# AATSR Level 1B (ENV_AT_1_RBT) Product Notices

This Readme file contains the Product Notice (**PN**) information for the AATSR Level 1B products: ENV_AT_1_RBT.

## Contents



## Applicable Datasets

The PNs listed here are applicable to the Fourth Reprocessing AATSR L1B dataset, released to users in 2022.

Users are strongly recommended to use this dataset as it is the most recently generated. The products are available in SENTINEL-SAFE-like/NetCDF format.

## Product Notice Index

The Product Notice Index is displayed in Table 1. Some PNs have been carried over from the Third Reprocessing as they are still applicable to the Fourth Reprocessing dataset.

**Table 1: Product Notice Index**

| Product Notice Reference | Product Notice Title |
|---|---|
| ENVI-GSOP-EOGD-QD-04-0065 | Exception values and corresponding confidence flags in the visible and 1.6 micron channels at night |
| ENVI-GSOP-EOGD-QD-04-0066 | Calibration of visible channels during and immediately after outgassing |
| ENVI-GSOP-EOGD-QD-14-0123 | Instrument pixel co-ordinates regridding x/y offset |
| INC0023756 | Exception flags are missing from cosmetically filled pixels |

| Product Notice Reference | Product Notice Title |
|---|---|
| INC0023758 | The duplicate pixel flag has not been raised to show an orphan pixel exists |
| INC0023759 | Orthogeolocation of measured pixels could fall outside the tie-point grid |
| INC0023760 | Equal spatial (rather than time) intervals exist in the tie-point grid in the along-track direction |
| INC0023761 | startOffset and trackOffset xml values do not contain the correct information to allow expected image- and tie-point grid alignment |

## Product Notices

| Field: | Contents: |
|---|---|
| PQR Title | Exception values and corresponding confidence flags in the visible and 1.6 micron channels at night |
| PQR Reference | ENVI-GSOP-EOGD-QD-04-0065 |
| Affected Data Sets | All data |
| Description | At the Envisat Calibration Review held in September 2002, it was reported that at night, noise in the visible and short-wave infra-red (1.6 micron) channels cannot be distinguished from pixel exception values, and can therefore be masked into the confidence flags. This is not strictly an error in the AATSR processing scheme, but rather an unexpected result of adopting the ATSR-2 processing scheme for AATSR (ATSR-2 visible channel data were not available at night).<br><br>The AATSR pixel exception values are small negative numbers (ranging from -1 to -8). At night, the noise in the visible channels can mimic these exception values, so that the interpretation of negative visible channel reflectances is ambiguous. Also, because the confidence flags are derived from the union of the exception values across all channels, this can cause the confidence flags to be wrongly set. Note that the latter effect affects any user who is using the confidence flags to filter the data, regardless of whether they are interested in the visible channels or not.<br><br>Note that the individual pixel exception values are always valid for the thermal infra-red channels, and can be used to identify and filter invalid data in these channels.<br><br>**Updated information for the 4th reprocessing:** This PN is still applicable, as no change has been implemented to address this behaviour. Users should bear this in mind when using the confidence flags. However, the $4^{th}$ reprocessing product format has confidence flags *per channel*, and so this behaviour does not now affect the confidence flags for brightness temperature channels |
| Prepared by | IDEAS AATSR QC Team |
| Originator | P. Goryl |
| Approver | P. Lecomte |

| Field: | Contents: |
|---|---|
| PQR Title | Calibration of visible channels during and immediately after outgassing |
| PQR Reference | ENVI-GSOP-EOGD-QD-04-0066 |
| Affected Data Sets | All data acquired during and immediately after periods of outgassing |
| Description | The dates of AATSR outgassing periods can be found at https://earth.esa.int/eogateway/instruments/aatsr/description<br><br>During outgassing periods, ATS_VC1_AX auxiliary files cannot be generated (the 1.6 $\mu$m channel data is absent when the infrared FPA is warm). Consequently, visible channel data acquired and processed during outgassing periods will be processed with a non-optimal VC1 file.<br><br>The supply of VC1 files at a frequency greater than once per day is recommended during periods of outgassing and for approximately three weeks afterwards, owing to the effect of returning condensation build-up. However, before 01 February 2007, the system was not designed to provide files at a greater frequency than once per day. Consequently, visible channel data acquired and processed for 3 weeks after an outgassing would also have been calibrated with sub-optimal VC1 files (i.e. the calibration accuracy is not maintained beyond one orbit, on account of the drift in the signal caused by the returning condensation build-up).<br><br>For data acquired after 01 February 2007, VC1 files were available with greater frequency so the calibration accuracy after an outgassing showed improved performance.<br><br>**Updated information for the 4th reprocessing:** This PN is still applicable. A complete set of VC1 files was regenerated for use in the 3rd reprocessing: the calibration accuracy of the 3rd reprocessed dataset following an outgassing showed further improved performance which carries through to the 4th reprocessing. |
| Prepared by | IDEAS AATSR QC Team |
| Originator | P. Goryl |
| Approver | P. Lecomte |

