MEMO ATSR Exploitation Board

From :	Hugh Kelliher	**Reference** :	AEB.MEM.004
To :	AEB Members	**Date** :	12 February 2019
		Issue :	16
cc :	SAG and IAG Members	**Nº Pages** :	16

Subject: ATSR Exploitation Board - New Work Items Status

1. Introduction

The ATSR Exploitation Plan (AEP) included a set of proposed projects for consideration by AEB members. This memo provides an update to that list, as amended since the 17th AEB meeting (WebEx) on 21 January 2019.

The following proposal has been superseded by various projects:

STATS – Science activities

2. Projects for which funding has been approved since the last issue of the memo

None.

3. Projects on hold

"ATSR – The Story"	ESA
The process of producing an instrument and a satellite remain mysterious to most people. By creating a minimally technical book that tells the ATSR story from a human perspective, it is hoped that a few more people will feel engaged with science and engineering. **UKSA have confirmed that it is not a project they would be able to fund.**	

4. Projects for which funding is being sought

Project Title	Lead
Impact of backward view on SLSTR to continuity of data from ATSR	ESA
Peter North has looked at this is part but more work is needed. There are differences between SLSTR and ATSR, i.e. comparing September one year with September the following year, but no one is sure what is causing the differences yet (could be cloud flagging, sunglint, scattering). There is good agreement between AATSR and MODIS for aerosols. PN (2018 08 09): However we do have evidence from our retrievals - we obtain a predicted error per retrieval. Indeed we see the predicted error pattern reversed compared to (A)ATSR, i.e. higher error over land in northern hemisphere than southern for SLSTR. Inspection of images and preliminary comparison with AERONET seems to confirm this, though we have not properly tested with calibrated data and correct LUTs yet. SD (2018 11 26) - important that we get an understanding of this and it would be good to have a comparison study on this. It would be good to introduce the MISR centre into the study (looking at the backward and forward views). Different viewings have a different swath geometry which are also important.	
Improvements to ATSR and SLSTR solar channel calibration	ESA
Climate studies using ATSR and SLSTR demand stable and consistent radiometric calibration of the solar reflectance channels to uncertainties below 1% (TBC). The ESA CCI programme in particular is driving demand for accurate analysis of long term stability of AATSR and SLSTR channels and the associated uncertainty in order substantiate trends in derived products. It is also important to understand the biases between different derived products as a function of the absolute calibration accuracy of the instrument.	
Polar Surface Temperature – next stage	ESA
This is an option in the LST CCI proposal: to derive a Polar Surface Temperature time series and a combined high spatial resolution ATSR/SLSTR Polar All-Surface Temperature data product in order to improve our understanding of recent changes in the polar regions. SLSTR will enable continuation of the time series and requires solving the problem of the AATSR-SLSTR data gap. Availability of high resolution/high coverage SAR data from Sentinel 1 will allow improvements to the product through higher accuracy of ice masking which will feed into improved cloud detection. Production of a high resolution, long-term data set will be a valuable tool in model verification.	

Project Title	**Lead**
Development of long-term landscape fire and gas flaring record via application of SLSTR fire algorithm to ATSR night-time SWIR and MWIR channel data	TBD
The SLSTR active fire detection algorithm would require very few adjustments to work with the ATSR data once in SLSTR format. After initial testing, any optimisation required would be made and routines also derived for mapping night-time gross cloud cover and scene coverage (also adapted from SLSTR versions). Using JASMIN-CEMS the algorithm would then be run on the entire global ATSR-2 and AATSR archive for fires (and ATSR-1 in addition for gas flares, since it had limited operation of the 3.7 micron band). In addition to the new dataset produced, which would become publically available, analysis of trends shown in the new record would be conducted to demonstrate its potential value to users and produce some first science outputs. In addition to vegetation fires, this would now include analysis of the global gas flaring trends for the last 20+ years.	
Full assessment of atmospherically-corrected surface reflectance quality, errors and range of validity	TBD
Correction for atmospheric effects are required for accurate surface reflectance, necessary for albedo, separation of anomalies due to surface change from climate or disturbance atmospheric anomalies in time series, and accurate mapping of surface cover and biophysical parameters. Methods have been developed under previous funding for ATSR and will be continued operationally on SLSTR (Synergy branch) but they have not yet been validated.	
Derivation of vegetation parameters for ATSR	TBD
ATSR has potential for a valuable long-term record of land surface biophysical parameters, relevant to modelling of carbon, water and energy cycles, and detection of anomalies. Recent improvements in model inversion and atmospheric correction will allow a high fidelity dataset to be produced. Existing datasets (MODIS, VGT, and MERIS) do not have such a long series, and show large disagreements.	
Retrieval of cloud-top water vapour column (CTWVC) using AIRWAVE algorithm	ESA
The Advanced InfraRed WAter Vapour Estimator (AIRWAVE) algorithm, developed in the context of the ALTS project (ESA), has proven to provide very good water vapour information from the ATSR TIR (thermal infra-red) measurements when applied to clear sky – sea surface scenes. The objective of this project is to include cloudy scenarios in the retrieval of water vapour columns using nadir and forward TIR measurements of the ATSR series.	

