EUMETSAT

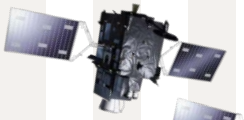
MARINE SATELLITE DATA SERVICES

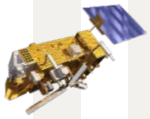
Hans Bonekamp

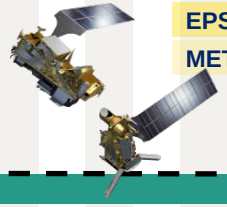
BoM

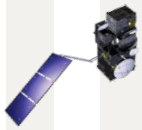
9 November 2015

What is EUMETSAT?: www.eumetsat.int









YEAR... 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

METEOSAT FIRST GENERATION

METEOSAT-7

METEOSAT SECOND GENERATION

METEOSAT-8

METEOSAT-9

METEOSAT-10

MSG-4/METEOSAT-11*

METEOSAT THIRD GENERATION

MTG-I-1 : IMAGERY

MTG-S-1: SOUNDING

MTG-I-2: IMAGERY

MTG-I-3: IMAGERY

MTG-S-2: SOUNDING

MTG-I-4: IMAGERY

Mandatory Programmes

EUMETSAT POLAR SYSTEM (EPS)

METOP-A

METOP-B

METOP-C

EPS-SECOND GENERATION (EPS-SG)

METOP-SG A: SOUNDING AND IMAGERY

METOP-SG B: MICROWAVE IMAGERY

JASON

JASON-2

JASON-3

JASON-CS/SENTINEL-6

Optional Programmes

SENTINEL-3 A/B/C/D (COPERNICUS)

SENTINEL-4 ON MTG-S (COPERNICUS_

SENTINEL-5 ON EPS-SG (COPERNICUS)

Third Party Programmes

YEAR... 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

Operational Marine Satellite Services (EUMETSAT)

- **Meteosat and Metop: (mandatory programs)**
  EUMETSAT does the Level 1 products
  OSI-SAF (paid by EUMETSAT) does the level 2 (www.osi-saf.org)

- **Jason-2/3 Programs (Optional programs) + Altika: (with US partners)**
  EUMETSAT does the NRT (OGDR) services
  CNES/CLS do the offline and higher level services (partly paid by EUM ETSAT))

- **Sentinel-3 (third party program): (http://www.copernicus.eu/main/sentinels)**
  - EUMETSAT and ESA do level-1 jointly
  - **EUMETSAT does level 2 for the Marine (ESA for the land)**
  - CMEMS does the higher level (partly paid by EUMETSAT)
    (http://marine.copernicus.eu)

- **Sentinel-6/Jason-CS: (with US partners)**
  - Developed as EUMETSAT optional program
  - Operated (Phase E) as a Copernicus Sentinel Mission

The Sentinel-3 Satellites : Two Missions

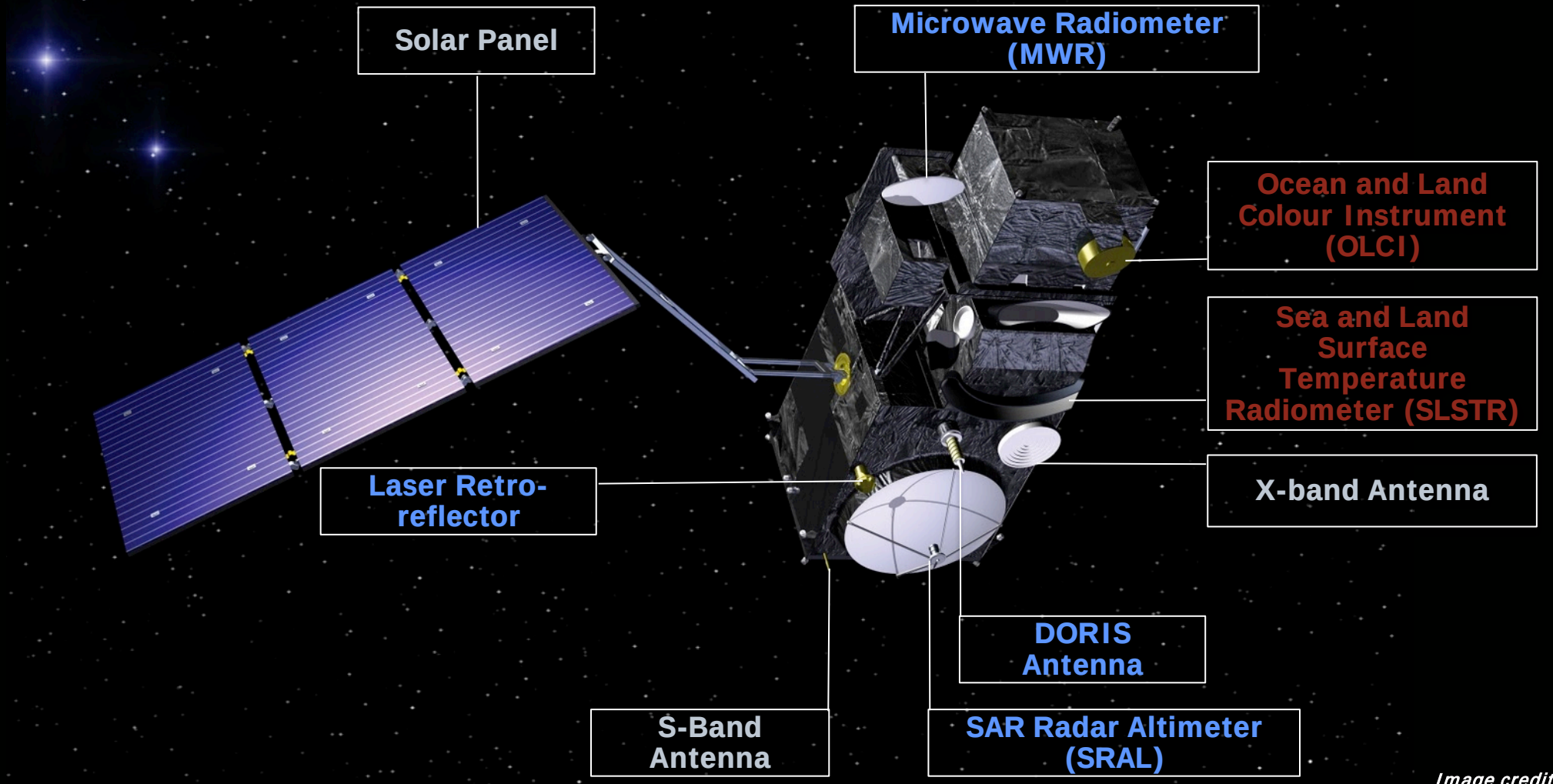


Image credit: ESA

Altimetry **Optical**

S-3 System & Ground Segment Overview

Space Segment

- Sentinel-3 A Satellite — SENTINEL 3
- Sentinel-3 B Satellite — SENTINEL 3
- Sentinel-3 C ... Satellites — SENTINEL 3

Payload Data Ground Segment

CGS & NRT Land PAC
- X Band Dump Acquisition
- Production of L0
- Production of NRT L1
- Production of NRT L2 Land
- Dissemination of NRT Land (ODA)

