

# HYDROCOASTAL SAR/SARin Radar Altimetry for Coastal Zone and Inland Water Level

## Coastal and FF-SAR processing of S6 data Test Data Set, CCN#2, deliverable D1

Sentinel-3 and Cryosat SAR/SARin Radar Altimetry for Coastal Zone and Inland Water

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For ESA		

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### 1. Introduction

#### 1.1. The HYDROCOASTAL Project

The HYDROCOASTAL project is a project funded under the ESA EO Science for Society Programme and aims to maximise the exploitation of SAR and SARin altimeter measurements in the coastal zone and inland waters, by evaluating and implementing new approaches to process SAR and SARin data from CryoSat-2, and SAR altimeter data from Sentinel-3A and Sentinel-3B.

One of the key objectives is to link together and better understand the interactions processes between river discharge and coastal sea level. Key outputs are global coastal zone and river discharge data sets, and assessments of these products in terms of their scientific impact.

#### **1.2.** Scope of this Document

This document describes the contents and formats of the Test Data Set used for the CCN 2 of the project, which includes two different studies using Sentinel-6 data. The first study uses the CORS (Coastal Ocean Retracker for the Sentinels) processor in coastal areas already considered during the project (the Baltic Sea, the California coast, and the Aegean Sea). The second study uses the FF-SAR isardSAT processor over one specific track of interest on the coasts of the Aegean Sea islands.

#### **1.3.** Applicable Documents

AD-01: Sentinel-3 and CryoSat SAR/SARin Radar Altimetry for COASTAL ZONE and INLAND WATER - Statement of Work, V1.0 10/01/2019 Ref: EOP-SD-SOW-2018-089

#### 1.4. Reference Documents

RD-01 HYDROCOASTAL Technical Proposal. V1.1 28/11/2019, SatOC and HYDROCOASTAL team.

RD-02 HYDROCOASTAL Implementation Proposal. V1.1 28/11/2019, SatOC and HYDROCOASTAL team.

RD-03 HYDROCOASTAL Management Proposal. V1.3 26/11/2019, SatOC and HYDROCOASTAL team

RD-04 HYDROCOASTAL Financial Proposal. V1.2 28/11/2019, SatOC and HYDROCOASTAL team

RD-05 HYDROCOASTAL Contractual Proposal. V 1.2 26/11/2019, SatOC and HYDROCOASTAL team

RD-06 HYDROCOASTAL Deliverable 1.3 ATBD (Algorithm Theoretical Basis Document). V1.1 08/10/2020, isardSAT and HYDROCOASTAL team.

RD-07 HYDROCOASTAL POCCD (Processing Option Configuration Control Document). V1.1 08/10/2020, isardSAT and HYDROCOASTAL team.

RD-08 HYDROCOASTAL Deliverable 2.1 IODD (Input Output Data Definitions). V1.1 08/10/2020, isardSAT and HYDROCOASTAL team.

RD-09 HYDROCOASTAL Deliverable 2.3 PSD (Product Specification Document). V1.1 08/10/2020, isardSAT and HYDROCOASTAL team.

#### 1.5. Document Organisation

After this introductory section, section 2 includes the description of the test data set used for the study of the CORS processor. Section 3 describes the test data set used for FF-SAR study processing.

## 2. Test Data Set for the Sentinel-6 Coastal Processor (CORS) study

For the DD Coastal Processing study, we include the same areas considered in previous stages of this project: Aegean Sea, Baltic Sea, and California Coast. The cycles included are from cycle 5 to cycle 42.

The delivered Test Data Set consists in a set of L2 products in NetCDF format containing time-stamped and geolocated epoch, range, SWH, Sigma0 and quality flags (including WF flag, the retracker flag, the misfit and Pearson coefficient output from the retracker) derived from the coastal re-tracking processing and a subset of the geophysical estimates and geophysical parameters and range corrections from the Sentinel-6 L2 operational products. It also includes the distance to the coast solution developed by isardSAT from the Open Street Map collection, in addition to the solution included in the Sentinel-6 L2 operational products. The name of the CORS product includes the same sensing start and stop times of its correspondent Sentinel-6 L2 operational product.

The files are uploaded to the Hydrocoastal Drive: HYDROCOASTAL / Deliverables / Data / HYDROCOASTAL\_CCN2 / DD coastal (https://drive.google.com/drive/folders/1o6FuietqNSqHaa63cGq9ro2DC 2vCIHa?usp=drive link)

Three folders containing the following data (in NetCDF format) are included:

	Aegean Sea	Baltic Sea	California Coast
Folder name	Greece	Baltic	California
Number of products	209	279	245

#### Table 1: Test Data Set for the Sentinel-6 DD coastal processing.

The input data used to generate these products have been downloaded from the EUMETSAT EO Portal. The data used corresponds to reprocessed F06 data. Hence, we have a homogeneous updated dataset.

