European Commission

Ship traffic and oil spill monitoring with Sentinel-1

Copernicus for Entrepreneurs and Developers

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Europe's eyes on Earth

Space

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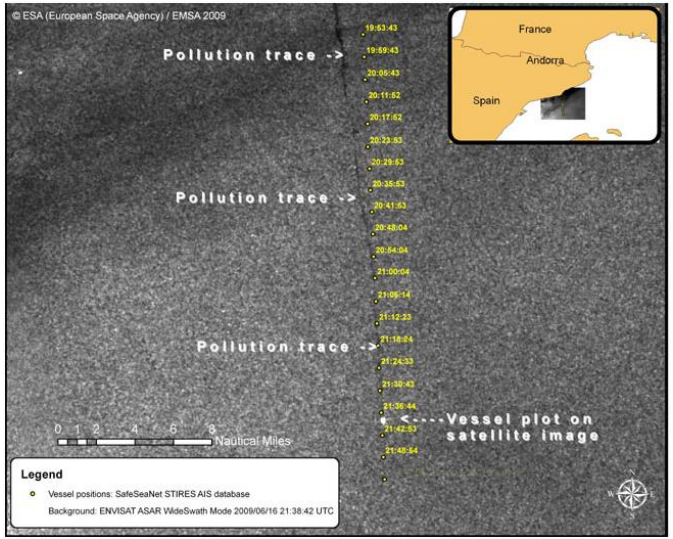
Copernicus and maritime monitoring

- Uses Sentinel -1 – a SAR sensor
  - High reliability due to all-weather + darkness capabilities
  - Detects textures:
    - Ships are bright spots against a dark sea
    - Oil spills are dark areas against the waves of the sea
  - Technology was developed in the 90s
  - Mature operational use with satellites with similar sensors (C-band SAR): ERS, Envisat, Radarsat, …



How is it being used currently?

- Operational oil spill by EMSA: CleanSeaNet
  - Orders images and oil spill detection services all over Europe and Overseas Territories
  - Analysed results get integrated with vessel traffic and other maritime information
  - Within 30 minutes after data acquisition
- Operational ship traffic monitoring by EMSA: SafeSeaNet
  - Used for safety and security at sea and in ports
  - Integration of many different sources of information: AIS, VMS, documents and archived information, …
- Also used for illegal fishing and border monitoring

User Uptake

Economics

Copernicus for entrepreneurs

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Use cases

- EMSA CleanSeaNet: 25 years of development into a mature, international service
  - History
  - How the EU contributed to the development
  - Future
- Winter navigation in the Baltic
  - Impact of satellite imagery
  - Economic benefits of Copernicus to Finnish icebreakers

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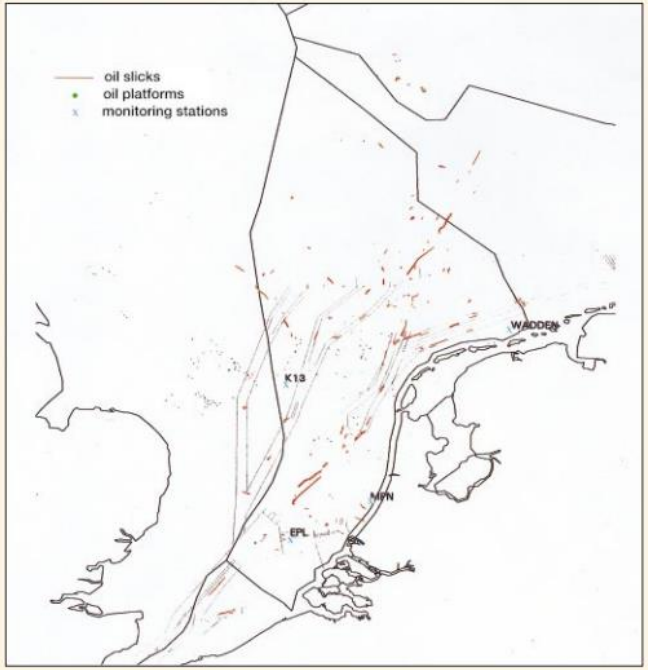
Brief history of operational monitoring

- Legislation:
  - Bonn Agreement (1969): almost daily surveillance of pollution on North Sea Continental Shelf
  - Helsinki Commission Agreement (1992): protection of coasts along Baltic Sea
- Methods:
  - Patrols by planes and ships
  - Side-looking Radar on ships
  - Satellite based SAR monitoring since ERS-1 (1991)

Development of the service

- Start: Norwegian government with satellite receiving station
  - Norwegian Pollution Control Agency
  - Dutch North Sea Directorate



All slicks detected by ERS-1 in the Dutch North Sea during the second half of 1993 (in red). Green points mark the positions of the oil platforms, whilst blue crosses show the positions of the monitoring stations. A clear correlation is apparent between the positions and directions of the slicks and the locations of the shipping lanes

(http://www.esa.int/esapub/br/br128/br128_1.pdf)

Improvement of the service

- Research funding under the Framework Programmes:
  - FP4:
    - Development of methods and instruments for oil spill detection
  - FP6:
    - Spill Response Experience: Improved oil spill response in case of incidents
  - FP7:
    - SeaU: Multi-sensor capabilities for improving oil spill detection
  - Horizon2020:
    - Grace: Integrated oil spill response actions and environmental effects

Elevating the service to Europe

- Directive 2005/35/EC (since amended by Directive 2009/123/EC) on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences.
- EMSA tasked to "work with the member states in developing technical solutions and providing technical assistance in actions such as tracing discharges by satellite monitoring and surveillance.“
- CleanSeaNet is now the most comprehensive oil spill monitoring and polluter identification service in Europe, and supplies over 2,000 satellite radar images a year to the 28 participating states including EU Member States and their overseas territories, candidate countries and EFTA Member States.

