Annex 2

Copernicus Task Force on Cultural Heritage

Users' needs Matrix

High level users need 1	**Detection of underground archaeological sites through the study of the natural environment**	
Users' needs	**1 - Normalized difference vegetation index (NDVI)** (More indexes will be included in the Copernicus WP2019 for service improvement)	**2- Thermal anomaly**
Weight (From 0 to 5)	**5**	**4**
Spatial Resolution (m)	**5 - 10m**	**10-30m**
temporal resolution (dd / M)	**2weeks late winter/early summer** **3M the rest of the year**	**1 M**
Requirements	**NDVI layer**	**Land Surface Temperature Monitoring & Thermal Anomaly layer**

Matching with Copernicus products		
Copernicus Products Capacity	**High Resolution phenology product over EEA39, following the vegetation cycle in a continuous mode and with yearly updates of intra-seasonal information (10m res)** **CLMS Global Compopnent already produces global scale dynamic 20m surface reflectance through the Sentinnel-2 Global Mosaic service element (**https://land.copernicus.eu/imagery-in-situ/global-image-mosaics/**).** **This is a possible platform for monitoring non-EU sites of CH interest, NDVI estimation could be added as a toolbox element, with minimum cost implications.** **Planned for evolution in next MFF, in particular for application on CH of EU interst outside of EU, thematic including NDVI/FAPAR at 20m resolution globally (and produce**	**To wait Sentinel Expansion development CLMS Global LST product will move to higher resolution**

		multiple temporal repeat cycles).	
Source (Core Services or Space Component)		**CLMS (incl. Global Component)**	**CSC, Global Component of CLMS**
Sustainability for Core Services / Space Component		**High**	**To be verified in the next Copernicus Programme**
COPERNICUS PRODUCT		S2GM Surface Relflectance	**Future High Priority Candidate Missions - Land Surface Temperature Monitoring**
Characteristics	Spatial resolution	20, 30, 60m	
	Update frequency		
SENSOR TYPE (Sentinel or CM)		• Sentinel-2 • Possibly CM Group 2b (Optical VHR1/2)	• Possibly CM Group 2 (Optical HR1/2) • Possibly HPCM LSTM • Also Sentinel-3, but too low res
Characteristics	Spatial resolution	• Sentinel-2: max 10m • CM Group 2b: around 1m	• LSTM: possibly meet requirement of 30m resolution in thermal bands • Sentinel-3 thermal bands: 1km
	Spectral resolution	Sentinel-2: 13 bands from VIS to SWIR Full spectrum surface reflectance (selectable)	Sentinel-3 SLSTR MWIR & TIR bands: 3742 to 12022.5 nm
	Revisit time	Sentinel-2: At most 5 days 1 10, monthly, seasonal, annual	Sentinel-3: 1-4 days

END OF HIGH LEVEL USERS NEED 1

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High level users need 2	**Non-destructive analysis of the underground / underwater positioning of the CH features**

Users' needs	**3 -Bathymetry** (Bathimetry is an in situ data to be asked to MSs in its capacity - To wait Coastal Service development)	**4 -Stratigraphic description of the archaeological site and identification of individual layers or stratigraphic units** ***to be better investigated***
Weight (From 0 to 5)	**4**	**3**
Spatial Resolution (m)	**5-10 m Horiz. 1cm Vert.?**	**1m**
temporal resolution (dd / M)	**3M**	**2Y**
Requirements	**Bathimetry**	**Geological/stratigraphic Maps**

Matching with Copernicus products			
Copernicus Products Capacity		**links/interfaces with EMODnet portals and activities (bathymetry, seabed habitats, chemistry) will be reinforced to get some of their additional data via CMEMS**	**None**
Source (Core Services or Space Component)		MSs / CMEMS	none
Sustainability for Services/SC		Once in the catalogue -> Medium to High	low
COPERNICUS PRODUCT		CMEMS: Discussions are on-going to establish timeline for cooperation on exchange of data like bathymetry and seabed habitats with EMODnet. Physic and Chemistry, the agreement is already in place	
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)		Possibly high resolution passive optical bathymetry in clear waters with CM Group 2b (Optical VHR1/2)	
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

Continue

High level users need 2	**Non-destructive analysis of the underground / underwater positioning of the CH features**	
Users' needs	**5 - Geodetic recording**	**6 - Metal detecting** **(**Not delivered nowadays)
Weight (From 0 to 5)	**1**	**5**
Spatial Resolution (m)	**1-2 cm Vertical**	**7-10 - m**
temporal resolution (dd / M)		**1Y**
Requirements		**Maps of metal anomalies/detection**

Matching with Copernicus products			
Copernicus Products Capacity		**None**	**None**
Source (Core Services or Space Component)		None	Airborne S-L-P (Bands) SAR in dry soils
Sustainability for Services/SC		low	low
COPERNICUS PRODUCT		Collecting requirements and data information via GMS in-situ (EEA) – available in the next months	
Characteristics	Spatial resolution	Depends from MS capacity	
	Update frequency	Depends from MS capacity	
SENSOR TYPE (Sentinel or CM)			
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

END OF HIGH LEVEL USERS NEED 2

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High level users need 3	**Non-destructive analysis of the surface positioning of the CH features**	
Users' needs	**7 - Elevation modelling - Elevation Change** (Available in CORDA)	**8 - Photogrammetric mapping**
Weight (From 0 to 5)	**4**	**4**
Spatial Resolution (m)	**10 - 30m Horiz - 1-10 cm Vert.**	**30cm - 1m**
temporal resolution (dd / M)	**1Y**	**3Y**
Requirements	**Raster elevation - elevation change layer**	**Coverage of High res. Images - Orthophotogrammetry**

Matching with Copernicus products		
Copernicus Products Capacity	**The EEA will continue maintaining the EU-Hydro and EU-DEM reference datasets in the frame of the existing framework service contracts. Maintenance may be reconsidered if an overarching solution would be found for a high resolution high quality DEM as programme level solution, to be made available for multiple purposes, amongst other the ortho-rectification of Sentinel 2 imagery and of CCMs, as well as use by the Copernicus services.** EU-DEM is a digital surface model (DSM) of EEA member and cooperating countries representing the first surface as illuminated by the sensors. It is a hybrid product based on SRTM and ASTER GDEM data fused by a weighted averaging approach.	**MSs in-situ capacity**
Source (Core Services or Space Component)	**CLMS - EUDEM**	**National capacity**
Sustainability for Core Services / Space Component	**high**	**low**
COPERNICUS PRODUCT	Digital Surface Model, based on stereo imagery from Cartosat satellites, whereby the stereo is taken North-South, on the same track when the satellite passes, but one take from a Northern position, and one take from a Southern position. 5m x 5m horizontal resolution, and +/- 1m vertical resolution. It can distinguish	List of available photogrammetric data stored into CIS2

		rather small disturbances in the earth's surface.	
Characteristics	Spatial resolution		Depends from MS capacity
	Update frequency		Depends from MS capacity
SENSOR TYPE (Sentinel or CM)		• SAR: InSAR / DInSAR for elevation / elevation change. Sentinel-1, possibly also CM Group 1 (SAR VHR1-MR1) • Optical photogrammetry (see adjacent)	Possibly CM Group 2b
Characteristics	Spatial resolution	Sentinel-1 IW SLC: around 5m x 20m	
	Spectral resolution		
	Revisit time	Sentinel-1: max 6 days	

Continue

High level users need 3	**Non-destructive analysis of the surface positioning of the CH features**		
Users' needs	**9 - Topographic mapping** (on-demand service)	**10 - Visual identification via imagery**	**11 - Identification of previously searched sites in the area - Monitoring** (It would need a HI-RES approach)
Weight (From 0 to 5)	**5**	**4**	**5**
Spatial Resolution (m)	**1:500 scale** *(Note by SatCen) It depends from the target, Area of interest and user needs.* *The representation scale can be defined with the users depending on specific needs while the data interpretation/extraction usually is done at the best possible scale depending on the EO data)*	**1 m** *(Note by SatCen) Depends on the target and the extension of the AOI. Usually VHR data (<1m) can be used for detailed analysis.*	**1-3 m Horiz. - 1 cm Vert.**
temporal resolution (dd / M)	Every two years	By User request	**6M**
Requirements	**High scale topographic mapping**	**CH feature identification by visual interpretation**	**Identification of previously searched sites in the area Hi-Res.** **Elevation change Optical change detection**

Matching with Copernicus products			
Copernicus Products Capacity	**CEMS and CSS-SEA Only by activation and high scale**	**Only on demand CEMS CSS-SEA small-medium areas**	**On demand CM VHR1 and VHR2 tasking contribution would be of support**

Source (Core Services or Space Component)		**CEMS- CSS**	**Space Component, CEMS, CSS-SEA** ***Sentinels 1,2 VHR1 and VHR2 SAR and Optical CM***	**SatCen** **Sentinels 1,2 VHR1 and VHR2 SAR and Optical CM**
Sustainability for Core Services / Space Component		**High**	**High**	**medium**
COPERNICUS PRODUCT		*SEA products:* • *Digital Geographic Information (DGI) Image Map;* • *Digital Geographic Information (DGI) City Map;* • *MapBook*	*SEA products* • *Quick Report (QR);* • *First Impression Report (FIR);* • *Briefing Note (BN)* • *Geospatial products. Digital* • *Geographic Information (DGI) Image Map;*	*The specific need can be fulfilled or partially fulfilled by the Copernicus SEA portfolio.* *The monitoring of an area for the identification of previously searched sites is possible with HR/VHR data.* *The identification could be confirmed cross checking with collateral information.*
Characteristics	Spatial resolution	Up to VHR1 Very High Resolution (resolution <=1m)	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)	
	Update frequency	According to the user needs (weekly, every 15 days, monthly...)	According to the user needs (weekly, every 15 days, monthly…)	
(SatCen)SENSOR TYPE (Sentinel or CM)		Both depending on the user needs, characteristics of the Area, targets…	Both depending on the user needs, characteristics of the Area, targets…	
(SatCen) Characteristics	Spatial resolution	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m) and from VHR2 to HR 2 over extended areas	
	Spectral resolution	Related to the target, usually 4 band (RGB+NIR)	Related to the target, usually 4 band (RGB+NIR)	

	Revisit time	Depending on the user needs, target...	Depending on the user needs, target….	
(ESA) SENSOR TYPE (Sentinel or CM)		Possibly through VHR optical photogrammetry: CM Group 2b (Optical VHR1/2)	• Sentinel-2 • Possibly CM Group 2b (Optical VHR1/2)	Change detection with VHR optical or SAR, possibly with: • CM Group 1 (SAR VHR1-MR1) • CM Group 2b (Optical VHR1/2)
(ESA) Characteristics	Spatial resolution		S2 10m, CCM less than 1m	
	Spectral resolution		S2 13 bands from VIS to SWIR	
	Revisit time		S2 at most 5 days	