## 3. Test Data Set for the Sentinel-6 Fully-Focused SAR processor coastal study

For the FF Coastal Processing study, an off nadir pass over an island in the Aegean Sea was considered: pass 94 from Sentinel-6 data around the end of year 2021, from cycle 37 to cycle 41.

The delivered Test Data Set contains:

- Generated L1b FF products including all variables generated by the L1B FF processing and needed to retrack FF-SAR L1b waveforms. The different configurations detailed in HYDROCOASTAL\_ESA\_TN\_CCN2\_D2 are included.
- Generated L2 products, containing time stamped and geolocated epoch, range, SWH, Sigma0 and quality flags (including WF flag, the retracker flag, the misfit and Pearson coefficient output from the retracker) estimated by **isardSAT's analytical retracker** from the generated FF L1b data, together with a subset of the geophysical estimates and geophysical parameters and range corrections from the Sentinel-6 L2 operational products.
- Generated L2 products, containing time stamped and geolocated epoch, range, SWH, Sigma0 and quality flags (including WF flag, the retracker flag, the misfit and Pearson coefficient output from the retracker) estimated by isardSAT's CORS retracker from the generated FF L1b data, together with a subset of the geophysical estimates and geophysical parameters and range corrections from the Sentinel-6 L2 operational products.

The files (in NetCDF format) are uploaded in a .ZIP file (HCA\_CNN2\_FFSAR\_cdata\_package.zip) to the Hydrodcoastal Drive: HYDROCOASTAL / Deliverables / Data / HYDROCOASTAL\_CCN2 / FF coastal (<u>https://drive.google.com/drive/folders/1HvtTQixIdIREGvA38o9q2J5H5OALMPSw?usp=drive\_link</u>).

For each product the folders are organised as follows:

- results
  - o L2
- SL04\_ML300\_fromL1B
  - plots
  - o data
  - SL04\_10

     plots
    - pious
       data
    - SL1 ML10
  - SL1\_ML10
     plots
    - o piors
    - o data
  - coastal\_processing

o L1B

- SL04\_ML300\_fromL1B
  - SL04\_10
  - o ML
- SL1\_ML10

   ML

DD

L2\_isd\_coastal
plots
Data
L2\_isd
plots
data
L2\_EUM
L1B

The input data used for the study were downloaded from the EUMETSAT EO Portal and consist in 5 products of pass 94 from Sentinel-6 L1A NTC.

## 4. List of Acronyms

ACE2	Altimeter	Corrected	Elevations	СТОН	Centre de T	Fopographie de	es Océans et
(vers. 2)				de l'Hydros	ohère (Cen	tre of Topogra	aphy of the
AD	Applicable D	ocuments		Oceans and	the Hydros	phere)	
AGC	Automatic G	ain Control		DAO	Data Acces	ss Object	
AH	Alti-Hydro			DARD	Data Acces	ss Requiremen	t Document
AHP	Alti-Hydro P	roduct(s)		DDM	Delay-Dop	pler Map	
AI	Action Item			DDP	Delay-Dop	pler Processor	
AIM	Action Item	Management (t	tool)	DEM	Digital Elev	ation Model	
AltiKa	Altimeter in	Ka band and bi	i-frequency	DGC	Doppler Gr	ound Cell	
radiometer in	nstrument			DPM	Detailed Pr	ocessing Mode	el
AMSR-E	Advanced	Microwave	Scanning	DPP	Data Procu	irement Plan	
Radiometer-	Earth Observ	/ing System	-	DTC	Dry Tropos	pheric Correct	ion
ANA	Agência Na	cional de Água	s (National	DTU	Danmarks	Tekniske	Universitet
Water Agend	cy, Brazil)	-	·	(Technical U	Iniversity of	Denmark)	
AoA	Angle of arri	val		DVT	Data Valida	ation Table	
API	Application I	Programming Ir	nterface	ECMWF	European	Centre for Me	dium-Range
AR	Acceptance	Review		Weather For	recasts		
ASAP	As Soon As	Possible		ECSS	European	Cooperation	for Space
ASCII	American	Standard (	Code for	Standardisat	tion		•
Information I	nterchange			EGM	Earth Grav	itational Model	
ATBD	Algorithm Te	echnical Basis	Document	ENVISAT	ENVIronme	ent SATellite	
ATK	ALONG-TRAC	к S.A.S.		EO	Earth Obse	ervation	
AVISO	Archivage, \	/alidation et Int	terprétation	EOEP	Earth C	Observation	Enveloppe
des données	s des Satellite	es Océanograp	hiques	Programme			
BIPR	Background	Intellectual	Property	EOLi	Earth Obse	ervation Link	
Right	-			EOLi-SA	EOLi-Stand	d Alone	
CĂSH	Contribution	de l'Altimetrie	Spatiale à	EPN	EUREF Pe	rmanent Netwo	ork
l'Hydrologie	(Contribution	n of Space A	ltimetry to	ERA	ECMWF R	eAnalysis	
Hydrology)			-	ESA	European S	Space Agency	
CCN	Contract Ch	ange Notice		EUREF	IAG Re	ference Fra	me Sub-
CFI	Customer F	urnished Item		Commission	for Europe		
CLASS	NOAA/Com	prehensive La	rge Arrav-	FBR	Full Bit Rat	e	
Data Stewar	dship Systen	n	0 ,	FFT	Fast Fourie	er Transform	
CoG	Centre of G	ravity		FR	Final Revie	W	
CPP	CryoSat-2	Processing	Prototype	FTP	File Transfe	er Protocol	
(CNES)	-	-		FCUP	(from por	tuguese) <i>"Fa</i>	culdade de
CryoSat-2	Altimetry	satellite	for the	Ciências da	Universida	de", Science fa	aculty of the
measuremen	nt of the pol	lar ice caps a	nd the ice	University of	Porto		
thickness				GDAL	Geospatial	Data Abstracti	on Library
CRISTAL	Copernicus	polaR Ice a	and Snow	GDR, [I-,S-]	Geophysica	al Data Recor	d, [Interim-,
Topography	ALtimeter			Scientific-]			
CRUCIAL	CRyosat-2	sUCcess ov	ver Inland	GFZ	Deutsche	GeoForschu	ingsZentrum
wAter and La	and			(German Re	search Cen	tre for Geoscie	nces)
CSV	Coma Sepa	rated Values		GNSS	Global Nav	igation Satellite	e System

