

CRISTAL marine data center

Ocean Surface Topography Science Team
OSTST 2022, Venice, Italy

EUMETSAT CONTRIBUTION TO THE CRISTAL MISSION

INTRODUCTION

- Within the expansion of the Copernicus Sentinel Constellation, ESA is developing the Copernicus polaR Ice and Snow Topography ALtimeter (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

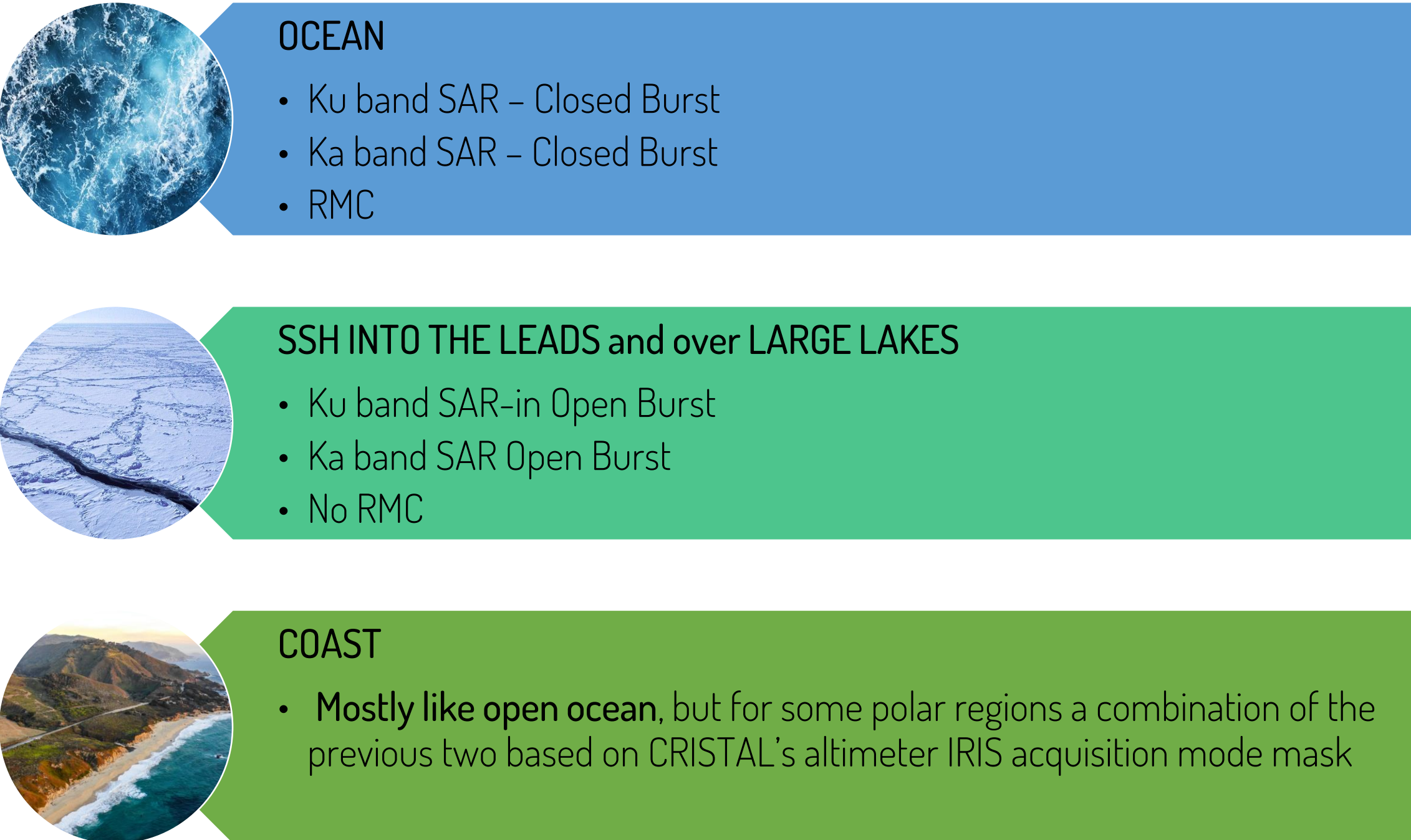
- As per Mission Requirements, ocean products shall be produced at NRT, STC and NTC.
- Products format will resemble to Sentinel-6
 - SAFE packaging (Manifest + NetCDF)
 - Separate HR and LR (pseudo-LRM or LRM depending on IRIS mode)
- NetCDF grouping
- Maintain variable names as reference mission
-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

