



# Demonstration of a Heterogeneous Satellite Architecture during RIMPAC 2018

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# Agenda



- INTRODUCTION
- EXPERIMENT DESCRIPTION
- RESULTS
- KEY FINDINGS & CONCLUSIONS





# MSMU Overview



- The Micro-Satellite Military Utility (MSMU) PA is an agreement under the Responsive Space Capabilities (RSC) MOU involving the Departments and Ministries of Defence of Australia, Canada, Germany, Italy, Netherlands, New Zealand, Norway, United Kingdom and United States.
- Within the RSC MOU there are several RDT&E cooperation projects, each detailed in a separate PA. The MOU allows the exchange of information for the purpose of harmonizing the participants' military requirements to assist in defining potential cooperative efforts under this MOU.
- Within the RSC MOU, the MSMU PA is aimed at developing a blueprint for a Multinational Heterogeneous Space Enterprise, to provide military users with reliable access to a broad spectrum of information in an opportunistic environment.



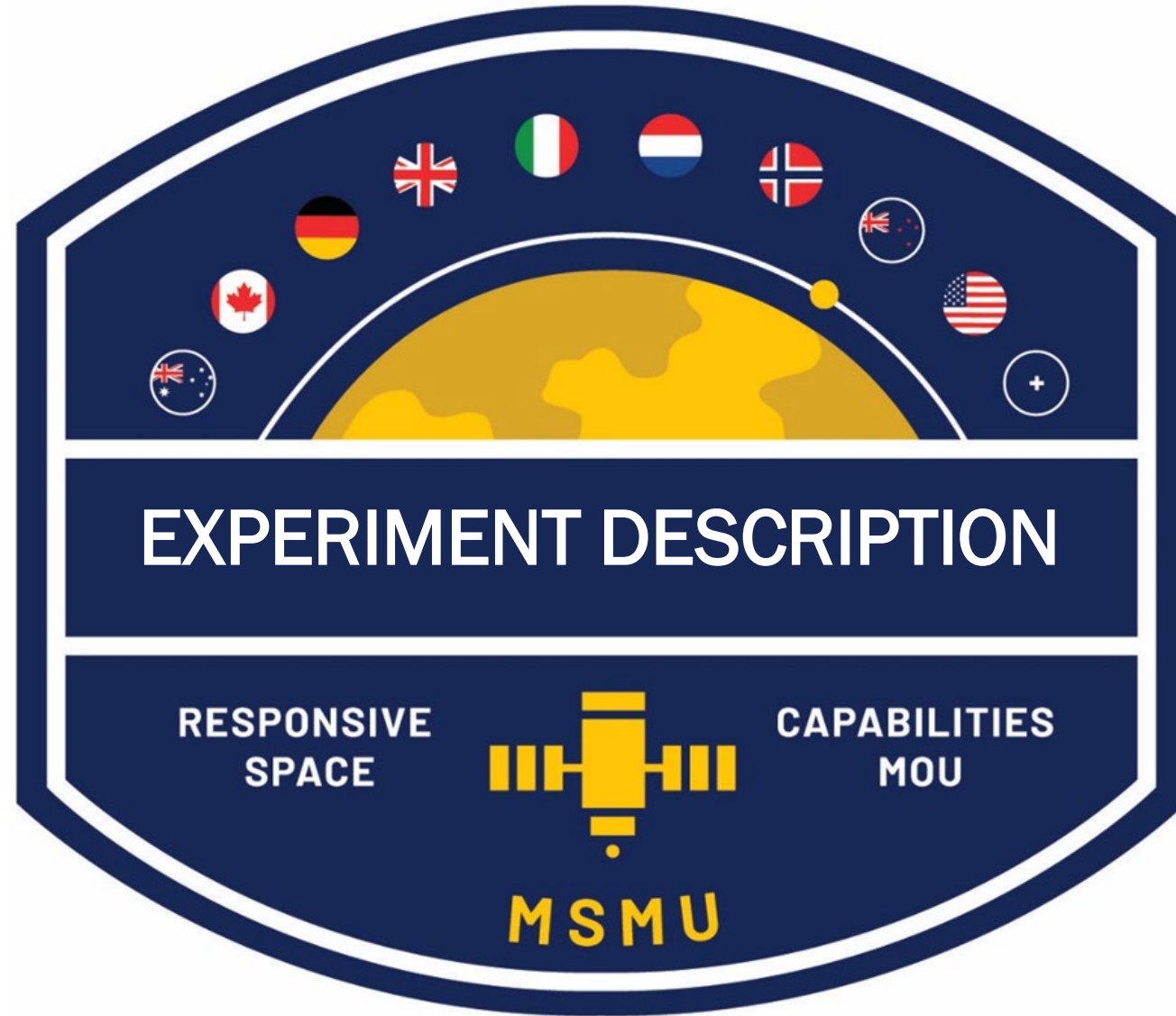
# Heterogeneous Space Architecture Concept



