

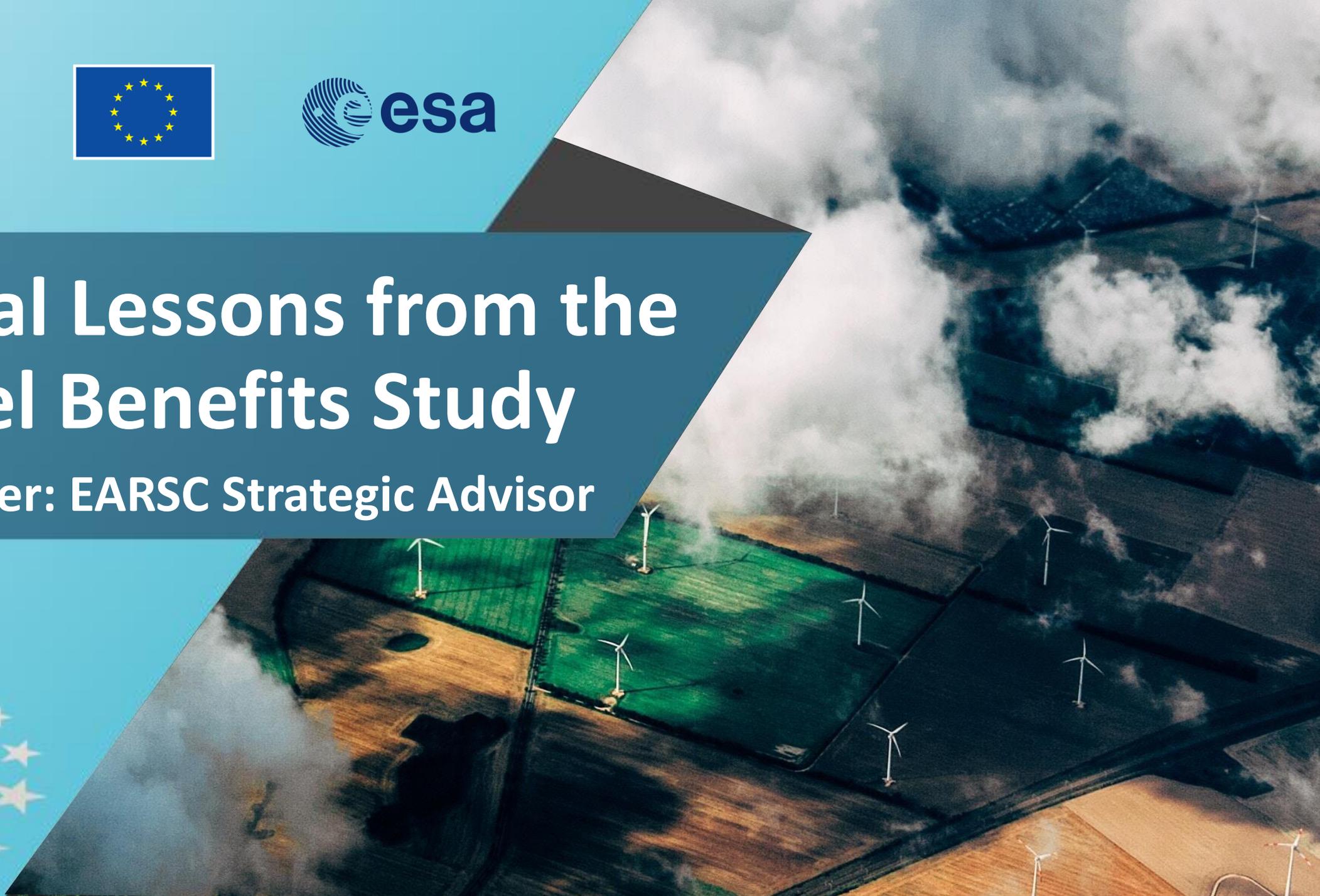


# Practical Lessons from the Sentinel Benefits Study

Geoff Sawyer: EARSC Strategic Advisor

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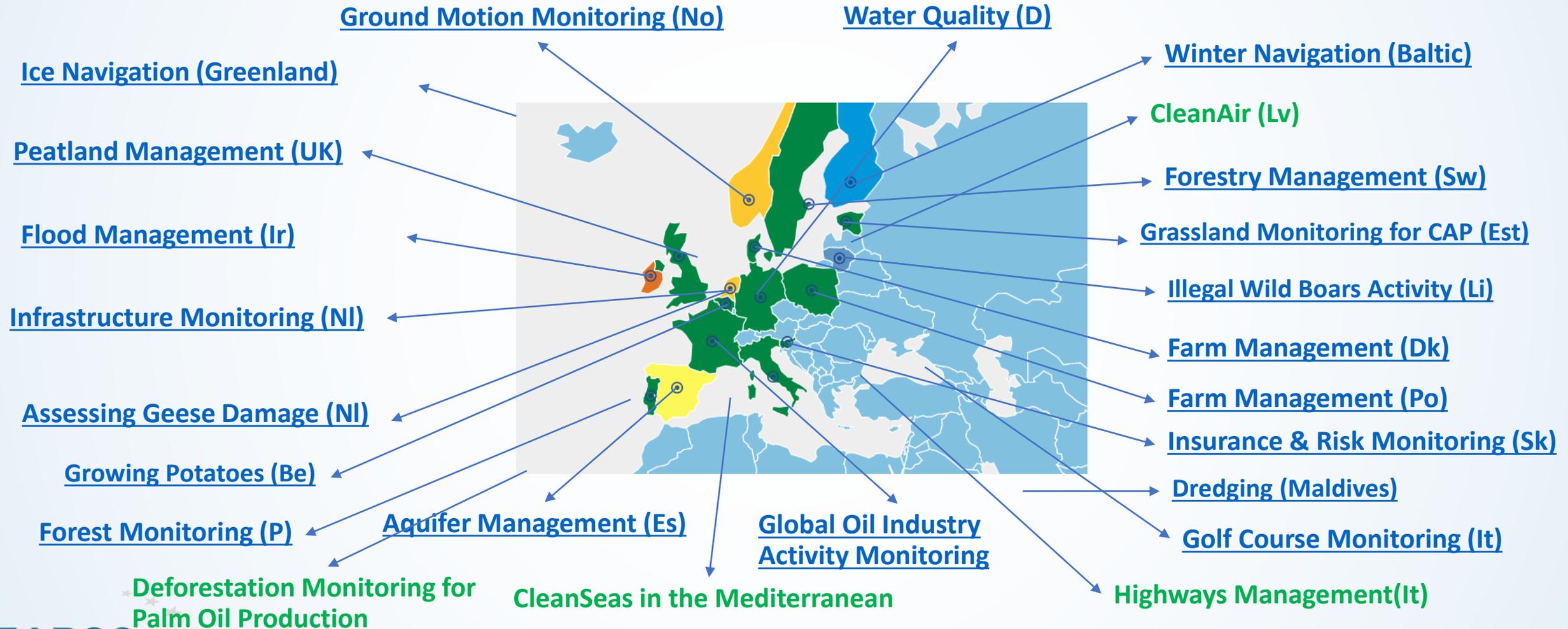


# Roadmap

1. A sound methodology for measuring the value of EO and a rich portfolio of cases have been developed within the Sentinel Benefits Study (SeBS).
2. Over 250 potential cases have been identified with 24 selected as sufficiently mature for a sound analysis with express support throughout the organisation.
3. Evaluation of the benefits has moved beyond “just” Economics to include also benefits that cannot be easily monetized.
4. Cross-cutting analyses, leveraging on understandings developed within each case, leads to a rich set of insights.
5. The focus of this presentation will be on the benefits of the use of Sentinel data for Policy making and public administration.

