EARSC

European Association of Remote Sensing Companies

EARSC Workshop On: Exploiting the Value of EO Data

Satellites Benefiting Citizens

Study on behalf of ESA

Look at the Economic Value created through the use of Satellite data.

Bottom up approach working through the value chain

3 cases studied and reports published (see EARSC web-site).

Geoff Sawyer & Marc de Vries

From the Copernicus Economic Benefit Study performed under an assignment from the European Space Agency

Workshop Agenda

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09:00-09:10	Welcoming remarks
09:10-09:30	***The socio-economic benefits of Copernicus, Thibaud Delourme, DG-GROW***
09:30-09:50	***Presentation of the Copernicus economic value study, Alessandra Tassa, ESA***
09:50-10:10	***Introduction on the CEVS methodology, Geoff Sawyer, EARSC/ Marc de Vries, The GreenLand***
10:10-10:45	***Winter navigation in Finland, Jarkko Toivola, FTA / Geoff Sawyer, EARSC***
10:45-11:30	Networking Tea/Coffee Break
11:30-12:05	***Forest management in Sweden, Erik Willen, FRI / Marc de Vries, The GreenLand***
12:05-12:40	***Infrastructure monitoring in NL, Ivo Visser, Stedin / Jos Maccabiani, SkyGeo / Marc de Vries, The GreenLand***
12:40-12:50	***Conclusions***
12:50-13:00	***Global discussion***
13:00-14:00	Networking Lunch

What is EARSC?

EARSC is a trade association (non-profit Belgian company), founded in 1989, which represents European companies: *providing services (including consultancy) or supplying equipment in the field of remote sensing.*

Our mission is:

- to foster the development of the European Geo-Information Service Industry
- to represent European geospatial-information providers, creating a sustainable network between industry, decision makers and users

Our focus is on the use of remote sensing from space-based platforms (satellites) and we have members from the full value-chain including aircraft and RPAS operators.

Network

67 full members, 9 observers
From 22 countries in Europe

Members: any commercial company providing services (including consultancy) or supplying equipment in the field of remote sensing shall be eligible for full membership. based in a European country which contributes to the European Space Agency or which is a member of the European Union

Observer: any organisation engaged in the supply or use of Remote Sensing which does not qualify to become a full member of the Association

What does EARSC do?

1. Provide information to our members on programmes, policy and the sector; (business intelligence)
2. Maintain a knowledge of the industry, i.e. statistics, market information, etc.
3. Promote professional standards within the industry (certification)
4. Promote the industry and its capabilities by:
   - Creating links between EO services sector and other business sectors, e.g. oil & gas, insurance, public institutions e.g. the World Bank
   - Organising events offering networking opportunities as well as focused information
   - Advocacy towards policy makers on issues of concern
   - Awareness and media. e.g. eomag, OGEOZine, etc.

EARSC focus is on enabling the development of new business

Introduction to the Methodology

Objectives of the Study

To provide a bottom up assessment of economic value coming from the use of satellite data by analysing 3 cases where satellite EO data is being used operationally. For each:

- Identify value chains which should be mature and operational and which are benefiting from the use of EO derived geospatial information as part of their operations.
- For 3 of these value chains, a quantified economic benefit to be provided as a result of a detailed examination of the uses to which the geospatial information is being put.
- A methodology designed and tested on the selected value-chains and which can be used to extend the analysis to further chains in the future.

The key difference from previous analyses is to work through the full value chain where the benefits of using EO data can be felt.

Selection of 3 cases

A number of potential cases have been identified and reduced to 3 following review and discussion

1. Winter navigation in the Baltic
    - The use of satellite (radar) imagery to help clear directways through the ice to help ships transporting goods.
2. Forests management (in Sweden)
    - Satellite optical imagery is used to map clear cut areas which are controlled by Swedish and EU law
3. Infrastructure: Ground Movement Impact on gas pipelines in the Netherlands
    - SAR images are used to detect fine movements in the ground surface mapped to gas and water pipelines serving mainly domestic customers.