COMPARISON BETWEEN ALTIMETRY MISSIONS TIMELINESS

Near-Real time	Short Time Critical	Non Time Critical
<ul style="list-style-type: none">Mainly for operational Met agencies (wind and wave mainly)Products split by satellite dump/granules (LR/HR)NetCDF and BUFR	<ul style="list-style-type: none">For ocean modelling and assimilationProduct split by pass (pole to pole)NetCDF	<ul style="list-style-type: none">For oceanographic and geophysical research and climate studiesProducts split by pass (pole to pole)NetCDF
JASON-3/ALTIKA		
<ul style="list-style-type: none">3-hour latencyOGDR1-Hz and 20-Hz	<ul style="list-style-type: none">48-hour latencyIGDR1-Hz and 20-Hz measurements	<ul style="list-style-type: none">60-day latencyGDR and SGDR (including waveforms)1-Hz and 20-Hz measurements
SENTINEL-6 MF		
<ul style="list-style-type: none">3-hour latencyLevel 2: Low- and high-resolution products<ul style="list-style-type: none">Standard (1-Hz and 20-Hz)Reduced (1-Hz)BUFR (1-Hz and 20-Hz)MWR L2: 16-Hz AMR-C and HRMR measurements	<ul style="list-style-type: none">36-hour latencyLevel 1A: Individual echoes (HR only)Level 1B: LR and HRLevel 2: LR and HR<ul style="list-style-type: none">Standard (1-Hz and 20-Hz)Reduced (1-Hz only)MWR L2: 16-Hz AMR-C and HRMR measurements	<ul style="list-style-type: none">60-day latency (effectively 30 days)Level 1A: Individual echoesLevel 1B: LR and HRLevel 2: LR and HR<ul style="list-style-type: none">Standard (1-Hz and 20-Hz)Reduced (1-Hz only)MWR L2: 16-Hz AMR-C and HRMR measurements
SENTINEL-3		
<ul style="list-style-type: none">3-hours latencyLevel 1B: PLRM and SAR (equivalent to LR and HR L1B in other missions)Level 2: pseudo-Low- and high-resolution products<ul style="list-style-type: none">Enhanced (1-Hz and 20-Hz + waveforms)Standard (1-Hz and 20-Hz)Reduced (1-Hz)BUFR (1-Hz and 20-Hz)	<ul style="list-style-type: none">48-hours latencyLevel 1B: PLRM and SAR (equivalent to LR and HR)Level 1B-S: HRLevel 2: pseudo-LR and HR<ul style="list-style-type: none">Enhanced, Standard, Reduced	<ul style="list-style-type: none">30-day latencyLevel 1A: Individual echoesLevel 1B: PLRM and SAR (equivalent to LR and HR)Level 1B-S: HRLevel 2: pseudo-LR and HR<ul style="list-style-type: none">Enhanced, Standard, Reduced
CRYOSAT - 2 (ESA EARTH EXPLORER)		
<ul style="list-style-type: none">3-hour latencyL2 NOP (Near-real time ocean product) - Low- and High-resolution products	<ul style="list-style-type: none">48-hour latencyL2 IOP - Low- and High-resolution products	<ul style="list-style-type: none">30-day latencyL2 GOP - Low- and High-resolution products
CRISTAL		
<ul style="list-style-type: none">≤ 3-hours latency (TBC)Level 2:<ul style="list-style-type: none">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	<ul style="list-style-type: none">≤ 48-hours latency (TBC)Level 1A: TBCLevel 1B: TBCLevel 2:<ul style="list-style-type: none">Standard & ReducedMWR L2 (TBC): 16-Hz AMR-C and HRMR measurements	<ul style="list-style-type: none">TBCLevel 1A: Individual echoesLevel 1B:Level 2:<ul style="list-style-type: none">Standard & ReducedMWR L2 (TBC): 16-Hz AMR-C and HRMR measurements

