



Value in EO Workshop

Round Table V: Measuring impacts on  
advancements in understanding (in science and  
technology)

Dimitrios Papadakis (EARSC)

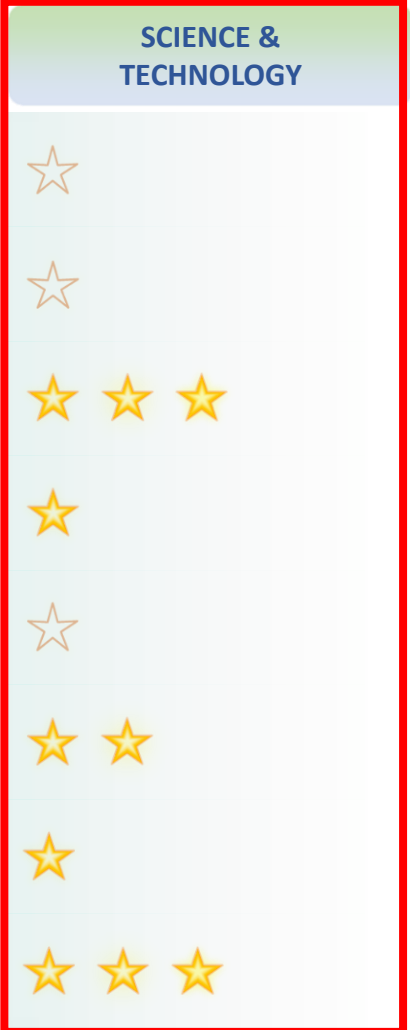




# Focusing on scientific and technological impacts

RT V: Science and Technology

|  | ECONOMIC | ENVIRONMENTAL | REGULATORY | INNOVATION & ENTREPRENEURSHIP | SCIENCE & TECHNOLOGY |
|--|----------|---------------|------------|-------------------------------|----------------------|
| Farming in Denmark                           | ☆☆☆      | ☆☆☆           | ☆☆☆        | ☆☆☆☆☆                         | ☆                    |
| Flood management in Ireland                  | ☆☆☆      | ☆             | ☆          | ☆                             | ☆                    |
| Ice navigation off Greenland                 | ☆☆☆☆     | ☆☆            | ☆          | ☆                             | ☆☆☆                  |
| Farming in Poland                            | ☆☆☆      | ☆☆☆           | ☆☆☆        | ☆☆☆☆☆                         | ☆                    |
| Winter navigation in the Baltic              | ☆☆☆☆☆    | ☆             | ☆          | ☆                             | ☆                    |
| Forestry management in Sweden                | ☆☆☆      | ☆             | ☆☆☆☆☆      | ☆☆                            | ☆☆                   |
| Infrastructure management in the Netherlands | ☆☆☆☆     | ☆             | ☆          | ☆☆☆                           | ☆                    |
| Growing potatoes in Belgium                  | ☆☆☆      | ☆☆☆           | ☆☆         | ☆☆☆                           | ☆☆☆                  |



Advancing the understanding and measurement of the societal benefits of Earth Observations, Rome, July 2019



# Impacts on science and technology

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## How can we identify the impacts of EO on science and technology?

- Potential signals include:
  - Academic output
  - Utilisation in R&D projects
  - Human capital (e.g. researchers and students)
  - Applied science leading to operational services

### Challenges:

- Isolating specific programmes and removing false positives
- Attribution / causality
- Impact via data applications

# Measurements of science and technology

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| Category                 | What it can mean                        | Examples of possible indicators/markers   | Measurement approaches                                |
|--------------------------|---|---|---|
| Human capital            | EO data subject of high-level education | Number of researchers<br>Number of EO/RS courses<br>Number of students on courses | University databases/desk research                    |
| Research and development | EO data used in R&D projects            | Number of R&D projects using Sentinels data (outside from space Calls)            | Open data on projects + semi-automated classification |



# Measurements of science and technology

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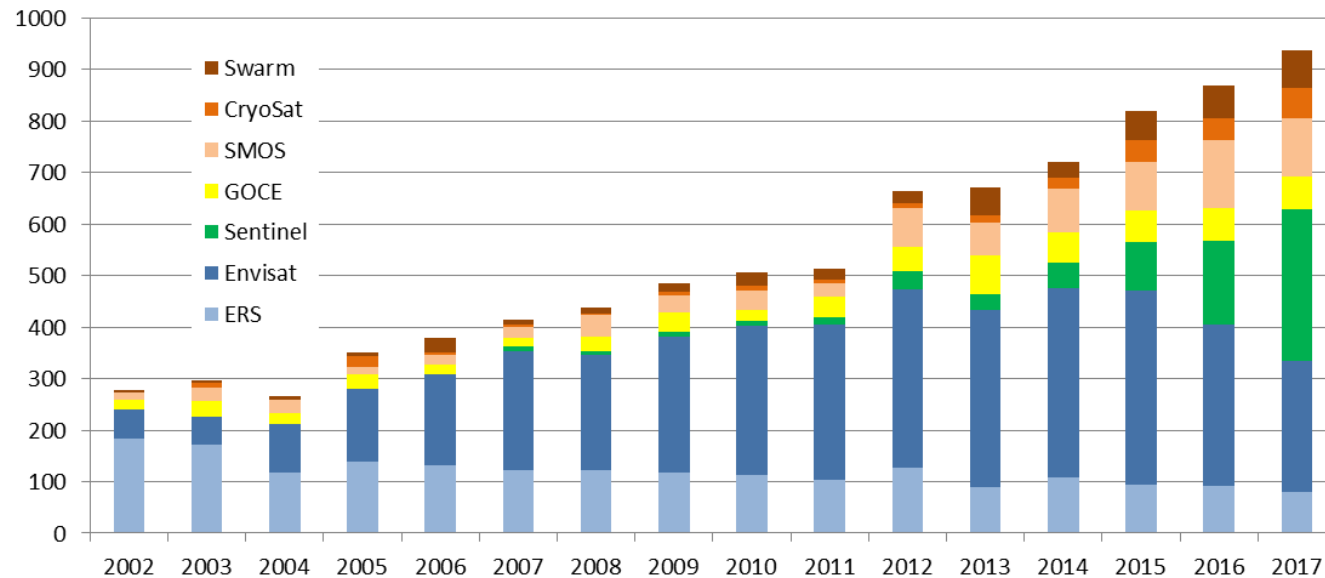
| Category                                | What it can mean  | Examples of possible indicators/markers                | Measurement approaches       |
|---|---|--|------------------------------|
| Applied science to operational services | Sentinels data used within research centres to develop operational services | Research institutes contribution in the SEBS use cases | Interviews with stakeholders |