Overall Methodology

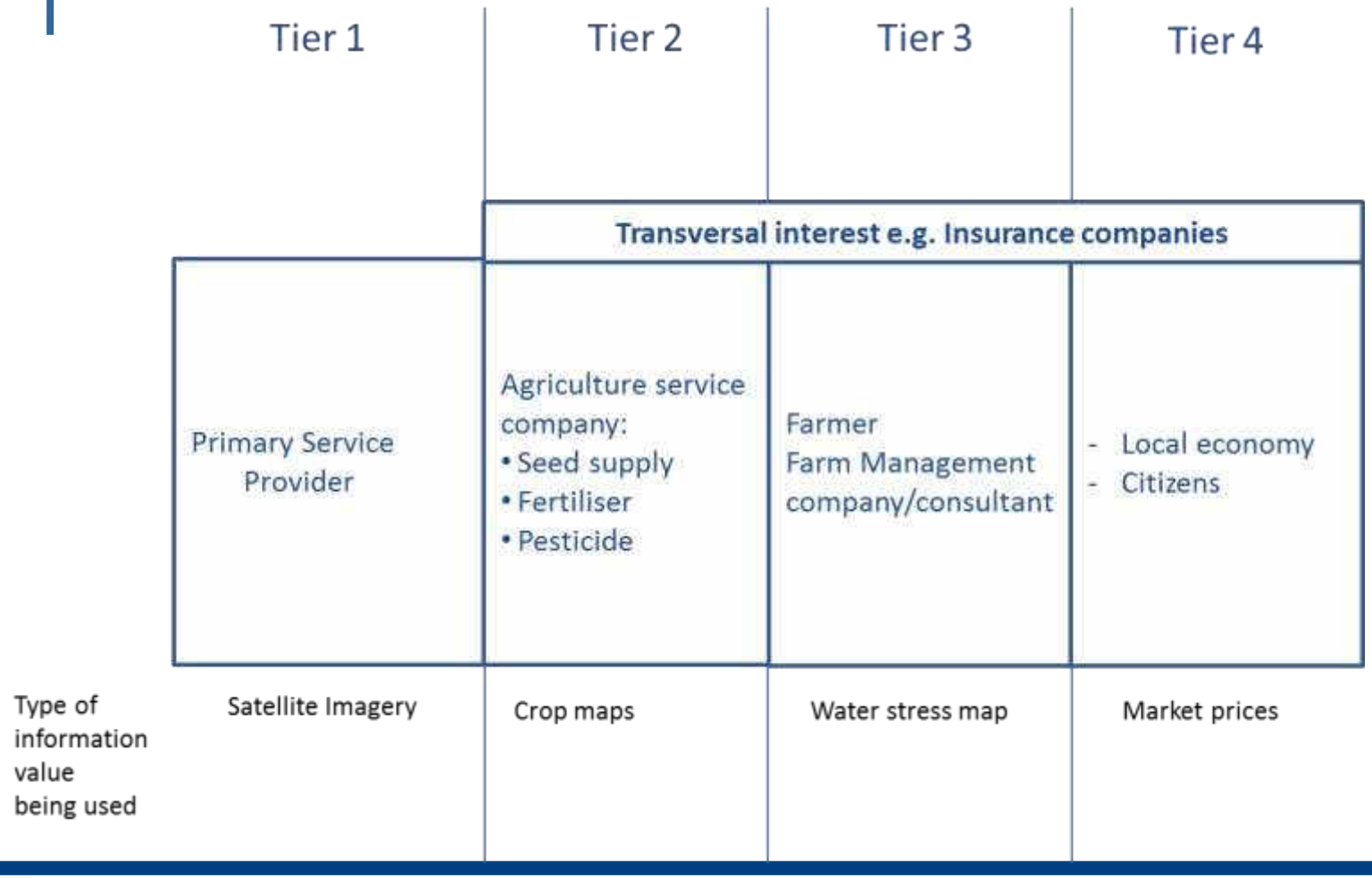
1. Find a product used in an operational process
2. Validate case against success criteria.
3. Understand how the products are used elsewhere and develop the value chain picture
4. Understand the information type which is characterising the value chain and how this benefits for each user and user type.
5. Develop a model which allows the benefits to be assessed in economic terms (linking economics to reality)
6. Assess how much of the value can be attributed to the use of satellite data.
7. Where appropriate look at factors which can allow extrapolation to a wider region (country).
8. Calculate the economic value for each beneficiary tier and hence the overall economic value for the product.

Note: where assumptions need to be made, they should be visible and open to challenge.

Criteria for Success

1. Presence of a good sponsor at the start of the value chain. Can be in the primary user or in the supplier but they need to be
    1. Enthusiastic for the case (see the value for themselves)
    2. Able and willing to open doors at the next level of the value chain
    3. Have an excellent understanding of the way the information has been used and by whom to what success.
2. Willing interlocutors at least at the next step in the value chain
3. Benefits can be measured in economic terms (presence of other softer benefits may be an advantage but is secondary)

The Value-Chain: generic example



Importance of the model:

- The model is used to translate the reality into economic benefits
- It is key to the process and differs for each case as we shall see.
- Model may be:
  - Financial as in pipeline infrastructure case
  - Statistical as in ice-navigation case
  - Economic as in forestry case

Case 1: Winter Navigation in the Baltic

What it is about

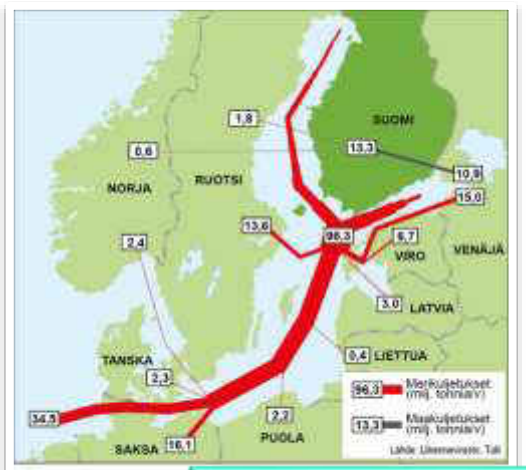
Winter navigation in the Baltic has an outstanding importance for Finnish economy. Copernicus Sentinel-1 data contributes to make it more efficient.

