Study on Copernicus Sentinels' Products Economic Value

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Workshop: *Exploiting the value in EO data*
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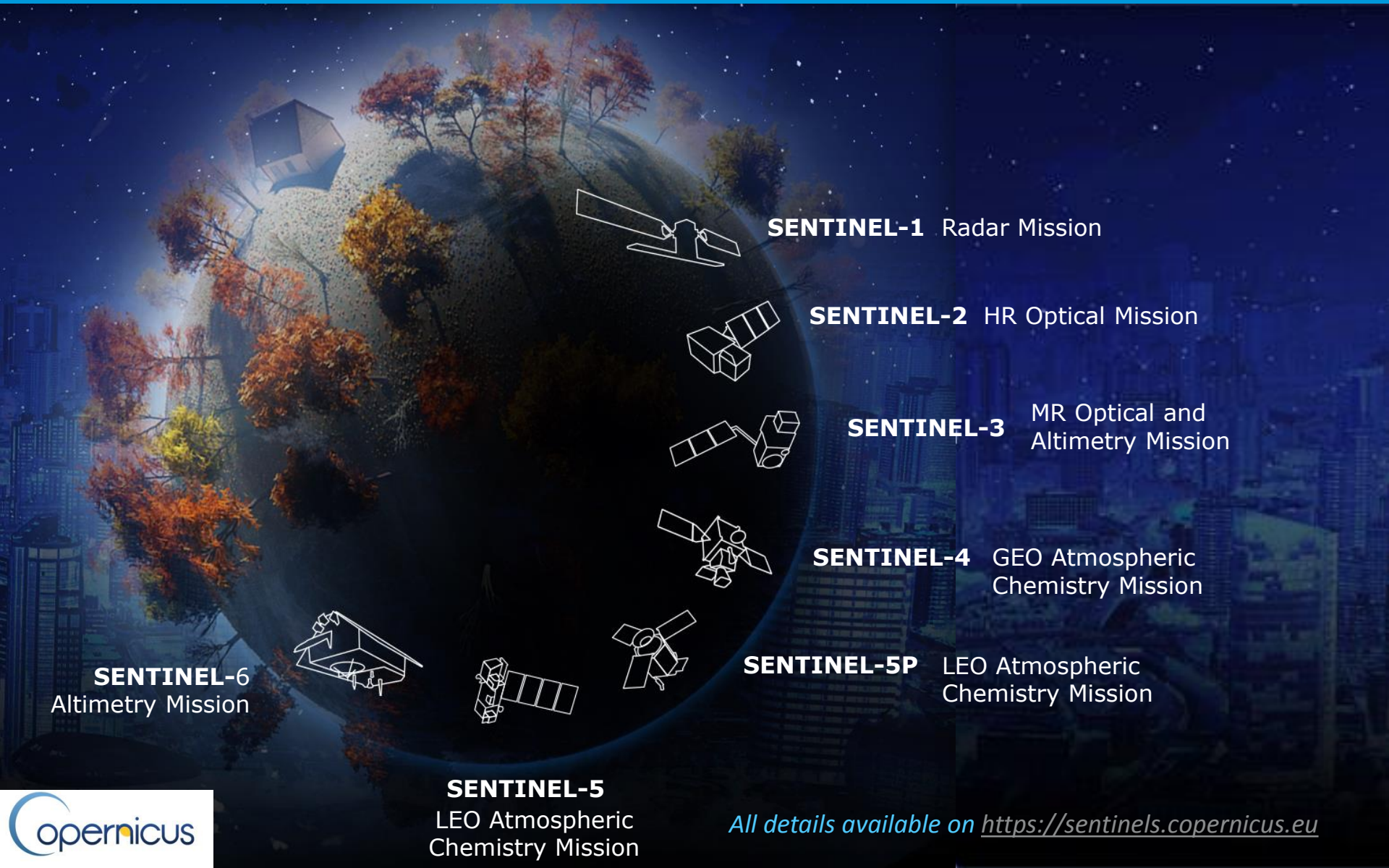
Outline of presentation

- **Copernicus Sentinels**
  - Short introduction and current status

- **The study on the economic value of Copernicus Sentinels data**
  - Rationale, approach, strengths and further developments