# Measurements of science and technology

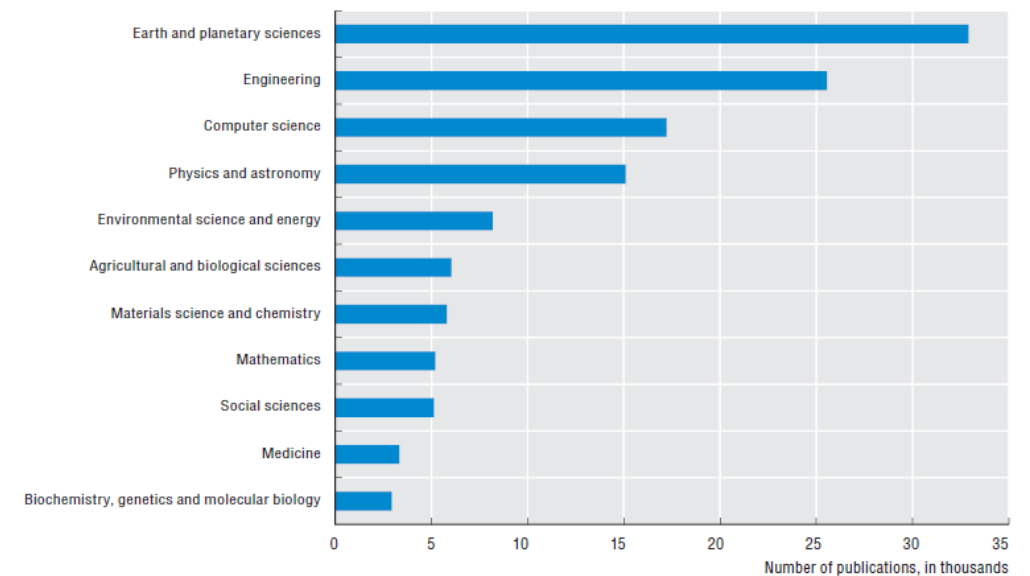
RT V: Science and Technology

| Category        | What it can mean                            | Examples of possible indicators/markers                               | Measurement approaches |
|-----------------|---|---|------------------------|
| Academic output | EO data used to perform scientific research | Number of scientific publications<br>Number of theses (PhD, Master's) | Bibliometrics          |



16.2. Scientific production in satellite technologies by subject area

Number of publications, 2008-13



ESA/Albani (2018) ESA User Metrics, Presentation at 3rd GEOSS Data Providers Workshop

OECD (2014), The Space Economy at a Glance



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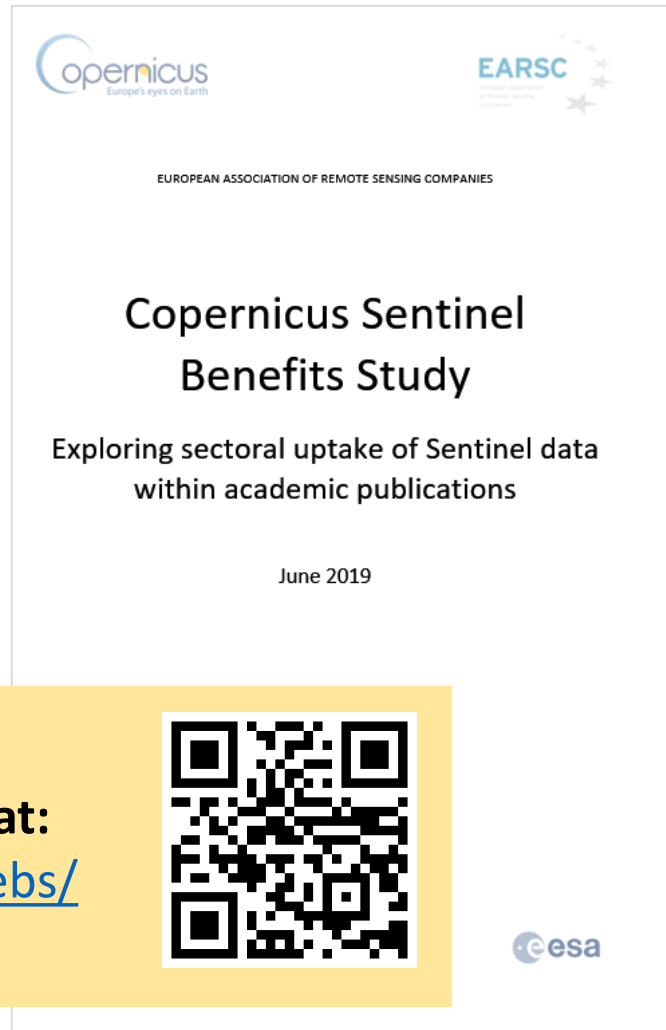


# What have we done? Study overview

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## Exploring sectoral uptake of Sentinel data within academic publications

- Approach: Bibliometric indicators on academic output related to Sentinels (1998-2018+2019 Q1)
- Aims: Develop an understanding of how Copernicus Sentinel data is being exploited within academic, scientific and research contexts
- Key dimensions: **Thematic/EO-related**, volume/rate of publications, mode of use, **nature of link to Sentinels**, authorship and geography.