Continue

High level users need 3		**Non-destructive analysis of the surface positioning of the CH features**	
Users' needs		**12 - Rock assay analysis**	**13 - Vegetation levels monitoring - Infesting vegetation** (On demand hi-res imagery may be required for infesting vegetation)	**14 - Tectonic petrography**
Weight (From 0 to 5)		**3**	**5**	**1**
Spatial Resolution (m)		**250 - 500m**	**3 m**	**250 - 500m**
temporal resolution (dd / M)		**20Y**	**3M**	**20Y**
Requirements		**Geologic/stratigraphy Map**	**Vegetation & vegetation change layer, including infesting vegetation**	**Geological Map**

Matching with Copernicus products				
Copernicus Products Capacity		**None**	**High Resolution phenology product over EEA39, following the vegetation cycle in a continuous mode and with yearly updates of intra-seasonal information (10m res)**	**None**
Source (Core Services or Space Component)		**In situ component - EEA / MSs In situ capacity**	**CLMS**	**In situ component - EEA / MSs In situ capacity**
Sustainability for Core Services / Space Component		**Low**	**medium**	**low**
COPERNICUS PRODUCT		National Capacity to be investigated		National Capacity to be investigated
Characteristics	Spatial resolution			
	Update frequency			
SENSOR TYPE (Sentinel or CM)			Possibly CM Group 2b (Optical VHR1/2)	
Characteristics	Spatial resolution			
	Spectral resolution			
	Revisit time			

Continue

High level users need 3	**Non-destructive analysis of the surface positioning of the CH features**		
Users' needs	**15 - Lithology**	**16 - Sea salinity levels measurement** **(**already released)	**17 - 3D reconstruction**
Weight (From 0 to 5)	**1**	**2**	**2**
Spatial Resolution (m)	**250 - 500m**	**10km**	**0,1m**
temporal resolution (dd / M)	**20Y**	**7 - 15 dd**	**/**
Requirements	**Geological Map**	**Sea salinity layer**	**Hi res 3d of ancient buildings**

Matching with Copernicus products				
Copernicus Products Capacity		**None**	**The Copernicus Marine Monitoring Service assimilates earth observation data as well as in-situ data into 4-D models. Main parameters calculated and provided are currents, temperature, salinity, sea level, sea ice waves and biogeochemistry**	**MSs' Downstream services Capacity**
Source (Core Services or Space Component)		**In situ component - EEA / MSs In situ capacity**	**CMEMS**	**none**
Sustainability for Core Services / Space Component		**low**	**high**	**low**
COPERNICUS PRODUCT		National Capacity to be investigated	(CMEMS) 37 products related to Salinity are available in the catalogue, from model output reanalysis, NRT and forecast and observation, from Global to European.	
Characteristics	Spatial resolution		(CMEMS) The spatial resolution only concerns Model output (Reanalysis, forecast and NRT) Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1,5km Iberian Biscay Irish (Atlantic) 2,8km Med Sea 4km Black Sea 3km	
	Update frequency		(CMEMS) Reanalysis (model) and reprocessing (observations) cover the period 1993-2017 and are yearly updated	

			and contains monthly or daily mean. BAL Reanalisys provide also hourly mean Regarding the NRT and forecast products, temporal resolutions are: Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic) : monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : daily-mean, hourly-mean Forecast are generally for 5 to 10 days ahead	
SENSOR TYPE (Sentinel or CM)			(ESA) Future possibility with HPCM CIMR, but probably too low resolution. Secondary objective = Sea Surface Salinity (~40 km)	
Characteristics	Spatial resolution			
	Spectral resolution			
	Revisit time			

END OF HIGH LEVEL USERS NEED 3

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High level users need 4	**Mapping of the cultural landscape of the site and identification of the specific risks it is exposed to**	
Users' needs	**18 - Ground motion monitoring** (Tender published - each 12 months is not enough)	**19 - Mapping of frequentation patterns** (In situ - By mobile monitoring - 5G)
Weight (From 0 to 5)	**5**	**5**
Spatial Resolution (m)	**10m Horiz. - 1 cm Vert.**	**100 - 500 m**
temporal resolution (dd / M)	**4 -6 M**	**real time**
Requirements	**Ground motion layer (Under construction)**	**Real-time Frequentation map**

Matching with Copernicus products			
Copernicus Products Capacity		**EU-GMS will provide ground motion time-series information with full spatial and temporal resolution over land areas of the Copernicus participating states. Ground motion products provided by the Service will be updated every 12 months (TBC).** **More detailed:** **SAR VHR CM (higher spatial/temporal resolution) &** **MSs' downstream services capacity**	**/**
Source (Core Services or Space Component)		**CLMS**	
Sustainability for Core Services / Space Component		**High**	
COPERNICUS PRODUCT			
Characteristics	Spatial resolution		
	Update frequency		
(ESA) SENSOR TYPE (Sentinel or CM)		DInSAR, Sentinel-1	
(ESA) Characteristics	Spatial resolution	If Persistent Scatterers, will be point targets, but Sentinel-1 IW SLC: around 5m x 20m	
	Spectral resolution		
	Revisit time	Sentinel-1: max 6 days	

Continue

High level users need 4	**Mapping of the cultural landscape of the site and identification of the specific risks it is exposed to**		
Users' needs	**20 - Identification of previously searched sites in the area - changes detection** (It would need an HI-RES approach)	**21 - Mapping of surrounding infrastructure (roads, pipelines, waterconducts etc.)** (To be verified if sentinels can help - It would be needed the use of CMs)	**22 - Photogrammetric mapping**
Weight (From 0 to 5)	**3**	**5**	**4**
Spatial Resolution (m)	**1-3 m Horiz. - 1 cm Vert.** **To identify the changes they has to be a minimum size according to the resolution of the satellite imagery**	**1- 5-m H. Res.**	**30cm - 1m**
temporal resolution (dd / M)	**6M**	**1Y**	**3Y**
Requirements	**Identification of previously searched sites in the area** **Hi-Res. Elevation change** **Optical change detection**	**Vector layer of linear element into and surrounding the site (roads, pipelines, waterconducts etc.)**	**Coverage of High res. Images**

Matching with Copernicus products			
Copernicus Products Capacity	**On demand CM tasking contribution would be of support**	**VHR1 and VHR2 Optical CM**	**MSs in-situ capacity**
Source (Core Services or Space Component)	**none**	**Potentially CLMS** **CSS-SEA** The analysis of these type of infrastructures are included in the SEA portfolio, in particular in the following **categories:** **-** Support to evacuation plan	**National capacity**

			- Road network status assessment; - Critical Infrastructure analysis	
Sustainability for Core Services / Space Component		**high**	**High**	**low**
(SatCen) COPERNICUS PRODUCT		The specific need can be fulfilled or partially fulfilled by the Copernicus SEA portfolio. The monitoring of an area for the identification of previously searched sites is possible with HR/VHR data. The identification could be confirmed cross checking with collateral information.	SEA products: • Digital Geographic Information (DGI) – Image Map; • Digital Geographic Information (DGI) – City Map; • MapBook	EEA - List of available photogrammetric data stored into CIS2
(SatCen) Characteristics	Spatial resolution		Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)	EEA - Depends on MS capacity
	Update frequency		According to the user need – weekly, every 15 days, monthly….	EEA - Depends on MS capacity
(ESA) SENSOR TYPE (Sentinel or CM)		Possibly: • CM Group 1 (SAR VHR1-MR1) CM Group 2b (Optical VHR1/2)	Possibly: • CM Group 1 (SAR VHR1-MR1) CM Group 2b (Optical VHR1/2)	Possibly: CM Group 2b (Optical VHR1/2)
(SatCen) Characteristics	Spatial resolution		Up to VHR1, (resolution <=1m, usually 0.5 m) and VHR2 to HR2 over extended areas	
	Spectral resolution		Related to the target, usually 4 band (RGB+NIR)	
	Revisit time			

			Depending on the user needs, target.	

Continue

High level users need 4	**Mapping of the cultural landscape of the site and identification of the specific risks it is exposed to**		
Users' needs	**23 - Topographic mapping**	**24 - Tectonic petrography**	**25 - Visual identification via imagery**
Weight (From 0 to 5)	**5**	**1**	**4**
Spatial Resolution (m)	**1:5000 scale**	**250 - 500m**	1 m
temporal resolution (dd / M)	**1Y**	**20Y**	**Suggestion:continuos of imagery provided**
Requirements	**High scale topographic mapping**	**Geological Map**	**CH feature identification by visual interpretation**

Matching with Copernicus products				
Copernicus Products Capacity		**CEMS and CSS-SEA Only - by activation and big scale**	**MSs in-situ capacity**	**Only on demand CEMS CSS-SEA**
Source (Core Services or Space Component)		**CEMS - CSS-SEA – In-SItu?**	**none**	**Space Component, CEMS, CSS-SEA**
Sustainability for Core Services / Space Component		**High**	**Low**	**High**
(SatCen) COPERNICUS PRODUCT		*SEA products:* • *Digital Geographic Information (DGI) Image Map;* • *Digital Geographic Information (DGI) City Map;* • *MapBook*	EEA: National Capacity to be investigated	*SEA products* • *Quick Report (QR);* • *First Impression Report (FIR);* • *Briefing Note (BN)* • *Geospatial products. Digital Geographic Information (DGI) Image Map;*
(SatCen) Characteristics	Spatial resolution	Up to VHR1 Very High Resolution (resolution <=1m)		Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)
	Update frequency	According to the user needs (weekly, every 15 days, monthly...)		According to the user needs (weekly, every 15 days, monthly…)
(SatCen) SENSOR TYPE (Sentinel or CM)		Both depending on the user needs,		Both depending on the user needs,

		characteristics of the Area, targets…		characteristics of the Area, targets…
(SatCen) Characteristics	Spatial resolution	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)		Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m) and from VHR2 to HR 2 over extended areas
	Spectral resolution	Related to the target, usually 4 band (RGB+NIR)		Related to the target, usually 4 band (RGB+NIR)
	Revisit time	Depending on the user needs, target...		Depending on the user needs, target….
(ESA) SENSOR TYPE (Sentinel or CM)		• Optical photogrammetry: possibly CM Group 2 (Optical HR1/2) • SAR DEM products: Possibly CM Group 1 (SAR VHR1-MR1)		• Sentinel-2 • Possibly CM Groups 1 & 2
(ESA) Characteristics	Spatial resolution			Sentinel-2: up to 10m
	Spectral resolution			
	Revisit time			Sentinel-2: at most 5 days
(EEA) COPERNICUS PRODUCT		National and local topographic maps at large scales - Vector dataset (Identified Providers: Austria Belgium Bulgaria Croatia Cyprus Czech Republic Denmark Estonia Finland France Germany Greece Hungary Ireland Italy Latvia Lithuania Luxembourg Malta Netherlands Poland Portugal Romania Slovakia Slovenia Spain Sweden United Kingdom)		
(EEA) Characteristics	Spatial resolution	1:5,000 to 1:25,000		
	Update frequency	Irregular		