Winter shipping in the Baltic

- Ice monitoring with SAR data:
  - Where are the ridges, where are the leads, where is the ice more broken up?
  - Can operate under bad weather conditions, unlike helicopters
  - Can be used for route planning through the ice

Economic benefits of Copernicus

- Finland and Sweden benefit between € 24M and € 116M per year thanks to satellite imagery.
  - Keeping sea lanes and ports open more efficiently
  - Reduced transit times and uncertainties

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Demonstration

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DEMO: INTRODUCTION

- Perform a ship and oil spill detection in Sentinel-1 in SNAP Toolbox
- Sentinel-1 image from Copernicus Sentinel Hub
- Best practices:
  - Oil spill detection: HH/VV at steep incidence angles
  - Ship detection: HV at steep incidence angles, HH at shallow angles
- Links:
  - https://scihub.copernicus.eu/dhus/
  - http://step.esa.int/main/download/

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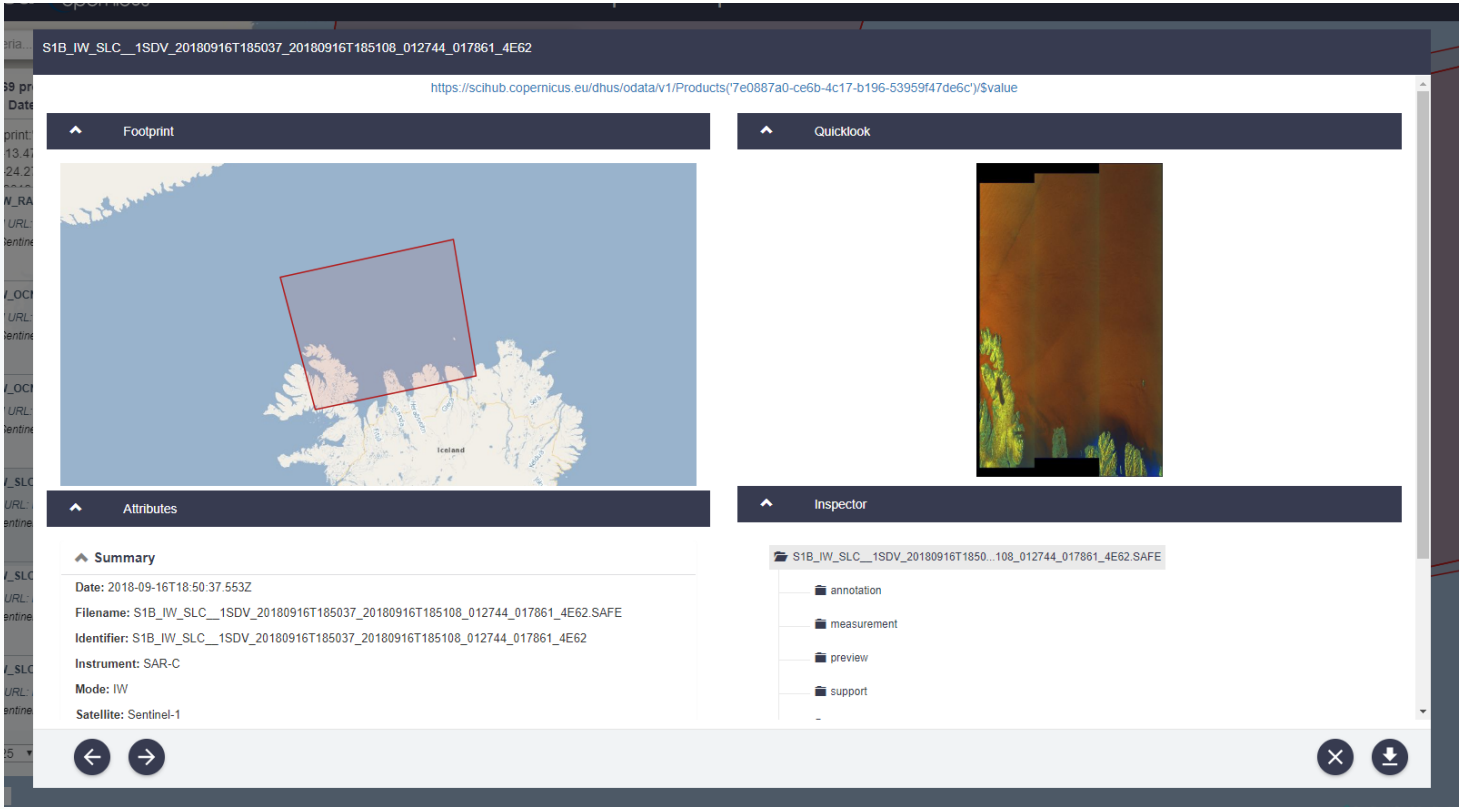
Demo: finding images



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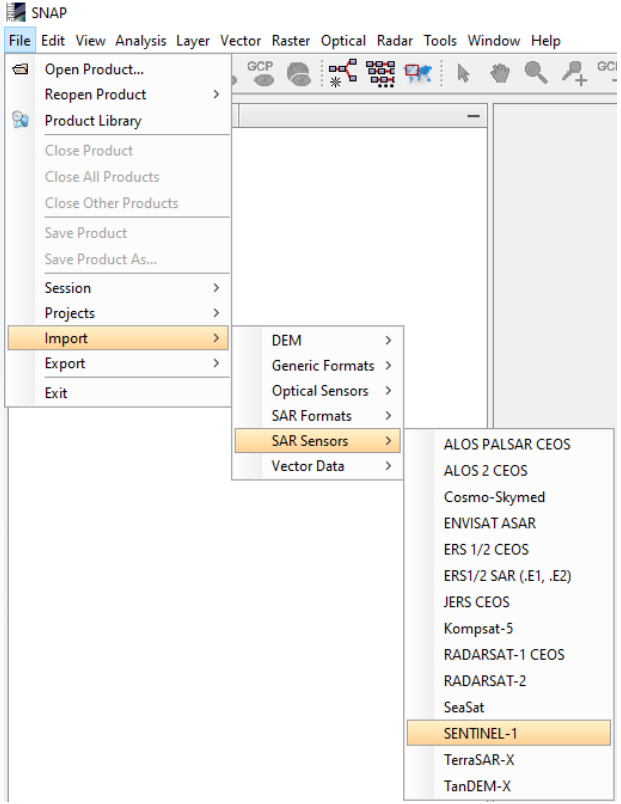
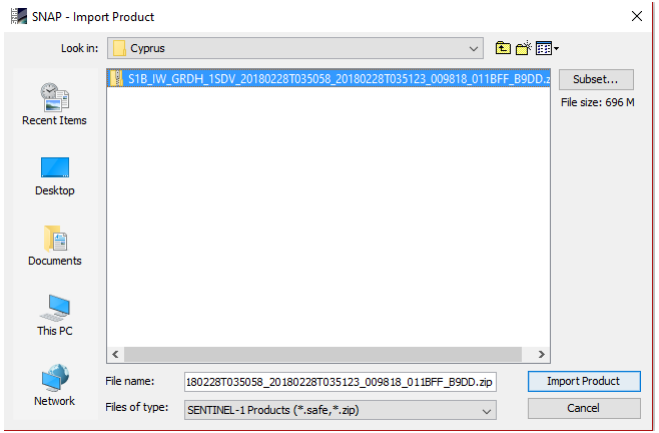
DEMO: IMPORT AND PREPROCESS IN SNAP