| Field: | Contents: |
|---|---|
| PQR Title | Instrument pixel co-ordinates regridding x/y offset |
| PQR Reference | ENVI-GSOP-EOGD-QD-14-0123 (issue date: 12 May 2014) |
| Affected Data Sets | All data |
| Description | Because of the conical scanning geometry of the AATSR instrument, measured AATSR instrument pixels lie on a series of curves defined by the intersection of the scan cone and the surface of the Earth. In order to present the data on a rectangular grid, AATSR Level 1b processing includes a regridding stage in which the measured instrument pixels are relocated by migrating them to a nearby image position. The image pixel positions form a quasi-Cartesian grid centred on the satellite ground track.<br><br>As a result, the image pixels in the full resolution products (ATS_TOA_1P and ATS_NR__2P) are displaced slightly from their measured positions. This displacement does not exceed the 1-km resolution of the instrument in either co-ordinate, and so is not significant for the many applications for which the surface is relatively homogeneous. For example, over the sea the brightness temperatures and sea surface temperature are in general slowly varying on this scale. However, for some applications, in particular studies of land surface temperature in regions where the surface characteristics are highly variable on scales shorter than 1 km, the displacement may be significant.<br><br>Historically, the ATSR product set included ungridded products containing the instrument pixel geolocation, but these are not part of the ESA product set. However, the information is available in the products, and the additional notes below explain how it can be recovered.<br><br>**Updated information for the 4th reprocessing:** This PN can be considered still applicable; users can take account of this by following the guidance below. However, $4^{th}$ reprocessing products contain orthogeolocated measured pixel positioning (in geodetic_in and geodetic_io files), scan and pixel information, and so are improved and more self-standing. |
| Prepared by | IDEAS+ AATSR QC Team |
| Approver | P. Goryl |

| Field: | Contents: |
| --- | --- |
| PQR Reference | Additional notes for PQR ENVI-GSOP-EOGD-QD-14-0123 |

The following notes are an extract from the AATSR Technical Note, 'Instrument Pixel Co-ordinates in AATSR Products' by A. R. Birks (November 2006). They explain how the x and y co-ordinates of the instrument pixels can be recovered from the Scan pixel x and y Annotation data Set (ADS). Given these values it is then possible to recover the instrument pixel latitude and longitude by interpolation in the geolocation ADS.

The instrument pixel geolocation must be reconstructed via the scan pixel x and y co-ordinates. However, the procedure is rather involved, while as explained below a crucial piece of information is missing from the Level 1b and Level 2 gridded products, and must be supplied separately. The outline of the procedure is as follows.

**Step 1: Identify the instrument scan and pixel indices from the Scan and Pixel Number ADS for the appropriate (nadir or forward) view.**

To begin with, we define the indexing. Define scan and pixel indices *s, p* for the instrument pixels measured by AATSR. The scan number *s* is simply the number of the instrument scan (equivalent to the number of the instrument source packet) counting from an origin close to the start of the product. In fact (for a somewhat technical reason that will not be explained here) the first instrument scan contributing to a product is numbered *s* = 32.

The absolute pixel number *p* is the number of the pixel in the measured scan; AATSR measures 2000 pixels per scan. In fact not all of these pixels are telemetered to the ground (because many of them fall inside the instrument housing), but only those corresponding to the nadir and forward views (and to the black body and VISCAL pixels). However, the Scan and Pixel Number ADS contains the absolute pixel number *p* of the instrument pixels corresponding to the regridded image pixels.

Let us also define indices *i*, *j* for the image pixels, where *i* is the along-track index (essentially the number of the product record, counting from zero) and *j* (0 to 511) is the index of the pixel in the record. Now because the Scan and Pixel Number ADS are sampled once per granule, the first record of the ADS corresponds to MDS record 0, the second to MDS record 32, and so on.