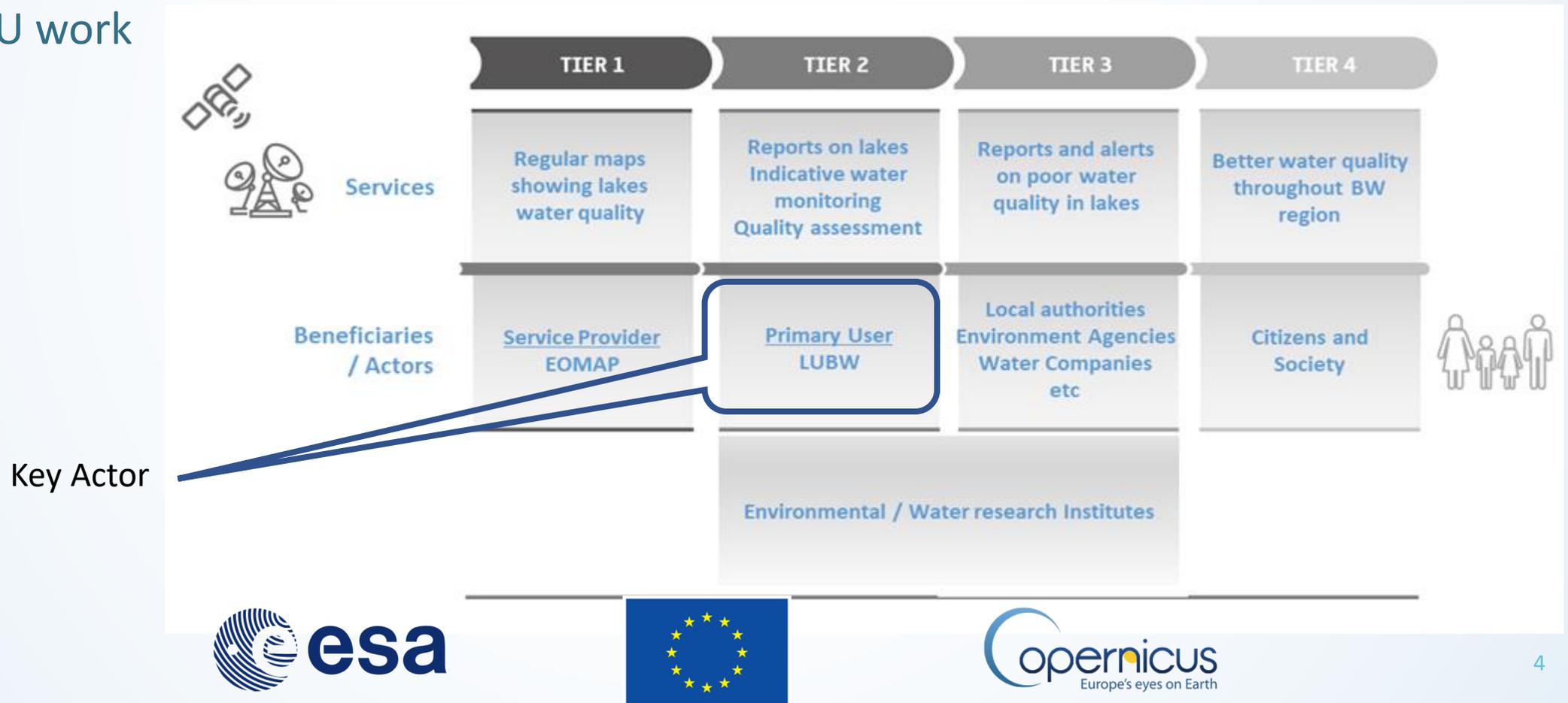
# A rich portfolio of cases

Cases Completed  
Cases in Progress



# The pillars of SeBS methodology

- Bottom-up approach resting on specific and real use-cases for a defined product.
- Value chain approach based on the primary user (PU) and others which benefit from the PU work



# Water Quality Management in Germany (1)

- EOMAP, a small German company offers a service EoLytics which allows subscribers to download measurements of water quality for water bodies in their areas of interest.
- LUBW - the Baden-Württemberg State Institute for the Environment - accesses data for the region via eoLytics so providing a better service to its citizens for an affordable cost.

- Case Report
- Flyer

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Sentinels Benefits Study (SeBS)

A Case Study  
Lake Water Quality Management in Germany

April 2021

EU Copernicus ESA

SEBS-CR-001 Page 1 May 2021

LUBW

EU Copernicus EARSC THE GREEN LAND ITASA ESA

### WATER QUALITY MANAGEMENT IN GERMANY

**What it is about**

Satellite 2 and 3 data are used to monitor water bodies in Germany and particularly in the region of Baden-Württemberg. These measurements allow regional environmental agencies – in this case LUBW, the Baden-Württemberg State Institute for the Environment – to monitor the quality of water in lakes throughout their region to an extent that is not possible using traditional sampling and testing. The data complements the in-situ measurements required for reporting purposes against regulations contained in the EU Water Framework Directive and/or

the EU Bathing Waters Directive to name but two. But, while only a very limited number of the 260 water bodies over 10ha in size in Baden-Württemberg can be tested in the accepted, traditional way, the satellite-derived data can provide good information for all of them. This allows the LUBW and other regional agencies to provide a better service for their citizens for a moderate cost helping to reduce exposure to dangerous harmful algal blooms (HABs) whilst improving the environment, reducing pollution and helping nature conservation.

**What we have found:**

- Satellite-derived measurements of the quality of water in lakes help local and regional authorities monitor the lakes in their region more effectively, more frequently and more comprehensively.
- The regional environmental agency is able to provide a better service to its citizens for an affordable cost.
- District councils can improve the planning of sample testing and analysis and are able to improve transparency and trust within the local community.
- Citizens can enjoy leisure activities whilst reducing their risk of exposure to dangerous toxins in the water.

Copernicus Sentinel Benefits Study: A Show Case  
Landed by ESA EO Graphics Bureau Funded by the EU and ESA



# Institute for Lake Research (ISF) of the LUBW → Classic Lake Monitoring Tasks

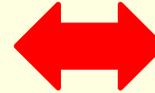
## Lakes in federal state Baden-Württemberg

- 28 WFD-lakes > 50 hectar
- 260 lakes > 10 hectar
- 1300 lakes > 1 hectar



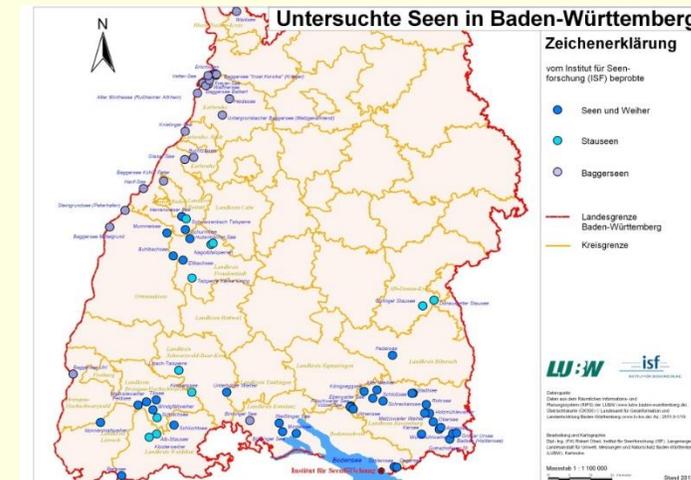
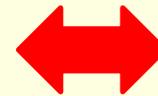
Using Classic lake monitoring methodology

→ approx. 4 - 6 lakes/year



Total during the last 20 years

- Lake Constance (area 536 km<sup>2</sup>)
- 50 Natural, small lakes
- 20 Gravel ponds



# Satellite-based inland water monitoring

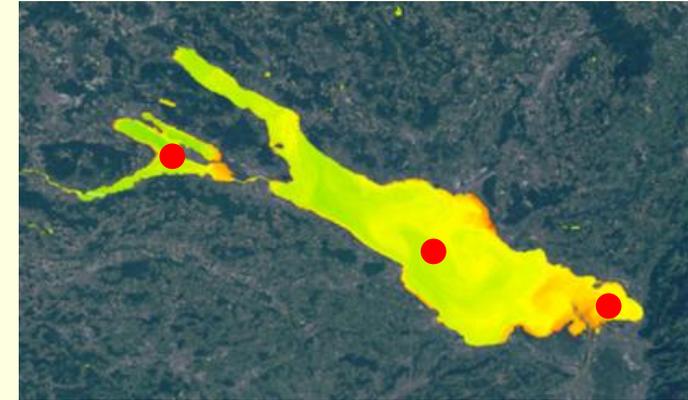
- Expanding the lake monitoring data base through satellite-based information
- Use at LUBW : External service provider **and** in house data processing

More frequent monitoring of **all lakes > 10ha**  
→ **Higher temporal & spatial resolution**

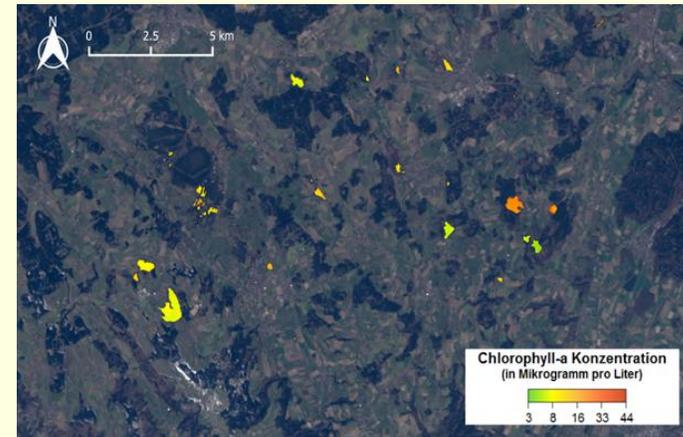
Detection of **spatial inhomogeneities**  
→ **Patchiness**

Monitoring of a **large number of small lakes**  
→ **Indicative water monitoring**

- **Trusted quality** → continued validation (BIGFE)
- **Regulations** → use of Copernicus for WFD ?