>70M  
Records searched

~2500  
Publications analysed

Report available at:  
<http://earscl.org/Sebs/>



esa

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# What have we done? Methodology

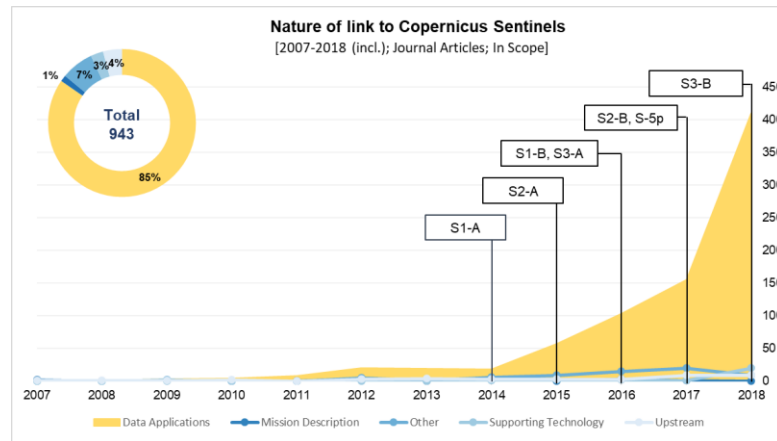
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- 1. Data acquisition:** Dataset of published materials from Scopus (keywords: “Copernicus” “Sentinel”, “satellite”)
- 2. Filtering and exclusions:** Removing duplicate/irrelevant entries, validation and quality control
- 3. Source characterisation:** Characterising publication sources based on quality, subject areas and thematic nature
- 4. Classification of records:** Range of dimensions, including nature of their link with the Copernicus Sentinels, publication context, and application area.
- 5. Analysis and interpretation:** Examining relationships between categories, querying and extracting insights and conclusions: conferences and journal papers separately.

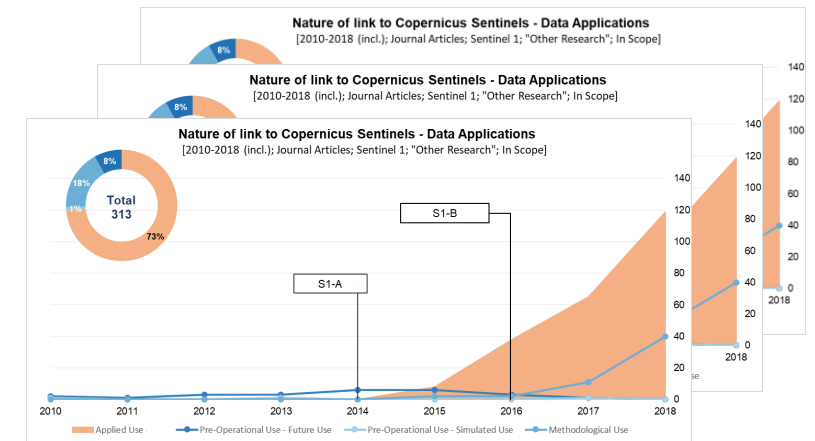
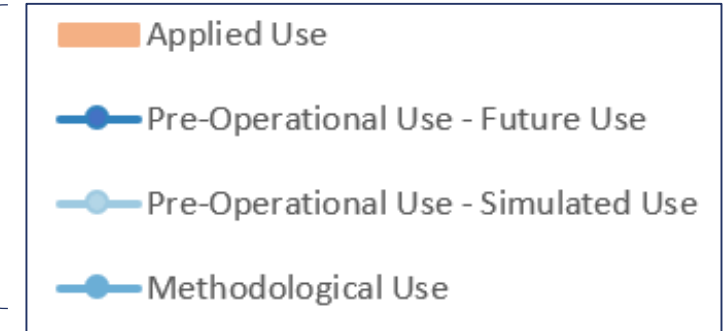
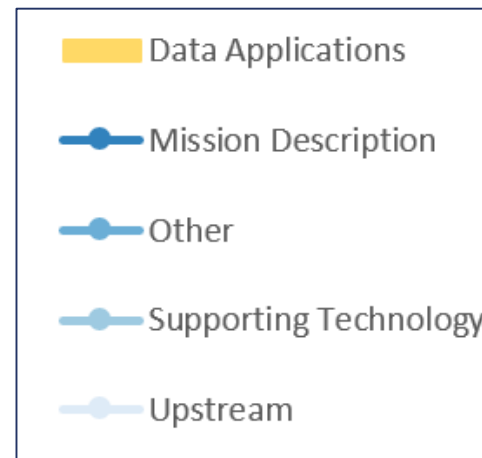


