CCI Land Surface Temperature

Data Access Requirements Document

WP1.3 – LST-CCI-D1.3

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Change log

Version	Date	Changes
1.0	7-Feb-2019	First version
1.1	06-June-2019	Updated version taking into account RIDs from ESA
2.0	04-Aug-2021	Updates with new auxiliary data
3.0	10-Nov-2022	Updates with new data for Phase-2

List of Changes

Version	Section	Changes

Table of Content

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1. Executive Summary

This document identifies all the data that are needed as input to perform the LST_CCI project, including:

- all Level 1 satellite products from ESA and Third Party Missions for LST ECV development
- all ancillary data
- all in situ observation data sources for validation
- higher-level products for product intercomparison and climate assessment

The LST_CCI consortium is responsible for obtaining all input data for use within the LST_CCI project. Most input data are available via FTP, SFTP or HTTP for external parties to obtain from source. The LST_CCI consortium will provide necessary data outside the project team within deliverable data packages (RRDP and CRDP). LST output products from the project in ESA CCI format will be distributed from the ESA CCI Open Data Portal.

This Data Access Requirements Document (DARD) is effectively a live document, which will be updated as new information on datasets is available. Version 3.0 contains updates to the usage of data in product development, additional data for Phase-2.

2. Introduction

This Data Access Requirements Document (DARD) identifies all data that are needed as input to perform the LST_CCI project. In this document we outline the data required (including version number and references), give information about spatio-temporal coverage, availability, estimates of dataset size, and how the data is to be used in the LST_CCI project.

2.1. Structure of the Document

After this introduction, the document is divided into a number of major sections that are briefly described below:

- **Section 2**: Definition of table fields
  - This section provides definitions of the table fields used throughout the rest of the document.
- **Section 3:** Summary of data sets required
  - This section lists all the data products required by the LST_CCI project. The information in this section identifies the product, its version number, the original source, the date the product is first required by the project, the sub-set of the record required, where the data can be obtained and the size of the data set.
- **Sections 4 to 8**
  - These sections provide further information about the data products listed in Section 3. For each data source the DARD includes:
    - information about the original source of the data
    - identification of the data type
    - the sensor type and key technical characteristics
    - information about data availability and coverage
    - the product name and reference to product technical specification documents
    - estimates of data quantity (total)
    - indication of data quality and reliability
    - description of the ordering and delivery mechanism
    - identification of access conditions and pricing
    - details of any formal agreements with data suppliers for delivery of the data product to the project.
    - any requirements for resolving issues concerning data access, calibration, validation and performance issues specific to the ground segment should they exist any potential algorithm upgrades that would enable the regeneration of improved input products for the LST ECV.

2.2. Reference Documents

The following is a list of documents with a direct bearing on the content of this report. Where referenced in the text, these are identified as RD-xx, where 'xx' is the number in the table below.

Table 1: Reference documents.

ID	Reference
[RD-1]	Llewellyn-Jones, D., et al. (2001), AATSR: Global-change and surface temperature measurements from Envisat, ESA Bulletin-European Space Agency (105), 11-21.
[RD-2]	Murray, J., P. Bailey, A. Birks, and D. Smith, cited 2018: The ATSR-1/2 User Guide. [Available online from http://www.atsr.rl.ac.uk/documentation/docs/userguide/index.shtml.]
[RD-3]	Birks, A., ESRIN Product Control Service, Vega Group plc, EOS University of Leicester, M. Buckley, and M. Fletcher, cited 2018: The AATSR Product Handbook. [Available online from http://envisat.esa.int/pub/ESA_DOC/ENVISAT/AATSR/aatsr.ProductHandbook.2_2.pdf.]
[RD-4]	Edwards, T., R. Browning, J. Delderfield, D. J. Lee, and K. A. Lidiard, 1990: The Along Track Scanning Radiometer - Measurement of sea-surface temperature from ERS-1. The Journal of The British Interplanetary Society, 43, 160-180.
[RD-5]	Smith, D. L., et al. (2002), Calibration monitoring of the visible and near-infrared channels of the Along-Track Scanning Radiometer-2 by use of stable terrestrial sites, Applied Optics, 41(3), 515-523.
[RD-6]	Smith, D. L., et al. (2001), Calibration of the AATSR instrument, Advances in Space Research, 28(1), 31-39.
[RD-7]	Tahnk, W. R., and J. A. Coakley (2002), Improved calibration coefficients for NOAA-12 and NOAA-15 AVHRR visible and near-IR channels, Journal of Atmospheric and Oceanic Technology, 19(11), 1826-1833.
[RD-8]	Trishchenko, A. P., et al. (2002), Trends and uncertainties in thermal calibration of AVHRR radiometers onboard NOAA-9 to NOAA-16, Journal of Geophysical Research-Atmospheres, 107(D24).
[RD-9]	Wang, L. K., and C. Y. Cao (2008), On-Orbit Calibration Assessment of AVHRR Longwave Channels on MetOp-A Using IASI, IEEE Transactions on Geoscience and Remote Sensing, 46(12), 4005-4013.
[RD-10]	Mittaz, J. P. D., et al. (2009), A Physical Method for the Calibration of the AVHRR/3 Thermal IR Channels 1: The Prelaunch Calibration Data, Journal of Atmospheric and Oceanic Technology, 26(5), 996-1019.
[RD-11]	Mittaz, J., & Harris, A. (2011), A physical method for the calibration of the AVHRR/3 thermal IR channels. Part II: An in-orbit comparison of the AVHRR longwave thermal IR channels on board MetOp-A with IASI, Journal of Atmospheric and Oceanic Technology, *28*(9), 1072-1087.
[RD-12]	D.M.A. Aminou, D. M. A. (2002), MSG's SEVIRI Instrument, ESA Bulletin, 111(August), 15-17.
[RD-13]	Theocharous, E., Usadi, E. and Fox, N. P. 2010. *CEOS Comparison of IR Brightness Temperature Measurements in Support of Satellite Validation. Part I: Laboratory and Ocean Surface Temperature Comparison of Radiation Thermometers*, Teddington, UK: National Physical Laboratory. NPL REPORT OP3, ISSN: 1754-2944
[RD-14]	Augustine, J.A., J.J. DeLuisi, and C.N. Long, SURFRAD—A National Surface Radiation Budget Network for Atmospheric Research. Bulletin of the American Meteorological Society, 2000. 81(10): p. 2341-2357.
[RD-15]	Morris, V. R., Infrared Thermometer (IRT) Handbook (ARM TR-015). Atmospheric Radiation Measurement, Climate Research Facility, U. S. Department of Energy, 2006. (https://www.arm.gov/publications/tech_reports/handbooks/irt_handbook.pdf)
[RD-16]	König-Langlo, G. and B. Loose, The Meteorological Observatory at Neumayer Stations(GvN and NM-II) Antarctica.Polarforschung, 2006. 76(1-2): p. 25 – 38.
[RD-17]	Guillevic, P., Göttsche, F., Nickeson, J., Hulley, G., Ghent, D., Yu, Y., Trigo, I., Hook, S., Sobrino, J.A., Remedios, J. and Román, M., 2017. Land Surface Temperature Product Validation Best Practice Protocol. Version 1.0. *Best Practice for Satellite-Derived Land Product Validation*, p.60.

ID	Reference
[RD-18]	Feltz, M; Borbas, E; Knuteson, R; Hulley, G; Hook, S (2018). The Combined ASTER and MODIS Emissivity over Land (CAMEL) Global Broadband Infrared Emissivity Product. REMOTE SENSING, 10(7), 1027.
[RD-19]	Baldridge, A. M., S.J. Hook, C.I. Grove and G. Rivera, 2009.. The ASTER Spectral Library Version 2.0. Remote Sensing of Environment, vol 113, pp. 711-715.
[RD-20]	Meerdink, S. K., Hook, S. J., Abbott, E.A., & Roberts, D.A. (in prep). The ECOSTRESS Spectral Library 1.0.
[RD-21]	Trigo, I. F., C. C. DaCamara, P. Viterbo, J.-L. Roujean, F. Olesen, C. Barroso, F. Camacho-de Coca, D. Carrer, S. C. Freitas, J. García-Haro, B. Geiger, F. Gellens-Meulenberghs, N. Ghilain, J. Meliá, L. Pessanha, N. Siljamo, and A. Arboleda, 2011: The Satellite Application Facility on Land Surface Analysis. Int. J. Remote Sens., 32, 2725-2744, doi: 10.1080/01431161003743199
[RD-22]	Caselles V., E. Valor, C. Coll and E. Rubio, 1997. “Thermal band selection for the PRISM instrument 1.Analysis of emissivity-temperature separation algorithms”, J. Geophs. Res., 102, D10, 11145-11164.
[RD-23]	Wan. Z., J. Dozier, 1996."A generalised split-window algorithm for retrieving land-surface temperature from space", IEEE Trans. Geosci. Remote Sens., vol. 34 no. 34, pp. 892-905.
[RD-24]	Seemann, S.W., Borbas, E.E., Knuteson, R.O., Stephenson, G.R. and Huang, H.L., 2008. Development of a global infrared land surface emissivity database for application to clear sky sounding retrievals from multispectral satellite radiance measurements. Journal of Applied Meteorology and Climatology, 47(1), pp.108-123.
[RD-25]	Fennig, Karsten; Schröder, Marc; Hollmann, Rainer (2017): Fundamental Climate Data Record of Microwave Imager Radiances, Edition 3, Satellite Application Facility on Climate Monitoring, DOI:10.5676/EUM_SAF_CM/FCDR_MWI/V003, https://doi.org/10.5676/EUM_SAF_CM/FCDR_MWI/V003.
[RD-26]	Rossow, W., and R. Schiffer (1999), Advances in understanding clouds from ISCCP, Bull. Am. Meteorol. Soc., 80(11), 2261–2287.
[RD-27]	Dee, D.P., Uppala, S.M., Simmons, A.J., Berrisford, P., Poli, P., Kobayashi, S., Andrae, U., Balmaseda, M.A., Balsamo, G., Bauer, D.P. and Bechtold, P., 2011. The ERA-Interim reanalysis: Configuration and performance of the data assimilation system. Quarterly Journal of the royal meteorological society, 137(656), pp.553-597.
[RD-28]	Duguay-Tetzlaff, A., Bento, V.A., Göttsche, F.M., Stöckli, R., Martins, J., Trigo, I., Olesen, F., Bojanowski, J.S., da Camara, C. and Kunz, H., 2015. Meteosat land surface temperature climate data record: Achievable accuracy and potential uncertainties. Remote Sensing, 7(10), pp.13139-13156.
[RD-29]	Göttsche, F.M., Olesen, F.S., Trigo, I.F., Bork-Unkelbach, A. and Martin, M.A., 2016. Long term validation of land surface temperature retrieved from MSG/SEVIRI with continuous in-situ measurements in Africa. *Remote Sensing*, *8*(5), p.410.
[RD-30]	Ramsay, B.H., 1998. The interactive multisensor snow and ice mapping system. Hydrological Processes, 12(10-11), pp.1537-1546.
[RD-31]	Helfrich, S.R., McNamara, D., Ramsay, B.H., Baldwin, T. and Kasheta, T., 2007. Enhancements to, and forthcoming developments in the Interactive Multisensor Snow and Ice Mapping System (IMS). *Hydrological Processes: An International Journal*, *21*(12), pp.1576-1586.
[RD-32]	Metsämäki, S., E. Ripper, O.-P. Mattila, R. Fernandes, G. Schwaizer, K. Luojus, T. Nagler, B. Bojkov, and M. Kern (2017), Evaluation of Northern Hemisphere and regional snow extent products within ESA SnowPEx-project, paper presented at Geoscience and Remote Sensing Symposium (IGARSS), 2017 IEEE International, IEEE.
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[RD-34]	Morris, V. R., Infrared Thermometer (IRT) Handbook (ARM TR-015). Atmospheric Radiation Measurement, Climate Research Facility, U. S. Department of Energy, 2006. (https://www.arm.gov/publications/tech_reports/handbooks/irt_handbook.pdf)
[RD-35]	Ghent, D.J., Corlett, G.K., Göttsche, F.M. and Remedios, J.J., 2017. Global Land Surface Temperature From the Along-Track Scanning Radiometers. *Journal of Geophysical Research: Atmospheres*, *122*(22).

