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1/6287/11/I-NB**

D4400 Updated Data Set User Manual

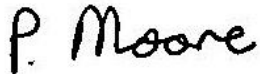
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Abstract

This report presents a Data Set User Manual (D4400) following on from the Milestone 1 Deliverables D3200 (Data Set User Manual) and D3300 (Data Set). This document details the repository of relevant datasets for use in Inland Water applications to augment the online data of the previous data deliverable D3300. The augmented data is from deliverable D4300.



This present document outlines the following key data sets:

- CryoSat-2 SAR FBR L1A data
- CryoSat-2 SARin FBR L1A data
- Geophysical correction data
- ACE2 and other GDEM data
- Jason-2 validation data
- Envisat validation data
- SARAL/Altika validation data
- River mask data
- In-situ river (gauge) data
- Data Assimilation for hydrology

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1. Introduction

1.1 Scope

CryoSat-2, launched on 8 April 2010, follows previous ESA Earth orbiting satellite radar altimeters (e.g. ERS2 and ENVISAT) that have been used for land surface applications. CryoSat-2's primary instrument is SIRAL (SAR / Interferometric Radar Altimeter), which uses radar to determine and monitor the spacecraft's altitude. Although CryoSat-2 primary aim is to measure sea ice and ice sheets it can provide valuable data over the rest of the earth surface. SIRAL operates in one of three modes, depending on where (above the Earth's surface) CryoSat-2 is flying. The three modes are: the conventional altimeter mode or Low resolution Mode (LRM), Synthetic Aperture Radar (SAR) and Interferometric Synthetic Aperture Radar (SARIN). CryoSat-2's has a low-earth orbit and is not Sun-synchronous, it has a period of 100 minutes. The CryoSat-2 mission is the first to operate a SAR mode Altimeter.



CRUCIAL is investigating innovative land and water applications from CryoSat-2 with a forward-look component to the future Sentinel-3 mission. As such it is important to bring all the relevant datasets for use in inland water applications theme together into a single repository including heights estimated from the FBR SAR and SARin processing and data assimilation of CryoSat-2 heights over the Brahmaputra for hydrological inferences. This is the aim of WP4000. This deliverable D4400 presents the Data Set User Manual with D4300 the corresponding dataset. Data sets include CryoSat-2 data, auxiliary data, in-situ data and other EO satellites data.

The final data set differs substantially from the earlier data set manual D3200 as CRUCIAL changed in emphasis from LRM data analysis to SAR and SARin FBR data analysis. Thus, earlier reference to LRM data and comparisons over Lake Malawi etc. are not discussed although the data has not been deleted from the repository. LRM data is essentially a well-defined product with little relevance to the recently launched Sentinel-3 mission which carries a SAR altimeter with all data telemetered to the ground rather than undergoing processing onboard the satellite.

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1.2 Abbreviations and Acronyms

Abbreviation	Meaning
ACE2	Altimeter corrected elevations 2 (digital elevation model)
CRUCIAL	CRyosat2 sUCcess over Inland water And Land
DTU	Danish Technical University
EO	Earth Observatory
ERS2	European Remote Sensing satellite 2
ENVISAT	Environmental Satellite
ESA	European Space Agency
FBR	Full Bit Rate
GDEMS	Global Digital Elevation models
L1A	Level 1A
L1B	Level 1B
LRM	Low Resolution Mode
JASON-2	US/French Altimeter Satellite
NCL	Newcastle University
RA	Radar Altimeter
SAR	Synthetic Aperture Radar mode of CryoSat-2 SIRAL
SARIN	Interferometric Synthetic Aperture Radar mode of CryoSat-2 SIRAL
Sentinel-3	ESA Earth Observation satellite mission
SIRAL	SAR Interferometric Radar Altimeter

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2. CryoSat-2 data

In this section, a general overview of the different CryoSat-2 data sets used is given. River masks derived as part of the ESA/ESRIN “Rivers and Lakes” contract have been replaced by those derived from Landsat data. Within subsequent tables, data is denoted as Input or Output; the former is data downloaded from other sites etc while Output denotes a valued added product derived within the CRUCIAL project. The data is summarized in Table 1. I/O denotes input and output respectively.



2.1 CryoSat-2 SAR FBR (L1A) data

SAR L1A FBR data has been processed to derive data at high temporal sampling as required for inland water studies. The data utilized is regional to cover areas in SAR mode with emphasis on the Mekong, Tonlé Sap and Amazon. Due to its size SAR FBR data is not stored on the data depository (see Table 1).