Project Title	**Lead**
Surface radiation for the solar energy sector from ATSR	TBD
The ability to derive accurate and consistent aerosol and cloud properties from ATSR requires the calculation of up- and down-welling radiation at the surface. Accurate direct and diffuse down-welling solar fluxes are of critical importance for the solar energy sector as well as for biophysical processes, but this capability is not yet utilised. Calculation of direct and diffuse PAR is already on AEB's list of proposed work topics, and the methodology to produce spectrally-integrated fluxes required for the solar energy sector would build directly on that. Informal discussions with a representative of one UK solar energy company have indicated that the sector could be interested in being involved in the specification and development of such a reliable, new satellite data product, and provision of validation data in the form of pyranometer measurements taken at potential UK sites for solar energy development.	
ATSR-1 pick-up errors, impacts on applications and implementation of empirical correction	ESA / MetEOC
Understanding of the errors associated with calibration systems in ATSR-1 is maturing via the MetEOC-3 analysis of AATSR (based on same principles). Preliminary analyses have characterised the pick-up errors to the degree that suggests useful correction is possible, but the impacts on LST, SST and use of ATSR-1 as a reference sensor are not well understood.	
Regenerating the (A)ATSR LUTs and calibration files into netCDF format	ESA
Updates to (A)ATSR look-up tables are quite difficult to produce (old files are in old Envisat formats), so it is worth regenerating the files into the netCDF format used for SLSTR.	

5. Complete Description of Proposed Projects

Project Title	"ATSR – The Story"
Application and/or Underpinning Activity	Education and Outreach
Objectives	To create a book which is interesting and accessible to the general public, to help improve public understanding of science and engineering
Maturity	The information exists on paper and in the heads of contributors to the ATSR programme.
Justification	The process of producing an instrument and a satellite remain mysterious to most people. By creating a minimally technical book that tells the ATSR story from a human perspective, it is hoped that a few more people will feel engaged with science and engineering.
Priority	Medium – this is not essential for the science but good for outreach
Urgency	High – the people who can contribute to the story are retiring
Project Description	The book would be composed of chapters written from different perspectives by individuals involved in the programme, so chapters could include the PI's story, the engineer's story, the validation scientist's story, the project manager's story, the civil servant's story, the designer's story, the climate scientist's story, the space agency story, the Australian story, etc. Each chapter could be a composite of experience's or just a single perspective, depending on who is willing to contribute. It should include high quality photographs and diagrams as appropriate and each chapter should include a box summarising the technical background of the chapter.
Project Schedule	Start early 2019, for about one year
Resources Required	Small editorial team, multiple contributors of several pages of material, small production team, external publisher
Budget	Approx. £35K with BEIS or ESA support for publication costs
Funding Agency	BEIS / ESA

Project Title	Impact of backward view on SLSTR to continuity of data from ATSR
Application and/or Underpinning Activity	Validation, Algorithms, Data Continuity
Objectives	To determine the consequences of a change from a forward to a backward view on SLSTR for existing ATSR products, including SST, LST, clouds and aerosols
Maturity	Sufficient knowledge of the ATSR dual-view characteristics is available to undertake this stage
Justification	Potential modifications need to be identified to the data processing algorithms and software for SLSTR, to ensure the continuity of the ATSR datasets.
Priority	High – need to identify any potential problems with the changed view before the cost of any modifications to the SLSTR algorithms becomes prohibitively high.
Urgency	High – originally driven by Sentinel-3 CDR but now required before the Sentinel-3 launch
Project Description	TBD
Project Schedule	6 months, starting in early 2014 (TBC)
Resources Required	TBD
Budget	TBD
Funding Agency	ESA (Open Call?)