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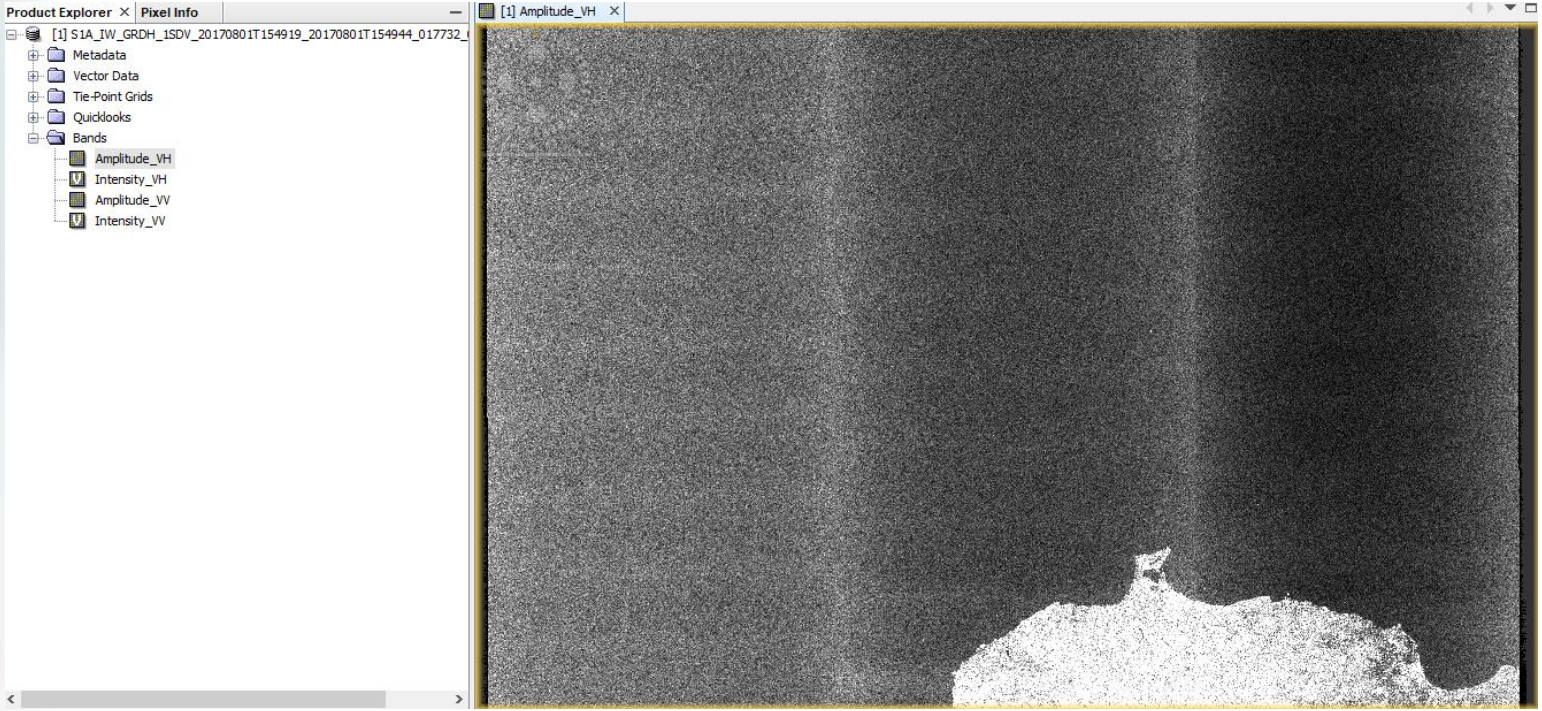

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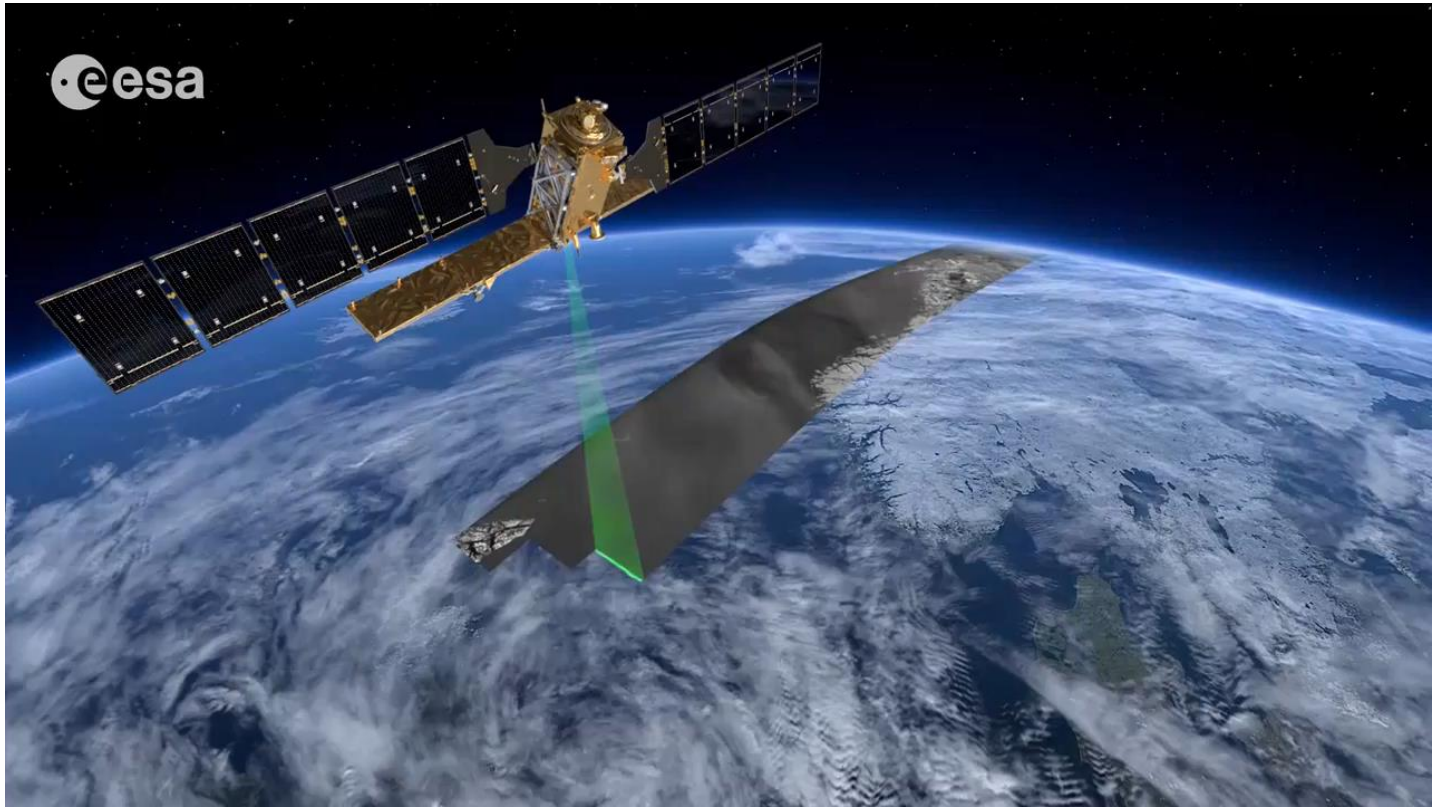

