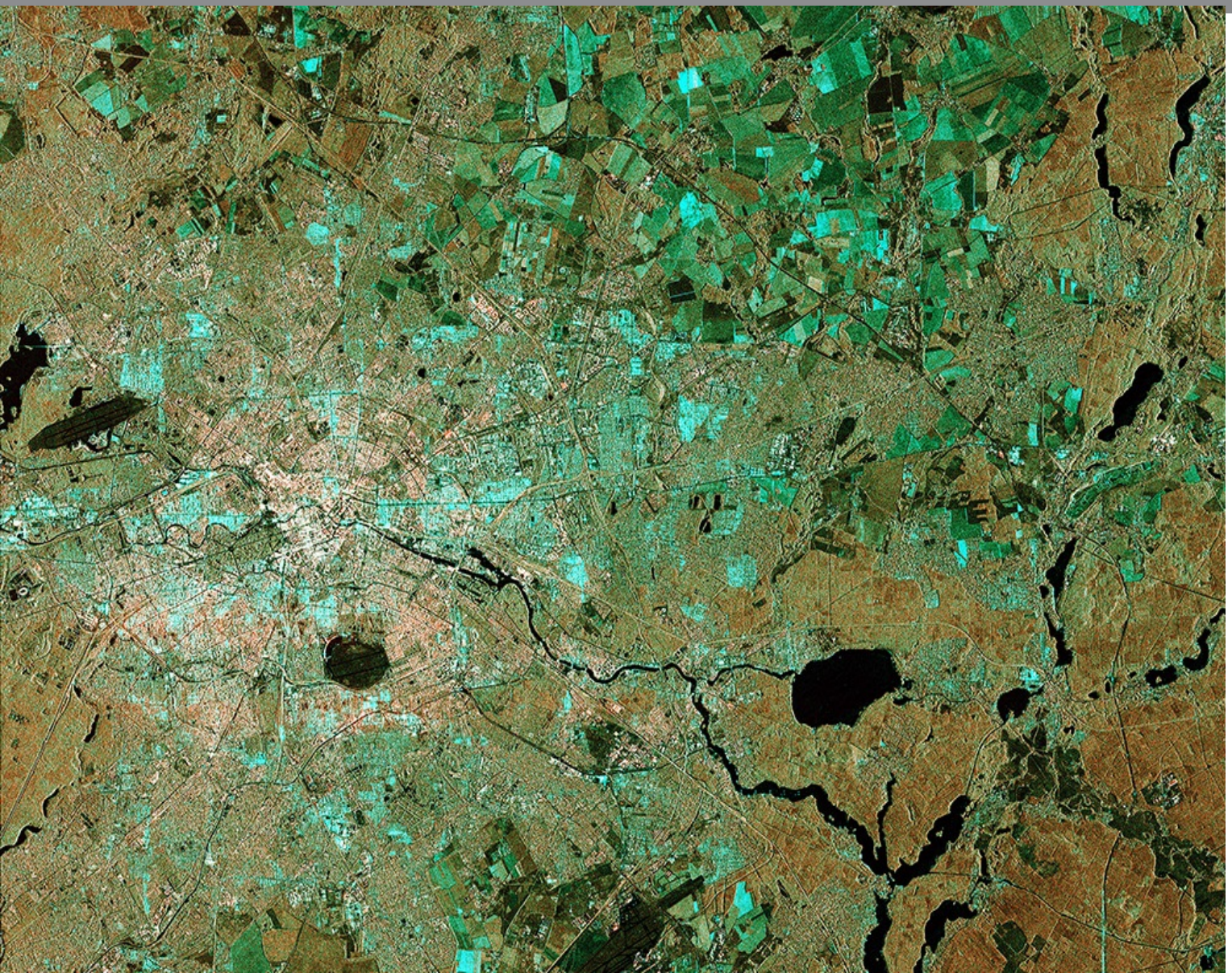
A.2 Copernicus, Sentinels und Meer

Daten der Sentinel Satelliten - Datenprodukte und Anwendungsbeispiele

Simon Jutz, Head, ESA Copernicus Space Office, ESA

Sentinel-1A: Berlin



Berlin

Nov. 2014

Copernicus Space Component: the dedicated Sentinels …

S1A/B: Radar Imaging Mission — 3 Apr 2014/early 2016

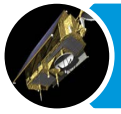
S2A/B: High Resolution Optical Mission — 23 June 2015/2016

S3A/B: Medium Resolution Imaging and Altimetry Mission — end 2015/2017

S4A/B: Geostationary Atmospheric Chemistry Mission — 2021/2027

S5P: Low Earth Orbit Atmospheric Chemistry Mission — 2016

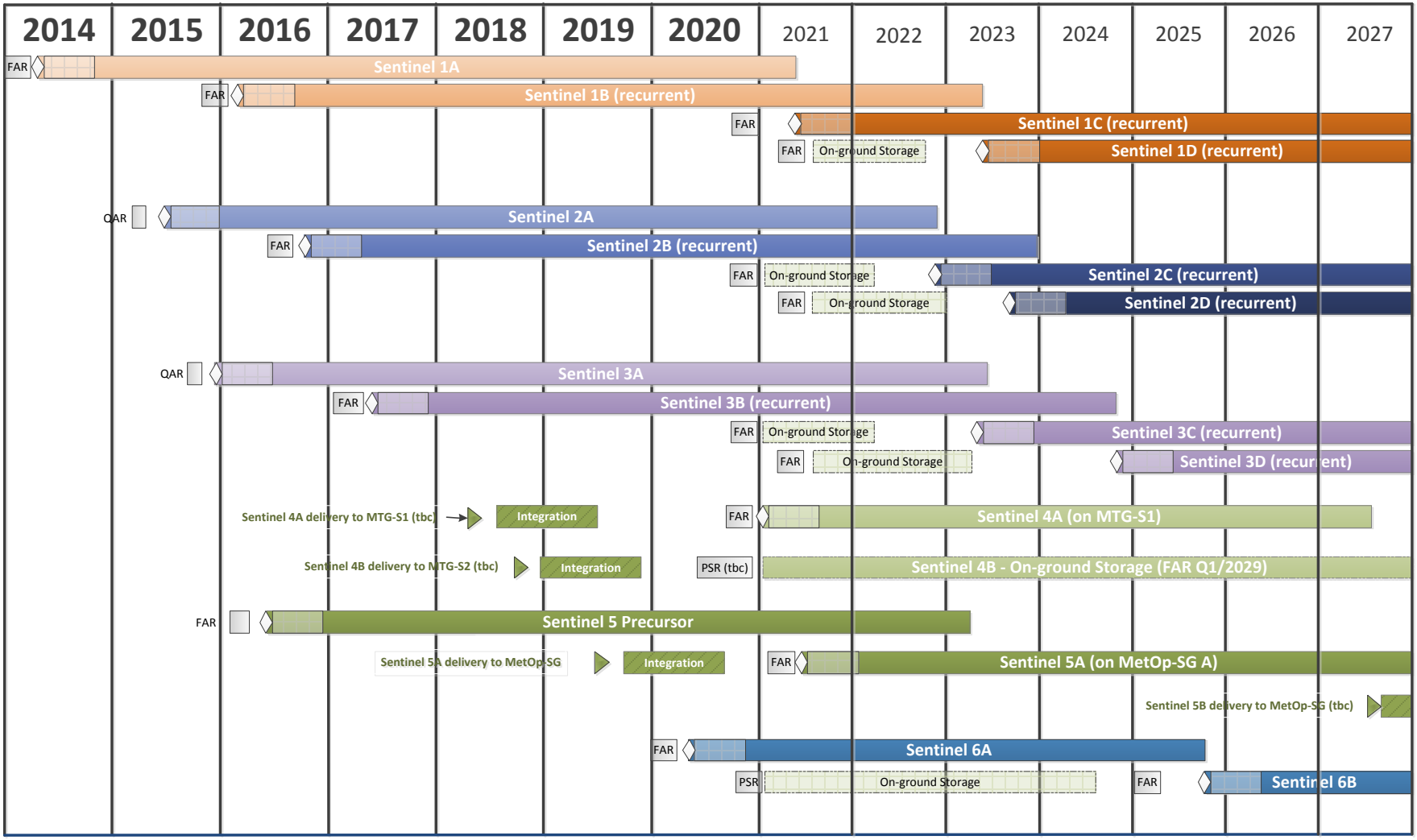
S5A/B/C: Low Earth Orbit Atmospheric Chemistry Mission — 2021/2027



