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Developing first time-series of land surface temperature from AATSR with uncertainty estimates

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Land surface temperature (LST) is the radiative skin temperature of the land, and is one of the key parameters in the physics of land-surface processes on regional and global scales. Earth Observation satellites provide the opportunity to obtain global coverage of LST approximately every 3 days or less. One such source of satellite retrieved LST has been the Advanced Along-Track Scanning Radiometer (AATSR); with LST retrieval being implemented in the AATSR Instrument Processing Facility in March 2004. Here we present first regional and global time-series of LST data from AATSR with estimates of uncertainty. Mean changes in temperature over the last decade will be discussed along with regional patterns.

Although time-series across all three ATSR missions have previously been constructed (Kogler et al., 2012), the use of low resolution auxiliary data in the retrieval algorithm and non-optimal cloud masking resulted in time-series artefacts. As such, considerable ESA supported development has been carried out on the AATSR data to address these concerns. This includes the integration of high resolution auxiliary data into the retrieval algorithm and subsequent generation of coefficients and tuning parameters, plus the development of an improved cloud mask based on the simulation of clear sky conditions from radiance transfer modelling (Ghent et al., in prep.). Any inference on this LST record is though of limited value without the accompaniment of an uncertainty estimate; wherein the Joint Committee for Guides in Metrology quote an uncertainty as “a parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand that is the value of the particular quantity to be measured”. Furthermore, pixel level uncertainty fields are a mandatory requirement in the on-going preparation of the LST product for the upcoming Sea and Land Surface Temperature (SLSTR) instrument on-board Sentinel-3.

The uncertainty analysis takes into account the expected performance of the retrieval algorithm under varying surface and atmospheric conditions. We characterise the uncertainties in terms of: radiometric noise; fractional vegetation cover as representative of surface emissivity; atmospheric water vapour; and uncertainties as a result of the coefficient fitting process. The total uncertainty budget is a combination of these four components added together in quadrature. The uncertainty due to misclassification of cloudy pixels is difficult to propagate to LST uncertainty bars and has yet to be evaluated in the framework of the current study. The progress made here will allow other time series of LST to be compared with the record from AATSR with greater certainty and hence increases confidence in our knowledge of recent surface temperature changes over the land.

References

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