END OF HIGH LEVEL USERS NEED 4

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High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**26 - Air pollution monitoring** **(**In situ measure as main source to be integrated with CAMS products - today 0,1 degree resolution - about 11km) Intermediate national monitoring layers would be needed for the target resolution)	**27 - Atmospheric Humidity measurement** (In situ measure as main source to be integrated with CAMS products (today 0,1 degree resolution - about 11km)
Weight (From 0 to 5)	**4**	**4**
Spatial Resolution (m)	**1-5 km**	**5 km**
temporal resolution (dd / M)	**1d**	**1d**
Requirements	**Pollutant Concentration map / model - NO2 – NO - SO2 - O3 – PM10-2.5**	**Atmospheric Relative Humidity layer**

Matching with Copernicus products		
Copernicus Products Capacity	**By monitoring atmospheric composition, the Atmosphere Monitoring Service supports applications in the domains of air quality, climate forcing, ultraviolet radiation, and solar energy** **In-situ: In parallel, EEA will ensure operational provision of up-to-date air quality data through the established Eionet core data flow.**	**C3S components will permit to derive climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, warming up of the ocean) and climate indices (e.g., based on records of temperature, precipitation, drought event)**
Source (Core Services or Space Component)	**CAMS**	**CAMS & C3S**
Sustainability for Core Services / Space Component	**Low (potentially higher than low)**	**Medium-high**
(ECMWF) COPERNICUS PRODUCT	Suitability may be higher than low as simple methodology exist for downscaling the CAMS products to match local condition (application potential to all those cases where there is no source at a local level).	It would be important to specify the timeliness requirements as ERA5t and ERA5Landt could ERA5Land datasets is at 9 km – ED. Following the recent release of ECMWF's ERA5 climate reanalysis from 1979 onwards, the release of the first subset of ERA5-Land data covering the period 2001 to 2018 is planned for this spring. The dataset will be updated in a

			timely manner together with ERA5 updates. Like ERA5, ERA5-Land is being produced by ECMWF as part of implementing the EU-funded Copernicus Climate Change Service (C3S). This is the first time that a global land surface dataset describing the **water and energy cycles** and spanning nearly two decades will be available at a grid spacing of 9 km and hourly temporal frequency. The main features of this new dataset compared to previous reanalyses and ERA5 are shown in the table. (REANALISYS PRODUCT)provide the required parameters
(ECMWF) Characteristics	Spatial resolution		9 km
	Update frequency		hourly
SENSOR TYPE (Sentinel or CM)		Sentinel-5P to monitor e.g. NO2, SO2, O3 and aerosols	Sentinel-3 OLCI derived water vapour
(ESA) Characteristics	Spatial resolution	S5-P TROPOMI: around 7 km	Around 300 m
	Spectral resolution	S5-P TROPOMI: 7 bands, from 270 to 2385 nm, spectral resolution from 0.25 to 0.55 nm.	From bands Oa18 (885 nm), Oa19 (900 nm)
	Revisit time	S5-P: Daily global coverage	Max 2 days

Continue

High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**28 - Coastal erosion monitoring (under and above the sea)** *(Note by CMEMS: From my understanding, coastal vulnerability may be part of the next DA, therefore no plans for the time being. Cfr coastal roadmap)*	**29 - Evolution of vegetation typology monitoring** (HI-RES layers available)
Weight (From 0 to 5)	**4**	**4**
Spatial Resolution (m)	**1-5m H. res. / 1cm V. res.**	**5 - 10m**
temporal resolution (dd / M)	**3M**	**6M**
Requirements	**Erosion trends map - Sedimentary ballance / Bathimetry**	**Vegetation & vegetation change layer, including infesting vegetation**

Matching with Copernicus products			
Copernicus Products Capacity		**The Coastal Zone (CZ) monitoring product, providing LC/LU information in VHR on a 10 km wide coastal strip, with a dedicated nomenclature taking stock of the specific habitats along the coastline and the vulnerability of the coast ecosystems. This product is being implemented in close cooperation with the Copernicus Marine Environment Monitoring Service.** *(Note by CMEMS)* *CMEMS and CLMS established a roadmap for cooperation to better address coastal needs. Some products will be soon available, other will be make available in the next MFF*	**High Resolution phenology product over EEA39, following the vegetation cycle in a continuous mode and with yearly updates of intra-seasonal information (10m res)** **See High Level User need 1. Within CLMS Global Component S2GM product exists now, thematic products will come through Copernicus Evolution in next MFF – Global Coverage, 20m resolution multiple temporal composites.**
Source (Core Services or Space Component)		**none**	**CLMS**
Sustainability for Core Services / Space Component		**Next MFF (after 2021)**	**high**
COPERNICUS PRODUCT			
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)			Sentinel-2
Characteristics	Spatial resolution		up to 10m
	Spectral resolution		13 bands from VIS to SWIR
	Revisit time		at most 5 days

Continue

High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**30 - Vegetation levels monitoring - Infesting vegetation** (Routinely potential)	**31 - Ice cover monitoring (sea)/Snow cover monitoring (land)** (0.05 degree x 0.05 degree (Surface only) Seaward - 500m resolution inland)
Weight (From 0 to 5)	**5**	**2**
Spatial Resolution (m)	**5 - 10 m**	**1 km inland**
temporal resolution (dd / M)	**6M**	**6M**
Requirements	**Vegetation & vegetation change layer, including infesting vegetation**	**Sea Ice & snow cover layer**

Matching with Copernicus products		
Copernicus Products Capacity	**High Resolution phenology product over EEA39, following the vegetation cycle in a continuous mode and with yearly updates of intra-seasonal information (10m res)**	**The global component of the CLMS is providing daily snow cover product at 1 km resolution on Europe based on data from the MODIS instruments and soon on Sentinel 3 data. Several other services mostly on hemispherical level and up, also deliver very valid data, and from these experiences it can be derived that the step to a Pan-European level becomes feasible in the Sentinel high resolution era.** **Global component of CLMS also providing lake ice coverage for all Northern European lakes, at 250m resolution within 1 day of accuisition** **The CMEMS ocean models provides 3D physical ocean products including sea ice parameters such as thickness, ice velocity, concentration, edge, drift, iceberg and snow Satellite abservations are also available.are available.**
Source (Core Services or Space Component)	**CLMS**	**CMEMS-CLMS –C3S**
Sustainability for Core Services / Space Component	**high**	**high**

COPERNICUS PRODUCT			CLMS-Global: Lake Ice Extent (LIE) classifies ice for freshwater bodies, per cloud-free pixel, into Fully snow covered ice Partially snow covered ice/clear ice Open water C3S: For glaciers the update is annual: https://cds.climate.copernicus.eu/cdsapp#!/dataset/insitu-glaciers-elevation-mass?tab=overview but it is difficult to define a resolution as they are provided as shapefiles with attributes linked to their mass balance and elevation. For sea-ice the update is monthly and the resolution depends on the specific parameter you are interested in (12.5 or 25 km) for sea-ice concentration and thinckness respectively https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-sea-ice?tab=overview CMEMS - 26 products related to Sea Ice are available in the catalogue, from model output reanalysis, NRT and forecast and satellite observations, from Global to European.
Characteristics	Spatial resolution		CLMS Global Lake Ice : 250m CMEMS: Global 8km Arctic 12.5km Baltic 2km
	Update frequency		Lake Ice coverage C3S: Annual CMEMS: Reanalysis (model) and reprocessing (observations) cover the period 1993-2017 and are yearly updated and contains monthly or daily mean. BAL Reanalisys provide also hourly mean Regarding the NRT and forecast products, temporal resolutions are:

			Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean Forecast are generally for 5 to 10 days ahead
SENSOR TYPE (Sentinel or CM)			Sea Ice CMEMS products from Sentinel 3 covering Global, Arctic & Baltic sea : Near Real Time of Sea ice fraction, sea ice displacement, sea ice thickness at and sea ice edge in Antarctic, from 2016 EUMETSAT Sentinel-3 products serving as an input to the CMEMS products
Characteristics	Spatial resolution		Norther European Lakes 250m Global : 10km Arctic 1km Baltic: 0.5km Antarctic: 1km
	Spectral resolution		
	Revisit time		
(ESA) SENSOR TYPE (Sentinel or CM)		Sentinel-2	Can be derived from: Sentinel-1 Sentinel-2 Sentinel-3: OLCI, SLSTR and SRAL Possibly future HPCM P-ICE
(ESA) Characteristics	Spatial resolution	up to 10m	Sentinel-1 IW GRD: 20m Sentinel-2: up to 10m Sentinel-3: various
	Spectral resolution	13 bands from VIS to SWIR	Various microwave and optical
	Revisit time	at most 5 days	Sentinel-1: max 6 days Sentinel-2: max 5 days Sentinel-3: various

Continue

High level users need 5	Monitoring of the evolution of the natural environment of the CH site	
Users' needs	**32 - Insolation monitoring**	**33 - Rainfall erosivity monitoring** (European Soil Data Centre (ESDAC) JRC - Soil erosion by water dataset)
Weight (From 0 to 5)	**3**	**3**
Spatial Resolution (m)	**10 km**	**100 m Horiz.**
temporal resolution (dd / M)	**1d**	**5 year**
Requirements	**3 hourly / Daily solar radiation layer**	**Soil erosion & rainfall erosivity monitoring**

Matching with Copernicus products			
Copernicus Products Capacity		**By monitoring atmospheric composition, the Atmosphere Monitoring Service supports applications in the domains of air quality, climate forcing, ultraviolet radiation, and solar energy with special focus on the Union regions**	**Not erogated by copernicus**
Source (Core Services or Space Component)		**CAMS**	**none**
Sustainability for Core Services / Space Component		**high**	**To be verified**
COPERNICUS PRODUCT		(ECMWF) OK	C3S is currently negotiating a demo case which should be able to provide relevant data for a member state. Should the demonstrator be successful the approach could be generalised.
Characteristics	Spatial resolution		
	Update frequency		
(ESA) SENSOR TYPE (Sentinel or CM)		Thermal radiation: Sentinel-3 SLSTR Possible future HPCM LSTM	
(ESA) Characteristics	Spatial resolution	S3 SLSTR MWIR and TIR bands 1km	
	Spectral resolution	S3 SLSTR MWIR and TIR bands (3742 to 12022.5 nm)	
	Revisit time	S3 SLSTR: 1-4 days	

Continue

High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**34 - Sea salinity levels measurement** (Service released)	**35 - Sediment levels measurement** (Bathimetry could help as in situ data to be asked to MSs in its capacity) (Note by CMEMS: We have use case where CMEMS data are used for dredging of sediment – maybe it could useful to pin point the use case and consider it as downstream service? http://marine.copernicus.eu/usecases/monitoring-sediment-plumes-dredging-operations/)
Weight (From 0 to 5)	**2**	**4**
Spatial Resolution (m)	**10km**	**5m Horiz. 1cm Vert.**
temporal resolution (dd / M)	**7 - 15 dd**	**3M**
Requirements	**Sea salinity layer**	**Sedimentary ballance / Coastal Bathimetry**