S6A/B: Altimetry Mission — 2020/2025

… with a long-term operational perspective

Copernicus Constellation Deployment Schedule



Status: 23 October 2015

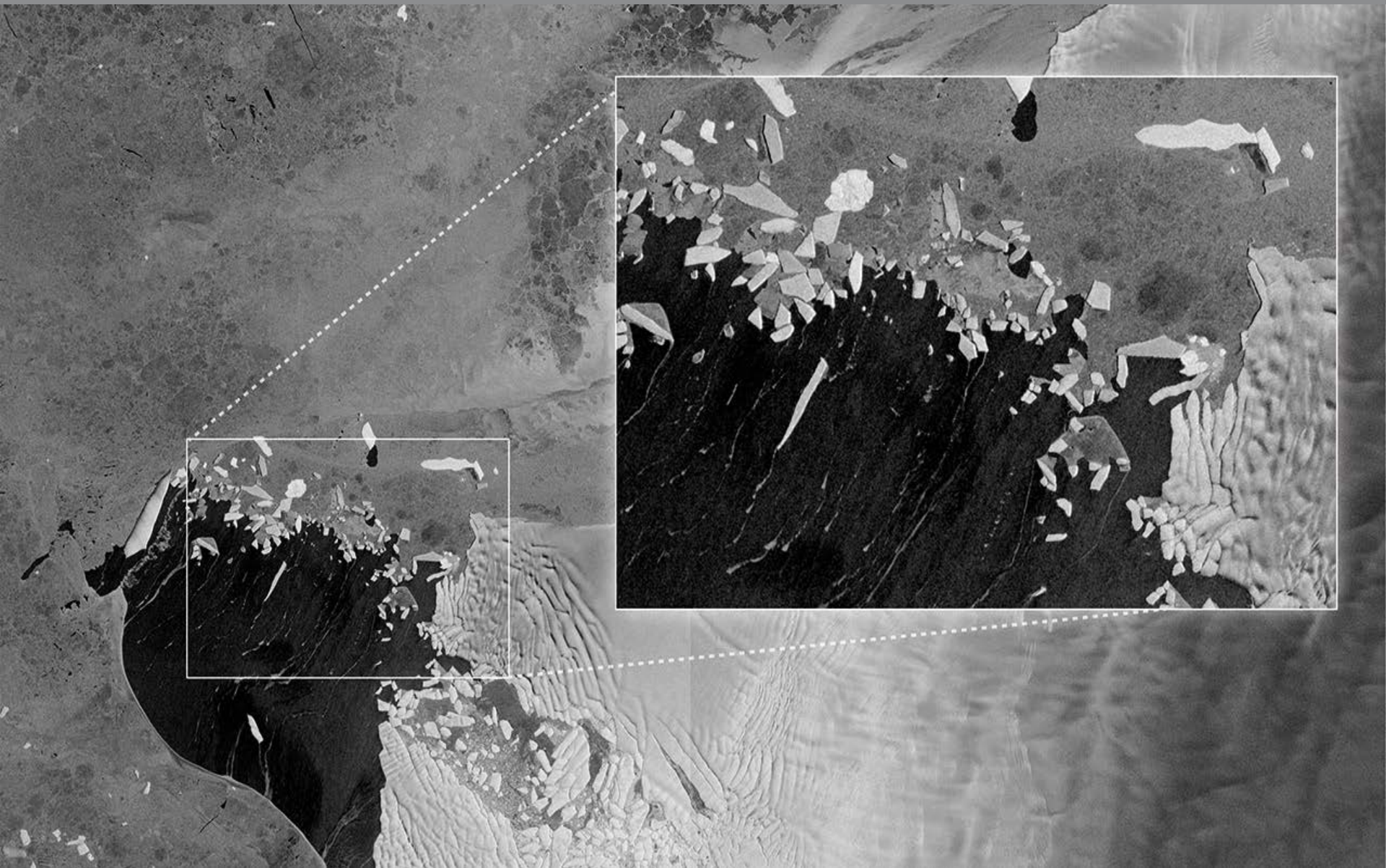
Copernicus Space Component: Role of ESA

- **Coordinator of overall Copernicus Space Component**
  - Definition of overall architecture and plan for future evolutions
  - Coordinating access to Copernicus missions from national, EUMETSAT and third party satellite owners
- **Development and procurement Agency for dedicated space infrastructure**
  - Development of first spacecraft and Ground Segment
  - Procurement of recurrent elements
- **Operator of Sentinel-1, Sentinel-2, Sentinel-3 (land) and Sentinel-5 precursor**
  - EUMETSAT is operator of Sentinel-3 (marine), Sentinel-4, Sentinel-5 and Sentinel-6

