Processed land SAR data

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DOCUMENT CHANGE LOG				
Product	**Release**	**Date**	**Comments**	**Changed by**
RL_2_LAN	1.0	21-08-2014	Temporary product	Karina Nielsen
RL_2_LAN	1.1	16-06-2015	Final product	Karina Nielsen

1 Data description

This document describes the processed land SAR data including the data products:

- RL_2_LAN River and lake levels
- SM_2_LAN Soil moisture
- SW_2_LAN Snow depth (not available at the moment)

The document change log (located in the beginning of this document) contains information regarding the data release. The individual data products are described in section 1.2-1.4.

1.1 Data release comments

Current data release is 1.1!

1.1.1 Changes since last release

1. The River and Lake product RL_2_LAN, has been changed. The waveforms have been retracked using the empirical threshold retracker (Narrow primary peak, REF1).

1.2 RL_2_LAN River and lake water levels

This data product contains 20 Hz river and lake levels relative to the reference ellipsoid WGS84. This product also contains an along track mean value for each inland water crossing, which can be used directly to generate time series.

1.2.1 Description of individual columns

The individual columns in product RL_2_LAN are explained in Table 1

Table 1: Description of data product RL_2_LAN column wise.

Short Name	Long Name	Unit	Description
Point characteristics			
time	Time	second	seconds since 2000-01-01 00:00:00.0
lat	Latitude	degrees_north	Latitude of the point
lon	Longitude	degrees_east	Longitude of the point
Inland water/Land parameters			
wl_se	Water level/ Surface elevation	m	Water levels or surface elevations relative to WGS84, based on the Narrow Primary Peak Threshold retracker (NPPTR). The following corrections are included: model ionosphere, model dry troposphere, modelled wet troposphere, solid earth tide, ocean loading tide, geocentric pole tide.

Short Name	Long Name	Unit	Description
mwl	Mean water level	m	Robust estimate of the along-track mean water level relative to EGM2008. This value is only returned if a water body contains 5 or more measurements otherwise the value 99999 is returned
Atmospheric/Land corrections			
Iono_corr_gim	GIM ionospheric correction	m	An ionospheric correction must be added (negative value) to the instrument range to correct this range measurement for ionospheric range delays of the radar pulse
tropo_dry_corr_model	Model dry tropospheric correction	m	Computed at the altimeter time-tag from the interpolation of 2 meteorological fields that surround the altimeter time-tag. A dry tropospheric correction must be added (negative value) to the instrument range to correct this range measurement for dry tropospheric range delays of the radar pulse
tropo_wet_corr_model	Model wet tropospheric correction	m	Computed at the altimeter time-tag from the interpolation of 2 meteorological fields that surround the altimeter time-tag. A wet tropospheric correction must be added (negative value) to the instrument range to correct this range measurement for wet tropospheric range delays of the radar pulse
solid_earth_tide	Solid earth tide height	m	Calculated using Cartwright and Tayler tables and consisting of the second and third degree constituents. The permanent tide (zero frequency) is not included
pole_tide	Geocentric pole tide height	m	Deformation of the Earth induced by polar motion
ocean_load_tide	Ocean loading tide	m	Deformation of the Earth due to the weight of the overlying ocean tide. The FES2004 loading tide model is used for this correction
geiod	Geoid	m	EGM2008
Additional information			
modis	MODIS mask value		Value that indicates the underlying surface type; water =1, land=0

1.2.2 Test data sets

Table 2 describes the defined test areas for river and lakes. Data has been processed for the entire regions. The MODIS mask value given in the product can be used to extract areas with inland. Where the value 1 indicates water and 0 indicates land. It must be noticed that this mask will contain errors!

Table 2: Information regarding test areas for rivers and lakes.

Geographical name	Geographical coverage	Temporal covarage
Denmark	8E-13E ; 54.5N-58N	July 2010 – July 2014

Thailand/ Chao Phraya river	99E-102E ; 13.25N-17N	July 2010-July 2014
Amazon river	47W-61W ;5S-3N	Oct. 2012- July 2014
Brahmaputra river	89.5E-91.5E ; 21.75N-24.25N	Oct. 2012 - July 2014

1.3 SM_2_LAN Soil moisture

This document contains a description of the field structure and content of the LOTUS Cryosat2 Surface Soil Moisture (CSME) demonstration data products derived from Cryosat2 SRAL Level 1B data (REF2) over the designated desert test regions as specified in REF3.

