Detection and monitoring of oil-like features in the coastal ocean using Sentinel-1 SAR and a fusion of machine learning and empirical methods

OCEANS AND ATMOSPHERE
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Oceania Geospatial Symposium 2022, 28th - 04th December 2022, Nouméa

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In the context of New Caledonia & the south

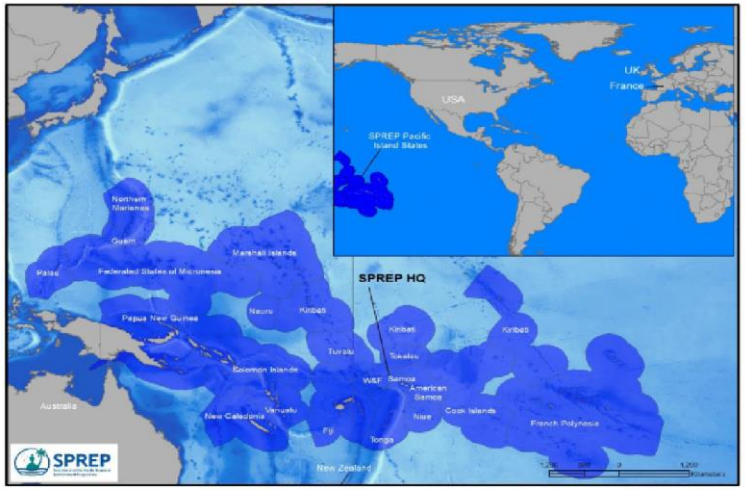
Market | Container | Maritime Events

New Caledonia Oil Spill from Stranded Containership

By **Baibhav Mishra** - December 1, 2017 787

For the past few days, lumps of oil have washed up on the beaches in the south-east coast of New Zealand. Authorities have launched a clean-up and collected almost 50kg of the substance. There are also reports of dead fish and snakes being washed ashore.

While an investigation was launched amid speculation that the oil might have come from the stranded Kea Trader container ship which broke up on the Durand Reef about 150 south-east of Lifou, French High Commissioner in New Caledonia, Thierry Lataste has confirmed it.



SPREP island members are grouped into two categories, the 14 independent and semi-independent countries (Pacific Island Countries) and the seven territories (Pacific Island territories - Table Three).

SPREP Island Members		SPREP Metropolitan Members
Pacific Island Countries	**Pacific Island Territories**	
Cook Islands	American Samoa (U.S.)	Australia
Fiji Islands	Northern Mariana Islands (U.S.)	France
Kiribati	French Polynesia (France)	New Zealand
Marshall Islands	Guam (U.S.)	United States of America
Federated States of Micronesia	New Caledonia (France)	United Kingdom
Nauru	Tokelau (NZ)	
Niue	Wallis & Futuna (France)	
Palau		
Papua New Guinea		
Samoa		
Solomon Islands		
Tonga		
Tuvalu		
Vanuatu		

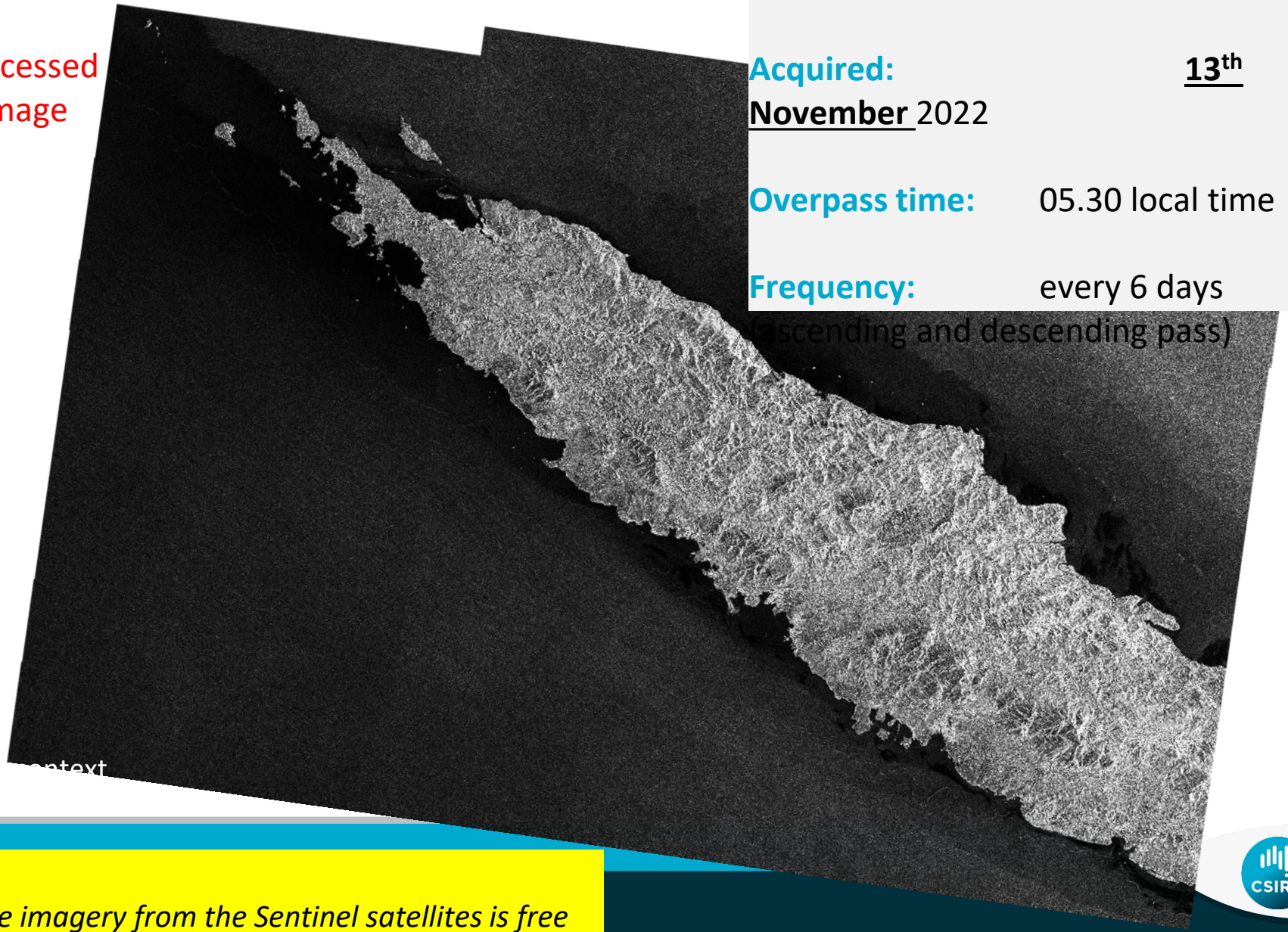
Pacific Community
Communauté du Pacifique