Matching with Copernicus products			
Copernicus Products Capacity		**The Copernicus Marine Monitoring Service assimilates earth observation data as well as in-situ data into 4-D models. Main parameters calculated and provided are currents, temperature, salinity, sea level, sea ice and biogeochemistry**	**links/interfaces with EMODnet portals and activities (bathymetry, seabed habitats, chemistry)**
Source (Core Services or Space Component)		**CMEMS-C3S**	**none**
Sustainability for Core Services / Space Component		**High**	**To be verified**
COPERNICUS PRODUCT		*ECMWF –we do indeed have daily value of salinity at 0.1 degree from the fisheries contract we have with Plymouth Marine Laboratories* (CMEMS) 37 products related to Salinity are available in the catalogue, from model output reanalysis, NRT and forecast and observation, from Global to European	
Characteristics	Spatial resolution	(CMEMS) The spatial resolution only concerns Model output (Reanalysis, forecast and NRT)	

		Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1,5km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3km	
	Update frequency	(CMEMS) Reanalysis (model) and reprocessing (observations) cover the period 1993-2017 and are yearly updated and contain monthly or daily mean. IBI and BAL provide also hourly mean. Regarding the NRT and forecast products, temporal resolutions are: Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic) : monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : daily-mean, hourly-mean Forecast are generally for 5 to 10 days ahead	
(ESA) SENSOR TYPE (Sentinel or CM)		Possibly future HPCM CIMR (Copernicus Imaging Microwave Radiometer): secondary objective to measure Sea Surface Salinity (but to approx. 40 km resolution)	Possible optical bathymetry with CM Group 2b (Optical VHR1/2)
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

Continue

High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**36 - Analysis of soil distribution and composition**	**37 - Water current monitoring** (4 km resolution product released)
Weight (From 0 to 5)	**3**	**3**
Spatial Resolution (m)	**500m H. res**	**5 km**
temporal resolution (dd / M)		**daily**
Requirements	**Soil distribution map**	**Sea & ocean current layer**

Matching with Copernicus products			
Copernicus Products Capacity		**MSs in-situ capacity**	**The Copernicus Marine Monitoring Service assimilates earth observation data as well as in-situ data into 4-D models. Main parameters calculated and provided are currents, temperature, salinity, sea level, sea ice and biogeochemistry**
Source (Core Services or Space Component)		**none**	**CMEMS**
Sustainability for Core Services / Space Component		**low**	**High**
(CMEMS) COPERNICUS PRODUCT		EEA: Harmonized World Soil Database (FAO) http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/	Currenty Velocity: 39 products (model &obs) covering Global and EU water, NRT, forecasts and Reanalysis.
(CMEMS) Characteristics	Spatial resolution	1:5.000.00	Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1.5km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3km
	Update frequency	Irregular	Reanalysis cover the period 1993-2017, are yearly updated and contain daily and monthly mean, and also hourly mean for BALTIC & IBI models. Regarding the NRT and forecast products, temporal resolutions are Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean

			North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic): monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : monthly-mean, daily-mean Forecast are generally for 5 to 10 days ahead IN SITU Observations (instantaneous): Current velocity: 7 insitu CMEMS products covering Global and EU water, NRT from 2010
SENSOR TYPE (Sentinel or CM)		Possibly future HPCM CIMR (Copernicus Imaging Microwave Radiometer): secondary objective to measure Sea Surface Salinity (but to approx. 40 km resolution)	Possible optical bathymetry with CM Group 2b (Optical VHR1/2)
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

Continue

High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**38 - Water pollution monitoring (also coastal waters)** (EOMORES project provides showcases using sentinels in coastal areas)	**39 - Water quality monitoring** (turbidity, trophic state, apparent colour of big lakes by **CLMS Global**)
Weight (From 0 to 5)	**4**	**3**
Spatial Resolution (m)	**10 m**	**100-300m**
temporal resolution (dd / M)	**4 days**	**daily**
Requirements	**Oil spill identification**	**Inland Water quality information on turbidity, trophic state/Chlorophyll, apparent color and illegal abstraction**

Matching with Copernicus products		
Copernicus Products Capacity	**Maritime Surveillance Service - CleanSeaNet service to be activated - EMSA**	**CLMS Global - CLMS Global – Existing products turbidity, trophic state/Chlorophyll for 1000 lakes global will increase over next few years to all lake which can be covered with 100m resolution (within 3 days of acquisition 10 day composites).** **Potential new activities include the development of products designed for cryosphere, raw material, inland water (illegal water abstraction) and support surveillance and environmental inspection.** **- The Coastal Zone (CZ) monitoring product, providing LC/LU information in VHR on a 10 km wide coastal strip, taking stock of the specific habitats along the coastline and the vulnerability of the coast ecosystems.**
Source (Core Services or Space Component)	**CSS - MS**	**CLMS & CMEMS**
Sustainability for Core Services / Space Component	**High - on demand only**	**High potential in the near future**

COPERNICUS PRODUCT	1. About monitoring of evolution of the natural environment of the CH / NH sites, and particularly with the quantification of pollution concentration: a) It is clear that currently, using the satellite capabilities deployed for CSN and CMS, it is not possible to determine the concentration of oil pollution in the water b) In the pollution monitoring context, both services focus on two main activities: i. Routine monitoring of European waters (CSN) or overseas territories of European interest (CMS) for the detection of illegal discharges from ships and offshore platforms, with respective polluter identification. In this activity the detection of the possible pollution is done, but subsequent verification by other means (e.g. aerial surveillance) is required to understand the type of pollutant and associated volumes. The satellite monitoring activity is implemented using Synthetic Aperture Radar (SAR) images from Sentinel-1, Radarsat-2 and TerraSAR-X. This routine process focus on monitoring systematically the areas of interest of Member States. For example, CleanSeaNet	LMS Global: Lake Water Quality Products Global coverage 100&300m resolution -turbidity, trophic state/chlorophyll CMEMS: 52 products contains parameters as Chlorophyll-a, dissolved Oxygen than can be usefull informations to monitor the sea water quality. 14 products related to Nutrients. 13 products are related to Suspended Particle Matter. These products cover Global and EU water: NRT, forecasts and Reanalysis from models and insitu & satellite observations

		(which focus on European Waters) already monitored 500 million Km2 in the first 6 months of 2019. ii. Support to accidental oil spills. In this case the focus in the support to response operations, which include monitoring of the accident area, tracking of the resulting oil spill and assessment of the impact/position of oil in coastal areas. In this case usually there is a combination of SAR images as well as very high resolution optical (to monitor the oil on the beach or in coastal areas). 2) In the future, the addition of other satellite sensors (e.g. hyperspectral) can improve the ability of the existing services to detect both the nature of the pollutant as well as the volume, which can provide a possible contribution to determine pollution concentration. Some research using Sentinel-2 data (multispectral) has shown promising results in what concerns estimation of oil spill volumes derived from these images. Nevertheless, and from a satellite based service perspective, developments are still required before these capabilities can be deployed into operations in a sustainable way.	
Characteristics	Spatial resolution		CLMS Global: Global lakes 100 & 300m resolution The spatial resolution only concerns Model output (Reanalysis, forecast and NRT)

			Global 50km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 7km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3km
	Temporal resolution		CLMS Global: Global Lakes 10 composities Reanalysis cover the period 1993-2017, are yearly updated and contain daily and monthly means, Regarding the NRT and forecast products, temporal resolutions are Global : monthly-mean, daily-mean Arctic : daily-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, Iberian Biscay Irish (Atlantic): monthly-mean, daily-mean Med Sea : monthly-mean, daily-mean Black Sea : daily-mean Forecast are generally for 7 to 10 days ahead (2 for the Baltic sea)
SENSOR TYPE (Sentinel or CM)		Sentinel-2 Sentinel-3 OLCI	Sentinel-2 Sentinel-3 OLCI
Characteristics	Spatial resolution	Up to 10m	Up to 10m
	Spectral resolution		
	Revisit time		

Continue

High level users need 5	**Monitoring of the evolution of the natural environment of the CH site**	
Users' needs	**40 - Wind direction & speed monitoring** (National Meteorologic Services as in situ contribution - CMEMS (0,25 x 0,25 degree, about 2km resolution) - C3S: 10m wind gust & speed anomaly (1 x 1 degree resolution)	**41 - Hydrological changes monitoring** (in-situ national contribution to be taken into account)
Weight (From 0 to 5)	**4**	**4**
Spatial Resolution (m)	**25 km (sea) – 10 km (Land)**	**10-30m (Higher is desired)**
temporal resolution (dd / M)	**daily**	**1Y**
Requirements	**Wind speed & direction layer**	**Hydrological changes & network changes layer**

Matching with Copernicus products		
Copernicus Products Capacity	**improving product consistency (especially of reprocessed time series and reanalyses) and improved quality assessment and the development and delivery of some ocean monitoring indicators...Further improvements on wind, waves and current products, sea ice automated products (answering to EMSA requirements for polar services)**	**CLMS Global: Water Level Products for Lakes and rivers. Water level available 4 days after acquisition global distribution of "stations". Based on multiple altimeters. Lake time-series from 1992 river timeseries from 2002. Global distribution of stations shown here https://land.copernicus.eu/global/sites/cgls.vito.be/files/images/products/wl_comm_201904_fig3.png Most in-situ related - integration with GMS would be of support**
Source (Core Services or Space Component)	**C3S - CMEMS**	**EU-Hydro River Network - CORDA**
Sustainability for Core Services / Space Component	**High**	**Low - medium**
COPERNICUS PRODUCT	C3S and CAMS appear to be more relevant than CMEMS when providing data about surface wind. Once more ERA5, ERA5Land (9 km resolution, hourly) and operational CAMS products may be able to meet the requirements. *ED. Following the recent release of ECMWF's ERA5 climate reanalysis from 1979 onwards, the release of the first subset of ERA5-Land data covering the period 2001 to 2018 is planned for this spring. The dataset will be updated in a timely manner*	CLMS Global: Water Level products for Lakes and Rivers C3S and CAMS provide relevant information about the current, past and future state of hydrological variables. The resolution of these products is typically coarser than the one required in the document though. *NOTE: For Europe we do have datasets at different resolutions but something of the order of 10 km (e.g. https://cds.climate.copernicus.eu/c*

		together with ERA5 updates. Like ERA5, ERA5-Land is being produced by ECMWF as part of implementing the EU-funded Copernicus Climate Change Service (C3S). This is the first time that a global land surface dataset describing the water and energy cycles and spanning nearly two decades will be available at a grid spacing of 9 km and hourly temporal frequency. The main features of this new dataset compared to previous reanalyses and ERA5 are shown in the table. (REANALISYS PRODUCT) *CMEMS:* 5 observation products about Wind are available, all of them at Global scale, both NRT or Reanalysis (1992-2018)	*dsapp#!/dataset/sis-water-quantity-swicca?tab=overview) is not uncommon*.
Characteristics	Spatial resolution	C3S/CAMS 9km CMEMS: Products L4 : 25km Products L3: 12.5Km	CLMS Global: resolution not relevant, based on crosstracks of altimeters. Global cover of stations https://land.copernicus.eu/global/sites/cgls.vito.be/files/images/products/wl_comm_201904_fig3.png
	Update frequency	C3S/CAMS hourly CMEMS: Products NRT: 6-hourly-mean or daily-instantaneous Products Reanalysis: monthly-mean	
(ESA) SENSOR TYPE (Sentinel or CM)		Sentinel-1	Jason, Sentinel-3,
(ESA) Characteristics	Spatial resolution	Various: from 20m, but depends on area (IW, EW or WV modes)	
	Spectral resolution		
	Revisit time	Max 6 days	
COPERNICUS PRODUCT			Possible derivation from riparian at 1:50.000 scale? EU-Hydro: The data model of the EU-Hydro river network consists of seven polygon feature classes, three polyline feature classes and two point feature classes: - point feature classes: Culverts and Nodes; - line feature classes: Canals_l, Ditches_l and River_Net_l; - polygon feature classes: Canals_p, Ditches_p, River_Net_p, InlandWater,