1.3.1 CSME Product Structure and Content

Each LOTUS CSME Demonstration Dataset contains a space delimited ascii text file. Each dataset comprises two header files, and a data file containing surface soil moisture estimates derived from the Cryosat2 altimeter. Currently, all desert regions are overflown in LRM mode. Data have been generated for a period of one year from 1/01/2013 to 31/12/2013 for all test areas.

1.3.1.1 CSME Header 1

The first product header gives information on the data origin (altimeter mission identifier) and the version of the processing scheme used to generate the product. Information on the data originator, data generation date and the region identifier are also given. The header structure is summarized in Table 3.

Table 3 Content of CSME Dataset Header 1

Altimeter (Cryosat2) and mode of operation (SAR or LRM)	Text fields
Pre-processor version and revision numbers	Textfields
CSME processor version	Textfield
Desert identifier	Textfield
Data originator and project	Textfields
Creation date	Date field dd/mm/yyyy

1.3.1.2 CSME Header 2

This header contains the following information on data content.

Table 4 Content of CSME Dataset Header 2

Name of desert region.	Textfield
Data Location information	Textfield
Time field information	Textfield
Input record information	Textfield
Soil moisture field information	Textfield

1.3.2 CSME Data set

Table 4 shows the fields included in the LOTUS CryoSat-2 soil moisture demonstration product. Each estimate is an averaged value along an arc of the satellite overpass. The start and stop locations for the arc used to generate the soil moisture estimate are given, together with the number of points used to form the estimate. It is noted that the current protocol of averaging each overpass to yield one value of soil moisture may be relaxed with further enhancements to the DREAMs.

Table 5 Content of CSME Surface Soil Moisture Dataset

Parameter	Unit
Segment start Latitude	Decimal degrees
Segment start Longitude	Decimal degrees
Segment end Latitude	Decimal degrees
Segment end Longitude	Decimal degrees
Date at centre of track segment	Year / Month / Day
Fraction of day at centre of track segment	Hour / Minute / Second
Number of points used to form estimate	None
Soil moisture mean estimate	Percent surface soil moisture

1.3.3 Test data sets

The three defined primary test regions for soil surface moisture production are listed in Table 6. The Latitude/Longitude boundary coordinates form the primary geographically based selection of data over the regions of interest.

Table 6 LOTUS test areas for Surface Soil Moisture derivation from Cryosat-2 data

Desert	Lower Longitude Bound (Degrees)	Lower Latitude Bound (Degrees)	Higher Longitude Bound (Degrees)	Higher Latitude Bound (Degrees)
Simpson	135.0 E	28.0 S	139.0 E	24.0 S
Tenere	9.0 E	15.0 N	16.0 E	21.0 N
Kalahari	18.0 E	27.0 S	28.0 E	17.0 S

A secondary selection is made when the data are confronted with the Dry Earth model (DREAM) for the region. Data points lying beyond the DREAM bounds or lying within a masked part of the DREAM are excluded from further analysis and are discarded.

1.3.3.1 Simpson desert

The Simpson desert Dry Earth Model (DREAM), re-formed and re-masked for use with Cryosat-2 data, is shown in Figure 1.

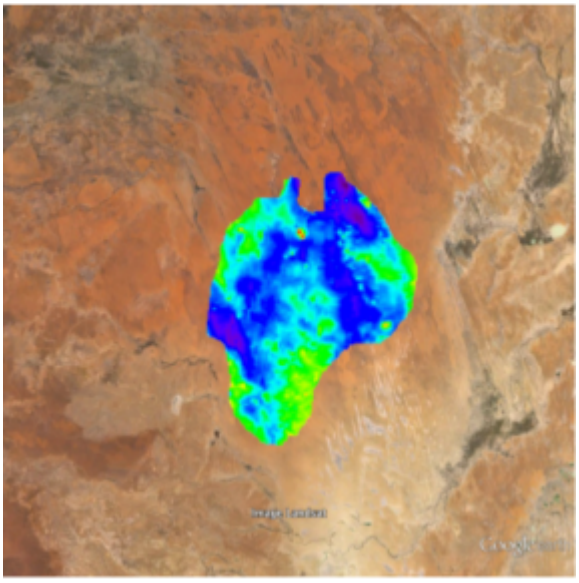

Figure 1 Simpson desert DREAM for CryoSat-2

1.3.3.2 Tenere desert

The re-calculated Tenere desert DREAM for Cryosat2 is illustrated in Figure 2. Note that further dynamic masking is performed on data over this model in addition to the masking within the DREAM (DREAM masking is shown here as transparent zones within the model).

