The Hakai Institute:

Supporting community-based science in British Columbia with global frameworks for biological Essential Ocean Variables (EOVs)

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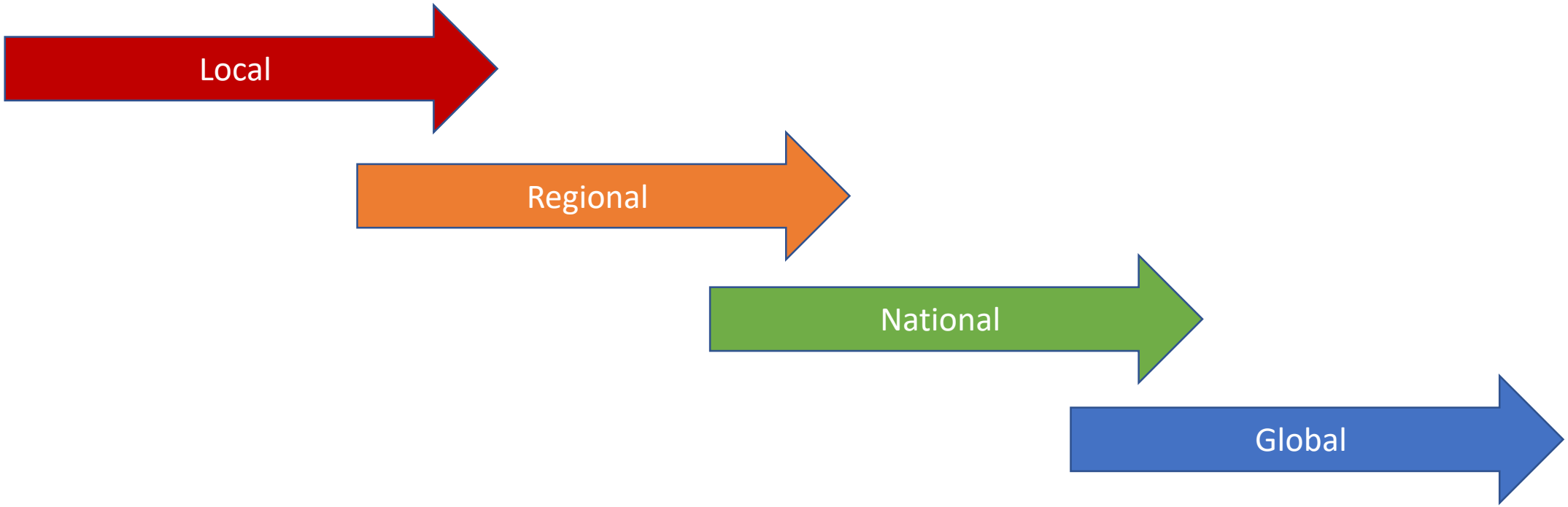
Hakai
Science on the Coastal Margin

MaPP

BRITISH COLUMBIA
Ministry of Forests, Lands, Natural Resource Operations and Rural Development

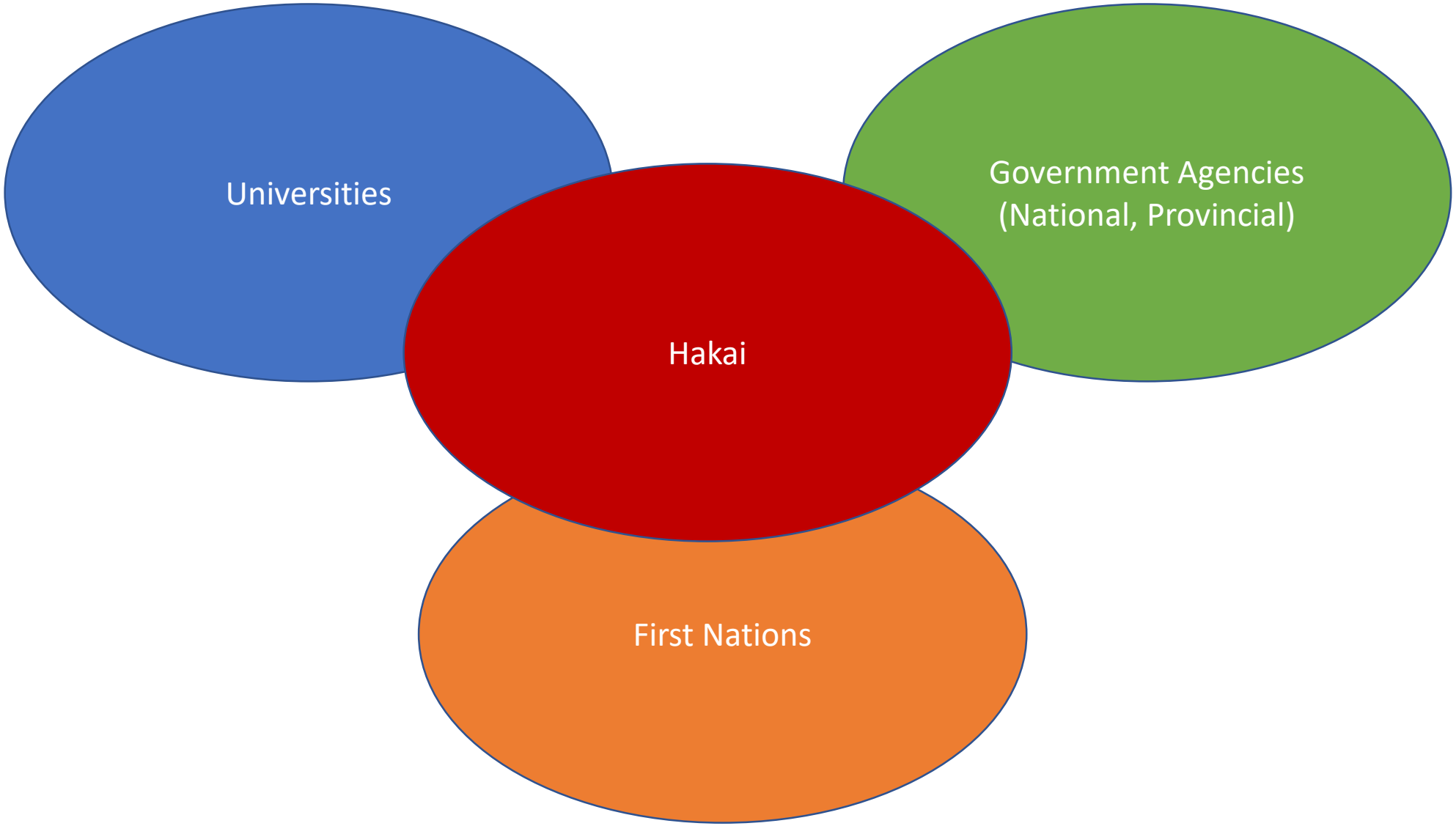
Hakai Institute

- Independent science organization, based in British Columbia.
- Mission: coastal science = observation + experimentation.
- Our roots are in local long term, place-based research.
- Via partners & networks we are now active at all spatial scales: local, regional, national and global.



Hakai Institute

Locally and regionally we convene a large network of partners.



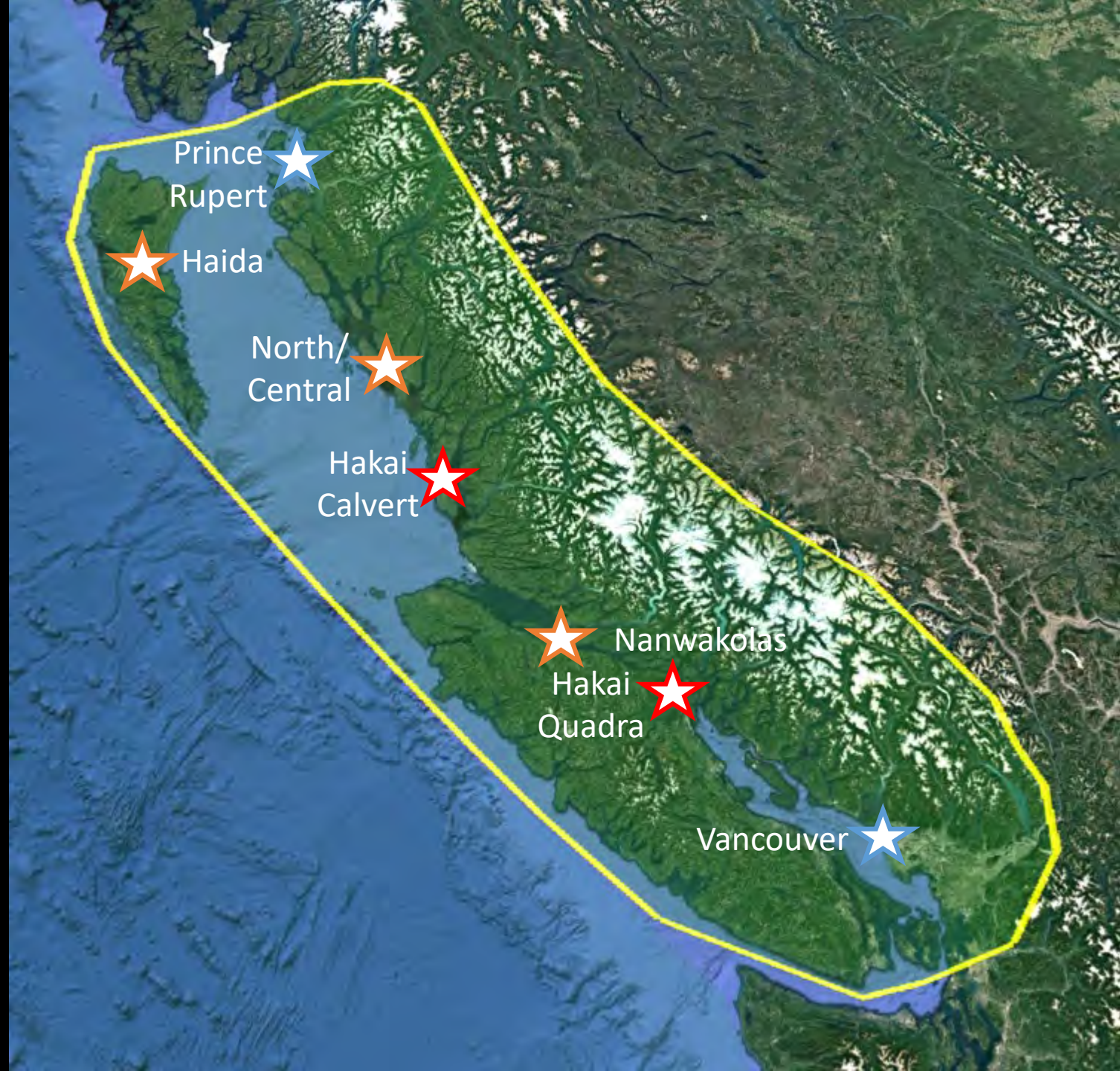
Our Regional Context: BC's Coastal Margin

A large stretch of sparsely populated coastline.

Hakai's two research stations are strategically placed for intensive local science.

But coverage of this vast coastline requires the participation of many capable partners, including First Nations, including:

- The Haida Nation.
- The North and Central Coast First Nations.
- The North Vancouver Island Nations (Nanwakolas).