Coalition of government-owned (military and civil), allied and commercial satellites.

- This architecture can span all government space capabilities including missile warning, weather, ISR, space situational awareness and communications.





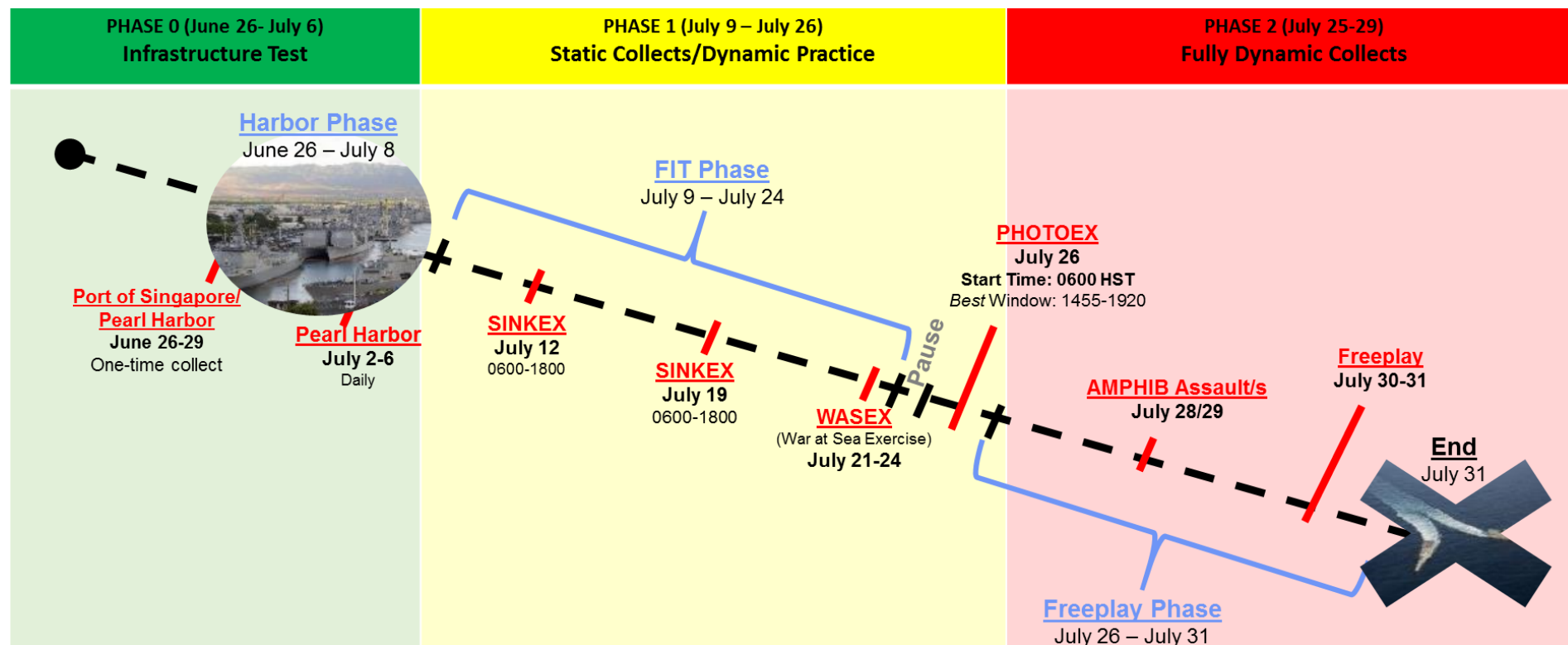




# Experiment Approach

The RIMPAC 2018 exercise was chosen to anchor modelling, simulation, and value-based metrics with real world data, operating in a non-interference basis.