KONGSBERG

ESA MPC
- Cal/Val activities
- Routine Quality Control
- Help Desk Support

ACRI GROUP

PDMC
esa ESRIN

WAN
T-Systems

Offline Land PACs
- Production of L1/L2 STC & NTC Land/SYN
- Dissemination of OFL Land Products (ODA)
- Long Term Archiving of L0 & L1
- Long Term Archiving of L2 Land/SYN
- Land Reprocessing

OLCI (Land) — DLR
SLSTR & SYN (Land) — ACRI GROUP
STM (Land) — CLS

POD Service
- POD QC
- ADF Provision

gmv

Marine Centre
- Mission Planning
- Production of L0
- Production of NRT L1
- Production of NRT L2 Marine
- Dissemination of NRT Marine (ODA)
- Dissemination of NRT Marine (EUMETCast)
- Production of L1/L2 STC & NTC Marine
- Dissemination of OFL Marine (ODA)
- Dissemination of L1/L2 STC (EUMETCast)
- Long Term Archiving of L0 & L1
- Long Term Archiving of L2 Marine
- Marine Reprocessing
- Cal/Val activities
- Routine Quality Control
- Help Desk Support
- Auxiliary Data Coordination
- Mission Management

EUMETSAT

Flight Operations Segment

LEOP & Commissioning
- Satellite M&C

esa ESOC

Routine Operations
- Satellite M&C

EUMETSAT

Mission Management Office
- Mission Management

esa ESRIN

SALP
- DORIS & SRAL support

SALP

Ext Aux Data Providers:
- ADF Providers
- GCE
- SALP

Ground Segment

Users:
- Copernicus Services
- Cal/Val Teams
- Other

European Commission — Copernicus — EUMETSAT

Sentinel-3 Marine Product Contents: Level 1B

Level 1B

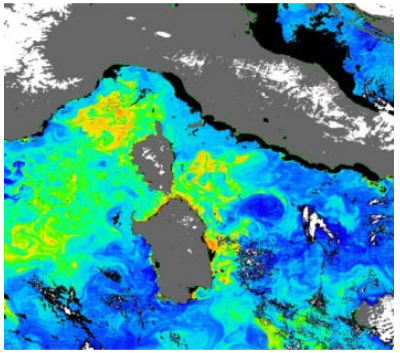
✓ SLTSR Calibrated and geolocated radiances and brightness temperatures computed from instrument source packets in the thermal, short wave and visible channels.

✓ OLCI Calibrated Top of Atmosphere Radiance values in the OLCI spectral bands, computed from the instrument digital counts applying radiometric processing and stray-light correction.

✓ SRAL Geo-located and calibrated radar echoes (i.e. waveforms) with all ancillary information annotated.

Sentinel-3 Marine Product Contents: Level 2

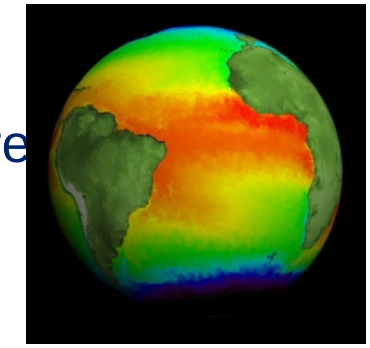
Level 2 OLCI "Ocean Colour":

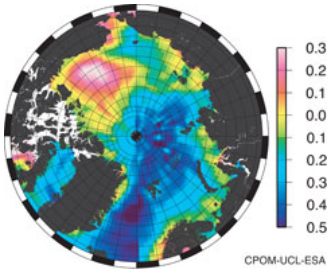


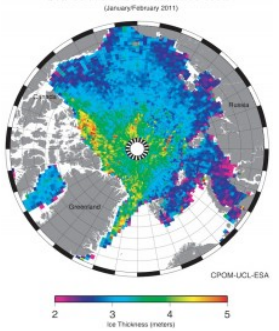
- Normalised water-leaving reflectance
- Algal pigment concentration for Case 1 (open) and for Case 2 (coastal) waters
- Total suspended matter concentration
- Diffuse attenuation coefficient
- Coloured dissolved matter absorption
- Photosynthetically active radiation
- Integrated water vapour column
- Aerosol optical depth
- Aerosol Angström exponent

Level 2 SLTSR:

- Sea surface temperature (L2P GHRSST standard)



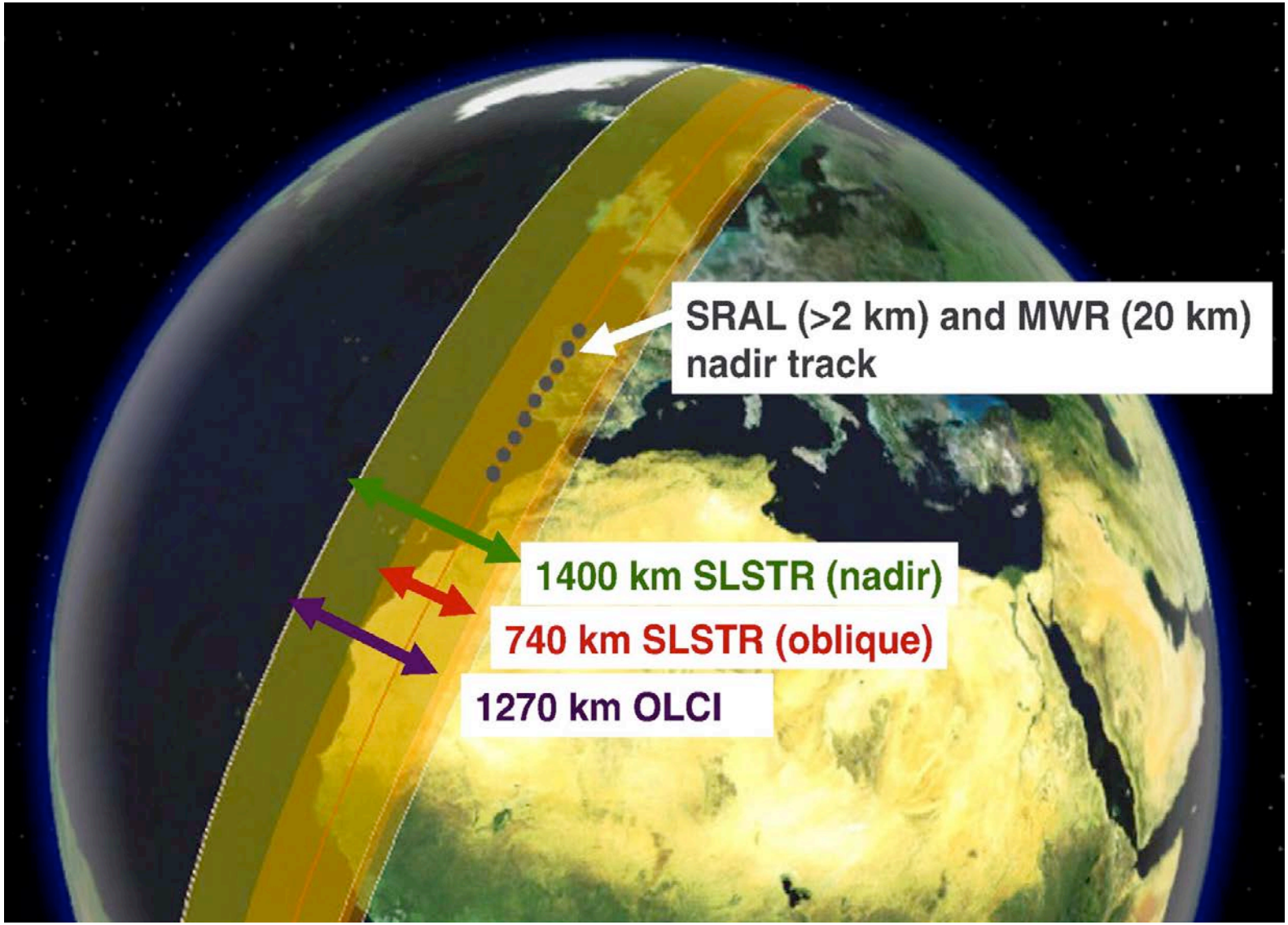




Level 2 SRAL "Altimetry":