Project Title	Improvements to ATSR and SLSTR solar channel calibration
Application and/or Underpinning Activity	Calibration, Data Quality
Objectives	Continue comparisons of ATSR/SLSTR solar reflectance channels over natural targets to reduce uncertainties in long term stability and inter-comparisons with similar sensors.
Maturity	Vicarious calibration methods have been used to improve the calibration of the ATSR/SLSTR Level-1b reflectances to an uncertainty level of ~3%. Recent activities performed under CEOS-IVOS (Libya-4 workshop, inter-comparison working group 4) suggest that further improvements could be achieved with a better understanding of the systematic biases caused by differences in spectral response and geometric effects.
Justification	Climate studies using ATSR/SLSTR demand stable and consistent radiometric calibration of the solar reflectance channels to uncertainties below 1% (TBC). The ESA CCI programme in particular is driving demand for accurate analysis of long term stability of ATSR/SLSTR channels and the associated uncertainty in order to substantiate trends in derived products. It is also important to understand the biases between different derived products as a function of the absolute calibration accuracy of the instrument.
Priority	High
Urgency	Medium
Project Description	1. Continue comparisons of ATSR/SLSTR solar reflectance channels over natural targets to reduce uncertainties in long term stability and inter-comparisons with similar sensors. 2. Introduce additional sites to extend the dynamic range over which comparisons are performed (for example darker targets). 3. Use dark targets to provide an offset calibration for ATSR-1 1600nm channel. 4. Improve uncertainty estimates on satellite inter-calibrations due to spectral response differences and geometric effects. This can be done using spectrometer data (e.g. GOME-2, SCIA) over specific targets to test assumptions about spectral corrections. Use CNES BRDF model of Libya-4 site to test uncertainties due to geometric effects. 5. Improve analysis of SNO measurements to account for spectral differences between sensors. 6. Provide end to end uncertainty budgets and estimates for each ATSR sensor. 7. Revisit AATSR pre-launch calibration data and investigate possible causes of systematic bias between AATSR and MERIS. 8. Disseminate results via publications and website portals. 9. Provide updated calibration tables and tools for users and as inputs to further reprocessing. 10. Repeat the above for SLSTR.
Project Schedule	18 months, starting in Summer 2019
Resources Required	TBD
Budget	TBD
Funding Agency	ESA

Project Title	Polar Surface Temperature – next stage
Application and/or Underpinning Activity	1. Application a. Climate monitoring b. Operational product for NWP c. Model verification 2. Underpinning Activity a. DECC funded work on ATSR Arctic ST dataset b. GlobTemperature output c. ARC/CCI_SST output
Objectives	To derive a Polar Surface Temperature time series and a combined high spatial resolution ATSR/SLSTR Polar All-Surface Temperature data product.
Maturity	Good maturity for SST component provided ATSR L2P v2.1 (1 km resolution) ARC is produced. Will require verification in the Arctic and Antarctic. Medium maturity for LST (non-ice). Lower maturity for ice-ST and sea-ice ST. Lower maturity for cloud clearing and sea-ice/ice/snow detection. Status of SAR data needs to be established.
Justification	1. Improvements to our understanding of recent climate change in the Polar Regions. 2. Launch of SLSTR on Sentinel 3 will enable continuation of the time series and requires solving the problem of the AATSR-SLSTR data gap. Availability of high resolution/high coverage SAR data from Sentinel 1 will allow improvements to the product through higher accuracy of ice masking which will feed into improved cloud detection. 3. Production of a high resolution, long (in satellite terms) data set will be a valuable tool in model verification.
Priority	High
Urgency	High
Project Schedule	3 person years. Recommend 6 month pilot study to determine suitability of SAR data for ice/snow masking and extent of work required.
Resources Required	Knowledge of sea-ice mapping with SAR. Leicester.
Project Description	1. Improvements to masking of cloud and snow/ice. 2. AATSR-SLSTR gap-filling and gap-bridging. 3. Improvements to ST retrieval over snow and ice 4. Extension of product to include Antarctic 5. Extension into SLSTR era. 6. Development of operational Sentinel Arctic [and Antarctic] ST product.
Budget	£300K
Funding Agency	DECC/NERC/ESA?