Hakai's Calvert Island Observatory: Isolated, Off the Grid, Capable

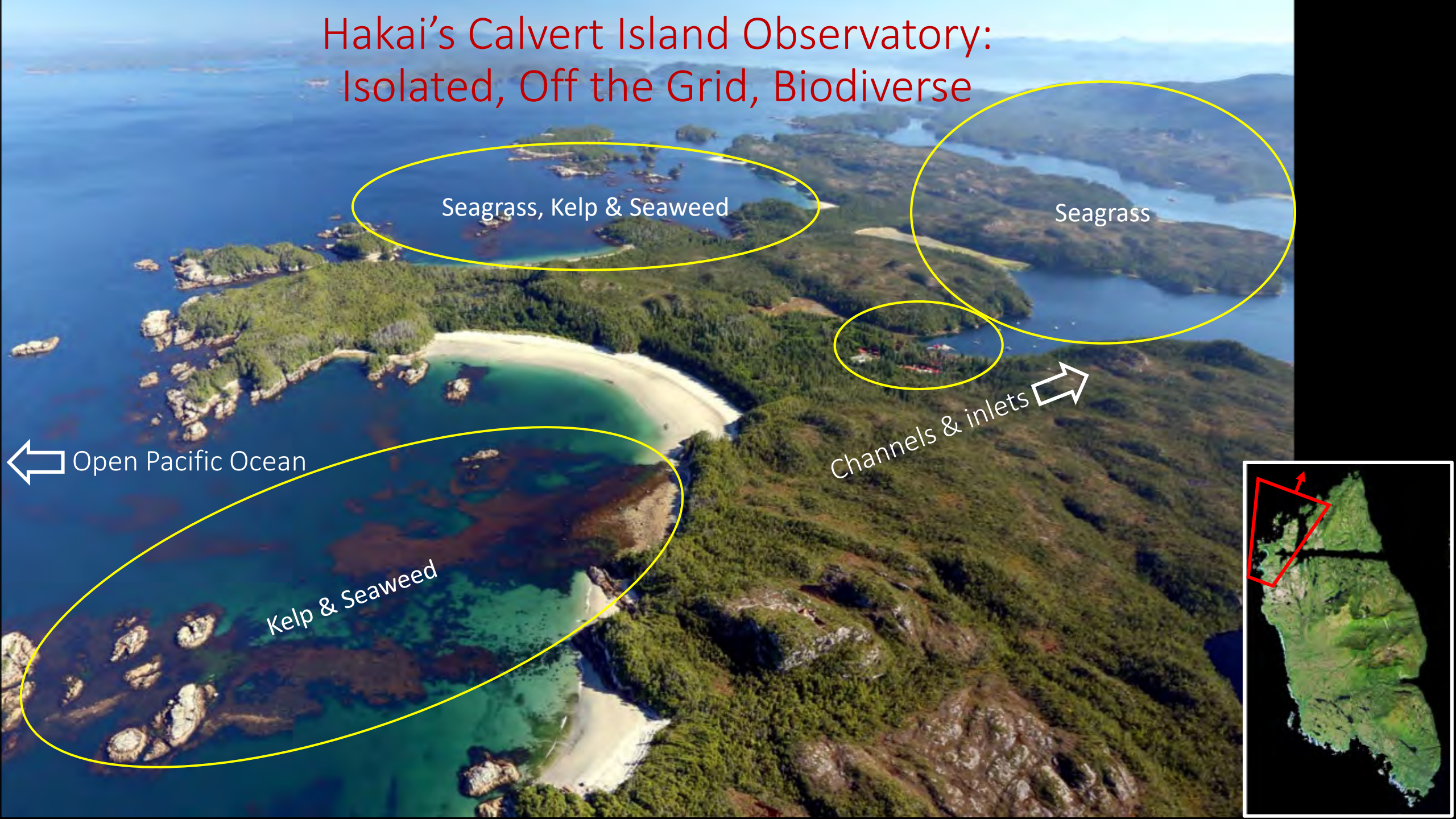
Accommodation for 100
Laboratories
Classrooms
Energy

Solar Panels

Solar Panels

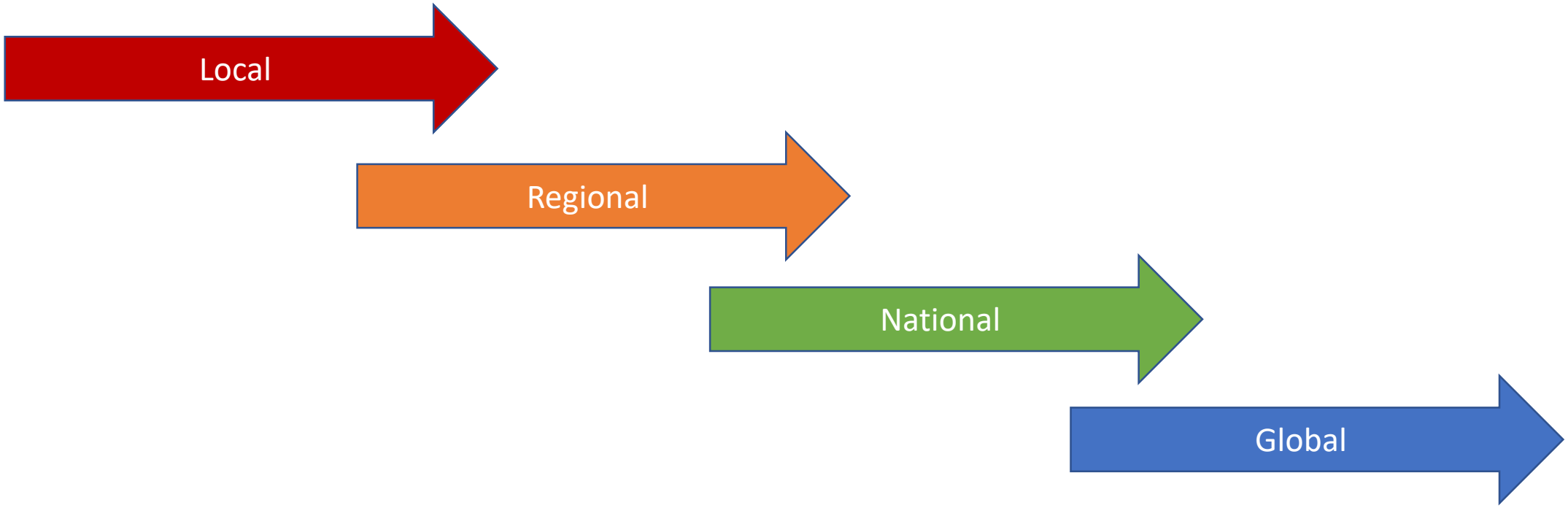
Gen-Shed & Batteries

Hakai's Calvert Island Observatory: Isolated, Off the Grid, Biodiverse

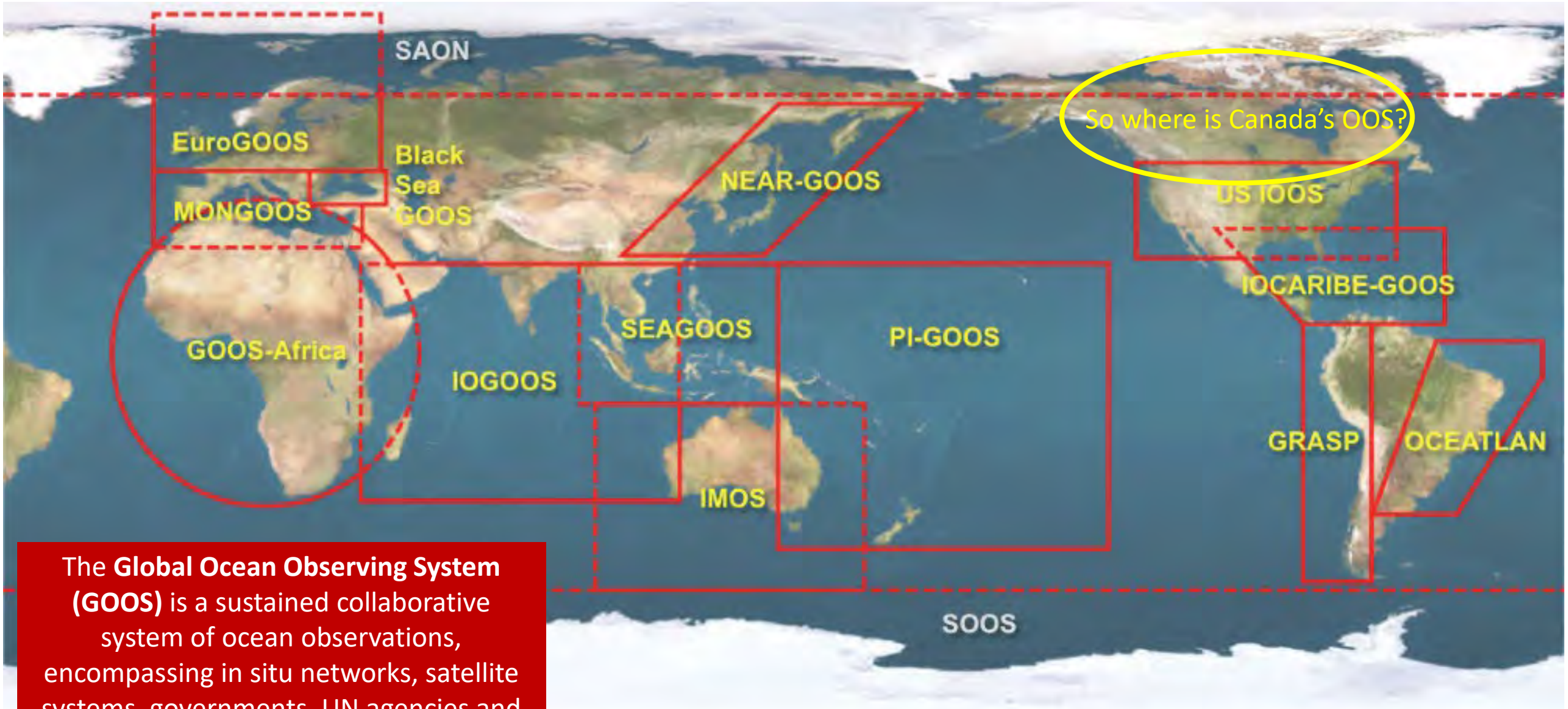


Local & Global

- We are committed to our coast and our local partners.
- But we are also aware of our responsibilities as global citizens, particularly in the face of our shared climate crisis.



