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The Spectral Response Recharacterisation of the Advanced Along Track Scanning Radiometer (AATSR) Using a High Resolution Fourier Transform Spectrometer.

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Ever since the launch of the Advanced Along Track Scanning Radiometer, AATSR, on the ENVISAT satellite, comparisons between the AATSR and the previous ATSR-2 brightness temperatures (BT) have shown a constant bias in the 12μm spectral channel. Analysis performed by the Rutherford Appleton Laboratory (RAL), has shown that there was good agreement between the two instruments at 11μm and 3.7μm, however, the comparison of the 12μm BT measurements, made by the two instruments over clear sea, showed a mean difference between the BTs measured by AATSR and ATSR-2 of the order of -0.2 K.

A suggested cause for the difference between AATSR and ATSR-2 is that there is an out of band spectral response within the 12μm channels that was not characterised in the initial calibration, and therefore that the observed bias could be due to signal contributions above the wavelength of 13.5μm. Simulations performed at RAL revealed that a 0.25% out of-band leakage at long wavelengths could explain the observed brightness temperature differences between AATSR and ATSR-2.

In the original spectral response calibration of the AATSR focal plane assemblies, a grating spectrometer system was used to characterise the spectral response function of the infrared channels. As the original calibration instrument was found to be no longer available, a further study into the spectral characteristics of the visible and infrared channels within the AATSR Focal Plane Array (FPA) was initiated.

The spectral response re-characterisation of the AATSR flight spare FPA was performed using a high resolution Fourier Transform Spectrometer (FTS), where each channel within the FPA was used to detect the interferogram generated by the spectrometer. Acting as the spectrometer detector, the signal from AATSR channels were coupled directly into the spectrometer where the measured interferogram was stored and processed into the resultant spectral response for the channel.

The advantage of this method is the increased Signal to Noise (SNR) ratio achievable and the improved wavelength accuracy over the grating based method. Additionally, the FTS method captures all wavelengths simultaneously, replicating the illumination conditions experienced in flight.

The comparison between the original 12 μm spectral response measurement and the re-characterisation using the FTS method show good agreement between FM-01 (Flight Spare) and FM-02 (As flown), hence providing evidence that the tests on FM-01 can be taken as representative of FM-02. The results show that there is no measurable out of band response in 12 μm spectral response above the 13.5μm region as originally proposed. However the measurements show that filter response shifts as a function of temperature which is confirmed by data recorded by the University of Reading in a measurement of the ATSR-1 instrument. These results imply a small wavelength calibration error in the original grating based measurements of 3cm^{-1}. A sensitivity analysis using the latest is needed to investigate if the effect can explain the 0.2K bias.