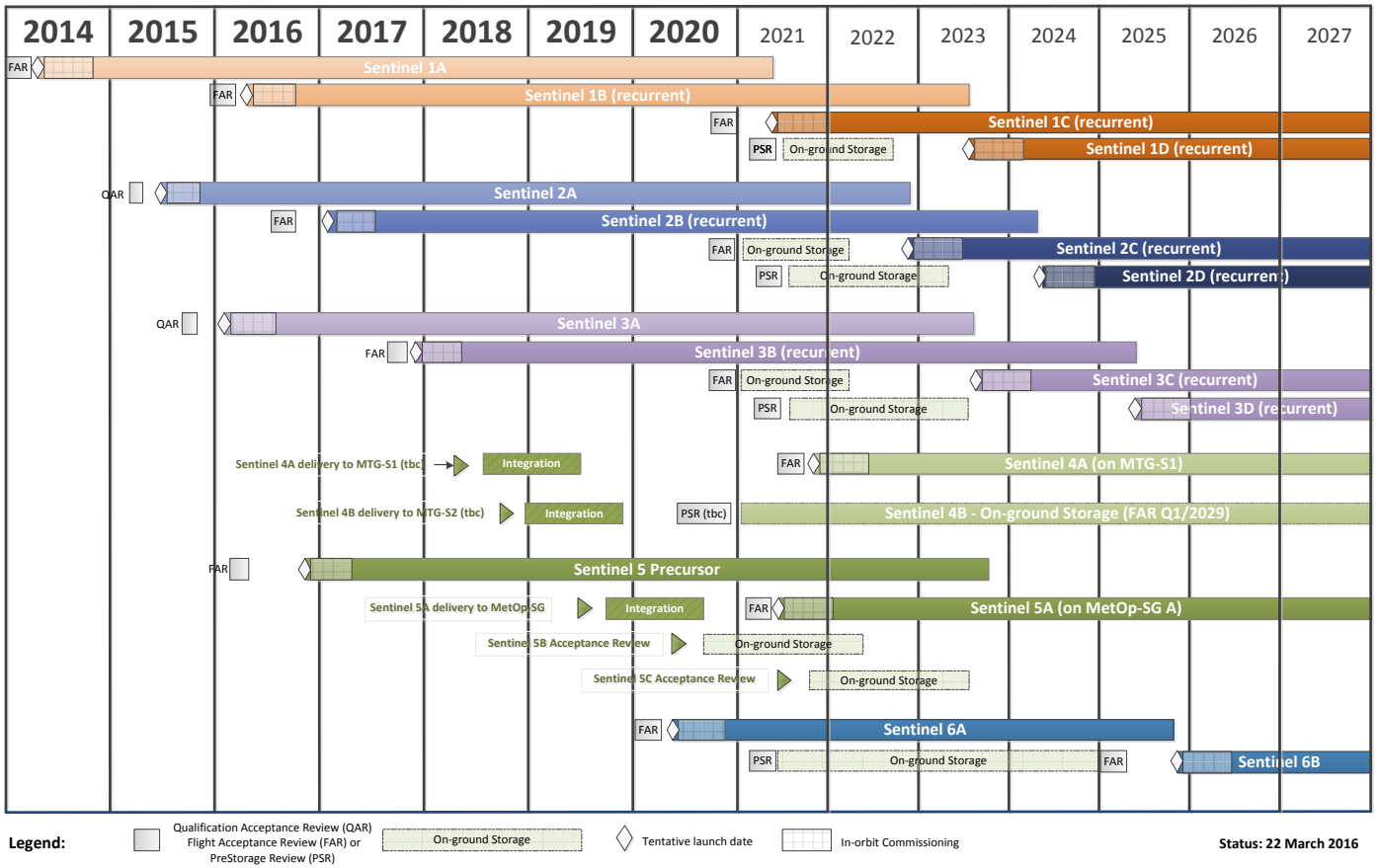
Sentinel missions



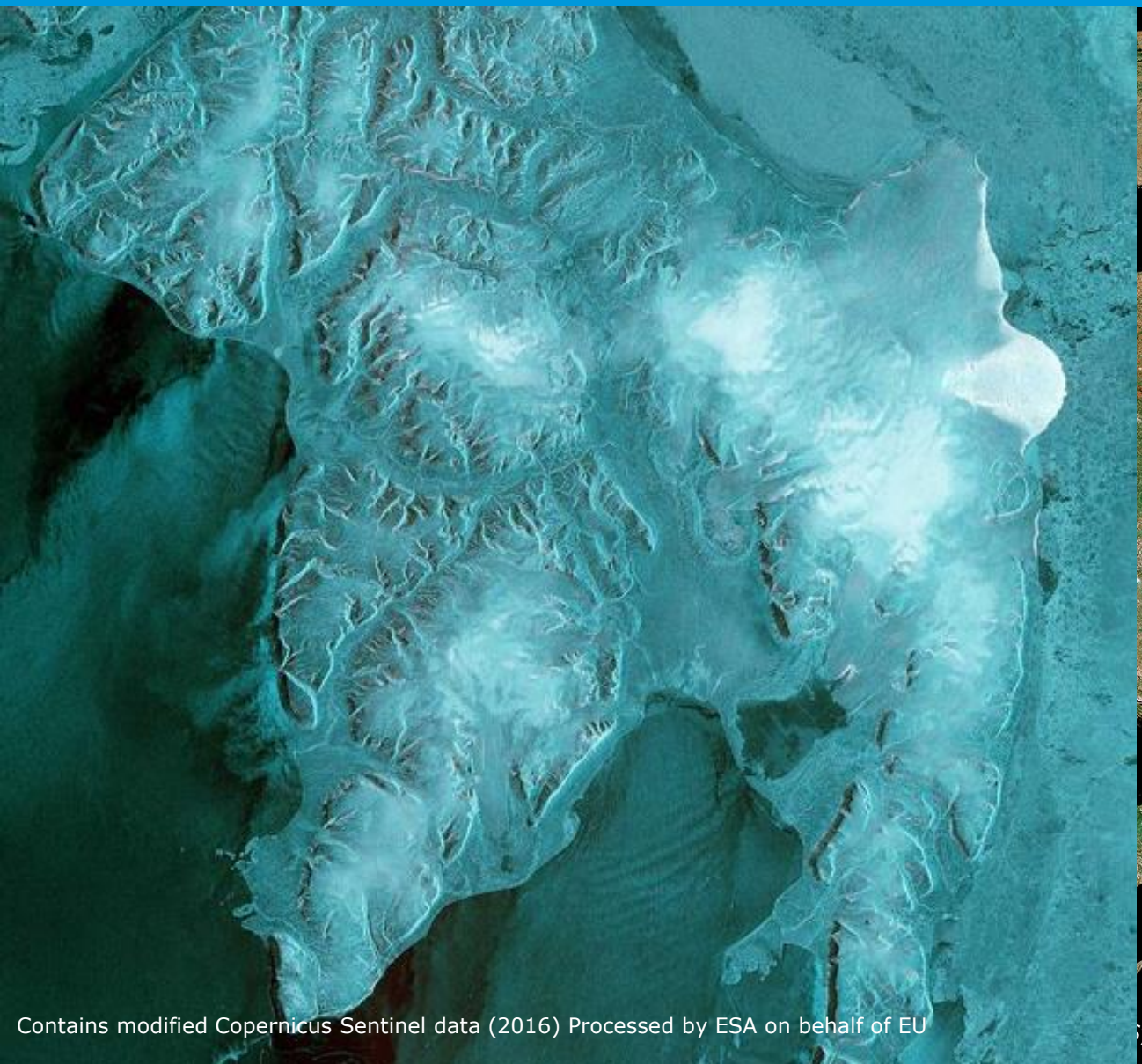
All details available on https://sentinels.copernicus.eu