The Global Ocean Observing System (GOOS) prior to 2018: a federation of national & regional systems

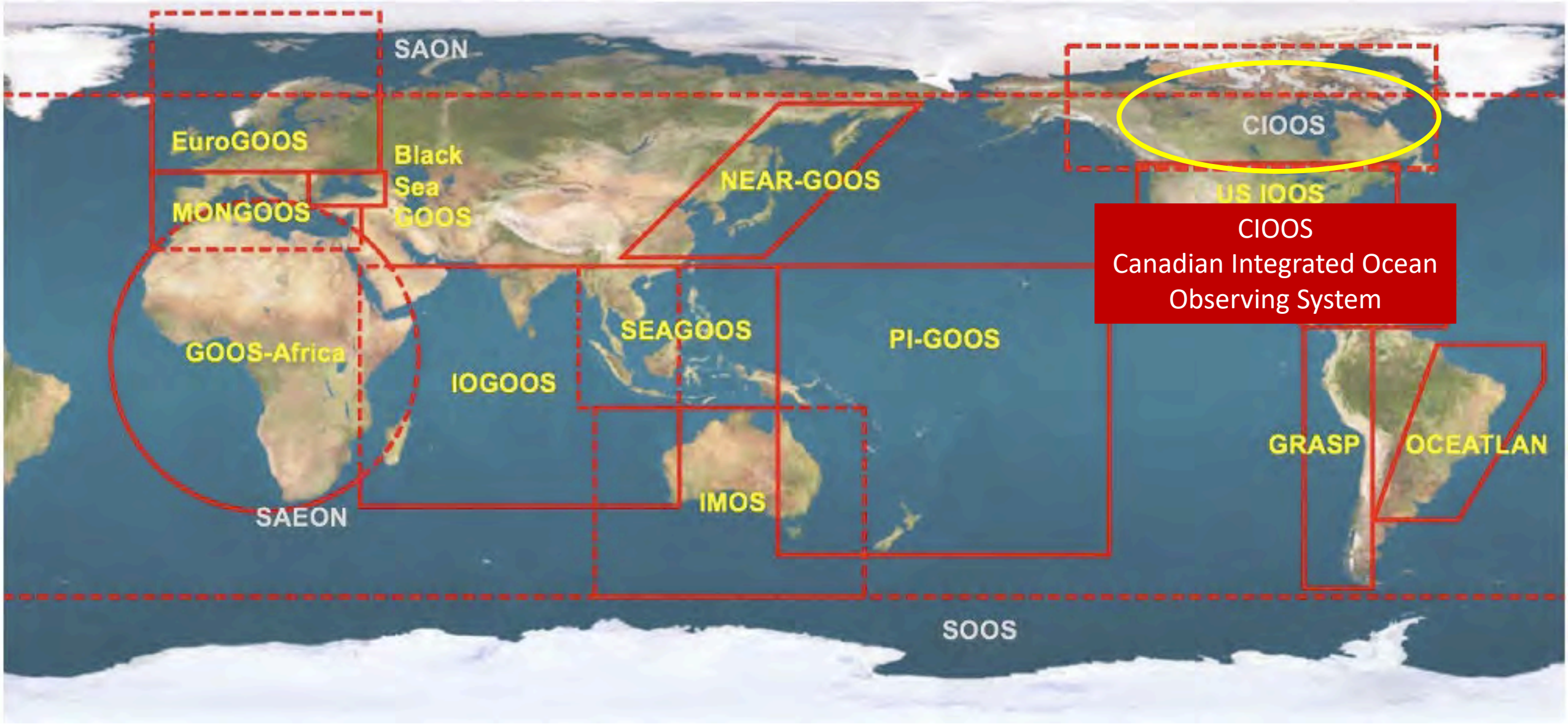


The **Global Ocean Observing System (GOOS)** is a sustained collaborative system of ocean observations, encompassing in situ networks, satellite systems, governments, UN agencies and individual scientists.

GOOS (Prior to 2018)

Hakai believed so strongly in international collaboration that we joined the regional affiliates of the US IOOS system—
Alaska (AOOS) and Pacific Northwest (NANOOS)—in a coastal alliance.

But we're very happy that Canada has finally joined the GOOS global network

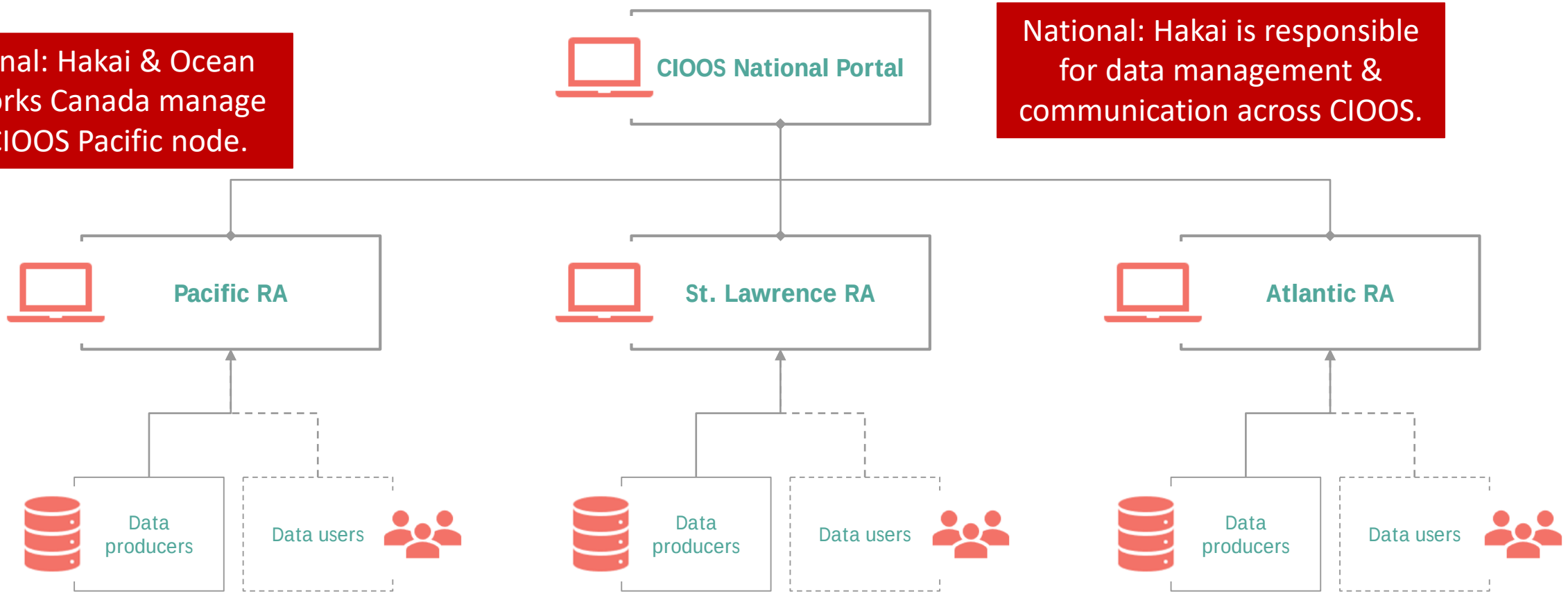


Hakai's Role in the Canadian Integrated Ocean Observing System (CIOOS)

Global: Hakai is committed to the integration of CIOOS with US/IOOS and GOOS.

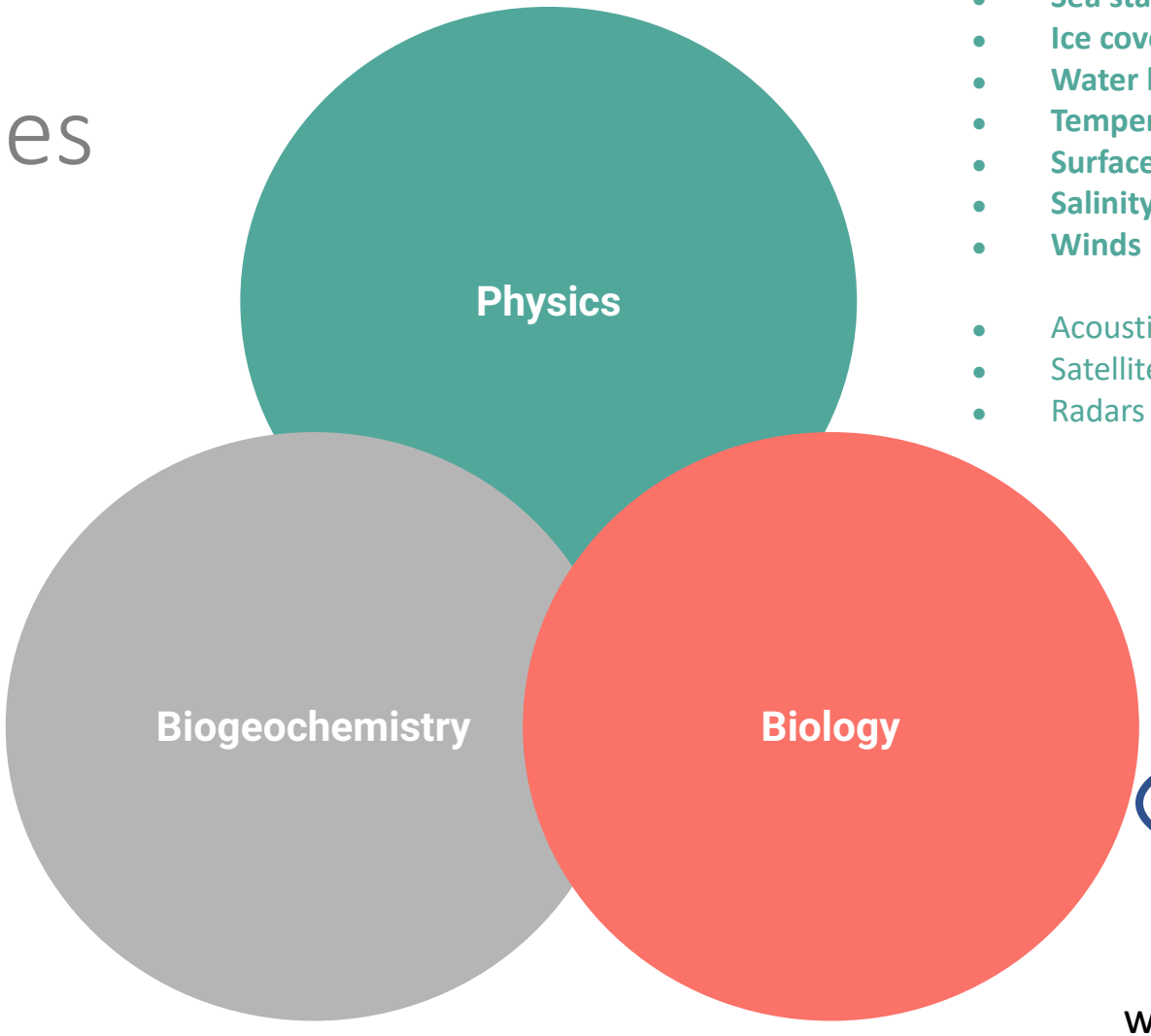
National: Hakai is responsible for data management & communication across CIOOS.

Regional: Hakai & Ocean Networks Canada manage the CIOOS Pacific node.



Local: Hakai works with local providers and users including First Nations.

Ocean core variables



- **Sea state (waves)**
- **Ice cover**
- **Water level**
- **Temperature**
- **Surface currents**
- **Salinity and density**
- **Winds**

- Acoustic
- Satellite/ocean color
- Radars HF

- Fish abundance
- Marine mammals
- Kelps & seaweeds
- Seagrasses

- **Oxygen Saturation**
- **Inorganic Carbon (pH)**
- **Nutrients**
- **Omics**

Hakai shares an interest with First Nations in these **Foundation Species**.