- Sea/coastal zone surface height
- Significant wave height
- Wind speed
- Backscatter coefficient σ_0
- Sea ice height, freeboard
- Total water, liquid water (from MWR)

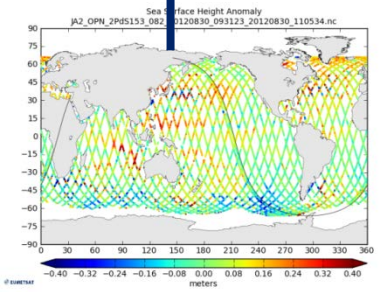
Sensing overlap

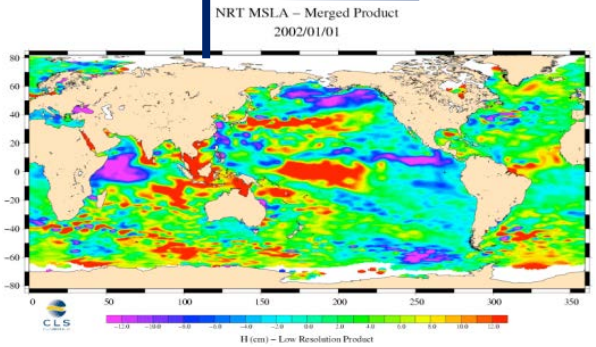


Sentinel-3 Products Timeliness

3 h | 48 h | 30 d | ~1/2 y | time

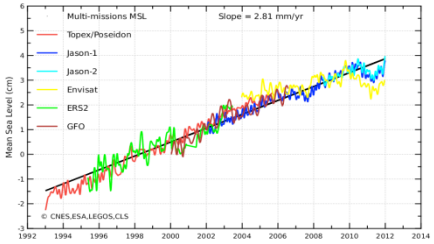
NRT products — *Weather and ocean forecasting, sea state forecasting*





STC products — *Operational ocean monitoring and forecasting*

NTC products — *Climate monitoring, Oceanography*



Reprocessing Campaign

NTC products

Climate monitoring

Data exploitation for science

NRT: Near Real Time

STC: Short Time Critical

NTC: Non Time Critical

EUMETSAT

Sentinel-3 Altimetry Products: Land/Sea Overlap

Level 1 products

- SRAL & MWR L1 products
  L1B, L1A, L1B-S

→ Generated by ESA/EUMETSAT
@ CGS, Marine Center, Land Centers

Level 2 Marine products

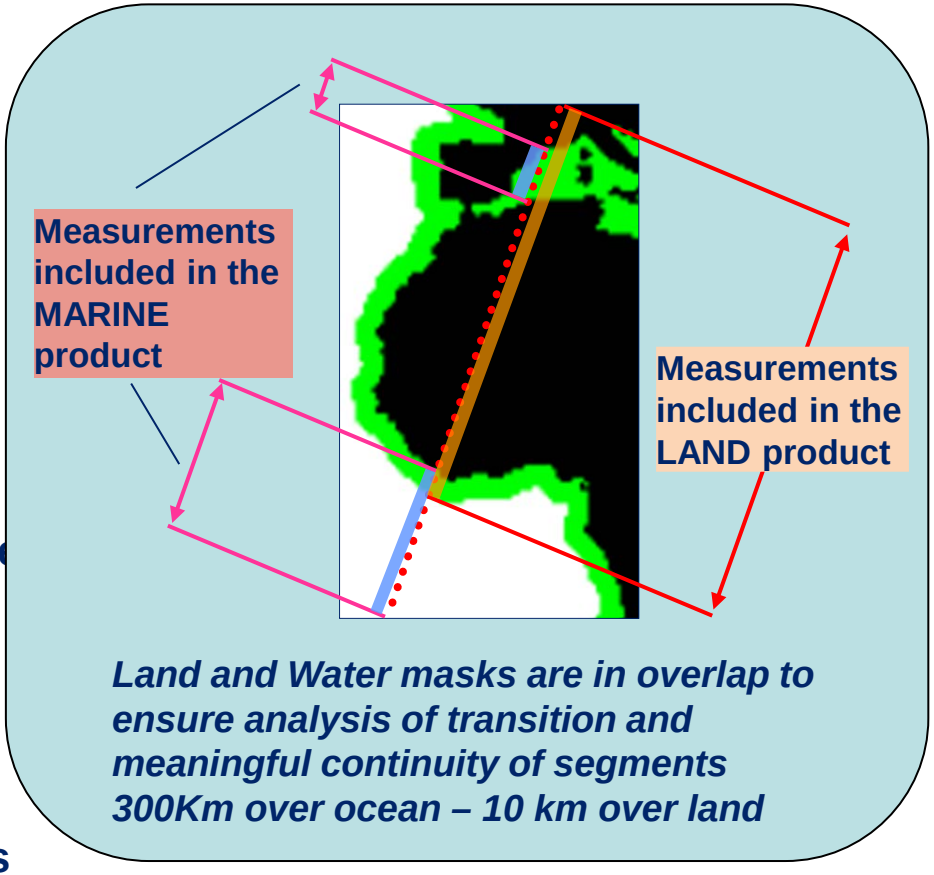
- STM L2 Marine product "SR_2_WAT"

→ Generated by EUMETSAT at PDGS Marine Center

Level 2 Land products

- STM L2 Land product "SR_2_LAN"

→ Generated by ESA at PDGS Land Centers



Marine product: information sensed over open ocean, coastal areas, sea-ice + mask margin
Land product: information sensed over land, coastal areas, sea-ice, land ice and inland water + mask margin