Project Title	Development of long-term landscape fire and gas flaring record via application of SLSTR fire algorithm to ATSR night-time SWIR and MWIR channel data
Application and/or Underpinning Activity	Fire Disturbance, Climate, Data Continuity, Algorithms, Science
Objectives	To apply the active fire and gas flare detection algorithm developed for Sentinel-3 SLSTR to the ATSR and AATSR archives, to deliver a long-term, consistent active fire record for climate studies and other initiatives such as global gas flaring reduction.
Maturity	The work will utilise the outputs of three other activities, the SLSTR Active fire detection & FRP algorithm definition (Copernicus & NERC funded), the re-processing of ATSR data into SLSTR format, and the recent development of a gas flare radiative power approach that can be applied to the older ATSR data as well as to SLSTR (Fisher and Wooster, 2018). It is considered a mature application since ATSR has already been shown to indicate detectable active fire signals at night, the SLSTR algorithm exists and will need relatively little adjustment to apply to ATSR, and the re-processing of AATSR data into SLSTR format is not expected to prove problematic.
Justification	The ESA World Fire Atlas (WFA) is the first and longest archive of global fire observations and has been used in numerous biomass burning studies. The WFA was derived from night-time ATSR data, and is extremely widely used, including as part of the contributing data to the Global Fire Emissions Database (GFED) - which has been cited over 1000 times. However, the algorithm used to derive the WFA fire detections from the ATSR data consists of a very simple thresholding approach of the 3.7 µm data, and this has been shown to be the cause of many false alarms (estimated to lie in the range 20-30%). Furthermore, other particular problems of time-vary biases exists for the WFA in northern latitude regions such as the boreal forests, where fire patterns are known to be changing under changing climates but where biases in the satellite data hinder accurate depiction and analysis of this. The uniqueness of the fire record present in ATSR, which extends far back before the current "MODIS era", and the wide use to which the WFA has been put attest to its value. However, the issue with its quality also preclude its use in certain science studies, and degrade its value to others. They also will prevent its data being optimally blended with that from SLSTR which will provide the equivalent active fire dataset after the 16 February 2016 launch. We propose to capitalise on the new SLSTR fire detection algorithm and the ATSR reprocessing to optimise and apply the SLSTR algorithm to the ATSR archive, in order to develop a consistent climate quality fire and also global gas flaring dataset from ATSR that can also be in future blended with the ongoing record from SLSTR to assess trends in biomass burning and global and national gas flaring reduction efforts. In addition to the simple "fire location" information the current WFA reports, we would also include cloud cover and overpass coverage information in the product, such that analyses can take these parameters into account when evaluating trends over time, as is done for example in the now operational Copernicus Atmosphere Service fire emissions estimation system. In terms of gas flaring, recent work (Fisher and Wooster, 2018) has shown the ability to derive gas flaring radiative power output from even the single band SWIR observations provided by SLSTR. This opens the way to providing an extremely long duration (back to mid-1990's) record of global gas flaring, to support initiatives such as the World Banks 'Zero Routine Flaring' Initiative. In addition to improved air quality and reduced GHG emissions, the aim of zero flaring would provide significant economic benefits. It has been estimated (Siemens, 2018) that Iraq alone could save about US$5.2 billion over the next four years by reducing gas flared from its fields in addition to other power generation efficiency efforts. Currently Iraq looks to end flaring by 2021, and understanding the trends in flaring over the past decades, plus the ability to provide independent data on