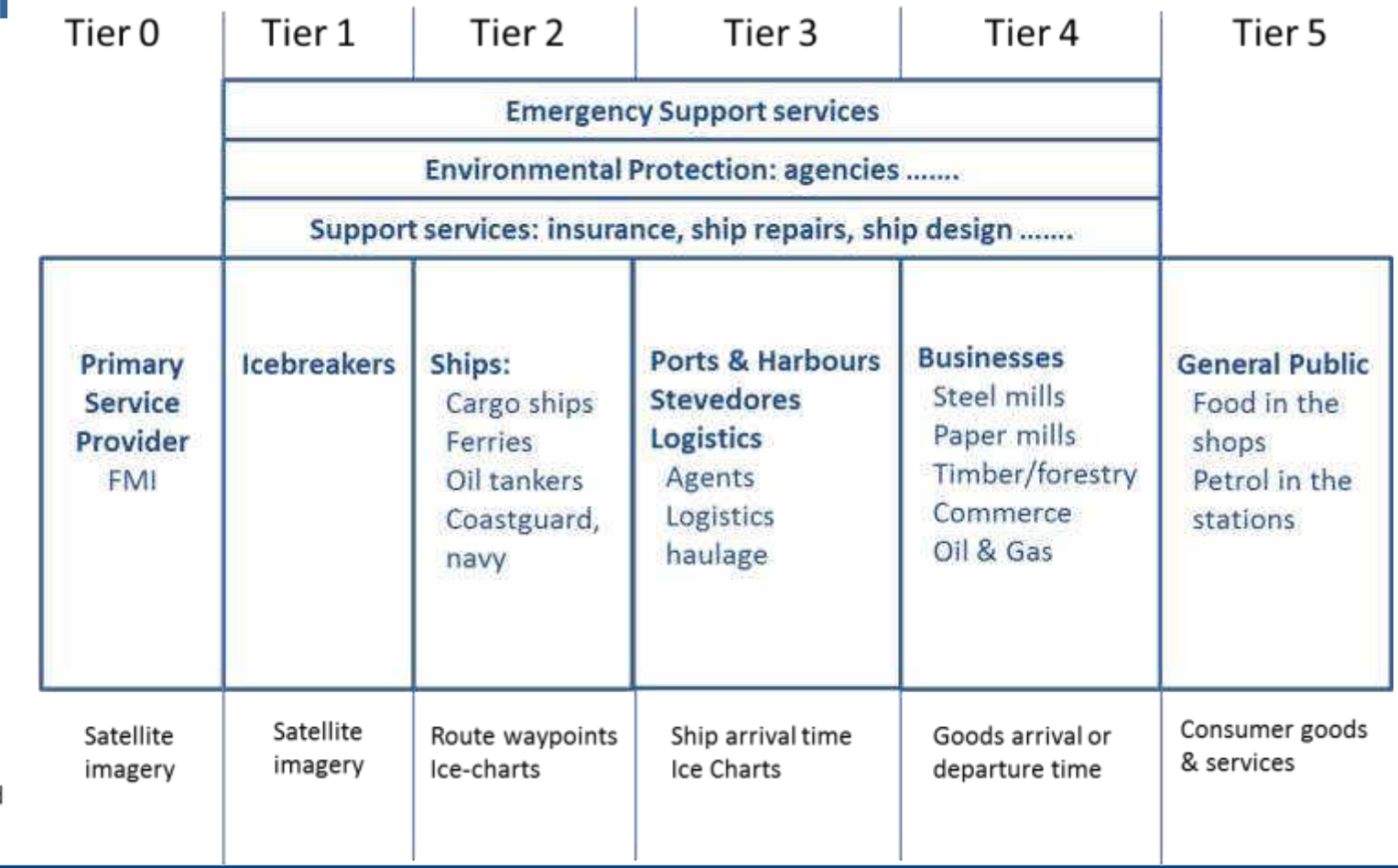
Satellite radar (SAR) imagery is used to observe ice conditions in the Baltic by Finland and Sweden. With their synoptic view, satellites allow icebreakers to keep sea-lanes ("Motorways of the Sea") and ports open more effectively. This allows reducing transit times and uncertainties, which in turn has positive impacts on ports operations and down to goods transportation and availability for the local population.

