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EUSTACE

(Grant Agreement 640171)



EU Surface Temperature for All Corners of Earth

Deliverable D1.3

Uncertainties added to satellite datasets in CEMS

Deliverable Title	Uncertainties added to satellite datasets in CEMS	
Brief Description	<i>This report includes information on the uncertainties added to the satellite datasets in CEMS. The reports aims to briefly describe the data and specify the type of uncertainties added.</i>	
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1	12/01/2016	Nick Rayner	Consolidation of review comments
1.1	05/01/2017	Karen Veal	Updated SEVERI dataset information
	03/02/2017	Nick Rayner	Corrected typo

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1. Executive Summary

This report lists the uncertainties included with the satellite-derived surface temperature data sets within the EUSTACE project, i.e., the satellite skin observations of the oceans, land, and ice surfaces. All these data sets will be used for the EUSTACE analysis. Each satellite-derived data will include three components of uncertainty (for each 0.25° latitude-by-longitude cell), representing the uncertainty from effects whose errors have distinct correlations properties: random, locally systematic, and systematic.

A forward look towards eventual dissemination of this new information is also included.

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 <i>in situ</i> 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 <i>in situ</i> 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		X

3. Data lists

3.1 List of data sets used in EUSTACE

A detailed list of all data sets (in-situ and satellite-derived) used in the EUSTACE analysis is provided in D1.1. Uncertainty information is provided for the satellite temperature products.



The datasets in which uncertainty information is provided is given below. Note that the partner responsible for providing the uncertainty data is indicated in the parenthesis following each temperature product.

- Satellite sea surface temperatures from SST CCI (UREAD)
- Land surface skin temperature data sets from GlobTemperature (ULEIC; includes LSA-SAF and NASA data sets)
 - Aqua-MODIS Level-2 LST (GT_MYD_2P)
 - Satellite LST and Auxiliary (AUX) data derived from Aqua-MODIS
 - SEVIRI Level-2 LST (GT_SEG_2P)
- Ice surface skin temperature observations (sea ice and ice sheets) from AVHRR GAC reanalysis and Metop-A from NAACLIM (DMI)
 - Arctic and Antarctic ice Surface Temperatures from thermal Infrared satellite sensors (AASTI)
 - Metop A operational Ice Surface Temperatures

3.2 Principles upon which consistent uncertainty estimates are provided

Detailed descriptions of the principles upon which consistent uncertainty estimates are provided with the satellite-based surface temperature datasets to the EUSTACE analysis are provided in D1.2 (Common approach to providing uncertainty estimates across all surfaces).

D1.2 defines acceptable “methods” for uncertainty information, and the methods selected for each variable are listed below (section 2.3 tables).

3.3 Information on uncertainty added to satellite data sets:

Dataset name	ESA SST CCI Analysis Long-term product
Dataset creation date	20 th November
Version	1.2
Originator	University of Reading
Reference (manuscript etc.)	http://www.esa-sst-cci.org
Dataset level (1 - 3)	3

Comments	"Bespoke" version of SST CCI data for EUSTACE project, using SST CCI v1.2 processor, but output directly to 0.25 degree resolution.				
Uncertainty components					
Type	Yes	No	Variable name	Method	...
Random	X		uncorrelated_uncertainty	L3 Random 1	
Local	X		synoptically_correlated_uncertainty	L3 Locally correlated 1	
Systematic	X		large_scale_correlated_uncertainty	L3 Systematic 1	
Total	X		sst_depth_total_uncertainty	Combination of individual components + adjustment uncertainty (see ncfles for more detail)	Also include: sses_standard_deviation, which is the uncertainty for sea_surface_temperature.

Dataset name	Land surface skin temperature from GlobTemperature Aqua-MODIS dataset				
Dataset creation date	20th November 2015				
Version	2.0				
Originator	University of Leicester				
Reference (manuscript etc.)					
Dataset level (1 - 3)	2				
Comments	LST and accompanying auxiliary data (quality control flags, channel emissivity, full resolution geolocation, solar and satellite angles, and the land-water mask) in 5-minute granules for Aqua-MODIS utilises a Generalised Split Window retrieval for GlobTemperature with coefficients categorised by classes of water vapour and satellite viewing angle				
Uncertainty components					
Type	Yes	No	Variable name	Method	...

