**ACTIVITY: Analysing satellite data for finding dark vessels**

**Activity idea**

This activity uses data from ©Starboard Maritime Intelligence gathered from a satellite image. It is part of a suite of activities that support the [Build a satellite](https://www.sciencelearn.org.nz/embeds/149-build-a-satellite) interactive. These activities support students to engage with the science capabilities ‘Gather and interpret data’, ‘Critique evidence’ and ‘Interpret representations’.

By the end of this activity, students should be able to:

* discuss why national and international agencies monitor vessel movements
* discuss the advantages and disadvantages of using satellites to monitor vessels
* use a satellite image to engage with one or more of the science capabilities.

**For teachers**

***Introduction/background***

Seafood is a valued commodity, so how do we ensure that marine fishing is sustainable, responsible and regulated?

National systems like New Zealand’s Quota Management System help to protect fish stocks. The Ministry for Primary Industries (MPI) ensures that fishers follow these regulations.

MPI monitors fishing activities in a number of ways, including patrol boats, aircraft, cameras with artificial intelligence capability and observers on commercial fishing boats. The sea is an enormous place, so MPI also relies on satellite technology to monitor fishing activity.

[Xerra Earth Observation Institute](https://www.sciencelearn.org.nz/resources/3133-remote-sensing) has developed ©Starboard Maritime Intelligence, a software platform that helps MPI and others monitor activities including dark vessels – ships that turn off their automatic identification systems to avoid being tracked.

Xerra uses satellites with synthetic aperture radar (SAR), which strikes the steel surface of a vessel and pings back to the satellite. It also uses satellites that collect radio frequency data and those that take optical images (photos).

Using multiple data sources provides a more complete picture when reporting activated vessels and dark vessels that are in a particular location. Radar and radio are particularly useful in that they are not blocked by clouds or large waves.

This activity is designed to introduce students to the ‘why and how’ of satellite surveillance rather than expecting them to fully analyse the screenshot/data provided by ©Starboard Maritime Intelligence.

***Interpreting the satellite data***

The activity [Interpreting observations from satellite images](https://www.sciencelearn.org.nz/resources/3142-interpreting-observations-from-satellite-images) explores strategies that scientists and others use when making sense of satellite data:

1. Use colour.
2. Use map skills – orientation and scale.
3. Use prior knowledge.
4. Look for textures, patterns and shapes.

For example, with the satellite image/screenshot used in this activity:

* colour provides visual clues – the screenshot shows multiple layers of data – blue background for the Tasman Sea, the black and grey colours represent satellite passes and radar imaging over the area and coloured ovals and squares represent detected vessels
* the screenshot includes a scale for distance, coordinates showing latitude and longitude and also contains a time scale
* people tasked with monitoring vessel movements will have an understanding of the Starboard platform and will use their prior knowledge to interpret what they see
* the Starboard platform also uses optical images and can detect vessels based on shape.

***Satellites and alternative conceptions***

How Earth observation satellites actually function may differ from how satellites appear to function in fictional media. Following are some alternative conceptions students may hold about satellites and the scientifically accurate concepts:

* Satellites are always overhead. In reality, satellites have orbits and they fly really quickly. Satellites in low Earth orbit travel about 28,000 km/h. Depending on the type of orbit, a satellite may only cover the same spot every few days or even every few weeks. Regular observation may require the use of multiple satellites.
* People who operate satellites can ‘zoom’ the satellite’s instruments to see something in a higher resolution. In reality, satellites have a fixed view at a set resolution. Those who use the downloaded data may be able to magnify the image for a closer look.
* Satellites can see everything. In reality, satellites that take optical images (photographs) cannot see through the clouds so the images they take may not be of use to those monitoring what is under the clouds.

Keep these in mind when discussing the satellite images so that students have the opportunity to alter their thinking.