			Transit_p, Coastal_p and RiverBasinsis. EU-Hydro river network has been derived from 20 metres resolution imagery. The feature data extraction has been performed by photointerpretation of Very High Resolution Image Data (2011 - 2013), with resolution of 2.5 meters. Integrated EU-Hydro database (hydrographic and drainage database) is available in geodatabase format and contains: - hydrographic nodes, lines, and polygons; - drainage network elements (basins, catchments, drainage lines and nodes); - dams; - coastlines and land polygons.
Characteristics	Spatial resolution		2.5m maximum
	Update frequency		Irregular

END OF HIGH LEVEL USERS NEED 5

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High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**	
Users' needs	**42 - Air pollution monitoring** (In situ measure as main source to be integrated with CAMS products - today 0,1 degree resolution - about 11km)	**43 - Atmospheric relative Humidity measurement** (In situ measure as main source to be integrated with CAMS products - today 0,1 degree resolution - about 11km)
Weight (From 0 to 5)	**3**	**3**
Spatial Resolution (m)	**10km**	**10km**
temporal resolution (dd / M)	**1d**	**1d**
Requirements	**Pollutant Concentration map / model** **NO2 – NO - SO2 - O3 - PM10-2.5**	**Atmospheric Relative Humidity layer**

Matching with Copernicus products		
Copernicus Products Capacity	**- Atmospheric composition monitoring supports applications air quality, climate forcing, ultraviolet radiation, and solar energy** **- In-situ: In parallel, EEA will ensure operational provision of up-to-date air quality data through the established Eionet core data flow.**	**The C3S components will permit us to derive a number of climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, warming up of the ocean) and climate indices (e.g., based on records of temperature, precipitation, drought event) for both the identified climate drivers and the expected climate impacts.**
Source (Core Services or Space Component)	**CAMS**	**CAMS/C3S**
Sustainability for Core Services / Space Component	**High**	**High**
COPERNICUS PRODUCT	(ECMWF) OK	It should read C3S/CAMS in the source box above. Once more ERA5 land could be suitable. ED. Following the recent release of ECMWF's ERA5 climate reanalysis from 1979 onwards, the release of the first subset of ERA5-Land data covering the period 2001 to 2018 is planned for this spring. The dataset will be updated in a timely manner together with ERA5 updates. Like ERA5, ERA5-Land is being produced by ECMWF as part of implementing the EU-funded Copernicus Climate Change Service

			(C3S). This is the first time that a global land surface dataset describing the water and energy cycles and spanning nearly two decades will be available at a grid spacing of 9 km and hourly temporal frequency. The main features of this new dataset compared to previous reanalyses and ERA5 are shown in the table. (REANALISYS PRODUCT)
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)		Sentinel-5P to monitor e.g. NO2, SO2, O3 and aerosols Future Sentinel-4 and Sentinel-5 products to monitor atmospheric composition	Possibly derived from Sentinel-3, Sentinel-5P, Sentinel-4, Sentinel-5 and meteorological missions (MetOp, MSG, MTG)
Characteristics	Spatial resolution	S5-P TROPOMI: around 7 km Future Sentinel-4 and -5 satellites: resolution depending upon the product	
	Spectral resolution	S5-P TROPOMI: 7 bands, from 270 to 2385 nm, spectral resolution from 0.25 to 0.55 nm.	
	Revisit time	S5-P: Daily global coverage Sentinel-4: hourly Sentinel-5: daily	

Continue

High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**	
Users' needs	**44 - Coastal erosion monitoring (under and above the sea)** (New service on coastal monitoring is wished by MSs. Today it falls into insitu requirement - CMs would help)	**45 - Evolution of vegetation typology monitoring** (HI-RES layers available)
Weight (From 0 to 5)	**4**	**4**
Spatial Resolution (m)	**1-5m H. res. / 1cm V. res.**	**5 - 10m**
temporal resolution (dd / M)	**3M**	**6M**
Requirements	**Erosion trends map - Sedimentary ballance / Bathimetry**	**Vegetation & vegetation change layer, including infesting vegetation**

Matching with Copernicus products			
Copernicus Products Capacity		**The Coastal Zone (CZ) monitoring product, providing LC/LU information in VHR on a 10 km wide coastal strip, with a dedicated nomenclature taking stock of the specific habitats along the coastline and the vulnerability of the coast ecosystems. This product is being implemented in close cooperation with the Copernicus Marine Environment Monitoring Service.**	**CLMS Global: Global dynamic Land cover product and CLMS Hotspot Activity for Land Cover Change. See also comment under High Level User Requirement 1 on plans for future evolution and S2GM existing capability at 20m resolution globally.** **High Resolution phenology product over EEA39, following the vegetation cycle in a continuous mode and with yearly updates of intra-seasonal information (10m res)**
Source (Core Services or Space Component)		**none**	**CLMS**
Sustainability for Core Services / Space Component		**not in the short term**	**high**
COPERNICUS PRODUCT			
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)			Sentinel-2
Characteristics	Spatial resolution		up to 10m
	Spectral resolution		13 bands from VIS to SWIR
	Revisit time		at most 5 days

Continue

High level users need 6	Monitoring of the evolution of the natural environment of the NH site	
Users' needs	**46 - Forest coverage monitoring**	**47 - Vegetation levels monitoring - Infesting vegetation**
Weight (From 0 to 5)	**3**	**4**
Spatial Resolution (m)	**10m**	**10m**
temporal resolution (dd / M)	**1Y**	**1Y**
Requirements	**Forest/Tree coverage layer**	**Vegetation & vegetation change layer, including infesting vegetation**

Matching with Copernicus products			
Copernicus Products Capacity		**A set of High Resolution Layers (imperviousness, forest (tree cover density, forest type), grassland, wetness and water and small woody features). These HRLs provide complementary thematic content, i.e. characteristics of 5 land cover classes, but with a finer spatial resolution of 1 ha versus 25 ha for the CLC; (time series (2006-2009 (imperviousness only))-2012-2015-2018 following a 3-yearly update cycle and synchronised with CLC);**	**High Resolution phenology product over EEA39, following the vegetation cycle in a continuous mode and with yearly updates of intra-seasonal information (10m res)**
Source (Core Services or Space Component)		**CLMS**	**CLMS**
Sustainability for Core Services / Space Component		**High**	**High**
COPERNICUS PRODUCT			
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)			Sentinel-2
Characteristics	Spatial resolution		up to 10m
	Spectral resolution		13 bands from VIS to SWIR
	Revisit time		at most 5 days

Continue

High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**	
Users' needs	**48 - Ice cover monitoring (sea)/Snow /ice cover monitoring (land)** (0.05 degree x 0.05 degree (Surface only about 5 km) seaside 500m resolution inland)	**49 - Lithology**
Weight (From 0 to 5)	**2**	**1**
Spatial Resolution (m)	**10 km at sea - 1 km inland**	**250 - 500m**
temporal resolution (dd / M)	**6M**	**20Y**
Requirements	**Map of Sea Ice & snow cover**	**Geological Map**

Matching with Copernicus products		
Copernicus Products Capacity	**The global component of the CLMS is providing daily snow cover product at 1 km resolution on Europe based on data from the MODIS instruments and soon on Sentinel 3 data. Several other services mostly on hemispherical level and up, also deliver very valid data, and from these experiences it can be derived that the step to a Pan-European level becomes feasible in the Sentinel high resolution era.** ***Note by CMEMS:*** *The CMEMS ocean models provide 3D physical ocean products including sea ice parameters such as ice-thickness, ice velocity, ice-concentration, edge, drift, iceberg and snow Satellite observations are also available..*	**MSs in-situ capacity**
Source (Core Services or Space Component)	**CMEMS-CLMS**	**none**
Sustainability for Core Services / Space Component	**High potential**	**none**
COPERNICUS PRODUCT	C3S can provide relevant information for sea ice and glaciers C3S: For glaciers the update is annual: https://cds.climate.copernicus.eu/cdsapp#!/dataset/insitu-glaciers-elevation-mass?tab=overview but it is difficult to define a resolution as they are provided as shapefiles with	National Capacity to be investigated

		attributes linked to their mass balance and elevation For sea-ice the update is monthly and the resolution depends on the specific parameter you are interested in (12.5 or 25 km) for sea-ice concentration and thinckness respectively https://cds.climate.copernicus.eu/cdsapp#!/dataset/satellite-sea-ice?tab=overview CMEMS: 26 products related to Sea Ice are available in the catalogue, from model output reanalysis, NRT and forecast and satellite observations, from Global to EuropeanCMEMS:	
Characteristics	Spatial resolution	Global 8km Arctic 12.5km Baltic 2km	
	Update frequency	**CMEMS -** Reanalysis (model) and reprocessing (observations) cover the period 1993-2017 and are yearly updated and contains monthly or daily mean. BAL Reanalisys provide also hourly mean Regarding the NRT and forecast products, temporal resolutions are: Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean Forecast are generally for 5 to 10 days ahead	
(CMEMS) SENSOR TYPE (Sentinel or CM)		Sea Ice CMEMS products from Sentinel 3 covering Global, Arctic & Baltic sea : Near Real Time of Sea ice fraction, sea ice displacement, sea ice thickness at and sea ice edge in Antarctic, from 2016	
(CMEMS) Characteristics	Spatial resolution	Global : 10km Arctic 1km Baltic: 0.5km Antarctic: 1km	
	Spectral resolution		
	Revisit time		