Sentinels tentative deployment schedule

Copernicus Constellation Deployment Schedule



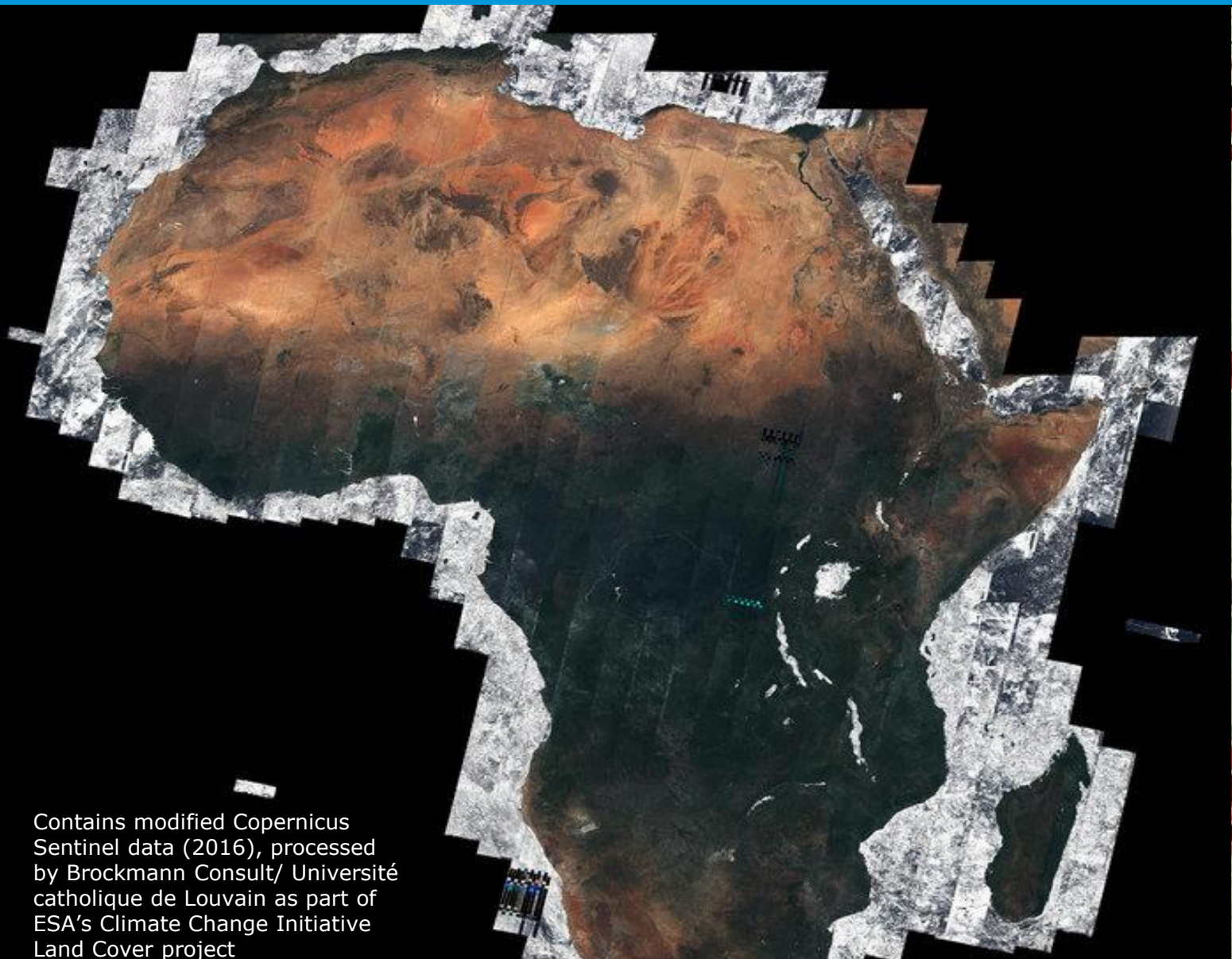
Sentinel–1 Mission



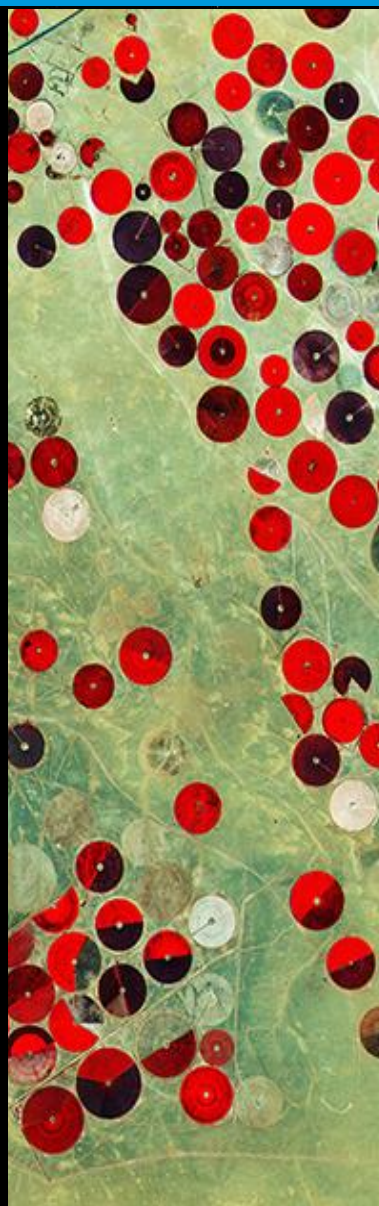
Contains modified Copernicus Sentinel data (2016) Processed by ESA on behalf of EU