# What have we done? Methodology

## Nature of link to Sentinel data



Journals vs Conferences

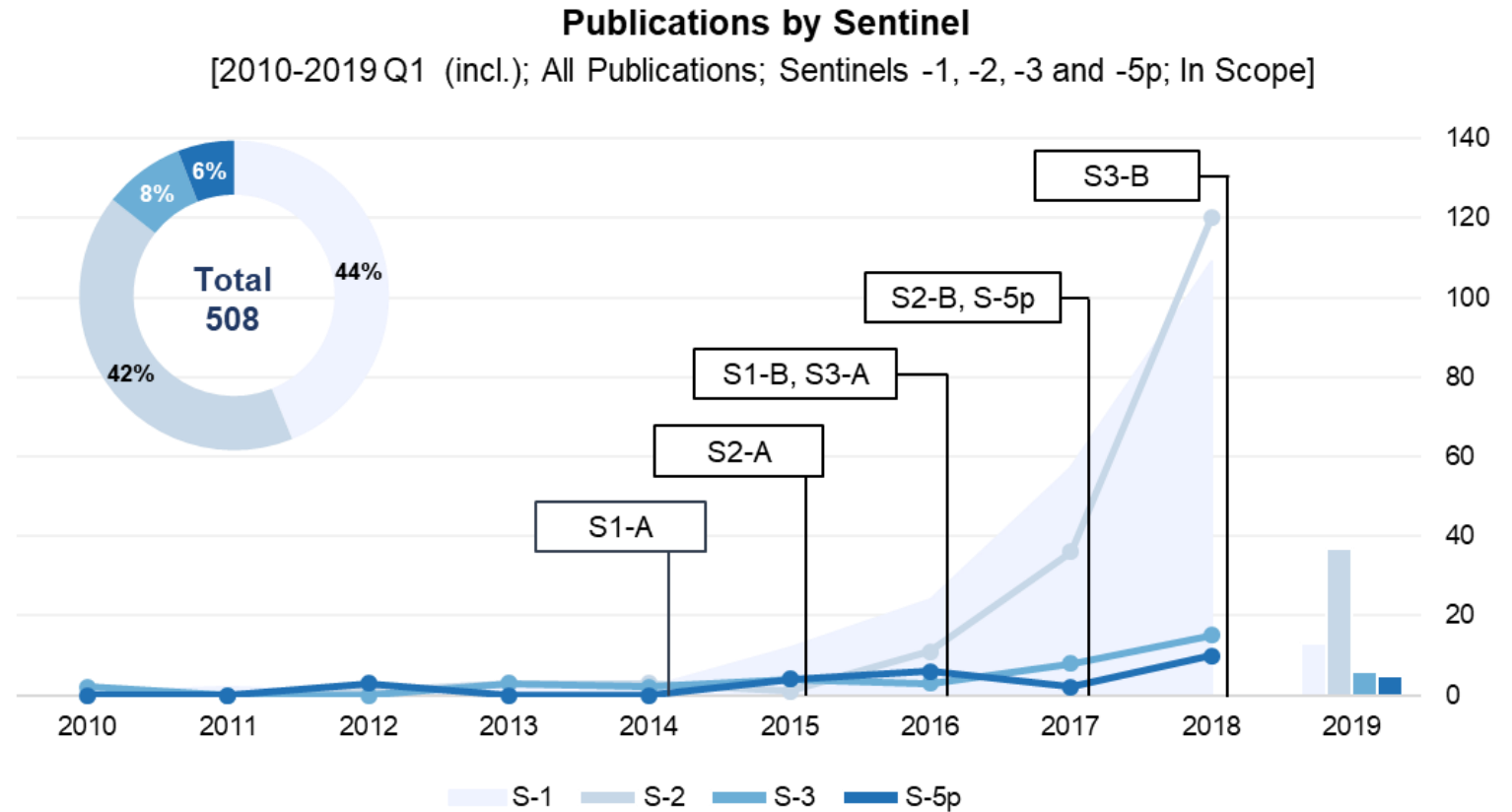


By Sentinel

# What have we learned?

## Publications by Sentinel

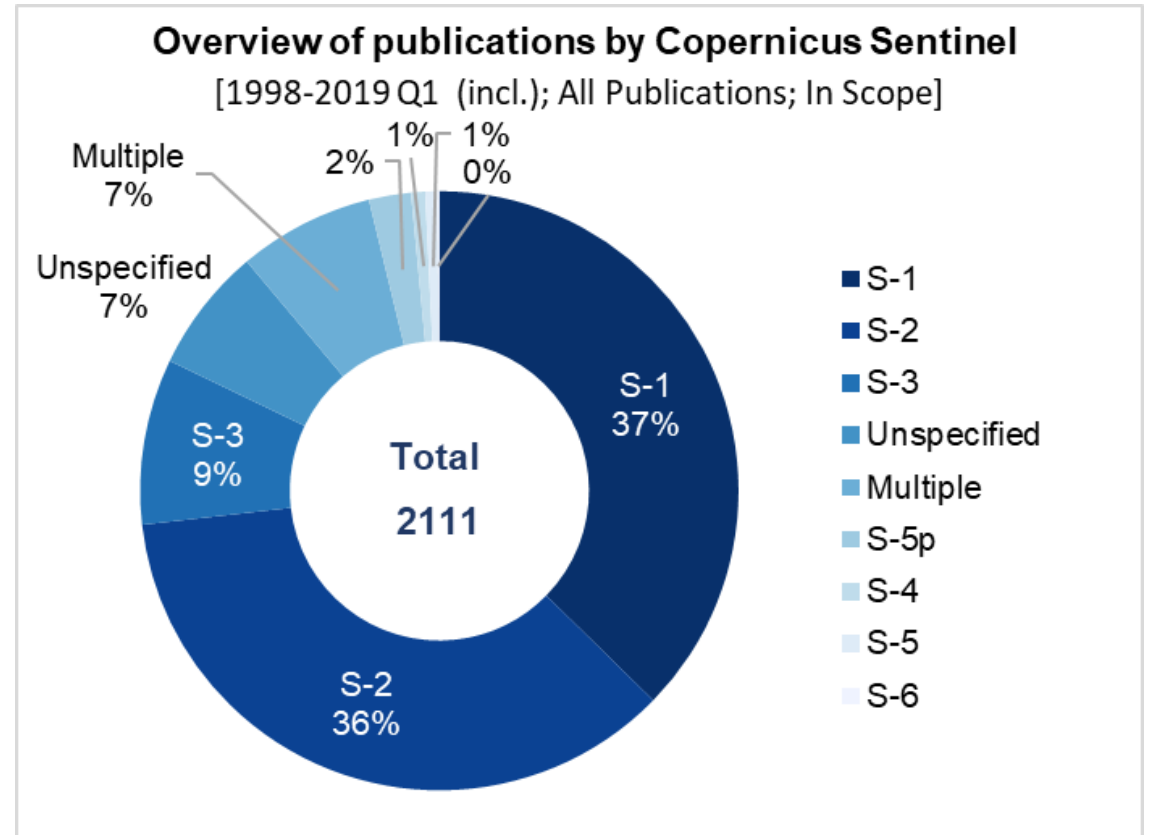
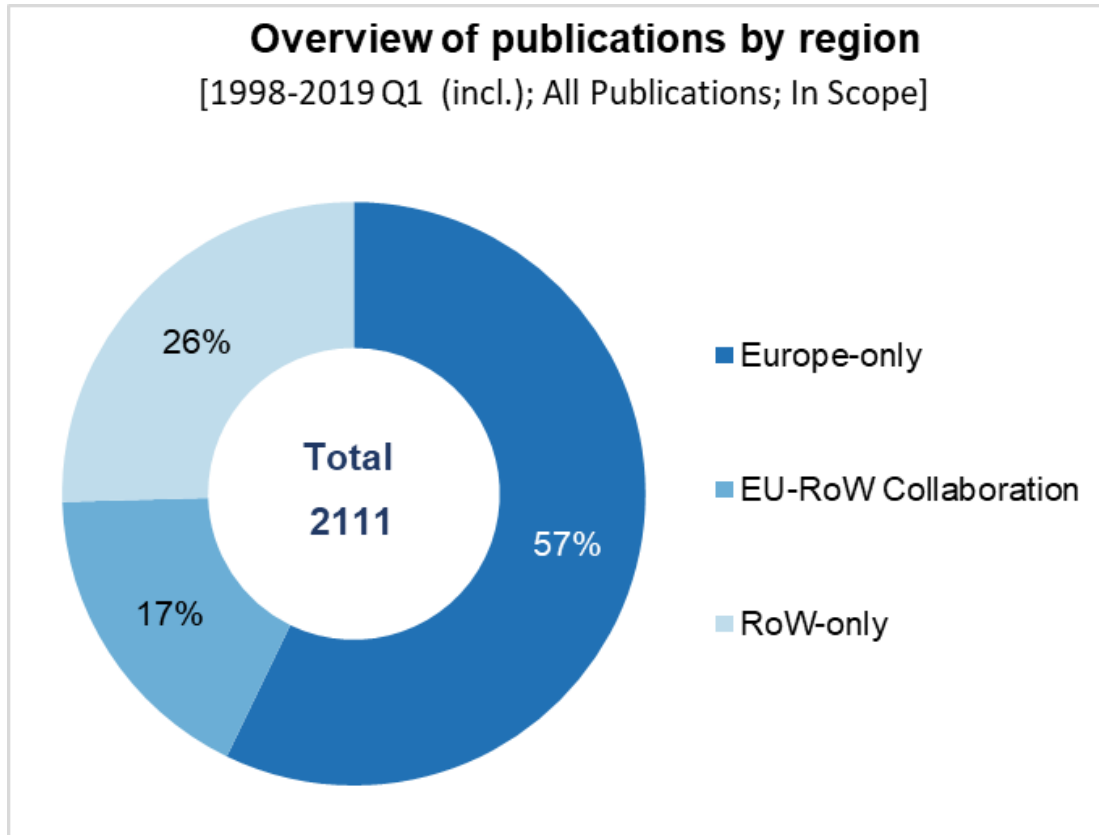
- The total volume of publications in 2018, at 770 publications of both types, more than doubled the 2017 watermark
- Publications on Sentinel-2 overtook Sentinel-1 for the first time in 2018