We, EARSC and The Green Land, investigated these cascaded effects and the benefits brought by the use of satellite imagery for each tier down to such value chain. We found clearly identifiable impacts for each tier. According to our analysis, between €24m and €116m per annum of economic value is being generated in Finland and Sweden thanks to the use of satellite radar images. Copernicus Sentinel-1 mission will provide more frequent observations which will allow better interpretation between the passes.

Winter Navigation in Finland

- *"Finland is an island!"* : over 90% of Finnish imports and exports travel by sea.
- Decision in 1971 that all major Finnish ports (25) should be kept open through the winter
- In 2003, decision to use Satellite imagery to replace helicopters on board ice-breakers
- Whilst helicopters provide an instant view; conditions change under bad weather conditions when they may not be able to fly
- Satellite imagery provides a synoptic view of the whole of the Baltic which allows icebreaker captains to plot a route right through the ice fields




Tier 0
Tier 1
Tier 2
Tier 3
Tier 4
Tier 5
Emergency Support services
Environmental Protection: agencies .....
Support services: insurance, ship repairs, ship design .....
Primary Service Provider
FMI
Icebreakers
Ships:
Cargo ships
Ferries
Oil tankers
Coastguard, navy
Ports & Harbours
Stevedores
Logistics
Agents
Logistics haulage
Businesses
Steel mills
Paper mills
Timber/forestry
Commerce
Oil & Gas
General Public
Food in the shops
Petrol in the stations
Type of Service Being used
Satellite imagery
Satellite imagery
Route waypoints
Ice-charts
Ship arrival time
Ice Charts
Goods arrival or departure time
Consumer goods & services

Sources of Benefits

The Ice Monitoring Value Chain

1. The Finnish Met Office (FMI) produce daily maps of the ice conditions that are used by ships, ports and media
2. Satellite imagery is used by icebreakers to keep sea-lanes and ports open; “Motorways of the Sea”.
3. Icebreakers guide ships to the ports so reducing transit time, fuel use, damages to ships (ice collisions) etc.
4. More precise arrival time allows ports to improve their planning of operations
5. Factories (paper mills / steel mills / oil refineries) can plan stock arrival and goods shipment.
6. Consumers benefit by greater assurance of the availability of food, fuel and medicines.

The Model

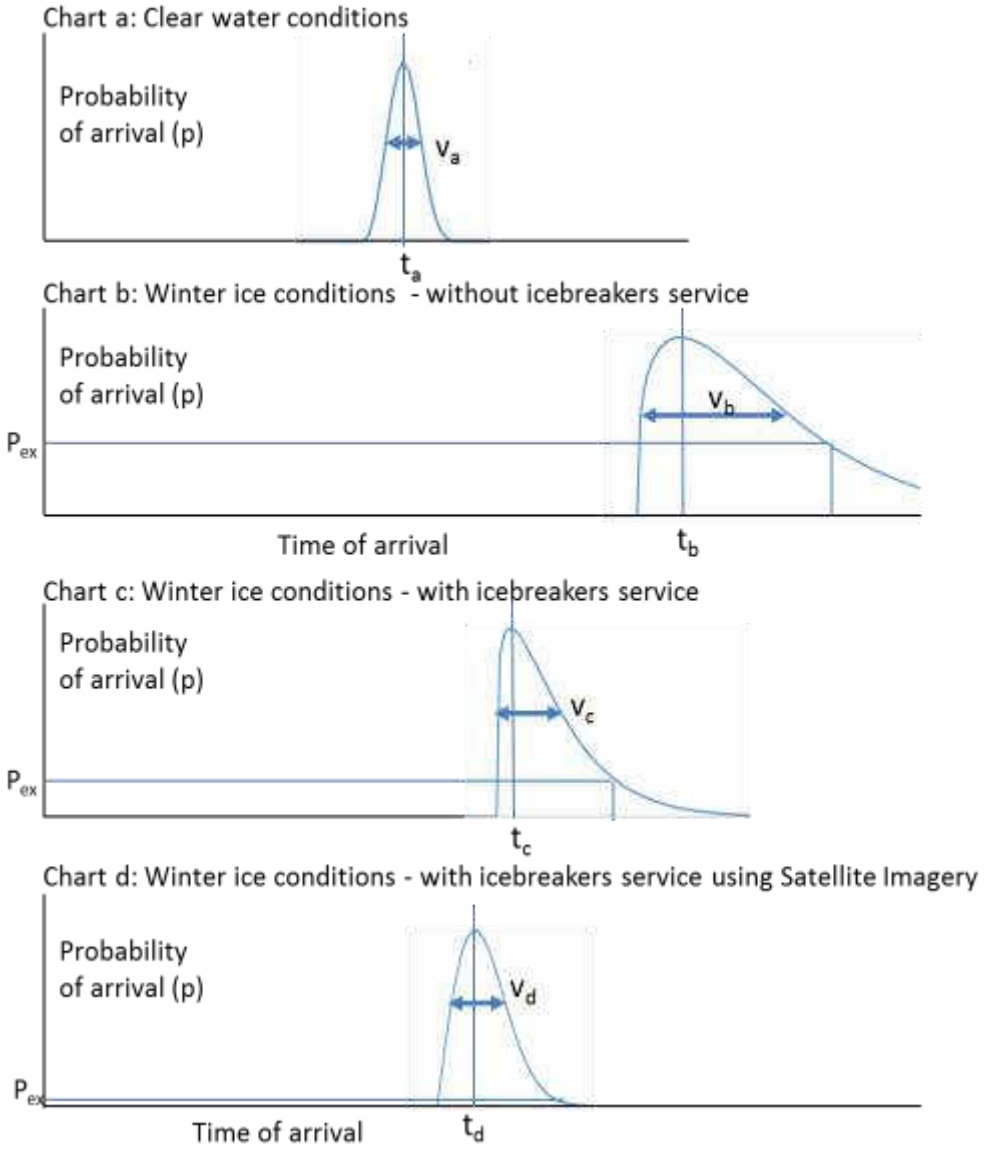
Generic model: no specific data to derive precise distributions