Lake Constance (processed by EOMAP)



Oberschwäbische Seen (processed by EOMAP)

# Water Quality Management in Germany (2)

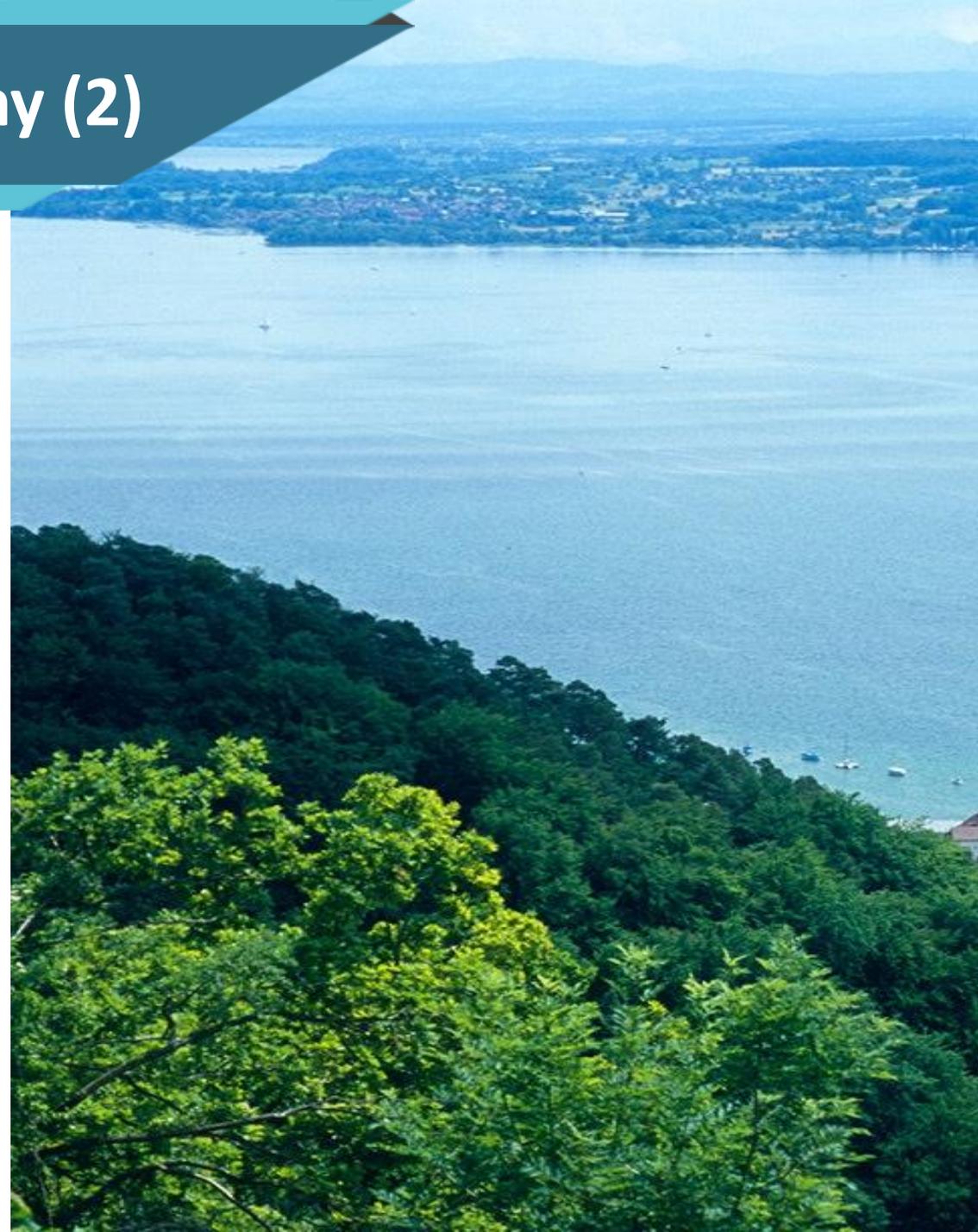
## Benefits:

- Monetary benefits are real but the main benefit is to help LUBW do their job better.
- The service helps to reduce human exposure to dangerous harmful algal blooms (HABs) whilst improving the environment, reducing pollution and helping nature conservation.
- Satellite-derived measurements of the quality of water in lakes help local and regional authorities monitor the lakes in their region more effectively, more frequently and more comprehensively and to keep their citizens informed.

## Total benefits



Anticipated Monetary Benefits: €4m – 7.8m pa across Germany



# Complementary Cross-cutting Analyses

Use cases are supported and complemented by cross-cutting analyses with the goal to:

- Analyse commonalities across different cases and potential for extrapolation.
- Bring additional perspectives (e.g. academic publications, innovation and start-ups)
- Increasingly strengthen the SeBS methodology.



SeBS Methodology

Showcasing Examples of  
Regulatory Benefits



# Richness of the Cases bring new insights

Consistent framework for the analysis of more and more cases allows transversal analyses yielding highly valuable conclusions – some examples are:

## Working together



In **Ireland**, flood mapping with shared information helps services co-ordinate their activities better through a common operating picture



In **Belgium**, having a common picture helps to bring together many different stakeholders across the potato industry, cutting across political and administrative lines.



In **Sweden**, families can plan their future as a result of knowing better the evolution of their woodland and when it may be harvested.



In **Greenland**, knowing where the ice has formed and when supply ships can pass, allows whole communities, living in isolated areas, to plan their lives better and to develop the strategic value of the island.

## Better Regulation



In **Norway**, liabilities for co-lateral damage coming from road works are more easily managed by knowing when movement took place as well as the precise location. Allows better definition in regulations; ie 20 years limits rather than 5 years.

# Other Benefits for Public Authorities

As our study has developed, the methodology has been refined drawing upon the lessons learned from each case studied.

Every case contains an analysis of the monetized benefits.

However, as we progressed, it became clear that the monetized elements were found to not reflect fully the value being generated and the non-monetary benefits have been introduced progressively.

Full details and explanations can be found in the [SeBS Methodology Report](#)

**Often it is the non-monetary benefits which are the main driver for adoption by PA's.**

# 6 Dimensions of Value



## ECONOMIC

Impacts related to the production of goods or services, or impacts on monetary flow or volume, such as revenue, profit, capital and (indirectly, through turnover generation) employment.



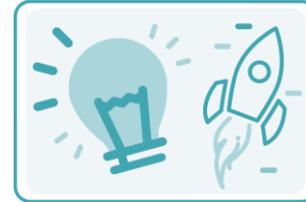
## ENVIRONMENTAL

Impacts related to the state and health of the environment, particularly as regards the ecosystem services on which human societies depend.



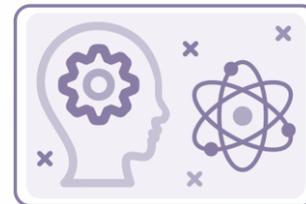
## REGULATORY

Impacts linked to the development, enactment or enforcement of regulations, directives or other legal instruments by policy makers.



## INNOVATION AND ENTREPRENEURSHIP

Impacts linked to the development of new enterprises, business or jobs and/or the introduction of technological innovation into the market.



## ADVANCEMENTS IN SCIENCE AND TECHNOLOGY

Impacts linked to academic, scientific or technological research and development, the advancement of the state of knowledge in a particular domain.

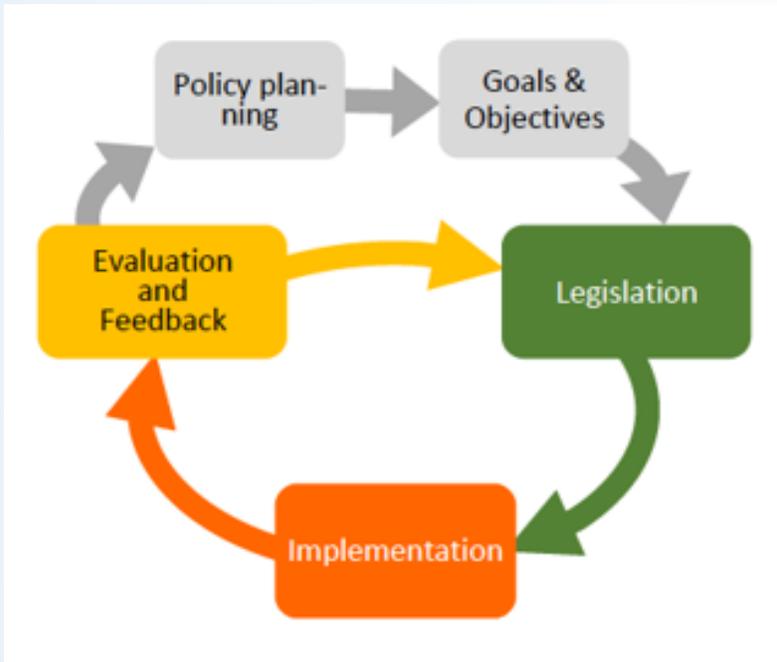


## SOCIETAL

Impacts related to societal aspects such as increased trust in authorities, better public health or secured geostrategic position.

# Policy & Regulatory Benefits

## Policy Cycle



- Preparation & Design of Legislation
- Policy Implementation
  - Compliance Monitoring
  - Compliance Reporting
  - Follow-up and Enforcement
  - Compliance Promotion
- Evaluation of the Impact



# Preparation & Design of Legislation

**Description of Benefit:** *By offering new measurements, EO data allows the design of regulations to be improved to reflect existing or new policy needs.*

**SeBS Findings:** Examples were found where regulations have been changed (or are planned) as a result of the availability of Sentinel data.

Managing Forests in Sweden	Availability of satellite monitoring provided the tool to change the regulatory basis completely to one of “freedom with responsibility” for the 300,000 owners of forest in Sweden.
Ground Motion Monitoring in Norway	Identifying and measuring movement more precisely together with a long time series of measurements will allow future legislation to be drafted with clearer responsibility for the consequences of damage.
Aquifer Monitoring in Spain	The ability to measure ground movement with precision over a large area enables Murcia to control water abstraction more precisely and establish responsibility for any damages caused, to be included in legislation.
Sand Dredging in Finland*	Local legislation was updated following exposure of Sentinel-derived measurements of turbidity. Now turbidity limits are included in permits to extract sand in Finnish waters. *this has not been fully analysed as a SeBS case.

# Compliance Monitoring

**Description of Benefit:** *EO data are used by the relevant authorities to assess the level of alignment to the prescribed behaviour and/or its breaches.*

**SeBS Findings:** Examples were found where compliance with existing regulations is monitored better through the use of Sentinel data.

