SEA SURFACE TEMPERATURE

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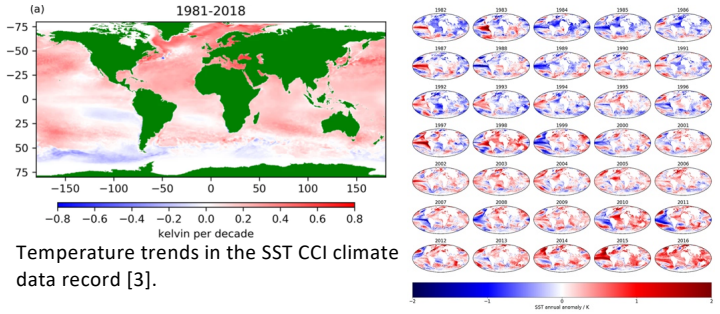
Climate Data Record

Version 2 (Recent Release)

Sea surface temperature (SST) CCI published its v2 climate data record (CDR), in October 2019 [1].

- Spans 1981 to 2016, with ongoing data to 2020 generated as an interim CDR for the Copernicus Climate Data Store
- Globally, this is the only SST CDR that integrates European and international observations in a consistent approach at all levels of data (swath SST imagery, gridded observations, gap-filled analysis)
- >4 x 10^{12} thermal radiances have been processed to achieve a mean observation density of >13 km^{-2} yr^{-1} over a 38 year record
- European dual view sensors are, uniquely, used as physics-based references for the time-series that are independent of in situ data, giving SST CCI particular scientific weight for intercomparisons
- World-leading physics-based algorithms deliver stable SSTs with quantified, low uncertainty
- SST CCI data are key inputs to the Copernicus Climate Change Service and Copernicus Marine Environment Monitoring Service
- Daily analysis on 5 km grid with reliable feature resolution ~20 km



Temperature trends in the SST CCI climate data record [3].

Version 3 (delivery: end 2021)

Ongoing developments focus on: (i) improving the CDR during the climatically crucial 1980s and early 1990s, including better accounting for atmospheric aerosols; (ii) expansion to new sensors (Sentinel 3 SLSTRs, microwave radiometers and pre-2000 sounders) making series more resilient to issues arising from individual satellites

New bias-aware optimal estimation methods [2], developed by and for SST CCI, will increase the consistency between observations and drive improvements in stability towards established climate user requirements.

Version 4 (provisional target date: end 2024)

Extend the CDR in time at both ends, giving the only 45 year satellite record of SST in the world.

Add new US sensors to achieve maximal stability of observation (and extend start of record).

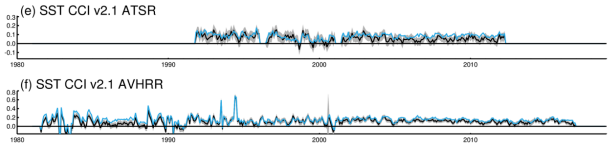
Include "rescued" higher resolution data from early period to increase quality and data density.

Further innovations in bias aware optimal estimation, cloud screening and uncertainty modelling.

Science

Intercomparisons

Comparisons of alternative histories of SST build confidence in our quantitative understanding, especially where there is a high degree of independence in the data – e.g., comparing satellite-only and in-situ only datasets.

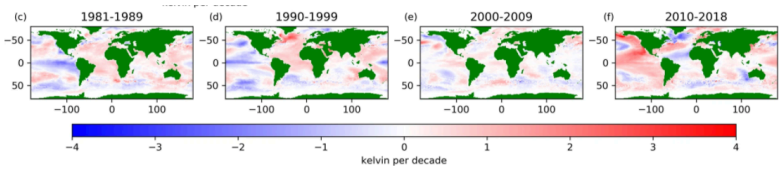


Average SST difference (°C) between HadSST.4.0.0.0 (black with grey shading) and ERSSTv5 (blue) and (e) SST CCI v2.1 ATSR and (f) SST CCI v2.1 AVHRR [4].

Post-1995, the above comparisons show better than 0.05°C/decade stability between independent datasets (ATSRs vs in situ). AVHRR-based SSTs show more fluctuation from limitations of the sensors (and are not fully independent prior to the ATSR era). Both satellite and in situ datasets are more uncertain in the 1980s; v3 will address the principle limitations of CDR v2, providing a tougher test for the in situ analyses.

Quantifying climate: e.g., trend variability

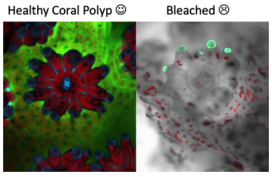
The rate of SST change fluctuates from decade-to-decade, although the long-term trend is for warming across nearly all of the ocean. The 2000s were a period of relative pause in warming, but the overall warming rate in the 2010s has been higher [3].



Ecosystem stresses & responses

This is an example of uptake of the dataset by independent users. NOAA Coral Reef Watch have adopted the CDR as their baseline timeseries for assessing thermal stresses on corals and coral reefs.

Corals are long-lived organisms adapted to the marine climate of past decades and are experiencing relatively rapid thermal change, particularly since the 1990s. The associated large-scale bleaching and dieback of reefs is well known and ongoing.



Quantifying thermal stress on coral reefs requires a stable (low-bias) multi-decadal dataset (defining what corals are adapted to) with daily reef-scale resolution (to quantify the periods of stress). SST CCI v2 CDR provides Coral Reef Watch with the back-history of marine temperatures they need, which is combined with (non-CCI) near-real time data for present-day real-time monitoring.

References: 1. Merchant et al., Nature Scientific Data, 2019, 10.1038/s41597-019-0236-x (in the top 2% for attention across all journals). 2. Merchant et al., Remote Sensing of Environment, 2020, 10.1016/j.rse.2019.111590. 3. Bulgin et al., Nature Sci. Rep., 2020, 10.1038/s41598-020-64785-9. 4. Rayner and Kennedy, in review, 2020.