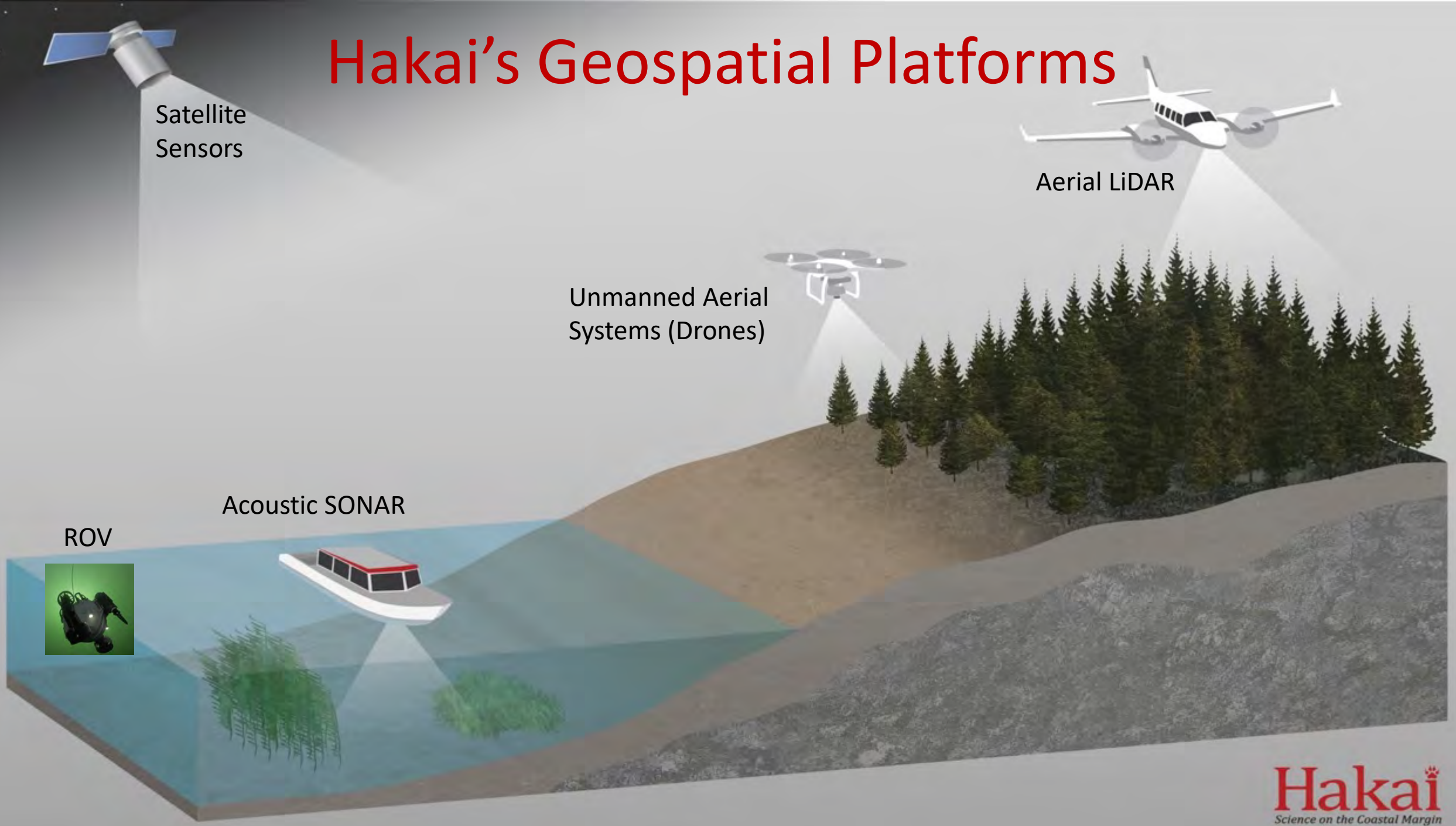
Foundation Species: Kelp

Wei Wai Kum Guardians
Owen Bay, Sonora Island
Photo: Markus Thompson

Foundation Species: Seagrass

K’omoks Guardians
Read Bay, near Johnstone Strait
Photo: Markus Thompson

Hakai's Geospatial Platforms



Hakai
Science on the Coastal Margin

Macrophyte EOV Development

Local | Regional | Global

Seagrass

- Seagrass cover
- Seagrass composition

MaPP

- Seagrass cover
- Seagrass composition

MarineGEO
THE TENNENBAUM MARINE OBSERVATORIES NETWORK
Smithsonian Institution

Kelp

- Kelp canopy cover
- Kelp canopy composition

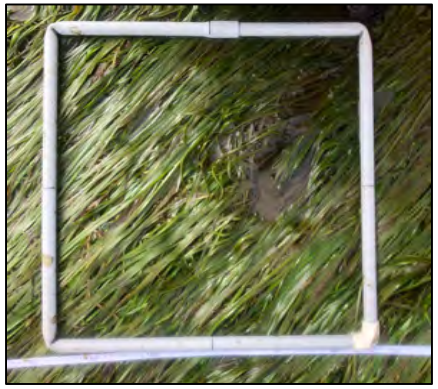
- Kelp canopy cover
- Kelp canopy composition

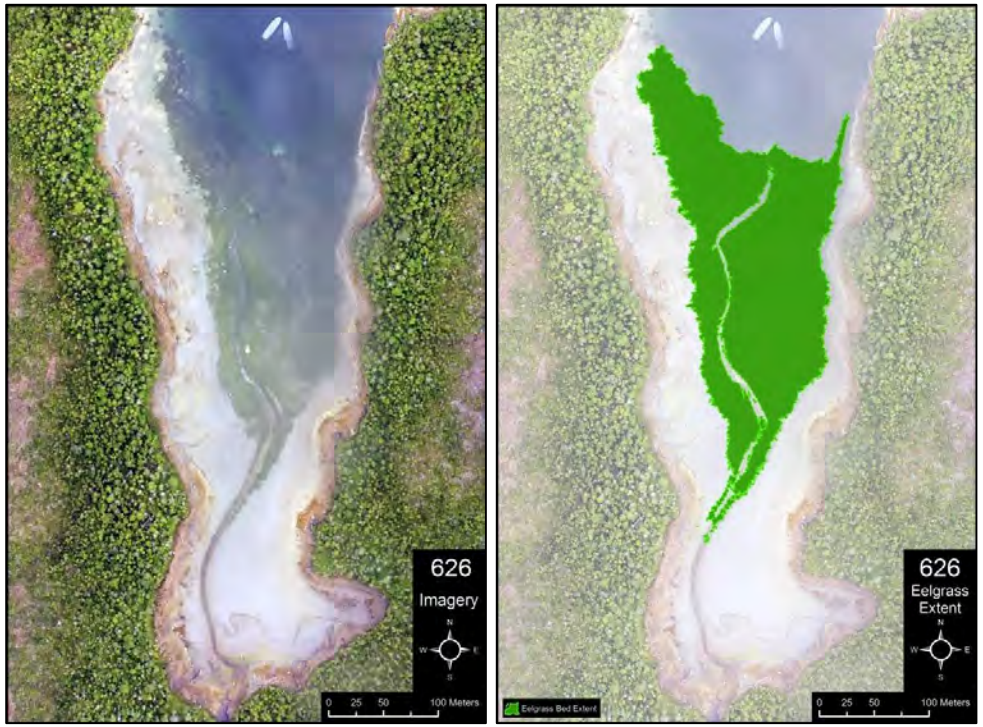
Macrophyte EOV Development: Data Collection