Consider a given image pixel *i*, *j*. Calculate the granule index *ig* = integer part of [*i*/32], and *i'* = *i* – 32**ig*, and find record *ig* of the relevant ADS (counting from 0). If *i* is an exact multiple of 32 (so *i'* = 0) then ADS record *ig* contains the scan and pixel numbers for the pixels in row *i*. In the notation used by EnviView

(1) *s* = instr_scan_num[*j*]
(2) *p* = pix_num[*j*]

Otherwise

(3) *s* = instr_scan_num[*j*] + *i'*
(4) *p* = pix_num[*j*]

Of course use the ADS appropriate to the view. If you are working with a nadir view pixel, use the Scan and Pixel Number Nadir View ADS, or for a forward view pixel use the Scan and Pixel Number Forward View ADS.

**Step 2: Use the indices *s* and *p* found in Step 1 to determine the x and y co-ordinates of the instrument pixel from the Scan Pixel x and y ADS.**

Each record of this Annotation Data Set corresponds to one instrument source packet, or instrument scan, and contains the scan number *s* in the record instr_scan_num at the start of the record. (Throughout we are using the names defined by EnviView for the product fields, but note that although EnviView numbers records from 1, here we are numbering them from 0.) However, the ADS does not contain every scan, but is sampled once per 32 scans.

Each record of the ADS contains 99 pairs of x-y co-ordinates in 2 arrays tie_pix_x and tie_pix_y of 99 elements each. Essentially (with a slight modification) these represent the co-ordinates of every 10th pixel in the nadir and forward views, arranged according to their relative pixel indices. When the earth view pixels are unpacked from the source packet, they are separated into two sets of buffer arrays, one for each view, and these arrays are indexed by relative indices *pn*, *pf* for the nadir and forward views respectively. There are 575 elements in the nadir view array and 391 in the forward view array, so *pn* runs from 0 to 574 and *pf* runs from 0 to 390. (In fact the AATSR source packet contains only 555 nadir view pixels and 371 forward view pixels, but the arrays were declared slightly oversize in case of changes in the pixel map.)

The x-y co-ordinates are supplied for every 10th pixel in the scan; that is, for the pixels *pn* = 0, 10, 20, … 570, 574 in the nadir view (note the short interval at the end) and pixels *pf* = 0, 10, 20, … 390 in the forward view. This is (58 + 1 + 40 = 99) pixels in all. Co-ordinates of intermediate pixels must be calculated by interpolation. The above set of indices is actually available in the specific product header, in the fields xy_tie_points_pixel_num[0:98]. What the product does not show is the relationship between the relative pixel indices *pn*, *pf*, and the absolute pixel number *p* calculated at Step 1. This is the missing piece of information mentioned.

The relationship is:

(5) Nadir view pixels: *p* = *pn* + first_nadir_pixel_number (*pn* = 0, 574)
(6) Forward view pixels: *p* = *pf* + first_forward_pixel_number (*pf* = 0, 390)

The parameters first_nadir_pixel_number and first_forward_pix-el_number are given in the Level 1b Characterisation File ATS_CH1_AX; their values are:

(7) first_nadir_pixel_number = 213
(8) first_forward_pixel_number = 1305

So, *s* and *p* were calculated in Step 1. Given *s*, then if *s0* is the scan number of the first ADS record, the tie scan corresponding to, or preceding, scan *s* is expected to be at record numbered by *sg* = integer part of[(*s* – *s0*)/32] and should have:

(9) instr_scan_num = 32**sg* + *s0*.

This should be checked, because it might not be true if there are data gaps, in which case one might have to search for the correct ADS record.

Having identified the correct instrument scan, calculate the relative index from the above equations. For example, if the pixel in question is from the nadir view, calculate

(10) *pn* = *p* - first_nadir_pixel_number

then find the x and y co-ordinates by linear interpolation between the adjacent tie pixels. Thus if *pn0* = integer part of *pn*/10,

(11) pixel_x = (1 – *w*)*tie_pix_x[*pn0*] + *w**tie_pix_x[*pn0* + 1]

where *w* = (*pn*/10 – *pn0*), and similarly for tie_pix_y.

If *s* corresponds to a tie scan (i.e. if the ADS record has instr_scan_num = *s*) these are the required x, y coordinates of the pixel. If not, repeat the interpolation for ADS record *sg* + 1 and then interpolate linearly with respect to scan number between the scan pixel co-ordinates.