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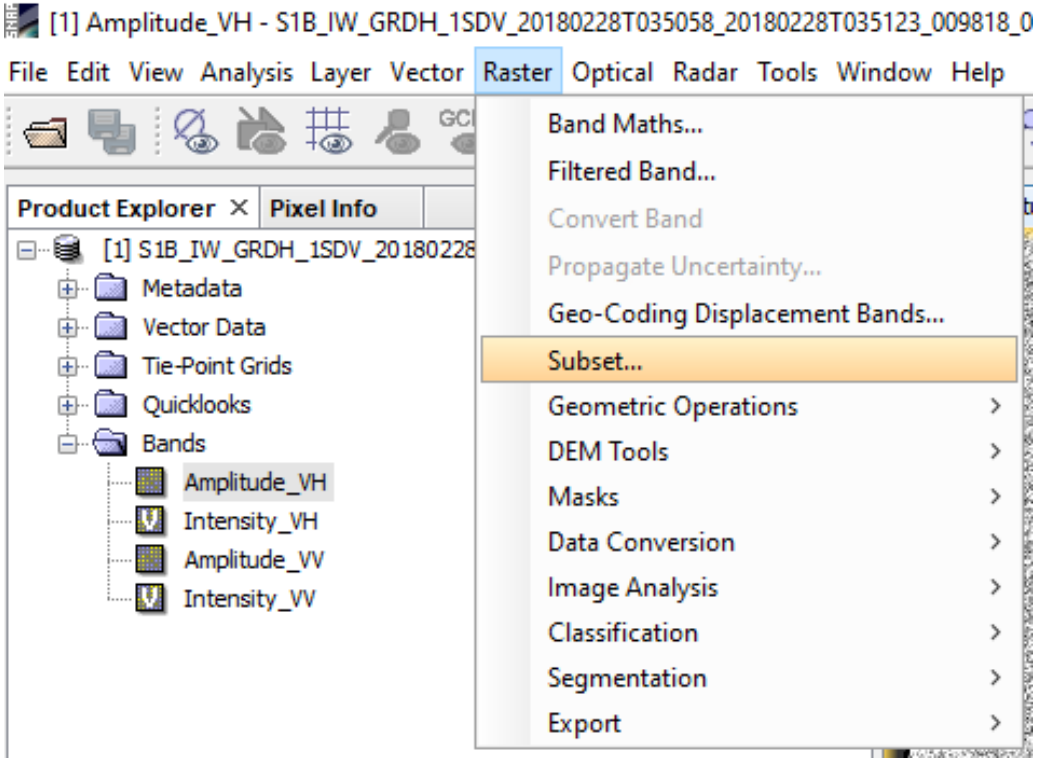

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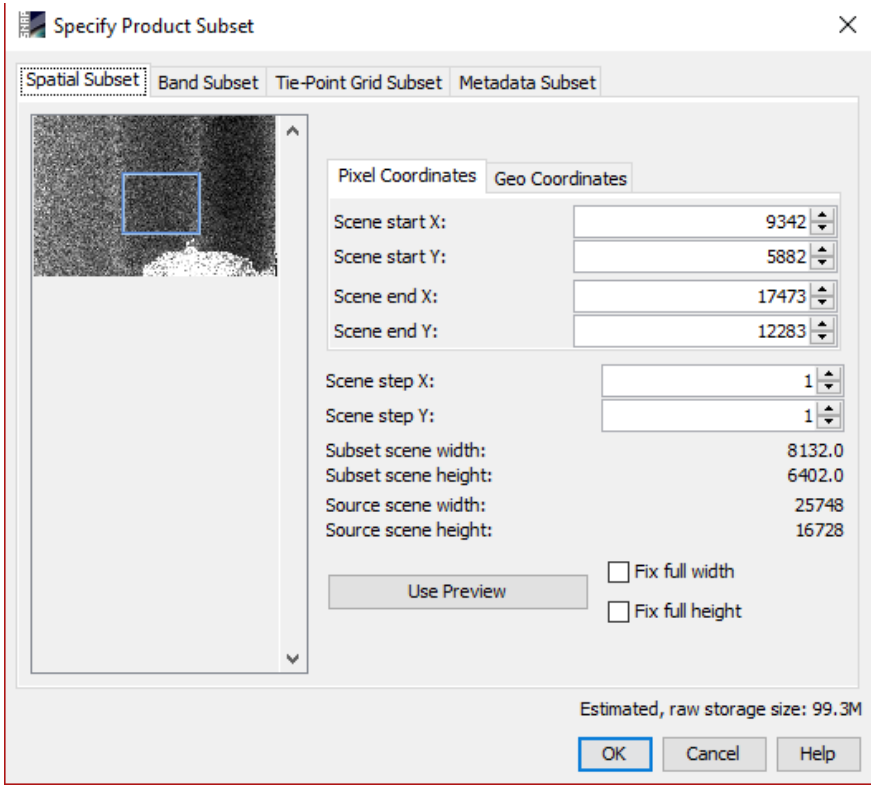