Systems Inc. and ESA

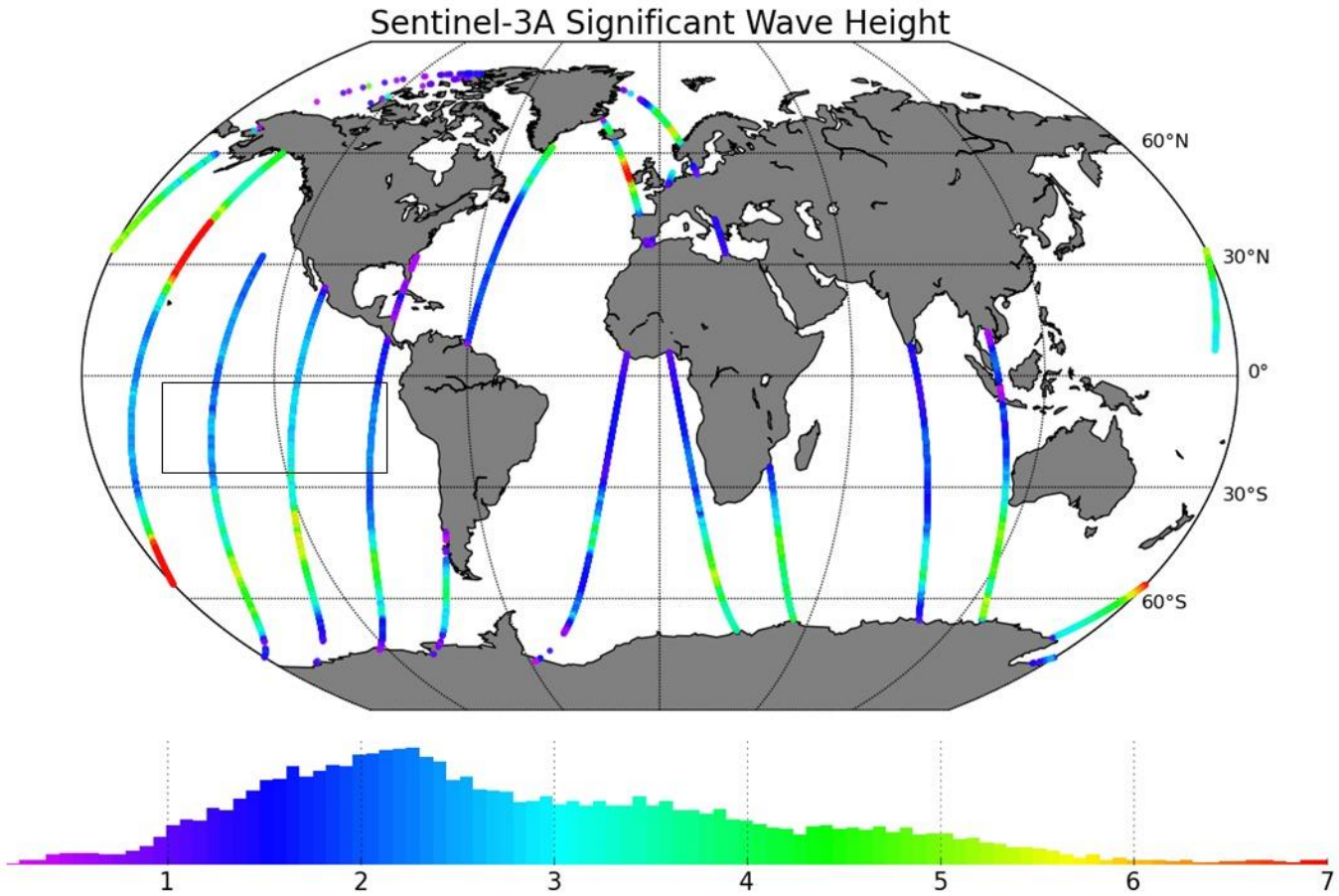
Sentinel–2 Mission



Contains modified Copernicus Sentinel data (2016), processed by Brockmann Consult/ Université catholique de Louvain as part of ESA's Climate Change Initiative Land Cover project



Sentinel–3 Mission



Copernicus Sentinel data (2016)

Sentinel-5P Mission

- Low Earth orbiting satellite, embarking a UV-VIS-NIR-SWIR spectrometer payload derived through tailoring of Sentinel-5 specifications
- Systematic acquisition with systematic processing and publication according to pre-defined product types
