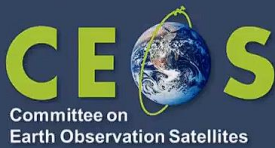


Session 4: Land Surface Temperature CDRs and GCOS Implementation Plan Response

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LSI-VC-15
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WGClimate Coordinated Action Plan



- ❖ Recommendation #19: The CEOS Land Surface Imaging-Virtual Constellation (LSI-VC) to coordinate on the formulation of **future high resolution missions and seamless continuity of sustained Land Surface Temperature CDRs**.
- ❖ Recommendation #20: The CEOS Land Surface Imaging-Virtual Constellation (LSI-VC) together with WGCV and WGClimate to **devise a way forward for the combined use of past, current and future instruments to create sustained Land Surface Temperature CDRs**.

- ❖ CDRs are robust, sustainable, and scientifically sound climate records that provide trustworthy information on how, where, and to what extent the land, oceans, atmosphere and ice sheets are changing. These datasets are thoroughly vetted time series measurements with the longevity, consistency, and continuity to assess and measure climate variability and change (NOAA, 2004).
- ❖ ECV Inventory contains ~40 LST CDRS (existing + planned)
- ❖ A CDR is not the same as a consistently reprocessed dataset

- ❖ A **Fundamental Climate Data Record (FCDR)** is a well-characterised, long-term data record, usually involving a series of instruments, with potentially changing measurement approaches, but with overlaps and calibrations sufficient to allow the generation of products that are accurate and stable, in both space and time, to support climate applications. FCDRs are typically calibrated radiances, backscatter (for active instruments), or radio occultation bending angles. FCDRs also include the ancillary data used to calibrate them. The term FCDR has been adopted by GCOS and can be considered as an international consensus definition.
- ❖ A **Thematic Climate Data Record (TCDR)** - also known as the Climate Data Record (CDR) means the counterpart of the FCDR in geophysical space. A (T)CDR is equivalent to an ECV Product covering only one geophysical variable. For instance, the ECV Cloud includes six different geophysical variables, each of them constituting an ECV product or (T)CDR. The term (T)CDR has been taken up by many space agencies and can be considered as a de facto standard.
- ❖ An **Interim Climate Data Record (ICDR)** regularly extends in time a Fundamental or Thematic Climate Data Record using a system having optimum consistency with and lower latency than the system used to generate the FCDR or TCDCR.

Requirements



Item	Type	Value	Notes
Horizontal resolution	G	<1 km	Only polar orbiting satellites can currently provide data at these resolutions
	B	<1 km	
	T	1 km	
Temporal resolution	G	<1 hour	Only Geostationary data can provide data at these resolutions but these are regional datasets.
	B	1 hour	
	T	6 hours	Very nearly met by day/night temporal resolution from polar orbiting satellite
Timeliness	B	2 days	
	T	30 days	
Required Measurement Uncertainty	G	<1 K	Total uncertainty per pixel combining four components: random, locally correlated atmospheric, locally correlated surface, and large scale systematic. Requirement for correlation length scale knowledge
	B	<1 K	
	T	<1 K	
Stability	G	0.1 K per decade	For climate modeling community long-term product stability is noted as high priority. Temporal stability of the LST products need to be sufficient for global and regional trends in LST anomalies
	B	0.2 K per decade	
	T	0.3 K per decade	

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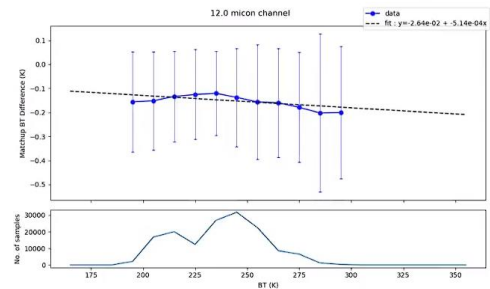
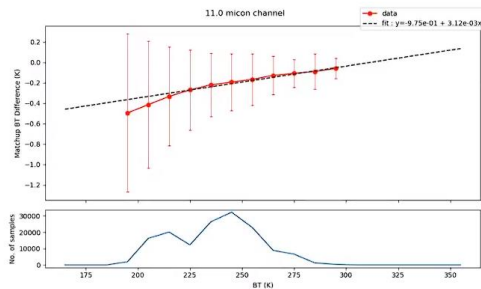
Building a CDR



- ❖ For a CDR, LST data records from multiple sensors need to be consistently processed and harmonized
- ❖ Level-1 input data should itself constitute a Fundamental Climate Data Record (FCDR)
 - Consistent calibration (brightness temperatures)
 - Corrections for orbital drift, stray light, ...
 - Traceable uncertainty budget from the measurement equation
 - Harmonisation across missions
- ❖ Consistency in processing includes retrieval algorithm, auxiliary data, cloud masking, uncertainty model

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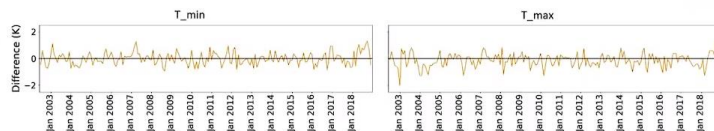
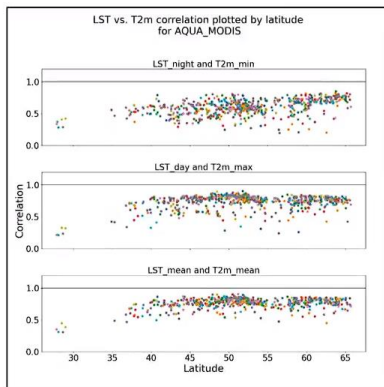
Intercalibration



- ❖ Where no FCDR exists LST CDR data providers need to build a FCDR
- ❖ Intercalibration in BT space against a reference sensor, such as IASI, with BTs processed from reference sensor spectra using SRFs.
- ❖ Method of GSICS heritage

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Assessment



- ❖ Compared LST_cci anomalies with homogenised near-surface air temperature anomalies from EUSTACE dataset.
- ❖ LST vs T2m correlations are significantly improved in the datasets recently released to the CCI Open Data Portal.
- ❖ Conclusion is datasets, such as LST_cci Aqua-MODIS, are considered homogeneous and thus suitable for use for robust climate trend analysis.
- ❖ Good et al., 2022, An Analysis of the Stability and Trends in the LST_cci Land Surface Temperature 1 Datasets over Europe, ESS

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- ❖ Example Thematic CDRs:
 - ESA LST_cci CDRs (**MODIS**, **SLSTR**, Merged IR, **ATSRs**, SSM/I, GOES)
 - CM SAF TCDR (**MVIRI** + **SEVIRI**)
 - NASA MEaSURES (GEO LST [GOES], LEO LST [MODIS + VIIRS])
- ❖ Interim CDRs to address the GCOS timeliness requirement
 - NRT data underpinned by a consistent historical data record
 - UK EOCIS ICDR (SLSTR)

- ❖ ECV Inventory reports the current and planned LST CDRs
 - No independent assessment of the quality of these CDRs
- ❖ Most satellite level-1 data from agencies used for LST are not processed as FCDRs
 - LST data providers should develop an FCDR if one doesn't exist
- ❖ GCOS requirements for a CDR are very demanding particularly on stability
 - LST data products are usually validated but not assessed for long-term stability
- ❖ Surface Temperature PFS contains information on uncertainty but not stability
- ❖ **LSI-VC could be best placed to address Recommendations #19 and #20 in CAP**
- ❖ **LSI-VC could be best placed to address GCOS Actions F1 and F2 on LST**