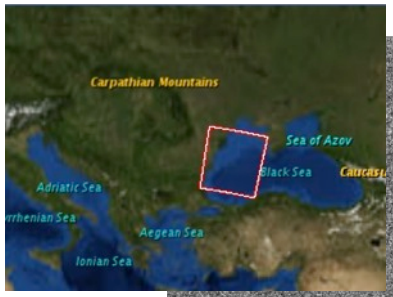
Sentinel-1 core operational products

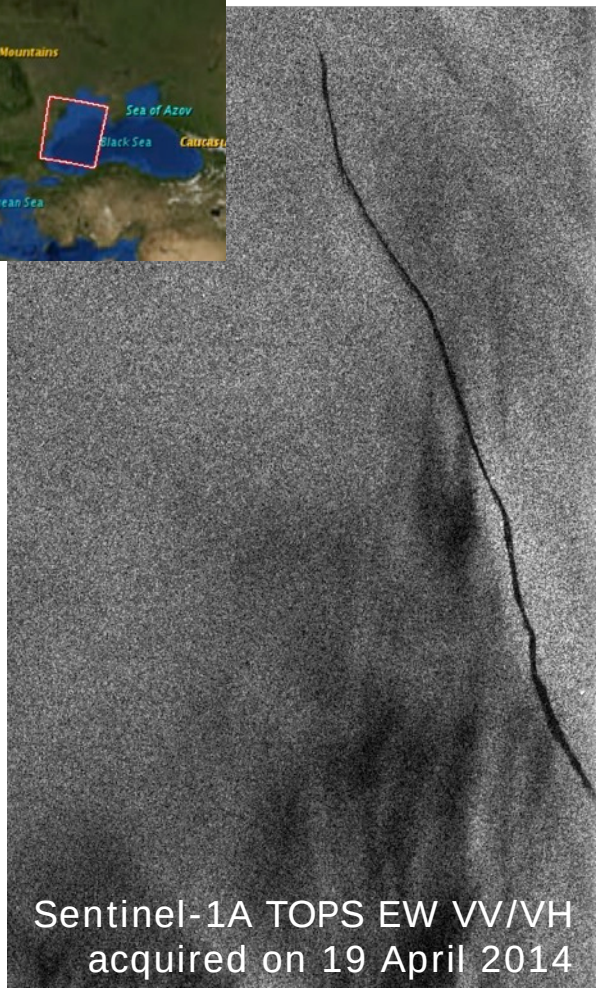
Sentinel-1 Core products			
	Product type and/or consolidation level	**Product content**	**Timeliness for Copernicus users (from data downlink)**
Level 0	**L0 standard product StripMap mode (SM)**	Compressed unfocused SAR raw data	< 1 h for some areas < 24 h for all acquired data
	Lo standard product Interferometric Wide Swath mode (IW)		
	Lo standard product Extra Wide Swath mode (EW)		
Level 1 SLC	**SM Single Look Complex (SLC)**	Focused SAR complex data, geo-referenced, provided in slant-range geometry	< 1 h for some areas < 24 h for all systematic regional data
	IW SLC		
	EW SLC		
Level 1 GRD	**SM Ground Range Detected (GRD) Full Resolution**	Focused SAR complex data detected, georeferenced, multilooked and projected to ground range geometry	< 1 h for some areas < 24 h for all systematic regional data
	SM GRD High Resolution		
	SM GRD Medium Resolution		
	IW GRD High Resolution		
	IW GRD Medium Resolution		
	EW GRD High Resolution		
	EW GRD Medium Resolution		
Level 2 OCN	**SM Standard L2 Ocean product**	Geolocated Geophysical parameters: • Ocean Wind Field • Ocean Wave spectra • Surface Radial velocity	< 1.5 h for some areas
	IW Standard L2 Ocean product	Geolocated Geophysical parameters: • Ocean Wind Field • Surface Radial velocity	
	EW Standard L2 Ocean product	Geolocated Geophysical parameters: • Ocean Wind Field • Surface Radial velocity	
	WV Standard L2 Ocean product	Geolocated Geophysical parameters: • Ocean Wind Field • Ocean Wave spectra • Surface Radial velocity	