PACPLAN

PACIFIC ISLANDS REGIONAL MARINE SPILL CONTINGENCY PLAN 2019

Grande Terre seen from Sentinel-1 SAR

Unprocessed
Raw image



Sentinel-1A SAR scene

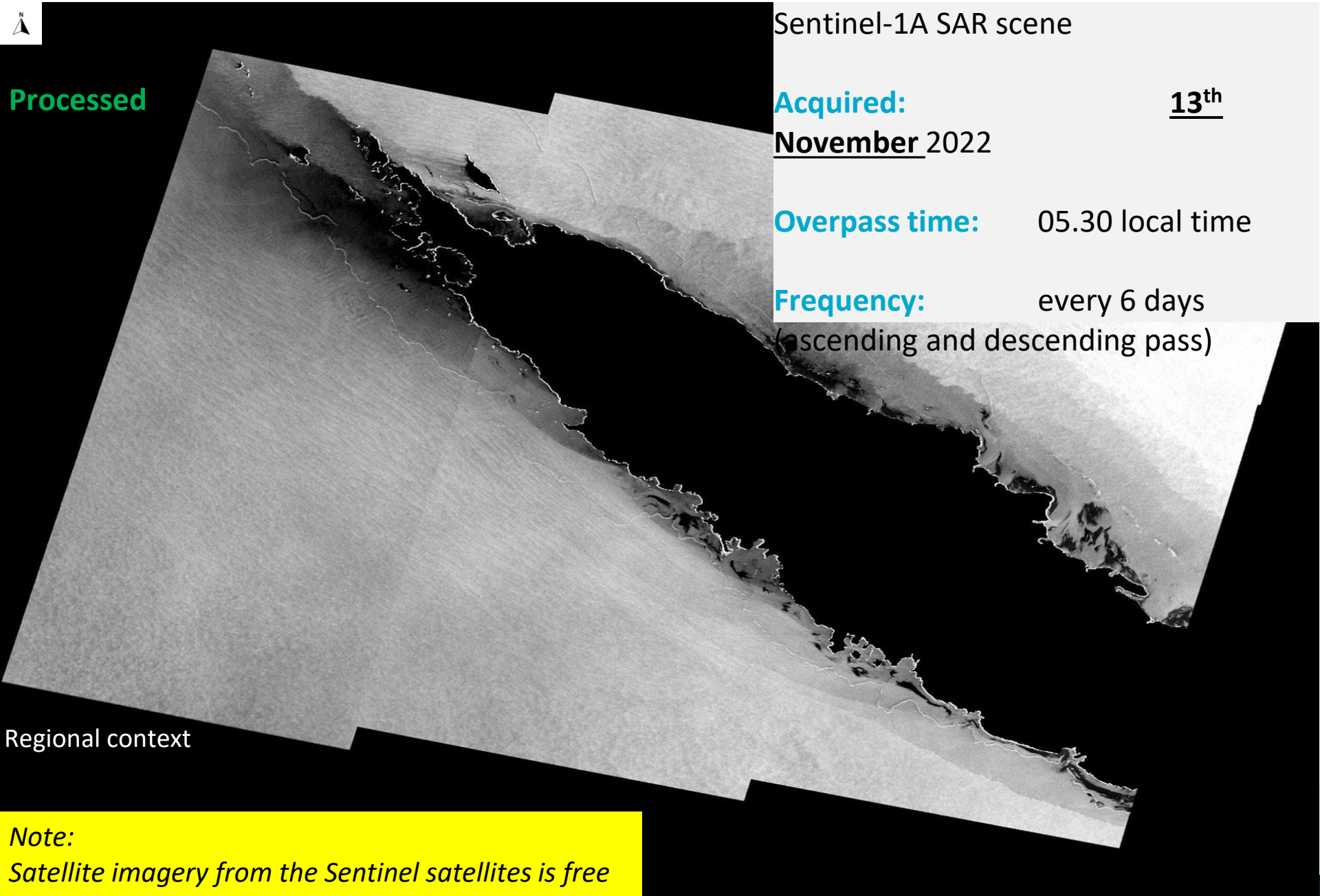
Acquired: **13th November** 2022

Overpass time: 05.30 local time

Frequency: every 6 days
(ascending and descending pass)