The experiment was conducted using three incremental steps overs six weeks



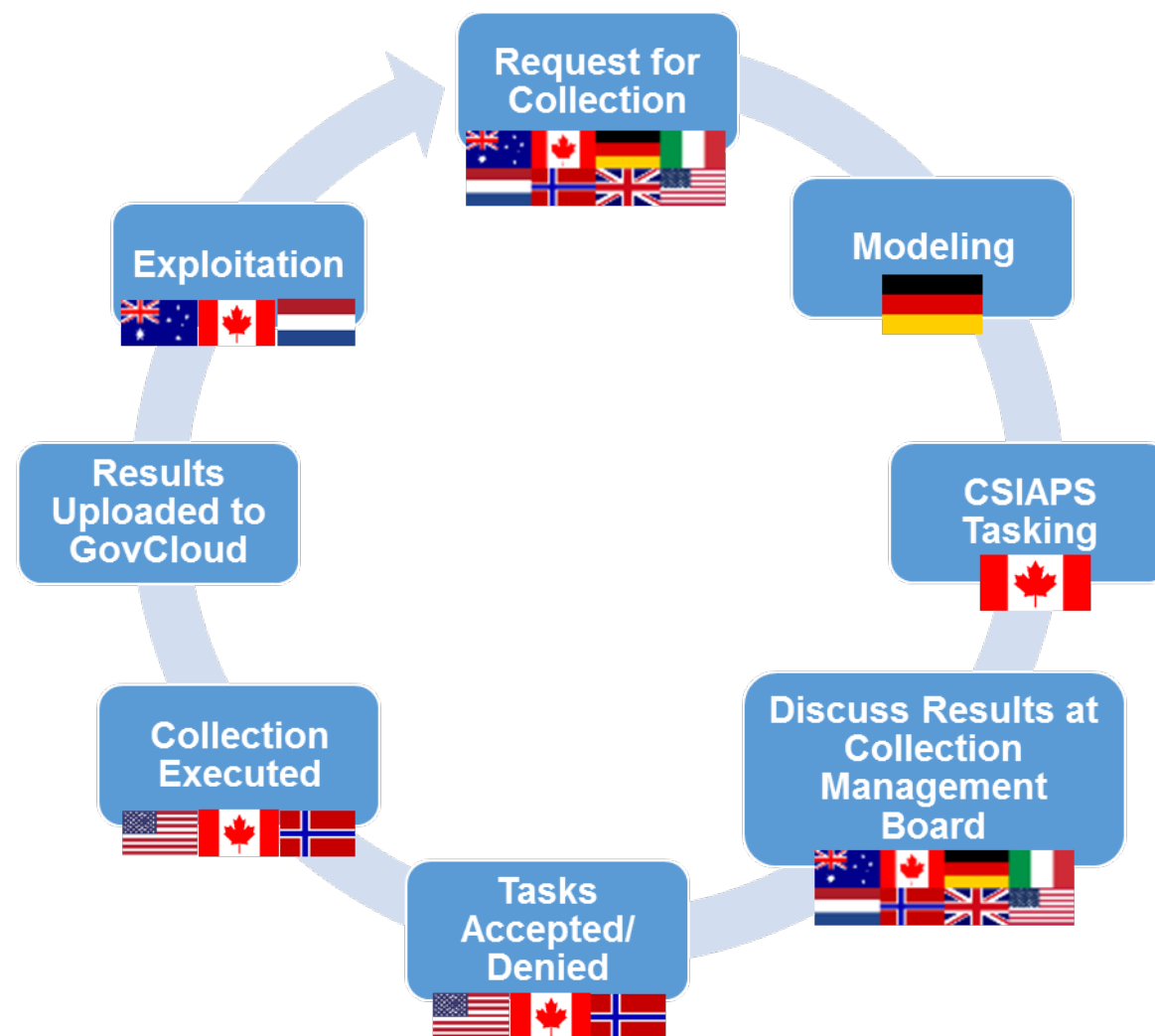


# Experiment Execution Process



Intelligence Requirements Management and Collection Management (IRMCM) process, broken down into two main parts:






