Three parameters:

1. Delayed arrival time
2. Uncertain arrival time
3. Probability of severe delay.

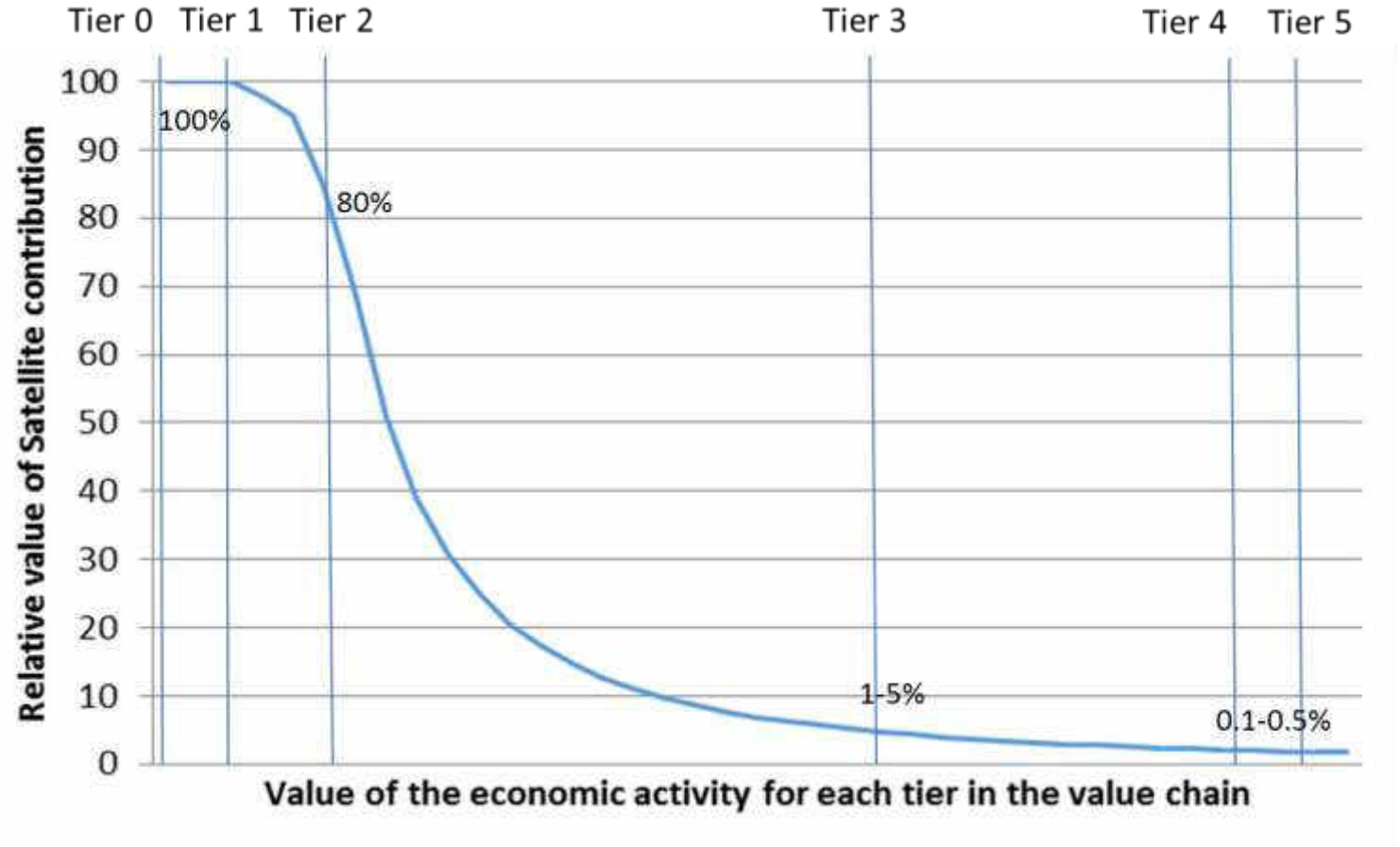
Variations between winters is greater than variation within a single year which makes precise analysis hard.