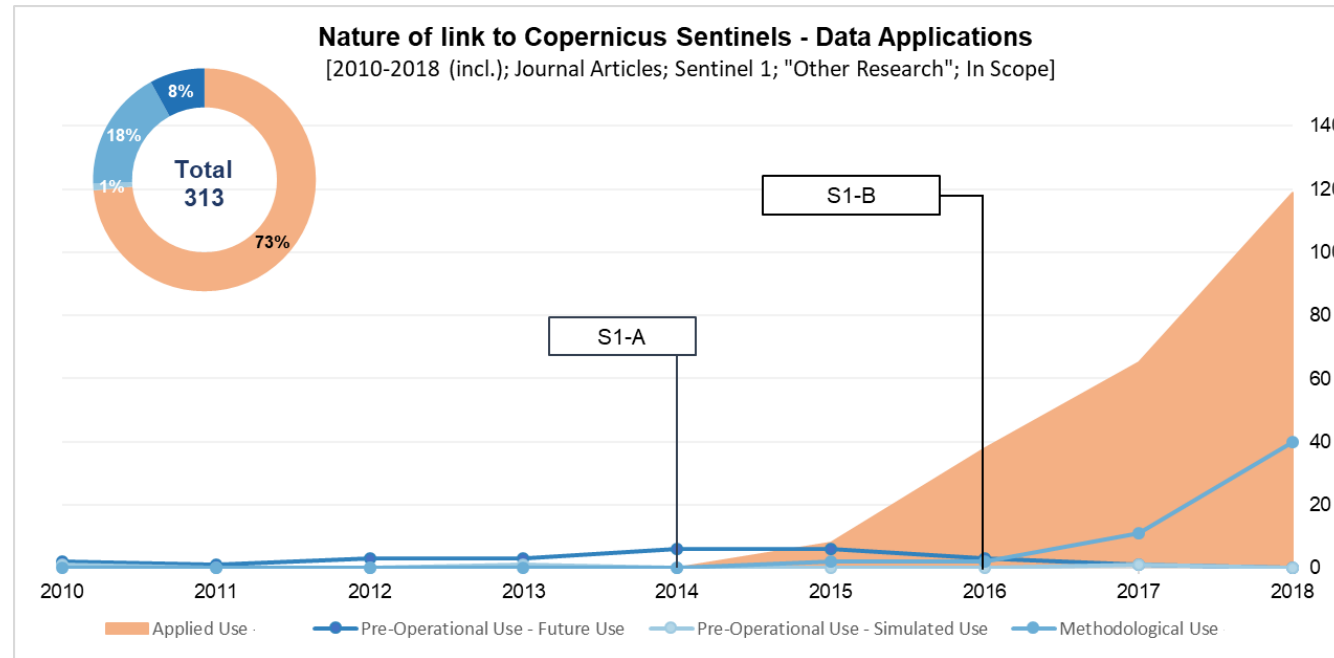
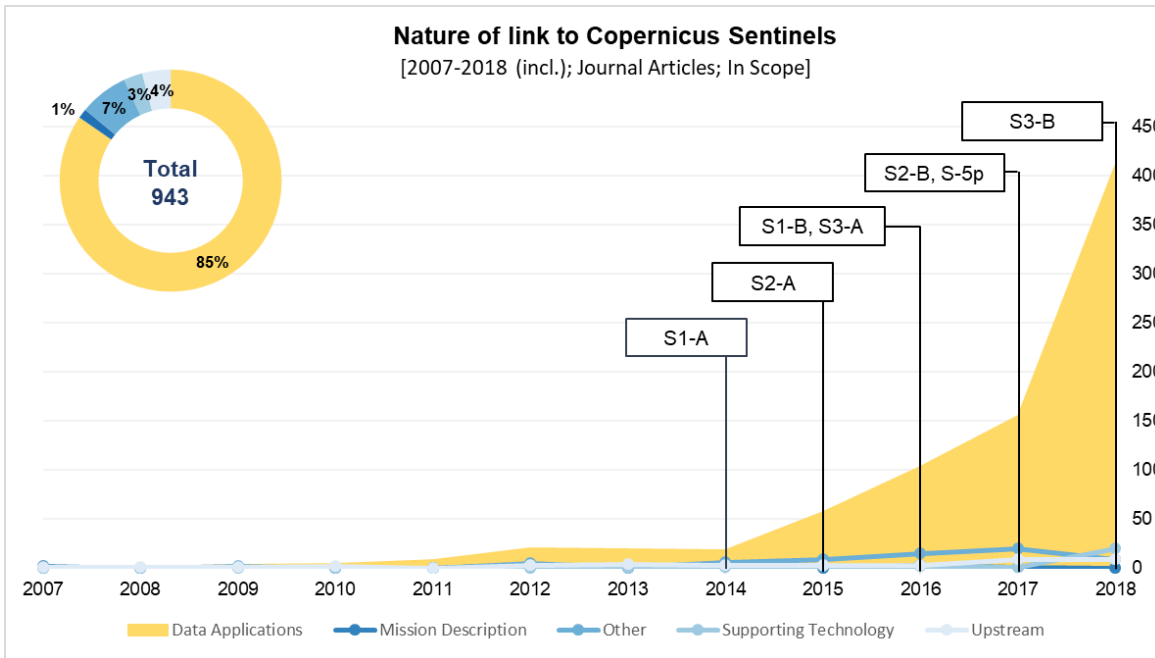
# What have we learned?