- Applications include monitoring of atmospheric chemistry, with advanced capabilities to study tropospheric variability
- UVN module of TROPOMI provided as a national contribution by the Netherlands

Link to Sentinel-3 Web Pages

Sentinel data

Sentinel data are available:

- ❑ **Over a very long term**
- ❑ **Systematically, in an operational fashion**
- ❑ **Open and free**

Sentinel data access @ ESA

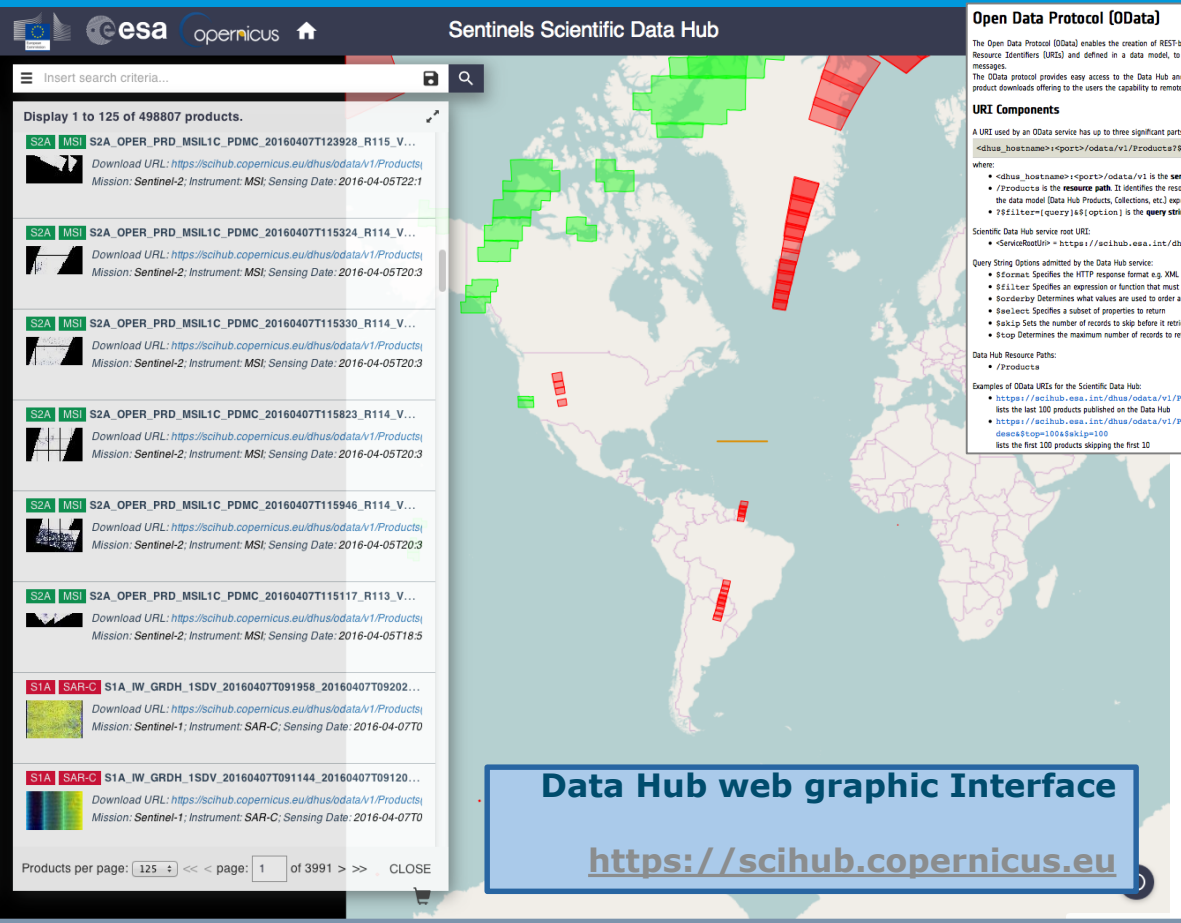
ESA implements on line access to Sentinel products via dedicated data hubs