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[RD-36]	Arino, O., Gross, D., Ranera, F., Leroy, M., Bicheron, P., Brockman, C., Defourny, P., Vancutsem, C., Achard, F., Durieux, L. and Bourg, L., 2007, July. GlobCover: ESA service for global land cover from MERIS. In *2007 IEEE international geoscience and remote sensing symposium* (pp. 2412-2415). IEEE.
[RD-37]	Savtchenko, A., Ouzounov, D., Ahmad, S., Acker, J., Leptoukh, G., Koziana, J. and Nickless, D., 2004. Terra and Aqua MODIS products available from NASA GES DAAC. *Advances in Space Research*, *34*(4), pp.710-714.
[RD-38]	Wan, Z. and Li, Z.L., 2010. MODIS land surface temperature and emissivity. In *Land Remote Sensing and Global Environmental Change* (pp. 563-577). Springer, New York, NY.
[RD-39]	Wan, Z., 2014. New refinements and validation of the collection-6 MODIS land-surface temperature/emissivity product. *Remote Sensing of Environment*, *140*, pp.36-45.
[RD-40]	Hulley, G.C., Hook, S.J., Abbott, E., Malakar, N., Islam, T. and Abrams, M., 2015. The ASTER Global Emissivity Dataset (ASTER GED): Mapping Earth's emissivity at 100 meter spatial scale. *Geophysical Research Letters*, *42*(19), pp.7966-7976.
[RD-41]	Liu, S., X. Li, Z. Xu, T. Che, Q. Xiao, M. Ma, Q. Liu, R. Jin, J. Guo, L. Wang, W. Wang, Y. Qi, H. Li, T. Xu, Y. Ran, X. Hu, S. Shi, Z. Zhu, J. Tan, Y. Zhang, and Z. Ren. The Heihe Integrated Observatory Network: A Basin-Scale Land Surface Processes Observatory in China. Vadose Zone J. 2018, 17:180072.
[RD-42]	Li, X.; Cheng, G.; Liu, S.; Xiao, Q.; Ma, M.; Jin, R.; Che, T.; Liu, Q.; Wang, W.; Qi, Y.; Wen, J.; Li, H.; Zhu, G.; Guo, J.; Ran, Y.; Wang, S.; Zhu, Z.; Zhou, J.; Hu, X.; Xu, Z. Heihe Watershed Allied Telemetry Experimental Research (HiWATER): Scientific Objectives and Experimental Design. Bulletin of the American Meteorological Society 2013, 94, 1145–1160.
[RD-43]	NASA Visible Infrared Imaging Radiometer Suite Level-1B Product User Guide, Version 2.0, August 2019
[RD-44]	Xiong, X.; Angal, A.; Chang, T.; Chiang, K.; Lei, N.; Li, Y.; Sun, J.; Twedt, K.; Wu, A. MODIS and VIIRS Calibration and Characterization in Support of Producing Long-Term High-Quality Data Products. *Remote Sens.* 2020, *12*, 3167. https://doi.org/10.3390/rs12193167
[RD-45]	Arata OKUYAMA, Masaya TAKAHASHI, Kenji DATE, Keita HOSAKA, Hidehiko MURATA, Tasuku TABATA, Ryoko YOSHINO, Validation of Himawari-8/AHI Radiometric Calibration Based on Two Years of In-Orbit Data, Journal of the Meteorological Society of Japan. Ser. II, 2018, Volume 96B, Pages 91-109
[RD-46]	T. Kawanishi, T. Sezai, Y. Ito, K. Imaoka, T. Takeshima, Y. Ishido, A. Shibata, M. Miura, H. Inahata, and R. W. Spencer, “The Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E), NASDA’s contribution to the EOS for global energy and water cycle studies,” IEEE Trans. Geosci. Remote Sens., vol. 41, no. 2, pp. 184– 194, 2003.
[RD-47]	T. Maeda, Y. Taniguchi and K. Imaoka, "GCOM-W1 AMSR2 Level 1R Product: Dataset of Brightness Temperature Modified Using the Antenna Pattern Matching Technique," in IEEE Transactions on Geoscience and Remote Sensing, vol. 54, no. 2, pp. 770-782, Feb. 2016, doi: 10.1109/TGRS.2015.2465170.

2.4. Glossary

The following terms have been used in this report with the meanings shown.

Term	Definition
AATSR	Advanced Along-Track Scanning Radiometer
AMSR-E	Advanced Microwave Scanning Radiometer for EOS
AMSR2	Advanced Microwave Scanning Radiometer 2
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
ATSR	Along-Track Scanning Radiometer
AVHRR	Advanced Very High Resolution Radiometer
AWI	Alfred-Wegener-Institut
CAMEL	Combined ASTER and MODIS Emissivity database over Land
CEDA	Centre for Environmental Data Analysis
CM SAF	Satellite Application Facility on Climate Monitoring
CIMSS	Cooperative Institute for Meteorological Satellite Studies database of monthly land surface emissivity
DARD	Data Access Requirements Document
DEM	Digital Elevation Model
EASE-grid	Equal-Area Scalable Earth Grid
ECMWF	The European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
ERA5	ECMWF Reanalysis 5
ERA-Interim	ECMWF Reanalysis - Interim
ESA	European Space Agency
FCOVER	Copernicus Global Land Fraction of Vegetation Cover dataset
FTP	File Transfer Protocol
GEO	Geostationary Earth Orbit
GOES	Geostationary Operational Environmental Satellite
HTTP	HyperText Transfer Protocol
IASI	Infrared Atmospheric Sounding Interferometer
ISCCP	International Satellite Cloud Climatology Project
IGKB	International Commission for the Protection of Lake Constance
IMS	Interactive Multisensor Snow and Ice Mapping System
IR	Infrared
KIT	Karlsruhe Institute of Technology
LEO	Low Earth Orbit
LSA SAF	EUMETSAT Satellite Application Facility on Land Surface Analysis
LP DAAC	Land Processes Distributed Active Archive Center
LST	Land Surface Temperature
LUBW	Baden-Württemberg State Institute for the Environment, Survey and Nature Conservation
MERIS	MEdium Resolution Imaging Spectrometer
MFG	Meteosat First Generation
MMDB	Multi-sensor Match-up Database
MODIS	Moderate-resolution Imaging Spectro-radiometer
MSG	Meteosat Second Generation
MW	Microwave
NASA JPL	NASA Jet Propulsion Laboratory
NOAA	National Oceanic and Atmospheric Administration
NSIDC	National Snow & Ice Data Center
NWP	Numerical Weather Prediction
RRDP	Round Robin Data Package

Term	Definition
SEVIRI	Spinning Enhanced Visible and InfraRed Imager
SFTP	Secure File Transfer Protocol
SLSTR	Sea and Land Surface Temperature Radiometer
SSM/I	Special Sensor Microwave Imager
SSMIS	Special Sensor Microwave Imager/Sounder
SURFRAD	Surface Radiation Budget network
TERN	Australian Terrestrial Ecosystem Research Network
UOL	University of Leicester
USGS	United States Geological Survey
USGS EROS Center	USGS Earth Resources Observation and Science Center
WCRP	World Climate Research Program

3. Definition of Table Fields

This section gives definitions of the table fields used in Sections 3, 4, 5, 6, 7, and 8 of this document.

Table 2: Example of main product description table.

Variable	Description
Product Name	The name and, in the case of satellite data, the level of the data product described in the table.
Data type	Type of platform (satellite/in situ/model/analysis) and variable for which data is provided in product.
Source	The system or agency from which the data originates.
URLs	URLs of websites giving key information about the product.
Version	Version of data that will be used within the project.
Platform name and characteristics	The name of the platform(s) from which the data originates (not used for analysis products).
Platform characteristics	Key attributes of the platform (not used for analysis products).
Sensor(s) name(s)	The name of the instrument(s) from which the data originates (not used for analysis products).
Sensor type	The type of sensor(s) making the observations (applicable only for observational data).
Sensor key technical characteristics	Information concerning key sensor technical characteristics observations (applicable only for observational data).
Analysis characteristics	Analysis products: the observational data used in the analysis. Model: indication if product is model data.
References	References to external journal articles, reports and web pages that provide details of technical specifications of the instrument or data product specifications.
Data format	File format of data.
Data grid	Details of the grid where applicable.
Data coverage: temporal	Year of the first available data and year of the last available data or to present if data production is ongoing.
Data coverage: spatial	The locations for which data is available.

Product requirements

Table 3: Example of product requirements description table.

Variable	Description
Date required within project	Date that the data will be first required by the project.
Use within project	The LST_CCI project can be considered to have seven strands: (1) the production of a suite of high quality infrared (IR) and microwave (MW) LST ECV Products for geostationary (GEO) and low earth orbit (LEO) satellites; (2) the production of a merged IR Climate Data Record (CDR); (3) the production of an ATSR-SLSTR CDR; (4) the production of a prototype all-sky Merged product; (5) the construction of the Multi-sensor Match-up Database (MMDB), the production of the Round Robin Data Package (RRDP) and the algorithm selection process; (6) product validation; (7) intercomparison of the ECV with other SST products. These strands are referred to in subsequent tables as (1) LST ECVs; (2) merged IR CDR; (3) ATSR-SLSTR CDR; (4) all-sky merged product; (5) MMDB and algorithm selection; (6) validation and (7) intercomparison. Some data sets will be used for more than one strand and subsequent entries in the table are accompanied by the relevant number in brackets.
Reason for selection	The properties of the product that have led to its selection for use in the project.
Temporal coverage required	The period of data required will depend on the use to which the data is put in the project (see 'Use within project' entry in this table).

Data quality

Table 4: Example of product data quality description table.

Variable	Description
Data calibration	References to external journal articles, reports and web pages describing calibration procedures and results.
Data validation	References to external journal articles, reports and web pages giving data validation procedures and results.
Product limitations	Known access, calibration, validation and performance limitations.
Potential product upgrades	Details of any ongoing efforts that will provide upgrades to the product prior to generation of the ECV.

Data availability

Table 5: Example of main product data availability description table.

Variable	Description
Available from	The distributor of the data product.
Availability time scale	The time interval between data acquisition and data availability.
Estimates of data quantity (total)	An estimate of the computer storage capacity needed to store the required data.
Product delivery	A description of product ordering and delivery mechanisms.
Data reliability	Space and/or ground segment redundancy
Pricing	Cost of the data.

Variable	Description
Access conditions	Any conditions imposed by the data distributor and/or originator on the use of the data within this LST_CCI project.
Formal agreements with data suppliers	Details of any formal agreements that exist between the project and the data suppliers.

4. Summary of Data Sets Required

The tables in this section summarise the requirements for data access. The table fields are defined in Section 3.

Note: All volumes assume data compression

Note: For explanation of asterisk, see the 'Present required within project' field description in Section 3.

