Horizon 2020

H2020-EO-2014 New ideas for Earth-relevant Space Applications

EUSTACE

(Grant Agreement 640171)

EU Surface Temperature for All Corners of Earth

Deliverable D1.1

Short report on availability of regular updates to source data sets, with recommendations as to alternative data sources, if needed.

Deliverable Title	Short report on availability of regular updates to source data sets, with recommendations as to alternative data sources, if needed
Brief Description	*The report describes briefly the main data sets used within EUSTACE, and gives a status on the updates of the data set and alternative data sets.*
WP number	1
Lead Beneficiary	*Jacob L. Høyer, Danish Meteorological Institute*
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Nature of the Deliverable	R	*R – Report*
		DEM – Demonstrator, Pilot, Prototype
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Dissemination Level/ Audience	PU	*PU – Public*
		CO - Confidential, only for members of the consortium, including the Commission services

Version	Date	Modified by	Comments
1	30/4/2015		

Table of Contents

1. Executive Summary

This document identifies the data that are needed as input to perform the EUSTACE project, and to facilitate the product generation in the time after EUSTACE should follow-on funding be available.

The data sets include:

- Satellite skin observations of the oceans, land, lake and ice surfaces
- In situ observations
- Ancillary data

All these data are used for building and validating the skin surface temperature to air temperature relationships. A proportion of the in situ data will also be used directly in the product generation. Reprocessed data sets make a majority of the data sets. For future updates of the EUSTACE product, it is thus important to know the status of regular updates of the reprocessed data sets and alternative data sets, if no updates are planned for.

2. Project Objectives

With this deliverable, the project has contributed to the achievement of the following objectives (DOA, Section B1.1):

No.	Objective	Yes	No
1	Intensively develop the hitherto immature use of Earth Observation estimates of Earth's surface **skin** temperature to enable new Climate Data Records of the surface **air** temperature Essential Climate Variable (ECV) to be created, for all locations over all surfaces of Earth (i.e. land, ocean, ice and lakes), for every day since 1850. EUSTACE will achieve this by: combining information estimated from multiple satellites with surface air temperature measurements made *in situ* and **creating complete analyses** of surface air temperature, through the application of novel statistical in-filling methods.	X	
2	Integrate these new daily surface air temperature Climate Data Records into a range of applications in Earth System Science and Climate Services and research, amongst others. EUSTACE will achieve this via the active and continuous engagement of trail-blazer users, and the provision of products through already-existing user community data portals and service mechanisms, in standard formats.		X
3	Undertake and report detailed research into the relationships between surface skin temperature estimated from Earth Observation satellite measurements and surface air temperature observed *in situ* by conventional measurements, over all surfaces of the Earth, including the polar regions. This is likely to provide information useful for refining coupling in Earth system models.	X	

4	Create a sustainable, automated system at an appropriate level of maturity for the potential production of the products beyond the lifetime of the project. To enable this, EUSTACE will also identify Earth Observation and conventional data streams that could be used to update the surface air temperature Climate Data Records in the future, including those from Sentinel missions.	X	
5	Extensively validate the new surface air temperature Climate Data Records against independent, surface-based reference data, sourced by the project for this purpose.	X	
6	Develop and report new, consistent, validated estimates of uncertainty both in already-existing Earth Observation surface skin temperature estimates and in the new surface air temperature Climate Data Records, at all locations and times across the Earth's surface.	X	
7	Develop links with related activities within Europe and beyond to help to ensure the execution of a joined-up work programme, the Copernicus Services and to enable the provision of requirements for the future surface skin temperature and surface air temperature observing system.		X
8	Other – not directly linked to one of the above objectives		

3. Detailed Report

3.1 List of data sets used in EUSTACE

The detailed list of all the data sets to be used in EUSTACE and stored at CEMS/Jasmin was presented in the Description of Action (DOA) and is given below. The partner responsible for providing the data set and information is indicated in the parenthesis. The bold entries under each bullet are the titles of the data set as written in the data tables in Section 3.2, 3.3 and 3.4.

Satellite observations:

- Land surface skin temperature data sets from GlobTemperature (ULEIC; includes LSA-SAF and NASA data sets)

       i)   **Aqua-MODIS Level-2 LST (GT_MYD_2P)**

      ii)   **Satellite LST and Auxiliary (AUX) data derived from Aqua-MODIS**

     iii) **SEVIRI Level-2 LST (GT_SEV_2P)**

- Satellite sea surface temperatures from SST CCI (UREAD)
- Satellite lake surface water temperature observations (and ancillary data) from ARC-Lake/GloboLakes (UREAD) and Inland Water Temperature (IWT) from the Global Lake Temperature Collaboration (GLTC)
  - i)   **ARCLAKE**
- Ice surface skin temperature observations (sea ice and ice sheets) from AVHRR GAC reanalysis and Metop-A from NACLIM (DMI)
  - i)   **Arctic and Antarctic ice Surface Temperatures from thermal Infrared satellite sensors (AASTI)**
  - ii)   **Metop A operational Ice Surface Temperatures**

In Situ observations:

- Land and air temperature data from specific sites (e.g. ARM, USCRN, BSRN) (ULEIC) and LSA-SAF sites in Africa & Portugal) (Met Office)
  - i)   **ARM in situ measurements**
  - ii)   **USCRN in situ measurements**
  - iii) **BSRN in situ measurements**
  - iv) **KIT/Land Surface Analysis Satellite Applications Facility ground station observations**
- Land surface air temperature measurements such as ECA&D and GHCN-D (UBERN/KNMI)
  - i)   **European Climate Assessment & Dataset (ECA&D)**
  - ii)   **Global Historical Climatology Network – Daily (GHCN-D)**
- Marine air temperature observations from HadNMAT2 (Met Office)
  - i)   **HadNMAT2**
- Sea surface temperature observations from HadIOD (Met Office)
  - i)   **HadIOD (Hadley Centre Integrated Ocean Database)**
- In situ lake surface water temperature measurements through associates of GloboLakes and the Global Lake Temperature Collaboration (GLTC, UREAD)
  - i)   **Global Lake Temperature Collaboration (GLTC) data records**
- High latitude in situ observations of surface temperature (Radiometer, buoys and scientific campaigns) (DMI)
  - i)   **IST radiometric surface temperatures from infrared radiometers**
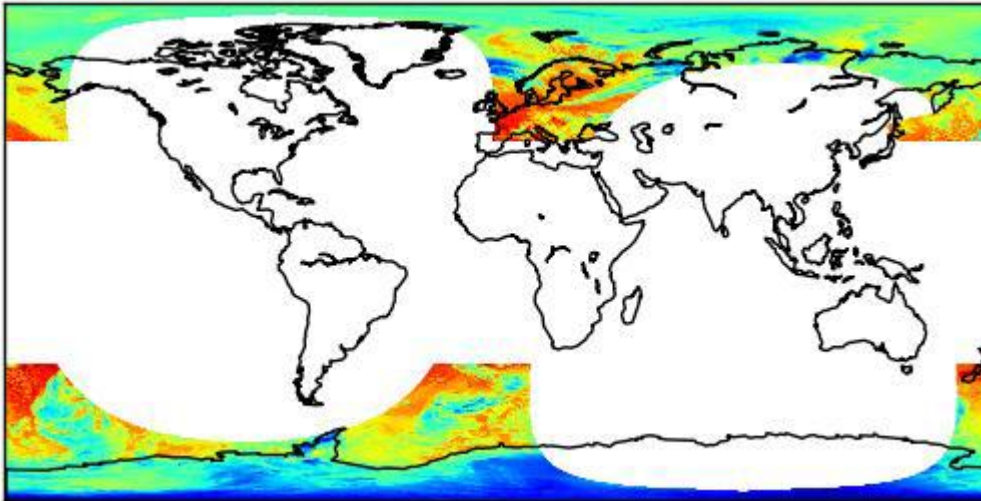 - ii)   **IMB from the NAACOS project**

