USER NOTE

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SUBJECT : ATSR-1 Pick-up Noise

This User Note gives a basic characterisation of the pick-up noise evident in some ATSR-1 products, and explains if using this data affects sea surface temperature (**SST**) values generated from the brightness temperature measurements.

ATSR-1 Pick-up Noise

The quality of measurements from the first Along-Track Scanning Radiometer (**ATSR**) instrument, ATSR-1, can be affected by electrical pick-up noise (as well as the usual accepted measurement noise). The pick-up noise had been unexpectedly induced by the magnetic coupling of the instrument's cycle cooler drive current with the signals produced by the infrared detectors. The issue was first reported in [RD.1].

An investigation by Rutherford Appleton Laboratory Space (**RAL Space**) showed that the magnitude of the pick-up noise gradually increased throughout the operational lifetime of the mission [RD.2]. This gradual increase was due to the changes that had to be made to the cooler drive amplitude (in order to reduce mechanical wear and so prolong the cooler's operational life), at various stages of the mission, in order to keep the detectors cold enough to provide the accurate spectral responses required. This investigation also showed that the pick-up noise was more noticeable in the 11 µm channel.

Figure 1 shows an example: striations can be seen in the lower image, which is a close-up of the red boxed section of the upper image.

This source of noise is absent from the images produced by ATSR-1's successor, ATSR-2, as the detector signal preamplifier was relocated away from the cooler and plugged directly into the instrument's focal-plane assembly [RD.2]. This improvement can be seen when ATSR-1 SST data are compared with those from ATSR-2 during the ATSR-1/ATSR-2 overlap period in 1995 (see Figure 2). Note the increased noise in the ATSR-1 data in the SST eddy structure in the western Mediterranean.