4.1. Satellite data

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
ATSR Level 1 (ATSR-2 and AATSR)	1991 to 2012	3.0	Q1 2019	(1) LST ECVs (require all available data 1995-2012) (2) Merged IR CDR (require all available AATSR data 2004-2012) (3) ATSR-SLSTR CDR (require all available data 1995-2012) (4) the production of a prototype all-sky Merged product (2008)	ESA	CEDA Archive	75TB	ATSR 4th re-processing is expected by end-2022.
AMSR-E Level 1	2002 to 2011	4.0	Q1 2023	(1) LST ECVs (require all available data 2002-2011)	JAXA	JAXA Archive	6.5TB	

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
AMSR2 Level 1	2012 to present	2.0	Q1 2023	(1) LST ECVs (require all available data 2012-2021)				
SLSTR Level 1 (Sentinel 3A and 3B)	2016 to present	1.0	Q1 2019	(1) LST ECVs (require all available data 2016-2023) (2) Merged IR CDR (require all available data 2016-2023) (3) ATSR-SLSTR CDR (require all available data 2016-2023) (4) the production of a prototype all-sky Merged product (2008)	ESA	CEDA Archive + JASMIN Fast Tape	2500TB	Only latest 2 years of data are available on disk, older data requires requests to the JASMIN Fast Tape

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
MODIS Level 1	1999 to present	6.1	Q1 2019	(1) LST ECVs (require all available data from both the Terra and Aqua satellites, 1999-2023 or until satellites stop operating) (2) Merged IR CDR (require all available data from both the Terra and Aqua satellites, 2004-2023 or until satellites stop operating) (3) ATSR-SLSTR CDR (require all available data from the Terra satellite, 2012-2016) (4) the production of a prototype all-sky Merged product (2008)	NASA	JASMIN Fast Tape	700TB	Terra has been drifting slowly from its LECT of 10:30 and will reach and exceed 10:15 LECT by October 2022 In January 2022, Aqua began its constellation exit, by stopping all manoeuvres except collision avoidance manoeuvres, and will drift and exceed a 1:45 LECT crossing in February 2023 from its nominal LECT of 1:30 Orbital drift corrections will be calculated and implemented to the ECV products to maintain them until they exceed these 15 minutes differences from their nominal LECTs (until October 2022 for Terra and February 2023 for Aqua)
Metop AVHRR/3 Level 1C	2007 to present	1.5	Q4 2019	(1) LST ECVs (require all available data 2007-2023) (2) Merged IR CDR (require all available data 2007-2023) (4) the production of a prototype all-sky Merged product (2008)	EUMETSAT	SST CCI workspace (JASMIN)	35TB	

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
NOAA AVHRR/3 Level 1C ~4 km GAC data	1998 to present	1.5	Q4 2019	(1) LST ECVs (require all available data from NOAA satellites 15—19, 1998-2023)	NOAA	SST CCI workspace (JASMIN)	22TB	
VIIRS Level 1B	2012 to present	2.0.3	Q2 2023	(1) LST ECVs (require all available data 2012-2023) (2) Merged IR CDR (require all available data 2012-2023) (4) the production of a prototype all-sky Merged product (2008)	NASA	LAADS DAAC	130TB	
SEVIRI Level 1	2002 to present	N/A	Q1 2019	(1) LST ECVs (require all available data from MSG satellites 1-4, 2004-2023) (2) Merged IR CDR (require all available data from MSG satellites 1-4, 2004-2023) (4) the production of a prototype all-sky Merged product (2008)	EUMETSAT	EUMETSAT Earth Observation Portal	50TB	No versions are given for TOA radiances as there is no back processing of GEO data. Calibration of SEVIRI is adjusted is there is an identified issue.

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
Imager / ABI Level 1	1994 to present	N/A	Q4 2019	(1) LST ECVs (require all available data from GOES satellites 12-16, 2004-2023) (2) Merged IR CDR (require all available data from GOES satellites 12-16, 2009-2023) (4) the production of a prototype all-sky Merged product (2008)	NOAA	IPMA	220TB	No versions are given for TOA radiances as there is no back processing of GEO data.
JAMI Level 1	2005 to 2015	N/A	Q4 2019	(1) LST ECVs (require all available data from the MTSAT-1 and 2 satellites, 2009-2015) (2) Merged IR CDR (require all available data from the MTSAT-1 and 2 satellites, 2009-2015) (4) the production of a prototype all-sky Merged product (2008)	JMA	IPMA	1TB	No versions are given for TOA radiances as there is no back processing of GEO data.

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
AHI Level 1	2015 - present	N/A	Q3 2022	(1) LST ECVs (require all available data from the Himawari-8 satellite, 2015-2023) (2) Merged IR CDR (require all available data from the Himawari-8 satellite, 2015-2023)	JMA	IPMA	30TB	
SSM/I Level 1	1987 to 2008	3.0	Q1 2019	(1) LST ECVs (require all available data from the DMSP satellites F11 and F13 1998-2008) (4) the production of a prototype all-sky Merged product (2008)	NOAA	CM SAF	500GB	
SSMIS Level 1	2009 to present	1.0	Q1 2019	(1) LST ECVs (require all available data from the DMSP satellite F17 2009-2023) (4) the production of a prototype all-sky Merged product (2008)	NOAA	NOAA	2TB	
AMSR-E Level 1	2003-2011	4.0	Q1 2023	(1) LST ECVs (require all available data from the Aqua satellite 2003-2011) (4) the production of a prototype all-sky Merged product (2008)	JAXA	JAXA	6.5TB	

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of total data quantity	Comments
AMSR2 Level 1	2012-present	2.0	Q1 2023	(1) LST ECVs (require all available data from the Aqua satellite 2003-2023)	JAXA	JAXA	8TB	
IASI Level 1	2007 to present	11.0	Q1 2019	(3) ATSR-SLSTR CDR (intercalibration data, require all available data 2007 to 2023)	EUMETSAT	EUMETCast	20TB	

4.2. In Situ data

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
KIT network data	2009 to present	1.0	Q2 2019	(5) MMDB and algorithm selection and (6) validation. Require all available data from	KIT	KIT	1GB	

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
				selected site/s for 2009-2023.				
SURFRAD network data	1994 to present	1.0	Q2 2019	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 1995-2023.	NOAA	NOAA	2GB	
ARM network data	2003 to present	1.0	Q2 2019	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 2003-2023.	ARM	ARM	720GB	
AWI network data	1992 to present	1.0	Q2 2019	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 1995-2023.	AWI	AWI	580MB	
IGKB network data	1962 to present	1.0	Q2 2019	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 1995-2023.	LUBW	LUBW	5MB	
Heihe river stations	2013/01/01 – present	1.0	Q3 2021	(5) MMDB and algorithm selection and (6) validation. Require all available data from	KIT	University of Electronic Science and	10 MB	HZZ___ , DMN___sites to present, BGB___ site to present

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
				selected site/s for 2013 – 2015		Technology of China (UESTC)		
LAW network data	2020 to present	1.0	Q1 2023	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 2020 – 2023	Copernicus	ACRI-ST	50MB	5 new sites focused on forest types not previously represented

4.3. Intercomparison data

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
ATS_NR__2	2002 to 2012	3.0	Q2 2019	(7) intercomparison (require all available data for 2002 – 2012)	ESA	CEDA Archive	8TB	
AT2_NR__2	1995 to 2003	3.0	Q2 2019	(7) intercomparison (require all available data for 1995 – 2003)	ESA	CEDA Archive	5TB	
S3A_SL_2_LST	2016 to present	1.0	Q2 2019	(7) intercomparison (require all available data for 2016 – 2023)	ESA	S3MPC	21TB	

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
S3B_SL_2_LST	2018 to present	1.0	Q2 2019	(7) intercomparison (require all available data for 2018 – 2023)	ESA	S3MPC	14TB	
MOD11_L2	1999 to present	6.0	Q2 2019	(7) intercomparison (require all available data for 1999 – 2022)	NASA	LP DAAC	4TB	MODIS L2 Collection 6.1 available.
MYD11_L2	2002 to present	6.0	Q2 2019	(7) intercomparison (require all available data for 2002 – 2023)	NASA	LP DAAC	4TB	
LSA SAF MLST	2005 to present	N/A	Q2 2019	(7) intercomparison (require all available data for 2005 – 2023)	EUMETSAT	LSA SAF	1TB	No versions are given for LSA SAF MLST as there is no back processing of this data.
CM SAF TCDR (LTP and LTS products)	1995 to present	1.0	Q2 2019	(7) intercomparison (require all available data for 1995 – 2023)	EUMETSAT	CM SAF	43GB	
ISCCP DX product	1983 to 2009	1.0	Q2 2019	(7) intercomparison (require all available data for 1995 – 2009)	WCRP	NOAA	900GB	

4.4. Ancillary data

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
ERA5	1979 to present	Earth System model IFS, cycle 41r2	Q4 2018	(1) LST ECVs; (5) MMDB and algorithm selection; and (7) intercomparison. Require all available data for 1995 – 2023.	ECMWF	CEDA Archive	6PB	
ERA-Interim	1979 to present	Earth System model IFS, cycle 31r2	Q4 2018	(1) LST ECVs (require all available data for 1995 – 2018)	ECMWF	CEDA Archive	114TB	
Copernicus Global Land Service FCOVER dataset	2016 to present	2.0	Q4 2018	(1) LST ECVs (require all available data for 2016 – 2023)	Copernicus	Copernicus Global Land Services	530GB	
Copernicus Global Land Service 1 km Global NDVI dataset	1998 to present	2.2	Q4 2018	(1) LST ECVs (require all available data for 1998 – 2023)	Copernicus	Copernicus Global Land Services	8GB	
UW/CIMSS Baseline Fit Global Infrared Land Surface Emissivity Database	2003 to 2016	3.0	Q4 2018	(1) LST ECVs (require all available data for 2003 – 2016)	CIMSS	CIMSS	7GB	
MEaSUREs CAMEL Broadband Emissivity Product	2000 to 2016	2.0	Q4 2018	(1) LST ECVs (require all available data for 2000 – 2016)	CIMSS	CIMSS IREMIS	10GB	
ECOSTRESS (formally ASTER) spectral library	N/A	1.0	Q4 2018	(1) LST ECVs	NASA JPL	NASA JPL	6GB	

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
The Interactive Multisensor Snow and Ice Mapping System (IMS) Daily Northern Hemisphere Snow and Ice Analysis.	1997 to present	1.3	Q4 2018	(1) LST ECVs (require all available data for 1997 – 2023)	US NSIDC	US NSIDC	10GB	
SRTM DEM	1931 to 2000	2.1	Q4 2018	(1) LST ECVs (require all available data for 1995 – 2000)	USGS	USGS EROS Center	472MB	
UOL ATSR LST Biome Classification data	Static	2.0	Q4 2018	(1) LST ECVs	UOL	UOL	1.7TB	
ASTER Global Emissivity Dataset (GED), Static at 100 m resolution	Static	3.0	Q4 2018	(1) LST ECVs	NASA JPL	LP DAAC	1TB	

4.5. Outputs from other CCI projects

Product Name	Available Temporal coverage	Version	Date required within project	Use of data in project and temporal coverage required	Source	Available from	Estimates of data quantity (total)	Comments
ESA CCI Land Cover Global LC maps	1992 - 2015	1.0	Q4 2018	(1) LST ECVs (require all available data for 1995 – 2015)	ESA	CCI Data Portal	10TB	
ESA CCI+ Water Vapour products	Currently unknown	Currently unknown	Phase 2	(1) LST ECVs	ESA	CCI Data portal	Currently unknown	Expected to become available by end of Phase 1.
ESA CCI+ Snow products	Currently unknown	Currently unknown	Phase 2	(1) LST ECVs	ESA	CCI Data portal	Currently unknown	
ESA CCI+ Lakes Lake Surface Temperature products	Currently unknown	Currently unknown	Phase 2	(1) LST ECVs	ESA	CCI Data portal	Currently unknown	
ESA CCI Aerosol Products	1995 to 2012	4.3	Q2 2019	(1) LST ECVs (require all available data for 1995 – 2012)	ESA	CCI Data portal	Currently unknown	ATSR-2 and AATSR Level 3 Daily Aerosol AER data produced by Swansea University.
ESA CCI+ High Resolution Land Cover data	Currently unknown	Currently unknown	Phase 2	(1) LST ECVs	ESA	CCI Data portal	Currently unknown	Expected to become available by end of Phase 1.

5. Satellite Data

This section contains more extensive information about the satellite data products that will be used for the ECV production and Algorithm selection. The information is displayed in the form of tables: one table for each product. Definitions of the table fields are given in Section 3.

5.1. ATSR Level 1

Variable	Description
Product Name	ATSR Level 1
Data type	Satellite: top of the atmosphere radiances
Source	ESA
URLs	AATSR Home page http://www.leos.le.ac.uk/aatsr/ ESA Envisat page http://envisat.esa.int/earth/www/area/index.cfm?fareaid=6 ESA AATSR page https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/envisat/instruments/aatsr RAL AATSR Ops page http://www.aatsrops.rl.ac.uk/ ATSR 1/2 Home page http://www.atsr.rl.ac.uk/ ESA ERS page http://earth.esa.int/ers/
Version	3.0
Platform name and characteristics	ERS-1, ERS-2, Envisat.
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	ATSR-1, ATSR-2, AATSR
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	Dual-view, on-board calibration, visible channels: 0.55 µm, 0.66 µm, 0.87 µm, 1.6 µm, IR channels 3.7 µm, 11 µm, 12 µm.
References	[RD-1], [RD-2], [RD-3]
Data format	Envisat
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	1991 - 2012
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(1) LST ECVs (require all available data 1995-2012) (2) Merged IR CDR (require all available AATSR data 2004-2012) (3) ATSR-SLSTR CDR (require all available data 1995-2012) (4) Prototype all-sky Merged product (2008)
Reason for selection	Long-term Fundamental Climate Record
Temporal coverage required	All available data for 1995-2012

Data quality

Variable	Description
Data calibration	[RD-4], [RD-5], [RD-6]
Data validation	[RD-17]
Product limitations	Information on data quality can be found at https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/envisat/instruments/aatsr
Potential product upgrades	ATSR 4th re-processing is expected to be available end-2022.