Ancillary data:

- ERA Interim and 20CR (Met Office)
  - i)   **ERA-Interim**
  - ii)   **20th Century Reanalysis**
- EUMETSAT OSI-SAF sea ice reprocessing and ESA CCI sea ice data sets (DMI)
  - i)   **OSI-SAF Global Sea Ice Concentration (OSI-409)**
- Elevation, vegetation (ULEIC) and land use (Met Office)
  - i)   **Level-3 DEM data**
  - ii)   **Level-3 FCOVER data**
  - iii) **ESA CCI Land Cover Map**
- Snow cover from the GlobSnow project (Met Office)

i) **CryoClim Snow cover**
- Existing climatologies for land, oceans, ice areas (Met Office)
    i) **CRU CL v2.0**
    ii) **MyOcean OSTIA reanalysis**
    iii) **HadSST2 climatology**
    iv) **HadNMAT2 climatology**
- Lake area, depth information (GloboLakes / UREAD)

3.2 Detailed information for satellite data sets:

Product name	**Arctic and Antarctic ice Surface Temperatures from thermal Infrared satellite sensors (AASTI)**
Data description	The observations are Level 2 satellite ice and sea surface temperature observations from 11 NOAA AVHRR sensors, (NOAA 7,9,11,12,14,15,16,17,18,Metop02,19)
Source	The data set has been produced by DMI and Met.no, as part of the NAClim project, and is based upon the level 1 data set compiled by EUMETSAT's Climate Monitoring, Satellite Application Facility. Contact jlh@dmi.dk or gd@dmi.dk for further information on the data set
Key Websites	Naclim website is : http://www.naclim.eu/
Version	1.0
References to technical specifications documents	NACLIM Deliverable D32.28 Report on the documentation and description of the new Arctic Ocean dataset combining SST and IST Contact jlh@dmi.dk or gd@dmi.dk for further information. This data is not available online due to large data volumes.
Product format	NetCDF 3, CF1.4 compliant
Data gridding and resolution	The data set is Global Area Coverage (GAC) data in approximately 5 km resolution
Data coverage: temporal	1982 to 2009 See comments box below for details on extension of this data
Data coverage: spatial	AASTI covers only the regions north of 40 degree north and south of 40 degree south, the figure below shows an example for 1 GAC swath
Third party redistribution.	The data are freely available to third parties
Availability of regular upgrades, update cycle	An update of this product to version 1.1 is expected when the level 1 brightness temperature from climate SAF have been updated within approximately 6 month, Regular updates on e.g. a yearly basis depends upon funding. No funding is available at the moment but it is being sought.

Alternative data sources	The operational ice surface temperature products from OSI-SAF (see description below) will be processed and used in EUSTACE. In addition, the operational Modis and VIIRS IST are available, which may be used for referencing at specific times if necessary.
Comments	Version 1.0 contains calibration errors in about 30 % of the orbits from NOAA 7 to 14, due to erroneous calibration correction in the CLARA data set. This will be fixed within the Climate SAF and a new version will be ready within 6 months. This version also includes a temporal extension to 2014, which closes the current gap with Metop_A IST observations

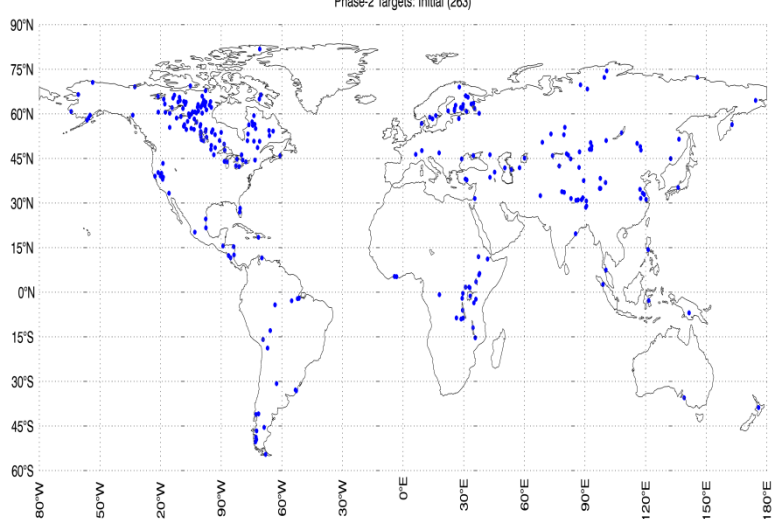|	
Product name	**Metop A operational Ice Surface Temperatures**
Data description	This surface temperature product is an integrated IST, SST and MIZ temperature product based on METOP AVHRR IR level 2 swath data. Swath data width is approximately 2000km in approximately 1km resolution. The data are provided in 3 minutes segments and is processed as such and the product is delivered in the same 3 minutes swath projection. The data includes the fields: • **ic**: Ice concentration • **st**: Ice and sea surface temperatures • **cm_flag**: Cloud mask and algorithm flag • **lat**:Latitude • **lon**:Longitude • **time**: time • **sza**: Sun-Zenith angle
Source	The data set have been produced by DMI under the Myocean project, but a transition is currently taking place, to include it as an official OSI-SAF product.
Key Websites	http://osisaf.met.no/
Version	1.0
References to technical specifications documents	The product is documented in the Myocean Product User Manual for Ice Surface Temperature Reference: MYO-WP14-SIW-DMI-ARC-SEAICE_TEMP-OBS-PUM Contact jlh@dmi.dk or gd@dmi.dk for further information.
Product format	NetCDF3, CF compliant
Data gridding and resolution	Spatial resolution is 1 km
Data coverage: temporal	From January 2013 to present
Data coverage: spatial	North of 60 deg N
Third party redistribution.	The data are freely available to third parties
Availability of regular upgrades, update cycle	Production will continue without gaps within the OSI-SAF.
Alternative data sources	The operational Modis and VIIRS IST are available.
Comments	A global extension will be implemented within 6 months to include Antarctic observations. The southern hemisphere IST will be rerun from January 1st 2015.