Note:
Satellite imagery from the Sentinel satellites is free

Grande Terre seen from Sentinel-1 SAR



Processed

Regional context

Sentinel-1A SAR scene

Acquired: **13th November** 2022

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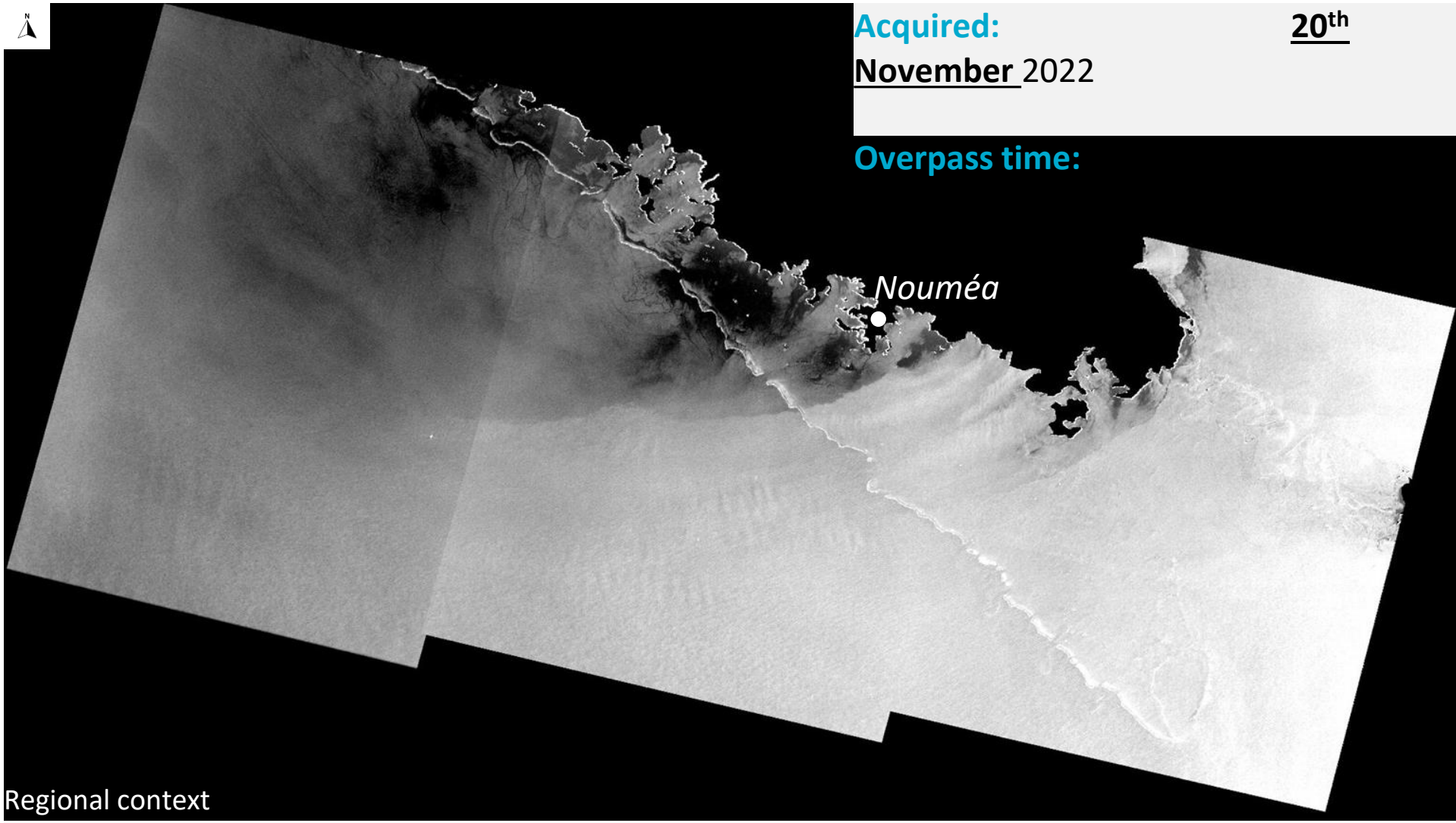
Nouméa seen from Sentinel-1 SAR



Regional context

Content overview

Synoptic overview of the research — a SAR satellite perspective

Methodology and Application — example cases

Summary and future work — take-home messages

This project - Rationale & main objective

Project's rationale:

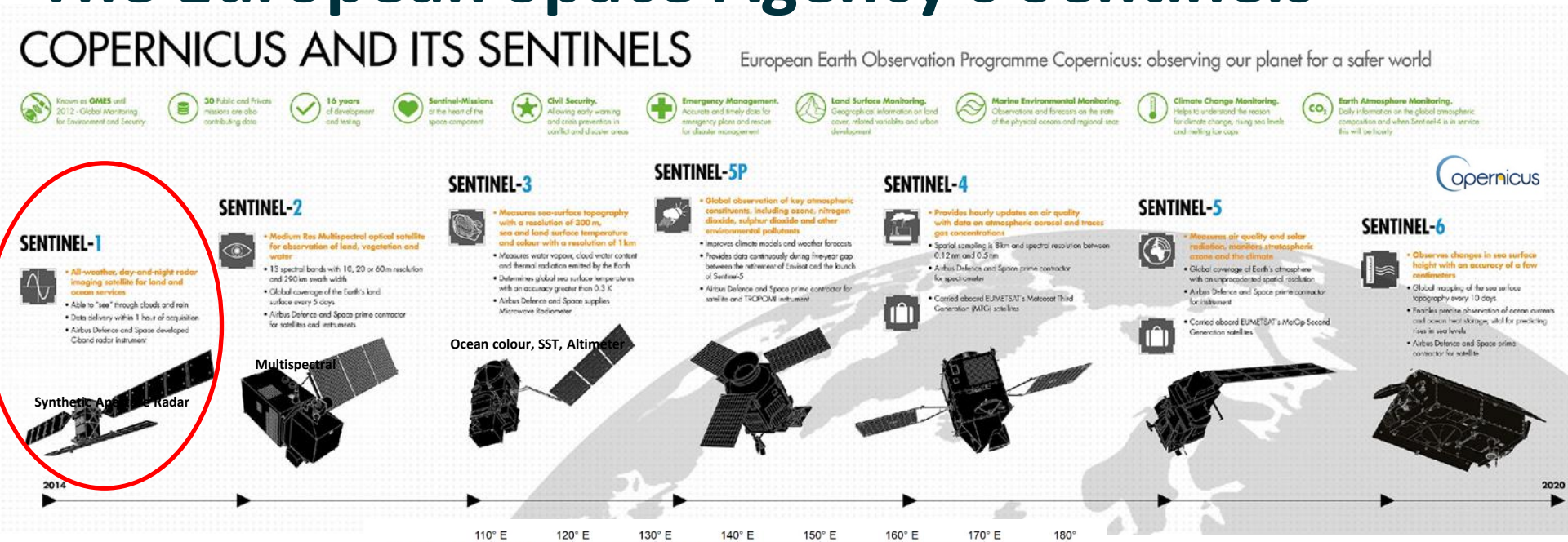
No regular routine, broad scale monitoring of oil spills

➡ Use of Synthetic Aperture Radar imagery is adequate

Project's main objective:

To develop a semi-automated satellite imagery-based oil spill detection system that is applicable to Australia, and possibly relocatable elsewhere.