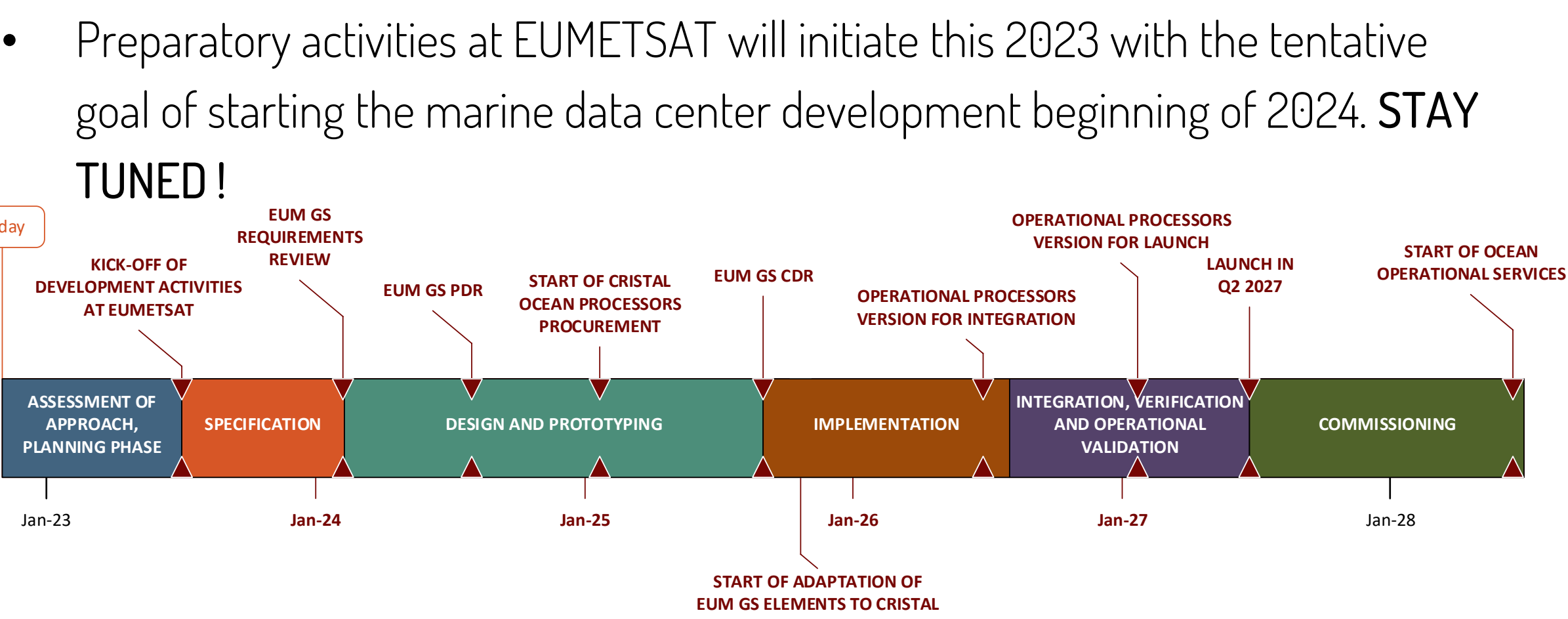
NOTE: CRISTAL open ocean products' timeliness and format is currently under design. Tentative information is provided in this table. The information in this table is not confirmed at the time of OSTST 2022.