Product name	**Aqua-MODIS Level-2 LST (GT_MYD_2P)**
Data description	Satellite LST and Auxiliary (AUX) data derived from Aqua-MODIS
Source	GlobTemperature product derived from the operational MYD11 observations distributed by the NASA Land Processes Distributed Active Archive Center (LP DAAC)
Key Websites	https://lpdaac.usgs.gov/products/modis_products_table http://data.globtemperature.info/
Version	GlobTemperature v1.0
References to technical specifications documents	Wan, Z. (1999). MODIS Land-Surface Temperature Algorithm Theoretical Basis Document (LST ATBD) Version 3.3. *NASA Report* Wan, Z. (2008). New refinements and validation of the MODIS land surface temperature/emissivity products. *Remote Sensing of Environment, 112*, 59– 74 Wan, Z., & Li, Z.L. (2008). Radiance-based validation of the V5 MODIS land-surface temperature product. *International Journal of Remote Sensing, 29*, 5373-5395
Product format	NetCDF v4.1.3
Data gridding and resolution	1 km swath data in 5-minute granules
Data coverage: temporal	2002 to present(timeliness of new updates is 1 month)
Data coverage: spatial	Global
Third party redistribution.	No restrictions on use or redistribution
Availability of regular upgrades, update cycle	Yearly updates to the product expected
Alternative data sources	If required the GlobTemperature Terra-MODIS product can also be made available
Comments	The mandatory LST data are stored in datafiles labelled "LST" with accompanying auxiliary data stored in datafiles labelled "AUX"

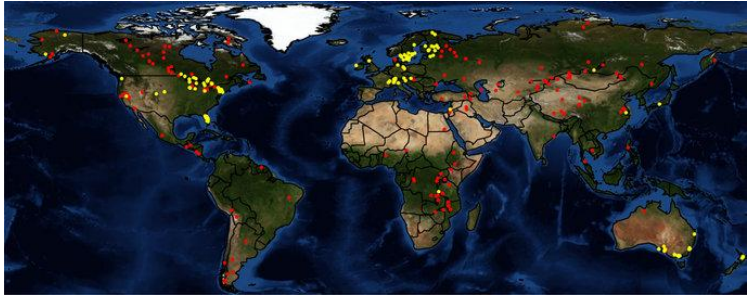|	
Product name	**SEVIRI Level-2 LST (GT_SEV_2P)**
Data description	Satellite LST data derived from MSG-SEVIRI
Source	GlobTemperature product derived from the EUMETSAT Land Surface Analysis SAF Product LSA-001
Key Websites	http://data.globtemperature.info/ http://landsaf.meteo.pt/
Version	GlobTemperature v1.0
References to technical specifications documents	http://www.eumetsat.int/website/home/Satellites/CurrentSatellites/Meteosat/MeteosatDesign/index.html Trigo, I., Freitas, S., Bioucas-Dias, J., Barroso, C., Monteiro, I., and Viterbo, P. (1999). SEVIRI Algorithm Theoretical Basis Document for Land Surface Temperature Issue 1.0. *LSA SAF Report* Trigo, I.F., Monteiro, I.T., Olesen, F., & Kabsch, E. (2008). An assessment of remotely sensed land surface temperature. *Journal of Geophysical Research-Atmospheres, 113*
Product format	NetCDF v4.3.1.1
Data gridding and resolution	0.05° x 0.05° equal-angle latitude-longitude gridded data for entire SEVIRI disk at hourly resolution

Data coverage: temporal	2007 to 2013 (timeliness of new updates is 1 month)
Data coverage: spatial	SEVIRI disk – Africa, Europe, part of S. America
Third party redistribution.	LSA SAF product (LSA-001) Background Intellectual Property Rights are applicable. The LSA-002 product is considered "essential" in accordance with the WMO Resolution 40 (Cg-XII). This means that access to these SAF products is granted to all users without a licence, without charge and they may not be redistributed without transformation, as stated in the Basic Principles of EUMETSAT Data Policy (http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_LEG_DATA_POLICY&RevisionSelectionMethod=LatestReleased&Rendition=Web)
Availability of regular upgrades, update cycle	Yearly updates to the product expected
Alternative data sources	Full temporal (15 minute) and spatial resolution data are available from the LSA SAF website: http://landsaf.ipma.pt
Comments	The hourly LST data derived from SEVIRI/Meteosat and available from GlobTemperature is entirely based on the LST product generated within the EUMETSAT Satellite Applications Facility on Land Surface Analysis (LSA SAF product LSA-001)

Product name	ESA SST CCI Analysis Long-term product
Data description	Interpolated (gap-filled) daily sea surface temperature
Source	European Space Agency Climate Change Initiative Sea Surface Temperature (SST CCI)
Key Websites	http://dx.doi.org/10.5285/878bef44-d32a-40cd-a02d-49b6286f0ea4 http://cci.esa.int http://badc.nerc.ac.uk/browse/neodc/esacci_sst
Version	v1.0
References to technical specifications documents	Merchant, C. J., Embury, O., Roberts-Jones, J., Fiedler, E., Bulgin, C. E., Corlett, G. K., Good, S., McLaren, A., Rayner, N., Morak-Bozzo, S. and Donlon, C. (2014), Sea surface temperature datasets for climate applications from Phase 1 of the European Space Agency Climate Change Initiative (SST CCI). Geoscience Data Journal. doi: 10.1002/gdj3.20 http://www.esa-sst-cci.org/sites/default/files/Documents/public/SST_CCI-PUG-UKMO-001_Issue-3-signed-accepted.pdf
Product format	NetCDF
Data gridding and resolution	0.05° x 0.05° equal-angle latitude-longitude gird
Data coverage: temporal	1991 to 2010
Data coverage: spatial	Global

Third party redistribution.	Access to ESA CCI SST data are available under a Creative Commons Licence by attribution, which means users may: **Share** — copy and redistribute the material in any medium or format: **Adapt** — remix, transform, and build upon the material; for any purpose, even commercially. This is conditional on appropriate attribution and providing a link to the license.
Availability of regular upgrades, update cycle	Next update in 2017
Alternative data sources	HadISST
Comments	The analysis takes as input satellite data only, from AVHRRs and ATSRs, processed by SST CCI techniques.