WinMOS model being constructed may help.



Contribution of the Imagery

The contribution falls but the volume of activity increases.

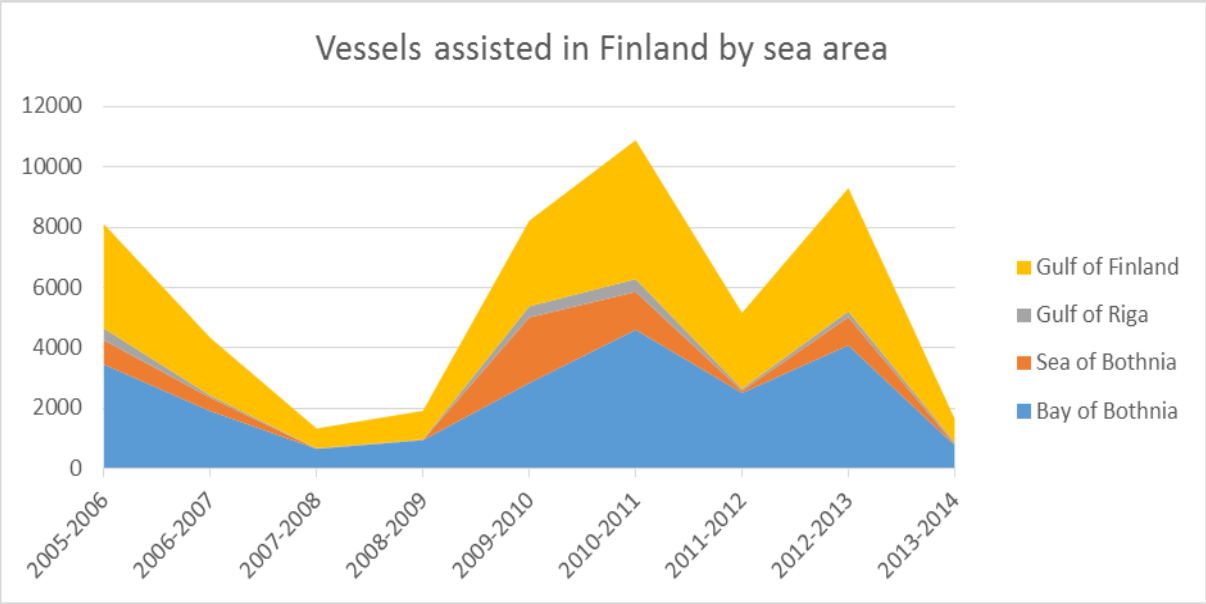


Number of ships assisted by icebreakers

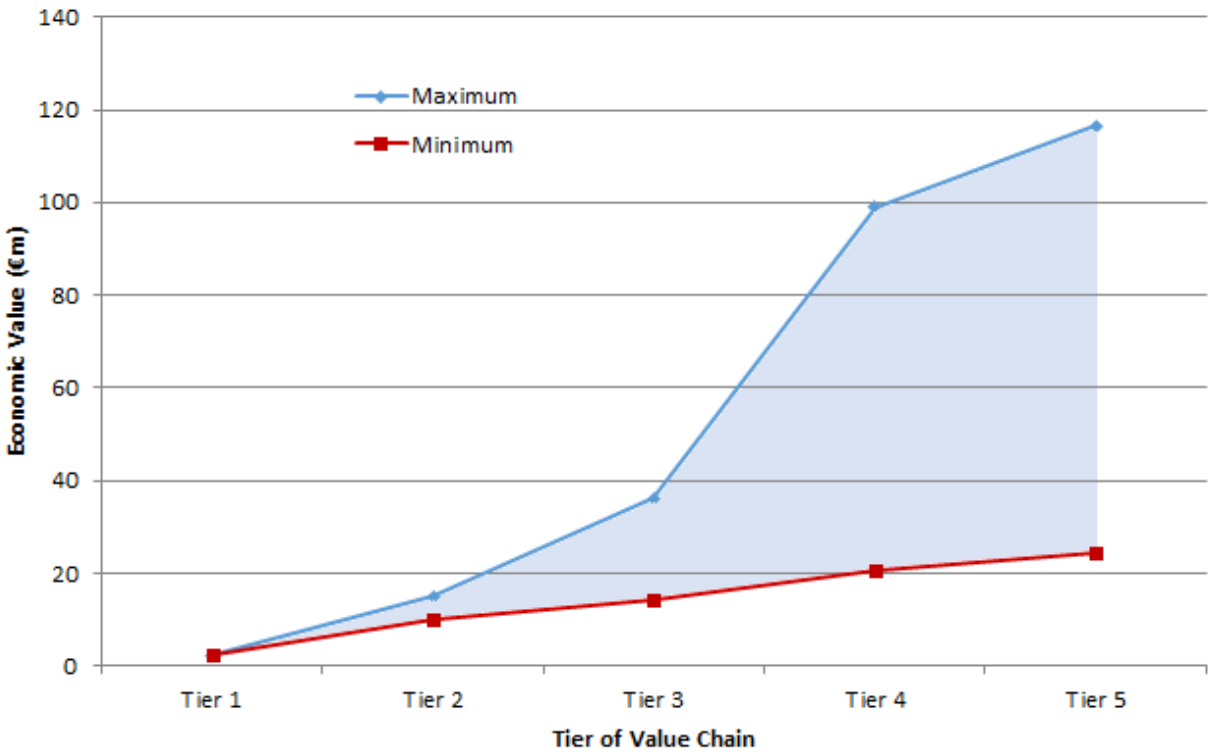
Variations caused by differing annual ice conditions.