***Satellite data and the science capabilities***

This activity enables students to build their understanding of the science capabilities. The most obvious capabilities are ‘Gather and interpret data’ and ‘Interpret representations’. However, students will also be critiquing and using evidence and engaging with science if they want to delve more deeply into an inquiry about dark vessels, biosecurity or the monitoring of marine protected areas. It may be helpful to choose the science capability you would most like to build and focus on this rather than trying to cover multiple capabilities.

***What you need***

* Access to the article [How do we find dark fishing vessels on the ocean?](https://www.sciencelearn.org.nz/resources/3108-how-do-we-find-dark-vessels-on-the-ocean)
* Access to an online map such as [Google Maps](https://www.google.com/maps/@-41.2571263,-167.2432341,4859166m/data=!3m1!1e3)
* Student handout [Satellite data from ©Starboard Maritime Intelligence](#bookmark=id.hbqh0sihhigz)

***What to do***

1. Use the article [How do we find dark fishing vessels on the ocean?](https://www.sciencelearn.org.nz/resources/3108-how-do-we-find-dark-vessels-on-the-ocean) to review information about monitoring marine fishers and why it is important to identify dark vessels.
2. Use [Google Maps](https://www.google.com/maps/@-41.2571263,-167.2432341,4859166m/data=!3m1!1e3) to view the vastness of the oceans surrounding Aotearoa, the Pacific Islands or other locations of interest.
3. Discuss ways in which government agencies like MPI – responsible for New Zealand’s territorial waters within our exclusive economic zone (EEZ) – or the International Maritime Organization – responsible for international waters outside of countries’ EEZs – monitor vessel behaviour.
4. Discuss the advantages and disadvantages of using satellites to monitor vessels.
5. Use the prompting questions to analyse the data gathered, interpreted and presented by ©Starboard Maritime Intelligence: [Satellite data from ©Starboard Maritime Intelligence](#bookmark=id.hbqh0sihhigz).

*Gather and interpret data*

* What can you observe in the screenshot of the Starboard data? Begin your observations with the words ‘I see’.
* What inferences can you draw ? Begin your inferences with the words ‘I think’.
* What visual clues are there in the image to help your observations and inferences?

*Critique evidence*

* How was this data collected?
* How has the data been recorded?
* How do we know the data is reliable?
* How confident are you that these are actually ships and not clouds, seagulls or drifting shipping containers that have fallen overboard? Why?
* How confident are you that the solid red square marks a dark vessel? Why?

*Use evidence*

* Who might be interested in using this evidence?
* How might this evidence help them?

*Interpret representations*

* What type of representation is this?
* What purpose does this representation serve?
* Are there components to help you interpret this representation?
* What are they and how do they help?
* Is this data qualitative or quantitative?
* Is there information missing from this representation?
* Is there anything that you’d like to know more about but cannot get the information from this screenshot?

*Engage with science*

* How important is this information?
* How can this information influence people’s decisions or actions – for example, MPI?
* How can you find out if this location is part of a marine protection area?