Grasslands in Estonia	Country-wide imagery identifies grasslands and whether they have been cut according to regulatory needs. Farmers are rewarded for compliance which is visible to them through an on-line app.
Aquifer Monitoring in Spain	Improvement through precise monitoring of ground surface movement over the whole water basin which links to the amount of water being abstracted in coherence with existing local/national limitations.
Managing Forests in Sweden	The Forest Agency is able to monitor where guidelines have been respected ie compliance with recommended best practice.
CleanSeas in Mediterranean	International regulations control deliberate oil dumping in the seas. Sentinel data used in the CleanSeaNet service provides the only means to monitor where ships are operating illegally by washing tanks.
Water Quality in Germany	Sentinel data provides widescale measurement of lake water quality and provides indicators of compliance with the Water Framework Directive and the Bathing Waters Directive providing guidance on where physical tests should be carried out.

# Compliance Reporting

**Benefit description:** *Improve the efficiency and effectiveness of agency reporting obligations.*

**SeBS Findings:** Not many examples were found where both reporting is required and Sentinel data can support this. Where legislation does not specifically include the use of EO data, public bodies cannot justify budgetary expenditure on non-referenced methods, even if this may ultimately result in greater efficiency and better use of resources.

Grasslands Monitoring in Estonia

Satellite imagery enables the Estonian Agricultural Registers and Information Board (ARIB) to report on the status of all the declared grasslands in an effective and transparent way.

Water Quality in Finland\*

National legislation has recognised the use of Sentinel data provides a series of satellite-derived measurements for coastal waterbodies in the 2014 WFD assessment and later introduced satellite-derived metrics to support WFD assessments in the 2015 – 2021 reporting cycle. \*this has not been fully analysed as a SeBS case.

Water Quality in Sweden\*

Metrics for the 2014 WFD status classification. Sweden is incorporating satellite-based Earth observations of chlorophyll-a for the ongoing 2nd round reporting (2015 – 2021) for coastal waterbodies. \*this has not been fully analysed as a SeBS case.

# Follow-up & Enforcement

**Description of Benefit:** *Provide courts with evidence of illegal activities: EO data are used in enforcement-related proceedings (e.g., judiciary or audits).*

**SeBS Findings:** We found limited examples of the use of Satellite data in courts due to the difficulty to overcome practical and legal obstacles. Aspects such as verifiability, traceability, and interpretation are always a concern requiring the implementation of more complex and top-down solutions, such as a certification system. One example was found where Sentinel data is being used to support legally-based audits on public authorities.

Wild Boar in Lithuania	Sentinel data used in courts to settle disputes between hunters and farmers: “The use of such Sentinel data should become commonplace in all future crop-damage case”. Judge Vitunskiene, Kouanas Regional Court
CleanSeas in the Mediterranean	Satellite imagery used to prove location of illegal discharge and, along with AIS, to identify the polluting vessel.
Sand dredging in Finland*	The example was found where local authorities and individual citizens are using Sentinel imagery in court in claims against sand extraction companies. *this has not been analysed as a SeBS case.



# Compliance Promotion

**Description of Benefit:** *Deterrence by raising awareness amongst potential offenders of the ability to detect non-compliance (and the possibility to enforce if necessary).*

**SeBS Findings:** We found numerous cases where communicating the capability to detect non-compliance coupled with public visibility of detections, plays a deterrent role *vis-à-vis* potential perpetrators.

## Some Examples:

Dredging in the Maldives	Providing international visibility of actions where dredging damages protected seabeds (flora) so encouraging better environmental responsibility.
CleanSeas in the Mediterranean	Ships captains and owners are informed about the wide-area / regular and timely surveillance which acts as a strong deterrence to discharge illegally.
Grasslands Monitoring in Estonia	Direct access and alerts to farmers provide transparency, promote fairness and encourage compliance.
Managing Forests in Sweden	Forest owners receive reminders from the Swedish Forest Agency if they have not followed required forest management practices. Freedom with responsibility.

# Policy Evaluation

**Benefit description:** *Evaluation phase: regarding systematic or ad-hoc monitoring of the adequacy of the policy and the efficiency of its implementation.*

**SeBS Findings:** This aspect has not figured in our case analysis. From the interaction with users, it would seem possible that some examples could show the use of Sentinel data for this purpose but mostly, cases do not have a sufficiently long history to be able to assess and evaluate a “before and after” to assess the impact of the policy.

# Public Accountability

**Benefit description:** *Not a part of the policy cycle, but an important attribute linked to public authority performance and evaluation.*

**SeBS Findings:** We found several examples where the objectivity of EO data, and in particular the full, free and open access granted by Copernicus, contribute to the successful enacting of core principles such as transparency and accountability.

Grassland in Estonia	Farmers access the Sentinel-derived data on grassland cuts which enables them to view the synoptic picture and promotes transparency and fairness under the regulatory regime.
Water Quality in Germany	Citizens are given access to information on lake water quality so building trust in the regional environment body.
Dredging in the Maldives	NGO's have access to imagery showing where dredging takes place and where protected marine grasses may be damaged to encouraging compliance by the dredging company.
Global Forest Monitoring	As well as making it possible to find non-compliant suppliers, the service provides objective evidence for certification or verification of authorised production. This evidence is essential when investigating grievances individually or together with NGOs and governmental authorities.
Sand Dredging in Finland	Companies dredging sand are using satellite imagery to self-control the level of turbidity.



# Other Benefits for Public Authorities (1/3)

Public authorities are able to secure additional benefits arising from the use of Sentinel data by helping to fulfil an operational role for the citizens (general public) and by communicating this better with increased transparency.

This leads to societal benefits reflecting on the PA.

	<p><b>ECONOMIC</b> : Public Agencies can save costs through change of equipment or more efficient processes.</p>
	<p><b>ENVIRONMENTAL</b> : Actions of PA's can impact on the environment by reducing carbon emissions or improving the ecosystem.</p>
	<p><b>INNOVATION AND ENTREPRENEURSHIP</b> : PA work can be improved through innovation stimulated by use of EO.</p>
	<p><b>ADVANCEMENTS IN SCIENCE AND TECHNOLOGY</b> : PA research &amp; development can benefit from the use of EO.</p>
	<p><b>SOCIETAL</b> : The PA role can be appreciated more and understood better by citizens. Improved co-operation between public (and private) actors.</p>

# Other benefits for Public Authorities (2/3)

## Example of Monetized (economic) benefit to PA:



Forest Management in Sweden

Savings of €10m by redeployment of surveyors from reduced on site inspections, changed process based on hot spot monitoring.

Baltic Navigation

Significant cost savings of €1.3m p.a. by removal of the helicopters from the ice breakers.

Sea-ice navigation Greenland

Saving of costs by the closure of airfield and non-deployment of a survey aircraft but offset by the purchase of commercial imagery to improve the service.

## Example of Environmental benefit to PA:



Baltic Navigation

Reduced carbon footprint due to removal of helicopters and reduced steaming time due to faster routes for ice breakers (and ships)

## Example of Innovation benefit to PA:



Ground Motion in Norway

Access to the ground motion map creating new services and innovative practices in a number of public agencies.

# Other benefits for Public Authorities (3/3)

## Examples of Societal benefit to PA:

 Water Quality in Germany	LUBW able to do a better job by using the Sentinel derived information on lake water quality to inform bathers when the quality of water in a lake becomes poor. So enhancing the image of the agency and improving its reputation by serving the public better.
Peatlands in UK	South West Water enhances its reputation by providing many NGO's and other organisations with a current picture of the state of peatlands over a wide area of moorland enabling them all to work together to improve the moorland ecosystem and improve biodiversity.
Sea-ice navigation off Greenland	DMI is able to demonstrate that it provides a better service for the Greenland population by improving their knowledge of the ice conditions and enabling ships transporting goods to serve better the isolated communities.
Navigation in the Baltic	The transport authorities can ensure better and more reliable transport connections so improving the quality of life for local citizens.
Flood Monitoring in Ireland	Local emergency services are able to prioritise better their interventions and provide evidence in communicating these decisions to the local citizens.

# Observations & Conclusions

- The SeBS analysis has been welcomed by suppliers and primary users alike to help understand how their work using Sentinel data drives benefits for society.
- The SeBS methodology is open and is being carefully elaborated through case development, and interaction with international experts, to provide a robust tool for practitioners.
- By analysing many cases, different elements can be extracted and understood ie. insights into the behaviour and issues faced by public authorities is one area where many cases are providing deeper understanding.