Product name	**ARCLAKE**
Data description	Satellite LSWT data derived from ATSR-2 and AATSR imagery for 263 large lakes
Source	University of Reading / University of Edinburgh
Key Websites	http://www.geos.ed.ac.uk/arclake
Version	2.0
References to technical specifications documents	http://www.geos.ed.ac.uk/arclake/ARC-Lake-Technical-Note-1-lake-selection_v1.0.pdf MacCallum, S.N., and Merchant, C.J. (2012). Surface water temperature observations of large lakes by optimal estimation. Can. J. Remote Sensing, 38(1), 25-45.
Product format	netCDF
Data gridding and resolution	0.05 degree grid/Lake-mean
Data coverage: temporal	1991 to 2011
Data coverage: spatial	The locations of the 263 lakes is shown below Phase-2 Targets: Initial (263)

Third party redistribution.	ODC Attribution License (ODC-By)
	[A plain language summary of the Open Database License](http://www.opendatacommons.org/licenses/by/summary/) is available.
Availability of regular upgrades, update cycle	There is also a v.3.0 of ARCLAKE
	ARCLAKE likely to be superseded by update from NERC GloboLakes
Alternative data sources	ARCLAKE v3.0
Comments	None

Product name	**Global Lake Temperature Collaboration (GLTC) data records**
Data description	Collation of long-term LSWT measurements from 291 lakes from satellite and in situ data. Satellite data were measured by the Advanced Very High Resolution Radiometer (AVHRR) series and the Along Track Scanning Radiometer (ATSR-1, ATSR-2, Advanced ATSR) series. In situ data were measured by various instruments, details of which are given by Sharma et al. (2015).
Source	The data set has been produced by phase 1 of the GLTC.
Key Websites	http://www.laketemperature.org/
Version	1.0
References to technical specifications documents	Sharma et al. (2015). A global database of lake surface temperatures collected by in situ and satellite methods from 1985-2009. Scientific Data 2, 150008.
Product format	comma delimited text files, R package 'laketemps'
Data gridding and resolution	Data provided are summer-time (June, August, September for Northern Hemisphere; January, February, March for Southern Hemisphere) averages from both satellite and in situ measurements. Satellite data is only included for lakes that exhibited at least a 10 x 10 km area of pure water surface without any islands or shorelines.
Data coverage: temporal	1985 to 2009
Data coverage: spatial	Yellow – in situ sampled lakes; Red – satellite sampled lakes
Third party redistribution.	The data policy is here http://www.lternet.edu/policies/data-access This states: "Redistribution. The data are provided for use by the Data User. The metadata and this license must accompany all copies made and be available to all users of this Data Set. The Data User will not redistribute the original Data Set beyond this collaboration sphere."
Availability of regular upgrades, update cycle	The data will be updated during phase 2 of the GLTC. Phase 2 aims to include more lakes, longer time series of in situ data, and depth-resolved measurements.

Alternative data sources	None
Comments	None

3.3 Detailed information for in situ data sets

Product name	**ARM in situ measurements**
Data description	In situ LST, air temperature and additional meteorological data measured at the Atmospheric Radiation Measurement (ARM) Climate Research Facility sites
Source	U.S. Department of Energy (DOE)
Key Websites	https://www.arm.gov/
Version	Version numbering is variable and site specific
References to technical specifications documents	http://www.arm.gov/publications/handbooks Mather, J.H., & Voyles, J.W. (2012). The ARM Climate Research Facility: A Review of Structure and Capabilities. *Bulletin of the American Meteorological Society, 94*, 377-392
Product format	NetCDF
Data gridding and resolution	Point data averaged every 60 seconds
Data coverage: temporal	1995 to present
Data coverage: spatial	Three primary locations: Southern Great Plains, North Slope of Alaska, Eastern North Atlantic Mobile facilities anywhere in the world Archive data from fixed locations in Tropical Western Pacific
Third party redistribution.	Free and open access to data; some sources restrict secondary distribution of data (see full data policy: http://www.arm.gov/data/docs/policy) The U.S. Department of Energy ARM Climate Research Facility should be acknowledged in publications as the programmatic origin of the field program
Availability of regular upgrades, update cycle	Not known
Alternative data sources	N/A
Comments	Data from the ARM network to be used for WP3 validation are independent of that to be used in WP1 relationship building

Product name	**USCRN in situ measurements**
Data description	In situ LST, air temperature and additional meteorological data measured at the US Climate Research Network (USCRN) sites
Source	National Climatic Data Center, NESDIS, NOAA, U.S. Department of Commerce
Key Websites	http://www.ncdc.noaa.gov/crn/
Version	N/A
References to technical specifications documents	http://www.ncdc.noaa.gov/crn/instrdoc.html Howard J. Diamond, Thomas R. Karl, Michael A. Palecki, C. Bruce Baker, Jesse E. Bell, Ronald D. Leeper, David R. Easterling, Jay H. Lawrimore, Tilden P. Meyers, Michael R. Helfert, Grant Goodge, and Peter W. Thorne, 2013: U.S. Climate Reference Network after One Decade of Operations: Status and Assessment. *Bull. Amer. Meteor. Soc.*, **94**, 485–498

Product format	ASCII
Data gridding and resolution	Point data averaged every 300 seconds
Data coverage: temporal	2006 to present for sub-hourly data
Data coverage: spatial	114 sites across the conterminous 48 states, with 16 additional sites in Alaska and 2 sites in Hawaii
Third party redistribution.	Users who redistribute or use USCRN data to create products and conduct analyses are asked to cite NCDC and the USCRN program as the source of the data (see full data policy: http://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/program/USCRN_Data _Management_Plan-September_2012.pdf)
	USCRN Program requests that users of USCRN data reference the following journal articles: Howard J. Diamond, Thomas R. Karl, Michael A. Palecki, C. Bruce Baker, Jesse E. Bell, Ronald D. Leeper, David R. Easterling, Jay H. Lawrimore, Tilden P. Meyers, Michael R. Helfert, Grant Goodge, and Peter W. Thorne, 2013: U.S. Climate Reference Network after One Decade of Operations: Status and Assessment. *Bull. Amer. Meteor. Soc.*, **94**, 485–498. doi, http://dx.doi.org/10.1175/BAMS-D-12-00170.1
	Or, if emphasizing soil moisture/temperature data: Bell, J.E., M.A. Palecki, C.B. Baker, W.G. Collins, J.H. Lawrimore, R.D. Leeper, M.E. Hall, J. Kochendorfer, T.P. Meyers, T. Wilson, and H.J. Diamond. 2013: U.S. Climate Reference Network Soil Moisture and Temperature Observations. J. Hydrometeorol., doi: 10.1175/JHM-D-12-0146.1
Availability of regular upgrades, update cycle	Not known
Alternative data sources	N/A
Comments	Data from the USCRN to be used for WP3 validation are independent of that to be used in WP1 relationship building

Product name	**BSRN in situ measurements**
Data description	In situ air temperature and additional meteorological data measured at the Baseline Surface Radiation Network (BSRN) sites
Source	World Radiation Monitoring Center (WRMC)
Key Websites	http://www.bsrn.awi.de/
Version	Version 1.0
References to technical specifications documents	Ohmura, A., E. G. Dutton, B. Forgan and 12 co-authors, 1998: Baseline Surface Radiation Network (BSRN)/WCRP): New precision radiometry for climate research. Bull. Amer. Meteoro. Soc. 79, 2115- 2136
Product format	ASCII (Station-to-archive format)
Data gridding and resolution	Point data averaged every 60 seconds
Data coverage: temporal	1992 to present for sub-hourly data
Data coverage: spatial	64 sites located around the world
Third party redistribution.	BSRN data is freely available to users for research purposes.
	Use of a particular station's data and the World Radiation Monitoring Center (WRMC) must always be explicitly acknowledged
	BSRN data sets provided by the WRMC must not be passed to a third party without the agreement of the WRMC