## Publications by region and Sentinel



# What have we learned?

## Nature of link to Copernicus Sentinels

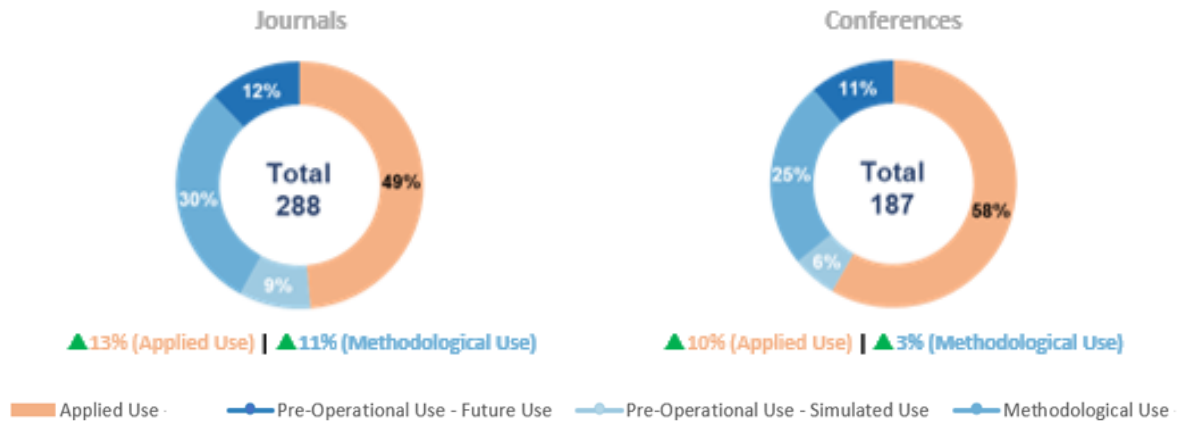
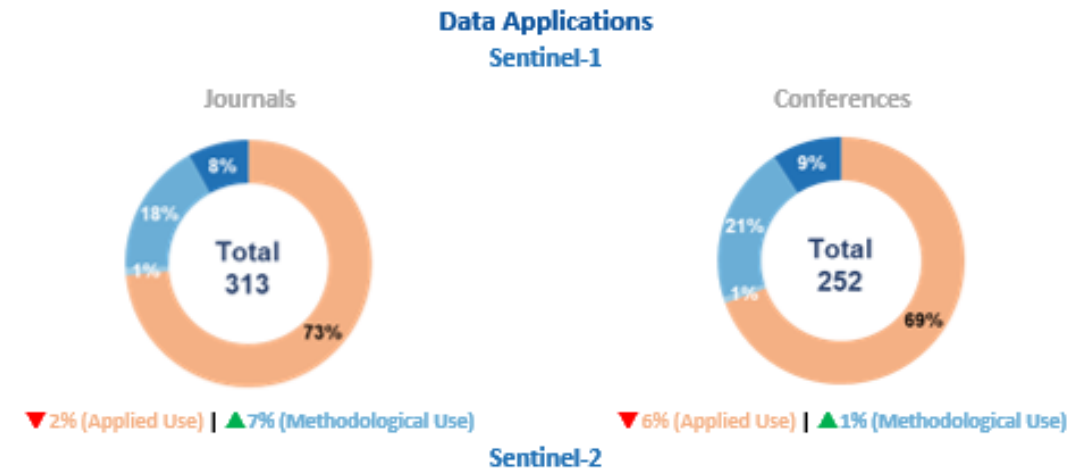
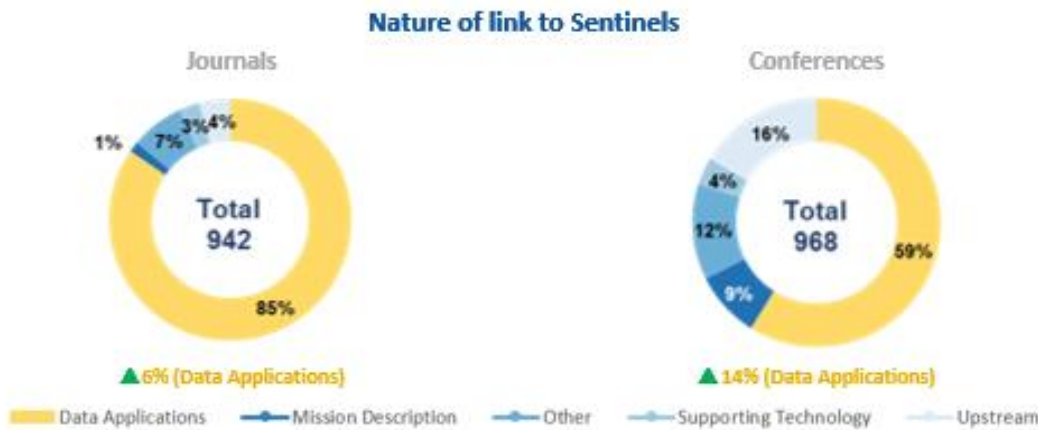
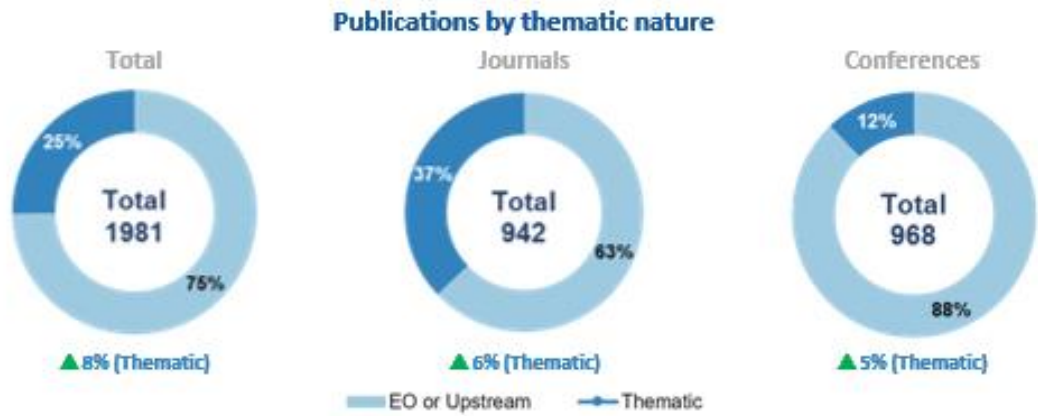