**Step 3: Interpolate latitude and longitude to the x-y co-ordinate *s* just found.**

How to interpolate the Geolocation ADS to the position of a pixel is described in a note that is appended to the AATSR FAQ document on the ENVISAT website: https://earth.esa.int/eogateway/documents/20142/37627/aatsr-frequently-asked-questions-faq-document.pdf/a3810659-9213-b828-aa41-374e6af6442f. It was written with the interpolation to image pixel co-ordinates in mind, but the generalisation to arbitrary co-ordinates should be evident.

| **Field:** | **Contents:** |
|---|---|
| Product Notice Title | Exception flags are missing from cosmetically filled pixels |
| PN Reference | INC0023756 (14 November 2022)<br>Associated with PRB0045133/CHG0032632 |
| Affected Data Sets | All data |
| Description | Due to the conical scanning radiometer viewing the Earth's curved surface, transfer of measured data onto the 1-km (quasi-Cartesian) image grid will result in some empty 1-km image grid pixels. This is especially true for the forward view, which views the Earth's surface at an acute angle, but can also apply to the nadir view away from the nadir.<br><br>The L1B processor uses a cosmetic-filling technique for the 1-km image grid, whereby a neighbouring "real" data measurement is copied into an empty 1-km pixel. The cosmetic fill flag within the confidence word is activated to indicate to the user that the pixel measurement is not original and has been copied from a nearby measurement.<br><br>While the measurement itself has been copied over, the related exception flags have not been, and so the cosmetically filled pixels have no exception information associated with them.<br><br>Users may wish to take the above in consideration if inspecting all data, including cosmetically filled pixels, and filtering for exception flags.<br><br>**Data from 4th reprocessing:** This is a new PN, and is applicable to $4^{th}$ reprocessing products |
| Prepared by | IDEAS-QA4EO AATSR QC Team |
| Originator | S. Pinori |
| Approver | P. Goryl |

| **Field:** | **Contents:** |
|---|---|
| Product Notice Title | The duplicate pixel flag has not been raised to show an orphan pixel exists |
| PN Reference | INC0023758 (14 November 2022)<br><br>Associated with PRB0045135/CHG0032633 |
| Affected Data Sets | All data |
| Description | Due to the conical scanning radiometer viewing the Earth's curved surface, transfer of measured data onto the 1-km (quasi-Cartesian) image grid will sometimes result in there being more than one eligible measurement to be placed inside a 1-km image pixel. This primarily affects the nadir view, but can sometimes apply to the forward view.<br><br>If a measurement cannot be placed within a 1-km pixel for this reason, its details, and relevant ancillary information, are saved within the 'orphan' data sections of the product.<br><br>When the above event occurs, the duplicate pixel flag, within the confidence word, should be activated for the receiving 1-km pixel. This has not happened.<br><br>Users may wish to take the above into account if inspecting the gridded data for the existence of duplicate (orphan) pixels. A duplicate measurement may exist for a certain pixel, but this cannot readily be known if inspecting via the duplicate pixel flag. Instead, users are advised to search the orphan data sections of the product.<br><br>**Data from 4th reprocessing:** This is a new PN, and is applicable to 4$^{th}$ reprocessing products |
| Prepared by | IDEAS-QA4EO AATSR QC Team |
| Originator | S. Pinori |
| Approver | P. Goryl |

| Field: | Contents: |
|---|---|
| Product Notice Title | Orthogeolocation of measured pixels could fall outside the tie-point grid |
| PN Reference | INC0023759 (14 November 2022)<br>Associated with PRB0045136/CHG0032634 |
| Affected Data Sets | All data |
| Description | The 16-km tie-point grid should extend beyond the range of the 1-km image grid. Some slowly varying information is stored on the 16-km grid that does not need to be available at 1-km resolution.<br><br>However, due to grid manipulation during processing, it can sometimes be the case that the orthogeolocation of the individual measurements, contained within the geodetic_in and geodetic_io data files, can fall outside (before) the first 16-km tie-point gridline.<br><br>The alignment between the tie-point grid and the image grid has been validated and any differences are within expected tolerances. Users are advised to read the related PN INC0023761.<br><br>Orthogeolocations of sampled individual measurements (within geodetic_in and geodetic_io) have been validated, and are within expected tolerances.<br><br>**Data from 4th reprocessing:** This is a new PN, and is applicable to 4$^{th}$ reprocessing products |
| Prepared by | IDEAS-QA4EO AATSR QC Team |
| Originator | S. Pinori |
| Approver | P. Goryl |