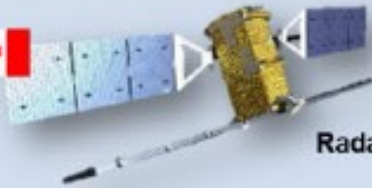


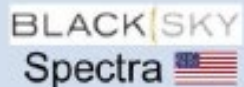





- Intelligence Requirements Management
- Collection Management, based on the NATO TCPED Cycle:
  - **Tasking:** CSIAPS/Modeling Results
  - **Collection:** Acceptance/denial of tasks; update on collections (pending, collected, processing, delivered)
  - **Processing & Exploitation:** Decide on exploitation needs; present & discuss results
  - **Dissemination:** Identify issues



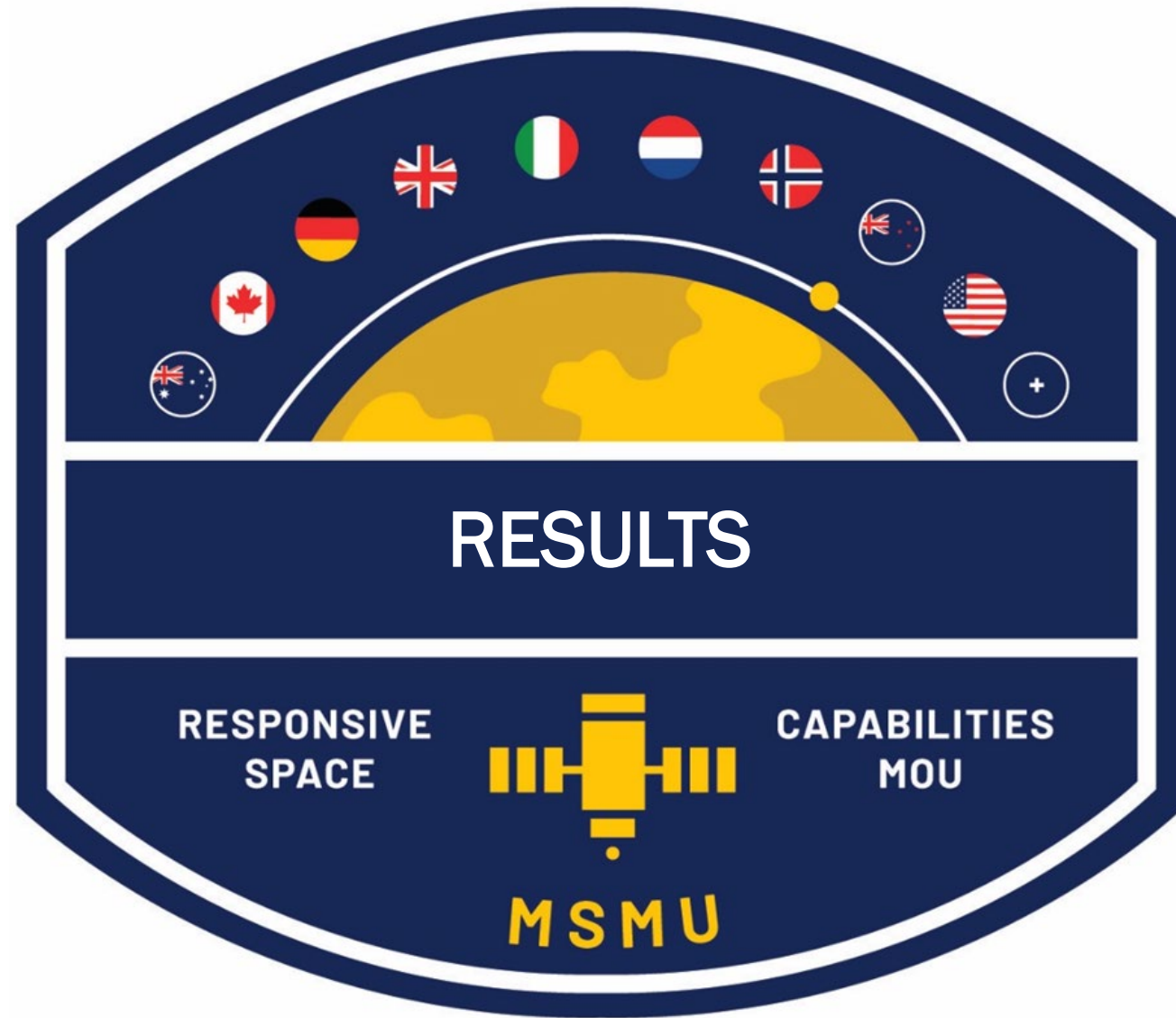




# Experiment National Contributions

	SATELLITES	TOOLS	OTHER
EO	    	 <b>CSIAPS</b>  <b>WISDOM</b>	 <b>ERNST</b> (simulated MWIR)  <b>Carbonite-2</b> (EO Imagery/Video & Analysis) 
AIS	 <b>NORSAT 1&amp;2</b>    <b>AISSAT 1&amp;2</b> 	 <b>ELIIXAR</b> <b>Modeling</b> 	 <b>BRIK-II</b> (simulated ESM)  <b>Exploitation Support</b>  <b>White cell Support</b>
SAR	  <b>RadarSat-2</b>	   	 <b>RIMPAC Planning Support</b>  <b>White cell Support</b>   <b>Collections Mgmt Board Leads</b>