**Data applications remain the dominant category for both Sentinel -1 and Sentinel-2**



# What have we learned?

## Indicators of Sentinel-based publications



# Limitations and areas for improvement

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- **Representativeness and scope:** e.g. limited to English-language publications
- **Source query** is limited by keyword reference in title, abstract or key word fields only
- **Manual classification** of “nature of link” can be biased by individual judgement – although several measures were taken to avoid/minimise this effect
- The study on publications is repeated annually to observe changes in the indicators presented – **comments on refinements to approach or analysis?**



# Proposals for further research

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- Deep-dive into specific emerging sectors of interest
- Deeper classification of methodologies/techniques (“innovation monitor”)
- Use of data within national research agencies/councils
  - Forestry/agriculture
  - Environment
  - Urban management





Thank you!

Dimitrios Papadakis

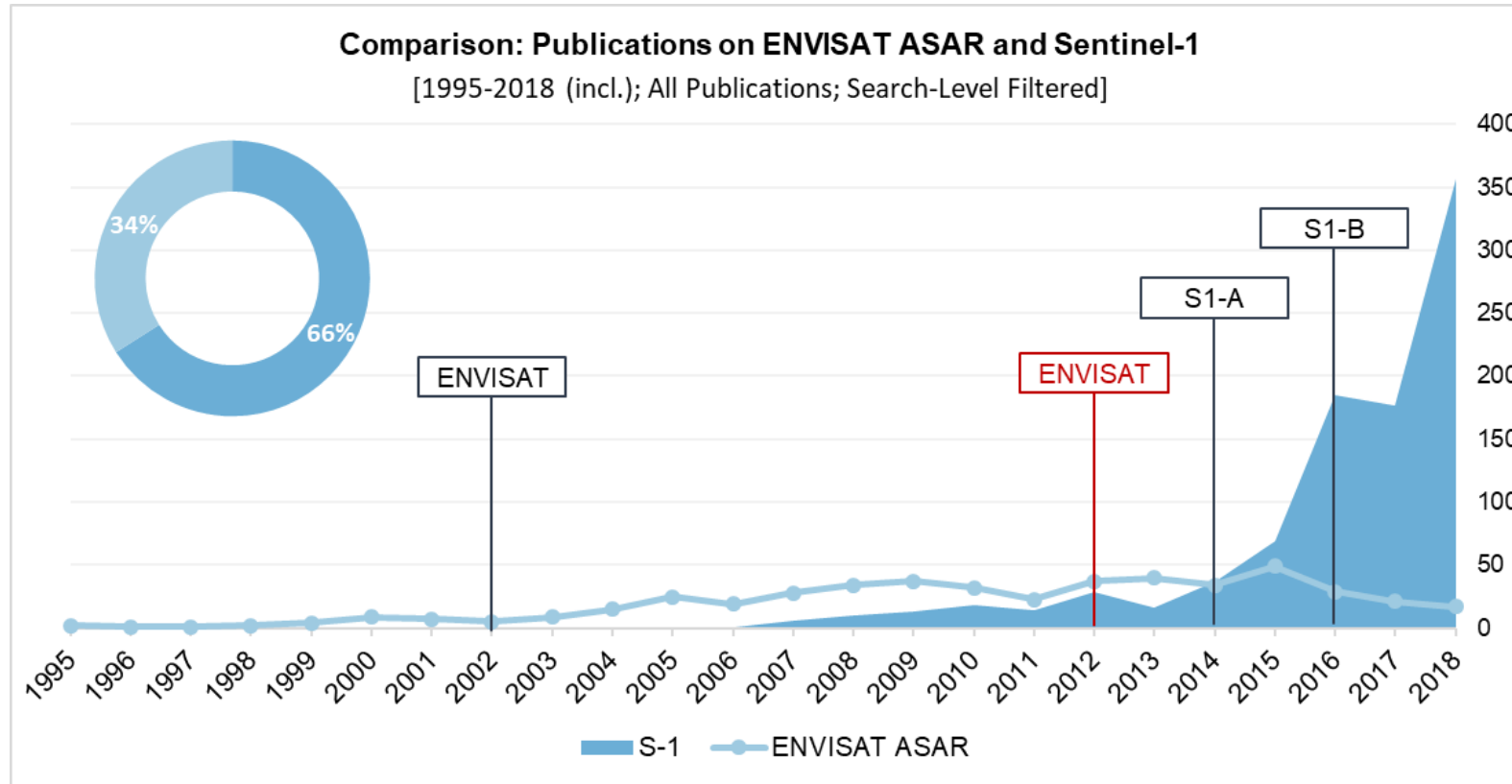
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# What have we learned?