Input: SAR FBR L1A data

Output:

- Mekong river mask
- Date/Location
- Retracked orthometric height
- Validation data

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2.2 CryoSat-2 SARin FBR (L1A) data

Analysis of SARin data over the Amazon and Brahmaputra has been undertaken. Due to its size SARin FBR data is not stored on the data depository (see Table 1).

Input: SARin FBR L1A data

Output:

- Date/Location
- Retracked orthometric heights from both antennae
- Cross angle
- Validation data





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Table 1: CryoSat-2 data sets. I/O denotes input and output respectively.

Theme	Product	Input (i) or Output (o)	Responsible	Data Producer	Area	Time Period	Time Frame	Supporting URLs
River Masks		I	NCL	ESA/ESRIN R&L	Global	N/A	N/A	http://gmt.soest.hawaii.edu/
		O		DMU	Brahmaputra			
		O		NCL	Mekong			
Waveform Data	SAR FBR	I	NCL	ESA	Amazon, Tonlé Sap Mekong	CS2 mission	2010-2015	http://www.esa.int/ESA
	Multi-look	O		NCL				
	SARin FBR	I	NCL	ESA	Amazon, ocean off Amazon estuary & Brahmaputra	CS2 mission	2010-2015	
Multi-look	O	NCL						
Inland water heights	Multi-look waveforms	O	NCL	NCL	Amazon, Mekong, Tonle Sap	CS2 mission	2010-2015	
Hydrological data assimilation	Heights	I	DTU	DTU	Brahmaputra	CS2 mission	2010-2013	
	Water masks	I		DTU				
	Meteorological data	I		ECMWF				
	Discharge	I/O						

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3. Auxiliary Data

3.1 Geophysical Corrections

The applied geophysical corrections for CryoSat-2 altimetric heights are summarized in Table 2. Inland water heights will be referenced to the WGS84 reference ellipsoid as realized by the ITRF2008 reference frame of the DORIS station coordinates. Orthometric heights (i.e. heights above mean sea-level) are derived by subtracting the geoid reference to the same ellipsoid from the ellipsoidal inland water heights. The geoid model applied is EGM2008. For convenience the data depository contains the required EGM2008 data sets, FORTRAN code to output the heights based on scattered lat/lon input through INPUT.DAT. A simple program getgrid.f is also in the depository for deriving the input file on a 1' by 1' lat/lon grid. Note that the rectangular box is hardcoded and will need editing for other areas.





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Table 2 Geophysical Corrections

Product	Responsible	Input or Output	Data Producer	Data Set	Supporting URLs + comments
Orbit		Input	(on data records)		DORIS precise orbit
Dry Tropo		Input	Meteo France ECMWF atmos pressure files (on data records)		
Wet Tropo		Input	Meteo France ECMWF model (on data records)		
Iono		Input	GIM (on data records)		
Solid Earth tides		Input	(on data records)		Standard software also available
Geoid	NCL	Output	NGA	EGM2008	http://earth-info.nga.mil/GandG/wgs84/gravitymod/egm2008/



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3.2 Global Digital Elevation Models

ACE2 and other Global Digital Elevation Models (GDEMs) can be used to estimate river slopes (Table 3). Data is 3rd party.

Table 3: GDEMS

Product	Responsible	Data Producer	Data Set	Supporting URLs
GDEMS	NCL	DMU	ACE2	http://tethys.eaprs.cse.dmu.ac.uk/ACE2/docs/ACE2_userguide.pdf
	NCL	JPL	ASTER	http://asterweb.jpl.nasa.gov/gdem.asp
	NCL	Curtin University	Earth2012	http://geodesy.curtin.edu.au/research/harmonic-topography/
	NCL DTU	JPL	SRTM	http://www2.jpl.nasa.gov/srtm/

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4. Validation Data

In situ and data from contemporaneous satellite missions are required for validation of the CryoSat-2 heights derived within CRUCIAL. The data utilized is summarised as Table 4. Note all validation results are described in detail in the Product Validation Report (D4200) except the use of ENVISAT and OSTM (Jason-2) data over the Amazon which is utilized in the Impact Assessment Report (D5000).