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



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

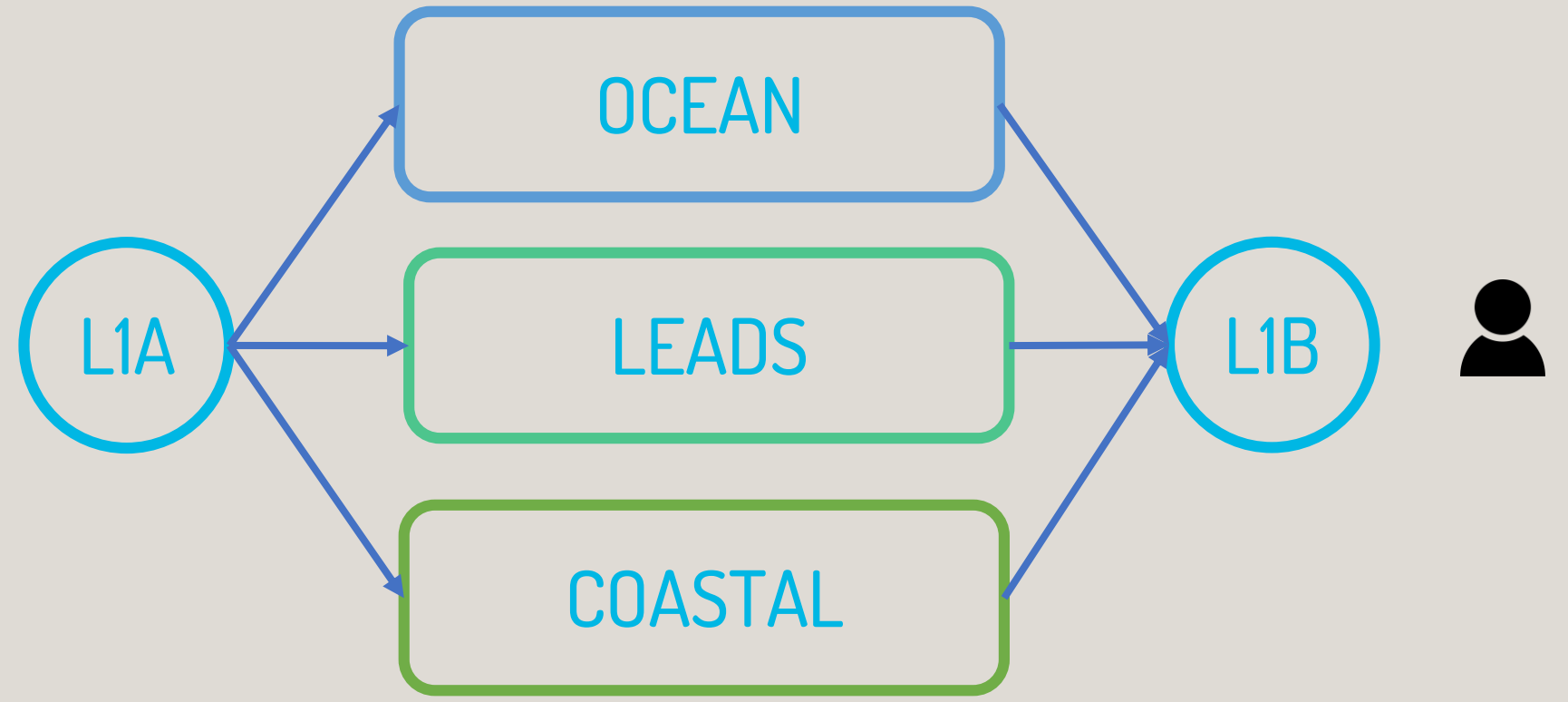


THE MARINE DATA CENTER CHALLENGES FOR CRISTAL ?

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>



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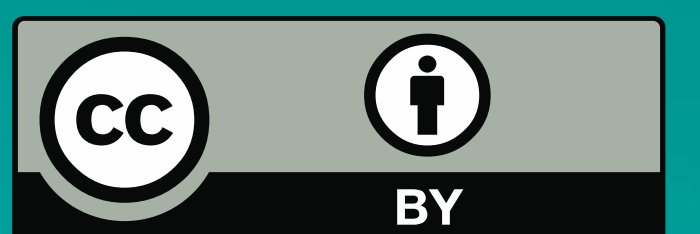
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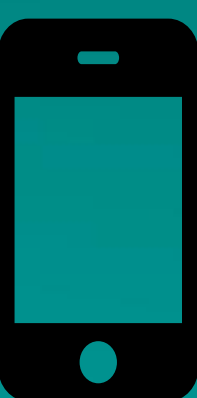
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