# Thank You for Listening

**Do you know an interesting case demonstrating the benefits derived from the use of Sentinels data?**

**Email [info@earsc.org](mailto:info@earsc.org)**

**More Information on Sentinels Benefits Studies:**

**[www.earsc.org/sebs](http://www.earsc.org/sebs)**

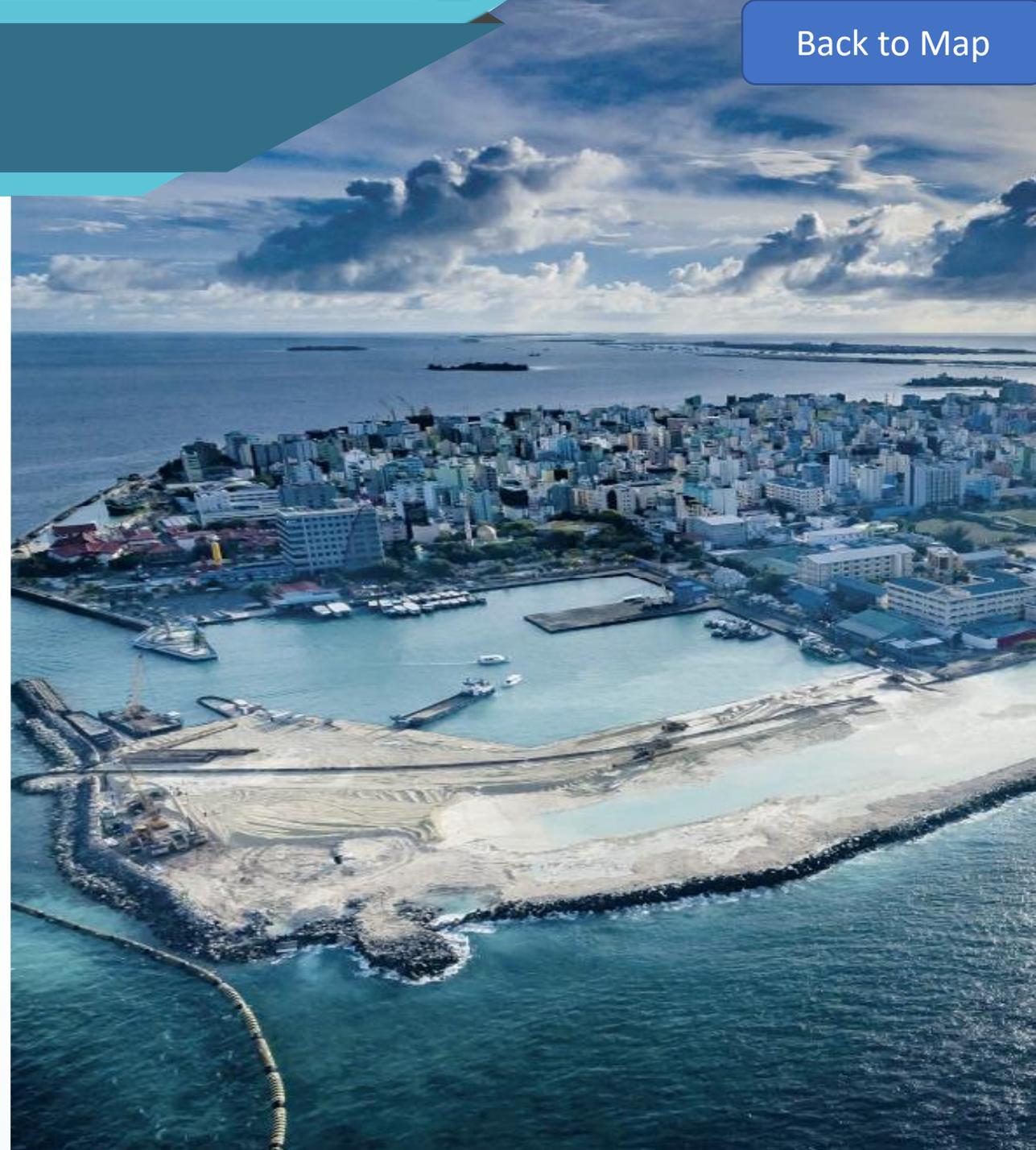


EARSC @ 26, Rue de la Loi, Brussels

[info@earsc.org](mailto:info@earsc.org)

# Dredging in the Maldives

- There is constant need for dredging to protect island areas
- Problem: hydrological maps are out of date/not accurate enough to guide dredgers
- S-2 data is used to generate usable maps (satellite-derived bathymetry) by EOMAP
- Benefits accrue to:
  - Dredging companies
  - Government
  - Environment
  - Local citizens



# Navigation through Sea-Ice off Greenland

- Sea-ice & icebergs pose a constant threat when shipping between villages and with Europe
- Navigators need latest information about locations of ice to navigate safely
- Using S-1 data, frequent ice charts are created for Royal Arctic Line and other maritime stakeholders
- **Benefits for:**
  - Primary user: Royal Arctic Line
  - Other direct users in transport
  - End use beneficiaries: businesses & local economy
  - Tertiary beneficiaries: citizens are assured of stocked shops
- **Overall Economic Benefits of €8.6-12.5m pa**



# Flood Management in Ireland

- A succession of Atlantic Storms hit Ireland in the winter of 2015-2016 resulting in heavy flooding
- Irish flood management authorities triggered Copernicus Emergency Management Service
- Using S-1 and other satellite data, this service provided all actors involved in flood management with flood delineation maps
- **Benefits for:**
  - Primary user: NDFEM, OPW, NECG
  - Other local authorities e.g. police & fire brigade
  - Citizens of affected areas through warnings & Flood Response Instructions (incl. evacuation)
- **Main findings:**
  - Overall Economic Benefits: €17.1m (event-related)



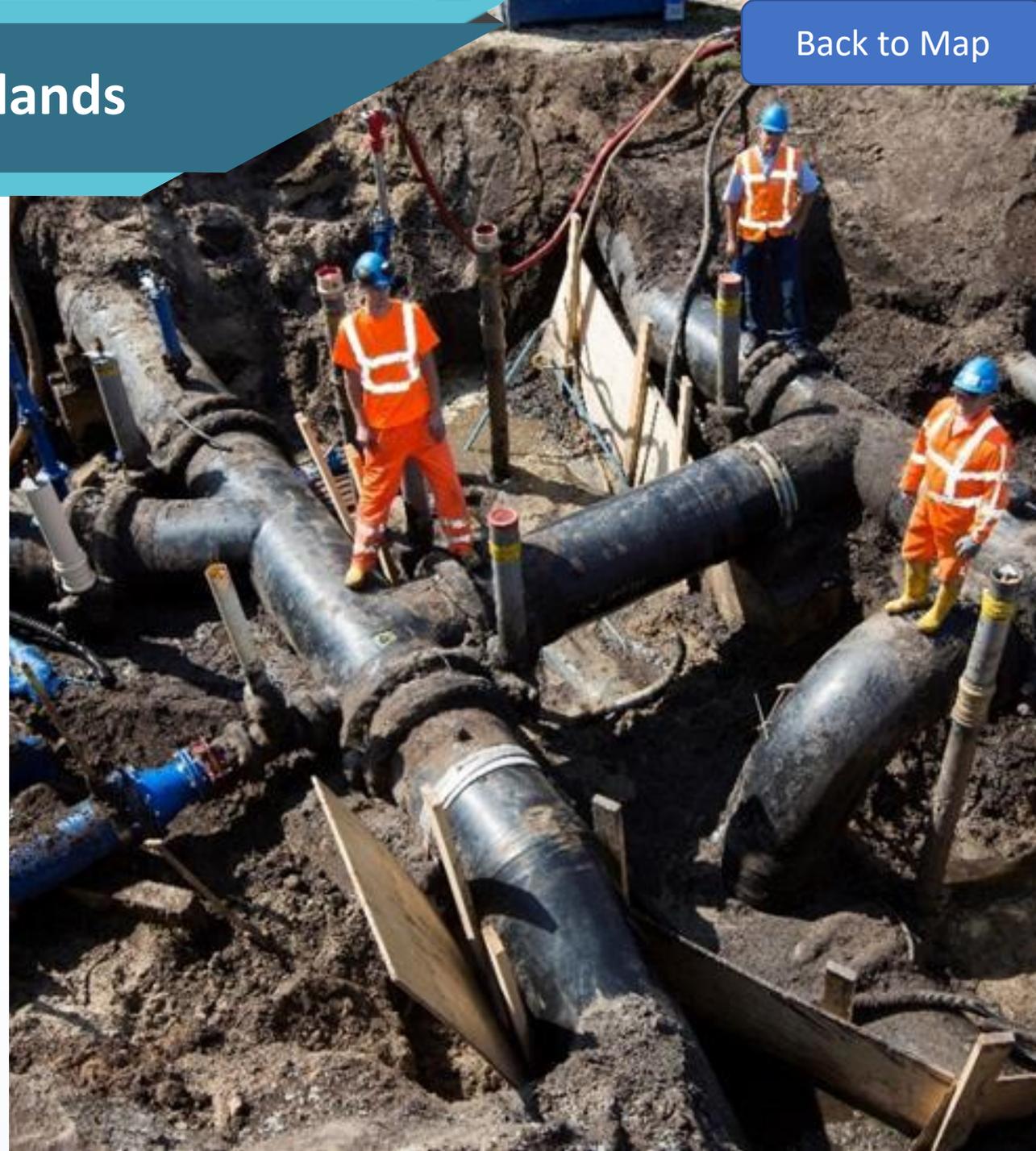
# Farm Management Support in Denmark

- Farmers with large cereal farms are using Fieldsense service maps to aid decision making
- S-2 data is processed into crop stress maps which are overlaid onto the farm field boundaries
- Benefits today are modest, but the potential is high
- Benefits for:
  - Primary user: Farmers – Direct economic benefits between €3.8m-€7.9m
  - Environment due to the reduced use of chemicals
- Main findings:
  - Current benefits: €160 - €335k pa
  - Full potential: €23.7- €54.5m pa