(ESA) SENSOR TYPE (Sentinel or CM)		Sentinel-1 and Sentinel-2 derived	
(ESA) Characteristics	Spatial resolution	Sentinel-1 IW GRD: 20m Sentinel-2: up to 10m	
	Spectral resolution	Sentinel-1: active microwave Sentinel-2: 13 bands from VIS to SWIR	
	Revisit time	Sentinel-1: at most 6 days Sentinel-2: at most 5 days	

Continue

High level users need 6	Monitoring of the evolution of the natural environment of the NH site	
Users' needs	**50 - Rock assay analysis**	**51 - Normalized difference vegetation index (NDVI)**
Weight (From 0 to 5)	**1**	**4**
Spatial Resolution (m)	**250 - 500m**	**5 - 10m**
temporal resolution (dd / M)	**20Y**	**2weeks late winter/early summer 3M the rest of the year**
Requirements	**Geologic/stratigraphy Map**	**NDVI layer**

Matching with Copernicus products			
Copernicus Products Capacity		**MSs in-situ capacity**	**CLMS including Global (see High level User Need 1) - More emphasis will continue to be put on the bio-geophysical parameters which are being used as a baseline for the HRL production; In the same context, the S2 data now allow for the production of a high resolution phenology service product, which exploits the high acquisition frequency and spectral richness of S2, which radically changed the possibilities to generate highly relevant and accurate phenology data. Proper processing of Sentinel-2 data allows the generation of daily HR vegetation index trajectories as well as parameters that summarize the growing seasons as well as biological productivity during the seasons.**
Source (Core Services or Space Component)		**none**	**CLMS**
Sustainability for Core Services / Space Component		**none**	**High**
COPERNICUS PRODUCT		National Capacity to be investigated	
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)			Sentinel-2
Characteristics	Spatial resolution		up to 10m
	Spectral resolution		13 bands from VIS to SWIR
	Revisit time		at most 5 days

Continue

High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**	
Users' needs	**52 - Rainfall erosivity monitoring** (European Soil Data Centre (ESDAC) JRC - Soil erosion by water dataset)	**53 - Sea salinity levels measurement** (Already released)
Weight (From 0 to 5)	**3**	**2**
Spatial Resolution (m)	**100m Horiz.**	**10km**
temporal resolution (dd / M)	**5 years**	**7 - 15 dd**
Requirements	**Soil erosion & rainfall erosivity monitoring**	**Sea salinity layer**

Matching with Copernicus products			
Copernicus Products Capacity		**High potential for a 10m resolution layer**	**The Copernicus Marine Monitoring Service assimilates earth observation data as well as in-situ data into 4-D models. Main parameters calculated and provided are currents, temperature, salinity, sea level, sea ice and biogeochemistry**
Source (Core Services or Space Component)		**none**	**CMEMS**
Sustainability for Core Services / Space Component		**To be verified**	**High**
COPERNICUS PRODUCT		C3S is currently negotiating a demo case which should be able to provide relevant data for a member state. Should the demonstrator be successful the approach could be generalised.	37 products related to Salinity are available in the catalogue, from model output reanalysis, NRT and forecast and observation, from Global to European.
Characteristics	Spatial resolution		The spatial resolution only concerns Model output (Reanalysis, forecast and NRT) Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1,5km Iberian Biscay Irish (Atlantic) 2,8km Med Sea 4km Black Sea 3km
	Temporal resolution		Reanalysis (model) and reprocessing (observations) cover the period 1993-2017 and are yearly updated and contain monthly or daily mean. IBI and BAL provide also hourly mean.

			Regarding the NRT and forecast products, temporal resolutions are: Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic) : monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : daily-mean, hourly-mean Forecast are generally for 5 to 10 days ahead
SENSOR TYPE (Sentinel or CM)			Possibly future HPCM CIMR (Copernicus Imaging Microwave Radiometer): secondary objective to measure Sea Surface Salinity (but to approx. 40 km resolution)
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

Continue

High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**	
Users' needs	**54 - Sediment levels measurement** (Bathimetry could help as in situ data to be asked to MSs in its capacity)	**55 - Analysis of soil distribution and composition**
Weight (From 0 to 5)	**3**	**3**
Spatial Resolution (m)	**5m Horiz. 1cm Vert.**	**500m H. res**
temporal resolution (dd / M)	**3M**	**una tantum**
Requirements	**Sedimentary ballance / Coastal Bathimetry**	**Soil distribution map**

Matching with Copernicus products			
Copernicus Products Capacity		**links/interfaces with EMODnet portals and activities (bathymetry, seabed habitats, chemistry)**	**MSs in-situ capacity**
Source (Core Services or Space Component)		**none**	**none**
Sustainability for Core Services / Space Component		**low**	**low**
COPERNICUS PRODUCT			EEA: Harmonized World Soil Database (FAO) http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/
Characteristics	Spatial resolution		1:5.000.000
	Update frequency		Irregular
SENSOR TYPE (Sentinel or CM)			
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

Continue

High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**	
Users' needs	**56 - Water current monitoring** (4 km resolution product)	**57 - Water pollution monitoring (also coastal water)** (EOMORES project provides showcases using sentinels in coastal areas)
Weight (From 0 to 5)	**3**	**4**
Spatial Resolution (m)	**5 km**	**10m**
temporal resolution (dd / M)	**daily**	**4 days**
Requirements	**Sea & ocean current layer**	**Pollution typology map**

Matching with Copernicus products		
Copernicus Products Capacity	**The Copernicus Marine Monitoring Service assimilates earth observation data as well as in-situ data into 4-D models. Main parameters calculated and provided are currents, temperature, salinity, sea level, sea ice and biogeochemistry**	**CLMS Global: see Water Quality products above. Also Lake Surface Water Temperature at 1km resolution.** **Maritime Surveillance Service - CleanSeaNet service to be activated - EMSA**
Source (Core Services or Space Component)	**CMEMS**	**CSS - MS**
Sustainability for Core Services / Space Component	**High**	**High - on demand only**
COPERNICUS PRODUCT	Current Velocity: 39 products (model &obs) covering Global and EU water, NRT, forecasts and Reanalysis.	2. About monitoring of evolution of the natural environment of the CH / NH sites, and particularly with the quantification of pollution concentration: a) It is clear that currently, using the satellite capabilities deployed for CSN and CMS, it is not possible to determine the concentration of oil pollution in the water b) In the pollution monitoring context, both services focus on two main activities:

		i. Routine monitoring of European waters (CSN) or overseas territories of European interest (CMS) for the detection of illegal discharges from ships and offshore platforms, with respective polluter identification. In this activity the detection of the possible pollution is done, but subsequent verification by other means (e.g. aerial surveillance) is required to understand the type of pollutant and associated volumes. The satellite monitoring activity is implemented using Synthetic Aperture Radar (SAR) images from Sentinel-1, Radarsat-2 and TerraSAR-X. This routine process focus on monitoring systematically the areas of interest of Member States. For example, CleanSeaNet (which focus on European Waters) already monitored 500 million Km2 in the first 6 months of 2019. ii. Support to accidental oil spills. In this case the focus in the support to response operations, which include monitoring of the accident area, tracking of the resulting oil spill and assessment of the impact/position of oil in coastal areas. In this case usually there is a combination of SAR images as well as very high resolution optical (to monitor the oil on the beach or in coastal areas). 2) In the future, the addition of other satellite sensors (e.g.

			hyperspectral) can improve the ability of the existing services to detect both the nature of the pollutant as well as the volume, which can provide a possible contribution to determine pollution concentration. Some research using Sentinel-2 data (multispectral) has shown promising results in what concerns estimation of oil spill volumes derived from these images. Nevertheless, and from a satellite based service perspective, developments are still required before these capabilities can be deployed into operations in a sustainable way.
Characteristics	Spatial resolution	The spatial resolution only concerns Model output (Reanalysis, forecast and NRT) Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1.5km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3kmReanalysis cover the period 1993-2017, are yearly updated and contain daily and monthly mean, and also hourly mean for BALTIC & IBI models.	
	Update frequency	Regarding the NRT and forecast products, temporal resolutions are Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic): monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : monthly-mean, daily-mean Forecast are generally for 5 to 10 days ahead InSitu Observations (Instantaneous): Current velocity: 7 INSITU CMEMS products covering Global and EU water, NRT from 2010	

SENSOR TYPE (Sentinel or CM)		Sentinel-1 (derived from SAR roughness) Sentinel-3 (derived from SST, SSH) Jason-3 and future Sentinel-6 products	Derived from: Sentinel-2 Sentinel-3 OLCI
Characteristics	Spatial resolution		
	Spectral resolution		
	Revisit time		

Continue

High level users need 6	Monitoring of the evolution of the natural environment of the NH site	
Users' needs	**58 - Water quality monitoring** (turbidity, trophic state, apparent colour of big lakes by CLMS Global)	**59 - Water level monitoring** (From 0.42 x 0.42 degree to 7 x 7 km res. Observation and reanalysis)
Weight (From 0 to 5)	**3**	**2**
Spatial Resolution (m)	**100 - 300 m**	**(500 M INLAND - 10KM SEAWARD km -**
temporal resolution (dd / M)	**daily**	**daily**
Requirements	**Inland Water quality information on turbidity, trophic state/Chlorophyll, apparent color and illegal abstraction**	**Sea level layer**

Matching with Copernicus products		
Copernicus Products Capacity	**- Potential new activities include the development of products designed for cryosphere, raw material, inland water (illegal water abstraction) and support surveillance and environmental inspection.** **- The Coastal Zone (CZ) monitoring product, providing LC/LU information in VHR on a 10 km wide coastal strip, taking stock of the specific habitats along the coastline and the vulnerability of the coast ecosystems.**	**CLMS Global: Water Level Products for Lakes and rivers. Water level available 4 days after acquisition global distribution of "stations". Based on multiple altimeters. Lake time-series from 1992 river timeseries from 2002. Global distribution of stations shown here https://land.copernicus.eu/global/sites/cgls.vito.be/files/images/products/wl_comm_201904_fig3.png** **The Copernicus Marine Monitoring Service assimilates earth observation data as well as in-situ data into 4-D models. Main parameters calculated and provided are currents, temperature, salinity, sea level, sea ice and biogeochemistry.**
Source (Core Services or Space Component)	**CLMS & CMEMS**	**CMEMS**
Sustainability for Core Services / Space Component	**High potential in the near future**	**High**
COPERNICUS PRODUCT	52 products contains parameters as Chlorophyll-a, dissolved Oxygen than can be usefull information to monitor the sea water quality. 14 products related	52 products of Sea Surface Height (model & obs) covering Global and EU water, NRT, forecasts and Reanalysis. The Ocean Monitoring Indicators also provide information on the

		to Nutrients. 13 products are related to Suspended Particle Matter. These products cover Global and EU water: NRT, forecasts and Reanalysis from models and insitu & satellite observations	trend of Sea Level from 1993 to today. For the time being there is only the global trend but regional will be soon provided (http://marine.copernicus.eu/science-learning/ocean-monitoring-indicators/catalogue/)
Characteristics	Spatial resolution	The spatial resolution only concerns Model output (Reanalysis, forecast and NRT) Global 50km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 7km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3km	The spatial resolution only concerns Model output (Reanalysis, forecast and NRT) Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1.5km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3km
	Temporal resolution	Reanalysis cover the period 1993-2017, are yearly updated and contain daily and monthly means, Regarding the NRT and forecast products, temporal resolutions are Global : monthly-mean, daily-mean Arctic : daily-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, Iberian Biscay Irish (Atlantic): monthly-mean, daily-mean Med Sea : monthly-mean, daily-mean Black Sea : daily-mean Forecast are generally for 7 to 10 days ahead (2 for the Baltic sea)	Reanalysis cover the period 1993-2017, are yearly updated and contain daily and monthly means, and also hourly mean for BALTIC & IBI models. Regarding the NRT and forecast products, temporal resolutions are Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic): monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : monthly-mean, daily-mean Forecast are generally for 5 to 10 days ahead
SENSOR TYPE (Sentinel or CM)		(ESA) Derived from: Sentinel-2 Sentinel-3 OLCI	Sea Surface Height: 19 satellite CMEMS products covering Global and EU water, NRT & Reprocessing included S3 A/B products (ESA) Sentinel-3 SRAL and possibly other altimetry