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Table 4: Summary of CryoSat-2 validation data

Product	Responsible	Data Producer	Area	Time Period	Supporting URLs
Jason2 virtual stage data	NCL	LEGOS USDA DAHITI	Amazon (D5000), Tonlé Sap	To overlap CryoSat2 data	http://www.legos.obs-mip.fr/soa/hydrologie/hydroweb/ http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/Default.aspx http://dahiti.dgfi.tum.de/en/
ERS2/ENVISAT virtual stage data	NCL DTU	ESA River and Lakes DAHITI	Brahmaputra Amazon (D5000) Mekong + others		http://tethys.eaprs.cse.dmu.ac.uk/RiverLake/shared/main http://dahiti.dgfi.tum.de/en/
River gauge (height + discharge)	NCL	MRC ORE HYBAM	Mekong, Tonle Sap Amazon	2010-2013	http://portal.mrcmekong.org/ http://www.ore-hybam.org/index.php/eng/Data/Station-Access-Maps/TSS-reference-network
River gauge (height, ADCP + discharge), Mask, historical altimetry	DTU	Various	Brahmaputra	Before 2009	See section 5.2
River gauge ADCP	NCL	ORE HYBAM	Amazon	2000-2011	http://www.ore-hybam.org/index.php/eng/Data/Station-Access-Maps/TSS-reference-network
EO data (Precipitation Etc)	DTU		Brahmaputra		http://trmm.gsfc.nasa.gov/

5. SAR analysis and Validation Data

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The data repository for the SAR/SARin analyses and validation contains the following directories:

Directory: [Inland water locations/Mekong/](#)

1. Sub-directory: **Cryosat2_Mekong_heights**

CryoSat-2 Inland water heights across the Mekong:

Melong_river_SARFBR_heights: tar/zipped file containing all epochs

columns;

year; month; day; seconds in day; lat (deg); long(deg); orthometric height from empirical retracker (m); orthometric height from OCOG/Threshold (m), EGM96 geoid (m); Normalised Residual Error of empirical retracker; empirical tracker type (see D4100, section 3.9.1); river mask (0 over land, 1 over river); count

2. Sub-directory: **Mekong_20110419_N_comparisons**

Heights using various N in multi-look stack for Mekong crossing 19 Apr 2011.

Files are named (for example)

CS_RPRO_SIR1SAR_FR_20110419T162433_20110419T163126_B002.DBL.output_NN
where NN is the number N for waveforms in the stack (see D4200) or burst for the burst echo data.



Format for NN=10, 20 etc columns are: year; month; day; seconds in day; lat (deg); long(deg); orthometric height from empirical retracker (m); orthometric height from OCOG/Threshold (m), EGM96 geoid (m); Normalised Residual Error of empirical retracker; tracker used; river mask (0 over land, 1 over river); count

For burst echoes (NN=burst) columns are: year; month; day; seconds in day; lat (deg); long(deg); orthometric height from OCOG/Threshold (m), EGM96 geoid (m);

RES_CS_LTA__SIR1SAR_FR_20110419T162433_20110419T163126_C001.nc is GPOD SARvatore file

3. Sub-directory: **Mekong River Mask**

Mekong_t8.asc is ascii file for the Mekong river mask from Landsat data.

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The files contains nrow (ncolumn) rows (columns). Data is 0 for over land and 1 over the river. The rows start in the lower left corner at lat (y11corner) and long (xllcorner). The ncolumn points along a circle of latitude increment by delx with xllcorner as first value in each row. The nrow rows increase in latitude by dely with yllcorner for the first row

```
ncols = 3000;
nrows = 3000;
xllcorner = 103.992840406796;
yllcorner = 12.016949246738;
delx = 0.000697264752;
dely = 0.002096842449;
```

4. Waveforms:

Files: Mekong_river_20XX.tar where XX denotes year

Multilook waveforms across the Mekong: tar/zipped file containing all epochs.

Each file:

row 1: number of ground points (Ng)

row 2: year, month, day

Block1 Ng rows: seconds in day, lat (deg); long(deg), orthometric height above EGM96 geoid (m); EGM96 geoid; cross track angle (deg) for the Ng groundpoints

Block2 Ng rows: waveform power for 1024 bins for all ground points of Block 1

Directory: [Inland water locations/TonleSap](#)

1. Sub-directory: **Cryosat2_TonleSap_heights**

TonleSap_SARFBR_heights: tar/zipped file containing all epochs

CryoSat-2 Inland water heights across the Tonlé Sap: tar/zipped file containing all epochs.



Format as for Mekong file Cryosat2_Mekong_heights. Excel file of gauge data courtesy of MRC.

2. Sub-directory: **TonleSap_20111203_N_comparisons**

Heights using various N in multi-look stack for Tonlé Sap crossing 3 Dec 2011. Files are named NN.dat where NN is the number N for waveforms in the stack (see D4200).