EUMETSAT Sentinel-3 Services and Data Access

User Support Services

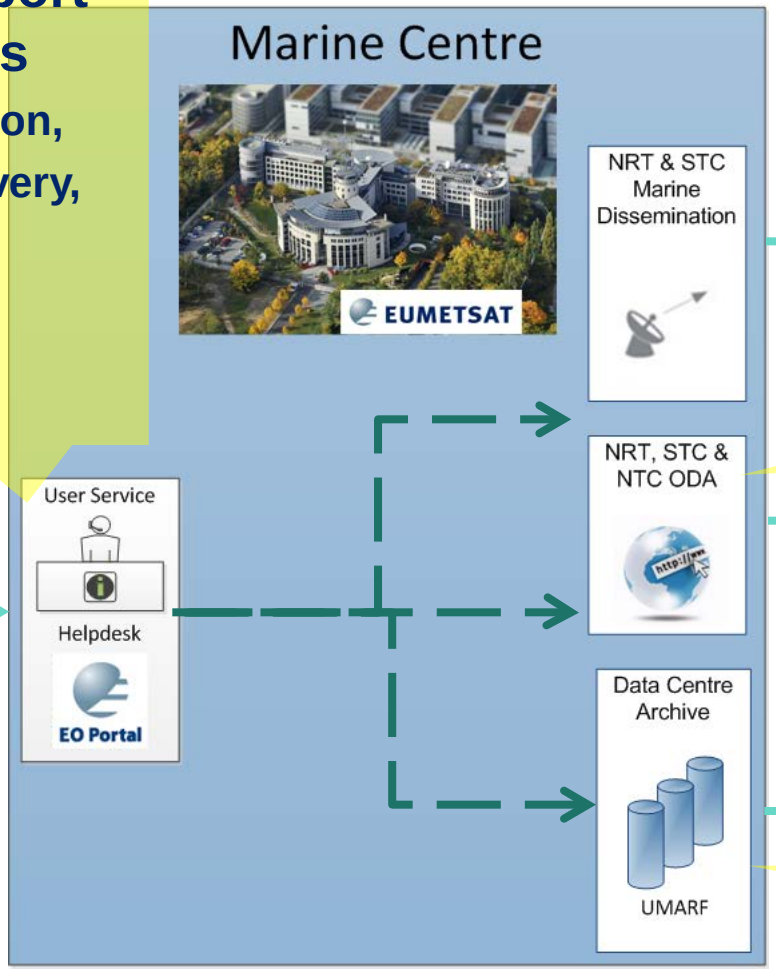
User Registration,

Product Discovery,

Subscription & Ordering,

Helpdesk,

Training, etc.



EUMETCast

« Traditional » method of disseminating NRT data in EUMETSAT. Can involve satellite and terrestrial methods.

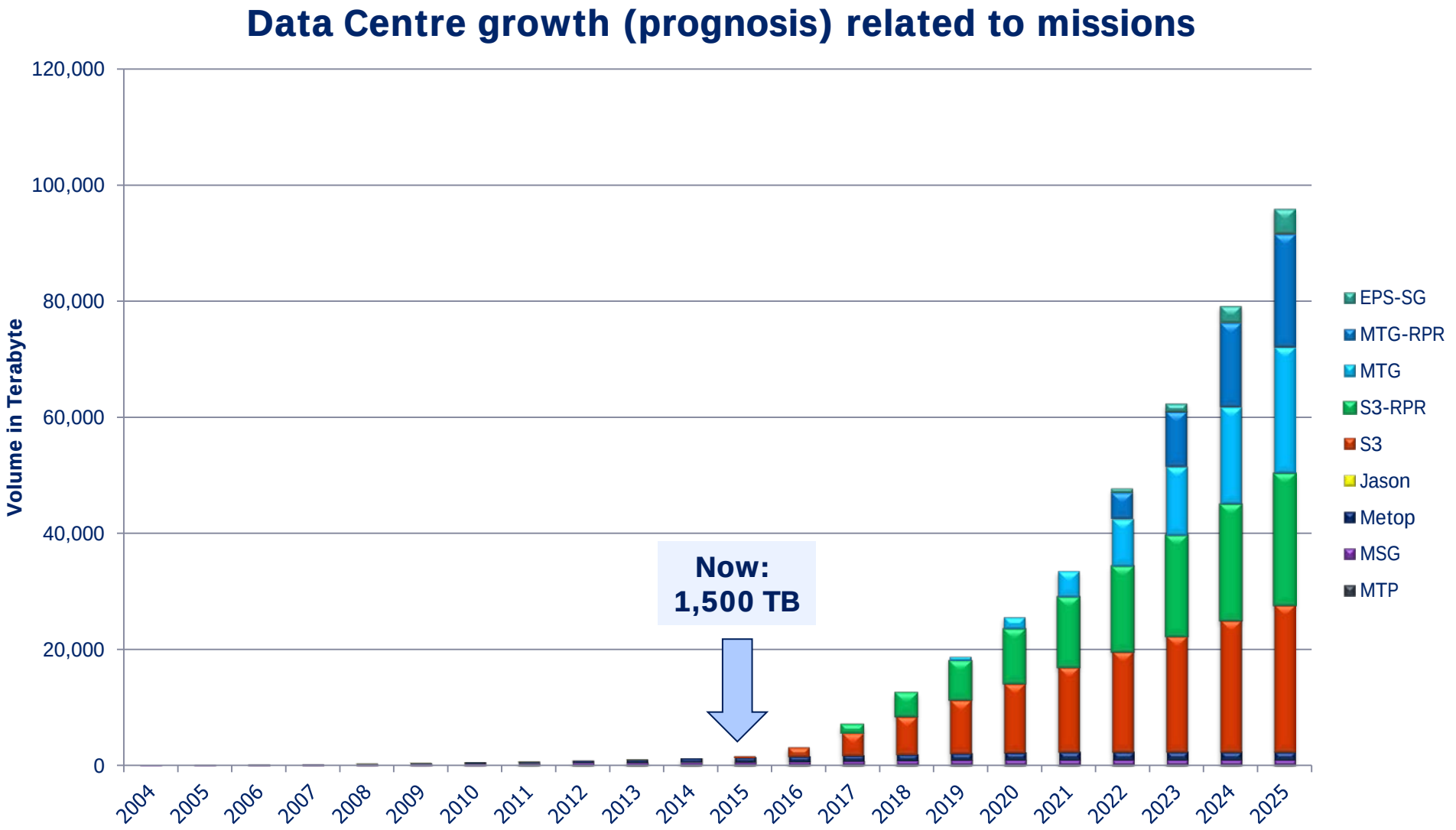
Online Data Access (ODA)

Rolling archive of 1 month of products supporting ftp/http access

EUMETSAT Data Centre

Complete historical archive of all EUMETSAT data including S-3 marine products

3. Data Centre: Estimated Data Volume increase



2. From the Online Data Archive

From the ODA a end-user will be able to request:

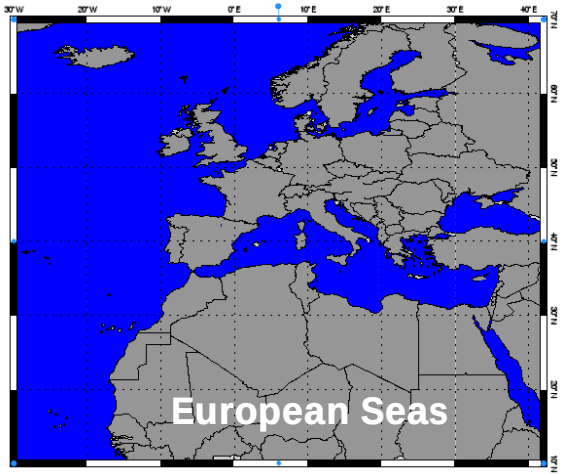
- **a subset of parameters from a product;**
- **a given ground / time coverage.**