First Images of Sentinel-1A

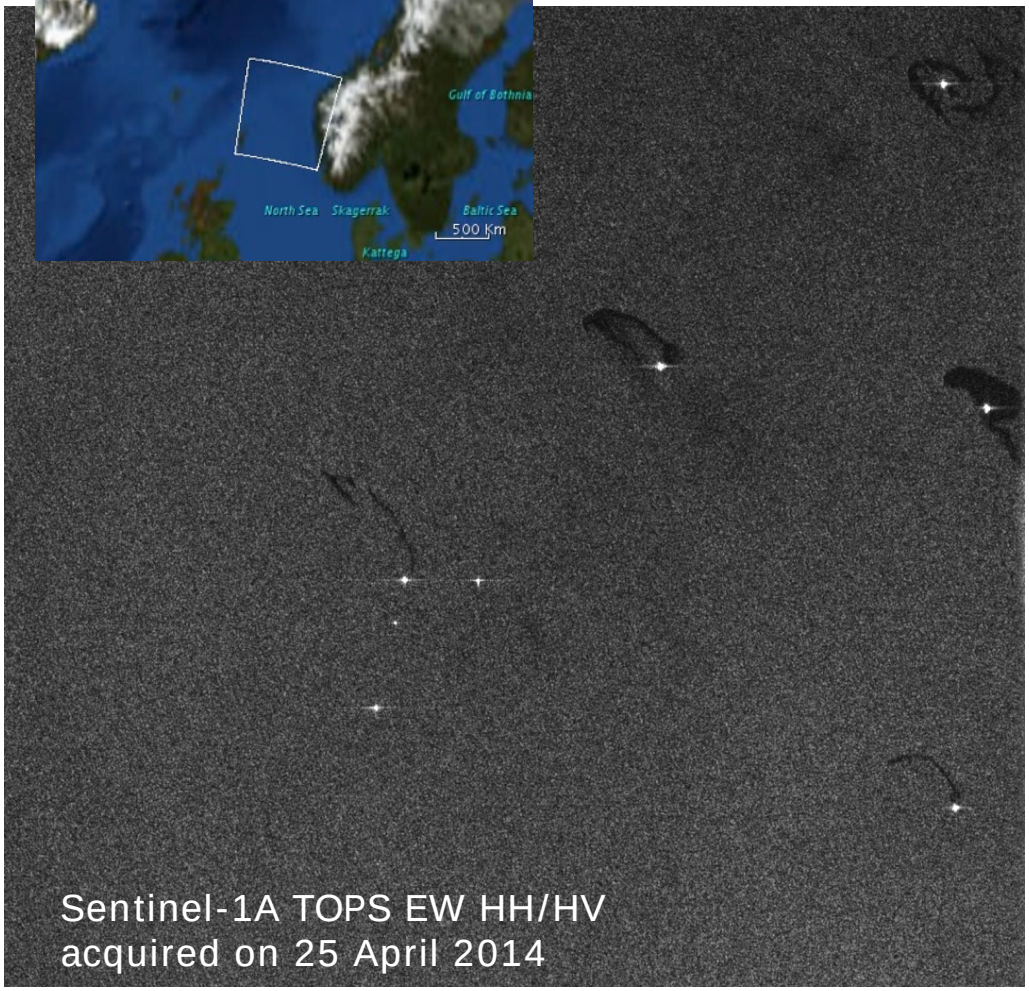


First Oil Spills Detected by Sentinel-1





Sentinel-1A TOPS EW VV/VH
acquired on 19 April 2014

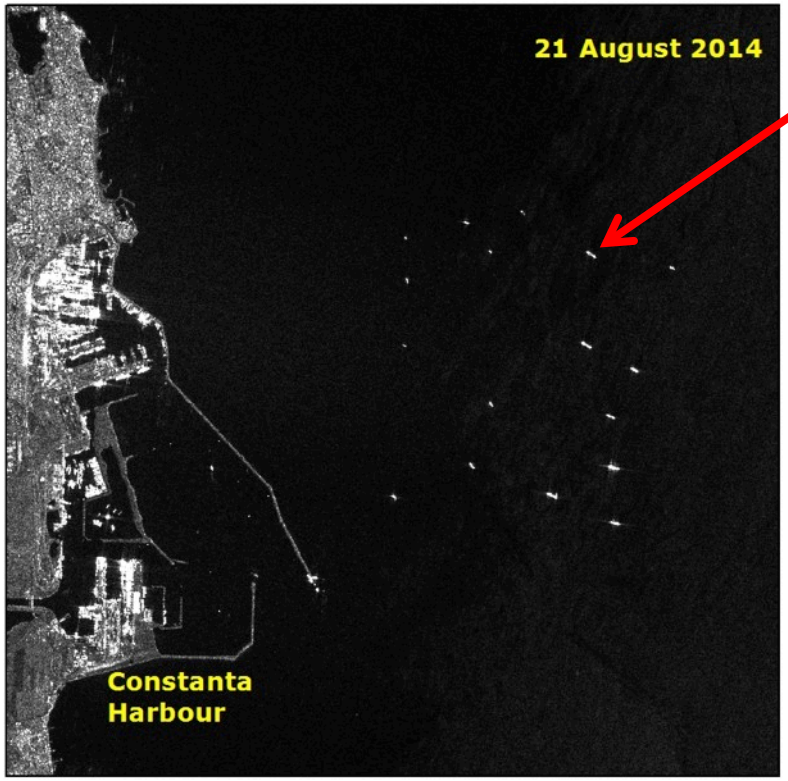


Sentinel-1A TOPS EW HH/HV
acquired on 25 April 2014

PRELIMINAY RESULTS
Ship detection

Correlation with AIS (Automatic Identification System) data*

*data acquired from www.marinetraffic.com



Wadi Alarish

Flag: Egypt

Home port: Alexandria

Build: 1994

Type: Cargo

Gross Tonnage: 37550

Deadweight: 64214 t

Length and Breath: 225m x32.24m

Status: Active

Sentinel-2 core operational products

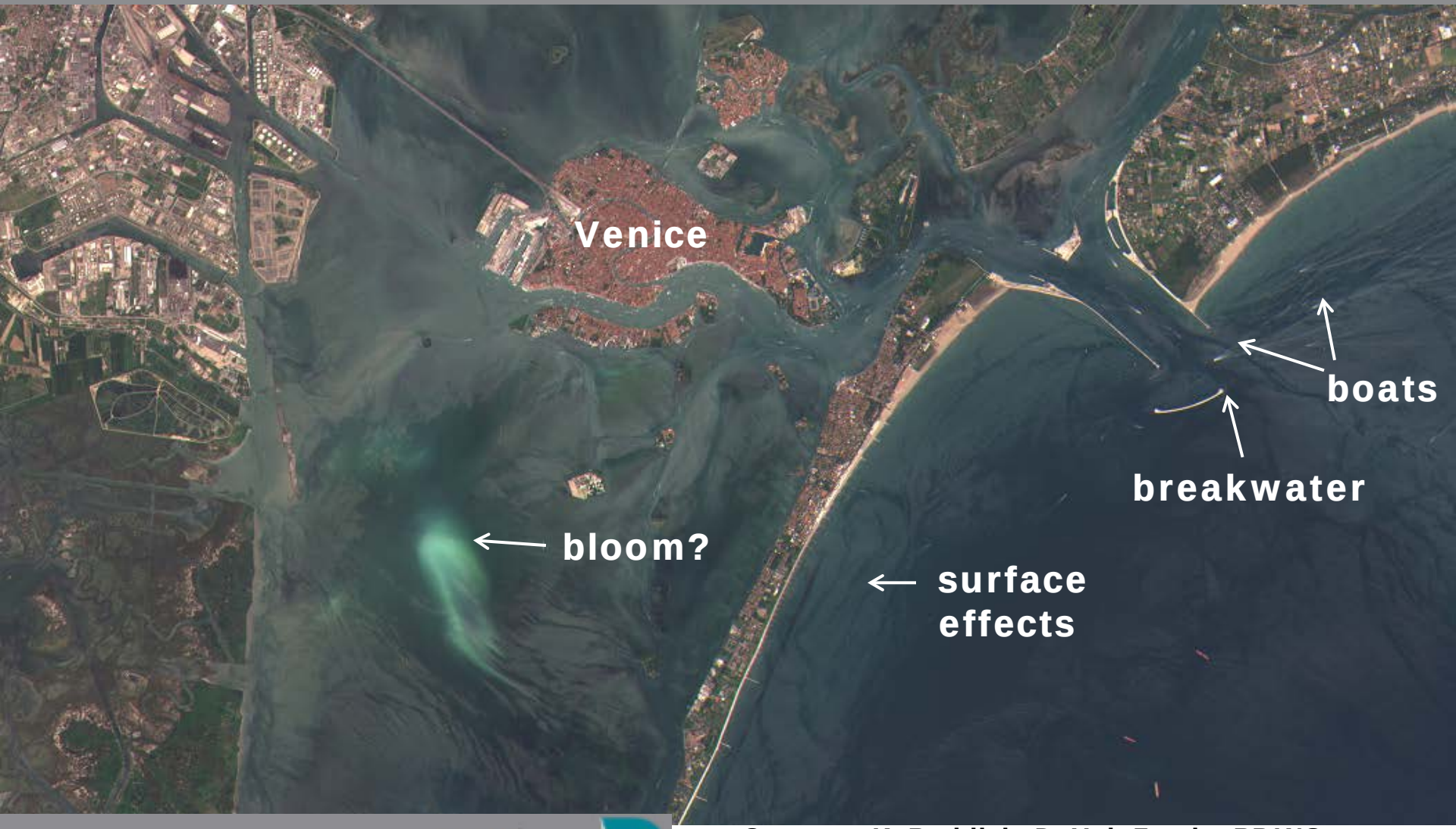
Sentinel-2 Core products			
	Product type and/or consolidation level	**Product content**	**Timeliness for Copernicus users (from data downlink)**
Level 1	MSI L1b	TOA radiances in sensor geometry	< 1.5 h
	MSI L1c	TOA reflectances in cartographic geometry	
MSI Level 2	MSI L2a	Bottom of Atmosphere reflectances in cartographic geometry	N/A

NB: Level 2 products are currently generated on the users' side by using a processor running on ESA's Sentinel-2 Toolbox. The possibility of making a standard core product systematically available from the Sentinels core ground segment is currently being assessed as part of the CSC evolution activities.