Format for NN=10, 20 etc as for Sub-directory Cryosat2_Mekong_heights. Files

110_unitwt.dat and 110_weighted.dat are for N=110 with unit weight and Hamming

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window weights respectively. File

RES_CS_LTA__SIR1SAR_FR_20111203T050938_20111203T051509_C001.nc is the GPOD SARvatore file for the pass

3. File: **TonleSap.tar**: contains file for each epoch (file name ***** follows ESA convention)

File *****.DBL.output_burst: CryoSat-2 Inland water burst echo heights:

columns;

(1-4) year; month; day; seconds in day

(5-6) lat (deg); long(deg);

(7) orthometric height from OCOG/Threshold (m);

(8) WGS84 EGM96 geoid (m)

File *****.DBL.output: CryoSat-2 Inland water multi-look heights (N=40):

columns;

(1-4) year; month; day; seconds in day;

(5-6) lat (deg); long(deg);

(7) orthometric height from empirical retracers (m);

(8) orthometric height from OCOG/Threshold (m),

(9) EGM96 geoid (m);

(10) Normalised Residual Error of empirical retracker;

(11) tracker used;

(12) river mask (0 over land, 1 over river);

(13) ground point count in pass

File *****.DBL.multi_look; CryoSat-2 Inland water multi-look waveforms:

row 1: number of ground points (Ng)



row 2: year, month, day

Block1 Ng rows: seconds in day, lat (deg); long(deg), orthometric height above EGM96 geoid (m); EGM96 geoid; cross track angle (deg) for the Ng groundpoints

Block2 Ng rows: waveform power for 1024 bins for all ground points of Block 1

Directory: [Inland water locations/Amazon/Obidos_SARFBR](#)

1. Obidos_output_burst.tar: CryoSat-2 Inland water burst echo heights across the Amazon near Obidos: tar/zipped file containing all epochs

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columns; (1-4) year; month; day; seconds in day;

(5-6) lat (deg); long(deg);

(7) orthometric height from OCOG/Threshold (m);

(8) WGS84 EGM96 geoid (m)File:

2. Obidos_output.tar: CryoSat-2 Inland water multi-look (N=40) heights across the Amazon near Obidos: tar/zipped file containing all epochs

columns; (1-4) year; month; day; seconds in day;

(5-6) lat (deg); long(deg);

(7) orthometric height from empirical retracker (m);

(8) orthometric height from OCOG/Threshold (m),

(9) EGM96 geoid (m);

(10) Normalised Residual Error of empirical retracker;

(11) tracker used;

(12) river mask (0 over land, 1 over river);

(13) ground point count in pass

3. Station Obidos

In situ description of Obidos gauge

4. Waveform (directory): Multilook waveforms across the Amazon near Obidos: tar/zipped file containing all epochs



Each file:

row 1: number of ground points (Ng)

row 2: year, month, day

Block1 Ng rows: seconds in day, lat (deg); long(deg), orthometric height above EGM96 geoid (m); EGM96 geoid; cross track angle (deg) for the Ng ground points

Block2 Ng rows: waveform power for 1024 bins for all ground points of Block 1

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Directory: [Inland water locations/Amazon/Manacapuru_SARFBR](#)

Same structure as directory for Obidos but for Amazon near Manacapuru

Directory: [Inland water locations/Amazon/Tabatinga_SARinFBR](#)

1. Tabatinga_output_burst.tar:

CryoSat-2 Inland water burst echo heights across the Amazon near Tabatinga: tar/ziped file containing all epochs

columns; (1-4) year; month; day; seconds in day;

(5-6) lat (deg); long(deg);

(7) orthometric height from OCOG/Threshold left antennae (m);

(8) WGS84 EGM96 geoid (m)

2. Tabatinga_output.tar:

CryoSat-2 Inland water multi-look (N=60) heights across the Amazon near Tabatinga: tar/ziped file containing all epochs



columns; (1-4) year; month; day; seconds in day;

(5-6) lat (deg); long(deg);

(7) height above WGS84 ellipsoid from OCOG/Threshold left antennae (m);

(8) height above WGS84 ellipsoid from OCOG/Threshold right antennae (m);

(9) WGS84 EGM96 geoid (m);

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(10) maximum power in waveform;

(11) cross track angle (deg);

(12) river mask (0 over land, 1 over river);

(13) multi-look count in pass

3. Waveform (directory):

Multilook waveforms across the Amazon near Tabatinga: tar/zipped file containing all epochs