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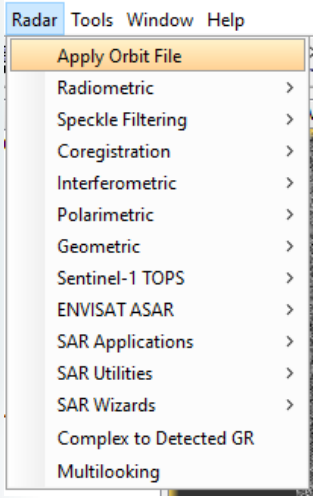

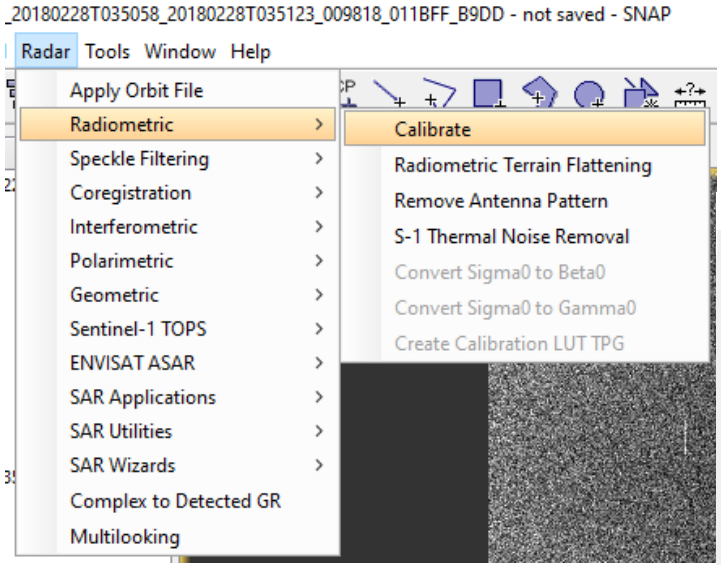

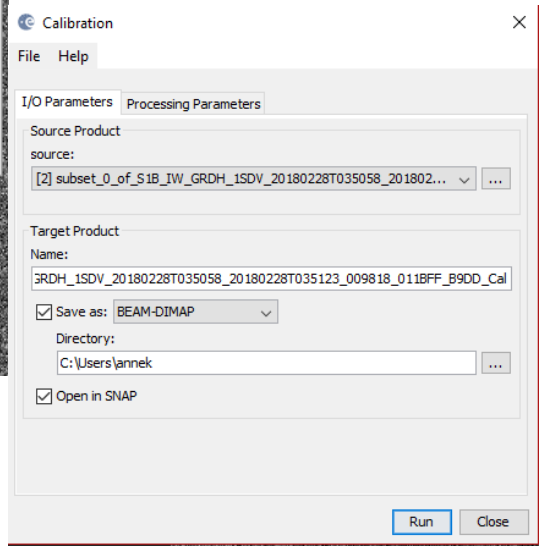

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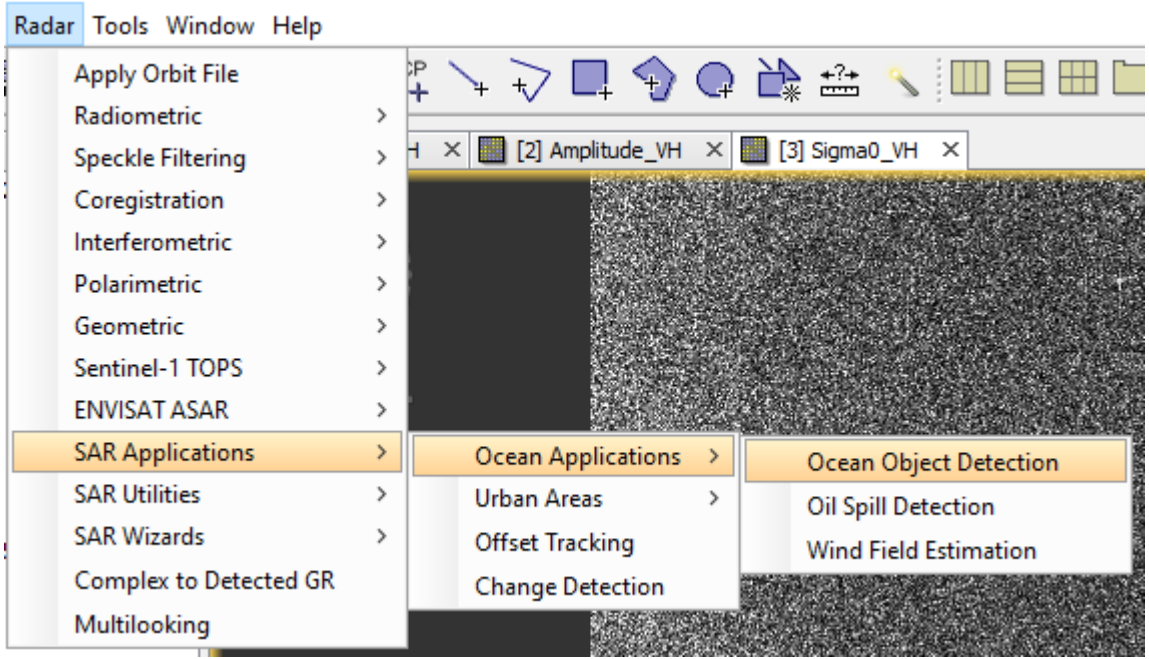
DEMO: SHIP DETECTION