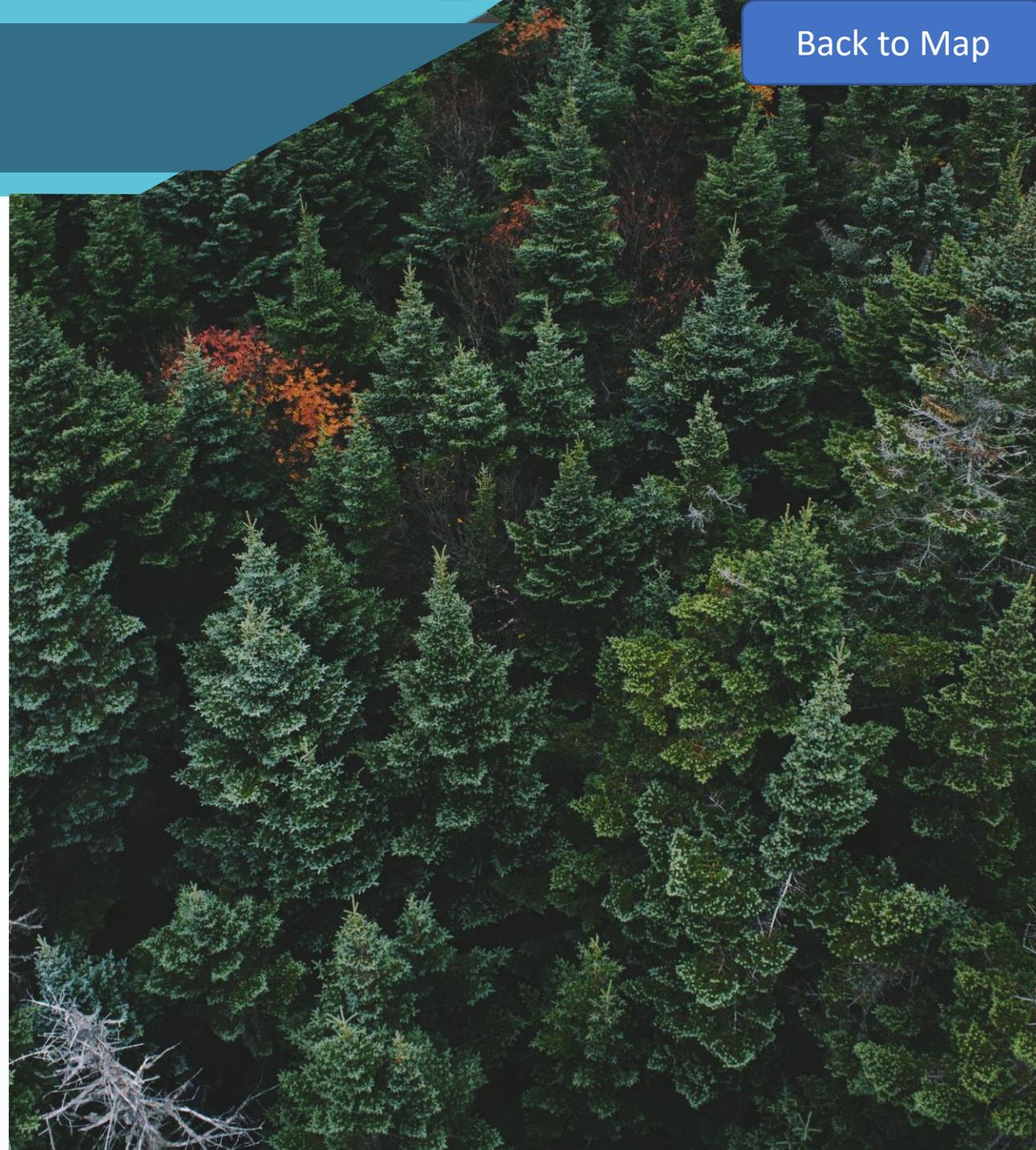
# Infrastructure Monitoring in the Netherlands

- Subsidence can cause gas & water pipelines to break especially where they enter houses.
- Satellite data (InSAR maps generated by SkyGEO) are used to monitor ground movements of gas pipelines at affordable costs
- Pipeline operators (Stedin and Oasen) identify connections at high risk to plan their maintenance operations
- **Benefits:**
  - better investment of resources by the pipeline operators
  - less risk to consumers from gas leaks or disruption from major water leaks
  - Public authorities can plan maintenance and have easier reporting under public obligations
  - Local citizens have a new perception of safety
- **Main findings:**
  - Current benefits: €6.6-7.9m pa
  - Full potential: €15.2-18.3m pa



# Forestry Management in Sweden

- In tree clear-cuts for areas greater than 3ha, forest owners are required to comply with specific regulations
- Satellite imagery is used to monitor and process clear-cutting
- Benefits today are modest, but the potential is high
- **Benefits for:**
  - Primary user: Swedish Forest Agency (SFA)
  - Other users: timber companies, sawmills
  - Industries: telecoms, water, electricity
  - Citizens and local economy by environmental and social values
- **Main findings:**
  - Overall Economic Benefits: €16.0-21.5m pa



# Winter Navigation in the Baltic Sea

- The variation in the severity of the Winters has a profound impact on the need for ice services for the Finnish economy
- Finnish and Swedish icebreakers use S-1 imagery (which replaced the use of helicopters) to help find the best routes through the ice
- **Benefit for:**
  - Primary user: icebreakers
  - Beneficiaries: cargo ships, ferries, oil tankers, coastguard, navy
  - Secondary beneficiaries: ports & harbours, stevedores, logistics
  - Citizens and local economy can be sure shops and petrol stations are well stocked
- **Main findings:**
  - Overall economic benefits: €24.2-116.5m pa



# Peatland Management in the UK

- 80% of UK peatland are in poor condition (drained or damaged by over-extraction)
- The problem faced by water companies is to localise areas of degraded peat
- Rezatec is using Sentinel-1 data to derive maps showing the extent and depth of peat across moorlands
- Benefit for:
  - Scottish Water & South-West Water reduce water purification costs
  - Wildlife trusts, heritage trusts, Moorland trusts, farmers/landowners benefit through biodiversity
  - Citizens enjoy better water quality & environment



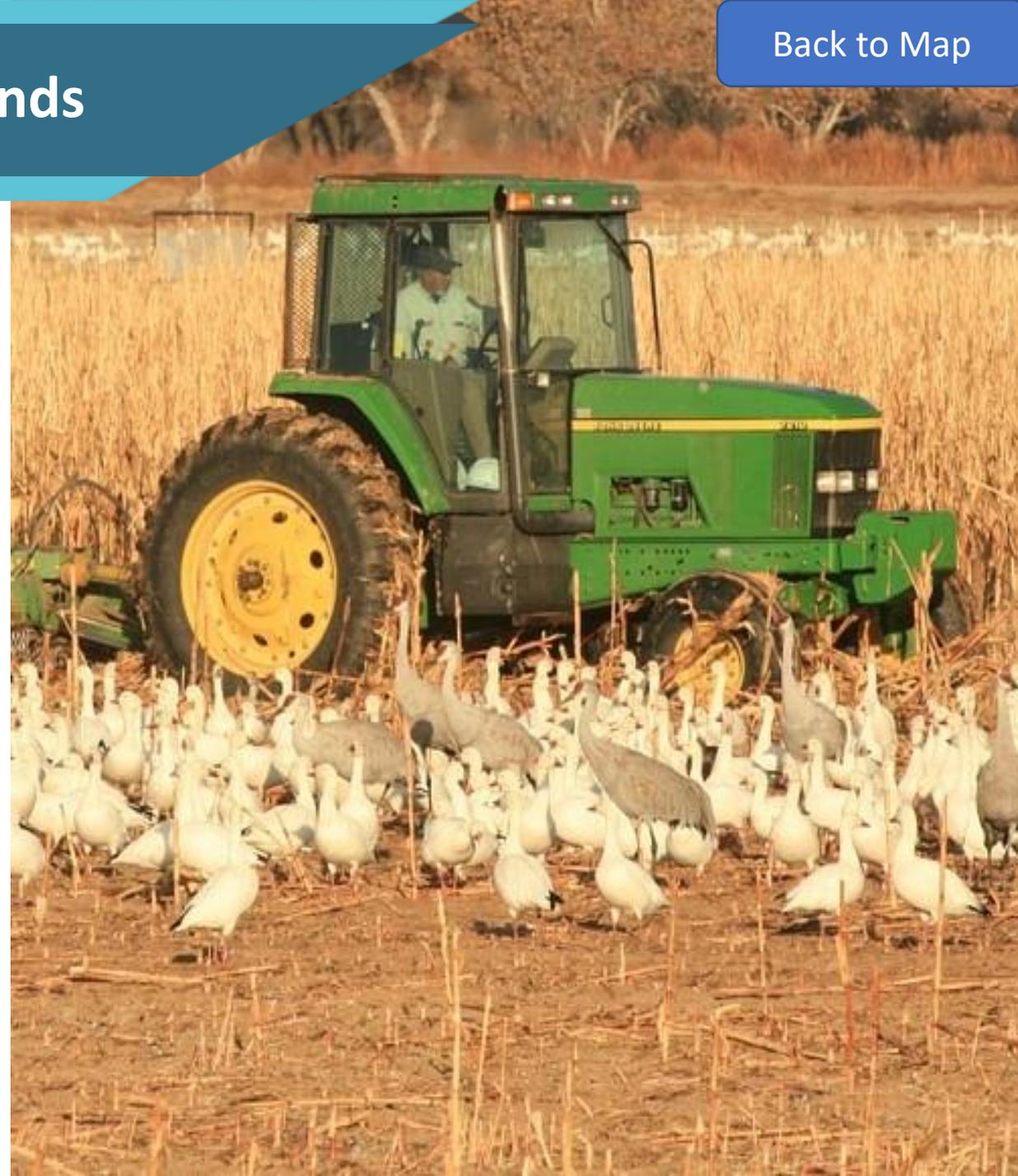
# Growing Potatoes in Belgium

- Potato growing & processing is important for the Belgian economy
- Given future challenges, potato growers are expected to “produce more with less”
- Sentinel-2 is used to support precision agriculture
- Direct beneficiaries are:
  - Farmers (higher output)
  - Agronomists & consultants (better advice)
  - Processing industry (improved strategic planning)
- Indirect beneficiaries
  - specialised companies in seeds, storage, processing profiting from higher output and demands
- Main findings:
  - Current benefits: €0.9 - €2.1m
  - Full potential: €38.5- €86m