Data availability

Variable	Description
Available from	CEDA Archive
Availability time scale	All available.
Estimates of data quantity (total)	75TB
Product delivery	Direct disk access from CEDA Archive
Data reliability	No redundancy
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None required.

5.2. SLSTR Level 1

Variable	Description
Product Name	SLSTR Level 1
Data type	Satellite: top of the atmosphere radiances
Source	ESA
URLs	https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-3-slstr/instrument
Version	Latest Collection is 4, but this is updated every re-processing
Platform name and characteristics	Sentinel-3A, Sentinel-3B
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	SLSTR
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	Dual-view, on-board calibration, visible channels: 0.55 µm, 0.66 µm, 0.87 µm, 1.39 µm, 1.6 µm, IR channels 3.7 µm, 11 µm, 12 µm.
References	Documents are available at https://sentinel.esa.int/web/sentinel/user-guides/sentinel-3-slstr/processing-levels/level-1
Data format	NetCDF-4
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	2016 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(1) LST ECVs (require all available data 2016-2023) (2) Merged IR CDR (require all available data 2016-2023) (3) ATSR-SLSTR CDR (require all available data 2016-2023)
Reason for selection	Input into Long-term IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 2016-2023

Data quality

Variable	Description
Data calibration	SLSTR Cyclic Reports available at https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-3-slstr/data-quality-reports
Data validation	
Product limitations	Geolocation errors likely to increase LST uncertainty.
Potential product upgrades	Hourly met data is being discussed.

Data availability

Variable	Description
Available from	CEDA Archive + JASMIN Fast Tape
Availability time scale	Within 3 days of release
Estimates of data quantity (total)	2500TB
Product delivery	Direct disk access from CEDA Archive or JASMIN Fast Tape for data older than 2 years
Data reliability	Two satellites in orbit and two others planned for launch.
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None required.

5.3. MODIS Level 1

Variable	Description
Product Name	MODIS Level 1
Data type	Satellite: top of the atmosphere radiances
Source	NASA
URLs	https://modis.gsfc.nasa.gov/
Version	6.1
Platform name and characteristics	Terra and Aqua
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	MODIS
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	36 channels in the visible and IR.
References	[RD-37]
Data format	HDF-EOS
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	1999 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(1) LST ECVs (require all available data from both the Terra and Aqua satellites, 1999-2023) (2) Merged IR CDR (require all available data from both the Terra and Aqua satellites, 2004-2023) (3) ATSR-SLSTR CDR (require all available data from the Terra satellite, 2012-2023) (4) Prototype all-sky Merged product (2008)
Reason for selection	Input into Long-term IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 1999-2023

Data quality

Variable	Description
Data calibration	[RD-37]
Data validation	[RD-17]
Product limitations	[RD-37] Terra has been drifting slowly from its LECT of 10:30 and will reach and exceed 10:15 LECT by October 2022 In January 2022, Aqua began its constellation exit, by stopping all manoeuvres except collision avoidance manoeuvres, and will drift and exceed a 1:45 LECT crossing in February 2023 from its nominal LECT of 1:30
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	JASMIN Fast Tape
Availability time scale	Available in near real time
Estimates of data quantity (total)	700TB
Product delivery	Direct access from CEDA Archive or requested access to CEDA NLA
Data reliability	Two satellites in orbit.
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None required.

5.4. Metop AVHRR/3 Level 1C

Variable	Description
Product Name	Metop AVHRR/3 Level 1C
Data type	Satellite: top of the atmosphere radiances
Source	EUMETSAT
URLs	EUMETSAT Metop AVHRR https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Metop/MetopDesign/AVHRR/index.html
Version	1.5
Platform name and characteristics	MetOp – A, B and C
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	AVHRR
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	AVHRR/3 has 6 channels: 0.58 - 0.68 µm, 0.725 - 1.00 µm, 1.58 - 1.64 µm, 3.55 - 3.93 µm, 10.30 - 11.30 µm, 11.50 - 12.50 µm.
References	https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Metop/MetopDesign/AVHRR/index.html
Data format	NetCDF
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 4 km x 4 km
Data coverage: temporal	2007 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2019
Use within project	(1) LST ECVs (require all available data 2007-2023) (2) Merged IR CDR (require all available data 2007-2023) (4) Prototype all-sky Merged product (2008)
Reason for selection	Input into merged IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 2007-2023

Data quality

Variable	Description
Data calibration	[RD-7], [RD-8], [RD-9], [RD-10], [RD-11]
Data validation	[RD-17]
Product limitations	None identified
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	CEDA Archive
Availability time scale	Currently available to present.
Estimates of data quantity (total)	35TB
Product delivery	Direct disk access from SST CCI workspace on JASMIN
Data reliability	Fully redundant ground segment. In case of METOP failure, EUMETSAT is committed to launch a successor within 6 months.
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None required.

5.5. NOAA AVHRR/3 Level 1C

Variable	Description
Product Name	NOAA AVHRR/3 Level 1C
Data type	Satellite: top of the atmosphere radiances
Source	NOAA
URLs	NOAA AVHRR https://noaasis.noaa.gov/NOAASIS/ml/avhrr.html
Version	1.5
Platform name and characteristics	NOAA satellites 15—19
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	AVHRR
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	AVHRR/3 has 6 channels: 0.58 - 0.68 µm, 0.725 - 1.00 µm, 1.58 - 1.64 µm, 3.55 - 3.93 µm, 10.30 - 11.30 µm, 11.50 - 12.50 µm.
References	
Data format	NetCDF
Data grid	~4 km GAC data
Data coverage: temporal	1998-present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2019
Use within project	(1) LST ECVs (require all available data from NOAA satellites 15—19, 1998-2023)
Reason for selection	Input into single sensor ECV Product
Temporal coverage required	All available data for 1998-2023

Data quality

Variable	Description
Data calibration	[RD-7], [RD-8], [RD-9], [RD-10], [RD-11]
Data validation	[RD-17]
Product limitations	None identified
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	SST workspace (JASMIN)
Availability time scale	Currently available to September-2020.
Estimates of data quantity (total)	19TB
Product delivery	Direct access from the SST CCI workspace on JASMIN
Data reliability	Multiple space craft in orbit and multiple ground receiving stations.
Pricing	Free
Access conditions	User registration and data access granted.
Formal agreements with data suppliers	None required.

5.6. VIIRS Level 1

Variable	Description
Product Name	VIIRS Level 1
Data type	Satellite: top of the atmosphere radiances
Source	NASA
URLs	https://modis.gsfc.nasa.gov/
Version	2.0.3
Platform name and characteristics	Suomi NPP and NOAA-20 (JPSS-1)
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	VIIRS
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	22 channels in the visible and IR.
References	[RD-43]
Data format	NetCDF

Variable	Description
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 750 m x 750 m
Data coverage: temporal	2012 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2023
Use within project	(1) LST ECVs (require all available data from both the SNPP and NOAA-20 satellites, 2012-2023) (2) Merged IR CDR (require all available data from both the SNPP and NOAA-20 satellites, 2012-2023)
Reason for selection	Input into single sensor ECV Product
Temporal coverage required	All available data for 2012-2023

Data quality

Variable	Description
Data calibration	[RD-44]
Data validation	[RD-44]
Product limitations	None identified
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	NASA LAADS DAAC
Availability time scale	Available in near real time
Estimates of data quantity (total)	130TB
Product delivery	FTP download
Data reliability	Two satellites in orbit. Suomi NPP crosses the equator about 1:30 a.m. and 1:30 p.m. and NOAA-20 crosses at 2:20 am and 2:20 pm, local time
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None required.

5.7. SEVIRI Level 1

Variable	Description
Product Name	SEVIRI Level 1
Data type	Satellite: top of the atmosphere radiances

Variable	Description
Source	EUMETSAT
URLs	EUMETSAT Meteosat https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Meteosat/MeteosatDesign/index.html
Version	N/A
Platform name and characteristics	MSG satellites 1-4
Platform characteristics	Geostationary orbit
Sensor(s) name(s)	SEVIRI
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	12 spectral channels, 1 km resolution in high resolution visible channel, 3 km in other visible channels
References	[RD-12]
Data format	HRIT
Data grid	Geo grid
Data coverage: temporal	2002 to present
Data coverage: spatial	79° W to 79° E longitude, 81° S to 81° N latitude

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(1) LST ECVs (require all available data from MSG satellites 1-4, 2004-2023) (2) Merged IR CDR (require all available data from MSG satellites 1-4, 2004-2023) (4) Prototype all-sky Merged product (2008)
Reason for selection	Input into merged IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 2004-2023

Data quality

Variable	Description
Data calibration	https://www.eumetsat.int/website/home/Data/Products/Calibration/MSGCalibration/index.html
Data validation	https://www.eumetsat.int/website/home/Data/Products/Calibration/Intercalibration/index.html
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	EUMETSAT Earth Observation Portal
Availability time scale	Within 1 hour
Estimates of data quantity (total)	50TB
Product delivery	Automated access from EUMETCAST

Data reliability	Fully redundant ground segment. Two operable satellites maintained in orbit at any one time.
Pricing	Free
Access conditions	See EUMETSAT data policy
Formal agreements with data suppliers	None required.

5.8. Imager / ABI Level 1

Variable	Description
Product Name	Imager / ABI Level 1
Data type	Satellite: top of the atmosphere radiances
Source	NOAA
URLs	https://www.goes.noaa.gov/
Version	N/A
Platform name and characteristics	GOES satellites 12-16
Platform characteristics	Geostationary orbit
Sensor(s) name(s)	Imager
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	7 visible and IR spectral channels: 0.65 µm, 3.90 µm, 6.55 µm, 10.70 µm - 11.2 µm, 13.35 µm 10.2
References	
Data format	GVAR
Data grid	Geo grid
Data coverage: temporal	1994 to present
Data coverage: spatial	156° W to 6° E longitude, 78° S to 78° N latitude

Product requirements

Variable	Description
Date required within project	Q4 2019
Use within project	(1) LST ECVs (require all available data from GOES satellites 12-16, 2004-2023) (2) Merged IR CDR (require all available data from GOES satellites 12-16, 2004-2023) (4) Prototype all-sky Merged product (2008)
Reason for selection	Input into merged IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 2004-2023

Data quality

Variable	Description
Data calibration	https://www.ospo.noaa.gov/Operations/GOES/calibration/
Data validation	[RD-17]
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	IPMA
Availability time scale	Within 3 hours.
Estimates of data quantity (total)	220TB
Product delivery	On request from IPMA
Data reliability	Fully redundant ground segment. Two operable satellites maintained in orbit at any one time.
Pricing	Free
Access conditions	See NOAA data policy
Formal agreements with data suppliers	None required.

5.9. JAMI Level 1

Variable	Description
Product Name	JAMI Level 1
Data type	Satellite: top of the atmosphere radiances
Source	JMA
URLs	
Version	N/A
Platform name and characteristics	MTSAT-1 and 2
Platform characteristics	Geostationary orbit
Sensor(s) name(s)	JAMI
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	5 channels at 4.0 km resolution for IR channels and 1.0 km resolution for the visible channels: 0.725 µm, 3.75 µm, 6.75 µm, 10.8 µm, 12.0 µm
References	
Data format	LRIT
Data grid	Geo grid
Data coverage: temporal	2005 to 2015
Data coverage: spatial	64° E to 134° W longitude, 81° S to 81° N latitude

Product requirements

Variable	Description
Date required within project	Q4 2019
Use within project	(1) LST ECVs (require all available data from the MTSAT-2 and 3 satellites, 2009-2015) (2) Merged IR CDR (require all available data from the MTSAT-2 and 3 satellites, 2009-2015)
Reason for selection	Input into merged IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 2009-2015

Data quality

Variable	Description
Data calibration	http://www.data.jma.go.jp/mscweb/en/operation/calibration_portal.html
Data validation	[RD-17]
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	IPMA
Availability time scale	Within 3 hours.
Estimates of data quantity (total)	1TB
Product delivery	On request from IPMA
Data reliability	Redundant ground segment not available.
Pricing	Free
Access conditions	See JMA data policy
Formal agreements with data suppliers	None required.