EOV Cover Variables

Seagrass Example

- Shoot Density
- Percent Cover
- Areal cover

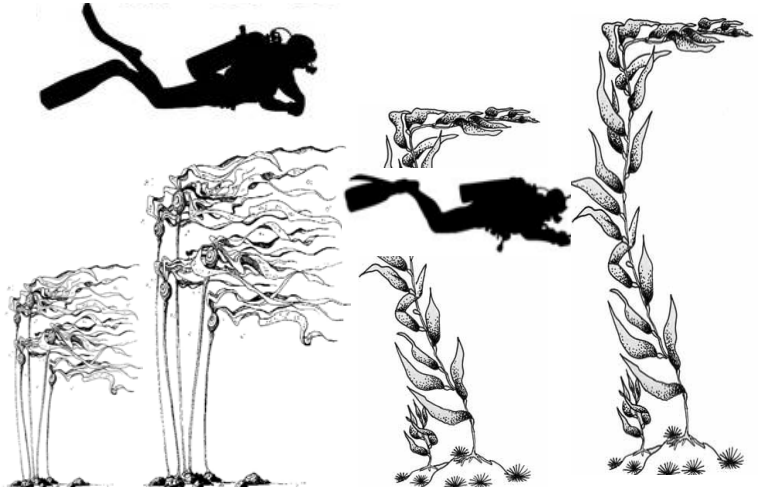




Macrophyte EOV Development: Data Collection

EOV Composition Variables

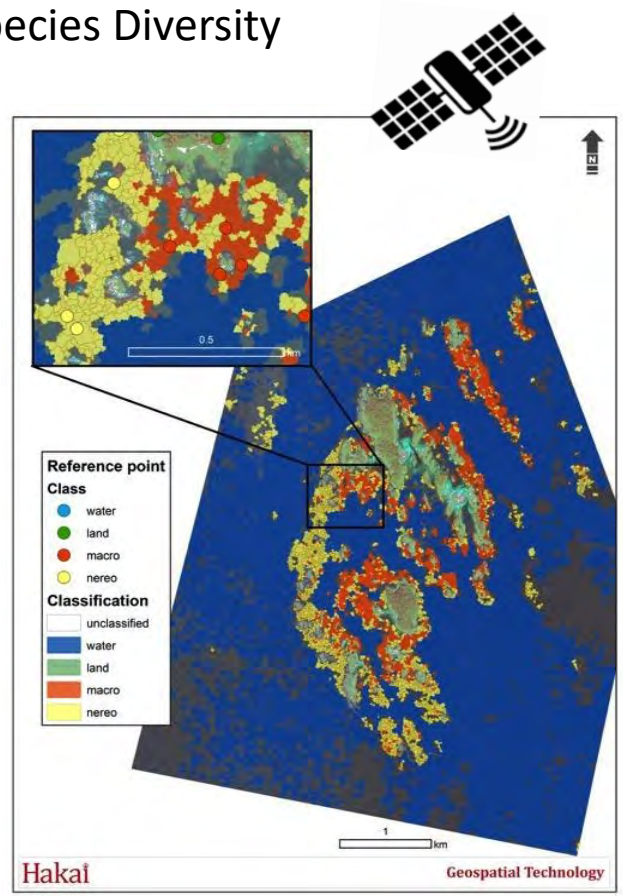
Kelp Example



- Species Diversity

Macrocystis

Nereocystis



- Traits

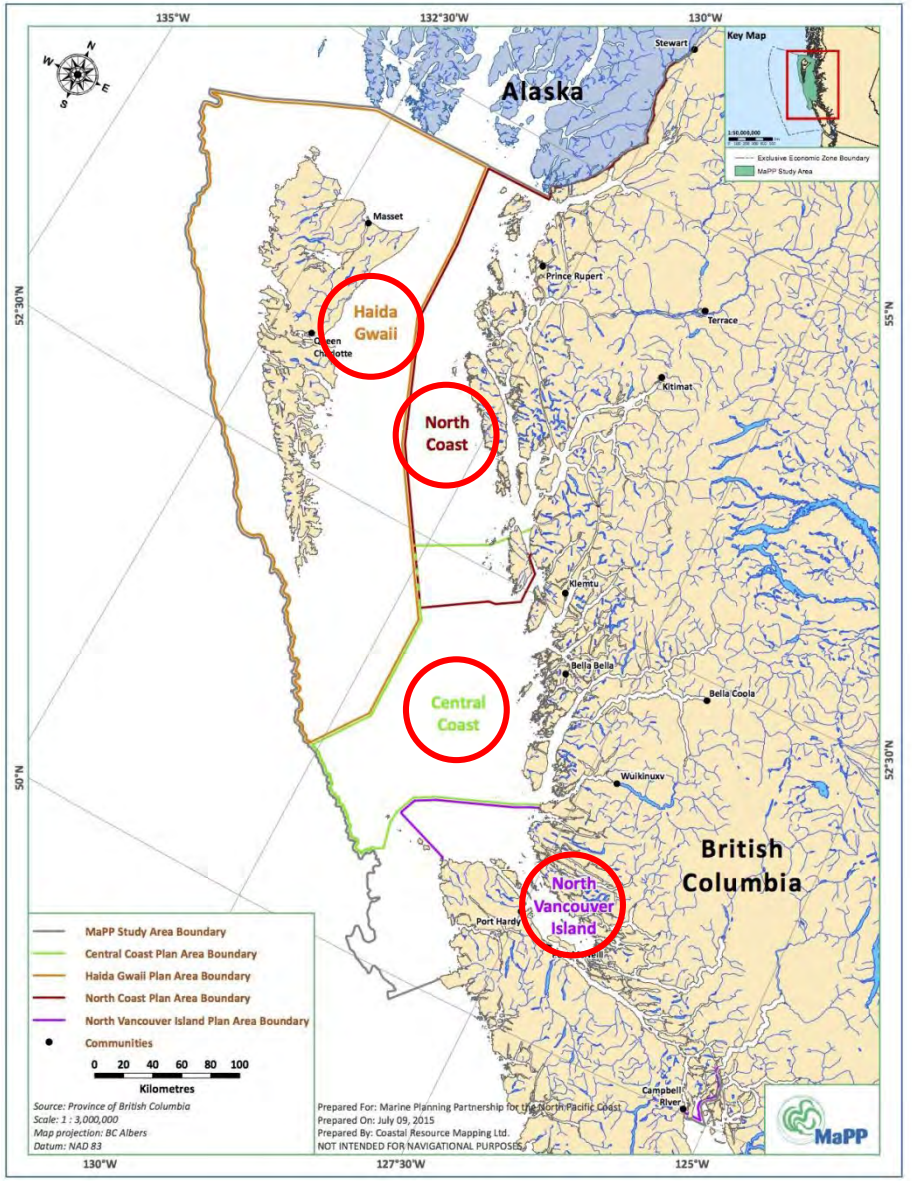
- Community Diversity

Our Challenge in Achieving Regional Scope

- How can we mobilize local knowledge and capabilities to serve local needs and fulfill our national and global responsibilities via CIOOS and GOOS?
- How can we collect data that meets the exacting standards required by GOOS?
- We need to recruit First Nations local experts.
- That requires knowledge transfer, close collaboration, and effective use of partner organizations like the Guardian Watchmen and MaPP.

Marine Planning Partnership (MaPP):

- Collaboration between BC Provincial Government and 16 First Nations
- 4 Sub-regional marine plans, supported by a Regional Action Framework
- Goals:
  - Integrity of marine ecosystems – structure, function, resilience
  - **Human well-being** supported through social, economic, spiritual and cultural connections to marine ecosystems
  - Collaborative, effective, transparent integrated **governance**, and management and public engagement
  - **Improved understanding** of complex marine ecosystems and changing environments



COASTAL FIRST NATIONS
GREAT BEAR INITIATIVE

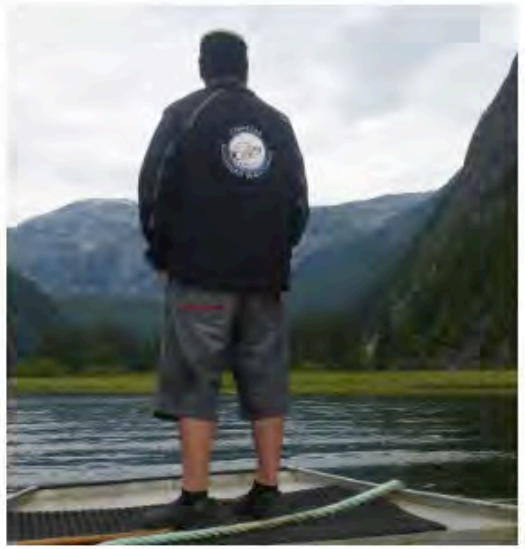
- Guardians are our partners for science on the North/Central Coast + Haida Gwaii.
- We have hosted the Guardians' annual meeting on Calvert Island, every year for the past decade. (40-50 attendees)

Coastal Guardian Watchmen Support

ABOUT COASTAL GUARDIAN WATCHMEN

Coastal Guardian Watchmen play a critical role in all aspects of stewardship for Coastal First Nations – ensuring resources are sustainably managed, that rules and regulations are followed and that land and marine use agreements are implemented effectively.

They uphold and enforce traditional and contemporary Indigenous laws passed down over countless generations, and work together to monitor, protect and restore the cultural and natural resources of these coastal territories.



Guardian Watchmen Conference:
Calvert Island Observatory

Guardian Watchmen Conference:
Seaweed monitoring training

The Challenges of Knowledge Transfer

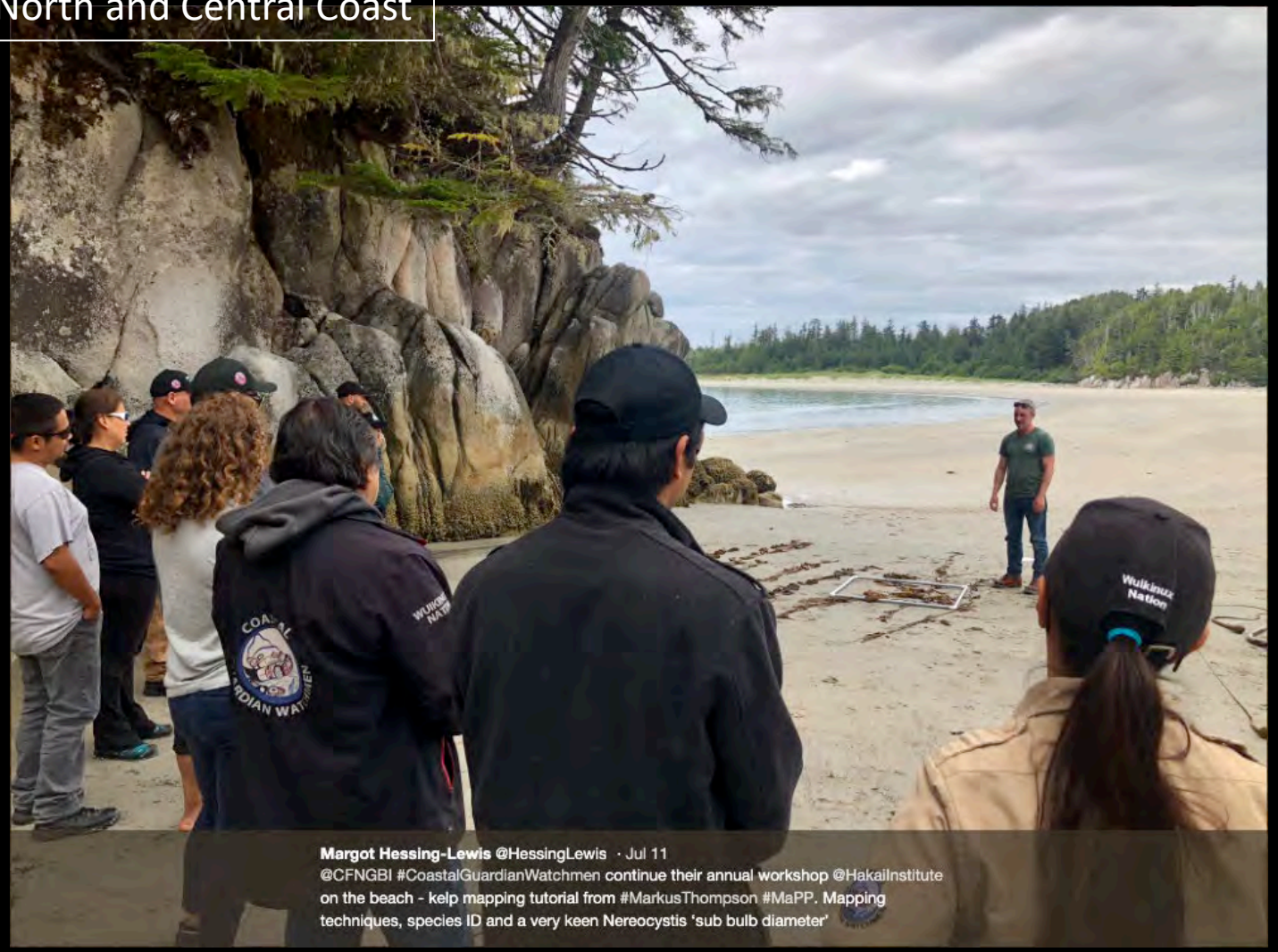
North and Central Coast

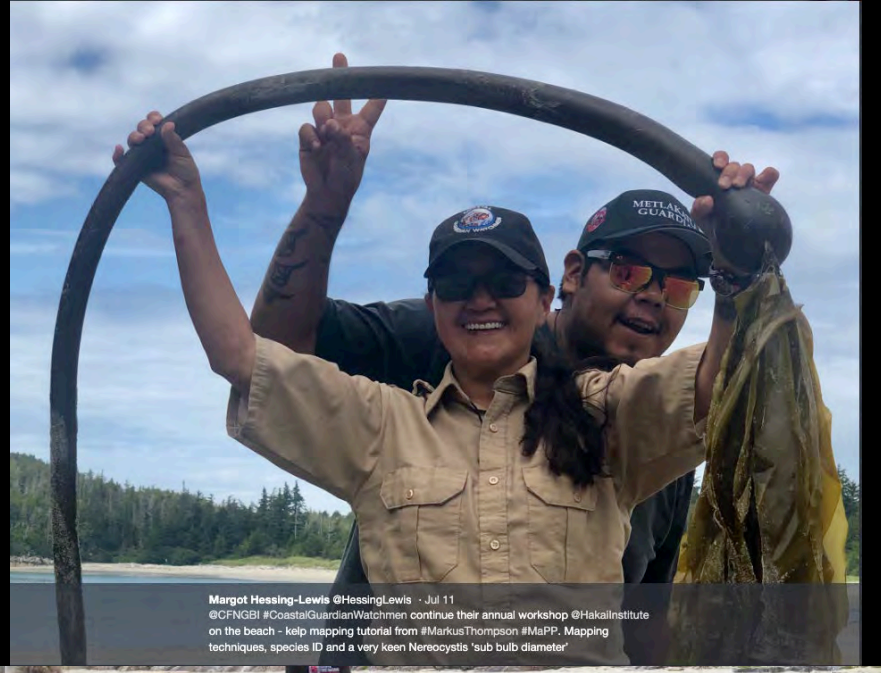
Guardians and MaPP help bridge the gap between Hakai technical experts and communities.

