Adding Value to ESA Heritage and Third-Party Mission Archived Datasets via Reprocessing: ATSR and ALOS

Fay Done[(1)], Pauline Cocevar[(1)], Michael Williams[(1)], Sabrina Pinori[(2)], Philippe Goryl[(3)] and Roberto Biasutti [(3)]

[(1)]*Telespazio UK (TPZ UK), 350 Capability Green, Luton LU1 3LU, UK;* [(2)] *Serco, Italy, for ESA/ESRIN;*

[(3)] *European Space Agency (ESA)/ESRIN, Via Galileo Galilei, Casella Postale 64, 00044 Frascati, Italy*

This poster describes the user benefits, and therefore the **Added Value,** that have been derived from the recent reprocessing of datasets from European Space Agency (ESA) Heritage missions, the Along-Track Scanning Radiometer (ATSR) series, and the Japanese mission Advanced Land Observing Satellite (ALOS).

ESA's IDEAS-QA4EO service oversaw the reprocessing organisation and quality control of these datasets before release to users. Among the user benefits were **improved measurements** (via recovered input data, improved processors, use of new or updated auxiliary data), **reformatting to align** with current operational missions, and continuing **documentation and helpdesk support**.

ATSR L1B Product Improvements and Enhancements

The ATSR series dataset (1991−2012), consisting of measurements from three instruments (ATSR-1, ATSR-2 and AATSR), holds more than 20 years of radiometric measurements, originally designed to generate accurate 1-km sea surface temperature measurements.

The recent ATSR 4th Reprocessing introduced a number of improvements and enhancements to the dataset, adding value to the previous reprocessed dataset (completed in 2013) in a number of ways.

1. IMPROVED AND EXTENDED DATASETS

- The use of improved and extended consolidated **L0** datasets.
- The generation and use of new **L1A** datasets.
- Completeness assessments for **L1B** products have shown:
  - **AATSR**
    - **Recovery of 32 hours** of measurement data.
  - **ATSR-2**
    - The dataset was curtailed at June 2003, due to uncertainty in geolocation quality during the ERS-2 Zero Gyro Mode period.
  - **ATSR-1**
    - **The recovery and improvement of data** due to historic processing issues (period of missing 1.6 μm channel data due to channel switching between 1.6 and 3.7 μm channels, uncalibrated brightness temperatures, etc.).

2. IMPROVED COLOCATION

The ATSR series instruments observe the earth in both forward-facing and nadir directions, and the separate view need to be colocated. An updated Auxiliary Data File (ADF), generated by RAL Space, was used to provide an improvement for AATSR nadir−forward view colocation. AATSR had retained an along-track shift of 1 pixel within the 3rd Reprocessing. The improvement is demonstrated in *Figure 1,* which shows an example of the nadir−oblique reflectance and radiance view differences for the 1.6 μm channel; there are "cleaner" land edges provided by the 4th Reprocessing, indicating an improvement in colocation.

Figure 1. AATSR, Morocco, nadir–oblique 1.6 μm radiance difference images: 3rd (left) and 4th (right) Reprocessings.

3. AATSR 12 MICRON CHANNEL ADJUSTMENT

An updated **calibration ADF**, generated by RAL Space, was used to incorporate the adjustment to the 12 μm channel, which showed evidence of a small temperature-dependent discrepancy. Previously, users had to apply the correction themselves.

4. IMPROVED SURFACE CLASSIFICATION

Improved surface classification via use of the **Sentinel-3 Land Water Masks** has been achieved; see *Figure 2*.

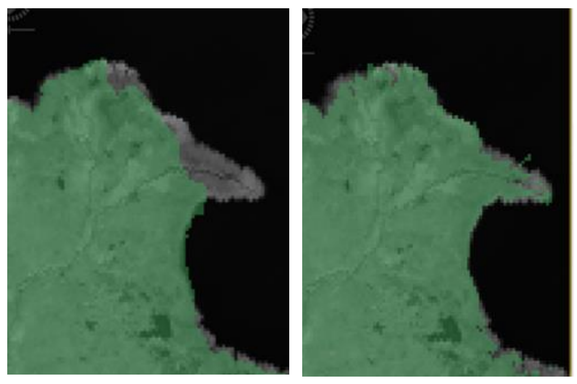

Figure 2. ATSR-1, Laizhou Bay, China. 3rd (left) and 4th Reprocessings (right). Land flag is green.

5. NEW UNCERTAINTY ESTIMATES

The addition of **uncertainty estimates** (as shown in *Figure 3*) for each pixel is novel for the ATSR dataset and especially useful to users. The random noise estimates are provided per pixel as a function of scene temperature, while the systematic noise estimates use "fixed" uncertainty estimates based on pre-launch data and knowledge of the instrument stability. *Figure 3* shows the differing uncertainties in the 3.7 and 12 μm channels (same scale). The contribution of the 10-scan average and the contribution from the blackbody detectors (alternating values within the scan arc) can be seen in low uncertainty parts of the image (blue areas). In high uncertainty areas, the calculation is dominated by the contribution from the measurements and so scan/pixel contributions can no longer be seen.

