

SST retrieval developments for the ESA Climate Change Initiative

Owen Embury and Chris Merchant
University of Reading

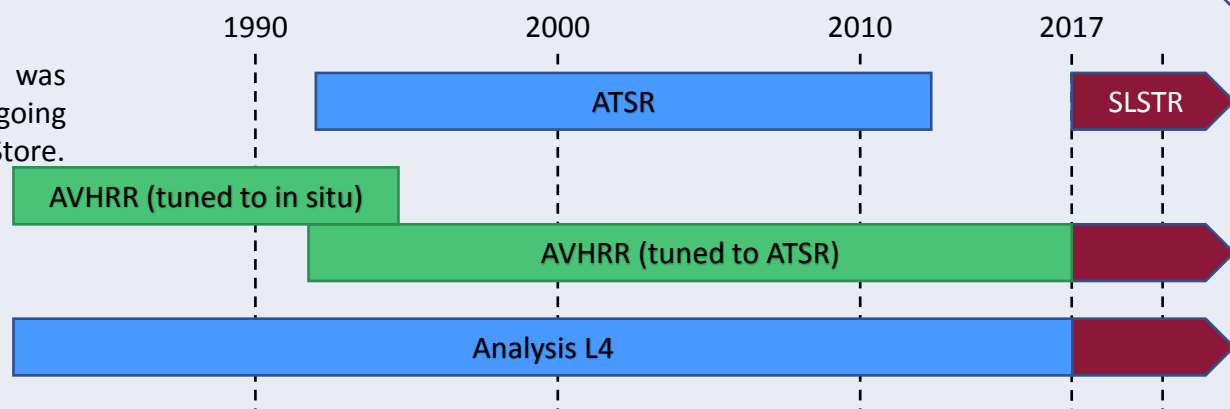
SST CCI CDR v2

The ESA CCI SST Climate Data Record (CDR) v2 was released last year. It is a 35-year CDR with an ongoing ICDR extension available from the C3S Climate Data Store.

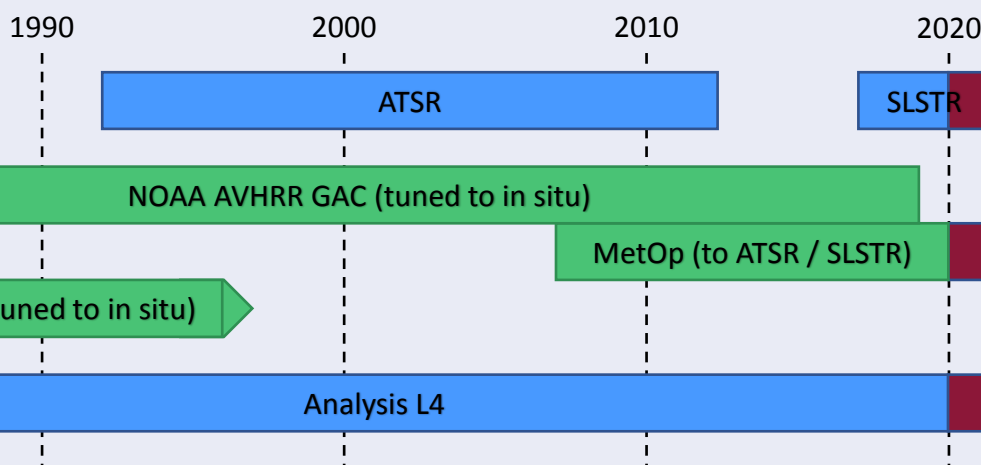
- Dual-view ATSR reference sensors
- AVHRR "GAC" (4 km) from NOAA-7, 9, 11-19 and MetOp-A
- L4 Analysis (OSTIA)

Available from:

- <http://cci.esa.int/data>
- <https://cds.climate.copernicus.eu>



See paper Merchant et al. 2019 [doi:10.1038/s41597-019-0236-x](https://doi.org/10.1038/s41597-019-0236-x)



SST CCI CDR v3

Work is currently underway towards version 3 of the Climate Data Record. Planned improvements are:

- SLSTR-A/B included in CDR as reference sensors
- Full resolution MetOp AVHRR data harmonised to ATSR and SLSTR
- Focus on pre-ATSR period:
 - Further work on AVHRR/1s (NOAA 6, 8, 10)
 - Addition of HIRS SST product
- Other updates:
 - ERA-interim → ERA-5
 - RTTOV11.3 → RTTOV 12.3

Bias-aware Optimal Estimation

For the AVHRR sensors in CDR v2 we used a simple Optimal Estimation (OE) retrieval. However, OE assumes that the errors in the prior, measurements, and forward model are zero mean with well known error covariance. In reality this is not often the case and we had to apply a post-retrieval bias adjustment to the SST (harmonisation to ATSR / in situ).

For CDR v3 we will use the bias-aware OE method described in Merchant et al. 2020 [doi:10.3390/rs12061048](https://doi.org/10.3390/rs12061048). Here, the retrieval state vector is extended to include both prior and measurement bias parameters allowing both to be retrieved from a dataset of matchups to reference observations. Improved estimates of the error covariance matrices can then also be estimated by checking the internal retrieval consistency.

HIRS and Stratospheric Aerosol

The HIRS instrument is a 19 channel infra red sounder including 5 window channels (3 SWIR, 2 TIR) sensitive to surface temperature. As a sounder it has a low resolution than AVHRR ~20 km at nadir; however, this is still comparable to the feature resolution of most SST analyses.

For CDR v2 we used HIRS to derive an auxiliary dataset of stratospheric aerosol following the method of Baran and Foot 1994 [doi:10.1029/94JD02044](https://doi.org/10.1029/94JD02044). For CDR v3 we will test a joint retrieval of SST and aerosol using the bias-aware OE method. As HIRS is carried on the same satellites as AVHRR this will not give increased coverage compared to the AVHRR-only records; however the additional channels have the potential to improve the retrieval in cloud-free regions, particularly when stratospheric aerosols are present.

Saharan Dust Aerosol

CDR v2 was affected by cold biases due to dust aerosol – particularly in the single-view AVHRR data. Work towards reducing these biases in version 3 includes quantifying the bias by comparing CDR v2 with the passive microwave dataset and using the new forward model (RTTOV 12.3) features to include dust in the radiative transfer calculation.