Open access data hub https://scihub.copernicus.eu

- On-line self-registration
- Free access to ALL products (>560000 today)
- Powerful API interface
- Open source SW (incl. toolbox)

Additional data access hubs deployed to provide tailored services to specific users, e.g. EU/ESA Member States, International Partners

Sentinel data access tools @ ESA



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

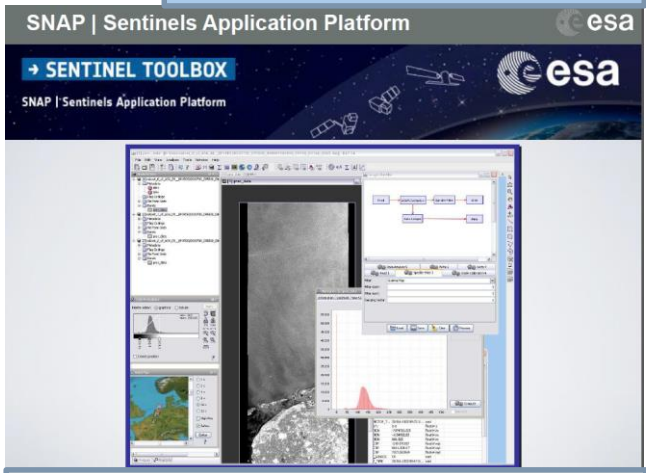
Data Hub APIs interface

Data Hub web graphic Interface

https://scihub.copernicus.eu

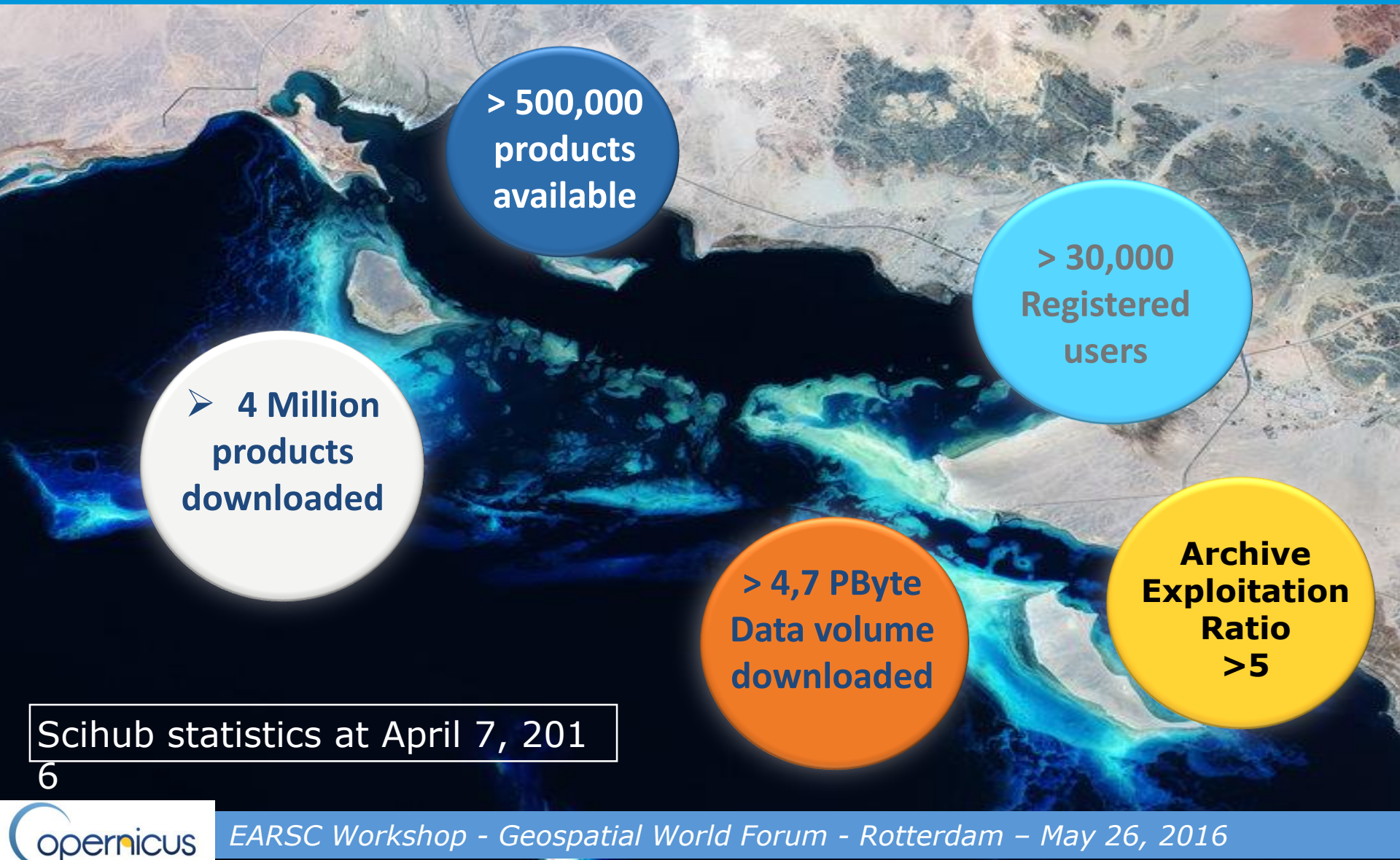
Data Hub Server available as open source software
https://github.com/SentinelDataHub/DataHubSystem.