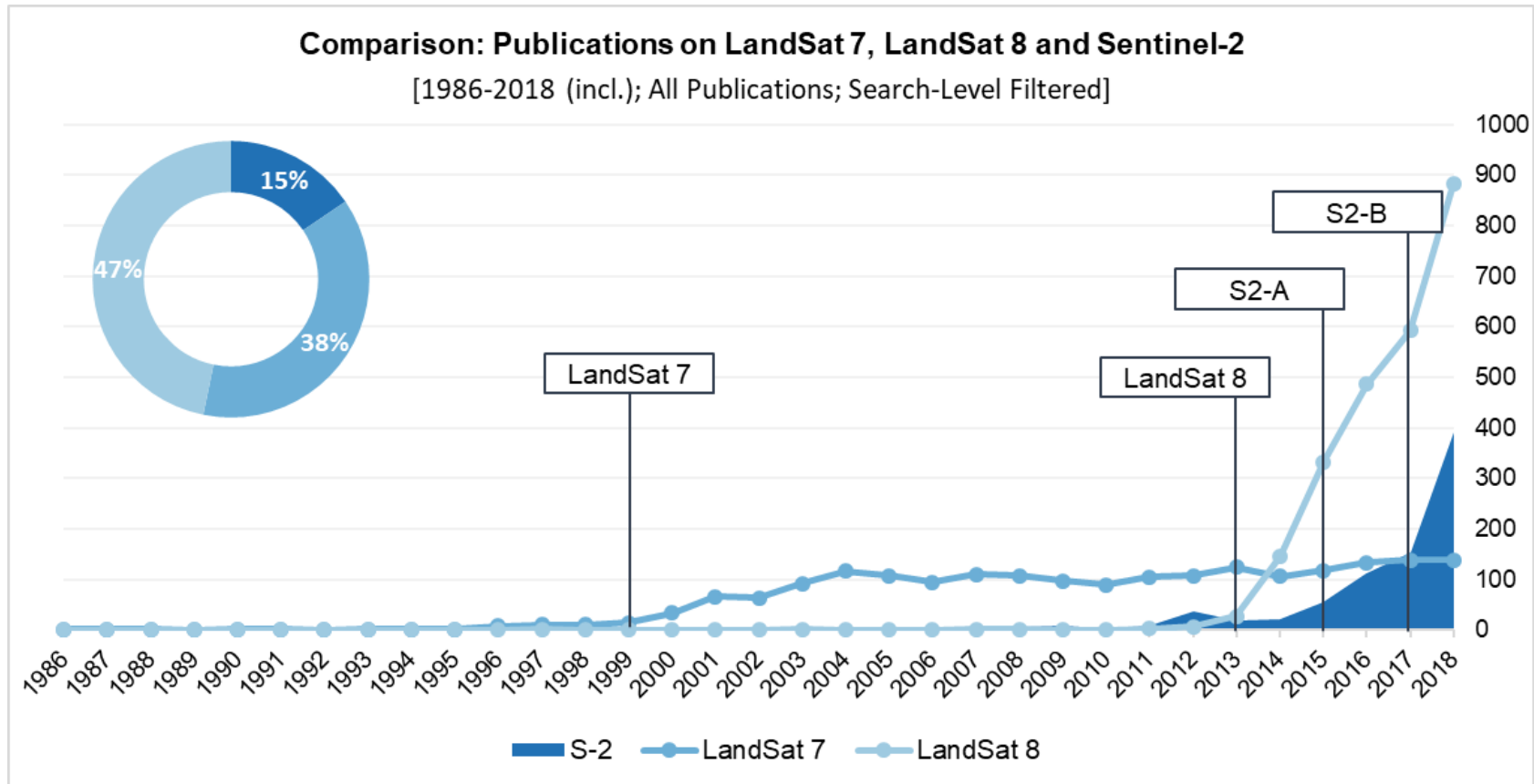
## Comparison: Sentinel-1 with ENVISAT





# What have we learned?

## Comparison: Sentinel-2 with Landsat



# What have we learned?

## Comparison: Sentinel-3 with ENVISAT (MERIS/AASTR/RA2)