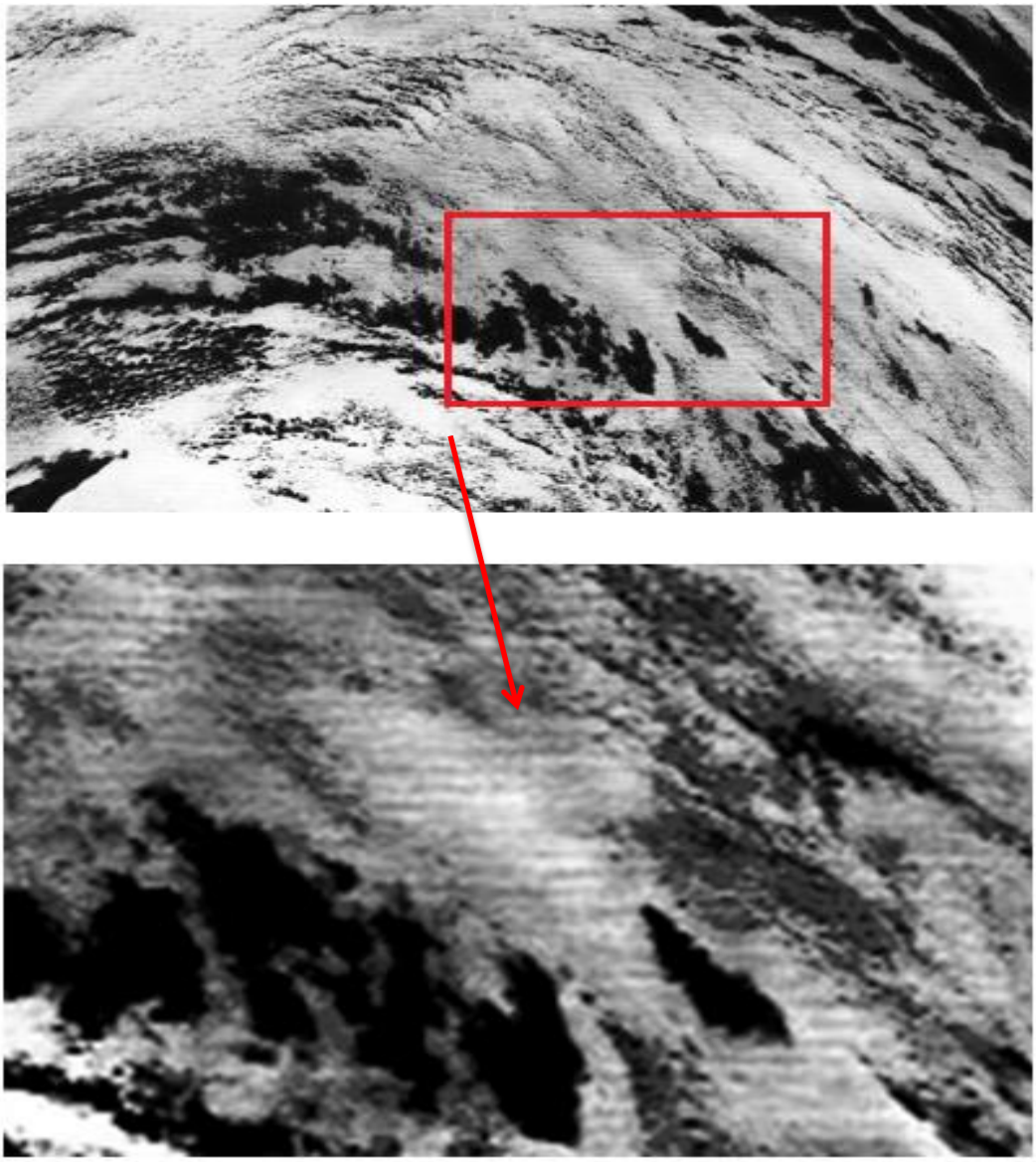

Figure 1. An example of pick-up noise affecting measurements. Striations can be seen in the lower image, a close-up of the red boxed section of the upper image.
(Presented by D. Smith at the 18th AATSR QWG Meeting, May 2009)

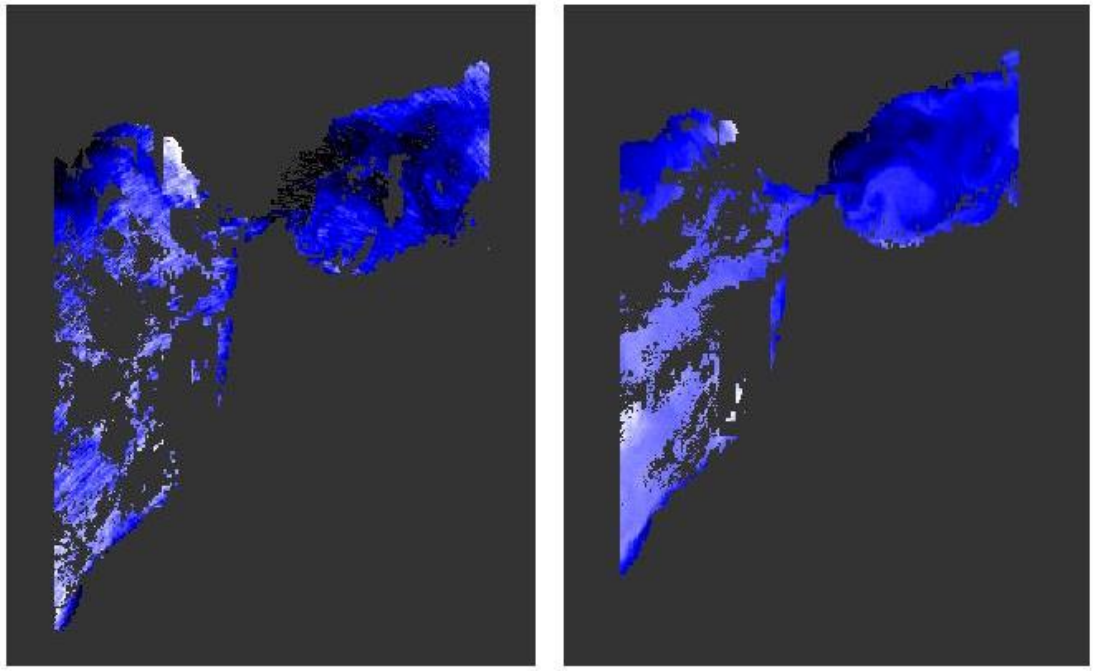

Figure 2. Full-resolution SST retrievals around the Straits of Gibraltar. Left: ATSR-1 data from 1st July 1995; Right: ATSR-2 data from 2nd July 1995. Note the increased noise in the ATSR-1 data in the western Mediterranean.
(AT1_NR__2PUBCM19950701_111531_000001588004_00179_20708_0001.E1, AT2_NR__2PUBCM19950702_111534_000001581002_00179_01035_0005.E2)

As noted previously, the degraded ATSR-1 SST data for July 1995 in Figure 2 is not necessarily attributable to the cooler pick-up noise alone. Due to the increase in the detectors during the lifetime of the mission, the overall Signal-to-Noise ratio became degraded such that the 11 µm and 12 µm NEDT were 0.08 K and 0.12 K, respectively.

A solution for reducing the pick-up noise signal has not yet been formulated, since clear scientific justification is needed. Its impact on the long-term sea surface temperature record is relatively minor [RD.3], however, more significant impacts may be seen in those studies that rely on imagery data for, for example, ocean front detection.

References

[RD.1] Harris, A. R. and M. A. Saunders (1996) Global validation of the along-track scanning radiometer against drifting buoys. *J. Geophys. Res.* **101**, 12,127-12,140.

[RD.2] Smith, D. *et al*. (2011) ATSR infrared radiometric calibration and in-orbit performance. *Remote Sensing of Environment* doi:10.1016/j.rse.2011.01.027.

[RD.3] Corlett, G. K. (2016) University of Leicester: (A)ATSR Validation Activities/Validation Issues report Ref: UL-AATSR-VIR Issue: 5D.