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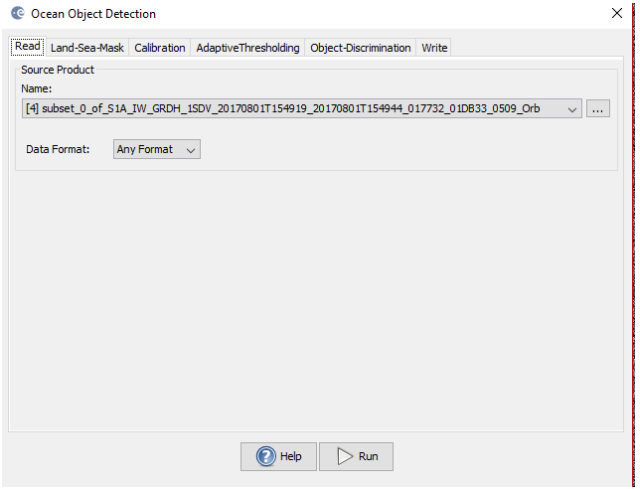

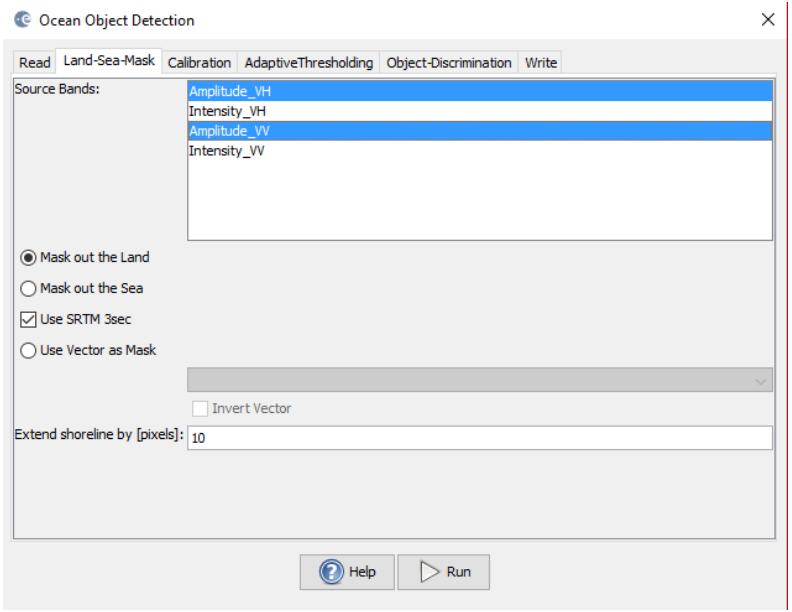

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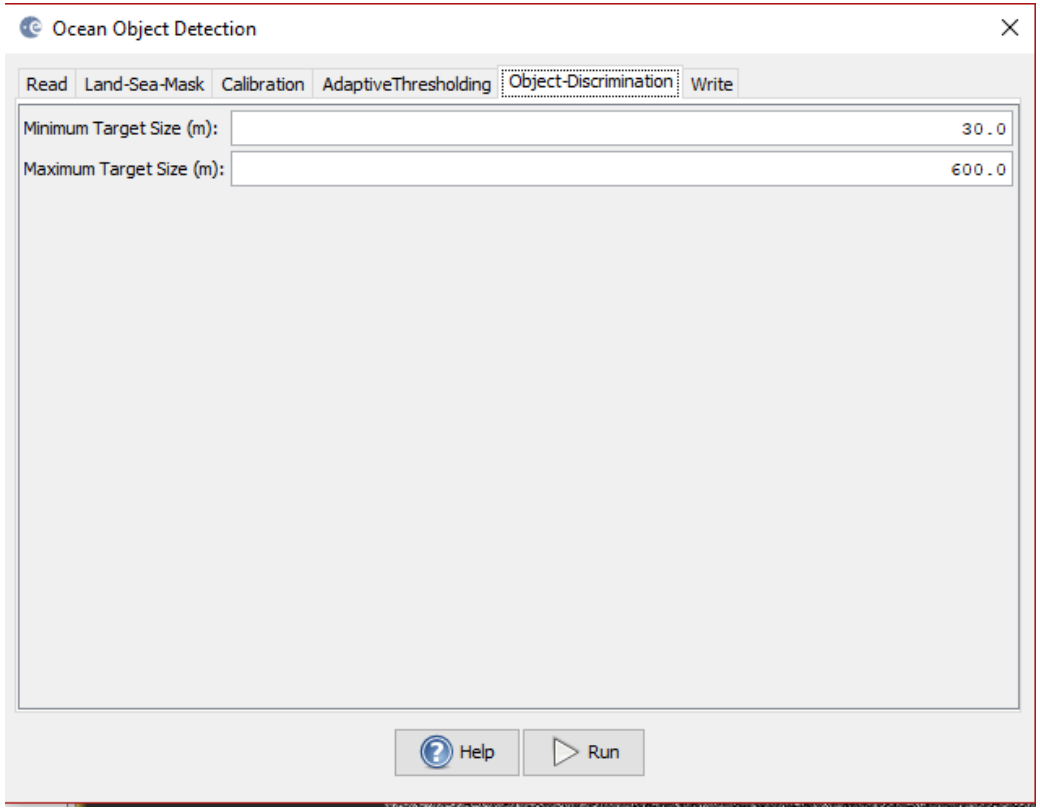