Strait of Gibraltar

Algeciras and Gibraltar

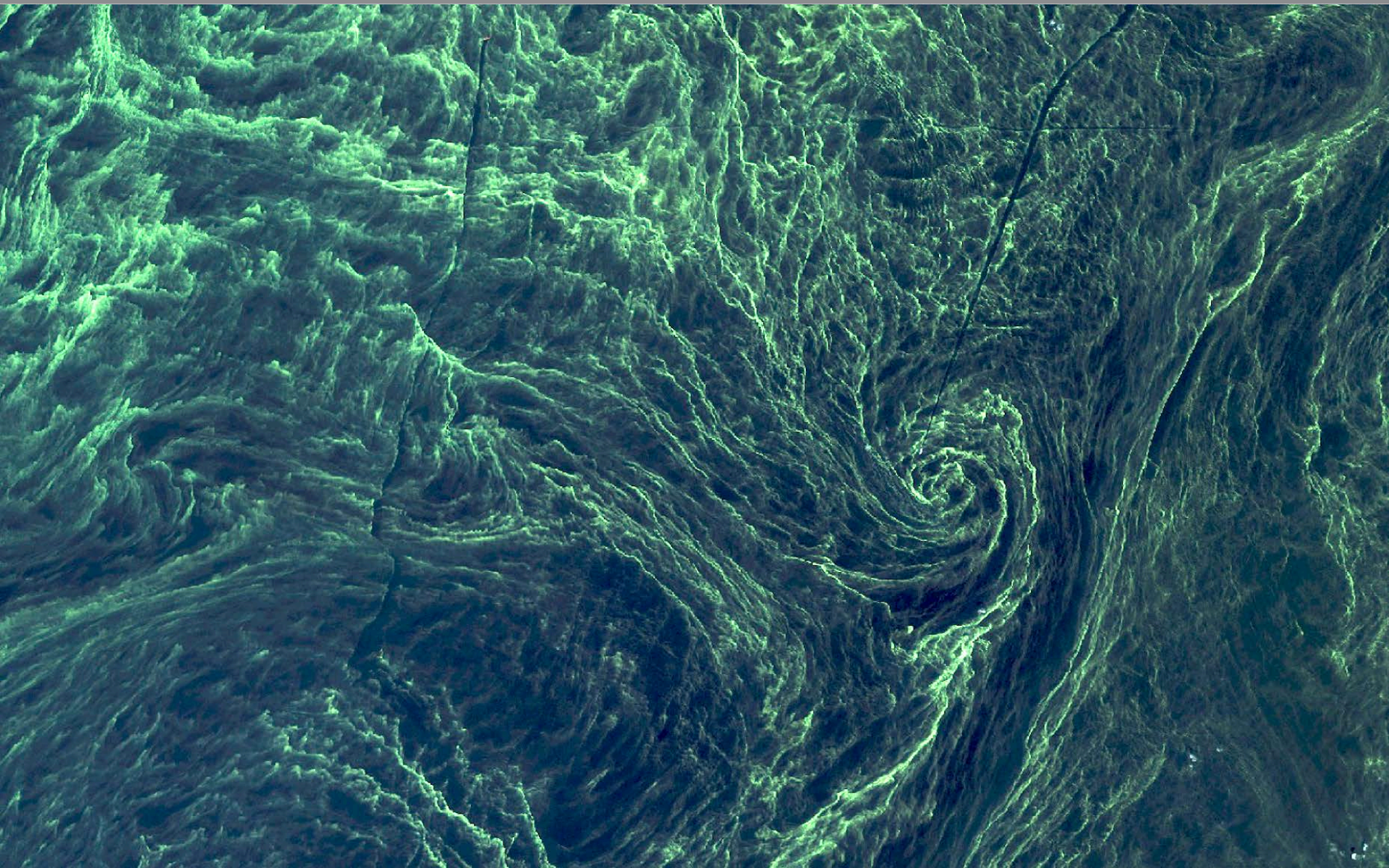
Land / Water interaction



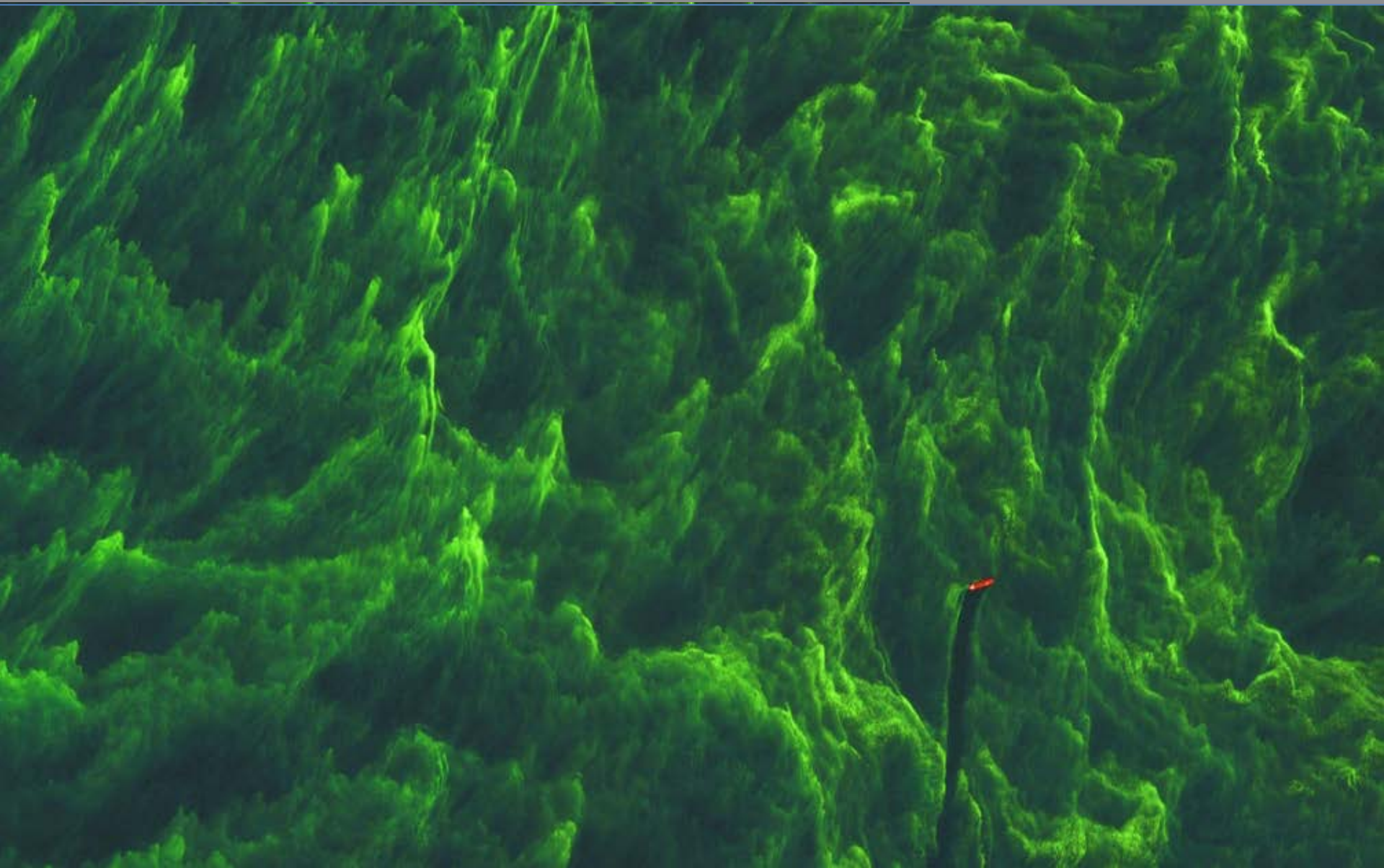
Courtesy K. Ruddick, D. V.d. Zande, RBINS

Copernicus Sentinel data 2015, RBINS processing

S2 & closed seas: Algal bloom in the Baltic Sea, August 2015



Stunning details: fronts and filaments of ocean biogeochemistry slashed open by shiptracks, wind blown structures…



Red Sea, Khuff, Saudi Arabia

Sentinel-3: Primary Objectives

- ***Sentinel-3 shall provide continuity of an ENVISAT type measurement capability for Copernicus Services, including:***

Continuity of ocean colour as good as ENVISAT MERIS or better

Continuity of SST as good as ENVISAT AATSR or better

Continuity of SSH as good as ENVISAT RA-2 or better with SAR capability derived from CryoSat-2

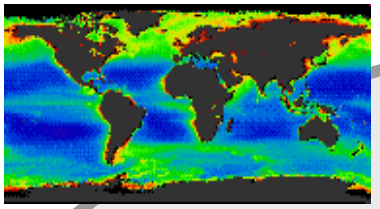
Continuity of land products (reflectance's, temperature) as good as ENVISAT MERIS and AATSR or better

Provide consistent quality L1 and L2 optical and topography products in a timely manner for Copernicus services