Random	X		LST_unc_ran	L2 Random 1 / Radiance noise Propagation + L2 Random 2 / Emissivity noise propagation	
Local	X		LST_unc_loc	L2 Local 2 / Uncertainty from atmosphere/fit for regression-based retrieval + L2 Local 2 / Uncertainty from emissivity	
Systematic	X		LST_unc_sys	L2 Systematic 1 / Reasoned estimate	
Total	X		LST_uncertainty	Combination of individual components	

Dataset name	Land surface skin temperature from GlobTemperature SEVIRI dataset				
Dataset creation date	Creation date: October 2016				
Version	1.0				
Originator	University of Leicester				
Reference (manuscript etc.)					
Dataset level (1 - 3)	2				
Comments	LST and accompanying auxiliary data (quality control flags, channel emissivity, full resolution geolocation, solar and satellite angles) for the full disk of SEVIRI utilises a Generalised Split Window retrieval for GlobTemperature with coefficients categorised by classes of water vapour and satellite viewing angle. Period covered is 01/01/2007 to 31/12/2012.				
Uncertainty components					
Type	Yes	No	Variable name	Method	...
Random	X		LST_unc_ran	L2 Random 1 / Radiance noise Propagation + L2 Random 2 / Emissivity noise propagation	
Local	X		LST_unc_loc	L2 Local 2 / Uncertainty from atmosphere/fit for regression-based retrieval + L2 Local 2 /	

				Uncertainty from emissivity	
Systematic	X		LST_unc_sys	L2 Systematic 1 / Reasoned estimate	
Total	X		LST_uncertainty	Combination of individual components	

Dataset name	Arctic and Antarctic ice Surface Temperatures from thermal Infrared satellite sensors with uncertainties (AASTI_u)				
Dataset creation date	20 th November, 2015				
Version	1.0				
Originator	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 jh@dm.dk or gd@dm.dk for further information on the data set				
Reference (manuscript etc.)	NACLIM Deliverable D32.28 Report on the documentation and description of the new Arctic Ocean dataset combining SST and IST Contact jh@dm.dk or gd@dm.dk for further information.				
Dataset level (1 - 3)	Level 2 GAC				
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 CLARA version 2 will be scheduled to May 1 st , 2016. This version also includes a temporal extension to 2014, which closes the current gap with Metop_A IST observations The dataset has been verified by a throughout check of file sizes and spot checks of file contents and metadata.				
Uncertainty components					
Type	Yes	No	Variable name	Method	...
Random	X		uncorrelated_uncertainty	L2 Random 1 / Radiance noise Propagation L2 Random / Geolocation uncertainty in Marginal Ice Zone	
Local	X		synoptically_correlated_uncertainty	L2 Local 2 / Uncertainty from Atmosphere fit for regression-based retrieval L2 Local 2 / Uncertainty from Emissivity	
Systematic	X		large_scale_correlated_uncertainty	L2 Systematic 1 / Reasoned Estimate	

Total	X		sses_standard_deviation	Combination of the three individual components	
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Dataset name	Metop A operational Ice Surface Temperatures				
Dataset creation date	20th November, 2015				
Version	1.0				
Originator	The data set has been produced by DMI under the Myocean project, but a transition is currently taking place, to include it as an official OSI-SAF product.				
Reference (manuscript etc.)	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@dm.dk or gd@dm.dk for further information.				
Dataset level (1 - 3)	Level 2, 1 km resolution				
Comments	The dataset has been verified by a throughout check of file sizes and spot checks of file contents and metadata.				
Uncertainty components					
Type	Yes	No	Variable name	Method	...
Random	X		uncorrelated_uncertainty	L2 Random 1 / Radiance noise Propagation L2 Random / Geolocation uncertainty in Marginal Ice Zone	
Local	X		synoptically_correlated_uncertainty	L2 Local 2 / Uncertainty from Atmosphere fit for regression-based retrieval L2 Local 2 / Uncertainty from Emissivity	
Systematic	X		large_scale_correlated_uncertainty	L2 Systematic 1 / Reasoned Estimate	
Total	x		sses_standard_deviation	Combination of the three individual components	

4. Future validation, verification and dissemination

Ultimately, these new data will be released via the CEDA archive. We expect release to take place soon after April 2016. Prior to that release, verification and validation activities need to take place.



Validation of the new uncertainties documented here will be reported in D3.1 “Validation report for surface temperature uncertainties”. This report is expected to be delivered in January 2016.

Thorough verification of the contents of the files will be undertaken prior to release using a mechanism developed under the EUSTACE Data Management Plan (D4.3).

5. Summary

Satellite and in situ observations (detailed in D1.1) have been gathered and put in the EUSTACE project data space. Uncertainty information on each of the satellite-derived surface temperature has been / will be included as listed in this report. The uncertainty information in each case uses methods defined in D1.2.

6 References

D1.1 Short report on availability of regular updates to source data sets with recommendations as to alternative data sources if needed (April 2015)

D1.2 Report on common approach to estimating uncertainties across all surfaces (August 2015)

D4.3 Data Management Plan (June 2015)