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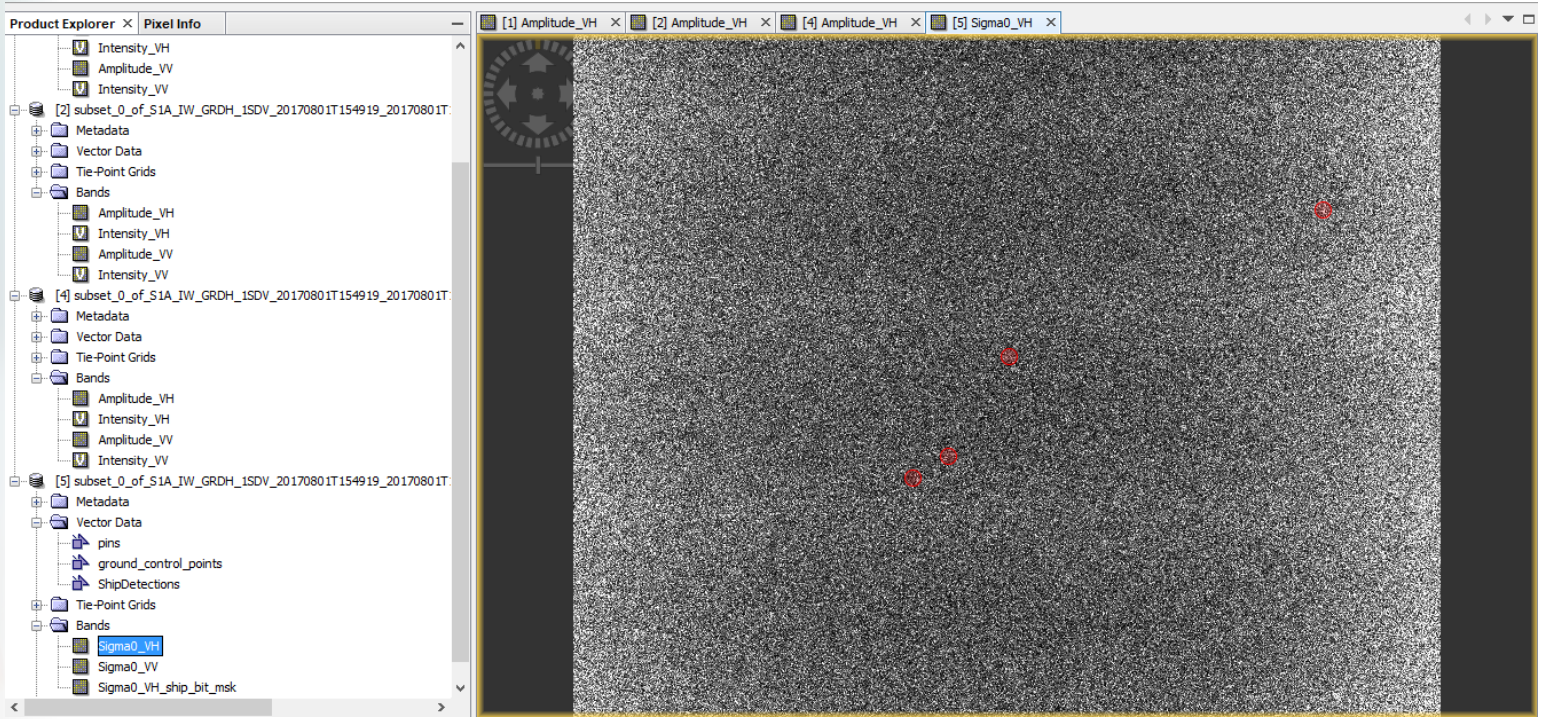

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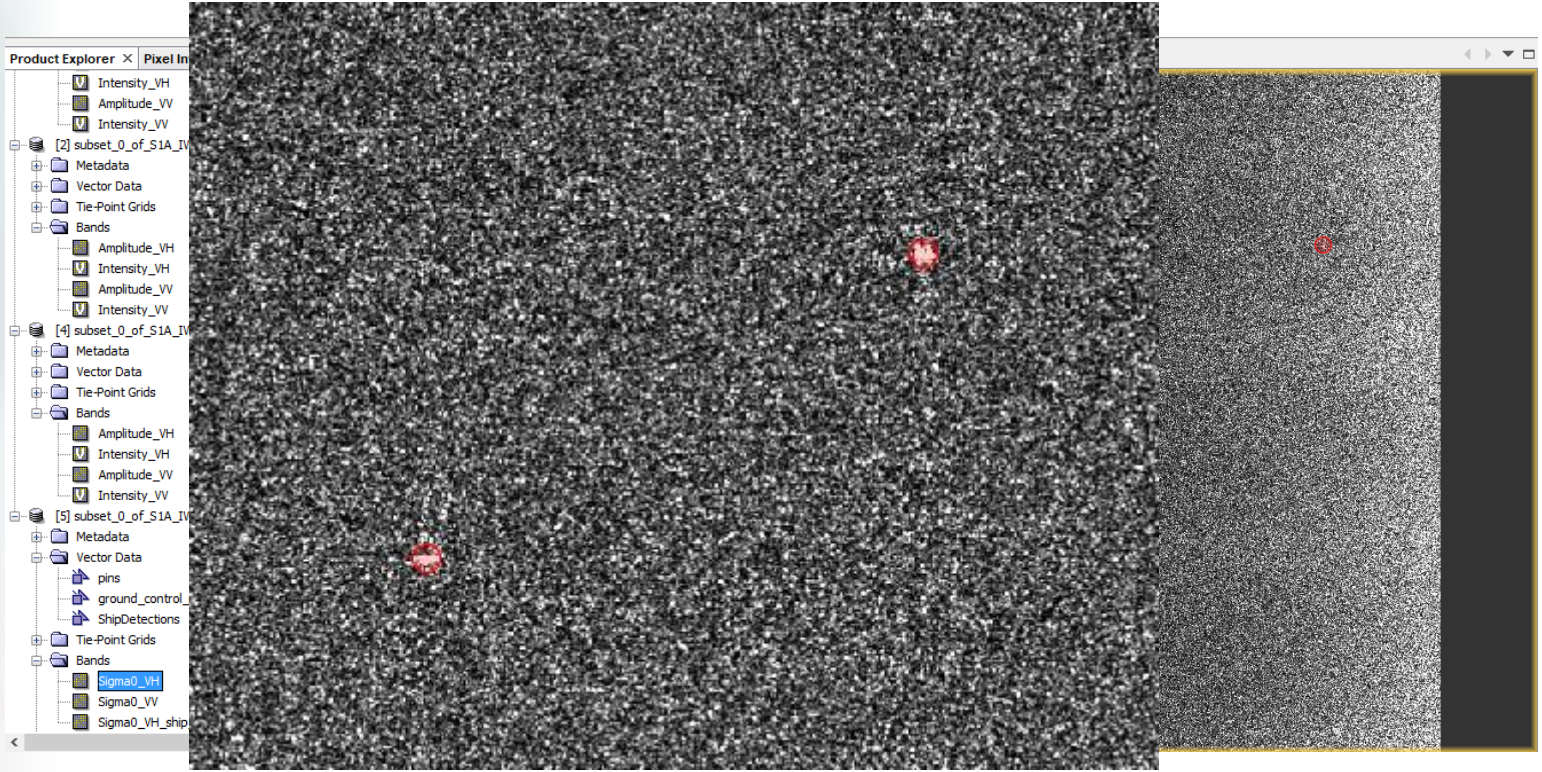