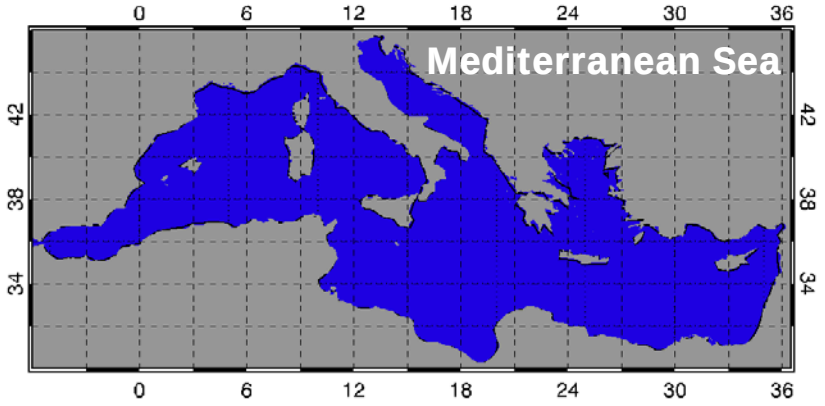
He will receive an object respecting the SAFE-S3 format with:

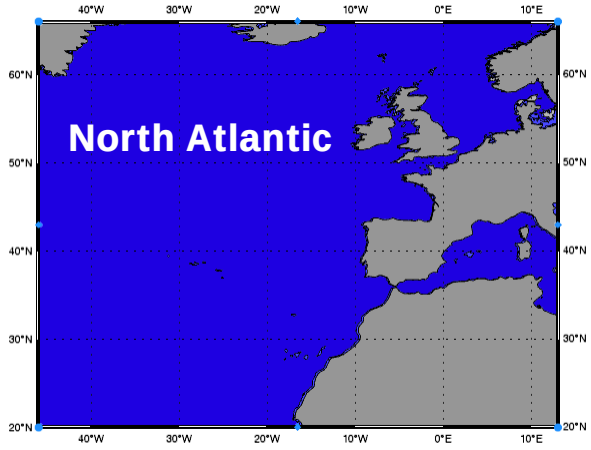
- **a reduced number of parameters;**
- **the ground / time coverage he requested.**

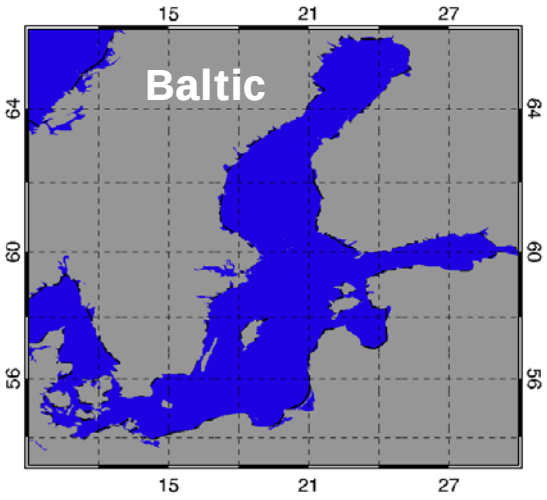
Those data sets do not exist physically and they are only made available in a virtual manner through hyperlinks / URLs; this concept requires extra information to be made available in the manifest file.

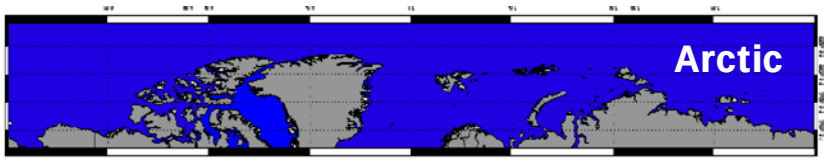
CMEMS Marine Datasets Examples (Bounding Box)

