CRISTAL marine data center

Ocean Surface Topography Science Team
OSTST 2022, Venice, Italy

EUMETSAT CONTIBUTION TO THE CRISTAL MISSION

INTRODUCTION

- Within the expansion of the Copernicus Sentinel Constellation, ESA is developing the **C**opernicus pola**R** **I**ce and **S**now **T**opography **AL**timeter (CRISTAL), planned for **launch** in **2027**. CRISTAL's **secondary objective** is to contribute to the **observation of global ocean topography** as a continuum **up to the polar seas**.
- CRISTAL will contribute to the observation system for global observation of mean sea level, mesoscale and sub-mesoscale currents, wind speed and significant wave height. Information from **this mission serves as critical input to operational oceanography and marine forecasting services** as well as ice thickness retrieval **in the polar oceans**.

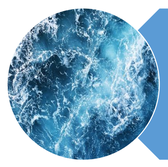
EUMETSAT´s ROLE

- EUMETSAT is entrusted to **operate the marine data center** generating operational global ocean products.

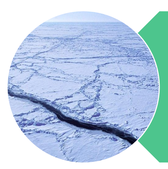
PRODUCT HERITAGE

- As per Mission Requirements, ocean products shall be produced at NRT, STC and NTC.
- Products format will resemble to **Sentinel-6**
  - SAFE packaging (Manifest + NetCDF)
  - Separate HR and LR (pseudo-LRM or LRM depending on IRIS mode)
  - NetCDF grouping
  - Maintain variable names as reference mission
  - Products File naming similar to Sentinel-6
- Product design should be completed before next OSTST in 2023 (see Figure2).

Figure 1: CRISTAL altimeter IRIS acquisition modes of interest for the ocean surface topography community



OCEAN
- Ku band SAR – Closed Burst
- Ka band SAR – Closed Burst
- RMC



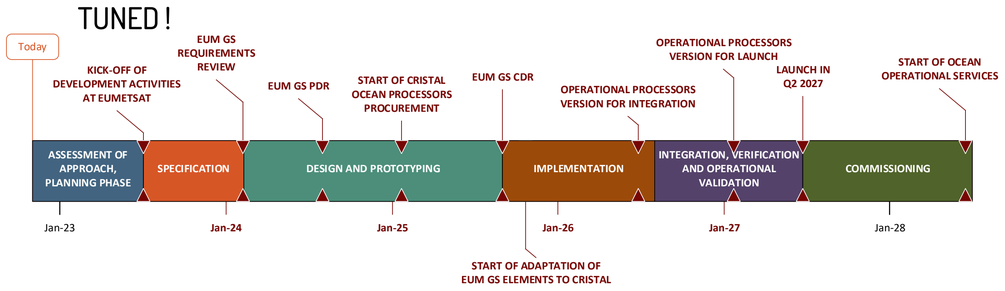
SSH INTO THE LEADS and over LARGE LAKES
- Ku band SAR-in Open Burst
- Ka band SAR Open Burst
- No RMC

COAST
- **Mostly like open ocean**, but for some polar regions a combination of the previous two based on CRISTAL's altimeter IRIS acquisition mode mask

IMPORTANT NOTE: *Hydrological products for CRISTAL are responsibility of ESA. Nevertheless, as per previous missions (e.g. Sentinel-3) the ocean surface topography modelers have always requested a few large lakes (e.g. Great Lakes) to also be part of the marine products. This is why there is a mention to LARGE Lakes in the figure above.*

Figure 2: EUMETSAT'S tentative development timeline

- Preparatory activities at EUMETSAT will initiate this 2023 with the tentative goal of starting the marine data center development beginning of 2024. **STAY TUNED !**



COMPARISON BETWEEN ALTIMETRY MISSIONS TIMELINESS

Near-Real time	Short Time Critical	Non Time Critical
• Mainly for **operational Met agencies** (wind and wave mainly) • Products split by **satellite dump/granules** (LR/HR) • **NetCDF** and **BUFR**	• For **ocean modelling and assimilation** • Product split by pass (**pole to pole**) • **NetCDF**	• For **oceanographic and geophysical research and climate studies** • Products split by pass (**pole to pole**) • **NetCDF**
JASON-3/ALTIKA		
• 3-hour latency • OGDR • 1-Hz and 20-Hz	• 48-hour latency • IGDR • 1-Hz and 20-Hz measurements	• 60-day latency • GDR and SGDR (including waveforms) • 1-Hz and 20-Hz measurements
SENTINEL-6 MF		

• 3-hour latency
• **Level 2:** Low- and high-resolution products
  • **Standard** (1-Hz and 20-Hz)
  • **Reduced** (1-Hz)
  • **BUFR** (1-Hz and 20-Hz)
• **MWR L2:** 16-Hz AMR-C and HRMR measurements
	• 36-hour latency
	• **Level 1A:** Individual echoes (HR only)
	• **Level 1B:** LR and HR
	• **Level 2:** LR and HR
	  • **Standard** (1-Hz and 20-Hz)
	  • **Reduced** (1-Hz only)
	• **MWR L2:** 16-Hz AMR-C and HRMR measurements
		• 60-day latency (effectively 30 days)
		• **Level 1A:** Individual echoes
		• **Level 1B:** LR and HR
		• **Level 2:** LR and HR
		  • **Standard** (1-Hz and 20-Hz)
		  • **Reduced** (1-Hz only)
		• **MWR L2:** 16-Hz AMR-C and HRMR measurements