| Field: | Contents: |
|---|---|
| Product Notice Title | Equal spatial (rather than time) intervals exist in the tie-point grid in the along-track direction |
| PN Reference | INC0023760 (14 November 2022)<br>Associated with PRB0045137/CHG0032635 |
| Affected Data Sets | All data |
| Description | The along-track intervals of the 16-km tie-point grid should be defined in relation to the satellite orbit along-track timings. These would be very close to, but not exactly, 16 km in spacing.<br><br>However, the 16-km tie-point grid has along-track intervals that are specified exactly at intervals of 16 km, and so the grid does not follow the required relationship.<br><br>The alignment between the tie-point grid and the image-grid has been validated and any differences are within expected tolerances. Users are advised read the related PN INC0023761.<br><br>**Data from 4th reprocessing:** This is a new PN, and is applicable to 4$^{th}$ reprocessing products |
| Prepared by | IDEAS-QA4EO AATSR QC Team |
| Originator | S. Pinori |
| Approver | P. Goryl |

| Field: | Contents: |
|---|---|
| Product Notice Title | startOffset and trackOffset xml values do not contain the correct information to allow expected image- and tie-point grid alignment |
| PN Reference | INC0023761 (14 November 2022)<br>Associated with PRB0045138/CHG0032636 |
| Affected Data Sets | All data |
| Description | The startOffset and trackOffset values within the product xfdumanifest.xml file, along with the associated resolutions for both 16-km tie-point and 1-km image grids, should allow for a straightforward relationship between the grids.<br><br>Due to very early application of SENTINEL-SAFE format, and subsequent grid manipulation during processing, the stated values do not follow the expected relationship, but one does exist.<br><br>Users can refer to the User Documentation for (A)ATSR 4$^{th}$ Reprocessing Level 1B products, or make use of the additional notes given below.<br><br>Sampled orthogeolocations of the individual measurements (within geodetic_in and geodetic_io) have been validated, and are within expected tolerances.<br><br>**Data from 4th reprocessing:** This is a new PN, and is applicable to 4$^{th}$ reprocessing products |
| Prepared by | IDEAS-QA4EO AATSR QC Team |
| Originator | S. Pinori |
| Approver | P. Goryl |

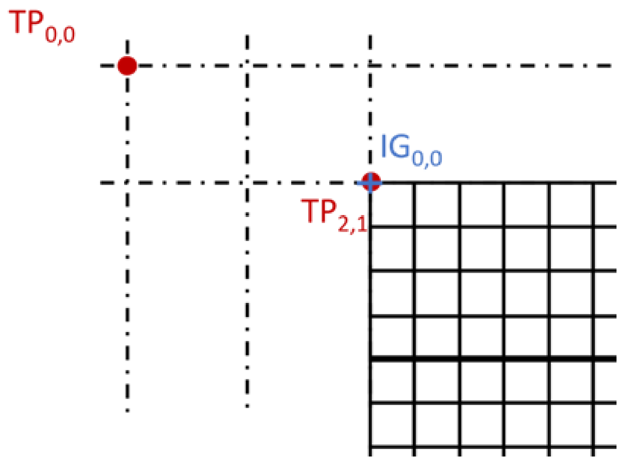
| Field: | Contents: |
|---|---|
| PN Reference | Additional notes for PN Reference INC0023761 |

The colocation of image and tie-point data (i.e. interpolation of the 16-km grid data to match the 1-km image grid data) cannot easily be made since the startOffset and trackOffset values for both grids are not correctly stated in the manifest file. Helpful investigations by Brockmann Consult generated an equation that aligns the grids initially, after which the usual interpolation can take place. This is done automatically within SNAP, but users who are dealing with the product data independently will find the following useful.

For SNAP, an offset is required which defines the location of the first tie-point in relation to the image grid, which are X-Offset and Y-Offset, and shown in Figure 1.

The offsets which were found are:

**X-Offset:** -32
**Y-Offset:** -16




This means that $TP_{0,0}$ in the image above has these offset values assigned. The tie-point $TP_{2,1}$ will be located at the upper-left corner of the first image pixel $IG_{0,0}$.

**Figure 1: Offsets that initially pin the image and tie-point grids.**
(Acknowledgement: M. Peters, Brockmann Consult)

The values are as given in Figure 1, or users can use the relationship below to generate the X-Offset and Y-Offset, where `tp` are tie-point and `img` are nadir image grid values for offsets and resolutions as already stated in the manifest metadata:

```
X-Offset= imgTrackOffset - ((tpTrackOffset - 1) *
        (tpResolution / imgResolution))

Y-Offset= (tpStartOffset - 1) * (tpResolution /
        imgResolution) - imgStartOffset
```

Once the corners of the grids are aligned correctly, as stated above, then the usual relationship between the grids regarding interpolation of the 16-km grid data to match the 1-km grid data can take place as usual.

## Change Log

| ISSUE | DATE | REASON |
| --- | --- | --- |
| 1.0 | 22 November 2022 | First official release |