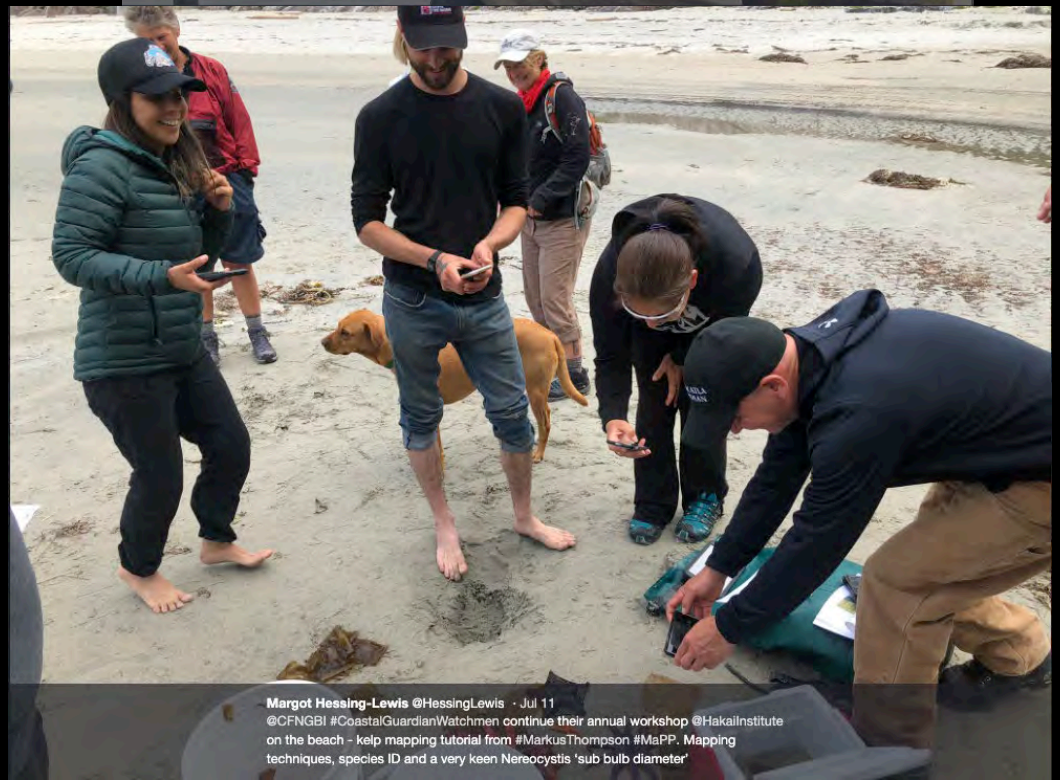
CoastalFirstNations
@CFNGBI

Following

North and Central Coast







This Year:
Expanded Work
With Guardians
to the south.

Nanwakolas

The Week in Pictures:

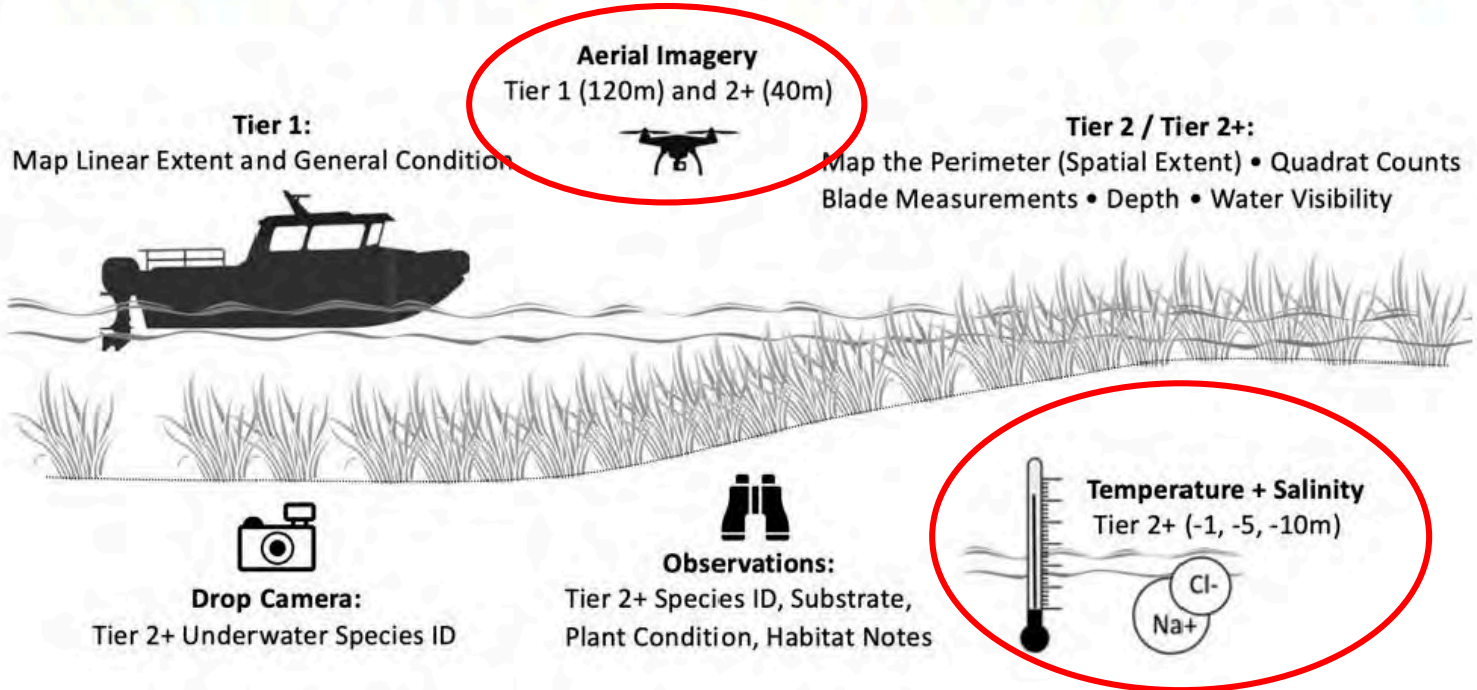
Tuesday - Deep Time Archaeological work with Daryl (Hakai) sites 200m above sea level & Inlailawatash reviewing site visits for field season

Wednesday - Pre-trip safety planning with Sue (Hakai) & Kelp survey methodology with Rebecca (Prov) & Markus (EBM Coordinator)

Thursday - eDNA with Sue (Hakai), K'omoks Guardians collecting samples, & Bill (Prov) using instruments for fresh water stream data collection

Nanwakolas

Friday - Drone training with Hakai & Eel grass with Rebecca (Prov Biologist) & Markus (MaPP EBM Coordinator)



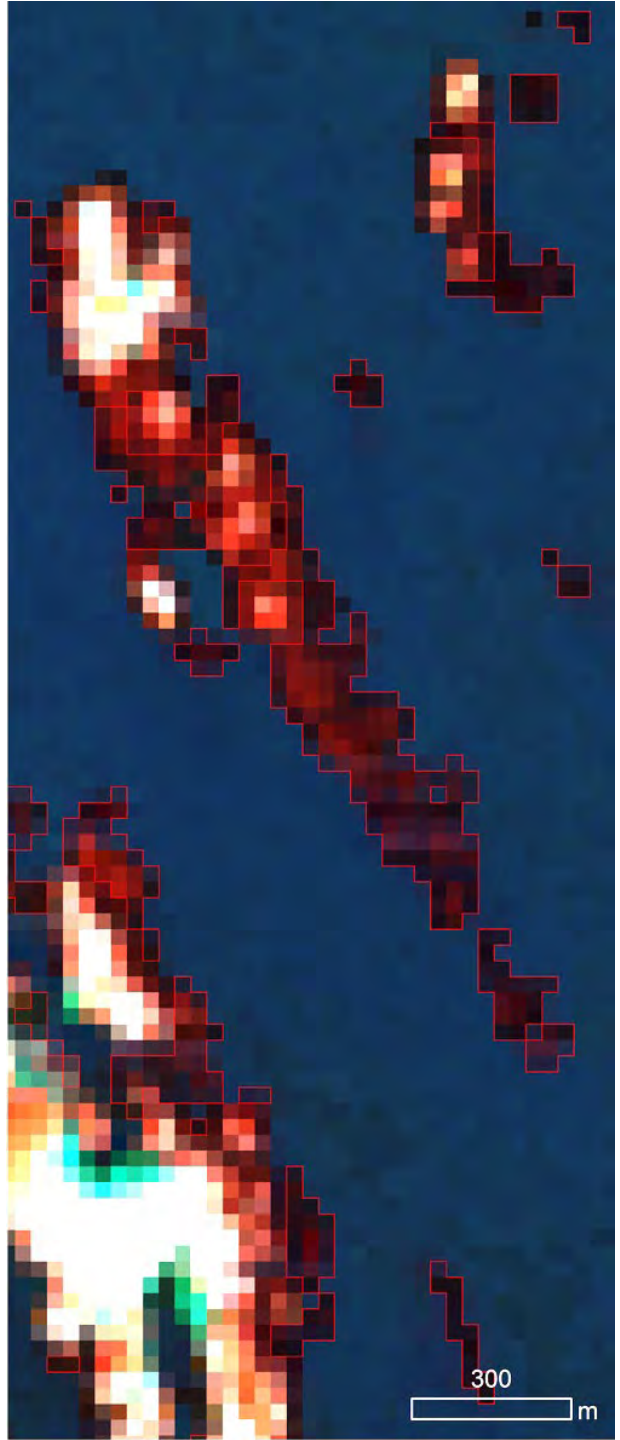
A mixture of old school methods …

… and new technology

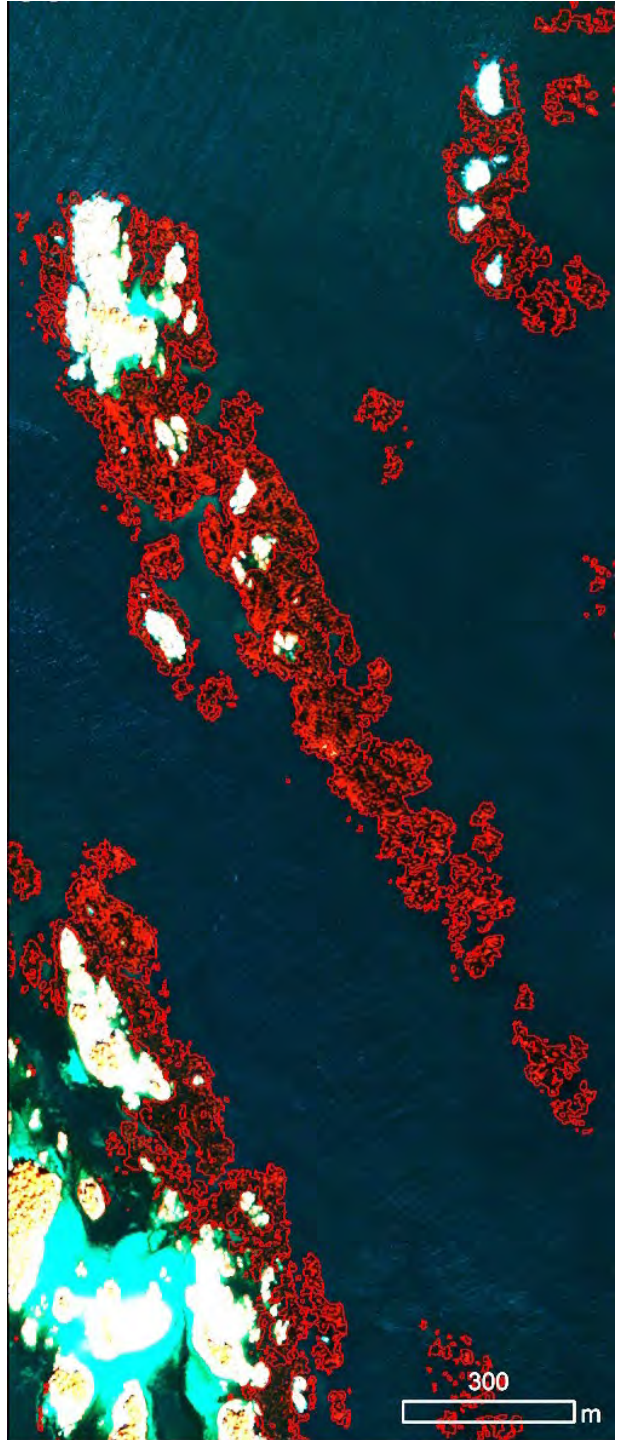
Tlowitisis mother and daughter team finishing a drone survey

Tlowitisis First Nation: Seagrass: 550-Photo Low Tide Drone Survey of Estuary

Doing more with better and better satellites.