Availability of regular upgrades, update cycle	Not known
Alternative data sources	N/A
Comments	Data from the BSRN to be used for WP3 validation are independent of that to be used in WP1 relationship building

Product name	**KIT/Land Surface Analysis Satellite Applications Facility ground station observations**
Data description	In situ station observations of land surface temperature (LST), 2 m temperature and moisture, wind speed (2-3 m and 20-25 m height), long- and short-wave radiation (up- and down-welling radiation).
Source	Karlsruhe Institute of Technology and University of Copenhagen (Dahra Met data only)
Key Websites	http://www.imk-asf.kit.edu/english/MSA-Validiation.php
Version	Not applicable
References to technical specifications documents	Gottsche et al., 2013, 'Validation of land surface temperature derived from MSG/SEVIRI with in situ measurements at Gobabeb, Namibia', IJRS, DOI: 10.1080/01431161.2012.716539
Product format	Ascii
Data gridding and resolution	Point observations at 1-minute intervals.
Data coverage: temporal	2005 – present (Evora, Portugal), 2007- present (Gobabeb, Namibia and Dahra, Senegal), 2009 – present (Kalahari, Namibia).
Data coverage: spatial	Evora (Portugal), Farm RMZ and Heimat (Kalahari, Namibia), Gobabeb (Namib Desert) and Dahra (Senegal).
Third party redistribution.	Not permitted.
Availability of regular upgrades, update cycle	Ongoing data collection confirmed until 2017; negotiations to continue to 2022 are currently underway. The data are updated daily in theory, but in practise there may be some delays owing to power failures, network problems, etc. Requests for new/updated data must be made to KIT/Uni. Copenhagen.
Alternative data sources	None available.
Comments	Data from the Dahra station have significant gaps owing to vandalism and theft. Meterological data for the Dahra station will be provided by the University of Copenhagen. Contacts: Folke Olseen (folke.olesen@kit.edu; KIT), Rasmus Fensholt (rf@ign.ku.dk; Uni. Copenhagen).

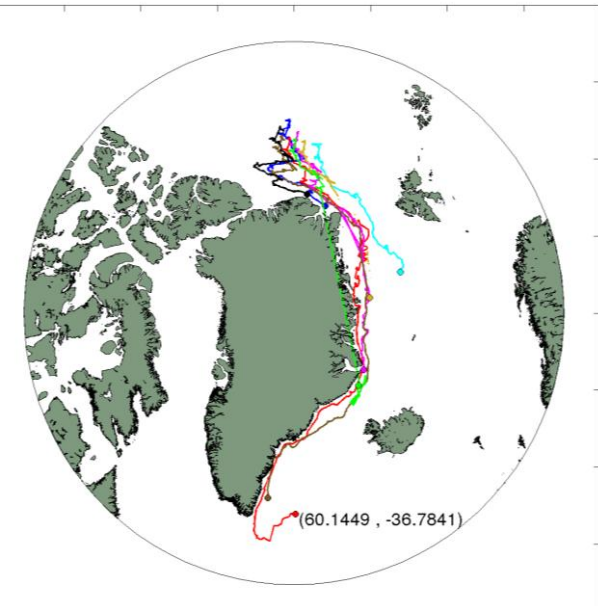|	
Product name	**HadIOD (Hadley Centre Integrated Ocean Database)**
Data description	In situ water temperature, with uncertainty estimates and bias adjustments
Source	Met Office Hadley Centre.
Key Websites	http://onlinelibrary.wiley.com/wol1/doi/10.1002/2014JC010053/abstract
Version	1.1.0.0
References to technical specifications documents	http://onlinelibrary.wiley.com/wol1/doi/10.1002/2014JC010053/abstract

Product format	Format is plain ascii, file format description is provided in the data directory
Data gridding and resolution	Data are point observations
Data coverage: temporal	1850-2014
Data coverage: spatial	All ocean areas
Third party redistribution.	No
Availability of regular upgrades, update cycle	Product is updated once per year.
Alternative data sources	ICOADS Real Time updates could provide near-surface water temperature
Comments	Other comments.

Product name	**HadNMAT2**
Data description	In situ air temperature measurements, corrected to a reference height of 10m
Source	National Oceanography Centre and Met Office Hadley Centre
Key Websites	http://www.metoffice.gov.uk/hadobs/hadnmat2/
Version	v.2.0.0.0
References to technical specifications documents	http://www.metoffice.gov.uk/hadobs/hadnmat2/
Product format	ascii
Data gridding and resolution	Data are point observations of air temperature
Data coverage: temporal	1856--2010
Data coverage: spatial	All ocean areas
Third party redistribution.	The data should be publicly available by the end of the project so redistribution would be unnecessary.
Availability of regular upgrades, update cycle	Air temperature measurements can be obtained from ICOADS real time updates. The data would need to be adjusted to a reference height.
Alternative data sources	n/a
Comments	

Product name	**IST radiometric surface temperatures from infrared radiometers**
Data description	ISAR and Cambell Scientific IR120) obtained during field campaigns to Greenland The campaigns and instruments are listed below include: • March/April 2011, Qaanaaq, Greenland: (ISAR and IR 120) • March/April 2012, Qaanaaq, Greenland: (IR 120 only) • March/April 2013, Qaanaaq Greenland : (ISAR + IR120) • March/April 2014, Qaanaaq Greenland: (IR 120) • January-April 2015, Qaanaaq Greenland, (IR 120 + AWS)
Source	All data have been acquired by DMI
Key Websites	
Version	

References to technical specifications documents	A data report from the 2011 experiment can be found at: http://www.dmi.dk/fileadmin/Rapporter/TR/tr11-18.pdf
Product format	All radiometer data are in ascii including information in the header
Data gridding and resolution	Point observations.
Data coverage: temporal	From 2011 to 2015. Field campaigns are typically carried out in 1-2 weeks in Late March and beginning of April. An AWS with an IR 120 was put out in January 2015, providing 10 minutes observations of T2m and Tskin until (at least) April 2015.
Data coverage: spatial	Inglefield Bredning, Greenland, about 77.45 N, -69.21 W
Third party redistribution.	Data can be used by the partners in EUSTACE
Availability of regular upgrades, update cycle	2-3 field campaigns with radiometers are planned every year for the next 3 years
Alternative data sources	
Comments	A data rescue task in WP3 will provide additional SIST in situ observations from historical data sets and research campaigns.

Product name	**IMB from the NAACOS project**
Data description	Temperature observations with 2 cm interval from 4 Ice mass balance buoys put out in multiyear sea ice floes during the: North Atlantic - Arctic coupling in a changing climate: impacts on ocean circulation, carbon cycling and sea-ice (NAACOS) project. The air-snow, snow-ice and ice-water interfaces are also identified in the data.
Source	All data have been acquired by DMI
Key Websites	Project website: http://www.staff.dtu.dk/cost/ProjectLinks/NAACOS/
Version	
References to technical specifications documents	The IMBs are produced by SAMS and follow the standard format for their IMBs.
Product format	All radiometer data are in ascii including information in the header
Data gridding and resolution	Point observations moving with the ice flows.
Data coverage: temporal	6 hourly observations from August 2008 to failure of the buoys. The longest recording buoy (number 3) observed until February 2014.