5.10. AHI Level 1

Variable	Description
Product Name	AHI Level 1
Data type	Satellite: top of the atmosphere radiances
Source	JMA
URLs	http://www.jma.go.jp/jma/indexe.html
Version	N/A
Platform name and characteristics	Himawari-8
Platform characteristics	Geostationary orbit
Sensor(s) name(s)	AHI
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	16 channels in IR and visible at 2.0 km resolution
References	[RD-45]
Data format	LRIT
Data grid	Geo grid
Data coverage: temporal	2015 to present
Data coverage: spatial	80° E to 160° W longitude, 60° S to 60° N latitude

Product requirements

Variable	Description
Date required within project	Q3 2022
Use within project	(1) LST ECVs (require all available data from the Himawari-8 satellite, 2015-2023) (2) Merged IR CDR (require all available data from the Himawari-8 satellite, 2015-2023)
Reason for selection	Input into merged IR CDR and single sensor ECV Product
Temporal coverage required	All available data for 2015-2023

Data quality

Variable	Description
Data calibration	https://www.data.jma.go.jp/mscweb/en/support/support.html
Data validation	[RD-45]
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	IPMA
Availability time scale	Within 3 hours.
Estimates of data quantity (total)	30TB
Product delivery	On request from IPMA
Data reliability	Redundant ground segment not available.

Variable	Description
Pricing	Free
Access conditions	See JMA data policy
Formal agreements with data suppliers	None required.

5.11. SSM/I Level 1

Variable	Description
Product Name	SSM/I Level 1
Data type	Satellite: top of the atmosphere radiances
Source	NOAA
URLs	https://doi.org/10.5676/EUM_SAF_CM/FCDR_MWI/V003
Version	3.0
Platform name and characteristics	DMSP satellites F11 and F13
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	SSM/I
Sensor type	MW radiometer
Sensor key technical characteristics	4 frequencies and 7-channels: 19.35Ghz, 22.235Ghz, 37.0Ghz, 85.5 Ghz, all frequencies with vertical and horizontal polarization, apart from the 22.235 GHz.
References	[RD-25]
Data format	NetCDF
Data grid	Twice per day (~ 6 am/pm), at instrument swath position (spacing depending on frequency, finest spacing ~15 km at 85.5 GHz).
Data coverage: temporal	1987 to 2008
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(1) LST ECVs (require all available data from the DMSP satellites F11 and F13 1998-2008)
Reason for selection	Input into single sensor ECV Product
Temporal coverage required	All available data for 1998-2008

Data quality

Variable	Description
Data calibration	The data processing accounts for several known issues with the instruments and corrects calibration anomalies due to along-scan inhomogeneity, moonlight intrusions, sunlight intrusions, and emissive reflector. Furthermore, an inter-calibration model incorporates a scene dependent inter-satellite bias correction and a non-linearity correction to the instrument calibration.
Data validation	
Product limitations	None identified so far
Potential product upgrades	None

Data availability

Variable	Description
Available from	CM SAF
Availability time scale	All available.
Estimates of data quantity (total)	500GB
Product delivery	Ftp download from CM-SAF archive.
Data reliability	Two operable satellites carrying SSM/I or SSMIS sensors have been maintained in orbit at any one time for the past 20 years.
Pricing	Free
Access conditions	See CM SAF data policy
Formal agreements with data suppliers	None required.

5.12. SSMIS Level 1

Variable	Description
Product Name	SSMIS Level 1
Data type	Satellite: top of the atmosphere radiances
Source	NOAA
URLs	https://doi.org/10.5676/EUM_SAF_CM/FCDR_MWI/V003
Version	3.0
Platform name and characteristics	DMSP satellite F17
Platform characteristics	Sun-synchronous polar orbit
Sensor(s) name(s)	SSMIS
Sensor type	MW radiometer
Sensor key technical characteristics	4 frequencies and 7-channels: 19.35Ghz, 22.235Ghz, 37.0Ghz, 85.5 Ghz, all frequencies with vertical and horizontal polarization, apart from the 22.235 GHz.
References	[RD-25]
Data format	NetCDF
Data grid	Twice per day (~ 6 am/pm), at instrument swath position (spacing depending on frequency, finest spacing ~15 km at 85.5 GHz).
Data coverage: temporal	2009 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(1) LST ECVs (require all available data from the DMSP satellite F17 2009-2020) (4) Prototype all-sky Merged product (2008)
Reason for selection	Input into single sensor ECV Product
Temporal coverage required	All available data for 2009-2020

Data quality

Variable	Description
Data calibration	The data processing accounts for several known issues with the instruments and corrects calibration anomalies due to along-scan inhomogeneity, moonlight intrusions, sunlight intrusions, and emissive reflector. Furthermore, an inter-calibration model incorporates a scene dependent inter-satellite bias correction and a non-linearity correction to the instrument calibration.
Data validation	None identified
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	CM SAF
Availability time scale	Inter-calibrated L1 data already available up to 2015, following years subject to CM-SAF processing scheduling.
Estimates of data quantity (total)	2TB
Product delivery	Ftp download from CM-SAF archive.
Data reliability	Two operable satellites carrying SSM/I or SSMIS sensors have been maintained in orbit at any one time for the past 20 years.
Pricing	Free
Access conditions	See CM SAF data policy
Formal agreements with data suppliers	None required.

5.13. AMSR-E Level-1

Variable	Description
Product Name	AMSR-E Level 1
Data type	Satellite: top of the atmosphere radiances
Source	JAXA
URLs	https://earth.jaxa.jp/en/data/
Version	4.0
Platform name and characteristics	AQUA
Platform characteristics	Sun-synchronous polar orbit
Sensor(s) name(s)	AMSR-E
Sensor type	MW radiometer
Sensor key technical characteristics	6 frequencies: 6.925, 10.65, 18.7, 23.8, 36.5, and 89.0 GHz, all frequencies with vertical and horizontal polarization
References	[RD-46]
Data format	HDF

Variable	Description
Data grid	Twice per day (~ 1.30 am/pm), at instrument swath position (spacing depending on frequency, finest spacing ~5 km at 89.0 GHz).
Data coverage: temporal	2003 to 2011
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2023
Use within project	(1) LST ECVs (require all available data 2003-2011)
Reason for selection	Input into single sensor ECV Product
Temporal coverage required	All available data for 2003-2011

Data quality

Variable	Description
Data calibration	The data processing accounts for several known issues with the instruments and corrects calibration anomalies due to along-scan inhomogeneity, moonlight intrusions, sunlight intrusions, and emissive reflector.
Data validation	None identified
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	JAXA
Availability time scale	2003 to 2011
Estimates of data quantity (total)	6.5TB
Product delivery	Ftp download from JAXA archive.
Data reliability	No redundancy
Pricing	Free
Access conditions	See JAXA data policy
Formal agreements with data suppliers	None required.

5.14. AMSR2 Level-1

Variable	Description
Product Name	AMSR2 Level 1
Data type	Satellite: top of the atmosphere radiances
Source	JAXA
URLs	https://earth.jaxa.jp/en/data/
Version	2.0
Platform name and characteristics	GCOM-W1
Platform characteristics	Sun-synchronous polar orbit
Sensor(s) name(s)	AMSR2
Sensor type	MW radiometer
Sensor key technical characteristics	6 frequencies: 6.925, 10.65, 18.7, 23.8, 36.5, and 89.0 GHz, all frequencies with vertical and horizontal polarization
References	[RD-47]
Data format	HDF
Data grid	Twice per day (~ 1.30 am/pm), at instrument swath position (spacing depending on frequency, finest spacing ~5 km at 89.0 GHz).
Data coverage: temporal	2012 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2023
Use within project	(1) LST ECVs (require all available data 2003-2011)
Reason for selection	Input into single sensor ECV Product
Temporal coverage required	All available data for 2012 to 2023

Data quality

Variable	Description
Data calibration	The data processing accounts for several known issues with the instruments and corrects calibration anomalies due to along-scan inhomogeneity, moonlight intrusions, sunlight intrusions, and emissive reflector.
Data validation	None identified
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	JAXA
Availability time scale	2012 to present
Estimates of data quantity (total)	8.0TB
Product delivery	Ftp download from JAXA archive.
Data reliability	No redundancy
Pricing	Free
Access conditions	See JAXA data policy
Formal agreements with data suppliers	None required.

5.15. IASI Level 1

Variable	Description
Product Name	IASI Level 1
Data type	Satellite: top of the atmosphere radiances
Source	EUMETSAT
URLs	EUMETSAT IASI https://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Metop/MetopDesign/IASI/index.html
Version	11.0
Platform name and characteristics	MetOp – A, B and C
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	IASI
Sensor type	Interferometer
Sensor key technical characteristics	Interferometer with 8461 channels, with one embedded IR imaging channel.
References	https://www.eumetsat.int/website/home/Data/TechnicalDocuments/index.html
Data format	NetCDF
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 12 km at nadir
Data coverage: temporal	2007 to present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q1 2019
Use within project	(3) ATSR-SLSTR CDR (intercalibration data, require all available data 2007 to 2023)
Reason for selection	Input into Long-term IR CDR
Temporal coverage required	All available data for 2007-2023

Data quality

Variable	Description
Data calibration	https://www.eumetsat.int/website/home/Data/TechnicalDocuments/index.html
Data validation	https://www.eumetsat.int/website/home/Data/TechnicalDocuments/index.html
Product limitations	None identified
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	EUMETCast
Availability time scale	Near Real Time
Estimates of data quantity (total)	20TB
Product delivery	HTTP from EUMETCast
Data reliability	Three operable satellites currently in orbit.
Pricing	Free
Access conditions	See EUMETSAT data policy
Formal agreements with data suppliers	None required.

6. In Situ Data

This section contains more extensive information about the in situ data products that will be used in the LST_CCI project. The information is displayed in the form of tables: one table for each product. Definitions of the table fields are given in Section 3.

6.1. KIT network data

Variable	Description
Product Name	KIT network data
Data type	In situ radiometric observations
Source	KIT
URLs	KIT Surface Temperature validation https://www.imk-asf.kit.edu/english/MSA-Validiation.php
Version	1.0
Platform name and characteristics	Evora, Portugal; Dahra tree mast, Senegal; Gobabeb wind tower, Namibia; Rust mijn Ziel (RMZ) Farm, Kalahari, Namibia; Farm Heimat, Kalahari, Namibia
Platform characteristics	Validation station
Sensor(s) name(s)	Heitronics KT15.85 IIP
Sensor type	infrared radiometers
Sensor key technical characteristics	KT15.85 IIP sensors measure IR radiance between 9.6 and 11.5 µm and provide brightness temperatures with a resolution of 0.03 K, an accuracy of ±0.3 K, and with a drift of less than 0.01 % per month. They are self-calibrating, chopped precision radiometers.
References	https://www.heitronics.com/en/infrarot-messtechnik/produkte/radiation-thermometers/universelle-spezialisten/kt15-ii-serie/kt15ii-series/
Data format	ASCII
Data grid	None
Data coverage: temporal	2009 to present
Data coverage: spatial	5 in situ sites in Portugal, Senegal and Namibia

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 2009-2023.
Reason for selection	KT15.85 radiometers are long-term stable with minimum drift. KIT network radiometers are regularly checked, recalibrated and maintained.
Temporal coverage required	All available data for 2009-2023

Data quality

Variable	Description
Data calibration	All radiometers are initially calibrated to specifications by the manufacturer (Heitronics GmbH, Wiesbaden, Germany). Once deployed the radiometers are checked annually in parallel runs with freshly calibrated reference instruments. Recalibration against a blackbody is performed by KIT about every two years and after an exchange of instruments [RD-13].
Data validation	Not Applicable
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	KIT
Availability time scale	Within 1 month.
Estimates of data quantity (total)	1GB
Product delivery	Will be made available by KIT.
Data reliability	Fully redundant ground station.
Pricing	Free
Access conditions	One year of in situ data is made available to all project partners, the other years are only accessible to the validation team.
Formal agreements with data suppliers	None required.

