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<tr>
<td>Memory Effect</td>
<td>New Limb correction</td>
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<tr>
<td>PMD scaling Non-Linearity Correction</td>
<td>Avoid non-physical values</td>
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<tr>
<td>Hot Pixel Correction</td>
<td>Improved detection</td>
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<tr>
<td>Polarisation Correction</td>
<td>New keydata</td>
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<td>SAA check</td>
<td>Off for etalon correction</td>
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<tr>
<td>Dark Calculation</td>
<td>Dark states selectable</td>
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<tr>
<td>Radiometric Correction</td>
<td>New keydata</td>
</tr>
<tr>
<td>Degradation</td>
<td>Scan Mirror Model</td>
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<tr>
<td></td>
<td>Add PMD m-factors to Level 1b</td>
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Atmospheric sensors: MIPAS (level-1, level-2) and GOMOS (level-2) updates in 2014 and in 2016

GOME: recalibration (and data consolidation) project with DLR to address calibration drifts seen by ozone CCI (available by end 2015)

Hi-res sensors: Landsat L1/L2 processing harmonised with USGS; similarly ALOS using same correction approach as Sentinel-2

Scaterometer: complete reprocessing to be available in mid-2014 (ERS-2) and mid-2015 (ERS-1) with better antenna patterns, gain constants, yaw steering, zero gyro mode, etc.
Large effort on-going to provide updated and relevant datasets, especially for level-1, even though many missions in Phase ‘F’ or LTDP

Product evolution address numerous issues addressed by and pertinent to CCI projects, especially with respect to instrument calibration, data completeness and data consistency

Feedback and communication of findings from CCI need to improve, both for level-1 and level-2 → a formal mechanism within the programme/projects should be considered
Thank you!

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