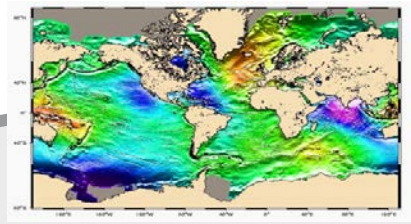
Continuity of SPOT VGT-P like products

Fire, River and lake height, atmospheric products…for Copernicus services

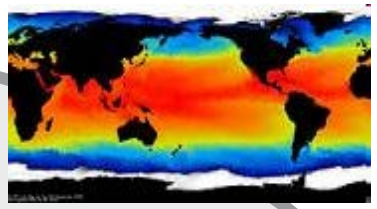
Sentinel-3: Primary Objectives



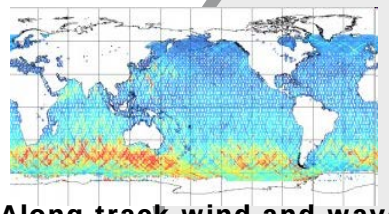
Ocean colour products
(Credit: MyOcean)



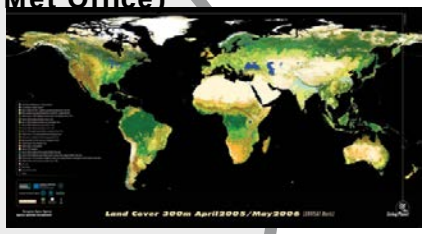
Sea Surface Height products
(Credit: CLS)



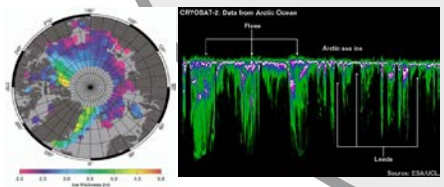
Sea Surface Temperature products
(Credit: Met Office)



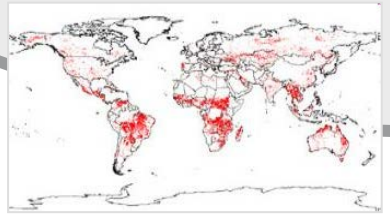
Along track wind and wave products
(Credit: AVISO)



Land cover products
(Credit: ESA)

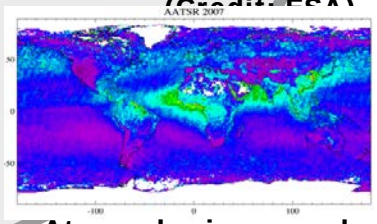


Sea Ice products
(Credit: UCL)



Fire products
(Credit: ESA World Fire atlas)

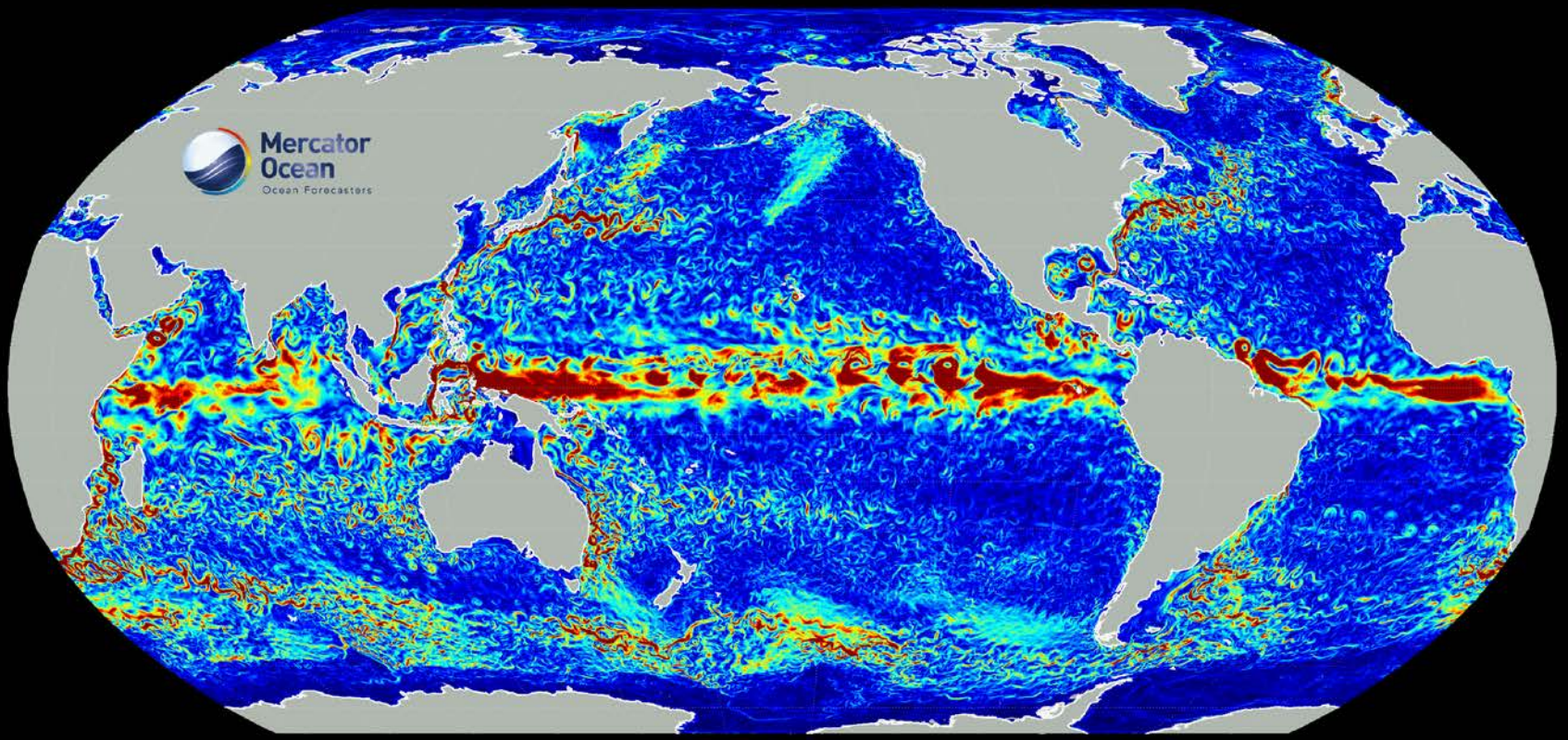
User parameters derived from L1b products (Credit: GEO)



Atmospheric aerosol products
(Credit: GlobAerosol)

Sentinel-3 Applications

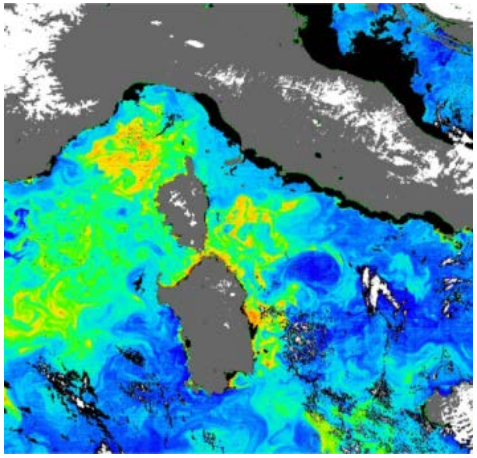
Mercator Global 1/12 Nov 2011 (6 day forecast) Surface Velocity m/s