**~185 operational satellites**

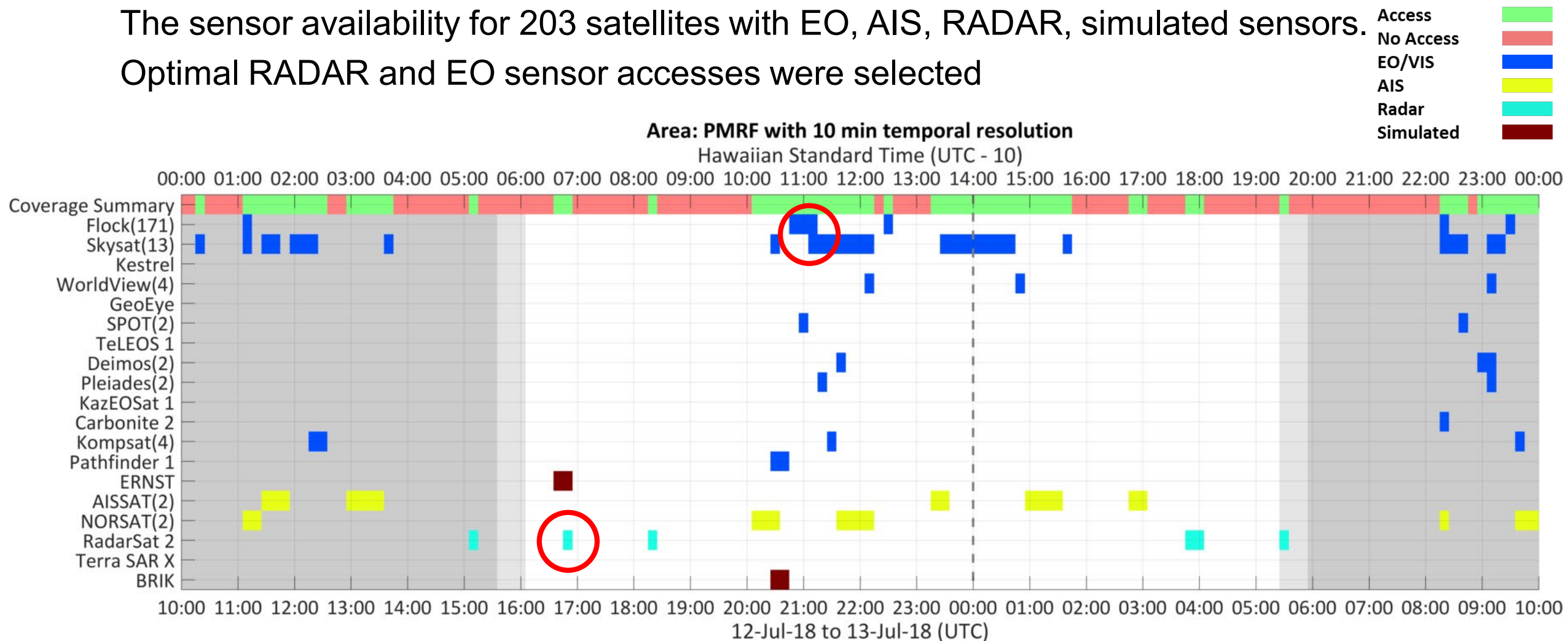




# Potential Sensor Availability Chart

The sensor availability for 203 satellites with EO, AIS, RADAR, simulated sensors.

Optimal RADAR and EO sensor accesses were selected







# Force Buildup – Ship Count

Ship counts obtained from multiple phenomenologies (SAR, AIS and EO).

Ship count discrepancies:

- not all ships were transmitting AIS
- AIS messaging is inconsistent
- significant force build-up at Pearl Harbor