Each file:

row 1: number of ground points (Ng)

row 2: year, month, day

Block1 Ng rows: seconds in day, lat (deg); long(deg), height above WGS84 ellipsoid from OCOG/Threshold left antennae (m); height above WGS84 ellipsoid from OCOG/Threshold right antennae (m); EGM96 geoid; cross track angle (deg) for the Ng ground points

Block2 Ng rows: waveform power for 1024 bins (left antennae) for all ground points of Block 1



Block3 Ng rows: waveform power for 1024 bins (right antennae) for all ground points of Block 1

Block4 Ng rows: coherence between waveforms for 1024 bins for all ground points of Block 1

4. Station Tabatinga

In situ description of Tabatinga gauge. Data available from Hybam (<http://www.ore-hybam.org/>).

Gauge data also available from DAHITI (<http://dahiti.dgfi.tum.de/en/>)

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Directory: [Inland water locations/Brahmaputra/SARinFBR](#)

1. File: Brahmaputra_SARin_heights.tar: tar/zipped file

CryoSat-2 ocean heights over the lower Brahmaputra

columns; year; month; day; seconds in day; lat (deg); long(deg); orthometric height from OCOG/threshold left antennae (m); orthometric height from OCOG/Threshold right antennae (m), EGM96 geoid (m); maximum power in waveform; cross track angle (deg); river mask (0 over land, 1 over river); count

2. File: DTU_NCL.dat:

Comparison of heights from SARin FBR data (Newcastle) and L1b data (DTU)

columns; date; year; month; day; seconds in day; lat (deg); long(deg); orthometric height from OCOG/threshold left antennae (m); orthometric height from OCOG/threshold right antennae (m); EGM96 geoid (m); DTU derived height; difference between NCL and DTU (m)

Difference derived by subtracting DTU height from average NCL derived heights of right and left antennae

(Note that columns might be across 2 rows depending on viewer)



Directory: [Inland water locations/SARin Ocean test](#)

1. File: SARin_ocean_pass.tar: tar/zipped file containing

a) CS_RPRO_SIR_SIN_FR_20110428T021402_20110428T021615_B002.DBL.output:
CryoSat-2 ocean heights near the Amazon estuary for 28 Apr 2011

columns; year; month; day; seconds in day; lat (deg); long(deg); orthometric height from OCOG/threshold left antennae (m); orthometric height from OCOG/Threshold right antennae (m), EGM96 geoid (m); maximum power in waveform; cross track angle (deg); river mask (0 over land, 1 over river); count

b) CS_RPRO_SIR_SIN_FR_20110428T021402_20110428T021615_B002.DBL.output:
CryoSat-2 burst echo ocean heights near the Amazon estuary for 28 Apr 2011

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columns; year; month; day; seconds in day; lat (deg); long(deg); orthometric height from OCOG/threshold left antennae (m); EGM96 geoid (m);

c) CS_RPRO_SIR_SIN_FR_20110428T021402_20110428T021615_B002.DBL.multi_lookup:

row 1: number of ground points (Ng)

row 2: year, month, day

Block1 Ng rows: seconds in day, lat (deg); long(deg), height above WGS84 ellipsoid from OCOG/Threshold left antennae (m); height above WGS84 ellipsoid from OCOG/Threshold right antennae (m); EGM96 geoid; cross track angle (deg) for the Ng ground points

Block2 Ng rows: waveform power for 1024 bins (left antennae) for all ground points of Block 1

Block3 Ng rows: waveform power for 1024 bins (right antennae) for all ground points of Block 1



Block4 Ng rows: coherence between waveforms for 1024 bins for all ground points of Block 1

2. File: RES_CS_RPRO_SIR_SIN_FR_20110428T021402_20110428T021615_B002.nc
GPOD SARinvatore file

6. Brahmaputra Data Assimilation

Directory: [Inland water locations/Brahmaputra](#)

1. README_WP4000.txt: a Readme file summarising Brahmaputra data for CRUCIAL WP4000 repository
2. README_WP3000.txt: a Readme file summarising Brahmaputra data for CRUCIAL WP3000 repository

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3. Sub-directory: **RiverMasks**

River masks with yearly minimum water extent, for each year between 2010 and 2015. Data extracted from 30m resolution Landsat NDVI imagery. Water defined as NDVI < 0.