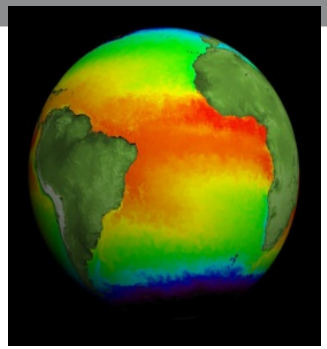


Sentinel-3 Level 2 Marine products

OLCI – Ocean Color:

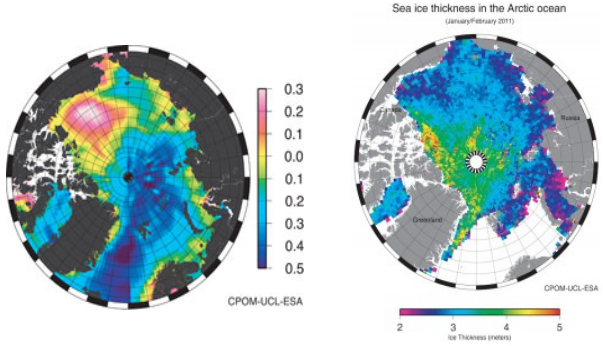
- Algal pigment concentration for Case 1 (open) and for Case 2 (coastal) waters
- Total suspended matter concentration
- Coloured dissolved matter absorption
- Photosynthetically active radiation
- Integrated water vapour column
- Aerosol optical depth





SLSTR:

- Sea surface temperature



SRAL (altimetry):

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

Sentinel-3 Level 2 marine products timeliness

3 h

48 h

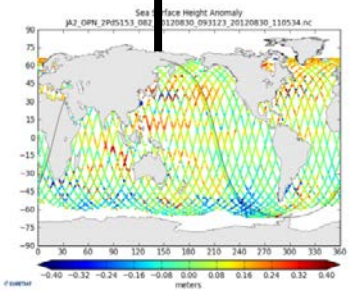
30 d

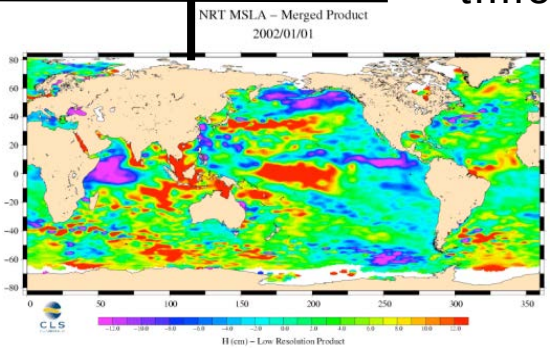
~1/2 y

time

NRT products

Weather and ocean forecasting, sea state forecasting





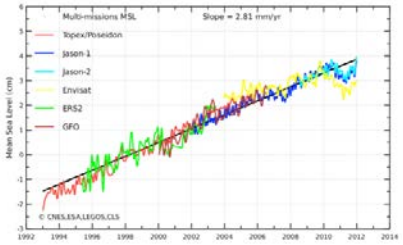
STC products

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*

Copernicus Data Policy

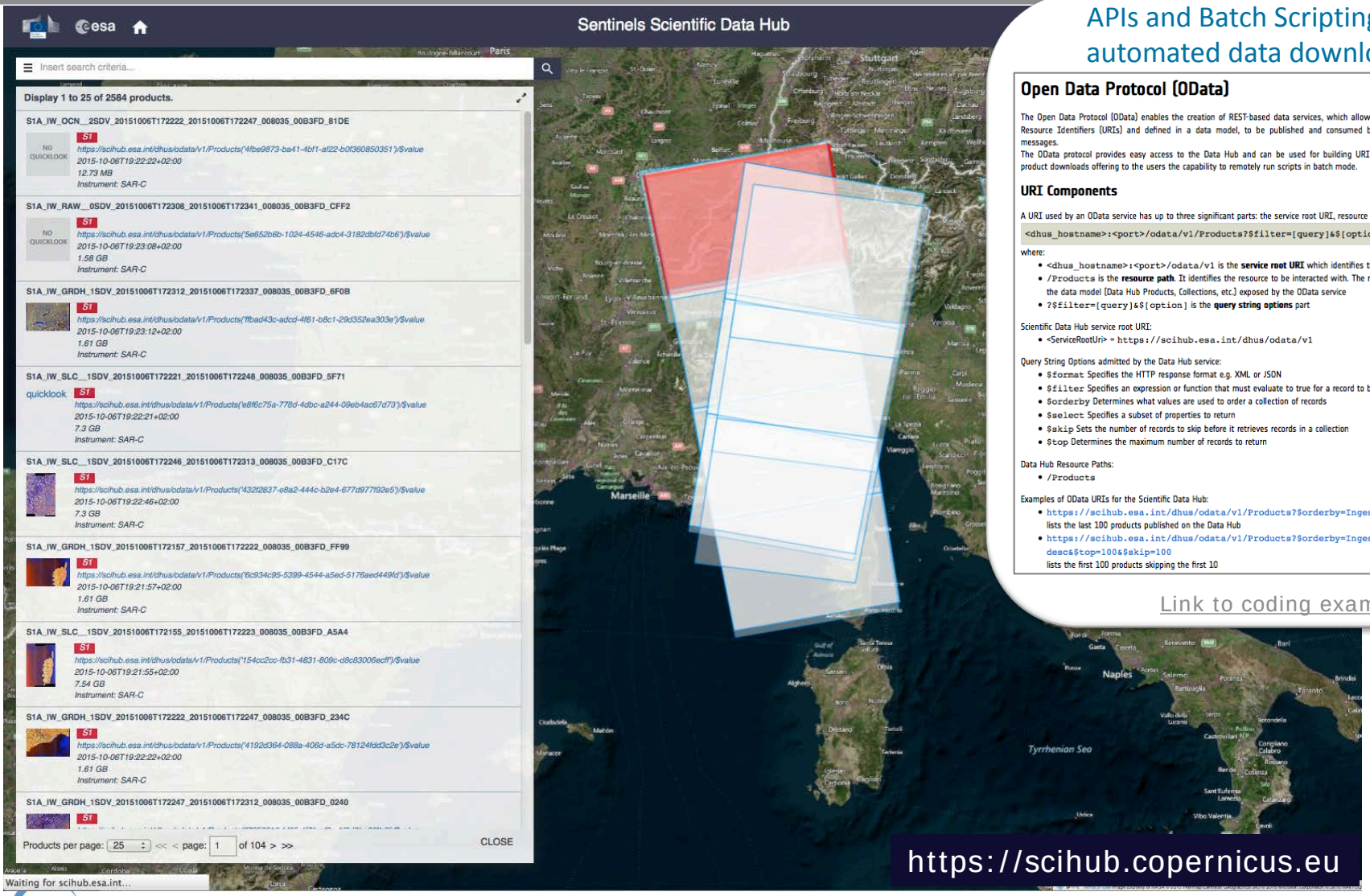
Sentinel Data Policy =
FULL, FREE, OPEN access

- **ESA Sentinel Data Policy** (Sep 2013) and **EU Delegated Act** on Copernicus Data and Information Policy (Dec 2013)
- Main principles of Sentinel data policy:
  - **Open** access to Sentinel data by anybody and for any use
  - **Free** of charge data licenses
  - Restrictions possible due to technical limitations or for security reasons

Copernicus Data Access

sentinels.copernicus.eu

How can you access Sentinels data?