# Assessing Geese Damage in the Netherlands

- Farmers in the Netherlands suffer from extreme geese damages
- ilionX helps the Province of Fryslân to automate appraisals & assess geese damage remotely saving time and cost for appraisers
- Automation leads to faster payments from the Fauna Fund & mitigation measures to curtail damage
- Societal benefits accrue from a more transparent system because fraudulent claims can be revealed more efficiently
- **Benefits for:**
  - Province of Fryslân can save money on compensation
  - Farmers recover use of invaded fields
  - General public through greater biodiversity



# Farm Management Support in Poland

- Polish farmers are increasingly striving towards sustainable productivity whilst reducing their environmental impact
- SatAgro uses Sentinel data for precision farming activities and VRA
- SatAgro partnered with Grupa Azoty to offer Sentinel-based services to their clients
- The cooperation benefits both partners by strengthening their corporate profiles
- Farmers, the environment and the general public benefit from the reduced use of fertilisers & increases in yield
- Direct beneficiaries:
  - The service provider: SatAgro
  - The primary user: Grupa Azoty
  - Farmers
  - Governmental agencies
  - The environment

EMRS Findings:

European Association  
of Remote Sensing  
Companies



SatAgro

GRUPA  
AZOTY

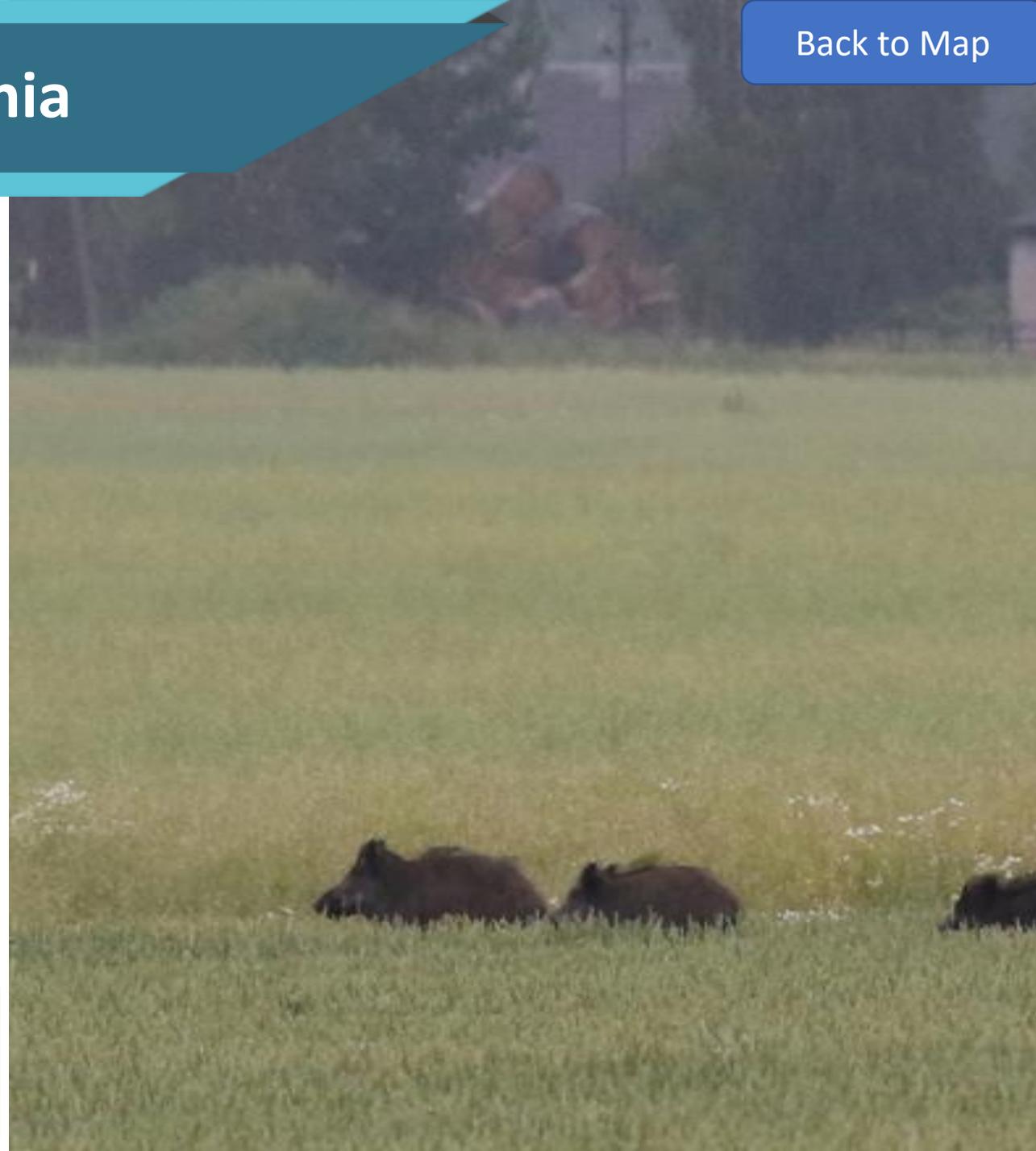
Current benefits: €1.1m pa

Full potential: €1.5m pa



# Illegal Wild Boar Activity in Lithuania

- A farmer suspected a local hunting club had driven wild boars into his fields destroying his corn yield
- With EO company GEOMATRIX, the farmer could prove in court that the crop damage resulted from localized animal activity and not widespread disturbances such as storms or heavy rain
- The farmer won his case and the hunting club were held liable for damages. The judge in this case recommended Sentinel imagery be used for other cases involving crop damage in the future.
- **Direct beneficiaries:**
  - Service provider: GEOMATRIX
  - Primary users:
    - Farmer
    - Vilkaviškis Municipality Department of Agriculture
  - Society benefits from a fairer, more objective judicial system



# Ground Motion Monitoring in Norway

- The Norwegian Geological Survey has developed a service (InSAR Norway) using Sentinel-1 data to show movement of the ground across the whole of Norway.
- This is being used by the Norwegian Roads Authority (NPRA) to support the construction and management of roads.

## Benefits:

- Able to identify where large-scale movement is occurring due to moraines or other geological instability.
- Reduced risk of damage to roads and buildings through better informed design process.
- Identify liabilities where construction leads to damage to nearby buildings
- Improved monitoring of potential rockslides causing infrastructure damage or risk to lives (through Tsunami)

**Economic benefits: €3.8m - €8.7m pa**



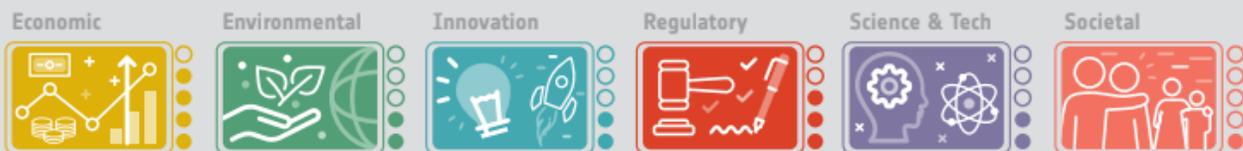
# Aquifer Monitoring in Spain

- The Segura River Basin management authority (CHS) in the region of Murcia abstracts water from deep-underground aquifers.
- Over abstraction leads to subsidence of the ground surface and potential damage to property in the region.
- IGME, the Spanish geological survey and DARES, a Spanish start-up are supplying maps showing ground movement

## Benefits:

- Better control of the water abstraction
- Reduced cost by avoiding the need for expensive in-situ sensors
- Better regulations through knowing that precise measurements can be made using InSAR
- Better compliance with environmental regulations governing the use of scarce resources (water).

## Total benefits



€31.7 - 71.8m pa



# Making Wine in France

- TerraNIS has developed the service Oenoview in partnership with ICV, which provides vineyards with information on the health and growth of the vines.
- The images enable better decisions when to harvest and how to blend their grapes to produce higher quality wine.
- Growers can lower costs and optimise and reduce their use of fertiliser.