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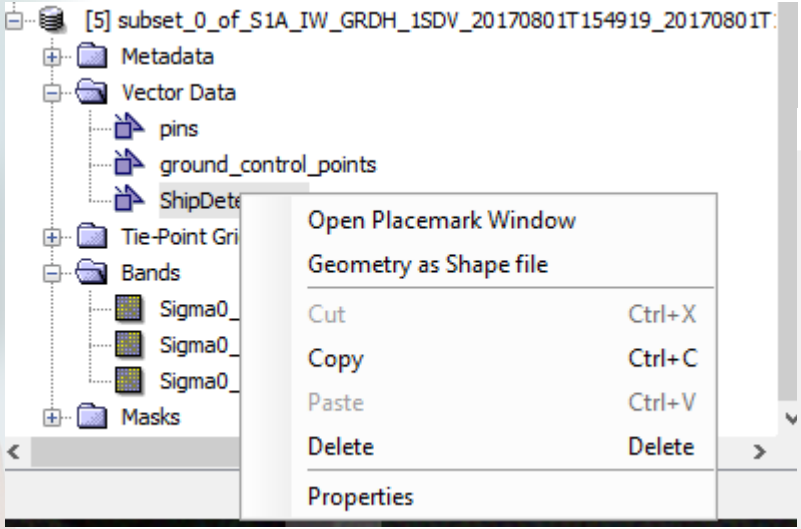
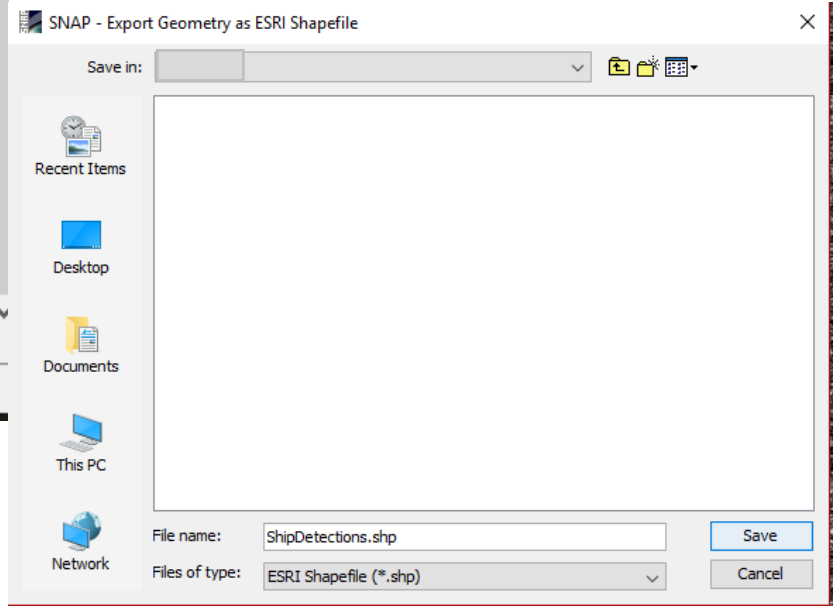
DEMO: VISUALISATION





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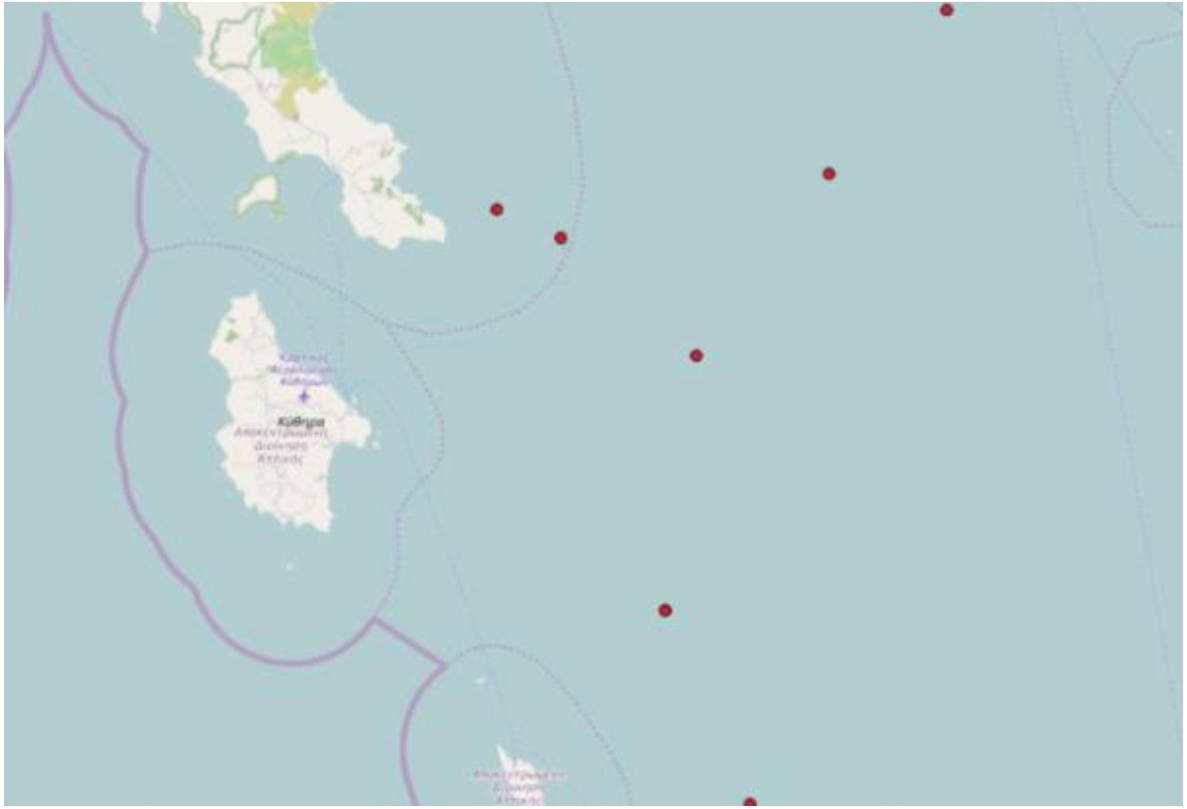
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