Characteristics	Spatial resolution		From 7 to 15km
	Spectral resolution		
	Revisit time		1993-2018
INSITU observations			7 INSITU CMEMS products covering Global and EU water, NRT from 2010
Characteristics	Spatial resolution		Instantaneous
	Spectral resolution		
	Revisit time		

Continue

High level users need 6	**Monitoring of the evolution of the natural environment of the NH site**		
Users' needs	**60 - Hydrological changes monitoring** (Also in-situ national data)	**61 - Temperature monitoring** (- C3S data Forecast and reanalysis - 1° x 1° res. - CMEMS 4km res. - National data to be used as a primary source)	**62 - Wildlife tracking** (GALILEO/GPS)
Weight (From 0 to 5)	**4**	**3**	**/**
Spatial Resolution (m)	**10-30m (Higher is desired)**	**10 km**	**/**
temporal resolution (dd / M)	**1Y**	**12h**	**Continuos**
Requirements	**Hydrological changes & network changes layer**	**Temperature & anomaly maps**	**Real Time wildlife tracking**

Matching with Copernicus products			
Copernicus Products Capacity	**Most in-situ related - integration with GMS would be of support**	**- The Copernicus Marine Service assimilates earth observation and in-situ data into 4-D models. Main parameters provided are currents, temperature, salinity, sea level, sea ice and biogeochemistry** **- The C3S components will permit to derive a number of climate indicators (e.g., temperature increase, sea level rise, ice sheet melting, warming up of the ocean) and climate indices (e.g., based on records of temperature, precipitation, drought event) for identified climate drivers and the expected impacts.**	
Source (Core Services or Space Component)	**EU-Hydro River Network – CORDA, CEMS**	**CMEMS & C3S**	
Sustainability for Core Services / Space Component	**Low - medium**	**High**	**?**
COPERNICUS PRODUCT	C3S and CEMS provide information on future changes of hydrological variables as well as retrospective analysis of what has happened in	C3S - Considering that CMEMS only provides data over the oceans, in the requirement is global, C3S should probably be the primary source. Once more ERA5Land will provide the relevant parameter at 9km	

		the last few months (state of the climate report) . CEMS flood early warning systems provide a reanalysis of river flow as well as short-term, medium-range and seasonal forecasts (P.Salamon). ECMWF NOTE: for Europe we do have datasets at different resolutions but something of the order of 10 km (e.g. https://cds.climate.copernicus.eu/cdsapp#!/dataset/sis-water-quantity-swicca?tab=overview) is not uncommon.	*ED. Following the recent release of ECMWF's ERA5 climate reanalysis from 1979 onwards, the release of the first subset of <u>ERA5-Land</u> data covering the period 2001 to 2018 is planned for this spring. The dataset will be updated in a timely manner together with ERA5 updates. Like ERA5, ERA5-Land is being produced by ECMWF as part of implementing the EU-funded Copernicus Climate Change Service (C3S). This is the first time that a global land surface dataset describing the water and energy cycles and spanning nearly two decades will be available at a grid spacing of 9 km and hourly temporal frequency. The main features of this new dataset compared to previous reanalyses and ERA5 are shown in the table. (REANALISYS PRODUCT) resolution.* *CMEMS:* 59 products of Sea Temperature (model &obs) covering Global and EU water, NRT, forecasts and Reanalysis.	
Characteristics	Spatial resolution	CEMS: 5km (Europe) – 10km (Global) (P.Salamon)	C3S: 9km CMEMS: The spatial resolution only concerns Model output (Reanalysis, forecast and NRT) Global 8km Arctic 12.5km Baltic 2km North West Shelf (Atlantic) 1.5km Iberian Biscay Irish (Atlantic) 3km Med Sea 4km Black Sea 3km	
	Update frequency	CEMS: forecasts are updated twice daily (Europe) or daily (global), River flow reanalysis products (model) are	C3S: hourly CMEMS: Reanalysis (model) cover the period 1993-2017 and are yearly updated and contain monthly or daily mean. IBI and BAL provide also hourly mean.	

		updated every two years (P.Salamon)	Regarding the NRT and forecast products, temporal resolutions are: Global : monthly-mean, daily-mean, hourly-mean Arctic : daily-mean, hourly-mean Baltic : daily-mean, hourly-mean North West Shelf (Atlantic) : daily-mean, hourly-mean Iberian Biscay Irish (Atlantic): monthly-mean, daily-mean, hourly-mean Med Sea : monthly-mean, daily-mean, hourly-mean Black Sea : monthly-mean, daily-mean Forecast are generally for 5 to 10 days ahead	
SENSOR TYPE (Sentinel or CM)			Sentinel-3 SLSTR	
Characteristics	Spatial resolution			
	Spectral resolution			
	Revisit time			
INSITU observations		CEMS collects river flow and water levels from national in-situ data in Europe (NRT and historical) and global (historical only) (P. Salamon)	CMEMS: Sea water Temperature : 16 INSITU CMEMS products covering Global and EU water, NRT (from 2010), & reprocessing.(1990-2016)	
Spatial resolution		NA	Discrete resolution	
Spectral resolution		NA		
Revisit time				
SENSOR TYPE (Sentinel or CM)			Sentinel-3 SLSTR	
Characteristics	Spatial resolution		1 km	
	Spectral resolution		MWIR and TIR 3742 to 12022.5 nm	
	Revisit time		1-4 days	
EEA - COPERNICUS PRODUCT			Possible derivation from riparian at 1:50.000 scale? EU-Hydro: The data model of the EU-Hydro river network consists of seven polygon feature classes, three polyline feature classes and two point feature classes: - point feature classes: Culverts and Nodes; - line feature classes: Canals_l,	

			Ditches_l and River_Net_l; - polygon feature classes: Canals_p, Ditches_p, River_Net_p, InlandWater, Transit_p, Coastal_p and RiverBasinsis. EU-Hydro river network has been derived from 20 metres resolution imagery. The feature data extraction has been performed by photointerpretation of Very High Resolution Image Data (2011 - 2013), with resolution of 2.5 meters. Integrated EU-Hydro database (hydrographic and drainage database) is available in geodatabase format and contains: - hydrographic nodes, lines, and polygons; - drainage network elements (basins, catchments, drainage lines and nodes); - dams; - coastlines and land polygons.
EEA Characteristics	Spatial resolution		2.5m maximum
	Update frequency		Irregular

END OF HIGH LEVEL USERS NEED 6

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High level users need 7	**Observation of changes on the built structure of a CH site**		
Users' needs	**63 - Material composition analysis**	**64 - Monitoring of the movements of building structure parts** (On demand only)	**65 - Identification of signs of mineralisation** **organic change / fossiles?**
Weight (From 0 to 5)		**5**	
Spatial Resolution (m)	**/**	**1m H. < 1cm V.**	**/**
temporal resolution (dd / M)		**2week - 1M**	
Requirements	**Material composition of CH features**	**Building structural movements, velocity and direction**	

Matching with Copernicus products				
Copernicus Products Capacity		**None**	**None**	**None**
Source (Core Services or Space Component)			**CM - CSS-SEA**	
Sustainability for Core Services / Space Component			**Low**	
COPERNICUS PRODUCT			**SEA products:** **Imagery intelligence products:** • **Quick Report (QR);** • **First Impression Report (FIR);** • **Briefing Note (BN)** **Geospatial products.** **Digital Geographic Information (DGI) – Image Map;**	
Characteristics	Spatial resolution		**SAR Very High Resolution 1**	
	Update frequency		**According to the user needs**	
SENSOR TYPE (Sentinel or CM)			**CM SAR VHR1 due to the specific target**	
Characteristics	Spatial resolution		**SAR VHR1 ((resolution <=1m)**	
	Methodology		**Interferometry** **PSI (Persistent Scatterers Interferometry)** **SAR Tomography ….**	
	Revisit time		Depending on the specific analysis and the users needs.	
(ESA) SENSOR TYPE (Sentinel or CM)			Possibly DInSAR with VHR SAR sensors: CM Group 1 (SAR VHR1-MR1)	

END OF HIGH LEVEL USERS NEED 7

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High level users need 8	**Drawing of conclusions to facilitate an emergency intervention**	
Users' needs	**66 - Geo-hazards monitoring/forecasting** **Note by CEMS (**Assuming this is about disaster impact or forecast mapping**)** (GMS - CEMS activations)	**67 - Human conflict risk monitoring** (CSS product)
Weight (From 0 to 5)	**5**	**5**
Spatial Resolution (m)	**<1-5 m H. Res / 1-2cm V. res**	Up to VHR1 Very High Resolution 1 where resolution <=1m (usually 0.5 m) – depending on the specific users need
temporal resolution (dd / M)	**7d**	**on demand**
Requirements	**Pre-event geohazard information**	**Conflict risk map**

Matching with Copernicus products		
Copernicus Products Capacity	**– CEMS Early Warning & Monitoring Service – Floods. Forest fires, droughts (P.Salamon)** **(floods, forest fires, droughts, earthquakes, tsunamis, volcanic eruptions, landslides, storms, etc.)** **– CEMS Early Warning & Monitoring Service – Floods. Forest fires, droughts** **-CEMS On-demand mapping (rapid and risk & recovery) (for floods, forest fires, droughts, earthquakes, tsunamis, volcanic eruptions, landslides, storms, etc.)**	**Conflict Damage Assessment: The Conflict Damage Assessment product uses change detection in order to provide visual interpretation containing information on distribution of damage in a crisis area. In urban areas, the urban blocks will be colour-coded to show the intensity of the damage. In dispersed areas, a heat map will be used to represent the damage, with grading colours to highlight how different sections of each area have been affected. This product is useful to identify the distribution of damage after a conflict in a given area;** **Activity Report: Monitor changes of goods in open storage areas (such as harbours).** **Please check the section 3 https://sea.security.copernicus.eu/**
Source (Core Services or Space Component)	**CEMS**	**CSS-SEA**