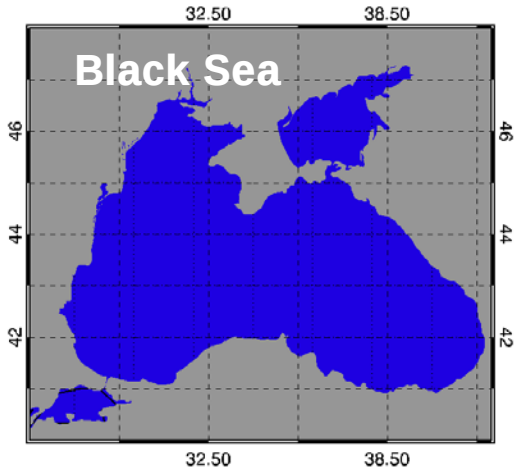




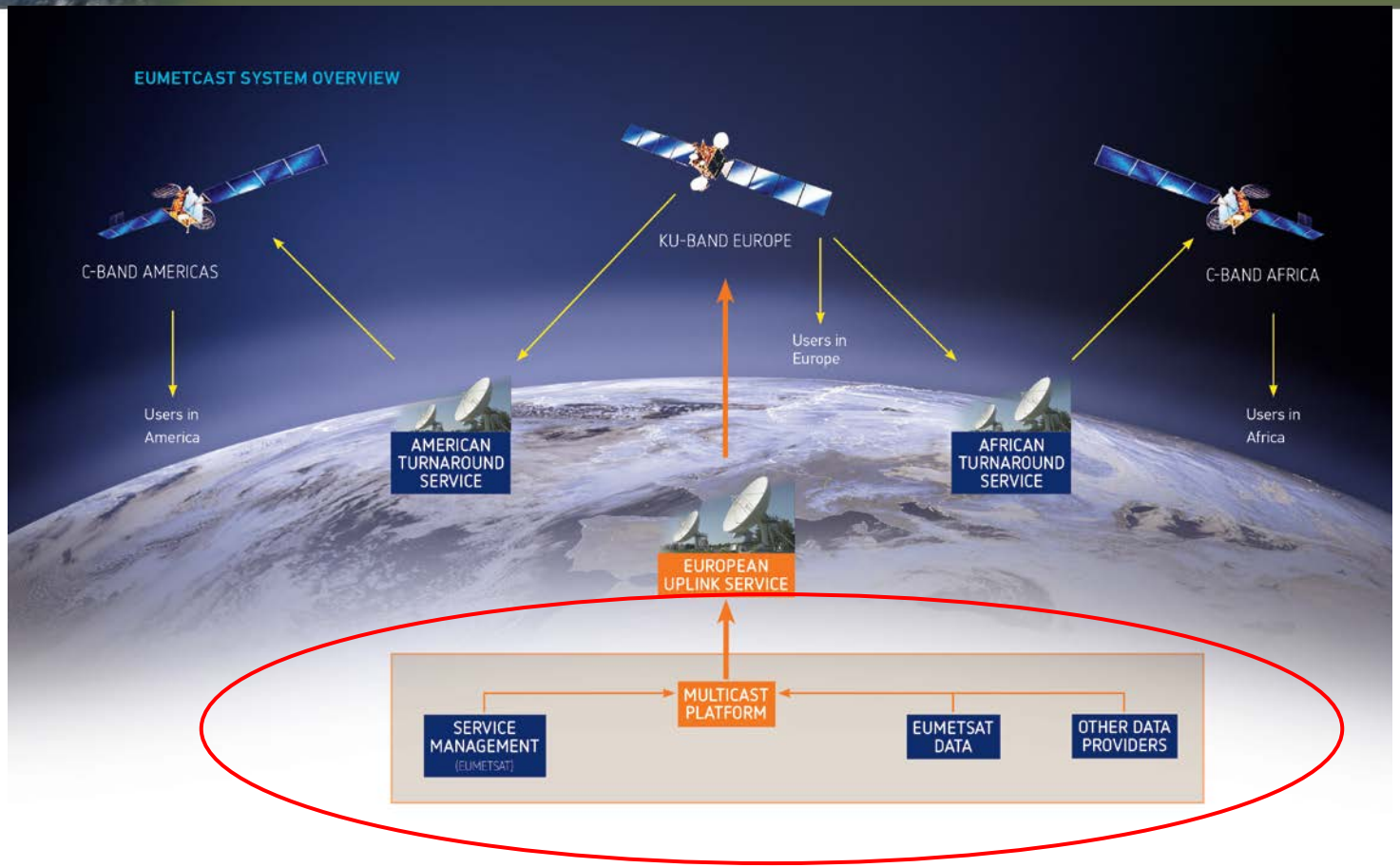








EUMETCast Transmission System



EUMETCast Reception Components

DVB-S2 Receiver

DVB-S2 PCI Card

DVB-S2 USB

EKU = USB dongle fro
EUMETSAT, to secure

European Commission

opernicus Europe's eyes on Earth

EUMETSAT

Evolution of EUMETCast – EUMETCast Terrestrial

- Implementation of a EUMETCast Terrestrial Demonstration Service with a planned start date 2016, running for 2 years;
- Best effort delivery of large data volume to bilateral data exchange partners (e.g. KMA, JMA, CMA, NOAA, ECMWF) serving as national “data hub” for authorised users;
- Makes use of GEANT and Nation Research Networks (NREN) infrastructure;
- EUMETSAT is in discussion with CSIRO to make Sentinel-3 data available in this way. Discussions are very preliminary so far.

EUMETSAT EO Portal: Central Registration Portal

Subscription to data services

- EUMETCast
- Online Data Access
- EUMETSAT Data Centre (Long Term Archive)