## Benefits:

- Reduced fertiliser costs and improved harvesting efficiency
- Improved wine quality
- In the future, better planting pruning & caring for vines as well as better irrigation
- Improved compliance with environmental regulations & changed business practices
- Enhanced reputation of the region leading to increased revenues & employment

## Total benefits

### Economic



### Environmental



### Innovation



### Regulatory



### Science & Tech



### Societal



Anticipated benefits: €5-9m pa



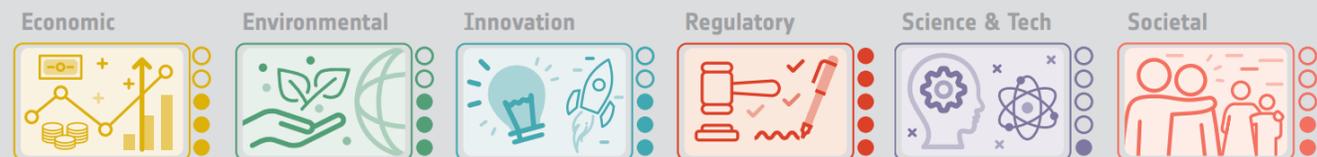
# Grassland Monitoring in Estonia

- KappaZeta have collaborated with ARIB to replace on-the-spot compliance checks of CAP grassland mowing requirements with automated, remote mowing detection.
- Compared to the 5% sample currently mandated by regulation, ARIB can accurately monitor 100% of registered grasslands, impossible without satellite data and, additionally, saving costs associated with in-person checks.

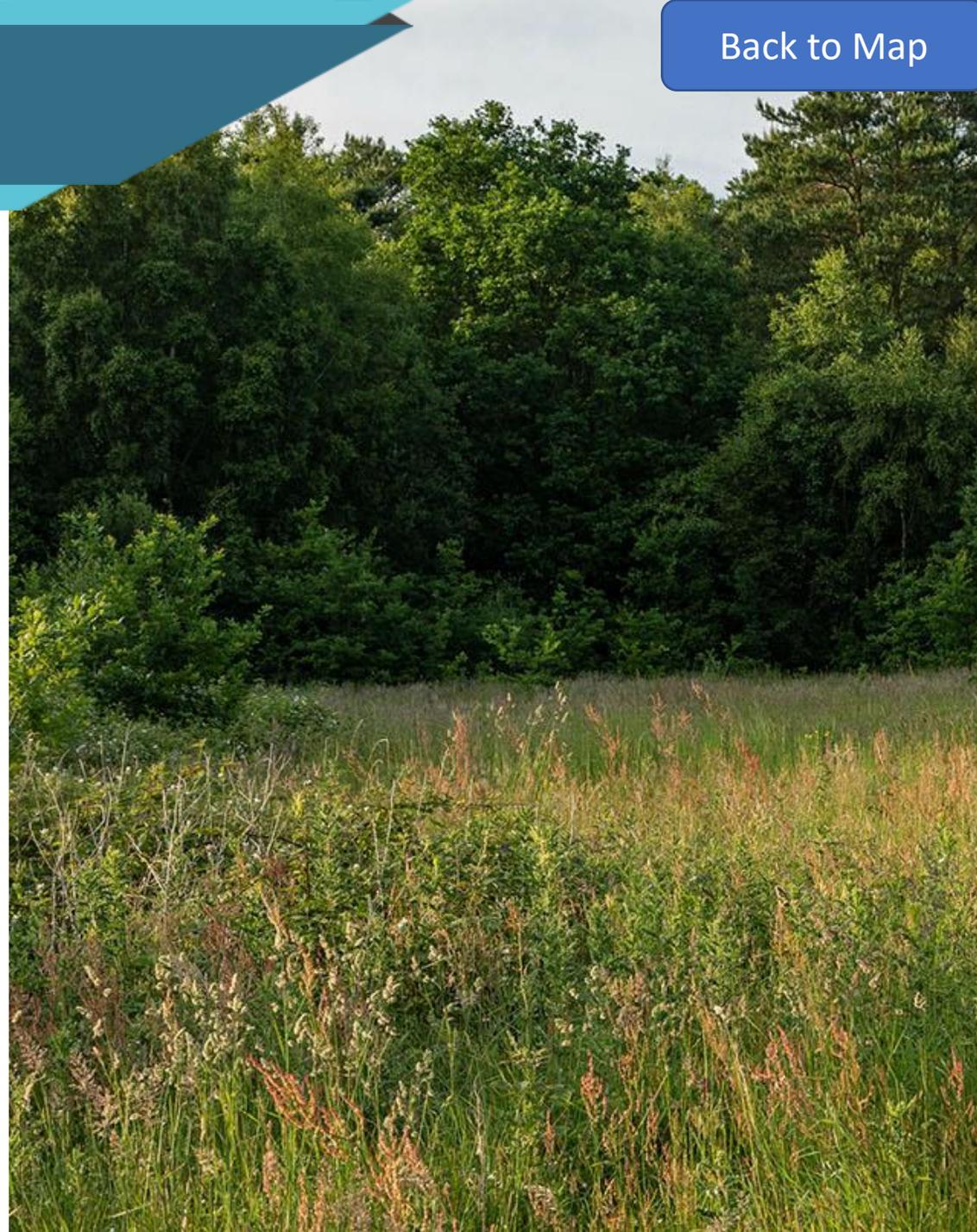
## Benefits:

- CAP regulation is enforced more efficiently and public funds are awarded to deserving, compliant farmers in a fairer and more transparent manner,
- The system helps to maintain and protect the biodiversity of Estonia's rural landscapes & contributes to the environmental sustainability goals of the CAP's initiatives i.e. keeping EU agricultural practices sustainable, maintaining the good condition of agricultural land, protecting natural habitats and aiding the sequestration of CO<sub>2</sub>.

## Total benefits



Anticipated benefits: 103k – 1.1M pa



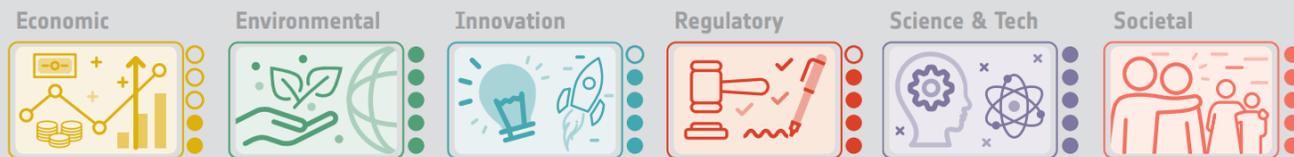
# Water Quality Management in Germany

- EOMAP, a small German company offers a service EoLytics which allows subscribers to download measurements of water quality for water bodies in their areas of interest.
- LUBW - the Baden-Württemberg State Institute for the Environment - accesses data for the region via eoLytics so providing a better service to its citizens for an affordable cost.

## Benefits:

- The service helps to reduce exposure to dangerous harmful algal blooms (HABs) whilst improving the environment, reducing pollution and helping nature conservation.
- Satellite-derived measurements of the quality of water in lakes help local and regional authorities monitor the lakes in their region more effectively, more frequently and more comprehensively and to keep their citizens informed.

## Total benefits



**Anticipated Monetary Benefits: €4m – 7.8m pa across Germany**



# Global Oil Industry Activity Monitoring

- Kayrros has leveraged Copernicus Sentinel-1 data to measure the heights of crude oil storage tank roofs globally. They have developed algorithms that can produce continuous and accurate estimates of where oil inventories are currently situated and how they are changing.
- Energy companies & commodity traders can all benefit from having more precise and timely information on movements within the crude oil market to make better decisions and plan their strategy.

## Benefits:

- TOTAL's Market Analysis team use the service to make better informed decisions, not only when it comes to their trading, but for their planned production volumes, as well as the short to medium term strategy of the company as a whole.
- Better information for market participants to make better informed business decisions, encouraging market competition and ultimately driving prices lower for end users.



# Golf Course Monitoring in Italy

- Centrale Valutativa has developed the decision-support application TETHYS that makes use of Sentinel-2 data to monitor the health status of fields and grasslands.
- Greenkeepers of golf courses, a major water consumer, can focus their attention to parts of the golf course that need their attention most as well as employ precision irrigation, saving time as well as both water and energy

## Benefits:

- Better overview of the Golf course's health thanks to synoptic, frequently updated view of the photosynthetic activity
- Better and earlier information on the health state several days before greenkeeper's naked eye providing extra time for mitigation measures
- Financial benefits through lower water and energy consumption (c. 20%)
- Increased timesaving for the superintendent to focus on areas that need care the most
- Overall environmental benefits in a water-stressed region



# Forest Monitoring in Portugal

- Tesselo monitors the lifecycle of tree plantations (new plantations, harvest, burnt areas), tree age as well as national land use (changes) using Sentinel-2 data and AI techniques.
- Forest managers & CELPA can access the platform to check tree health remotely, prioritising their work according to urgency and need and to understand more effectively the state of the tree plantations country-wide and market dynamics.

## Benefits:

- Efficiency gains and cost savings due to needs-based field inspections by at least 25%
- Increased revenues due to better tree care and maintenance increasing the yield
- Reduced pollution due to less use of fertilizer/pesticides & 25% less car trips
- Changed, more efficient business practice
- Increased student research on EO due to partnership between Tesselo and universities



# Insurance & Risk Monitoring in Slovenia

- Flycom Technologies uses Sentinel data to conduct risk assessments for insurance companies.
- In the wake of natural disasters, the data also allows for rapid mapping of impacted areas and helps in determining future exposure to similar events.
- The largest Slovenian insurer Zavarovalnica Triglav uses the Sentinel-derived mapping service to understand the impact of natural disasters and assess exposure to future risks.

## Benefits:

- Swifter, fairer and unbiased processing of claims
- Fair and efficient insurance services that protect customers in the wake of natural disasters and help restoration/rebuilding of affected areas
- Better assessment of damages and future risks over large areas remotely, reducing the need for costly and sometimes dangerous in-person assessments
- Easier diversification of service offerings by insurers and entering of new markets without major cost implications due to the free and open Copernicus data