4. Sub-directory: **InSitu_WP4000**

In situ data for discharge at Bahadurabad station, covering the years 2010 to 2015, however mostly limited to April to October (high flow season). This data was used to evaluate the data assimilation experiments with real CryoSat-2 data. Source: IWMBD (more data can be found in InSitu_WP3000 repository)

5. Sub-directory: **Altimetry_CRUCIAL**

CryoSat-2 dataset, filtered with the river masks in this repository. Full Baseline-B of CryoSat-2, from July 2010 to February 2016. For the data assimilation experiments reported in the deliverables, only data up to 2013 was available. More details in section 6.2 of D4100. The standard deviation was determined as described in sections 6.5.4 and 6.5.5 of D4100. Elevations in EGM08 datum.

Besides real CryoSat-2 data synthetic altimetry data used in the reported data assimilation experiments can be found in the repository.



This also applies to the synthetic altimetry data from Sentinel-3A that is referred to in CRUCIAL D5000.

6. Sub-directory: **Model**

Calibrated cross sections of the Brahmaputra River in the Assam Valley as described in section 6.1.4 of D4200. The mid point of each cross section is given with its river chainage (distance along the river, counted from the upstream end of the model), its location (lat, lon) and its datum (in mamsl). The cross section are assumed to be placed perpendicular to the river line (see shape file below) on their given midpoint. The datum is the bottom elevation, and the opening angle is the angle in degrees between a horizontal line and the triangle describing the cross section (compare Fig. 52 in D4200).

Shape file representing the 1D river line used in the Brahmaputra river model. Derived with hydrological routing tools from the SRTM DEM.

(more data can be found in the CRUCIAL WP3000 repository)

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7. Sub-directory: **DataAssimilation**

Cross correlation matrix of the simulated runoff in the subcatchments. These correlations were used to cross-correlate the perturbation errors in the data assimilation (see section 6.5.6 in D4100). The AR1 parameter used for temporal correlation is 0.9606

Results of the data assimilation runs (for open loop experiments, assimilation of real CryoSat-2 data, assimilation off synthetic CryoSat-2 and Sentinel-3A data) in terms of discharge at Bahadurabad station.

8. Sub-directory: **Altimetry_RiverLake**

Contains satellite altimetry data of ERS2, ENVISAT and Topex/Poseidon from the River & Lake project (see Product- Handbook): For each satellite

- .shp file for locations of virtual stations
- .rlh files for actual time series
- .mat file with data of actual time series

9. Sub-directory: **AssamValley_RiverMask**

- River masks for the Brahmaputra, Assam valley as GeoTIFF. WGS 1984. Based on Landsat 8 NDVI 32-day composites imagery. Water is defined where NDVI < 0. Resolution: 30 metres
- brah1314_12.zip: Areas are marked as water that are covered with water in 12 out of 12 "months" (32-day composites) from April 2013 to March 2014
- brah1314_8.zip: Areas are marked as water that are covered with water in at least 8 out of 12 "months" (32-day composites) from April 2013 to March 2014

10. Subdirectory: **GIS**



./BrahmaBasinRivers_I .shp file (polyline) with river lines, derived from SRTM.

Brahmaputra and some tributaries (WGS 1984)

./SRTM SRTM version 4.1 data. GeoTIFF, WGS 1984.

11. Sub-directory: **InSitu_WP3000**

Contains in situ data used in WP3000

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- ./Bahadurabad: Bahadurabad.xlsx: Discharge data at Bahadurabad (3-hourly from 2002 to 2007), from Bangladesh Water Development Board (BWDB)
- /Bahadurabad_RatingCurves: RatingCurves_Brahma.xlsx: Rating curves for Bahadurabad, based on Mirza, 2003. The article can be found in the folder
- /Bahadurabad_CFAN: Monsoon season discharge data at Bahadurabad, from 2004 to 2010. BrahmaputraRT_TechnicalReport.pdf: Report describes the extraction of data. See p. 2 for details. Q_Bahadurabad2004-2010.mat: The respective data.
 - Qnew and Tnew: only data extracted as described in the report, p. 2.
 - Qnew_withbase and Tnew_withbase: same data, with baseflow added from average values from 1950-2000 (as described in the report p. 11)
- /SAFFloodInformationSystem_Tibet: Discharge data at Nuxia and Nugesha, at the Brahmaputra in Tibet. 12-hourly values for the monsoon seasons 2005 to 2007. From the SAF Flood Information System: <http://southasianfloods.icimod.org/saf/reports/> Including .shp file for stations locations

7. Summary

This report presents a Data Set User Manual for accomplish the repository of relevant datasets for use in the Land and Inland Water applications theme. D4300 in conjunction with D3300 contains the corresponding dataset.