Landsat 8
30 meter pixels
4 spectral bands



WorldView-2
0.5 meter pixels
8 spectral bands

Luba Reshitnyk (Hakai)

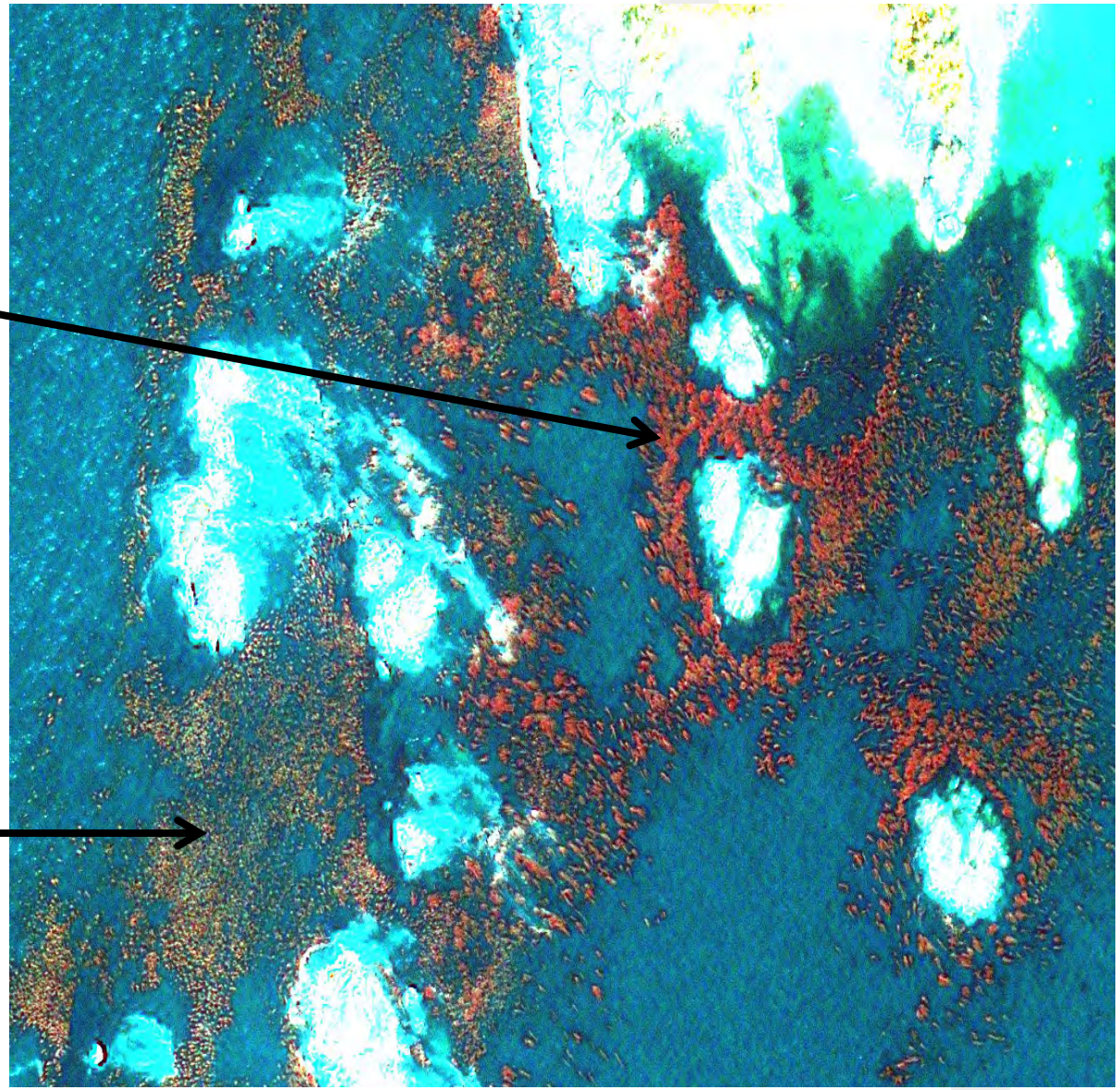
WorldView-2

Under favorable conditions:

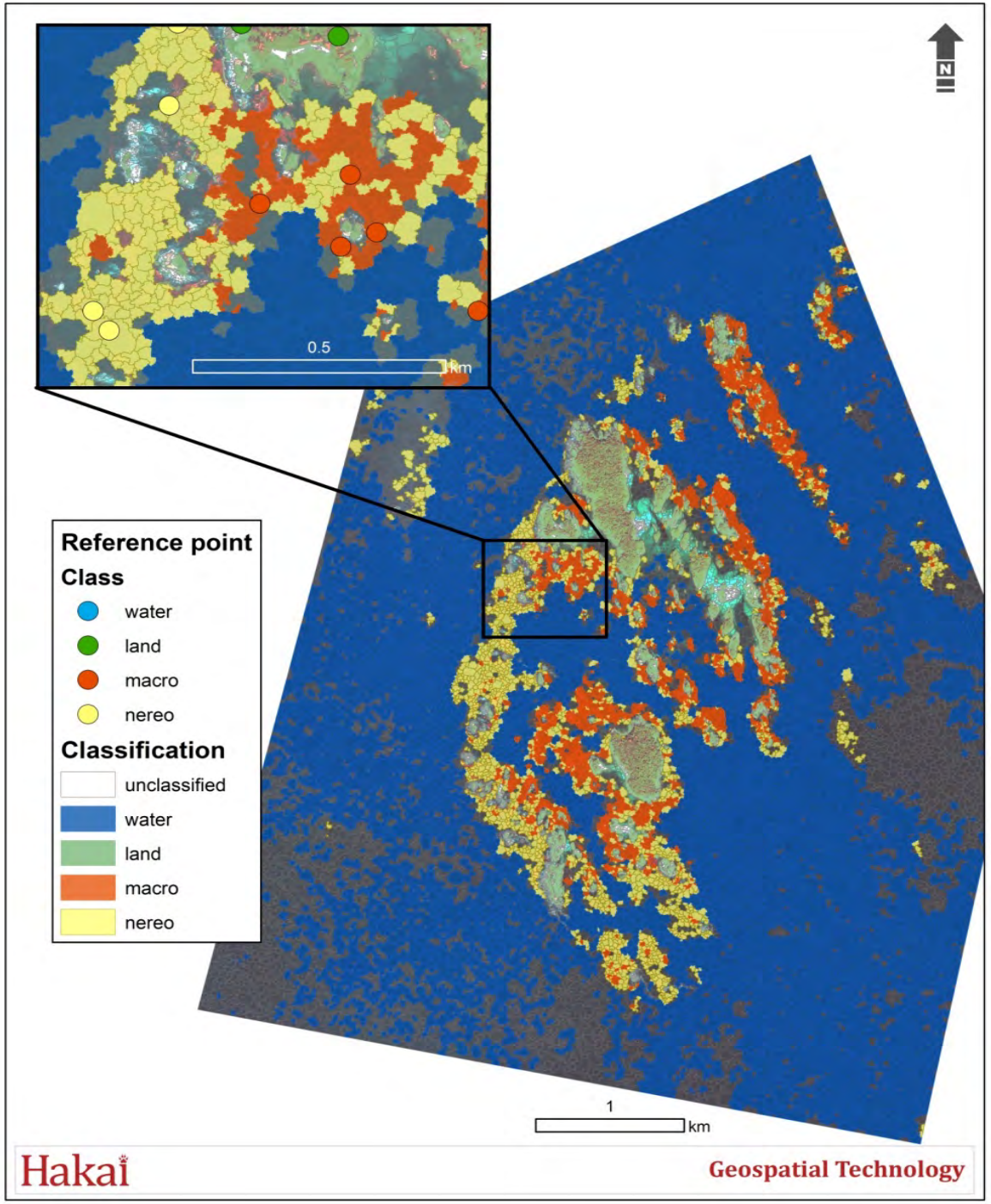
- Can detect and map kelp from space at high resolution.
- Can distinguish between the different species.

Giant Kelp

Bull Kelp



- Potentially a very powerful method for regional mapping, but not a panacea.
- Sensitive to many factors: weather, tides, sea conditions, sun angle, etc.
- Must be coupled with local analysis and ground-truthing.



Kelp at Regional Scale: Satellite Imaging

Porcher

Haida Gwaii

Cumshewa Inlet

SW Kunghit Is.

Pacific Ocean

Cape Mark

Goose/McMullin

Hunter Island

Simmonds/Triquet

NW Calvert Is.

Fitz Hugh Sound

0 10 20
km

Malcolm Is.

N Quadra Is.

NW Vancouver Is.

Vancouver Island

British Columbia

Mayne and Prevost Is.

Broken Group

S Vancouver Is.

N
W E
S

2019 WorldView-2 acquisitions

Imagery acquired

Imagery not acquired

WorldView-2 is a commercial satellite with 8 band multispectral data collected at a 2 m resolution.