	current levels, would be a significant benefit from the ATSR and SLSTR archive. Importantly this gas flare data goes beyond simple identification, and enables the radiative power output of the flares to be deduced (which is related to the amount of gas being flared off). The same technique can be applied to estimate the radiative power output of the detected fires at night from their SWIR signals, which will act as a replacement for the more standard version of this parameter (which cannot be used with ATSR as the 3.7 micron band is typically saturated over fires).
Priority	High
Urgency	Medium
Project Description	The SLSTR active fire detection algorithm would require very few adjustments to work with the ATSR data once in SLSTR format. After initial testing, any optimisation required would be made and routines also derived for mapping night-time gross cloud cover and scene coverage (also adapted from SLSTR versions). Using JASMIN-CEMS the algorithm would then be run on the entire global ATSR-2 and AATSR archive for fires (and ATSR-1 in addition for gas flares, since it had limited operation of the 3.7 micron band). In addition to the new dataset produced, which would become publically available, analysis of trends shown in the new record would be conducted to demonstrate its potential value to users and produce some first science outputs. In addition to vegetation fires, this would now include analysis of the global gas flaring trends for the last 20+ years.
Project Schedule	Early to mid 2019, for around 9 months maximum.
Resources Required	JASMIN-CEMS, one PDRA @ King's College London, ATSR Archive in SLSTR Format
Budget	Estimated less than £75k
Funding Agency	BEIS/NERC/ESA (ESA Open Call?)

Project Title	Full assessment of atmospherically-corrected surface reflectance quality, errors
Application and/or Underpinning Activity	Land surface climatology, especially surface energy budget, albedo, detection of vegetation anomalies related to climate feedbacks, land cover.
Objectives	To validate atmospheric correction methods for the ATSR, assess errors and range of validity
Maturity	High maturity. Builds on funded research under ESA GlobAlbedo, and Aerosol CCI, which allowed development of simultaneous aerosol and surface reflectance retrieval from ATSR.
Justification	Correction for atmospheric effects are required for accurate surface reflectance, necessary for albedo, separation of anomalies due to surface change from climate or disturbance atmospheric anomalies in time series, and accurate mapping of surface cover and biophysical parameters. Methods have been developed under previous funding for ATSR and will be continued operationally on SLSTR (Synergy branch) but have not previously been validated.
Priority	Necessary to facilitate use of ATSR time series over land surface relevant to several Essential Climate Variables.
Urgency	Needed to allow further exploitation, and to prepare for long term time series including Sentinel-3
Project Description	1. Establishment of database of surface reflectance measurements over ATSR lifespan, focussing on existing calibration sites, the AERONET-based Surface Reflectance Validation Network (ASRVN) developed for MODIS land validation (~160 sites, worldwide). 2. Development of scripts for automated correction of solar/view geometry and spectral transformation to allow comparison with existing estimates, based on methodology already developed under ESA ADAM project. 3. Derivation of surface directional reflectance from ATSR at visible channels for all cloud-free matches, using existing algorithms developed under ESA projects GlobAlbedo, Aerosol CCI and MERIS/AATSR Synergy. 4. Analyses of errors in comparison to estimated error, and establish range of validity including magnitude of impact of main factors on error (surface cover, aerosol optical thickness, geometric registration, cloud fraction in region.
Project Schedule	12 months, start date TBD
Resources Required	PDRA 12 months (North, Swansea University),
Budget	Approx £80-90k
Funding Agency	TBD

Project Title	Derivation of vegetation parameters for ATSR
Application and/or Underpinning Activity	Vegetation productivity; modelling of energy, water and carbon balance; impact of climate change and extreme events (e.g. droughts) on land surface.
Objectives	To develop and test an operational methodology for vegetation products of leaf area index, fraction of absorbed photosynthetically active radiation (fAPAR), and vegetation fractional cover from atmospherically corrected ATSR visible channels.
Maturity	Builds on NERC and ESA funded research towards model retrieval for vegetation biophysical parameters and building on accurate surface reflectance estimation from dual-angle ATSR.
Justification	ATSR has potential for a valuable long-term record of land surface biophysical parameters, relevant to modelling of carbon, water and energy cycles, and detection of anomalies. Recent improvements in model inversion and atmospheric correction will allow a high fidelity dataset to be produced. Existing datasets (MODIS, VGT, and MERIS) do not have such a long series, and show large disagreements.
Priority	Will enable long term vegetation product suite, and addressing current uncertainty on vegetation response to climate change.
Urgency	Demonstration of techniques relevant to SLSTR.
Project Description	1. Development of look-up table based on 3D radiative transfer model FLIGHT to provide simultaneous estimate of LAI, fAPAR and vegetation cover fraction from atmospherically corrected surface reflectance spectra, with uncertainty propagation. The LUT will implicitly account for BRDF effects. ATBD will be produced. 2. Validation of the method following protocols established in the GIO project. This will use the BEnchmark Land Multisite ANalysis and Intercomparison of Products (BELMANIP 2.1) , ~445 global sites, and DIRECT (113 further sites. Retrieval of (A)ATSR time series for 10 x0 10km regions centred on the global BELMANIP2.1 & DIRECT sites. Existing measured values of fAPAR, LAI and fractional cover will be compared with retrieved values. 3. Intercomparison with existing products (GIO, MODIS) for these sites to establish relative bias and highlight regions of agreement/disagreement. 4. Use of downwelling PAR product developed at RAL simultaneous with fAPAR generated to provide a first assessment of modelled GPP/NPP using a simple light use efficiency model. Assessment will be made for selected FLUXNET sites, comparison with MODIS NPP and focusing on areas of high existing disagreement between models.
Project Schedule	18 months, start date TBD
Resources Required	PDRA 18 months Swansea University (North), 3 months researcher at RAL (Poulsen)
Budget	Approx £150-160k
Funding Agency	TBD