APIs and Batch Scripting for automated data downloads

Open Data Protocol (OData)

The Open Data Protocol (OData) enables the creation of REST-based data services, which allow resources, identified using Uniform Resource Identifiers (URIs) and defined in a data model, to be published and consumed by Web clients using simple HTTP messages.
The OData protocol provides easy access to the Data Hub and can be used for building URI for performing search queries and product downloads offering to the users the capability to remotely run scripts in batch mode.

URI Components

A URI used by an OData service has up to three significant parts: the service root URI, resource path and query string options:

```
<dhus_hostname>:<port>/odata/v1/Products?$filter=[query]&$[option]
```

where:

- `<dhus_hostname>:<port>/odata/v1` is the **service root URI** which identifies the root of an OData service
- `/Products` is the **resource path**. It identifies the resource to be interacted with. The resource path enables any aspect of the data model (Data Hub Products, Collections, etc.) exposed by the OData service
- `?$filter=[query]&$[option]` is the **query string options** part

Scientific Data Hub service root URI:

- `<ServiceRootUri> = https://scihub.esa.int/dhus/odata/v1`

Query String Options admitted by the Data Hub service:

- `$format` Specifies the HTTP response format e.g. XML or JSON
- `$filter` Specifies an expression or function that must evaluate to true for a record to be returned in the collection
- `$orderby` Determines what values are used to order a collection of records
- `$select` Specifies a subset of properties to return
- `$skip` Sets the number of records to skip before it retrieves records in a collection
- `$top` Determines the maximum number of records to return

Data Hub Resource Paths:

- `/Products`

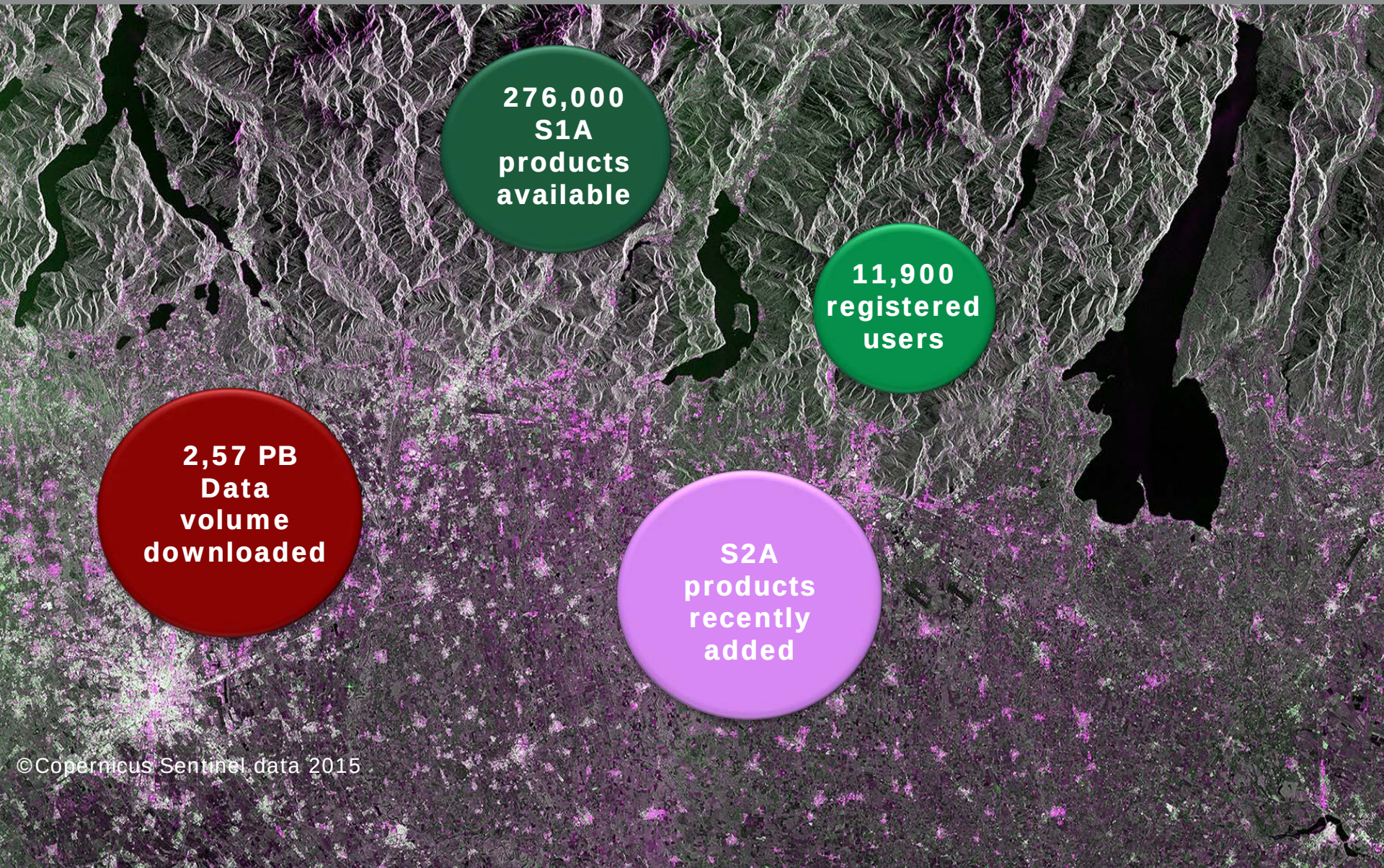
Examples of OData URIs for the Scientific Data Hub:

- `https://scihub.esa.int/dhus/odata/v1/Products?$orderby=IngestionDate desc&$top=100`
  lists the last 100 products published on the Data Hub
- `https://scihub.esa.int/dhus/odata/v1/Products?$orderby=IngestionDate desc&$top=100&$skip=100`
  lists the first 100 products skipping the first 10

Link to coding examples

https://scihub.copernicus.eu

Sentinel data access statistics (since October 2014)



PRAGUE 09-13 MAY 2016

living planet symposium | PRAGUE 09-13 May 2016

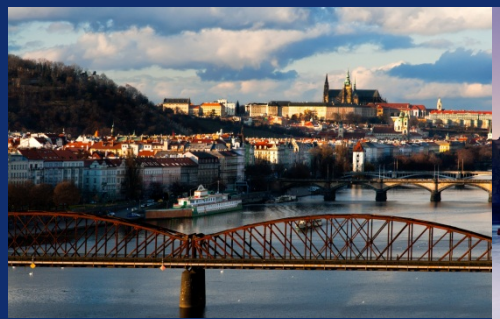
Main Objective:
Presentation of Exploitation Results based on ESA Earth Observation Measurements

Important Dates:

Deadline for abstract submission	16 October 2015
Notification of Acceptances	End January 2016
Issue of Preliminary Programme	February 2016
Opening of Registration to the Symposium	February 2016
Release of the Final Programme	at the symposium
Submission of Full Papers	at the symposium

Themes:
Atmosphere, Oceanography, Cryosphere, Land, Hazards, Climate and Meteorology, Solid Earth/Geodesy, Near-Earth Environment, Methodologies and Products, Open Science 2.0

http://lps16.esa.int



Danke fuer ihre Aufmerksamkeit!

ESA Copernicus website
http://www.esa.int/copernicus

EC Copernicus website
http://copernicus.eu