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GOCE Circulation E	Gravity field and steady-state Ocean xplorer	LEGOS Géophysique	(french acr.) Laboratoire d'Études en e et Océanographie Spatiale	
GPD	GNSS-derived Path Delay	(Laboratory for Studies in Geophysics and Spatial		
G-POD	Grid Processing on Demand	Oceanography)		
GPT2	Global Pressure and Temperature	LOTUS	Preparing Land and Ocean Take Up	
model (vers.	2)	from Sentine	I-3	
GPP	Ground Processing Processor	LPS	Living Planet Symposium	
GPS	Global Positioning System	IRM	Low Resolution Mode	
GRACE	Gravity Recovery And Climate	ISE	Least Square Estimator	
Experiment		I WI	Lake Water Level	
GRDC	Global Runoff Data Centre	IWS	Low Water Stage	
GRGS	Groupe de Recherche de Géodésie	MARS	Meteorological Archival and Retrieval	
Snatiale (Sna	ace Geodesy Research Group)	System		
GRI M	Global Reservoir and Lake Monitor	MDI	Minimum Description Length	
GTN-I	Global Terrestrial Network - Lakes	MMSE	Minimum Mean Square Error	
	Hierarchical Data Format - Farth		Modification of Normalised Difference	
Observing Sv	vetom	Water Index	Modification of Normalised Difference	
HGT	A SRTM file format	MoM	Minutes of Meeting	
HWS	High Water Stage	MPC	Mission Performance Centre	
HYCOS	Hycos Hydraulics & Control Systems	MRC	Mission Commission	
	Hydrological Predictions for the	MTD	Mid Torm Poviow	
Environment	model	MSS	Mean Square Slope	
	International Association of Geodesy	MSS	Mean Sea Surface	
	International Association of Geodesy		Microwayo Padiomotor	
Noighbourbo	and Adaptive		Navigation and Attitude	
	Individual Echoos		Normalized Difference Vegetation	
	International CNSS (Clobal	Index	Normalised Difference vegetation	
Novigation S	atellite Systems) Service		Normalised Difference Water Index	
INAVIGATION S	Internal Moeting (e.g. not with the		Notwork Common Data Form	
nivi aliant)	internal meeting (e.g. not with the		Netional Occapia and Atmospheria	
	Input Output Data Degument	Administratic	national Oceanic and Atmospheric	
	Input Output Data Document		Now Poquiroment (wirt the SeW)	
			Near Bool Time	
	International Terrestrial Deference		Numerical Weather Model	
Frama			Offeet Centre of Crevity	
	Impulse Response Function		One per Crossing	
IRF	Altimetry actallite T/D follow on	OFC	One per Crossing	
Jason-1	Altimetry satellite, 1/P 1010W-01		Ocean Sunace Topography Mission	
	Alumetry Salemie, also known as the	(also known	as Jason-2), is also the hame of the iso $T/D$ loson 1 loson 2 and loson 2	
« Ocean Su	nace ropography mission » (OSTM),		Orbit State Vector	
Jason-1 Iolio	W-011 Altimetry actallity Jacon 2 follow on		Drobobility Density Eurotian	
Jason-3	Allimetry satellite, Jason-2 lollow-on		Probability Density Function	
Jason-CS	Jason Continuity of Service		Prototype for Expertise on Allika for	
			Sontinol Broduct Exploitation Diotform	
		PEPS	Sentinei Product Exploitation Plationn	
			(french cor) Drototype Innovent de	
	LEVEFID		Troitoment neur les Appliestiers	
LID-0, LIB0	Level 2 (aka, Slack Cala)	Cotiòrea et "	e manement pour les Applications	
			Droipet Management Disc	
			Project Management Plan	
	Level-4	Control Doct	mont	
LAGEUS	Laser Geodynamics Satellite		lineur	