SENTINEL-3		

• 3-hours latency
• **Level 1B:** PLRM and SAR (equivalent to LR and HR L1B in other missions)
• **Level 2:** pseudo-Low- and high-resolution products
  • **Enhanced** (1Hz and 20-Hz + waveforms)
  • **Standard** (1-Hz and 20-Hz)
  • **Reduced** (1-Hz)
  • **BUFR** (1-Hz and 20-Hz)
	• 48-hours latency
	• **Level 1B:** PLRM and SAR (equivalent to LR and HR)
	• **Level 1B-S:** HR
	• **Level 2:** pseudo-LR and HR
	  • **Enhanced, Standard , Reduced**
		• 30-day latency
		• **Level 1A:** Individual echoes
		• **Level 1B:** PLRM and SAR (equivalent to LR and HR)
		• **Level 1B-S:** HR
		• **Level 2:** pseudo-LR and HR
		  • **Enhanced, Standard , Reduced**

CRYOSAT – 2 (ESA EARTH EXPLORER)		
• 3-hour latency • **L2 NOP (Near-real time ocean product) –** Low- and High-resolution products	• 48-hour latency • **L2 IOP** – Low- and High-resolution products	• 30-day latency • **L2 GOP** – Low- and High-resolution products
CRISTAL		

• ≤ 3-hours latency (TBC)
• Level 2:
  • **Standard** (1-Hz and 20-Hz)
  • **Reduced** (1-Hz)
  • **BUFR** (1-Hz and 20-Hz)
• **MWR L2 (TBC):** 16-Hz AMR-C and HRMR measurements
	• ≤ 48-hours latency (TBC)
	• **Level 1A:** TBC
	• **Level 1B:** TBC
	• **Level 2:**
	  • **Standard & Reduced**
	• **MWR L2 (TBC):** 16-Hz AMR-C and HRMR measurements
		• TBC
		• **Level 1A:** Individual echoes
		• **Level 1B:**
		• **Level 2:**
		  • **Standard & Reduced**
		• **MWR L2 (TBC):** 16-Hz AMR-C and HRMR measurements

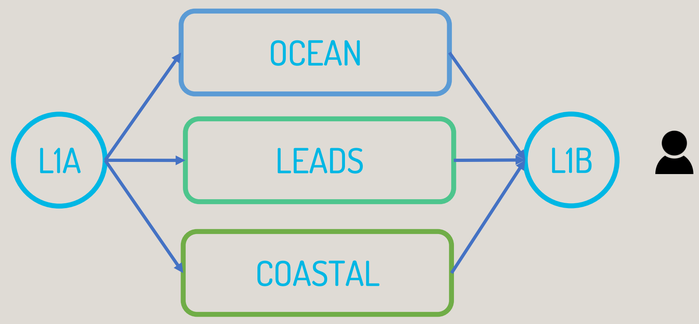
NOTE: *CRISTAL open ocean products' timeliness and format is currently under design. Tentative information is provided in this table. The information in this table is not confirmed at the time of OSTST 2022.*

THE MARINE DATA CENTER CHALLENGES FOR CRISTAL ?

THEMATIC L1B OCEAN PROCESSORS FOR CRISTAL

- A novelty of CRISTAL is that it will be the **first operational mission** offering the possibility to operationally exploit SAR CB (Ku and Ka), SARin OB (ku) and SAR OB (Ka) over different areas of our ocean (see Figure 1). Sentinel-3 and Sentinel-6 as they are currently operated offer the same acquisition mode over all regions in the Globe. CRISTAL instead will enrich the acquisition spectrum, in turn thematic L1B processing will be needed.

Figure 3: Thematic L1B processors for open ocean data



Ku AND Ka BANDS SIMULTANEOUS

- Another first of this mission is the **equal exploitation of the Ku and Ka band for oceanography**. Neither serves as a secondary band. Instead, the strengths of both are exploited to enrich the products, e.g., with an improved ionospheric correction, rain flagging, etc.

CRISTAL'S ORBIT – relevant facts for oceanography

Inclination	Altitude	Cycle
• 92 Degrees	• 683.62 Km	• 367 days

Sub-cycles	Relevance for mission secondary objective – Ocean
• 2 days	• Optimal to minimize wave correlation between altimeter tracks, in turn very convenient for SWH routinely assimilation in operational wave models. • Also convenient for polar mesoscale assimilation
• 5 days	
• 7 days	
• 12 days	• 15-17 days would have been optimal for global mesoscale
• 19 days	
• 31 days	• Monthly variability
• 112 days	• Orbits of 90/120/180 days would be optimal to analyse potential MSS biases from seasonal ice coverage

EUMETSAT RELEVANT ALTIMETRY INFORMATION

EUMETSAT Altimetry Resources
https://www.eumetsat.int/altimetry-resources

EUMETSAT
https://www.eumetsat.int

Cristina Martin-Puig, Carolina Nogueira Loddo, Remko Scharroo, Julia Figa Saldana, Conrad Jackson and Marco Meloni

EUMETSAT, Eumetsat Allee 1, Darmstadt, Germany

Want to know more about Altimetry services at EUMETSAT?

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Or contact us at:
cristal@eumetsat.int

eumetsat
@eumetsat
eumetsat1

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