Box Size	WISDOM (Maero-space data)	ELIIXAR(NOR AIS data)	NLD (NOR AIS, only A- class vessels)	USA (Dove imagery)
Small 10x10km	16	15	15	50
Medium 20x20km	21	19	19	
Large 100x30km	63	67	64	
Extra Large 300x300km		88	83	



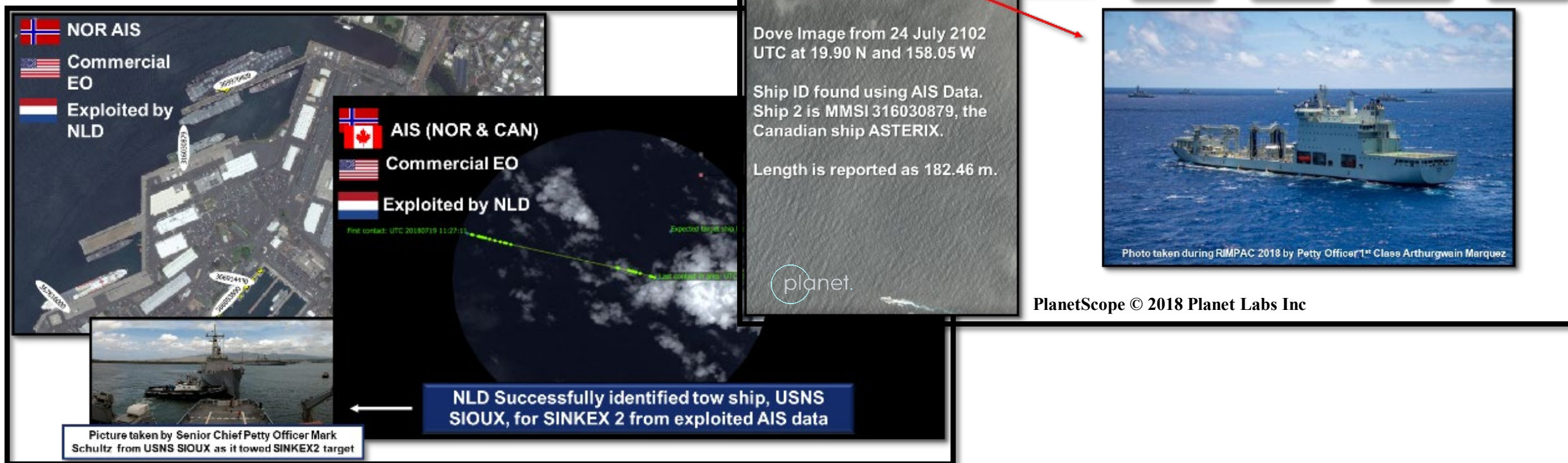
EO confirmed not ALL ships were transmitting AIS

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# Fusion of Multiple Data Sets

- Fusion of multiple data sets to identify targets, validate results, identify discrepancies
  - Compare AIS data and EO imagery
- Ship identification