Sustainability for Core Services / Space Component		**High**	**High**
(SatCen) COPERNICUS PRODUCT		Impact maps (e.g. Rapid Mapping: First Estimate, Delineation, Grading), fire hot spots and burnt area perimeters (EFFIS, GWIS), drought risk (EDO, GDO), flood risk (EFAS, GloFAS)	The selection of the appropriate product takes into account constraints such as timely responsiveness and accuracy as well as the nature of the analysis required the deadline and the temporal validity of the information to be provided SEA products: Imagery intelligence products: o Quick Report (QR); o First Impression Report (FIR); o Briefing Note (BN) Geospatial products. o Digital Geographic Information (DGI) – Image Map; o Digital Geographic Information (DGI) – City Map; o Country Map Coverage (CMC) Geo-intelligence products: o MapBook
(SatCen) Characteristics	Spatial resolution	Submeter to 1km (depending on CEMS component)	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)
	Update frequency	Max 2x/day for fire hot spots, or up to daily for impact estimates from Rapid Mapping. Other components at lower frequency (droughts)	According to the user need – weekly, every 15 days, monthly….
(SatCen) SENSOR TYPE (Sentinel or CM)		Both, depending on application. EFAS, GloFAS do not use EO data.	Both depending from the area of interest, targets….
(SatCen) Characteristics	Spatial resolution	Both, depending on application. EFAS, GloFAS do not use EO data.	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m) and from VHR2 to HR2 over extended areas
	Spectral resolution	Multispectral or panchromatic, SAR	Depends from the target usually 4 band (RGB+NIR)
	Revisit time	Different depending on component and user need	Depending on the user needs, target….

(ESA) SENSOR TYPE (Sentinel or CM)		Sentinel-1	Sentinel-2 possibly with: CM Group 1 (SAR VHR1-MR1) CM Group 2b (Optical VHR1/2)
(ESA) Characteristics	Spatial resolution	Sentinel-1 IW SLC: around 5m x 20m	Sentinel-2: up to 10m
	Spectral resolution		Sentinel-2: 13 bands from VIS to SWIR
	Revisit time	Sentinel-1: max 6 days	Sentinel-2: at most 5 days

Continue

High level users need 8	**Drawing of conclusions to facilitate an emergency intervention**	
Users' needs	**68 - Real-time monitoring of emergency events (e.g. flash floods, forest fires)** CEMS activations	**69 - Ground motion monitoring data analysis** **(**Tender published)
Weight (From 0 to 5)	**5**	**to be linked with the above geo-hazard - 5**
Spatial Resolution (m)	**Case specific/user defined, typically <10m**	**10m Horiz. - 1cm Vert.**
temporal resolution (dd / M)	**on demand**	**on demand**
Requirements	**Rapid mapping and risk & recovery maps/informations**	**Ground motion data analysis**

Matching with Copernicus products			
Copernicus Products Capacity		**(floods, forest fires, droughts, earthquakes, tsunamis, volcanic eruptions, landslides, storms, etc.)**	**EU-GMS will provide ground motion time-series information with full spatial and temporal resolution over land areas of the Copernicus participating states. Ground motion products provided by the Service will be updated every 12 months (TBC).**
Source (Core Services or Space Component)		**CEMS**	**GMS service**
Sustainability for Core Services / Space Component		**High**	**High**
COPERNICUS PRODUCT			**VHR1 and VHR2 SAR and Optical CM** **MSs' downstream services capacity**
Characteristics	Spatial resolution		
	Update frequency		
SENSOR TYPE (Sentinel or CM)		Sentinel-1, 2, any CM	Sentinel-1
Characteristics	Spatial resolution	Up to 10m	Sentinel-1 IW SLC: around 5m x 20m
	Spectral resolution	Pan or multispectral, radar	
	Revisit time	Max 5 or 6 days; CM specific	Sentinel-1: max 6 days

END OF HIGH LEVEL USERS NEED 8

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High level users need 9	**Enable public access to the site**		
Users' needs	**70 - Identification of previously searched sites in the area - changes detection** (It would need an HI-RES approach)	**71 - Ground motion monitoring** (Tender published - each 12 months is not enough)	**72 - Mapping of frequentation patterns** (In situ - By mobile monitoring - 5G)
Weight (From 0 to 5)	**5**	**/**	**5**
Spatial Resolution (m)	**1-3 m Horiz. - 1 cm Vert.**	**10m Horiz. - 1 cm Vert.**	**100 - 500 m**
temporal resolution (dd / M)	**6M**	**4 -6 M**	**real time**
Requirements	**Identification of previously searched sites in the area** **Hi-Res. Elevation change** **Optical change detection**	**Ground motion layer (Under construction)**	

Matching with Copernicus products			
Copernicus Products Capacity	**On demand CM tasking contribution would be of support** CSS-SEA	**EU-GMS will provide ground motion time-series information with full spatial and temporal resolution over land areas of the Copernicus participating states. Ground motion products provided by the Service will be updated every 12 months (TBC).**	**/**
Source (Core Services or Space Component)	**none**	**CLMS**	**None**
Sustainability for Core Services / Space Component	**High**	**High**	**low**
COPERNICUS PRODUCT	*The specific need can be fulfilled or partially fulfilled by the Copernicus SEA portfolio.* *The monitoring of an area for the identification of previously searched sites is possible with HR/VHR data.*		

		The identification could be confirmed cross checking with collateral information.		
Characteristics	Spatial resolution			
	Update frequency			
SENSOR TYPE (Sentinel or CM)		possibly with: CM Group 1 (SAR VHR1-MR1) CM Group 2b (Optical VHR1/2)	Sentinel-1	
Characteristics	Spatial resolution		Sentinel-1 IW SLC: around 5m x 20m	
	Spectral resolution			
	Revisit time		Sentinel-1: max 6 days	

Continue

High level users need 9	**Enable public access to the site**		
Users' needs	**73 - Mapping of surrounding infrastructure (roads, pipelines, waterconducts etc.)** (To be verified if sentinels can help - It would be needed the use of CMs)	**74 - Elevation modelling** (provided by CORDA)	**75 - 3D reconstruction**
Weight (From 0 to 5)	**5**	**3**	**2**
Spatial Resolution (m)	**1- 5-m H. Res.**	**10 - 30m Horiz - 1-10 cm Vert.**	
temporal resolution (dd / M)	**1Y**	**3M**	**una tantum**
Requirements	**Vector layer of linear element into and surrounding the site (roads, pipelines, waterconducts etc.)**	**Raster elevation map**	**Hi res 3d of ancient buildings**

Matching with Copernicus products			
Copernicus Products Capacity	**On demand CM tasking contribution would be of support**	**EU-Hydro and EU-DEM reference datasets. High resolution high quality DEM to be made available for multiple purposes, amongst other the ortho-rectification of Sentinel 2 imagery and of CCMs, as well as use by the Copernicus services.**	**Downstream segment**
Source (Core Services or Space Component)	**Potentially CLMS**	**EUDEM - CORDA**	**none**
Sustainability for Core Services / Space Component	**High**	**high**	**low**
(SatCen) COPERNICUS PRODUCT	SEA products: • Digital Geographic Information (DGI) – Image Map; • Digital Geographic Information	EEA:Digital Surface Model, based on stereo imagery from Cartosat satellites, whereby the stereo is taken North-South, on the same track when the satellite passes, but one take from a Northern position, and one take	

		(DGI) – City Map; MapBook	from a Southern position. 5m x 5m horizontal resolution, and +/- 1m vertical resolution. It can distinguish rather small disturbances in the earth's surface.	
Characteristics	Spatial resolution	Up to VHR1 Very High Resolution (resolution <=1m - usually 0.5 m)	5m x 5m horizontal resolution, and +/- 1m	
	Update frequency	According to the user need – weekly, every 15 days, monthly….		
(SatCen) SENSOR TYPE (Sentinel or CM)		Both depending on the user needs, characteristics of the Area, targets…		
(SatCen) Characteristics	Spatial resolution	Up to VHR1, (resolution <=1m, usually 0.5 m) and VHR2 to HR2 over extended areas		
	Spectral resolution	Related to the target, usually 4 band (RGB+NIR)		
	Revisit time	Depending on the user needs, target.		
(ESA) SENSOR TYPE (Sentinel or CM)		possibly with: CM Group 1 (SAR VHR1-MR1) CM Group 2b (Optical VHR1/2)	Through InSAR: Sentinel-1, possibly CM Group 1 (SAR VHR1-MR1) Through Optical Photogrammetry: possibly CM Group 2b (Optical VHR1/2)	
(ESA)Characteristics	Spatial resolution		Sentinel-1 IW SLC: around 5m x 20m	

	Spectral resolution			
	Revisit time		Sentinel-1: at most 6 days	

END OF HIGH LEVEL USERS NEED 9

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The table below presents the full list of Data Warehouse Phase 2 Copernicus Contributing Missions including Sentinels dedicated missions as well as ESA and Third Party missions, divided per mission group and resolution type (1=SAR VHR1-MR2, 2b=Optical VHR1/2= Optical HR1/2, 3=Optical MR1/2 and 4/5= Atmospheric Missions). The missions in italic bold will be available at a later stage, when launched or integrated into the CSCDA.

In addition, data from EUMETSAT's meteorological satellite missions (Meteosat, Metop) and third party missions are available (S-NPP) through the EUMETSAT dissemination mechanisms.

Mission Group 1 - SAR VHR1-MR2	Mission Group 2b Optical VHR1/2	Mission Group 2 Optical HR1/2	Mission Group 3 Optical MR1/2	Mission Group 4/5 Atmospheric missions	Others
ALOS-PALSAR	Deimos-2	ALOS-AVNIR-2	Proba-V	ERS-1/2	CryoSat
COSMO-SkyMed Constellation	Dubaisat-2	Deimos-1	Resourcesat-1, Resourcesat-2	Envisat	SMOS
Envisat	GeoEye-1	Landsat-5 Landsat-7 Landsat-8	Oceansat-2	GOSAT	ERS-1/2
ERS-1/2	IRS-P5 CartoSat	Proba	Sentinel-3	ODIN	Sentinel-3
Kompsat-5	Ikonos-2	RapidEye Constellation			
PAZ	Kompsat-2, Kompsat-3	ResourceSat-1, ResourceSat-2			

RADARSAT-2	Pleiades-1A/1B	Sentinel-2			
RISAT-1	QuickBird-2	SPOT-4, SPOT-5, SPOT-6-7			
Sentinel-1	SPOT-5, SPOT-6/7	TH constellation			
TerraSAR-X, TanDEM-X	TH constellation	UK-DMC2			
	WorldView-1, WorldView-2				
	WorldView-3				
	Worldview-4				

Table 2 Missions made available in Data Warehouse Phase 2