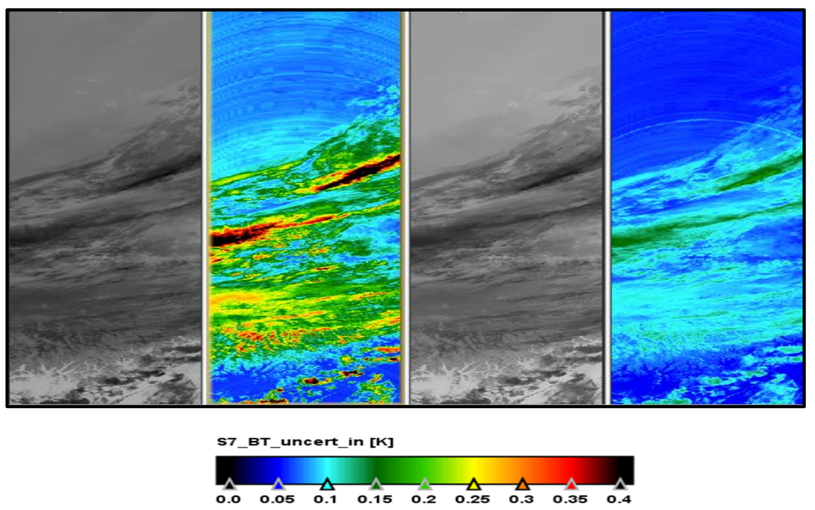

Figure 3. An example of the per-pixel uncertainty estimates for AATSR. Left to right: 3.7 μm brightness temperature (BT) and uncertainty, 12 μm BT and uncertainty (as viewed in SNAP).

6. GEOLOCATION IMPROVEMENTS

AATSR

- The mean offset to reference coordinates over 22 predetermined sites improved from 0.67 km to **0.62 km**.

ATSR-2

- 16 independent sites display a mean offset of **0.69 km** from reference coordinates.

ATSR-1

- 22 independent sites display a mean offset of **0.79** km.
- A comparison example for Isla Cariba, Venezuela (*Figure 4*) shows an improved offset from 1.07 km in the 3rd Reprocessing to **0.75 km** in the 4th Reprocessing.

Acknowledgements

The AATSR Quality Working Group has been vital in achieving the continual improvements to ATSR data and products over recent years. Funding has been a synergistic effort from ESA, BEIS, NERC, STFC and Australia, coordinated at different times by the ATSR Core Group, the AATSR Programme Steering Panel and the ATSR Exploitation Board.

ALOS L1B Product Improvements and Enhancements

The two, high resolution optical instruments included in the ALOS payload, the Advanced Visible and Near-infrared Radiometer 2 (AVNIR-2) and the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM), were operational between 2006 and 2011, and have played an important role in **cartographic** and **vegetation mapping**.

The observations from AVNIR-2 and PRISM, were subjected to a significant **Level 0 – 1C reprocessing campaign**. The main objectives of the reprocessing campaign was to produce enhanced datasets by including:

- **Recovery** and **consolidation** of Level 0 datasets;
- Development and implementation of **a new processor** to ESA EO-SIP package the native **Level 0 and Level 1B1** products;
- Development and implementation of another **new processor** to produce brand **new Level 1C (orthorectified)** products (including quality assessment metadata related to radiometric calibration and geometric calibration (e.g. geolocation accuracy metrics)).

The ALOS data were archived in three centres: Tromsoe, Matera, and ESRIN. All ALOS data, from the different ESA data centres, were repatriated to a single processing facility at MEEO (Ferrara, Italy) in EO-SIP format. The DSI (Data Service Initiative) led by Serco carried out L1B1 and L1C processing and QC of 43,634 AVNIR-2 products and 85,614 PRISM products.

The planimetric accuracy of the ortho rectified products were assessed by using as reference source a set GPS points collected from test field surveys. The **accuracy of the Ground Control Points (GCP) set is about 25 cm**. The overall **Root Mean Square (RMS) error is estimated to be 6.2 m** which is in agreement with the JAXA specification.

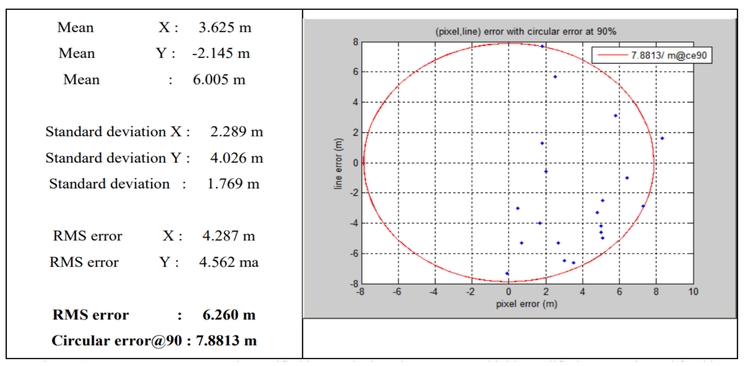

Figure 4. PRISM Orthorectified image planimetric accuracy

The processing approach maximised the number of orthorectified products and can be considered as a reference base map for many applications. It can be used synergistically with other ESA/Copernicus data (Landsat, Sentinel-2).

Acknowledgements

The ALOS AVNIR-2 and PRISM data, as well as (A)ATSR data were processed by DSI (Data Services Initiative), managed by the X-PReSS (eXpert Product Reprocessing Scalable Service) consortium led by Serco.

Data Availability

- The ALOS dataset has been published and is freely accessible (only PRISM data will be quota limited) at: http://tpm-ds.eo.esa.int/collections
- The **AATSR L1B** archive is available **via FTP now**. The ERS-1 and ERS-2 ATSR L1B datasets will follow.
- For information about the EO Sign In Service, visit TellUS at https://esatellus.service-now.com (FAQ).

PV 2023 CONFERENCE

PV2023: Adding value (to) and preserving Scientific & Technical data: 2nd – 4th May 2023, ID: 981, Poster pitch: 2nd May 17:52