SNAP Sentinel toolbox



Sentinel Toolbox available as open source software
https://github.com/senbox-org

Data access stats from the open and free data hub



Scihub statistics at April 7, 2016

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Preamble

1. Copernicus shall contribute to the following general objectives:

(a) monitoring the Earth to support the protection of the environment and the efforts of civil protection and civil security;

(b) maximising socio-economic benefits, thereby supporting the Europe 2020 strategy and its objectives of smart, sustainable and inclusive growth by promoting the use of Earth observation in applications and services;

[Copernicus Regulation, Art.4.1]

Various ex-ante studies foresee important benefits brought from the Copernicus Programme

Benefits are expected from Sentinels: their demonstration is vital to support further user uptake and to sustain investments

Preamble

- Wide acceptance of space-based solutions as a supporting tool for (non-space) end users remains the main weakness of EO services development
- EO market structure relatively poorly consolidated with a limited number of identified “mature”, self-sustained operational uses
- Copernicus, with its operational, long-term sustained data provision and its open and free data policy is expected to boost EO applications
- Copernicus may change the traditional EO operational paradigms (e.g. time to business, entry barriers): benefits estimation requires new approaches to be developed and maintained in the long term

Rationale for the approach

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Global comprehensive figures, Linkable to consolidated registries

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Very broad assumptions

Complementary approaches, potentially supporting mutual modelling improvements and asymptotically converging in the very long term.

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Limited to analysed use cases

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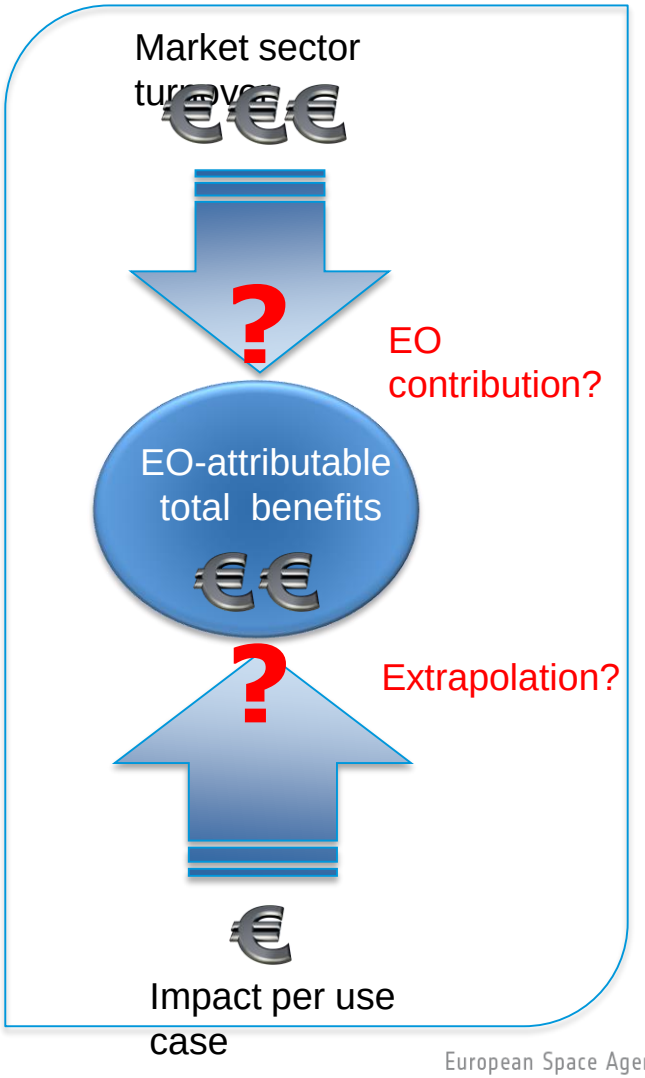
Strong link with EO technology; Reduced uncertainty (for the selected cases)



Rationale for the approach

- Bottom up approaches, taking into account the specificities of the users and data use, can provide important indications for technological developments and valuable examples of successful exploitation, potentially stimulating further user uptake.