Data coverage: spatial	The data coverage of the IMBs is shown in the figure below.
	NAACOS floats (60.1449 , -36.7841)
Third party redistribution.	Data usage us restricted to the partners in EUSTACE
Availability of regular upgrades, update cycle	IMBs will be deployed within the ICE-ARC during winter 2016, these data are also available to EUSTACE.
Alternative data sources	
Comments	

Product name	European Climate Assessment & Dataset (ECA&D)
Data description	In situ data, daily average temperature, daily maximum temperature, daily minimum temperature. The data comes is two flavours. One are the "non blended" data, which is the data as close as possible to what the European Meteorological Services have contributed. The other is the "blended" data, to which a gap-filling procedure has been applied and data from the GTS is used to update the series to a date as recent as possible.
Source	The ECA&D is compiled by KNMI and is a joint effort of National Meteorological and Hydrological Services and other data holding institutions in Europe and the Mediterranean
Key Websites	http://www.ecad.eu
Version	Version updated to Feb. 28 2015
References to technical specifications documents	http://www.ecad.eu/documents/atbd.pdf Klein Tank et al. (2002) Daily dataset of 20th-century surface air temperature and precipitation series for the European Climate Assessment, Intern. J. Climatol. 22:1441-1453
Product format	ASCII
Data gridding and resolution	Station data

Data coverage: temporal	daily
Data coverage: spatial	Data contained for Europe (incl. Greenland), the Middle East and North Africa.
Third party redistribution.	Data is available on CEMS and can be used by the partners in EUSTACE
Availability of regular upgrades, update cycle	Updated twice a year. EUSTACE will not use there updates. ECA&D dataset is extended forward in time every month.
Alternative data sources	-
Comments	More detailed metadata on the station (like relocations and instrument use) are available for a subset of the stations. This information includes a picture of the station, description of the land use and a link to Google Maps to give an impression of its surroundings. This information is accessible only through the ECA&D webpages at http://www.ecad.eu. For a station with ECA station id NNNN, the information can be access via: http://www.ecad.eu/utils/stationdetail.php?stationid=NNNN The ECA station identifiers are used in the file: stations.txt and in the data files.

Product name	**Global Historical Climatology Network – Daily (GHCN-D)**
Data description	In situ data, daily maximum temperature, daily minimum temperature, precipitation, snow fall and snow depth.
Source	The GHCN-D data set is compiled by NCDC/NOAA
Key Websites	ftp://ftp.ncdc.noaa.gov/pub/data/ghcn/daily/
Version	Version 3.20
References to technical specifications documents	The journal article describing GHCN-Daily is: Menne, M.J., I. Durre, R.S. Vose, B.E. Gleason, and T.G. Houston, 2012: An overview of the Global Historical Climatology Network-Daily Database. Journal of Atmospheric and Oceanic Technology, 29, 897-910, doi:10.1175/JTECH-D-11-00103.1. To acknowledge the specific version of the dataset used, please cite: Menne, M.J., I. Durre, B. Korzeniewski, S. McNeal, K. Thomas, X. Yin, S. Anthony, R. Ray, R.S. Vose, B.E.Gleason, and T.G. Houston, 2012: Global Historical Climatology Network -Daily (GHCN-Daily), Version 3.20 NOAA National Climatic Data Center. http://doi.org/10.7289/V5D21VHZ [April 2015].
Product format	ASCII
Data gridding and resolution	Station data
Data coverage: temporal	daily
Data coverage: spatial	Global
Third party redistribution.	Open for non-commercial research and education.
Availability of regular upgrades, update cycle	-
Alternative data sources	-
Comments	-

3.4 Detailed information for ancillary data sets

Product name	Level-3 DEM data
Data description	Down-sampled version of Digital Elevation Model (DEM) data from the Shuttle Radar Topography Mission (SRTM)
Source	National Aeronautics and Space Administration (NASA) and the National Geospatial-Intelligence Agency (NGA)
Key Websites	https://lta.cr.usgs.gov/SRTM http://www2.jpl.nasa.gov/srtm/index.html
Version	Version 1.0
References to technical specifications documents	Farr, T.G., M. Kobrick, 2000, Shuttle Radar Topography Mission produces a wealth of data, Amer. Geophys. Union Eos, v. 81, p. 583-585. Rodriguez, E., C.S. Morris, J.E. Belz, E.C. Chapin, J.M. Martin, W. Daffer, S. Hensley, 2005, An assessment of the SRTM topographic products, Technical Report JPL D-31639, Jet Propulsion Laboratory, Pasadena, California, 143 pp
Product format	NetCDF v4.1.3
Data gridding and resolution	1/120° equal-angle latitude-longitude gridded data
Data coverage: temporal	N/A
Data coverage: spatial	Global
Third party redistribution.	No restrictions on use or redistribution
Availability of regular upgrades, update cycle	Unknown
Alternative data sources	N/A
Comments	The product is derived from STRM full resolution, 3 arc-sec data but down-sampled to 30 arc-sec (~ 1km)

Product name	Level-3 FCOVER data
Data description	Satellite-derived fractional vegetation cover (FCOVER) data from SPOT-VGT and PROBA-V
Source	GlobTemperature product derived from the Copernicus Global Land Service FCOVER product
Key Websites	http://land.copernicus.eu/global/products/fcover
Version	FCOVER v1.0
References to technical specifications documents	Baret, F., Weiss, M., Lacaze, R., Camacho, F., Makhmara, H., Pacholcyzk, P., & Smets, B. (2013). GEOV1: LAI and FAPAR essential climate variables and FCOVER global time series capitalizing over existing products. Part1: Principles of development and production. Remote Sensing of Environment, 137, 299-309 Camacho, F., Cernicharo, J., Lacaze, R., Baret, F., & Weiss, M. (2013). GEOV1: LAI, FAPAR essential climate variables and FCOVER global time series capitalizing over existing products. Part 2: Validation and intercomparison with reference products. Remote Sensing of Environment, 137, 310-329
Product format	NetCDF v4.1.3
Data gridding and resolution	1/112° equal-angle latitude-longitude gridded data (10-day composites)
Data coverage: temporal	1999 to 2012
Data coverage: spatial	Global

½Third party redistribution.	Free and open access as defined under article 8 GMES data and information policy of the GIO regulation and the Copernicus data policy regulation No 1159/2013.
Availability of regular upgrades, update cycle	Version 2.0 expected Q3 2015
Alternative data sources	To be extended to present with a timeliness of 3 days from end of synthesis period, within the framework of Sentinel 3. Until then, climatology data can be used.
Comments	GlobTemperature product derived from the Copernicus Global Land Service FCOVER product whereby 10-day composites are created from the source input data and climatology where no data exists