6.2. SURFRAD network data

Variable	Description
Product Name	SURFRAD network data
Data type	In situ radiometric observations
Source	NOAA
URLs	NOAA SURFRAD Network https://www.esrl.noaa.gov/gmd/grad/surfrad/
Version	1.0
Platform name and characteristics	Bondville, Illinois; Table Mountain, Boulder, Colorado; Desert Rock, Nevada; Fort Peck, Montana; Goodwin Creek, Mississippi; Penn. State Univ., Pennsylvania; Sioux Falls, South Dakota
Platform characteristics	Validation station
Sensor(s) name(s)	Eppley Precision Infrared Radiometers
Sensor type	infrared radiometers
Sensor key technical characteristics	Eppley Precision Infrared Radiometers have a hemispheric field of view measuring radiances in a wavelength range of 4 - 50 µm.
References	http://www.eppleylab.com/instrument-list/precision-infared-radiometer/
Data format	SURFRAD
Data grid	None
Data coverage: temporal	1994 to present
Data coverage: spatial	7 in situ sites in the USA

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 1995-2023.
Reason for selection	Relatively long-term, actively maintained in situ data set
Temporal coverage required	All available data for 1995-2023

Data quality

Variable	Description
Data calibration	[RD-14]
Data validation	Not applicable
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	SURFRAD
Availability time scale	Within 1 month.
Estimates of data quantity (total)	2GB
Product delivery	ftp from BSRN
Data reliability	Fully redundant ground station.
Pricing	Free
Access conditions	Freely available.
Formal agreements with data suppliers	None required.

6.3. ARM network data

Variable	Description
Product Name	ARM network data
Data type	In situ radiometric observations
Source	ARM
URLs	ARM network https://www.arm.gov/
Version	1.0
Platform name and characteristics	Southern Great Plains Facility, Oklahoma; Barrow, North Slope of Alaska
Platform characteristics	Validation station
Sensor(s) name(s)	Eppley Precision Infrared Radiometers at Barrow and KT19.85 Infrared Thermometers at Southern Great Plains

Variable	Description
Sensor type	infrared radiometers or thermometers
Sensor key technical characteristics	Eppley Precision Infrared Radiometers have a hemispheric field of view measuring radiances in a wavelength range of 4 - 50 µm. The upwelling pyrgeometer is ventilated and shaded at these sites. KT15.85 IIP sensors measure IR radiance between 9.6 and 11.5 µm.
References	http://www.eppleylab.com/instrument-list/precision-infared-radiometer/ [RD-15]
Data format	NetCDF
Data grid	None
Data coverage: temporal	2003 to present
Data coverage: spatial	Various sites globally

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 2003-2023
Reason for selection	Relatively long-term, actively maintained in situ data set
Temporal coverage required	All available data for 2003-2023

Data quality

Variable	Description
Data calibration	[RD-34]
Data validation	Not applicable
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	ARM
Availability time scale	Within 1 month.
Estimates of data quantity (total)	720GB
Product delivery	Direct download from ARM.
Data reliability	Fully redundant ground station.
Pricing	Free
Access conditions	Freely available.
Formal agreements with data suppliers	None required.

6.4. AWI network data

Variable	Description
Product Name	AWI network data
Data type	In situ radiometric observations
Source	AWI
URLs	AWI network https://www.awi.de/en/science/long-term-observations/atmosphere/antarctic-neumayer/meteorology/radiation.html
Version	1.0
Platform name and characteristics	Georg-von Neumayer, Antarctica
Platform characteristics	Validation station
Sensor(s) name(s)	Eppley Precision Infrared Radiometers
Sensor type	infrared radiometers
Sensor key technical characteristics	Eppley Precision Infrared Radiometers have a hemispheric field of view measuring radiances in a wavelength range of 4 - 50 µm.
References	http://www.eppleylab.com/instrument-list/precision-infared-radiometer/
Data format	NetCDF
Data grid	None
Data coverage: temporal	1992 to present
Data coverage: spatial	One site in Antarctica

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 1995-2023
Reason for selection	Relatively long-term, actively maintained in situ data set
Temporal coverage required	All available data for 1995-2023

Data quality

Variable	Description
Data calibration	The instruments are serviced throughout the year and are re-calibrated once per year [RD-16].
Data validation	Not applicable.
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	AWI
Availability time scale	Within 1 month.
Estimates of data quantity (total)	580MB
Product delivery	Available online
Data reliability	Fully redundant ground station.
Pricing	Free
Access conditions	Freely available upon request.
Formal agreements with data suppliers	None required.

6.5. IGKB network data

Variable	Description
Product Name	IGKB network data
Data type	In situ radiometric observations
Source	LUBW
URLs	https://www.lubw.baden-wuerttemberg.de/wasser/institut-fuer-seenforschung
Version	1.0
Platform name and characteristics	Fischbach-Uttwil/Lange-nargen-Arbon, Lake Constance, Germany
Platform characteristics	Validation station
Sensor(s) name(s)	Multi-channel temperature loggers (RBR)
Sensor type	Thermistor
Sensor key technical characteristics	The temperature logger operates with thermistor strings in a temperature range from -5° C to 35° C.
References	http://rbr-global.com/wp-content/uploads/2018/01/0005559revB-RBRconcerto3-Tx-datasheet.pdf
Data format	NetCDF
Data grid	None
Data coverage: temporal	1962 to present
Data coverage: spatial	Two stations location on Lake Constance.

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 1995-2023
Reason for selection	Relatively long-term, actively maintained in situ data set
Temporal coverage required	All available data for 1995-2023

Data quality

Variable	Description
Data calibration	None identified
Data validation	Not applicable.
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	LUBW
Availability time scale	Within 3 months.
Estimates of data quantity (total)	5MB
Product delivery	Available directly from LUBW.
Data reliability	Fully redundant lake station.
Pricing	Free
Access conditions	Only for CCI+ Validation purposes
Formal agreements with data suppliers	Data use agreement.

6.6. Heihe river stations

Variable	Description
Product Name	HZZ___ , DMN___, BGB___
Data type	In situ radiometric observations
Source	University of Electronic Science and Technology of China (UESTC) / KIT
URLs	Not applicable
Version	1.0
Platform name and characteristics	Heihe River station (Huazhaizi Desert Steppe - HZZ___, Daman – DMN___, Bajitan Gobi – BGB___)
Platform characteristics	Validation station
Sensor(s) name(s)	CNR 1 (HZZ___, BGB___), PIR (DMN___)
Sensor type	CNR 1: Net Radiometer (pyranometer and pyrgeometer pair), PIR: pyrgeometer
Sensor key technical characteristics	Broadband infrared measurements in a wavelength range between 4-50 microns (PIR) and between 5 to 50 microns (CNR 1)
References	[RD-41], [RD-42]
Data format	netCDF
Data grid	Point measurements (station data)
Data coverage: temporal	10 min
Data coverage: spatial	Local

Product requirements

Variable	Description
Date required within project	Q3 2021
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s
Reason for selection	Three years of infrared measurements in the southern hemisphere, where in situ stations are sparse
Temporal coverage required	10 min

Data quality

Variable	Description
Data calibration	Calibration against a Fluke 4180 precision infrared calibrator 297 (Fluke Corp., USA) (Zhou et al., 2016)
Data validation	None identified
Product limitations	Mesurements stopped for BGB in 2015;
Potential product upgrades	None

Data availability

Variable	Description
Available from	March 2019 / University of Electronic Science and Technology of China (UESTC)
Availability time scale	3 years of data
Estimates of data quantity (total)	10 MB
Product delivery	Via email
Data reliability	Not known
Pricing	Free
Access conditions	Include references from data set producers
Formal agreements with data suppliers	Via mail (Mingsong Li, UESTC)

6.7. LAW network data

Variable	Description
Product Name	LAW network data
Data type	In situ radiometric observations
Source	Copernicus
URLs	https://law.acri-st.fr/home
Version	1.0
Platform name and characteristics	KIT Forest, Germany; Svartberget, Sweden; Hyytiala, Finland; Puechabon, France; Robson Creek, Australia
Platform characteristics	Validation station
Sensor(s) name(s)	Heitronics KT15.85 IIP
Sensor type	infrared radiometers

Sensor key technical characteristics	KT15.85 IIP sensors measure IR radiance between 9.6 and 11.5 µm and provide brightness temperatures with a resolution of 0.03 K, an accuracy of ±0.3 K, and with a drift of less than 0.01 % per month. They are self-calibrating, chopped precision radiometers.
References	https://www.heitronics.com/en/infrarot-messtechnik/produkte/radiation-thermometers/universelle-spezialisten/kt15-ii-serie/kt15ii-series/
Data format	NetCDF
Data grid	None
Data coverage: temporal	2020 to present
Data coverage: spatial	5 in situ sites in Europe (4) and Australia (1)

Product requirements

Variable	Description
Date required within project	Q1 2023
Use within project	(5) MMDB and algorithm selection and (6) validation. Require all available data from selected site/s for 2020-2023
Reason for selection	Actively maintained in situ data set in an area not observed through other radiometer networks
Temporal coverage required	All available data for 2020-2023

Data quality

Variable	Description
Data calibration	None identified.
Data validation	Not applicable.
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	ACRI-ST
Availability time scale	All available.
Estimates of data quantity (total)	50MB
Product delivery	Available online.
Data reliability	Fully redundant ground station.
Pricing	Free
Access conditions	Freely available.
Formal agreements with data suppliers	None required.

7. Intercomparison Data

This section contains more extensive information about the intercomparison data products that will be used in the LST_CCI project. The information is displayed in the form of tables: one table for each product. Definitions of the table fields are given in Section 3.

7.1. ATS_NR__2

Variable	Description
Product Name	ATS_NR__2
Data type	Satellite: retrieved LST
Source	ESA
URLs	http://catalogue.ceda.ac.uk/uuid/ebb0efd3bf06d7d0472503729201e624
Version	2.1
Platform name and characteristics	Envisat.
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	AATSR
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	Dual-view, on-board calibration, visible channels: 0.55 µm, 0.66 µm, 0.87 µm, 1.6 µm, IR channels 3.7 µm, 11 µm, 12 µm.
References	[RD-1], [RD-2], [RD-3]
Data format	Envisat
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	2002 - 2012
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 2002 – 2012)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 2002-2012

Data quality

Variable	Description
Data calibration	[RD-4], [RD-5], [RD-6]
Data validation	[RD-35]
Product limitations	Information on data quality can be found at https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/envisat/instruments/aatsr
Potential product upgrades	None Identified

Data availability

Variable	Description
Available from	CEDA Archive
Availability time scale	All available.
Estimates of data quantity (total)	8TB
Product delivery	Direct disk access from CEDA Archive
Data reliability	No redundancy
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.2. AT2_NR__2

Variable	Description
Product Name	AT2_NR__2
Data type	Satellite: retrieved LST
Source	ESA
URLs	http://catalogue.ceda.ac.uk/uuid/36473df8dd5b82309c06539a57210698
Version	2.1
Platform name and characteristics	ERS-2
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	ATSR-2
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	Dual-view, on-board calibration, visible channels: 0.55 µm, 0.66 µm, 0.87 µm, 1.6 µm, IR channels 3.7 µm, 11 µm, 12 µm.
References	[RD-1], [RD-2], [RD-3]
Data format	Envisat
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	1995 - 2003
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 1995 – 2003)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 1995-2003

Data quality

Variable	Description
Data calibration	[RD-4], [RD-5], [RD-6]
Data validation	[RD-35]
Product limitations	Information on data quality can be found at https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/envisat/instruments/aatsr
Potential product upgrades	None Identified

Data availability

Variable	Description
Available from	CEDA Archive
Availability time scale	All available.
Estimates of data quantity (total)	5TB
Product delivery	Direct disk access from CEDA Archive
Data reliability	No redundancy
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.3. S3A_SL_2_LST and S3B_SL_2_LST

Variable	Description
Product Name	S3A_SL_2_LST and S3B_SL_2_LST
Data type	Satellite: retrieved LST
Source	ESA
URLs	https://sentinel.esa.int/web/sentinel/missions/sentinel-3
Version	Latest Processing Baseline (currently PB2.37 S3A and PB1.12 S3B)
Platform name and characteristics	Sentinel-3A and 3B
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	SLSTR
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	Dual-view, on-board calibration, visible channels: 0.55 µm, 0.66 µm, 0.87 µm, 1.39 µm, 1.6 µm, IR channels 3.7 µm, 11 µm, 12 µm.
References	SLSTR Cyclic Reports available at https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-3-slstr/data-quality-reports
Data format	NetCDF-4
Data grid	Uniform grid of points in the common quasi-Cartesian coordinate system, approximate resolution is 1 km x 1 km
Data coverage: temporal	2016 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 2016 – 2023)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 2016-2023

Data quality

Variable	Description
Data calibration	SLSTR Cyclic Reports available at https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-3-slstr/data-quality-reports
Data validation	
Product limitations	Geolocation errors likely to increase LST uncertainty.
Potential product upgrades	Hourly met data is being discussed.