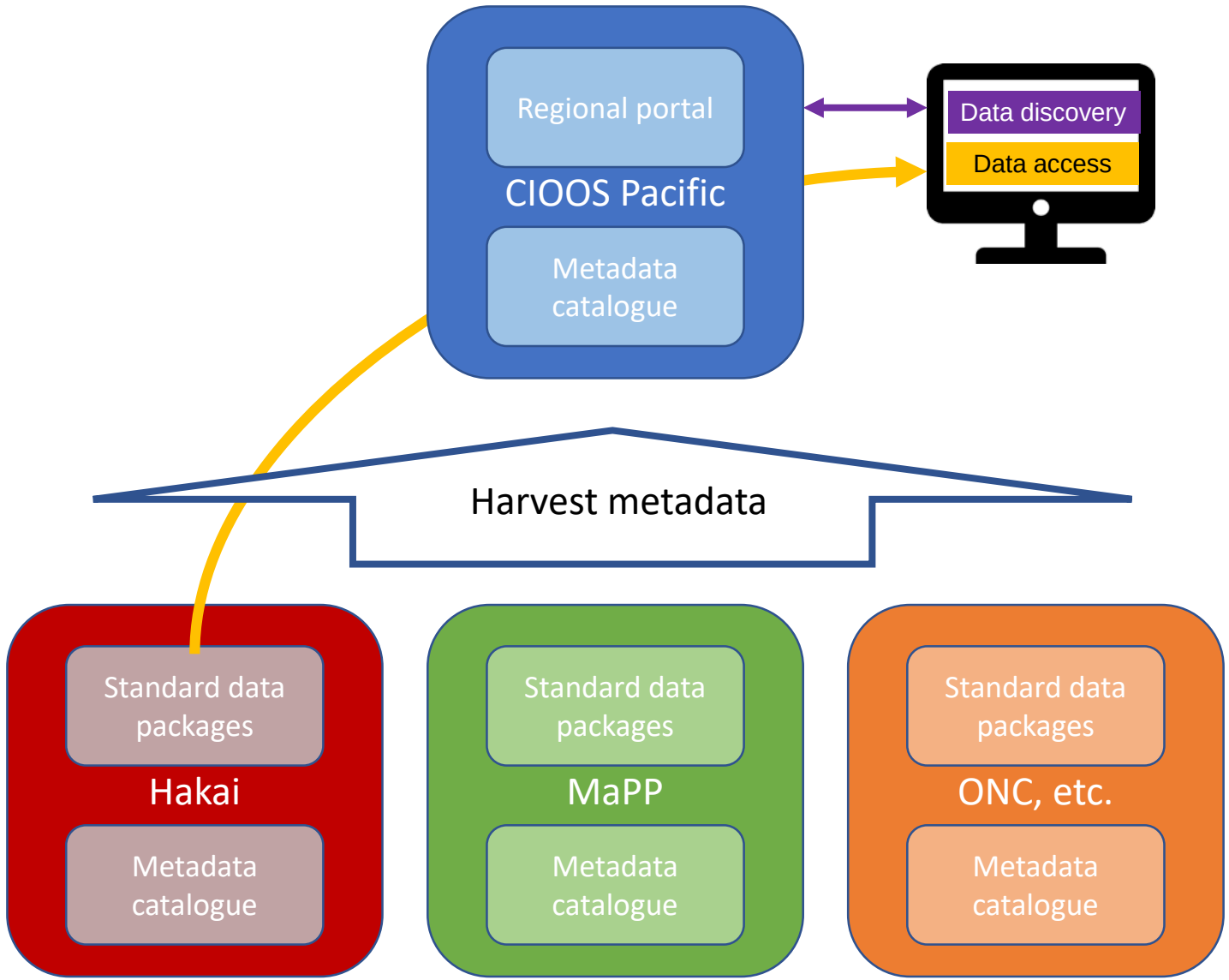
Imagery for Porcher, Malcolm Is. and Cape Mark regions were uncessful for image acquisition due to weather.

Hakai

0 50 100
km

CIOOS Data Management & Communication

- In general CIOOS nodes store metadata; data packages stay with local providers.
- CIOOS has standardized on CKAN as a metadata catalogue.
- Every data package has an associated ISO 19115 metadata record that complies with the CIOOS metadata profile.
- Metadata records are harvested from provider, to regional node, to national system.
- Data discovered via regional portal.
- Access to data gated/mediated by provider.
- Future EBOVs will comply fully with this model.
- Further, we would like to standardize as much as possible the methodologies, data packages, and data-specific metadata for EBOVs.
- As early adopters, we would be happy to work with other organizations to drive these emerging standards.



EOV Metadata

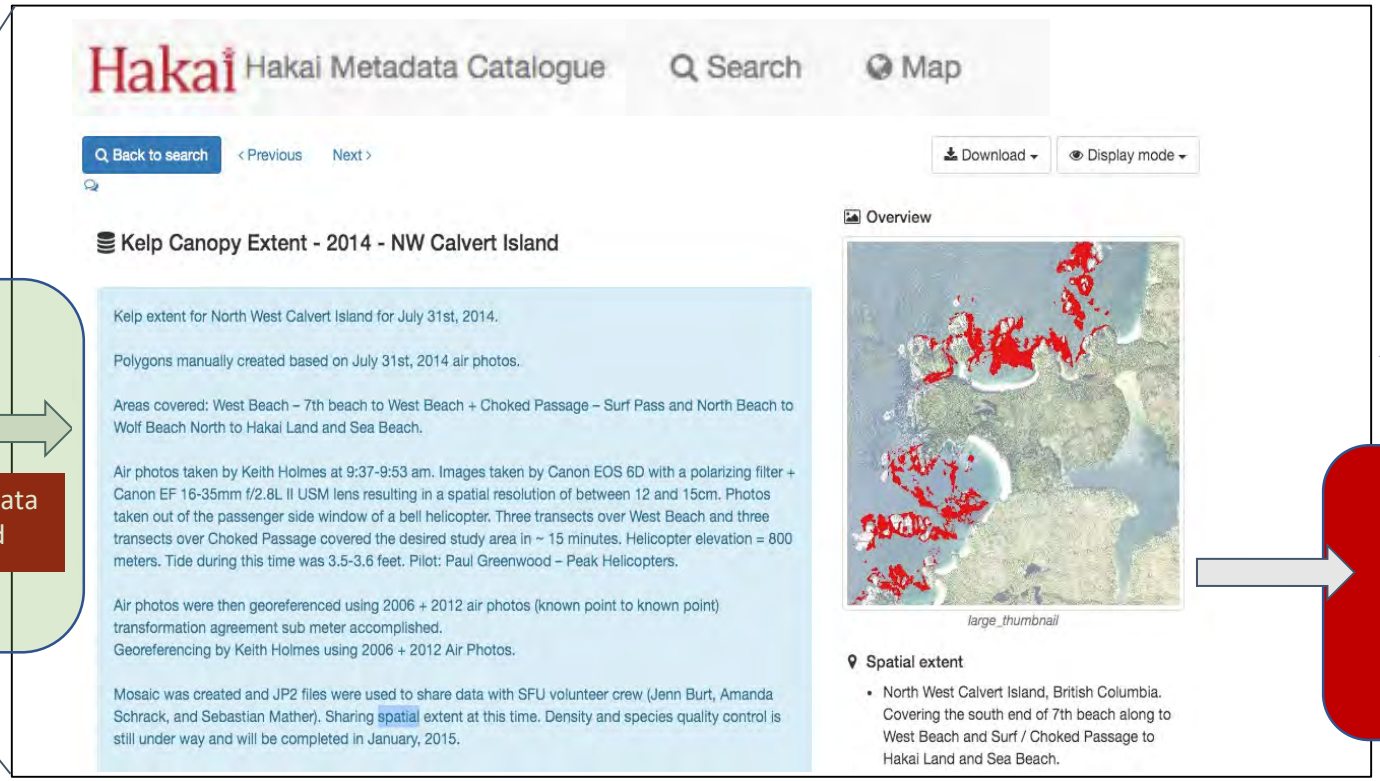
Field Data

Data Processing

Data QC

Data Package Creation

Metadata Record



Australian Seagrass / Kelp EOVs

GOOS

American Seagrass / Kelp EOVs

Canadian Seagrass / Kelp EOVs

CIOOS Pacific

BC Seagrass / Kelp EOVs

Hakai

Mapp

OBIS OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM

- **VISION** To be the most comprehensive gateway to the world's ocean biodiversity and biogeographic data and information required to address pressing coastal and world ocean concerns.
- **MISSION** To build and maintain a global alliance that collaborates with scientific communities to facilitate free and open access to, and application of, biodiversity and biogeographic data and information on marine life.

More than 20 OBIS nodes around the world connect 500 institutions from 56 countries. Collectively, they have provided over 45 million observations of nearly 120 000 marine species, from bacteria to whales, from the surface to 10 900 meters depth, and from the Tropics to the Poles. The datasets are integrated so you can search and map them all seamlessly by species name, higher taxonomic level, geographic area, depth, time and environmental parameters.

OBIS emanates from the Census of Marine Life (2000-2010) and was adopted as a project under IOC-UNESCO's International Oceanographic Data and Information (IODE) programme in 2009.

We recently completed a proof of concept, loading macrophyte data into OBIS.

Other Repositories

- GBIF: Global Biodiversity Information Facility
- MBON: Marine Biodiversity Observation Network

Other Key Partnerships

- Smithsonian MarineGEO: Marine Global Earth Observatory
- BOLD: Barcode of Life Database

Acknowledging some of our research partners

Heiltsuk Nation

Heiltsuk Integrated Resource Management (HIRMD)

Wuikinuxv Nation

MarineGEO
THE TENNENBAUM MARINE OBSERVATORIES NETWORK

Smithsonian Institution

ROYAL BC MUSEUM

UBC

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

VANCOUVER ISLAND UNIVERSITY

SFU

CIOOS
CANADIAN INTEGRATED OCEAN OBSERVING SYSTEM

University of Victoria

Fisheries and Oceans Canada

Pêches et Océans Canada

BCParks

Canada

Hakai

Science on the Coastal Margin

- Translating science and technology into field-based, community-engaged action
  - Acknowledging some of our community partners:

Heiltsuk

Heiltsuk Integrated Resource Management (HIRMD)

QQS Projects Society

Wuikinuxv Nation

Haida Nation

VIU

Coastal First Nations

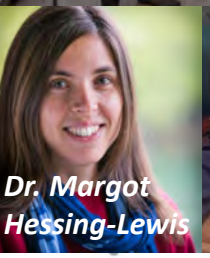
Coastal Guardian Watchmen

CCIRA

Nanwokolas

MaPP

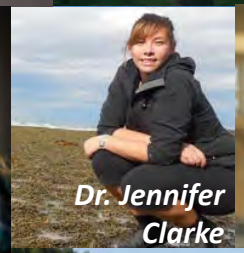
Slide: Hessing-Lewis


Dr. Margot Hessing-Lewis

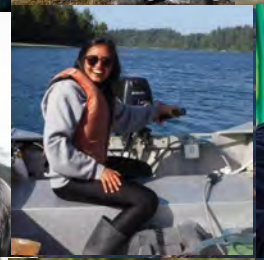

Dr. Rhea Smith

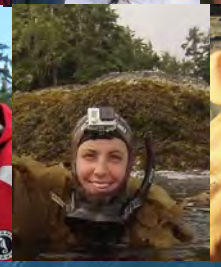

Dr. Alyssa Gehman


Erin Rechsteiner


Dr. Jennifer Clarke


Dr. Matt Whalen





Nearshore Team

Thank you!

HIRMD

Field Participation

Richard Reid, Jordan Wilson, Carey, Mike Vegh, Robert Johnson

Hakai Collaborators

Luba Reshitnyk, Keith Holmes, Will McInnes, Derek Heathfield, Brian Hunt, Jennifer Jackson, Wiley Evans, Ian Giesbrecht, Matt Lemay

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Tristan Blaine, Derek VanMaanen, Angeleen Olson, Keith Holmes, Derek Heithfield