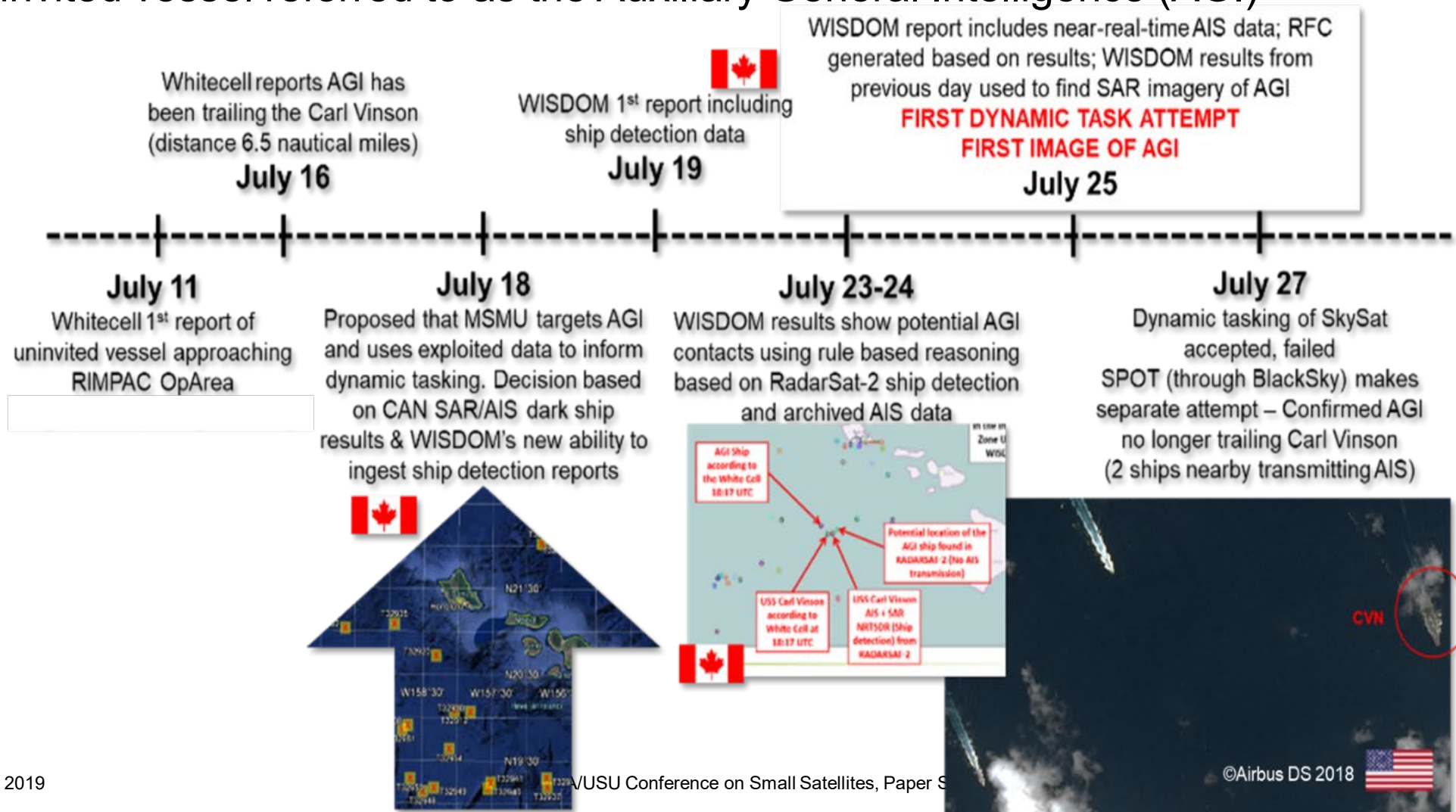
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# Tracking of Uninvited Vessel

- Uninvited vessel referred to as the Auxiliary General Intelligence (AGI)