Data availability

Variable	Description
Available from	S3MPC
Availability time scale	Non-time critical data within 4 days
Estimates of data quantity (total)	22 Tb (S3A) and 14 Tb (S3B)
Product delivery	Direct disk access from Collaborative Platform (CTCP) with FTP available to transfer to JASMIN
Data reliability	SLSTR PAC (Processing and Archive Centre) is based at ACRI-ST for land products with full redundancy
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.4. MOD11_L2

Variable	Description
Product Name	MOD11_L2
Data type	Satellite: retrieved LST
Source	NASA
URLs	https://modis.gsfc.nasa.gov/data/dataprod/mod11.php
Version	6.1
Platform name and characteristics	Terra
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	MODIS
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	36 channels in the visible and IR.
References	[RD-38], [RD-39]
Data format	HDF-EOS
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	1999 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 1999 – 2022)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 1999-2022

Data quality

Variable	Description
Data calibration	[RD-38], [RD-39]
Data validation	[RD-39]
Product limitations	[RD-39] Terra has been drifting slowly from its LECT of 10:30 and will reach and exceed 10:15 LECT by October 2022
Potential product upgrades	MODIS L2 Collection 6.1 is expected during the lifetime of the project.

Data availability

Variable	Description
Available from	LP DAAC
Availability time scale	Within a day of acquisition
Estimates of data quantity (total)	4TB
Product delivery	ftp
Data reliability	Two satellites in orbit.
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.5. MYD11_L2

Variable	Description
Product Name	MYD11_L2
Data type	Satellite: retrieved LST
Source	ESA
URLs	https://modis.gsfc.nasa.gov/data/dataprod/mod11.php
Version	6.1
Platform name and characteristics	Aqua
Platform characteristics	Sun-synchronous polar orbits
Sensor(s) name(s)	MODIS
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	36 channels in the visible and IR.
References	[RD-38], [RD-39]
Data format	HDF-EOS
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	2002 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 2002 – 2023)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 2002-2023

Data quality

Variable	Description
Data calibration	[RD-38] , [RD-39]
Data validation	[RD-39]
Product limitations	[RD-39] In January 2022, Aqua began its constellation exit, by stopping all manoeuvres except collision avoidance manoeuvres, and will drift and exceed a 1:45 LECT crossing in February 2023 from its nominal LECT of 1:30
Potential product upgrades	MODIS L2 Collection 6.1 is expected during the lifetime of the project.

Data availability

Variable	Description
Available from	LP DAAC
Availability time scale	Within a day of acquisition
Estimates of data quantity (total)	4TB
Product delivery	ftp
Data reliability	Two satellites in orbit.
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.6. LSA SAF MLST

Variable	Description
Product Name	LSA SAF MLST
Data type	Satellite: retrieved LST
Source	EUMETSAT
URLs	https://landsaf.ipma.pt/en/products/land-surface-temperature/lst/
Version	N/A
Platform name and characteristics	MSG 2 and 3
Platform characteristics	Geostationary orbit
Sensor(s) name(s)	SEVIRI
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	12 spectral channels, 1 km resolution in high resolution visible channel, 3 km in other visible channels
References	[RD-21], [RD-22], [RD-23]
Data format	HDF5
Data grid	Rectangular grid centred on instrument ground track, approximate resolution is 1 km x 1 km
Data coverage: temporal	2005 - present
Data coverage: spatial	79° W to 79° E longitude, 81° S to 81° N latitude

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 2005 – 2023)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 2005-2023

Data quality

Variable	Description
Data calibration	Contained in the Algorithm Theoretical Basis Document (ATBD) and the Validation Report (VR) available from https://landsaf.ipma.pt/documentsView.jsp
Data validation	
Product limitations	
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	LSA SAF
Availability time scale	Within 1 hour of last observation.
Estimates of data quantity (total)	1TB
Product delivery	EUMETCast or FTP transfer
Data reliability	Produced in a Near Real Time operational environment with a committed performance threshold of 95% per month. The reliability can be checked in the latest Operations Semester Reports (OSR).
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.7. CM SAF TCDR (LTP and LTS products)

Variable	Description
Product Name	CM SAF TCDR (LTP and LTS products)
Data type	Satellite: retrieved LST
Source	ESA
URLs	https://www.cmsaf.eu/EN/Home/home_node.html
Version	1.0
Platform name and characteristics	MFG and MSG
Platform characteristics	Geostationary orbit
Sensor(s) name(s)	MVIRI and SEVIRI
Sensor type	Visible and IR radiometer
Sensor key technical characteristics	MVIRI has three visible and IR channels: 0.70 µm, 6.40 µm, 11.5 µm. SEVIRI has 12 spectral channels, 1 km resolution in high resolution visible channel, 3 km in other visible channels.
References	[RD-28]
Data format	NetCDF
Data grid	Equal angle 0.05x0.05 degree grid.
Data coverage: temporal	1995 - present
Data coverage: spatial	MSG full disk (includes Europe, Africa, and the Atlantic Ocean).

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 1995 – 2023)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 1995-2023

Data quality

Variable	Description
Data calibration	[RD-28]
Data validation	[RD-29]
Product limitations	None Identified
Potential product upgrades	None Identified

Data availability

Variable	Description
Available from	CM SAF
Availability time scale	Currently available to 2015
Estimates of data quantity (total)	Currently 43GB
Product delivery	HTTPS/SFTP from CM SAF data server
Data reliability	No redundancy
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

7.8. ISCCP DX

Variable	Description
Product Name	ISCCP
Data type	Combined satellite: retrieved LST
Source	WCRP
URLs	https://isccp.giss.nasa.gov/
Version	1.0
Analysis characteristics	Combination of imaging radiometer data from GEO and LEO satellites e.g. AVHHR and GOES Imager
References	[RD-26]
Data format	HDF
Data grid	Approximately 30 km resolution.
Data coverage: temporal	1983 - 2009
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(7) intercomparison (require all available data for 1995 – 2009)
Reason for selection	Product for intercomparison with LST ECVs
Temporal coverage required	All available data for 1995-2009

Data quality

Variable	Description
Data calibration	None identified.
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	NOAA
Availability time scale	All available.
Estimates of data quantity (total)	900GB
Product delivery	
Data reliability	No redundancy
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8. Ancillary Data

This section contains further information about the data products that will be used as ancillary data in the ECV production. The information is displayed in the form of tables: one table for each product. Definitions of the table fields are given in Section 3.

8.1. ERA5

Variable	Description
Product Name	ERA5
Data type	NWP model forecast and analysis fields
Source	ECMWF
URLs	https://www.ecmwf.int/en/forecasts/datasets/archive-datasets/reanalysis-datasets/era5
Version	Earth System model IFS, cycle 41r2
Analysis characteristics	Model data
References	See ERA5 documentation at https://confluence.ecmwf.int/display/CKB/What+is+ERA5
Data format	NetCDF and GRIB
Data grid	31 km grid
Data coverage: temporal	1979 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs; (5) MMDB and algorithm selection; and (7) intercomparison. Require all available data for 1995 – 2023.
Reason for selection	Long-term consistent reanalysis dataset
Temporal coverage required	All available data for 1995-2023

Data quality

Variable	Description
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	ECMWF, Copernicus Data Service
Availability time scale	Archive updated monthly, 3 months behind real-time
Estimates of data quantity (total)	6TB
Product delivery	Via scripts from ECMWF WebAPI or the Copernicus Data Service API.
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8.2. ERA-Interim

Variable	Description
Product Name	ERA-Interim
Data type	NWP model forecast and analysis fields
Source	ECMWF
URLs	https://www.ecmwf.int/en/forecasts/datasets/archive-datasets/reanalysis-datasets/era-interim
Version	Earth System model IFS, cycle 31r2
Analysis characteristics	Model data
References	[RD-27]
Data format	NetCDF and GRIB
Data grid	80 km grid
Data coverage: temporal	1979 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 1995 – 2023)
Reason for selection	Long-term consistent reanalysis dataset
Temporal coverage required	All available data for 1995-2023

Data quality

Variable	Description
Data validation	[RD-27]
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	CEDA Archive
Availability time scale	Archive updated monthly, 2 months behind real-time
Estimates of data quantity (total)	114TB
Product delivery	Direct access from the CEDA Archive or download from ECMWF.
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8.3. Copernicus Global Land Service FCOVER dataset

Variable	Description
Product Name	Copernicus Global Land Service FCOVER dataset
Data type	Fractional Vegetation Cover
Source	Copernicus
URLs	https://land.copernicus.eu/global/products/fcover
Version	2.0
Analysis characteristics	Gap filled analysis of SPOT-VGT and PROBA-V satellite data.
References	
Data format	NetCDF and GeoTiff
Data grid	1 km
Data coverage: temporal	2016 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 2016 – 2023)
Reason for selection	Auxiliary Fraction of Vegetation Cover data for input into LST ECVs
Temporal coverage required	All available data for 2016-2023

Data quality

Variable	Description
Data validation	https://land.copernicus.eu/global/sites/cgls.vito.be/files/products/CGLOPS1_SQE2017_LAI1km-V1%26V2_I1.10.pdf
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	Copernicus Global Land Services
Availability time scale	Within 3 days after end of synthesis period.
Estimates of data quantity (total)	530GB
Product delivery	FTP or direct download from Copernicus Global Land Services
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8.4. Copernicus Global Land Service NDVI dataset

Variable	Description
Product Name	Copernicus Global Land Service NDVI dataset
Data type	Normalized Difference Vegetation Index
Source	Copernicus
URLs	https://land.copernicus.eu/global/products/ndvi
Version	2.0
Analysis characteristics	Rescaled standard 10-day synthesis of PROBA-V satellite data. Pixels wrongly identified as "land" in the S10 NDVI status map are re-classified as "sea".
References	
Data format	NetCDF and GeoTiff
Data grid	1 km
Data coverage: temporal	1998 - present
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 1998 – 2023)
Reason for selection	Auxiliary NDVI data for input into LST ECVs
Temporal coverage required	All available data for 1998-2023

Data quality

Variable	Description
Data validation	
Product limitations	None identified

Potential product upgrades	None

Data availability

Variable	Description
Available from	Copernicus Global Land Services
Availability time scale	Within 3 days after end of synthesis period.
Estimates of data quantity (total)	8GB
Product delivery	FTP or direct download from Copernicus Global Land Services
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8.5. UW/CIMSS Baseline Fit Global Infrared Land Surface Emissivity Database

Variable	Description
Product Name	UW/CIMSS Baseline Fit Global Infrared Land Surface Emissivity Database
Data type	Emissivity product
Source	CIMSS
URLs	http://cimss.ssec.wisc.edu/iremis/
Version	3.0
Analysis characteristics	Derived by fitting monthly averaged MODIS Aqua level 3 operational land surface emissivity product values to a baseline emissivity spectra determined using laboratory measurements of land surface materials.
References	[RD-24]
Data format	NetCDF
Data grid	0.05°
Data coverage: temporal	2003 - 2016
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 2003 – 2016)
Reason for selection	Auxiliary emissivity data for input into LST ECVs
Temporal coverage required	All available data for 2003-2016

Data quality

Variable	Description
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	CIMSS
Availability time scale	All available
Estimates of data quantity (total)	7GB
Product delivery	ftp access from http://cimss.ssec.wisc.edu/iremis/
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8.6. MEaSUREs CAMEL Broadband Emissivity Product

Variable	Description
Product Name	MEaSUREs CAMEL Broadband Emissivity Product
Data type	Emissivity product
Source	CIMSS
URLs	http://cimss.ssec.wisc.edu/iremis/
Version	2.0
Analysis characteristics	Combined ASTER MODIS Emissivity over Land
References	[RD-18]
Data format	NetCDF
Data grid	0.05°
Data coverage: temporal	2000-2016
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 2000 – 2016)
Reason for selection	Auxiliary emissivity data for input into LST ECVs
Temporal coverage required	All available data for 2000-2016