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PR	Progress Report	SOA	State Of the Art	
PRF	Pulse Repetition Frequency	SOW	Statement Of Work	
PSD	Product Specification Document	SPR	Software Problem Reporting	
PTR	Point Target Response	SPS	Sentinel-3 Surface Topography	
PVP	Product Validation Plan	Mission Syst	em Performance Simulator	
PVR	Product Validation Report	SRAL	SAR Radar Altimeter	
PVS	Pseudo Virtual Station(s)	SRTM	Shuttle Radar Topography Mission	
RADS	Radar Altimeter Database System	SSB	Sea State Bias	
RB	Requirements Baseline (document)	SSMI/IS	Special Sensor Microwave Imager	
RCMC	Range Cell Migration Curve	(SSM/I) Sour	nder	
RCS	Radar Cross Section	SSO Single Sign-On		
RD	Reference Document	Stack	Matrix of stacked Doppler beams	
RDSAR	Reduced SAR (also known as	STD	Standard Deviation	
Pseudo-I RM		STM	Sentinel-3 Surface Topography	
	l) Pandom Forost	Mission	Sentinel-5 Surface Topography	
PCB	Red Green Blue	SI IM	Software User Manual	
	Review Item Discropancy	SUM SW/RD	SPTM Water Body Data	
	Review item Discrepancy		Significant Ways Height	
RIP	Range integrated Power (of the MLD)		Significant wave reigni	
	elefted as Aligular Power Response	I AI (Internetione	Temps Alomique international	
(APR)		(Internationa	Tatomic Time)	
RMS	Root Mean Square	TBC		
ROI	(geographical) Region(s) Of Interest	TBD	To Be Done	
RP	Report Period (a month that is being		Total Column Water Vapour	
reported into	a Progress Report)	IDS	Test Data Set	
RSS	Remote Sensing Systems	ТМІ	Tropical Rainfall Measuring Mission	
RWD	River Water Discharge	(TRMM) Mic	rowave Imager	
RWL	River Water Level	TN	Technical Note	
SAMOSA	SAR Altimetry MOde Studies and	T/P	Topex/Poseidon (altimetry satellite)	
Applications		TR	Technical Risk	
SARAL	In Indian "simple", in english "SAtellite	UNESCO	United Nations Educational, Scientific	
for ARgos an	nd AltiKa.	and Cultural	Organization	
SARIn	SAR Interferometric (CryoSat-	URL	Uniform Resource Locator	
2/SIRAL mod	de)	USGS	United States Geological Survey	
SAR	Synthetic Aperture Radar	USO	Ultra Stable Oscillator	
SARvatore	SAR Versatile Altimetric Toolkit for	UTC	Coordinated Universal Time	
Ocean Resea	arch & Exploitation	UWM	Updated Water Mask	
SCOOP	SAR Altimetry Coastal & Open Ocean	VS	Virtual Station(s)	
Performance	,	VH	Vertical-Horizontal polarisation	
SDP	Software Development Plan	VV	Vertical-Vertical polarisation	
SEOM	Scientific Exploitation of Operational	WBS	Work Breakdown Structure	
Missions		WFR	Water Fraction Ratio	
SHAPE	Sentinel-3 Hydrologic Altimetry	WMO	World Meteorological Organization	
PrototypE	· - ·	WP	Work Package(s)	
SI-MWR	Scanning Imaging MWR	w.r.t.	with respect to	
SME	Small and Medium-sized Enterprise	WTC	Wet Tropospheric Correction	
SMHI	Swedish Meteorological and	XML	eXtensible Markup Language	
Hydrological	Institute	ZP	Zero Padding	
SNAP	SeNtinel Application Platform		-	