Correlate directly with winter severity

Variation between years is greater than variation within a year.



Cumulative Benefits

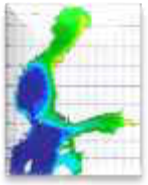


From Satellites to Supermarkets

The Economic Benefits

The Study shows that the Finnish & Swedish economies benefit from the use of satellite imagery like that coming from Copernicus;

Between **€24m and €116m** of economic benefit is made each year.



Icebreakers use imagery to find the best routes through the ice

€2.3m pa

Ships save fuel and time

€2.1-€3.3m pa

Ports are able to operate more efficiently

€5.8-€9.4m pa

Factories are able to operate all year round

€6.3-€63m pa

Citizens can be sure that the supermarkets (and petrol stations and pharmacies) are stocked.

€3.5-€17.5m pa

Case 2: Forest Management in Sweden

What it is about

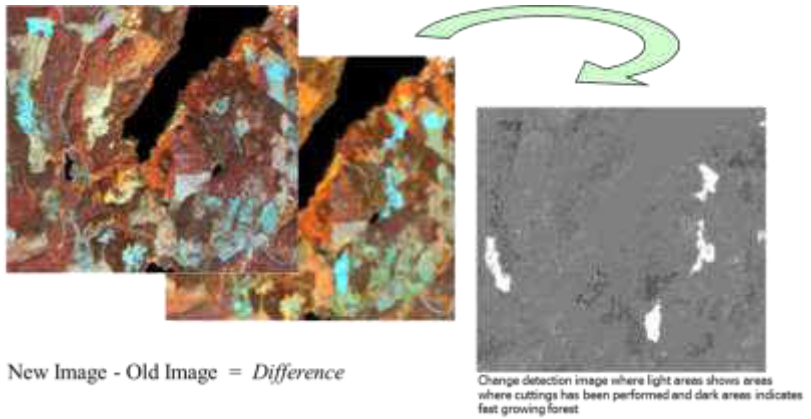
Forestry is a strategic sector for Sweden. Satellite optical imagery supports forests monitoring in a very cost-effective way.

Satellite optical imagery is used by the Swedish Forest Agency (SFA) to observe the forests in Sweden. Satellites allow the detection of illegal cutting and of sub-optimum management practice by private forest owners. This Swedish model has positive impacts on timber industry and ecotourism.

We, EARSC and The Green Land, investigated these cascaded effects and the benefits brought by the use of satellite imagery for each tier down to such value chain. We found clearly identifiable impacts for each tier. According to our analysis, the result leads to a significant economic benefit of between €16.1m and €21.6m per annum in Sweden. Copernicus Sentinel-2 mission will provide more frequent observations thus allowing better interpretation between the passes.

Forest Management in Sweden

- Satellite optical imagery has been used since 2000 to monitor clear-cut mapping in Sweden.
- Swedish Forest legislation is very light
  - Keeps industry costs low; encourage competitiveness
  - Develop forest stocks as national, exploitable asset
- Swedish Forest Agency implement and monitor the act; satellite imagery is most cost-effective tool.
- Knowledge of clear cutting and forest management allows SFA to promote best practise to the 300,000 private owners of forest land.



The Forest Management Value Chain

1.The Swedish Forest Agency purchases imagery (in co-operation with other government agencies) and processes it to detect / characterise the clear-cuts.

2. Following SFA advice, private forest owners benefit by complying with forest monitoring best practices and increase their stocks.

3.The Swedish citizens benefit from increased economic activity arising from the forest management practice and from the improved forest natural environment.

4. The clear-cut maps are used by other organisations public and private which benefit by using them either to improve their own work (PSB's) or develop additional business (private EO companies) in diverse industrial sectors (water/ telecommunications/ power)

Managing Forest Assets

The Study shows that the Swedish economy benefit from the use of satellite imagery like the one coming from Copernicus; Between **€16.1m and €21.6m** of economic benefit is made each year.