Data quality

Variable	Description
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	Eventually will be extended to 2017

Data availability

Variable	Description
Available from	CIMSS
Availability time scale	Updated periodically
Estimates of data quantity (total)	10GB
Product delivery	https from LP DAAC
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

8.7. ECOSTRESS (formally ASTER) spectral library

Variable	Description
Product Name	ECOSTRESS spectral library
Data type	Spectral library
Source	NASA JPL
URLs	https://speclib.jpl.nasa.gov/
Version	1.0
Analysis characteristics	A collection of over 2300 spectra of a natural and man-made materials covering the wavelength range 0.4–15.4 µm.
References	[RD-19], [RD-20]
Data format	Text files
Data grid	N/A
Data coverage: temporal	N/A
Data coverage: spatial	N/A

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs
Reason for selection	Auxiliary emissivity data for input into LST ECVs
Temporal coverage required	All available

Data quality

Variable	Description
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	NASA JPL
Availability time scale	All available
Estimates of data quantity (total)	6GB
Product delivery	Direct download from NASA JPL
Data reliability	N/A
Pricing	Free
Access conditions	None
Formal agreements with data suppliers	None

8.8. The Interactive Multisensor Snow and Ice Mapping System (IMS) Daily Northern Hemisphere Snow and Ice Analysis

Variable	Description
Product Name	The Interactive Multisensor Snow and Ice Mapping System (IMS) Daily Northern Hemisphere Snow and Ice Analysis
Data type	Transient snow cover dataset
Source	US NSIDC
URLs	https://www.ecmwf.int/en/forecasts/datasets/archive-datasets/reanalysis-datasets/era-interim
Version	1.3
Analysis characteristics	Derived by analysts using a mixture of satellite and in situ data.
References	[RD-30], [RD-31]
Data format	ASCII and GeoTIFF
Data grid	1 km, 4km and 24 km EASE-grid (dependant on time period)
Data coverage: temporal	1997 - present
Data coverage: spatial	Northern hemisphere

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 1997 – 2023)
Reason for selection	Auxiliary seasonal snow cover data for input into LST ECVs.
Temporal coverage required	All available data for 1997-2023

Data quality

Variable	Description
Data validation	[RD-32]
Product limitations	[RD-31]
Potential product upgrades	None

Data availability

Variable	Description
Available from	NSIDC
Availability time scale	Updated daily
Estimates of data quantity (total)	10GB
Product delivery	FTP from NSIDC
Data reliability	The IMS product is considered operational, but OSDPD does not guarantee availability or timely delivery of data via the OSDPD Web server, and NSIDC does not guarantee availability of this product via the NSIDC Web server.
Pricing	Free
Access conditions	None identified
Formal agreements with data suppliers	None

8.9. SRTM DEM

Variable	Description
Product Name	SRTM DEM
Data type	Digital Elevation Model
Source	USGS
URLs	https://www2.jpl.nasa.gov/srtm/index.html ftp://e0srp01u.ecs.nasa.gov/srtm/
Version	2.0
Analysis characteristics	Data from the SRTM radar system that flew on board the Space Shuttle Endeavour.
References	[RD-33]
Data format	DEM File (.HGT)
Data grid	30 arc-seconds
Data coverage: temporal	2000
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 2000)
Reason for selection	Auxiliary elevation data for input into LST ECVs.
Temporal coverage required	All available data for 2000

Data quality

Variable	Description
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	USGS EROS Center
Availability time scale	All available
Estimates of data quantity (total)	472MB
Product delivery	Download from https://dds.cr.usgs.gov/srtm/
Data reliability	N/A
Pricing	Free
Access conditions	None identified.
Formal agreements with data suppliers	None

8.10. UOL ATSR LST Biome Classification data

Variable	Description
Product Name	UOL ATSR LST Biome Classification data
Data type	Biome classification data
Source	UOL
URLs	None
Version	2.0
Analysis characteristics	A variant of the 2006 GlobCover product [RD-36] which includes modifications for Antarctic permanent ice classification, distinction between inland/coastal water and open ocean, and partition of a single bare soil class into the most dominant soil types.
References	[RD-34]
Data format	NetCDF
Data grid	0.01°, 0.05°
Data coverage: temporal	Static
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs
Reason for selection	Auxiliary biome classification.
Temporal coverage required	All available

Data quality

Variable	Description
Data validation	None identified.
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	UOL
Availability time scale	All available
Estimates of data quantity (total)	1.7TB
Product delivery	
Data reliability	N/A
Pricing	Free
Access conditions	None identified.
Formal agreements with data suppliers	N/A

8.11. ASTER Global Emissivity Dataset

Variable	Description
Product Name	ASTER Global Emissivity Dataset (GED)
Data type	Global emissivity data
Source	NASA JPL
URLs	https://lpdaac.usgs.gov/dataset_discovery/community/community_products_table
Version	3.0
Analysis characteristics	ASTER GED land surface temperature and emissivity data products are generated using the ASTER Temperature Emissivity Separation algorithm, with a Water Vapour Scaling atmospheric correction method using MODIS atmospheric profiles and the MODTRAN radiative transfer model. This dataset is computed from all clear-sky pixels of ASTER scenes acquired from 2000 – 2008.
References	[RD-40]
Data format	HDF and binary
Data grid	100 m
Data coverage: temporal	Static
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs
Reason for selection	Auxiliary emissivity data.
Temporal coverage required	All available

Data quality

Variable	Description
Data validation	https://lpdaac.usgs.gov/sites/default/files/public/files/ASTER_GED.pdf
Product limitations	None identified.
Potential product upgrades	None

Data availability

Variable	Description
Available from	NASA JPL
Availability time scale	All available
Estimates of data quantity (total)	1TB
Product delivery	LP DAAC
Data reliability	N/A
Pricing	Free
Access conditions	None identified.
Formal agreements with data suppliers	N/A

9. Outputs from other CCI projects

This section contains information about the CCI outputs from other CCI projects that may be used in the LST_CCI project. Whether or not a product is used will depend on the particular product's final specification and availability. The information is displayed in the form of tables: one table for each product. Definitions of the table fields are given in Section 3.

9.1. ESA CCI Global Land Cover Maps

Variable	Description
Product Name	ESA CCI Land Cover Global LC maps
Data type	Land cover dataset
Source	ESA
URLs	https://www.esa-landcover-cci.org/
Version	1.0
Analysis characteristics	MERIS and SPOT-VGT satellite data global surface reflectance composite time series.
References	http://data.ceda.ac.uk/neodc/esacci/land_cover/docs/ESACCI-LC-PUG-v2.5.pdf
Data format	NetCDF
Data grid	300m
Data coverage: temporal	1992-2015
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q4 2018
Use within project	(1) LST ECVs (require all available data for 1995-2015)
Reason for selection	Long-term consistent reanalysis dataset
Temporal coverage required	All available data for 1995-2015

Data quality

Variable	Description
Data validation	None identified
Product limitations	None identified
Potential product upgrades	None

Data availability

Variable	Description
Available from	CCI Data Portal
Availability time scale	All available.
Estimates of data quantity (total)	10TB
Product delivery	On request. Contact contact@esa-landcover-cci.org
Data reliability	N/A
Pricing	Free
Access conditions	On request.
Formal agreements with data suppliers	None

9.2. ESA CCI+ Water Vapour products

Variable	Description
Product Name	ESA CCI+ Water Vapour products
Data type	Water vapour datasets
Source	ESA
URLs	http://cci.esa.int/watervapour
Version	Unknown
Analysis characteristics	Unknown
References	None identified yet
Data format	Unknown
Data grid	Unknown
Data coverage: temporal	Unknown
Data coverage: spatial	Unknown

Product requirements

Variable	Description
Date required within project	Phase 2
Use within project	(1) LST ECVs
Reason for selection	Auxiliary water vapour data for input into LST ECVs.
Temporal coverage required	Unknown

Data quality

Variable	Description
Data validation	None identified yet
Product limitations	None identified yet
Potential product upgrades	None

Data availability

Variable	Description
Available from	CCI Data Portal
Availability time scale	Expected to become available by end of Phase 1
Estimates of data quantity (total)	Unknown
Product delivery	Unknown
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

9.3. ESA CCI+ Snow products

Variable	Description
Product Name	ESA CCI+ Snow products
Data type	Transient snow cover datasets
Source	ESA
URLs	http://cci.esa.int/node/274/
Version	Unknown
Analysis characteristics	Unknown
References	None identified yet
Data format	Unknown
Data grid	Unknown
Data coverage: temporal	Unknown
Data coverage: spatial	Unknown

Product requirements

Variable	Description
Date required within project	Phase 2
Use within project	(1) LST ECVs
Reason for selection	Auxiliary seasonal snow cover data for input into LST ECVs.
Temporal coverage required	Unknown

Data quality

Variable	Description
Data validation	None identified yet
Product limitations	None identified yet
Potential product upgrades	None

Data availability

Variable	Description
Available from	CCI Data Portal
Availability time scale	Expected to become available by end of Phase 1
Estimates of data quantity (total)	Unknown
Product delivery	Unknown
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

9.4. ESA CCI+ Lakes Lake Surface Temperature products

Variable	Description
Product Name	ESA CCI+ Lake Surface Temperature products
Data type	Lake Surface Temperature datasets
Source	ESA
URLs	http://cci.esa.int/
Version	Unknown
Analysis characteristics	Unknown
References	None identified yet
Data format	Unknown
Data grid	Unknown
Data coverage: temporal	Unknown
Data coverage: spatial	Unknown

Product requirements

Variable	Description
Date required within project	Phase 2
Use within project	(1) LST ECVs
Reason for selection	Auxiliary lake surface water data for input into LST ECVs.
Temporal coverage required	Unknown

Data quality

Variable	Description
Data validation	None identified yet
Product limitations	None identified yet
Potential product upgrades	None

Data availability

Variable	Description
Available from	CCI Data Portal
Availability time scale	Expected to become available by end of Phase 1
Estimates of data quantity (total)	Unknown
Product delivery	Unknown
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

9.5. ESA CCI Aerosol Products

Variable	Description
Product Name	ESA CCI Aerosol products
Data type	Aerosol optical depth datasets
Source	ESA
URLs	http://www.esa-aerosol-cci.org/
Version	4.3
Analysis characteristics	ATSR-2 and AATSR Level 3 Daily Aerosol AER data produced by Swansea University
References	http://www.esa-aerosol-cci.org/
Data format	NetCDF
Data grid	1° equal angle grid
Data coverage: temporal	1995 to 2012
Data coverage: spatial	Global

Product requirements

Variable	Description
Date required within project	Q2 2019
Use within project	(1) LST ECVs (require all available data for 1995-2012)
Reason for selection	Auxiliary aerosol optical depth data for input into LST ECVs.
Temporal coverage required	All available data for 1995-2012

Data quality

Variable	Description
Data validation	None identified
Product limitations	None identified
Potential product upgrades	None identified

Data availability

Variable	Description
Available from	CCI Data Portal or ftp from ftp.icare.univ-lille1.fr
Availability time scale	Unknown
Estimates of data quantity (total)	Unknown
Product delivery	ftp from ftp.icare.univ-lille1.fr
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

9.6. ESA CCI+ High Resolution Land Cover data

Variable	Description
Product Name	ESA CCI+ High Resolution Land Cover data
Data type	High resolution land cover data
Source	ESA
URLs	http://cci.esa.int/
Version	Unknown
Analysis characteristics	Unknown
References	None identified yet
Data format	Unknown
Data grid	Unknown
Data coverage: temporal	Unknown
Data coverage: spatial	Unknown

Product requirements

Variable	Description
Date required within project	Phase 2
Use within project	(1) LST ECVs
Reason for selection	Auxiliary high resolution land cover data for input into LST ECVs.
Temporal coverage required	Unknown

Data quality

Variable	Description
Data validation	None identified yet
Product limitations	None identified yet
Potential product upgrades	None

Data availability

Variable	Description
Available from	CCI Data Portal
Availability time scale	Expected to become available by end of Phase 1
Estimates of data quantity (total)	Unknown
Product delivery	Unknown
Data reliability	N/A
Pricing	Free
Access conditions	User registration
Formal agreements with data suppliers	None

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