Project Title	Retrieval of cloud-top water vapour column (CTWVC) using AIRWAVE algorithm
Application and/or Underpinning Activity	Water Vapour, Climate, Instrument Calibration
Objectives	The Advanced InfraRed WAter Vapour Estimator (AIRWAVE) algorithm, developed in the context of the ALTS project (ESA), has proven to provide very good water vapour information from the ATSR TIR (thermal infra-red) measurements when applied to clear sky – sea surface scenes. The objective of this project is to include cloudy scenarios in the retrieval of water vapour columns using nadir and forward TIR measurements of the ATSR series.
Maturity	New Proposal
Justification	The knowledge of CTWVC would provide a more complete picture of the water budget on global scale. In addition, due to the sensitivity of AIRWAVE to instrument radiometric and spectral calibration, the time series of CTWVC could be used as proxy for possible instrumental drifts. Possible studies on UTLS water vapour content. The extension of AIRWAVE CTWVC to SLSTR measurements should be straight forward.
Priority	High
Urgency	Medium
Project Description	1. Assess the impact of the emissivity of different cloud types in the AIRWAVE retrieval scheme using up-to-date radiative transfer models (RTM) using cloud properties databases 2. Develop a method for identifying cloud types from dual view TIR measurements using a priori atmospheric information (e.g. ECMWF collocated profiles) and RTM simulations 3. Produce a CTWVC data set spanning from 1991 to 2012 4. Validation of CTWVC using sondes 5. Long term data analyses (e.g. trends, inter-instrument biases)
Project Schedule	24-36 months, starting summer 2020
Resources Required	Two persons: one at CNR-ISAC (RTM, cloud detection), one at SERCO (algorithm implementation, cloud detection, data processing, validation)
Budget	300-400 kEuro
Funding Agency	ESA, Eumetsat

Project Title	Surface radiation for the solar energy sector from ATSR
Application and/or Underpinning Activity	Modelling and monitoring efficiency of photo-voltaic (PV) solar energy generation.
Objectives	To develop and test an operational methodology for the production of down-welling solar radiation at the surface, with comprehensive characterisation of the overlying atmosphere, for the solar energy sector.
Maturity	Builds on NERC and ESA funded research developing a radiatively consistent aerosol and cloud retrieval scheme applied to ATSR, which provides a high-quality “atmospheric correction” for calculation of surface parameters.
Justification	Increased utilisation of solar energy is in line with DECC’s strategy. The ability to derive accurate and consistent aerosol and cloud properties from ATSR requires the calculation of up- and down-welling radiation at the surface. Accurate direct and diffuse down-welling solar fluxes are of critical importance for the solar energy sector as well as for biophysical processes, but this capability is not yet utilised. Calculation of direct and diffuse Photosynthetically Active Radiation (PAR) is already on AEB’s list of proposed work topics, and the methodology to produce spectrally-integrated fluxes required for the solar energy sector would build directly on that. Informal discussions with a representative of one UK solar energy company have indicated that the sector could be interested in being involved in the specification and development of such a reliable, new satellite data product, and provision of validation data in the form of pyranometer measurements taken at potential UK sites for solar energy development. Will enable the production of an accurate long-term, global record (1km x 1km) of surface insolation, which has the potential to be of great utility in the solar energy sector
Priority	High
Urgency	Medium - techniques developed will be directly applicable to SLSTR.
Project Description	1. Adaption/extension of PAR code to produce direct and diffuse solar irradiance over the over the spectral range over which photovoltaic cells produce energy 2. Consultation with representatives of the solar industry to determine specific requirements for a satellite based solar irradiance product – data format, resolution, access and included products. 3. Production of a test product, based on existing ESA Climate Change Initiative aerosol and cloud climate data records from (A)ATSR. 4. Comparison of (A)ATSR product against solar irradiance measurements from (for example) met-stations or pyranometers deployed by solar energy firms.
Project Schedule	12 months, start date to be aligned with PAR initiative.
Resources Required	6 staff-months at RAL-RSG.
Budget	£60k
Funding Agency	TBD