SFA can ensure regular, country-wide monitoring of forests

€9.5m pa

Forest owners benefit from complying with replanting practices

€3.07 - €6.14 m pa

And with pre-commercial thinning practices

€2.43 - €4.86 m pa

Citizens enjoy increased economic activity & preserved environment

€1m pa

Maps of cuttings are used by public and private entities

€0.13m pa

Case 3 Pipeline Infrastructure Management in the Netherlands

What it is about

Subsidence can cause gas and water pipelines to break right where they enter houses. In the Netherlands, satellite data are used to monitor gas pipelines at affordable costs.

Copernicus satellite imagery, in combination with more detailed commercial imagery, is used by some Dutch utility companies to improve the management practices of sub-surface pipeline monitoring. It allows them to determine with greater accuracy where maintenance work is required and hence plan their investment programmes more efficiently. This impacts also citizens and local businesses positively.

We, EARSC and The Green Land, investigated these cascaded effects and the benefits brought by the use of satellite imagery for each tier down to such value chain. We found clearly identifiable impacts for each tier. According to our analysis, the potential overall economic benefit to the Netherlands is assessed to be between €14.5m and €17.6m per annum. The use of low resolution, free Sentinel-1 data is instrumental in making the case economic by pin-pointing the risky areas requiring further assessment.

Pipeline Monitoring

Ground subsidence is a particular problem in the Netherlands. Soil levels can change by as much as 1m within a few years.

Gas pipelines entering houses can be subject to very significant stress leading to a risk of rupture and threat of gas leakage and explosions.

Satellite images show hot spots where ground movement is taking place. And thus allow a targeted replacement programme: the maintenance strategy has now become focused on areas of higher risk. Instead of replacing pipes and connections in a single district pipes serving individual houses or streets can be replaced.

The result is better use of resources by the pipeline operators and less risk to consumers from gas leaks or disruption from water leaks.

The Pipeline Infrastructure Value Chain

1.Skygeo, a private company uses satellite data to generate InSar maps which is the basis for calculating ground movement and deformation

2. The maps are supplied to Infrastructure Management Companies dealing with gas and water distribution.

3. Improved planning of pipeline maintenance work also benefits the local authorities by enabling them to co-ordinate better between the companies digging up the road.

4. The Dutch citizens and local economy benefit from risk reduction in their households and less maintenance work which leads to less disruption to businesses in terms of road closures and delays.

Ground Deformation & Asset Management

The Economic Benefits

The Study shows that the Dutch economy may benefit from the use of satellite imagery like that coming from Copernicus to **€15.2m and €18.3m** each year in the whole country thanks to the combined use of Sentinel imagery and commercial high resolution imagery.

€500k pa

The service provider using EO data creates employment and revenues

€11.1 m pa

Maintenance and management of infrastructure assets

N/A

Municipalities can better plan maintenance activities in their territory

€3.6m-€6.6m pa

Citizens benefit from risk reduction in their households and less maintenance work

Conclusions

- The three cases have demonstrated the value coming from the satellite data – far higher than was initially considered.
- A new approach and methodology has been proven based on a value-chain which extends to individual citizens and their local economy.
- At the core, each case is based on a specific model which is used to derive the economic benefits.
- Each case has shown strikingly different characteristics but strong economic benefits
- In all the cases, conservative assumptions have been made which have not so far been challenged by experts.

Case Comparisons

The three cases show very interesting contrasting characteristics:

	Winter Navigation	Forestry	Pipelines
Service Provider	Public provider; Met office (FMI)	Public provider Responsible Agency (SFA)	Private, commercial service provider (SkyGeo)
Value Chain	Linear dependency	Indirect actors	Concentrated value
Source of Value	Direct relationship between the imagery and the value creation.	Indirect relationship created by light legislation	Commercial relationship driving more efficient operations.
Legislative Impact	Public decision to keep ports open through the winter. Public policy for icebreaker services.	Light legislation removes costs but brings responsibilities "freedom with responsibility"	Regulatory control of utility providers will change the beneficiaries.

Case Comparisons (2)

The three cases show very interesting contrasting characteristics:

	Winter Navigation	Forestry	Pipelines
Wider Applicability	To rest of the Baltic To other ice-bound regions	To other Boreal forests Depends on legislation	To many countries where ground subsidence occurs
Model	Statistical based on ship transit time and arrival time.	Economic based on reducing transaction costs	Financial based on life cycle costing and investment returns
Primary Information Type	SAR images used directly on the ice-breaker.	Optical images processed to show forest clear-cuts ie cleared land	SAR interferometry showing ground movement to very fine degree.
Copernicus applicability	Sentinel 1	Sentinel 2	Sentinel 1 plus commercial TerraSAR-X imagery

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Thank You