Product name	**MyOcean OSTIA reanalysis**
Data description	Analysed sea surface temperature (L4) and sea ice fraction
Source	The climatology was provided with the SST CCI tools, but its an average based on the MyOcean OSTIA reanalysis
Key Websites	http://www.myocean.eu/web/69-myocean-interactive-catalogue.php?option=com_csw&view=details&product_id=SST_GLO_SST_L4_REP_OBSERVATIONS_010_011
Version	Version 1
References to technical specifications documents	http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-11-00648.1
Product format	NetCDF
Data gridding and resolution	Daily, 0.05deg.x 0.05deg.
Data coverage: temporal	1985-2007
Data coverage: spatial	All ocean areas
Third party redistribution.	No, but data are publicly available
Availability of regular upgrades, update cycle	Climatology is static and needs no updates
Alternative data sources	n/a
Comments	

Product name	**HadSST2climatology**
Data description	In situ SST
Source	Met Office Hadley Centre
Key Websites	http://www.metoffice.gov.uk/hadobs/hadsst2
Version	2
References to technical specifications documents	http://www.metoffice.gov.uk/hadobs/hadsst2
Product format	NetCDF
Data gridding and resolution	5-day 1 degree by 1 degree
Data coverage: temporal	1961-1990 climatology

Data coverage: spatial	All ocean areas not covered by ice shelves
Third party redistribution.	No, climatology is publicly available already
Availability of regular upgrades, update cycle	Climatology is static and needs no update
Alternative data sources	n/a
Comments	

Product name	**HadNMAT2 climatology**
Data description	In situ .
Source	Met Office Hadley Centre
Key Websites	http://www.metoffice.gov.uk/hadobs/hadnmat2/
Version	2.0.0.0
References to technical specifications documents	http://www.metoffice.gov.uk/hadobs/hadnmat2/
Product format	NetCDF.
Data gridding and resolution	5-day 1 degree by 1 degree.
Data coverage: temporal	1961-1990 climatology.
Data coverage: spatial	All ocean areas.
Third party redistribution.	No, climatology is publicly available
Availability of regular upgrades, update cycle	Climatology is static and needs no update
Alternative data sources	n/a
Comments	

Product name	**CRU CL v2.0**
Data description	In situ based interpolated climatologies of mean temperature and diurnal temperature range, relative humidity, sunshine, ground frost, 10m windspeed, wet days, precipitation, elevation
Source	The Climatic Research Unit at the University of East Anglia.
Key Websites	http://www.cru.uea.ac.uk/cru/data/hrg/tmc/
Version	2.0
References to technical specifications documents	New et al. 2002 http://www.int-res.com/abstracts/cr/v21/n1/p1-25/
Product format	Ascii
Data gridding and resolution	Monthly 10 arc minute resolution.
Data coverage: temporal	Data are a climatogy for 1961-1990
Data coverage: spatial	Land areas except Antarctica.
Third party redistribution.	No, but data are publicly available from CRU

Availability of regular upgrades, update cycle	Climatology is static and not in need of updates
Alternative data sources	n/a
Comments	Other comments.

Product name	**ERA-Interim**
Data description	Reanalysis data set with separate products for: Surface analysis, Pressure level analysis, Model level analysis, Isentropic level analysis, Potential vorticity level analysis, Surface daily forecast, Pressure level daily forecast, Model level daily forecast
Source	European Centre for Medium-Range Weather Forecasts (ECMWF)
Key Websites	http://www.ecmwf.int/en/research/climate-reanalysis/era-interim
Version	Version 1
References to technical specifications documents	Berrisford et al., 2011, 'The ERA-Interim archive V2.0', ECMWF publication available from http://old.ecmwf.int/publications/library/ecpublications/_pdf/era/era_report_series/RS_1_v2.pdf Dee et al., (2011), The ERA-Interim reanalysis: configuration and performance of the data assimilation system. Q.J.R. Meteorol. Soc., 137: 553–597. doi: 10.1002/qj.828
Product format	NetCDF and GRIB
Data gridding and resolution	~ 80 km spatial resolution, 6-hourly, 60 vertical levels (surface to 0.1 hPa). T255 Spectral resolution and reduced N256 Gaussian grid.
Data coverage: temporal	1979-current
Data coverage: spatial	Global
Third party redistribution.	Prohibited.
Availability of regular upgrades, update cycle	Updated in real time for the foreseeable future (2 months lag).
Alternative data sources	ERA-interim will continue to be updated for the foreseeable future to be replaced eventually by ERA5 which will then be updated, possible around 2017.
Comments	

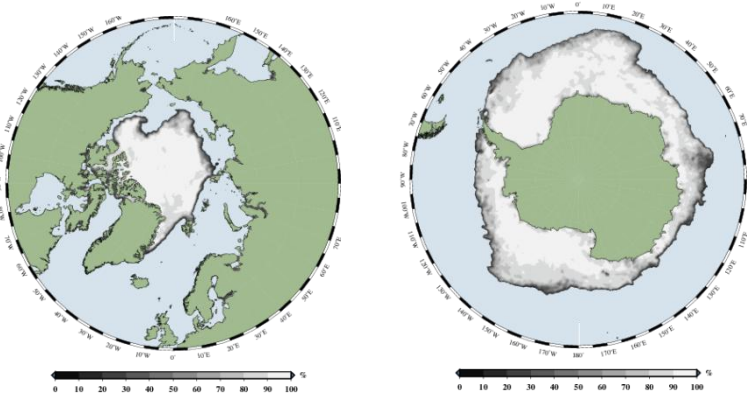|	
Product name	**ESA CCI Land Cover Map**
Data description	Three satellite-derived global land cover (LC) maps representative for the 1998-2002, 2003-2007 and 2008-2012 epochs, with associated uncertainty information
Source	European Space Agency (ESA) Climate Change Initiative (CCI)
Key Websites	http://www.esa-landcover-cci.org/
Version	Version 1 (Phase 1)
References to technical specifications documents	LC CCI Algorithm Theoretical Basis Document v2, 2013 (http://www.esa-landcover-cci.org/?q=webfm_send/75) LC CCI Product User Guide v2, 2014 (http://www.esa-landcover-cci.org/?q=webfm_send/84)
Product format	NetCDF (CF-1.6)
Data gridding and resolution	Regular 0.002778 degrees lat/long (approx. 300 m spatial resolution).

Data coverage: temporal	1998-2012
Data coverage: spatial	Global.
Third party redistribution.	Not permitted (but note data set is 'free and open access')
Availability of regular upgrades, update cycle	ESA LC CCI Phase 2 currently underway which will improve upon, and temporally extend Phase 1 products. Phase 2 will be undertaken 2015-2018.
Alternative data sources	Not known / not applicable.
Comments	Land cover classification is semi-static and version 1 land cover maps can be used during the EUSTACE lifetime and for a few years beyond the end of the project.