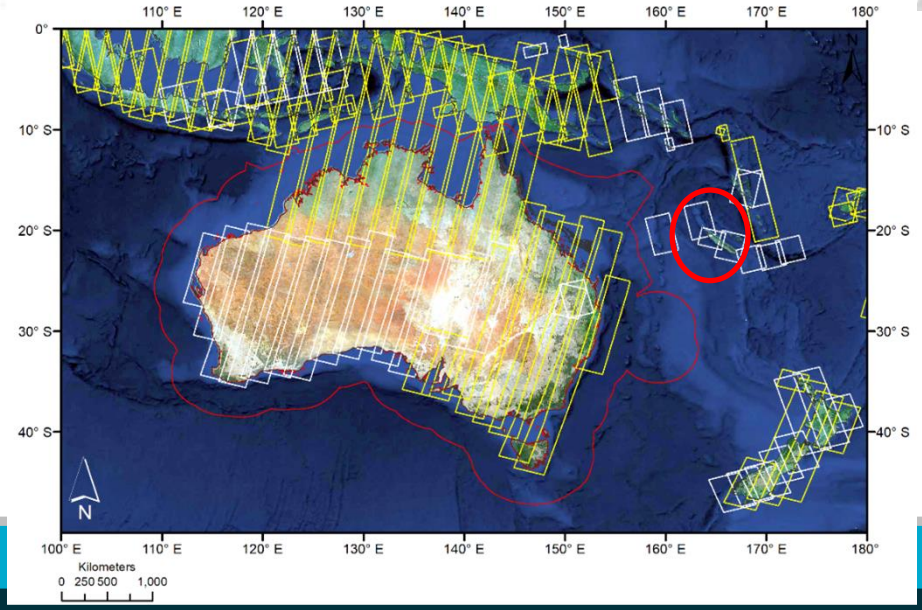
The European Space Agency's Sentinels



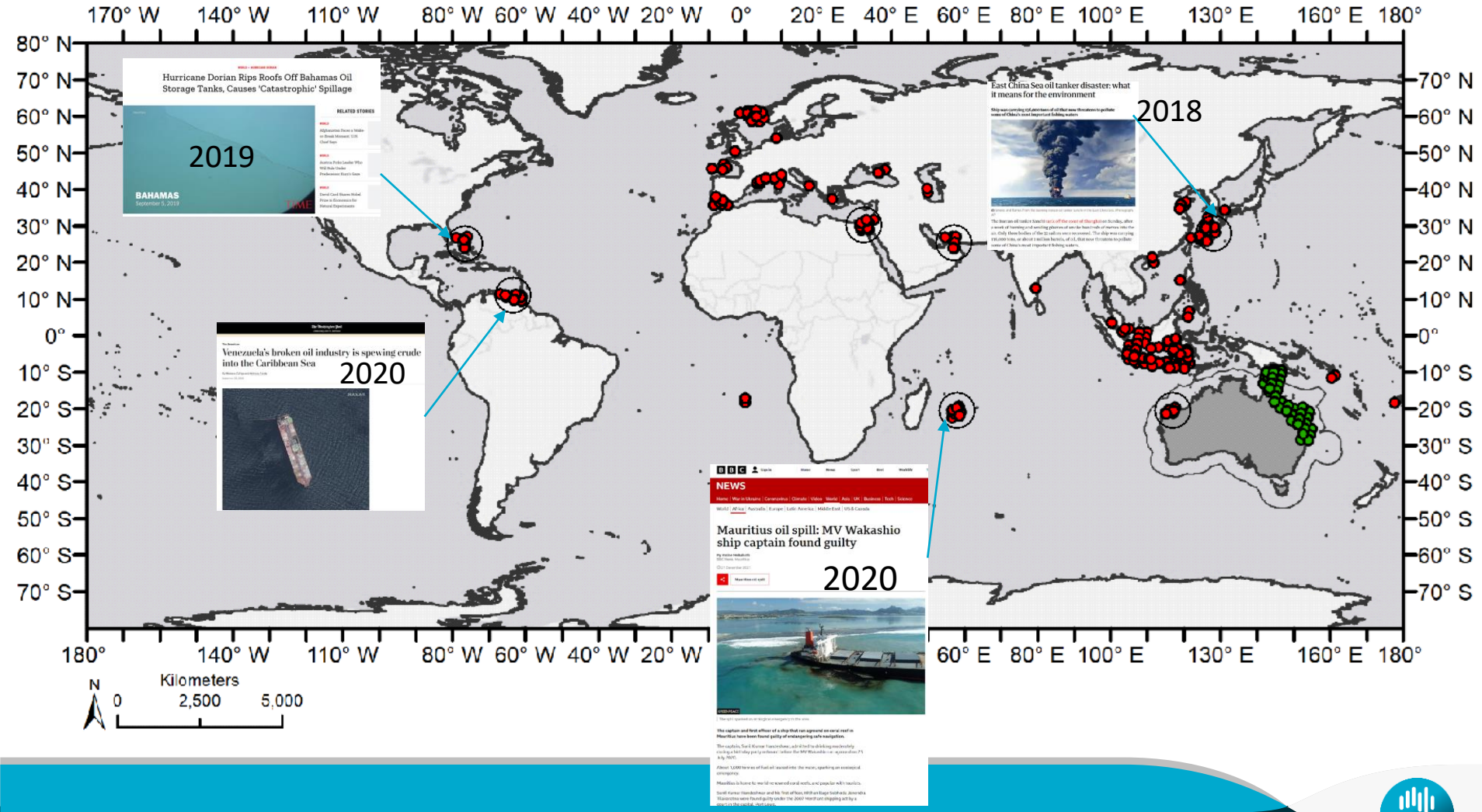
Sentinel-1A

~~Sentinel-1B~~

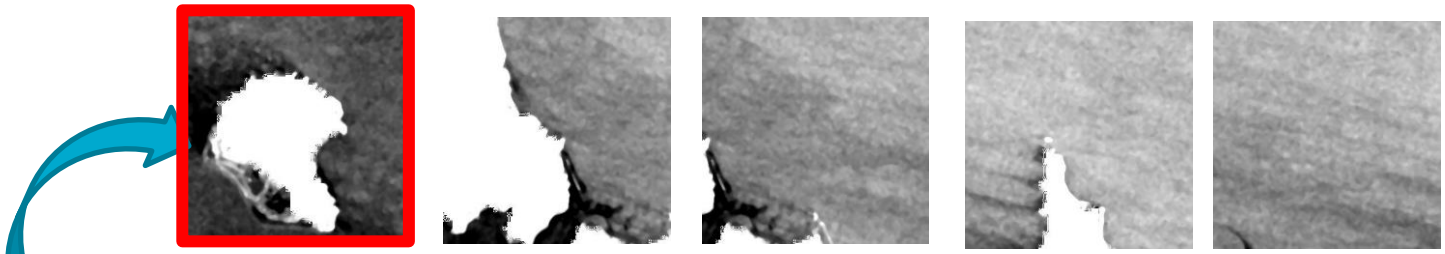
EEZ



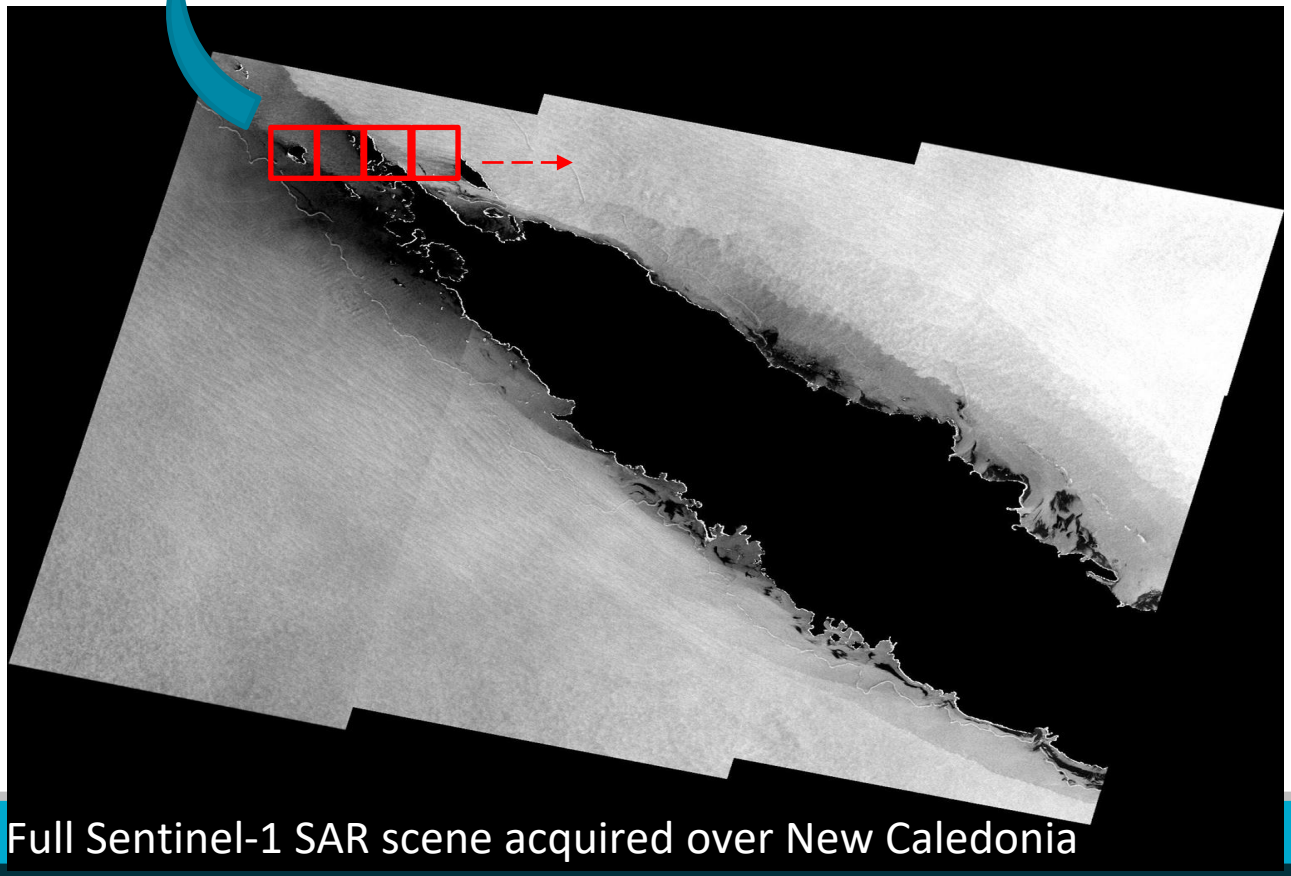
Methodology – Our database



Methodology – Image analysis



….etc.



Full Sentinel-1 SAR scene acquired over New Caledonia

Methodology – Deep learning + Empirical

Sentinel-1 SAR Image processing

1st opinion

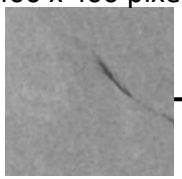
Use of convolutional neural networks (image based)

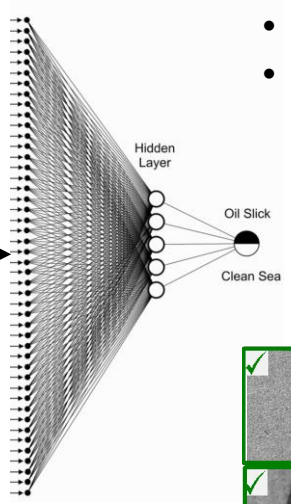
2nd opinion

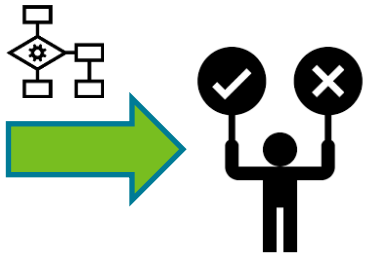
Rule-based approach (selected parameters)