Project Title	ATSR-1 pick-up errors, impacts on applications and implementation of empirical correction
Application and/or Underpinning Activity	Calibration, Data Quality
Objectives	To characterise the effect of ATSR-1 cooler pick-up errors in BT and the propagated uncertainty impact on LST/SST. As a demo on case studies, to apply empirical correction of the errors to assess the approximate degree of improvement possible to provide evidence as to the potential benefit of a full implementation of correction.
Maturity	Understanding of the errors associated with calibration systems in ATSR-1 is maturing via the MetEOC-3 analysis of AATSR (based on same principles). Preliminary analyses have characterised the pick-up errors to the degree that suggests useful correction is possible, but the impacts on LST, SST and use of ATSR-1 as a reference sensor are not well understood.
Justification	The ATSR-1 period is of great interest scientifically, in part because of the climate impact of Pinatubo. In terms of SST and LST observation, the ATSR-1 period is not well served by AVHRR observations because of relatively poorly performing AVHRR sensors during that period. Pick-up errors are expected to adversely affect cloud detection (both spectral and textural tests) which in turn increases LST/SST errors indirectly. Additionally, the errors directly propagate through to significant SST errors, especially in the dual view whose use is essential during the period of volcanic stratospheric aerosol (because dual view retrievals greatly amplify noise). Significant averaging (over 10 to 20 km scales) is needed to reduce the pick-up's impact, and in cloudier areas (where contiguous clear skies over such scales are absent) the errors are not reliably reduced, explaining the high uncertainty found in ATSR-1 validation. These effects apply not only to SST but to use of ATSR-1-to-AVHRR matches for improving AVHRR calibration.
Priority	High
Urgency	Medium – a practical target would be to have an improved ATSR-1 archive in time for SST CCI Phase 4 in 2022, which means this pilot project should start by 2020.
Project Description	1. Extract sample series of black-body counts per scan for different epochs of ATSR-1 mission from archives. 2. Characterise phase and amplitude of pick-up as a function of time (e.g. using wavelet analysis). 3. Quantify the uncertainty in phase and amplitude of pick-up given data when applied to correct a pixel radiance 4. Assess the cloud detection effects of such errors 5. Propagate the errors in simulation to SST retrieval of a uniform scene using mapping of pixel time to dual-view regular grid (from which SSTs are generally derived) 6. Quantify, using the phase-amplitude uncertainty, the post-correction impact on SST in principle obtainable 7. Write plan for what would be required for archive improvement and write scientific paper on results
Project Schedule	9 months starting early 2020 at latest
Resources required	EO metrological expertise, ATSR v4 or UBT archive
Budget	TBD
Funding	ESA, MetEOC

Project Title	Regenerating the (A)ATSR LUTs and calibration files into netCDF format
Application and/or Underpinning Activity	Calibration, Data Quality
Objectives	Updates to (A)ATSR look-up tables (LUTs) are quite difficult to produce (old files are in Envisat formats), so it is necessary to regenerate the files into the netCDF format used for SLSTR for any future reprocessing of the v4 (A)ATSR dataset.
Maturity	The files exist in Envisat format so no technical work is required. The process is just time consuming as there are lots of files to convert.
Justification	This would be the final step in making sure that we are not relying on old computers and people's memory for future updates.
Priority	High
Urgency	High – the computers used to generate the (A)ATSR LUTs and calibration files are obsolete and the people with the knowledge to do so are retiring.
Project Description	Convert (A)ATSR LUTs and calibration/auxiliary files to netCDF format. (To be elaborated.)
Project Schedule	9 months starting early 2020 at latest
Resources required	(A)ATSR LUTs etc., RAL Space experts
Budget	TBD
Funding	ESA