Sustainability and security at sea in the context of the EU’s Copernicus Earth observation program

Harm Greidanus

UN/UAE High Level Forum
Space as a Driver for Socioeconomic Sustainable Development
As the science and knowledge service of the European Commission, the JRC’s mission is to support EU policies with independent evidence throughout the whole policy cycle.
Contents

• Copernicus
  • Recent results in maritime monitoring
Copernicus
– The EU’s program for Earth observation

Space-based monitoring: Information valuable for
• Public authorities
• Companies, people – Private sector

Satellites provide data that is
• Regular, global, for common needs → EU role
• Only partial → Integration with non-satellite data
Use by public authorities

Keeping aware of state and changes of land, sea & air
• Need for new regulations?

Monitoring the implementation of regulations
• Agriculture, forestry, fisheries, environment, pollution, climate change, natural disasters risk & impacts, urban development, spatial planning, border security, ...
• Sustainability, safety, security

→ Better governance
Use by private sector

By end users
• Farmers, mariners, builders, miners, car drivers, ...

By service providers
• Intermediaries who make products for end users
• Value chain

→ Economic growth
Copernicus components

In space: Satellites
- “Sentinels”, EU-owned; 6 types (optical images, radar, ...)
- Data from 3rd party satellites

On ground
- Ground stations, etc.
- In-situ sensors (land, air, sea)
- Data access portals
Copernicus products

1. Data
   • Basic products (e.g., satellite images) from the Sentinels
   • Free & open

2. Services
   • Higher level products made from satellite data + other data + models
   • Mostly free & open
Hundreds of products, e.g.:

- Global forecast of sulphate aerosol
- Arctic surface chlorophyll concentration
  - Global vegetation productivity index
- Monthly surface air temperature
  - Hurricane Ophelia in Ireland
- Vessel tracking

http://copernicus.eu/
While the Copernicus Security Service provides (among other outputs) Maritime Surveillance, 
• operated by EMSA 
• unlike the other 5 Services not publicly accessible, 
Here we show some applications of the Copernicus Data, which are publicly available
Maritime spatial planning

Sentinel-1 image
(radar)

North Sea off
The Netherlands

Sentinel-1 image, 250 km wide, 25 Nov 2016, 05:57:20 UT © Copernicus 2016
Offshore wind farms

Sentinel-1, 25 Nov 2016 © Copernicus 2016
Maritime awareness around Africa

- Piracy, Maritime Awareness & Risks (PMAR) project
- Capacity building for maritime authorities in Africa
- Gulf of Guinea and Western Indian Ocean
  - Kenya Maritime Authority, Indian Ocean Commission
- Use of space & ICT technologies to become aware of what is happening at sea
  1. Automatic position reports from AIS (IMO-mandated);
     Received by 17 satellites (not Copernicus, not free)
  2. Radar images by 5 Earth observation satellites
Information from AIS messages (cooperative)

Real-time instantaneous: Ships on 6 May 2016 09:16 coloured by type

Over one month: Ship density in Jan 2015
Information from AIS messages (cooperative)

- **Fast moving, > 6.5 kn**
- **Slow moving, < 6.5 kn**

**Selection on speed**

- **Highlights traffic routes**
- **Highlights fishing activity**

6-9 Nov 2017, Dubai UN/UAE High Level Forum Space
Finding non-reporting ships

<table>
<thead>
<tr>
<th>Sat/mode</th>
<th>Resolution</th>
<th>Non-reporting</th>
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</thead>
<tbody>
<tr>
<td>A-2 WBD</td>
<td>90m</td>
<td>13 %</td>
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<tr>
<td>RS2 DVWF</td>
<td>70m</td>
<td>33 %</td>
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<tr>
<td>RS2 SNB</td>
<td>50m</td>
<td>12 %</td>
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<tr>
<td>CSK WR</td>
<td>30m</td>
<td>15 %</td>
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<tr>
<td>S-1 IW</td>
<td>20m</td>
<td>68 %</td>
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<tr>
<td>TSX SC</td>
<td>20m</td>
<td>56 %</td>
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<tr>
<td>A-2 FBD</td>
<td>10m</td>
<td>31 %</td>
</tr>
<tr>
<td>RS2 F0W2</td>
<td>10m</td>
<td>0 %</td>
</tr>
<tr>
<td>A-2 HBQ</td>
<td>5m</td>
<td>14 %</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>29 %</strong></td>
<td></td>
</tr>
</tbody>
</table>

- **Correlated SAR-AIS**
- **Uncorrelated SAR**

"Non-reporting ship"

**Satellites used:**
- Radarsat-2
- Cosmo-SkyMed
- Alos2-Palsar2
- TerraSAR-X
- Sentinel-1

Collaboration with:
- DRDC - Defence R&D Canada

[Deutsches Zentrum für Luft- und Raumfahrt]
Ship traffic in the Arctic

Selection on ship type and speed

Data: Satellite AIS from Norwegian Coastal Administration / FFI
Non-reporting ship traffic in the Arctic
1 year, Nov 2014 – Oct 2015

Data: Satellite AIS from Norwegian Coastal Administration / FFI

Uncorrelated Sentinel-1 targets (16% of the total). Many of these are likely to be non-reporting ships

Fishing
Exploration
Shipping

Reporting ships (AIS)

Non-reporting ships

From comparing 2,033 Sentinel-1 images with the AIS data
A Sentinel-1 image

Sentinel-1 IW image, 250 km wide
30 Jan 2017, 17:03:45 UT, VV polarisation, © Copernicus 2017
Ship density map
Mediterranean Sea

- 2 years of Sentinel-1 data
- 11,500 satellite images
- 485,000 ship detections
- Not depending on ship reporting
Conclusion

- Satellite data provide unique information – not only on human activities at sea, but also on other observables.
- Complementary to other data (such as reporting systems, in-situ measurements, ...)
- The EU’s Copernicus program is now routinely collecting satellite data over land, sea and air, in vast amounts (Terabytes per day).
- The free availability of these data will stimulate better governance and economic growth.
Thank you

Any questions?

You can find me at harm.greidanus@ec.europa.eu