Input

400 x 400 pixels







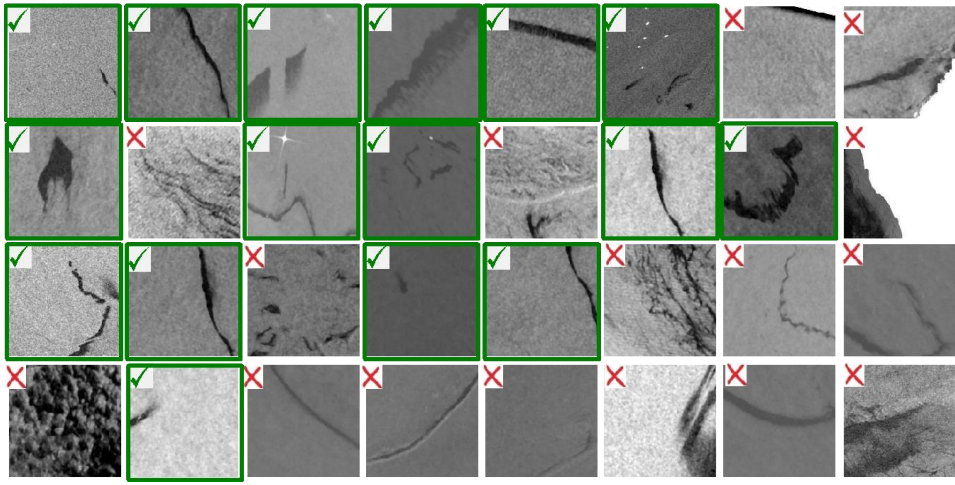
Decision

Dataset used for CNN training & testing

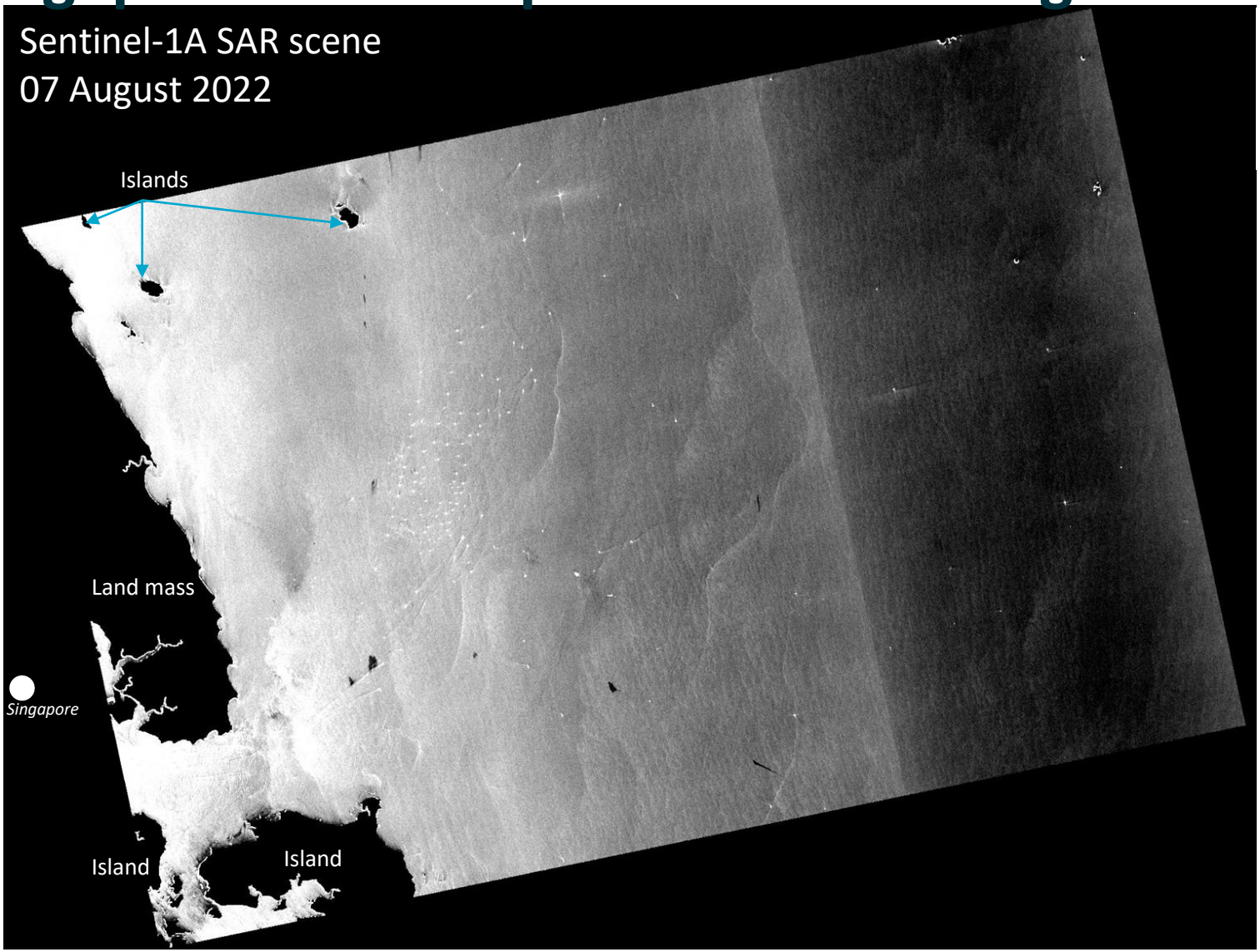
- **6,137 chips** from the O&A curated database
- 400 x 400 pixel size chips
- Binary class
- Chip extraction & labelling: manual, time consuming