# Multi-National Tasking

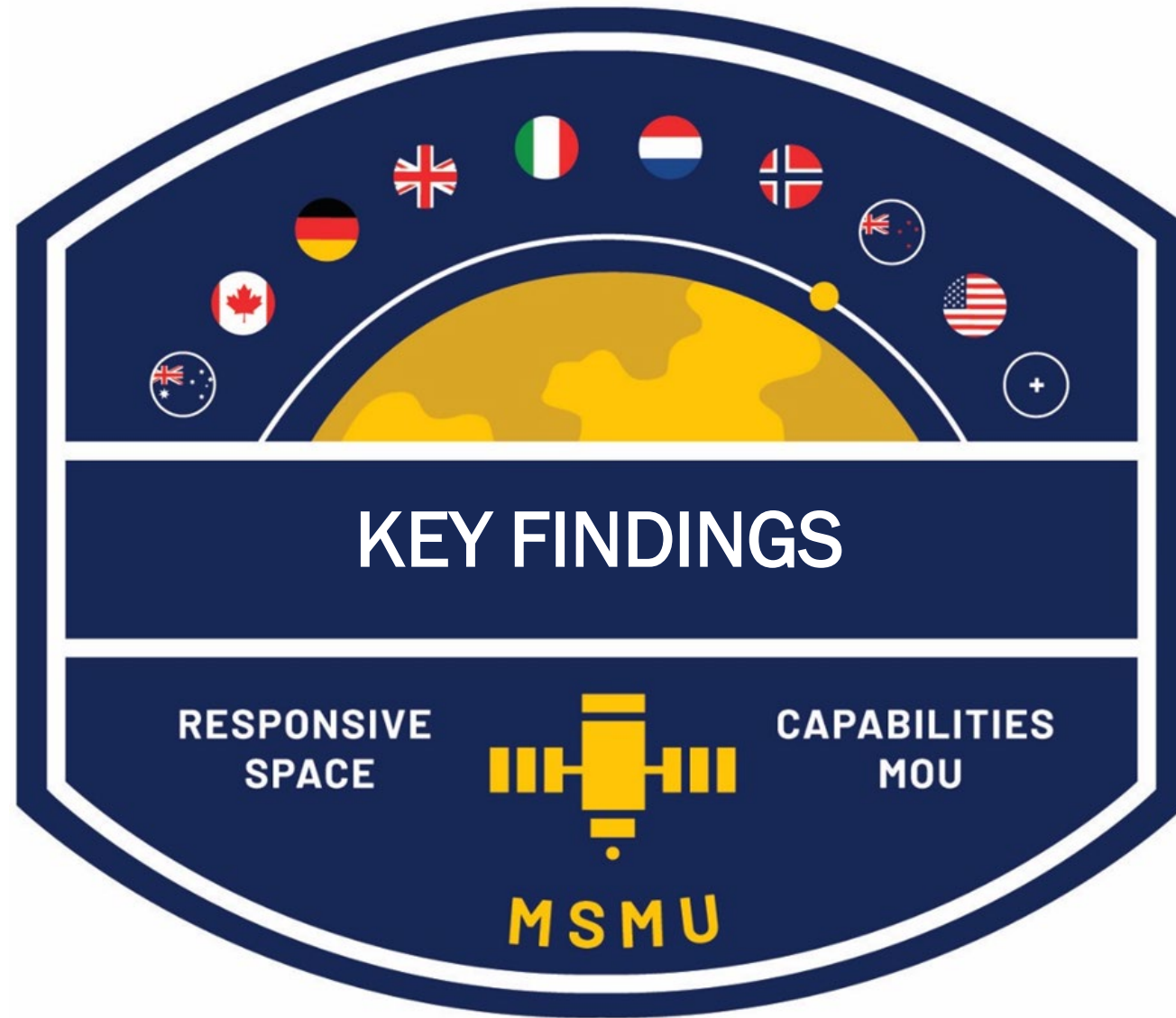


- Assess whether the airbase is in use by the Coalition Air Division, and if so, whether there are aircraft present that are similar in size to a combat jet or larger.
- Collect both EO/IR and SAR imagery as close to concurrently as possible, analyze and create a fused image product to provide additional insight



SkySat image © 2018 Planet Labs Inc

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# Key findings



- The RIMPAC 2018 Experiment revealed that a cooperative heterogeneous space architecture does have advantages and value, and that micro-satellites and nanosatellites contribute significant capability.
- The exercise execution highlighted a diverse set of insights that ranged from individual sensors and toolsets to architectural implications. All findings emphasized the need for significant infrastructure enhancements for improved collection planning, decreased TCPED latencies, expansion of exploitation toolsets, and collection management support.