EO Portal

- eoportal.eumetsat.int

Product Navigator

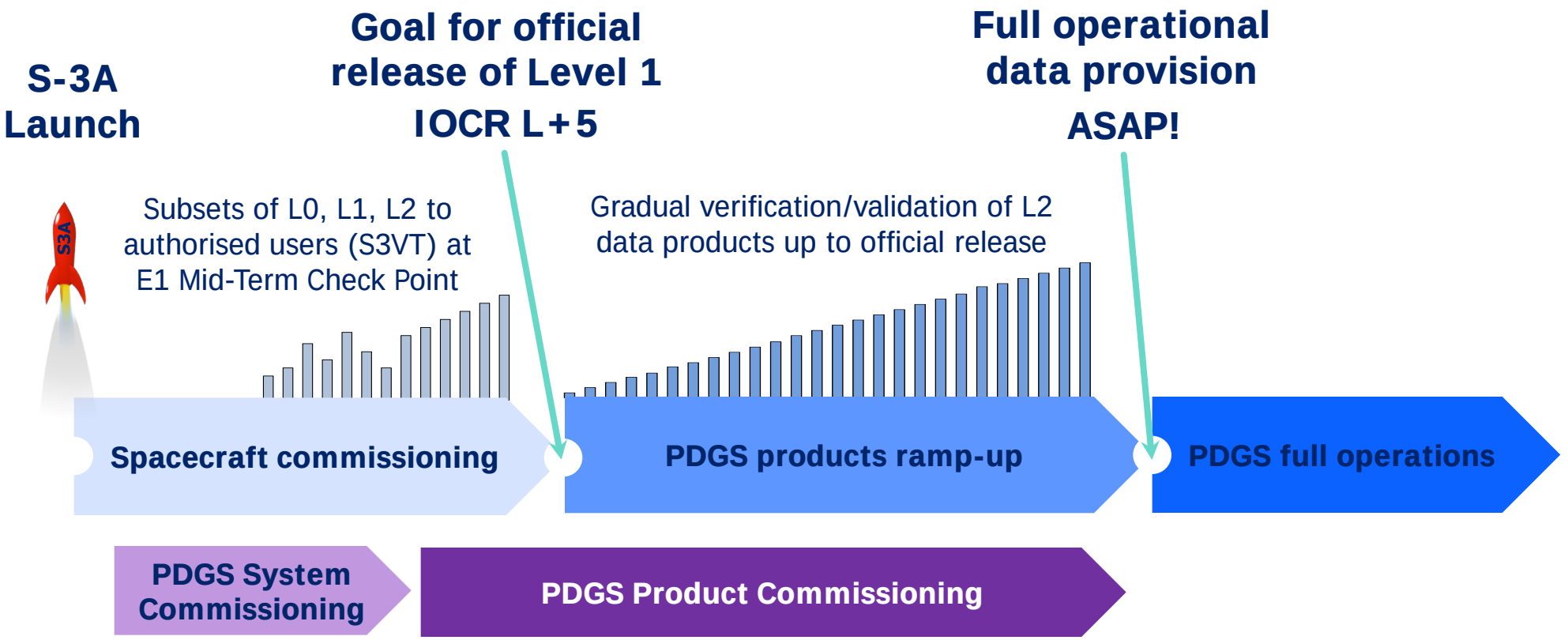
- navigator.eumetsat.int

User Notification emails

Helpdesk

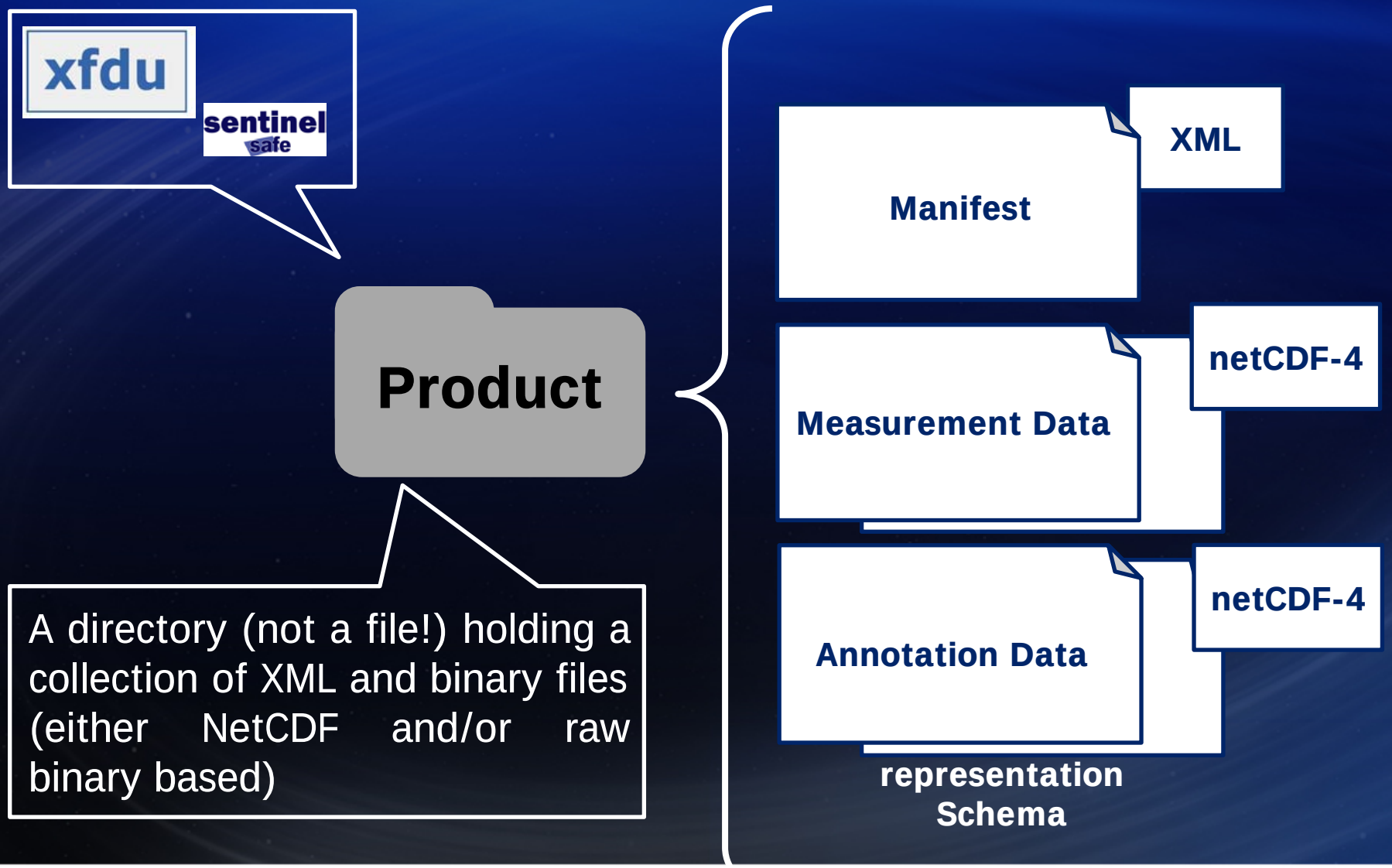
- Email: ops@eumetsat.int

Timeline for Data Product Availability

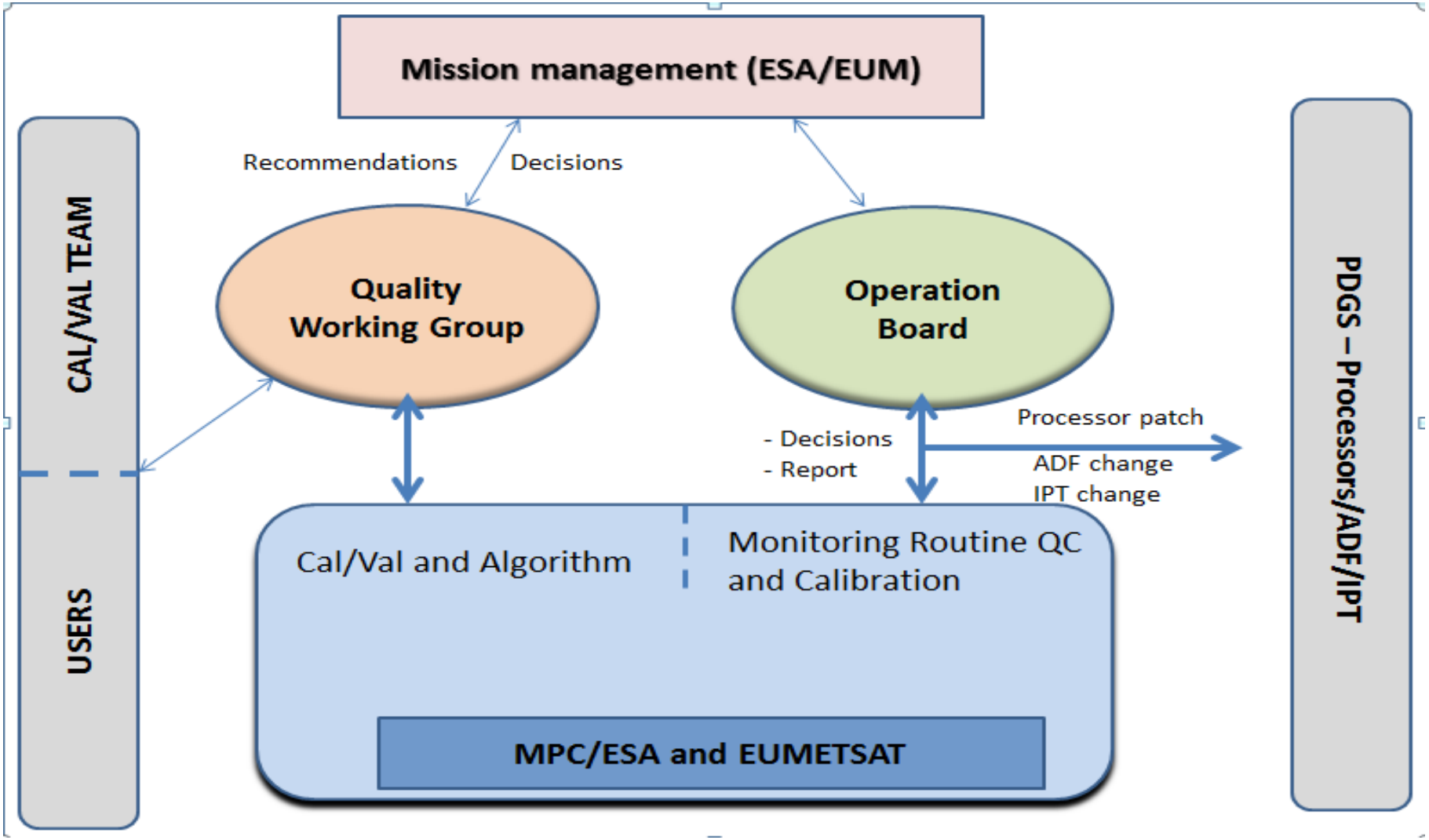


Launch date Sentinel-3 A: 23 Dec 2015 (TBC)

Sentinel-3 Marine Product Format



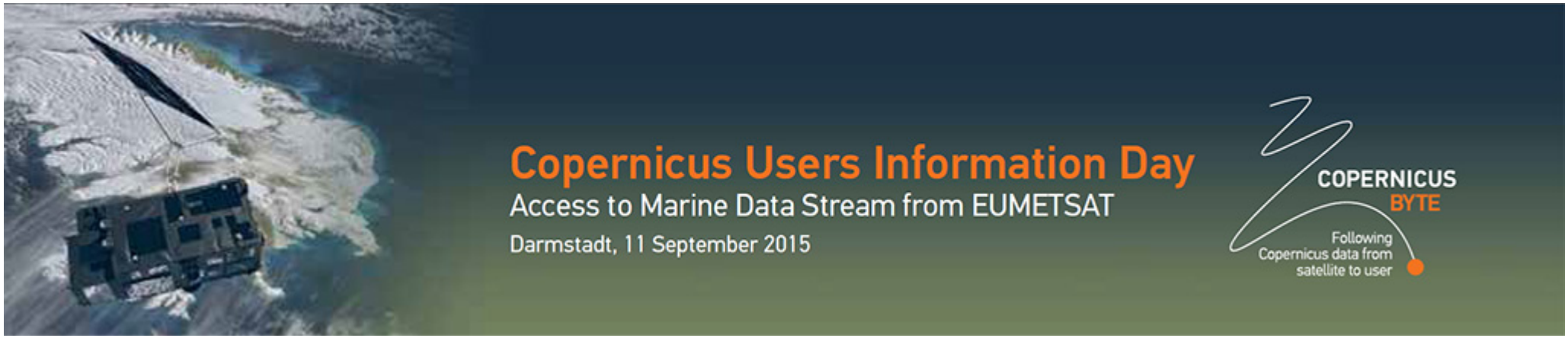
ESA/EUMETSAT Mission Performance Framework.