N=2,316 Oil ✓

N=3,821 Not oil ✗



Singapore – a hot-spot for oil discharges at sea



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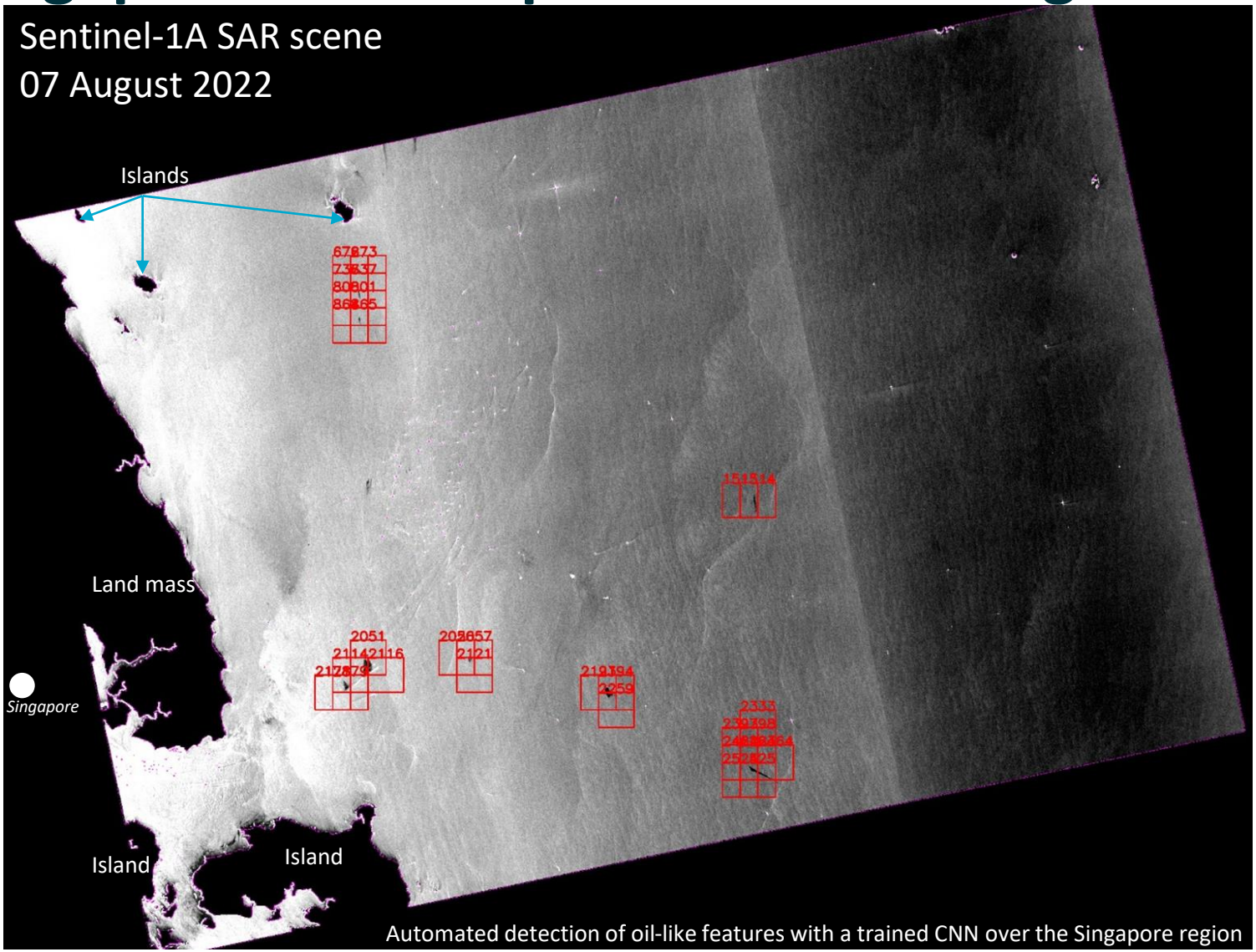

Automated detection of oil-like features with a trained CNN over the Singapore region

Legend

Detected features

GIS mask

Summary and future work

- **Unique CSIRO database** of past and current oil spill incidents
- Access to **multiple satellite sources**, some not presented such as NovaSAR (taskable SAR satellite; Dr Zheng-Shu Zou, CSIRO)
- **Spatio-temporal assessment** and incident evolution in near-real time.
- CSIRO detection workflow allows **semi-automated detection** of oil-like features, with automated reporting.
- Regional transfer to other areas of the Pacific **fast and effective**.

Acknowledgements

Australia's National Science Agency

Thank you

Contact us

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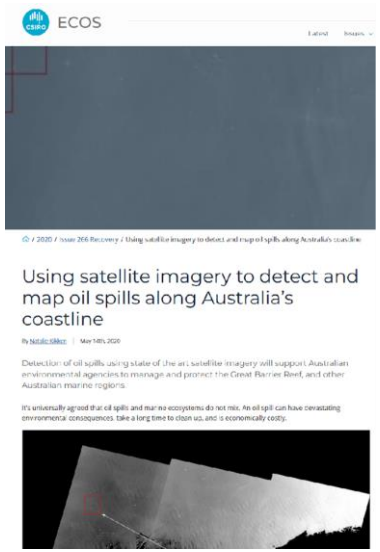
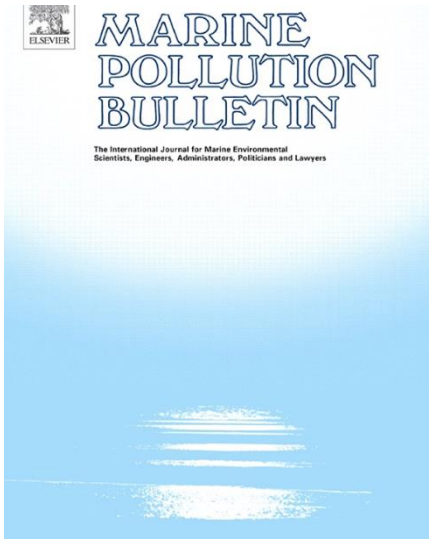
Online article



Upcoming research article



2020 CSIRO internal report