1. Use the extension ideas below to extend students’ thinking or experiences in this area.

***Extension ideas***

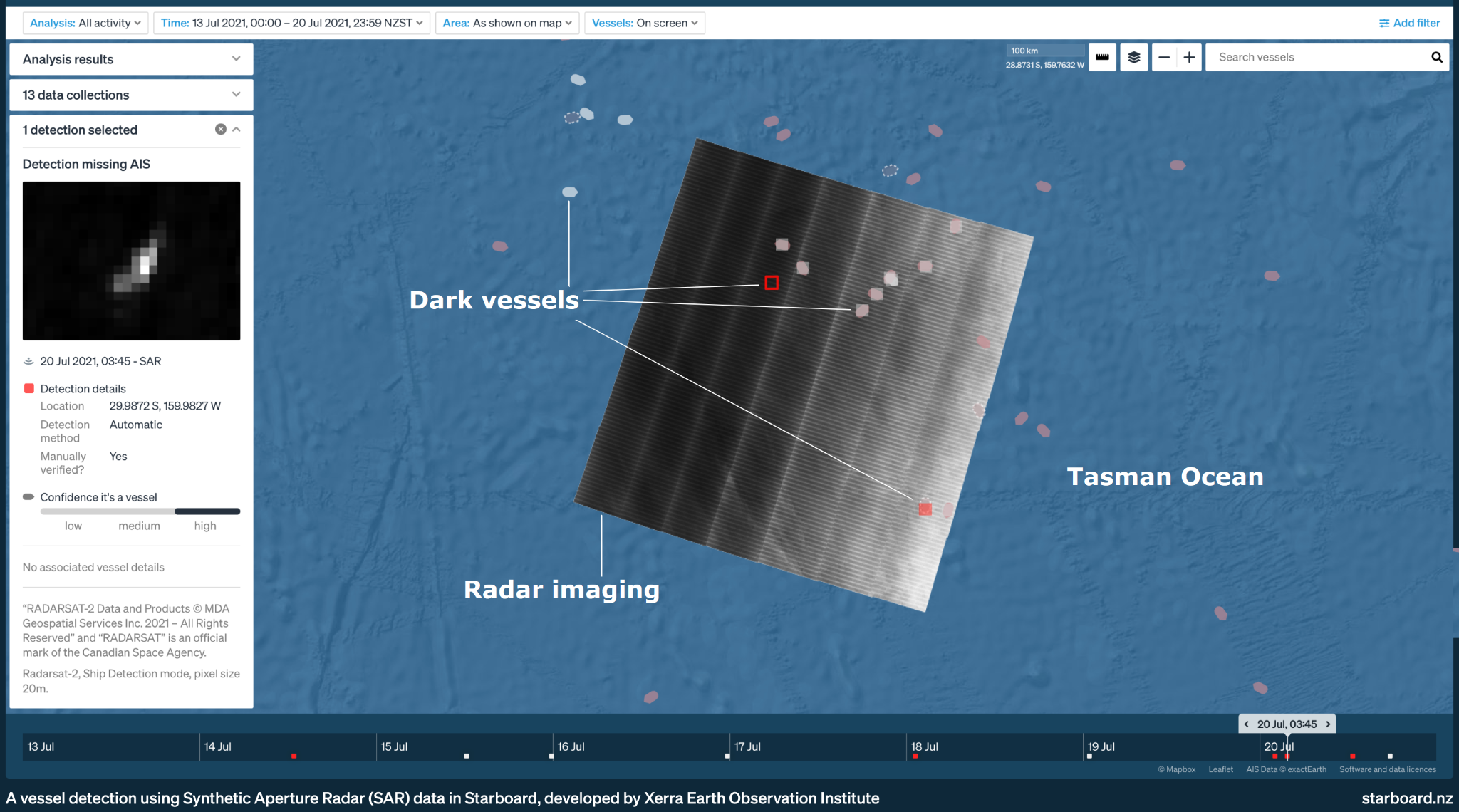
It is estimated that illegal and/or unregistered fishing vessels cost the global economy up to NZ$36 billion per year. Dark vessels are not limited to fishers. The ships may also be involved in transferring illegal goods or smuggling drugs or people. Consider investigating societal issues related to dark vessels and how scientific data supports action to tackle these issues.

The ©Starboard Maritime Intelligence platform is also useful for monitoring the biosecurity risks of arriving vessels. Investigate risks that pests like the brown marmorated stink bug present to Aotearoa and how tracking vessel movements and port visits helps to prevent their arrival.

Aotearoa has a variety of marine protected areas within its exclusive economic zone. Research where they are located and how satellite surveillance can help keep these areas safe from illegal behaviour.

**For students:** **Satellite data from ©Starboard Maritime Intelligence**

This is a screenshot from ©Starboard Maritime Intelligence. It shows layers of radar imaging of a location in the Tasman Sea.

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