The Sentinel-3 Validation Team (S3VT)

- ESA and EUMETSAT open rolling research call” for users/scientist to help out on the validation
- S3VT neither funded by ESA nor EUMETSAT
- Membership based on a accepted proposal.
- Zie ESA EOP website (https://earth.esa.int/aos/S3VT)
- sub-groups:
  - Altimetry (S3VT-ALT)
  - Ocean Colour (S3VT-OC)
  - Sea and Sea Ice Surface Temperatures (S3VT-T)
  - Land parameters (S3VT-L)

Marine data stream event 11 Sept 2015



http://www.eumetsat.int/website/home/News/ConferencesandEvents/PreviousEvents/DAT_2596891.html

Thanks !

Sentinel-3 Marine Core Products Distribution

Product	EUMET Cast	ODA	Data Centre	Timeliness	Dissemination Unit size	Size per orbit (GB) *(likely compressed sizes)*
OLCI L1 EFR	✓	✓	✓	NRT	Frame (3 min)	21.5
		✓	✓	NTC	*idem*	*idem*
OLCI L1 ERR	✓	✓	✓	NRT	Full Orbit Daylight (2666 sec)	1.4
		✓	✓	NTC	*idem*	*idem*
OLCI L2 WFR		✓	✓	NRT, NTC	Frame	14.2
OLCI L2 WRR	✓	✓	✓	NRT	Full Orbit Daylight	0.95
		✓	✓	NTC	*idem*	*idem*
SLSTR L1B		✓	✓	NRT, NTC	Frame (3 min)	29.0
SLSTR L2 WST	✓	✓	✓	NRT	Frame (3 min)	0.75
		✓	✓	NTC	Full orbit: South Pole to South Pole	Idem
SRAL L1B	✓	✓	✓	NRT, STC*	Full orbit: dump	0.4
		✓	✓	NTC	*Half Orbit: Pole to Pole	idem
SRAL L2 WAT	✓	✓	✓	NRT, STC*	Full orbit: dump	0.2
		✓	✓	NTC	*Half Orbit: Pole to Pole	idem

Table 1. OLCI spectral bands. Name and central wavelengths (bandwidth) in nanometers, see Nieke et al (2012).

OLCI spectral bands

Name	Wavelength	Name	Wavelength	Name	Wavelength
Oa01	400 (15)	**Oa08**	665 (10)	**Oa15**	767.5 (2.5)
Oa02	412.5 (10)	**Oa09**	673.75 (7.5)	**Oa16**	778.75 (15)
Oa03	442.5 (10)	**Oa10**	681.25 (7.5)	**Oa17**	865 (20)
Oa04	490 (10)	**Oa11**	708.75 (10)	**Oa18**	885 (10)
Oa05	510 (10)	**Oa12**	753.75 (7.5)	**Oa19**	900 (10)
Oa06	560 (10)	**Oa13**	761.25 (2.5)	**Oa20**	940 (20)
Oa07	620 (10)	**Oa14**	764.375 (3.75)	**Oa21**	1020 (40)

Table 1. OLCI spectral bands. Name and central wavelengths (bandwidth) in nanometers, see Nieke et al (2012).

SLSTR spectral bands

Name	Wavelength	Name	Wavelength	Name	Wavelength	Name	Wavelength
S1	555 (20)	**S4**	1375 (15)	**S7**	3740 (380)	**F1**	3740 (380)
S2	659 (20)	**S5**	1610 (60)	**S8**	10850 (900)	**F2**	10850 (900)
S3	865 (20)	**S6**	2250 (50)	**S9**	12000 (1000)		

Table 2. SLSTR spectral bands. Name and central wavelengths (bandwidth) in nanometers (Coppo et al, 2013). (S1, S2, S3), (S4, S5, S6) and (S7, S8, S9) are respectively, Visible (VIS), Short Wave and InfraRed (SWIR) and Infrared bands. (F1, F2) are Fire detection bands.

Ocean Surface Topography level 1 and 2 (SRAL)

ID	Level	Resolution	NRT	STC	NTC	Size (Gb)
SR_1_A	1a	Full	-	Half orbit	Half orbit	17
SR_1_BS	1bs	Full	-	Half orbit	Half orbit	17
SR_1_SRA	**1b**	**Full**	**Full orbit (E)**	**Half orbit**	**Half orbit**	**0.4**
SR_2_WAT	**2**	**Full**	**Full orbit (E)**	**Half orbit (E)**	**Half orbit**	**0.2**

Table 5. Ocean Surface Topography Data Products (SRAL).
All products are available from the monthly online rolling archive (ODA)
and the long-term archive (DC),
EUMETCAST dissemination is indicated by (E).
The sizes are given for a full orbit and are an approximation based on compression assumptions.
The SR_1_A and SR_1_BS products are in planning and the product sizes are a rough estimation.

Sea Surface Temperature SLSTR level 1 and 2 (SLSTR)

ID	Level	Resolution	NRT	STC	NTC	Size (Gb)
SL_L1_RBT	1	Full	PDU	-	Full Orbit (south pole – south pole)	29.0
SL_L2_WST	2	Full	PDU(E)	-	Full Orbit (south pole – south pole)	0.75

Table. Sea Surface Temperature User Data Products (SLSTR).
All products are available from the monthly online rolling archive (ODA) and the long-term archive (DC)
EUMETCAST dissemination is indicated by (E).
Granularity: The products are Provided as 3 min Product Data Uits (PDU's).
The sizes are given for a full orbit and are an approximation based on compression assumptions.

Ocean Colour level 1 and level 2 (OLCI)

ID	Level	Resolution	NRT	STC	NTC	Size (Gb)
OL_1_EFR	1	Full	PDU (E)	-	PDU	21.5
OL_1_ERR	1	Reduced	Daylight orbit	-	Daylight orbit	1.4
OL_2_WFR	2	Full	PDU	-	PDU	14.2
OL_2_WRR	2	Reduced	Daylight orbit (E)	-	Daylight orbit	0.95

All products are available from the monthly online rolling archive (ODA) and the long-term archive (DC)
EUMETCAST dissemination is indicated by (E).
Granularity: the products are provided as either 3 min Product Data Units (PDU's) or Daylight orbits.
The sizes are given for a full orbit and are an approximation based on compression assumptions.