- EO-derived benefits should be systematically monitored, via both top-down and bottom-up approaches

The study on the economic value of Sentinels data

ESA contract started with EARSC on Jan 2015: "*Assessing the detailed economic benefits derived from Copernicus Earth Observation data within selected value chains: a bottom-up study survey*"

Available @ Link

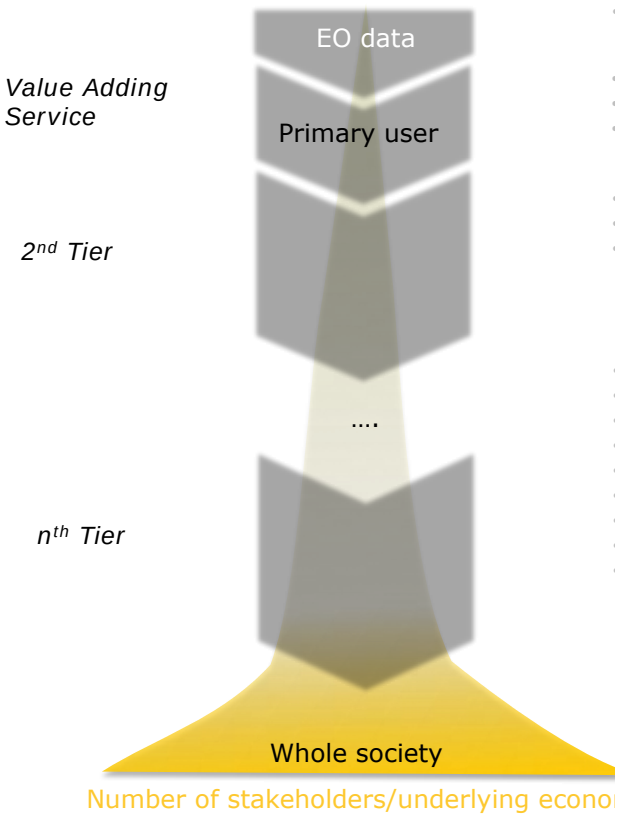
Study winning tips

- Value chain approach
- Based on concrete experience of people working in the field
- Explicit assumptions, models and uncertainties

The Value Chain approach

"From satellites to citizens"

- It is at least as important to understand the mechanisms through which EO data affect economy and society as the precise estimates themselves.
- The value chain approach developed for the study seems effective in showing these mechanisms.



The experience of people working in the field

The contribution of stakeholders is key to obtain reliable figures and showcase benefits in a most convincing way

Acknowledgments:

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EARSC THE GREEN LAND EARSC Economic Value Study @ ESA Living Planet; 12th May 2016 esa

Explicit assumptions and uncertainties

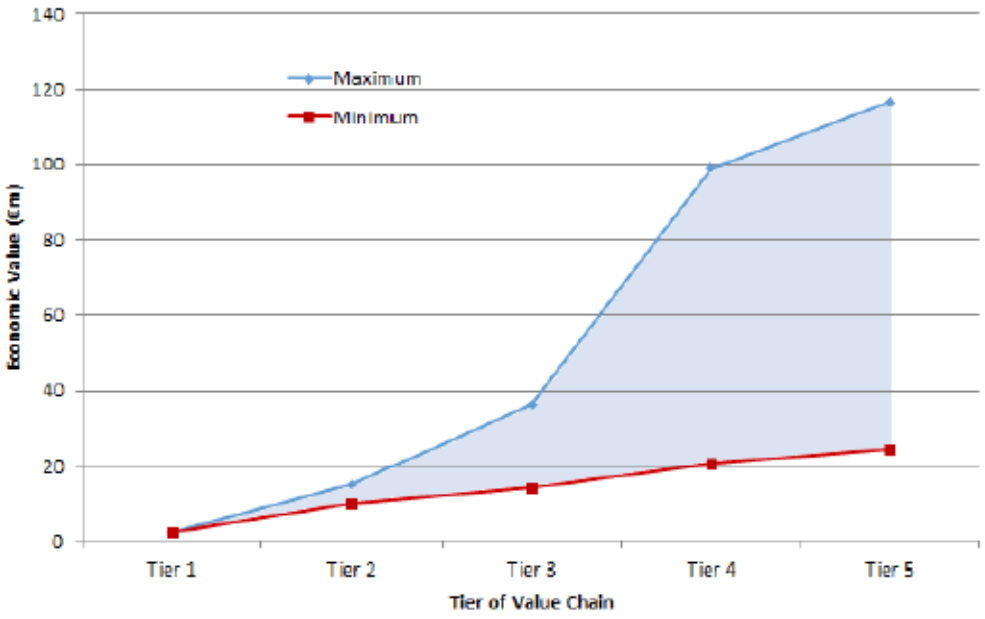

Figure 9-2: Cumulative economic value at each tier of the value chain per annum

[from EARSC Report, 2015]

Direct revenues from primary users is just the tip of the iceberg

What's next?

- The study is mostly based on results from pre-Sentinels era: operational paradigm changes might be difficult to anticipate
  ➔ time validity of the collected figures might be limited
- Copernicus satellite infrastructure is being progressively deployed
  ➔ meaningful assessments for Copernicus can only be planned in the long run
- In the long run, the accumulation of a sufficiently rich set of case studies (across different applications, scales of assessment and geographic areas) might allow a comprehensive overview
- New contract framework envisaged extending over four years, to set the basis for future systematic assessments (IITT published on EMITS and TED)

Conclusions

- Beyond the hard figures, the study convincingly shows that there is a traceable impact linking satellite imagery to the local economy and society ("from satellites to supermarkets")
- The methodology looks promising and worth to be enlarged to showcase additional value chains and benefits types
- The demonstration of Sentinels-derived benefits is vital to support further user uptake and to sustain investments
- This requires new approaches and cooperation with core stakeholders and beneficiaries

Thank you

for your kind attention

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