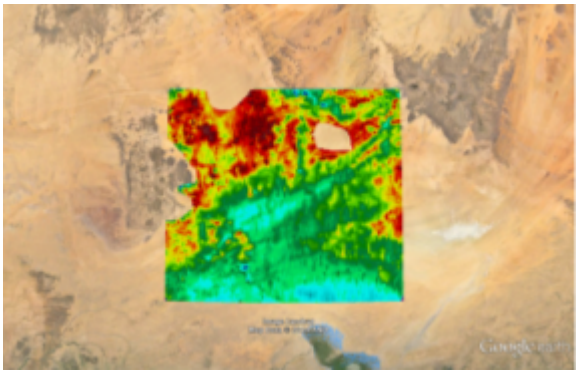

Figure 2 Tenere desert DREAM for CryoSat-2

1.3.3.3 Kalahari desert

The Cryosat2 DREAM for the Kalahari desert is shown in Figure 3. For this desert, the masking used or the ESA SMALT project (REF4; REF5) is retained, with additional dynamic masking utilized during data production for this desert. Note that part of the Eastern Kalahari desert has been excluded from this model, following the ESA SMALT masking protocols (ibid), due to the presence of the Okavango delta and its input rivers.

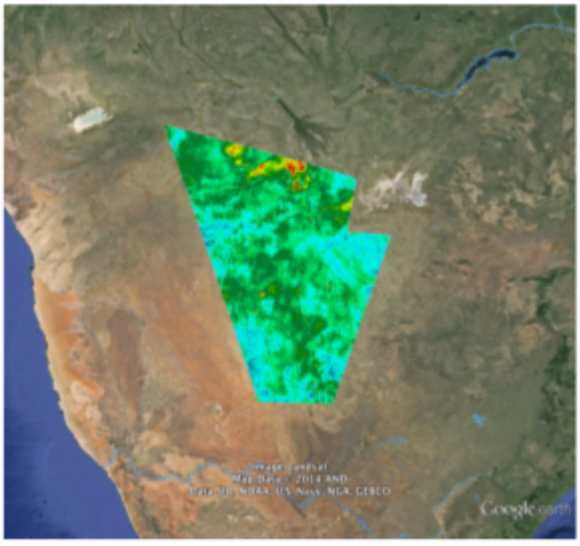

Figure 3 Kalahari desert DREAM for CryoSat-2

1.4 SW_2_LAN Snow depth

The snow depth estimation from altimetry waveforms is currently under investigating. No final process (experimental or not) to produce a snow depth dataset exists. Hence, is this product not available at the moment!

2 References

REF 1: Jain, Maulik, et al. "Sea surface height determination in the Arctic using Cryosat-2 SAR data from primary peak empirical retrackers." Advances in Space Research 55.1 (2015): 40-50.

REF 2: Cryosat Product Handbook, 2012: CryoSat-PHB-17apr2012.pdf.

REF 3: D2.4 Cryosat2 Soil Surface Moisture Algorithm Theoretical Basis Document v.1.1. LOTUS_D2_4_NEWC.pdf, June 2014.

REF 4: Berry, P.A.M., Dowson, M., Smith, R.G., Benveniste, J., 2012. Soil Moisture From Satellite Radar Altimetry (SMALT). Proceedings of the ESA Living Planet Symposium 2012.

REF 5: SMALT Product Handbook, 2014. DMU-SMALT-PRODSPEC-001, http://tethys.eaprs.cse.dmu.ac.uk/SMALT/

3 Download data

Data is available on the Lotus project webpage or ftp site under the following links

http://www.fp7-lotus.eu/Publications/Prototype-data

ftp://ftp.spacecenter.dk/pub/EU-LOTUS/