Product name	**CryoClim Snow cover** Level 3 data products: 'daily-multi-sce-nhl' and 'daily-multi-sce-nhl'
Data description	Snow cover estimated from optical and passive microwave satellite data.
Source	CryoClim (project funded and facilitated by the Norwegian Space Centre and the European Space Agency).
Key Websites	http://www.cryoclim.net/cryoclim/index.php/CryoClim
Version	Version 1 (prototype product)
References to technical specifications documents	None available (expected at a later date)
Product format	NetCDF (CF-1.4)
Data gridding and resolution	5 km EASE grid (Equal-Area Scalable Earth)
Data coverage: temporal	25-07-1992 to 01-08-2009 (anticipated from circa 2000 required for EUSTACE))
Data coverage: spatial	Global (one file per hemisphere)
Third party redistribution.	Not permitted without special permission from the Norwegian Computing Center. Data set is 'free and open access'.
Availability of regular upgrades, update cycle	Data for 2009 – present expected by end 2015. Regular updates anticipated thereafter (likely monthly but to be confirmed). Daily updates may also be available by the end of EUSTACE.
Alternative data sources	Snow mask included in LST products.
Comments	The satellite LST products used in EUSTACE include a per-pixel snow mask. These masks will also be used in the project with the CryoClim products used as an extra independent 'check' for identifying snow-covered pixels. The CryoClim dataset includes microwave observations, which provides additional useful information, especially at night. CryoClim Snow cover data field 'sca' contents: 41: water 43: glacier (or otherwise known permanent snow cover) 100: bare ground 200: snow cover Contact Øystein Rudjord (oystein.rudjord@nr.no) for further information.

Product name	**20th Century Reanalysis**
Data description	Reanalysis

Source	The 20th Century Reanalysis (Version 2) Dataset was produced by the National Oceanic and Atmospheric Administration (NOAA) and University of Colorado's Cooperative Institute for Research in Environmental Sciences (CIRES), members of the international Twentieth Century Reanalysis (20CR) project. The data were produced through international cooperation under the auspices of the international Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative, and working groups of the Global Climate Observing System (GCOS) and the World Climate Research Program (WCRP).
Key Websites	http://www.esrl.noaa.gov/psd/data/20thC_Rean/
Version	Version 2
References to technical specifications documents	http://www.esrl.noaa.gov/psd/data/20thC_Rean/
Product format	Grib1
Data gridding and resolution	Analyses every 6 hours on a 2 degree grid were produced to give the most likely state of the atmosphere based on a 56 ensemble member runs. Means, spreads and all ensemble members for each time step are available in the dataset archived at the BADC.
Data coverage: temporal	1871-2009
Data coverage: spatial	Global
Third party redistribution.	No, but data are freely available to all registered CEDA users.
Availability of regular upgrades, update cycle	20th Century reanalysis will only be used for historical part of EUSTACE so updates are not needed
Alternative data sources	n/a
Comments	Other comments.

Product name	**OSI-SAF Global Sea Ice Concentration (OSI-409)**
Data description	The reprocessed sea ice concentration dataset of the EUMETSAT OSI SAF, covering the period from October 1978 to October 2009 (SMMR and SSM/I). The dataset includes error-bars for each grid cell (uncertainties). Version 1.1 of the dataset was released late 2011. Recently, the data set has been extended to August 2014 The product consists of three major fields: ● sea ice concentration ● uncertainty estimate ● processing flag
Source	The data set have been produced by the OSI-SAF using passive microwave observations from the SMMR/SSMI(S) satellite series
Key Websites	http://osisaf.met.no/
Version	1.1 + extension
References to technical specifications documents	Product user manual can be found at: http://osisaf.met.no/docs/pum_seaicereproc_ss2_v1p3.pdf validation report can be found at: http://osisaf.met.no/docs/validation_report_seaicereproc_ss2_v1p3.pdf

Product format	Files are in NetCDF3 format. An example of a filename is: ice_conc_nh_ease-125_reproc_201401311200.nc
Data gridding and resolution	The sea ice concentration product is available on two projections and grids, each with one product for each hemisphere. The projections used are a Lambert Azimuthal Equal Area projection with grid a resolution of about 12.5 km, and a Polar Stereographic projection with a grid resolution of 10.0km. The Lambert grid is also called the EASE grid, and it is used by NSIDC for several of their sea ice products.
Data coverage: temporal	The OSI SAF sea ice concentration reprocessing data set covers the period from 26.10.1978 to 9.8.2014
Data coverage: spatial	Data products are available for the Northern and Southern hemispheres. The coverage is shown in the figures below
Third party redistribution.	The data are freely available to third parties
Availability of regular upgrades, update cycle	Regular updates are planned. With a timeinterval from 1 to 2 years. The next version is planned to be released fall 2016.
Alternative data sources	Alternative sea ice concentration data set are available from the ESA Climate change initiative (CCI) project for the sea ice. In addition, a ice concentration data is available at National Snow and Ice Data Center (NSIDC)
Comments	The extension from 2009 to 2014 is not an official part of the OSI-SAF reprocessed data set, but Is currently under review and will be included within a few months

3.5 Summary

A large amount of satellite and in situ observations (detailed in MS1) have been gathered and put on CEMS in the EUSTACE group workspace, ready to be used for the relationship building in WP1. The data sets were outlined in DOA and the vast majority of these have been uploaded to CEMS. A few deviations from the list given in DOA are described in the next section, with an explanation for the deviation. It has been identified for each data set whether it will be regularly updated, and if alternative data sources are available in order to facilitate the use of these data sets within and beyond the lifetime of the project.

3.6 Deviations from DOA

The CryoClim snow cover data set replaces the proposed 'GlobSnow' product. The CryoClim data set, which is a new product, has been selected here in preference to GlobSnow for the following reasons:

1) GlobSnow is northern hemisphere only (25°N to 84°N) whereas CryoClim is global.

2) GlobSnow will not extend beyond 2012; CryoClim currently ceases in 2009 but will shortly be updated to the present day and is expected to be updated regularly in the future.

3) The CryoClim data set is a multi-sensor product, produced from both optical and microwave observations, and is spatially complete; GlobSnow is produced from optical observations from the Along-Track Scanning Radiometer (ATSR), which has a very narrow swath, and therefore suffers from large gaps on a day-to-day basis.

The climatologies for land surface air temperature and sea surface temperature were not specified in the DOA.

4. Lessons Learnt

To collect the large amounts of different data types, to get access to CEMS, upload the data and agree upon a common archiving structure takes time. In addition, the process of getting permission to use the data sets can take time. The total time spent on these issues were probably underestimated and Month 4 for delivery was thus very ambitious. However, the majority of the data and all of the information have been provided. Several climatologies not originally listed in the DOA have also been added. The data not yet provided will be done so by UREAD in M5 of the project. All partners are aware of this and have confirmed that it will not adversely impact their work.

5. Cross Project Links

The data provision in WP1 is closely linked with the construction of the data set in WP2. Cross WP meetings have been held to ensure that the information required by WP2 is collected in WP1.

6. Future updates

It is very likely that data sets will be added to CEMS during the project from e.g. the data rescue tasks in WP3. This report should therefore be considered as a living document. It will be available on the project Wiki for all partners to access, and it will be updated when new data sets are included in the project.