Improving end-to-end tsunami notification along Canada's West Coast: Current challenges and new opportunities

Coastal Hazards Risk Communication Forum
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Warning System Elements

- Hazard identification, risk assessment and vulnerability analysis
- Detection and monitoring
- Emergency management structure
- Local dissemination
- Public education/exercises

Special Challenges for British Columbia's Tsunami Notification System

- Most effective in the case of far-field or telegenic tsunamis
- Not designed for locally generated tsunamis

Noted Canadian West Coast Tsunami Warning System Limitations

- Coverage – terrain and geography
- Coverage – community variations
- Coverage – means of communication and warning
- Community and industry preparedness
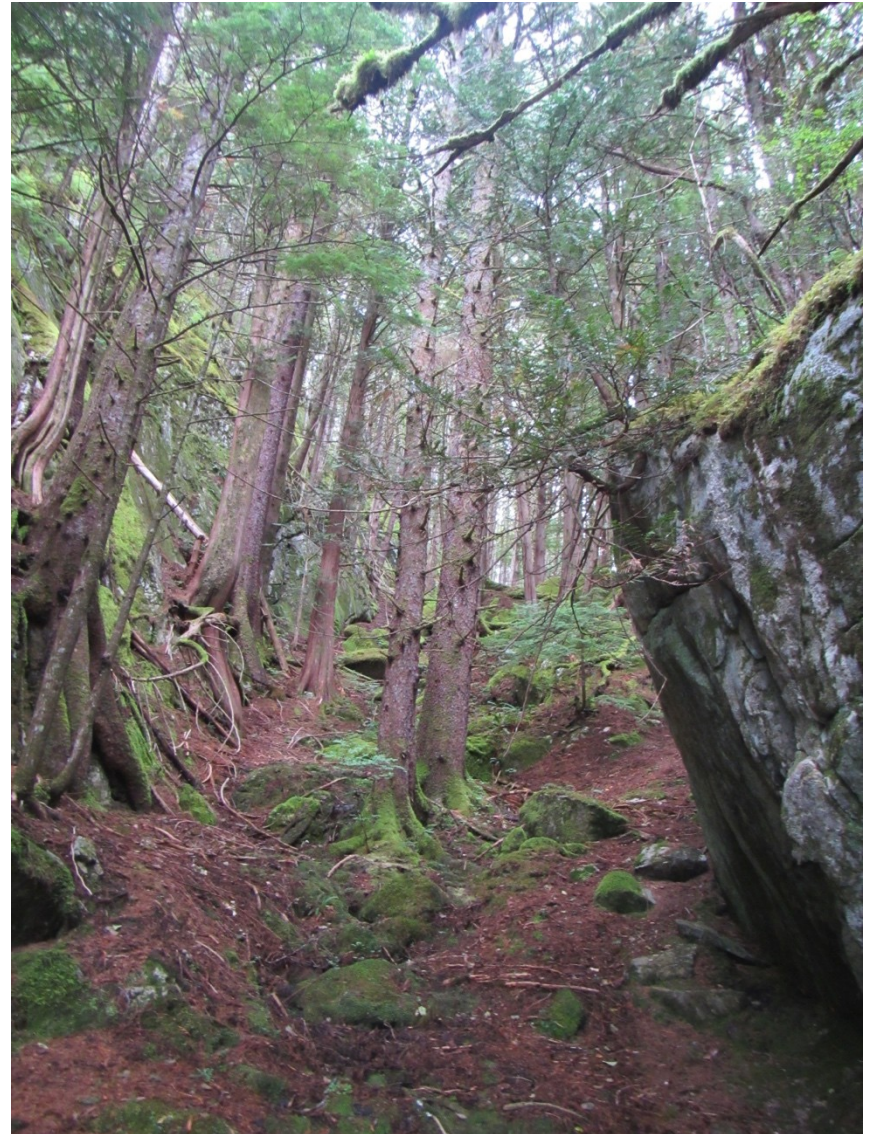- Public education and awareness

New Challenges

- Changing coastal socio-economic considerations
- Transformations of traditional industries such as logging and fishing
- New industries and social activities:
  - Import/export terminals
  - Proposed LNG plants
  - Aquaculture
  - Eco-tourism and recreation
- More people residing or traversing along the coast throughout the year
- Increased diversity in public tsunami notification

B.C. Notification Challenges

- 26,000+ kms of varying coastline, much of which is rugged and remote
- Biggest challenges:
  - notifying populations in remote permanent communities with limited and/or poor communications coverage
  - identifying and notifying populations on the move or in temporary fixed locations (transient populations) who now inhabit areas all year round
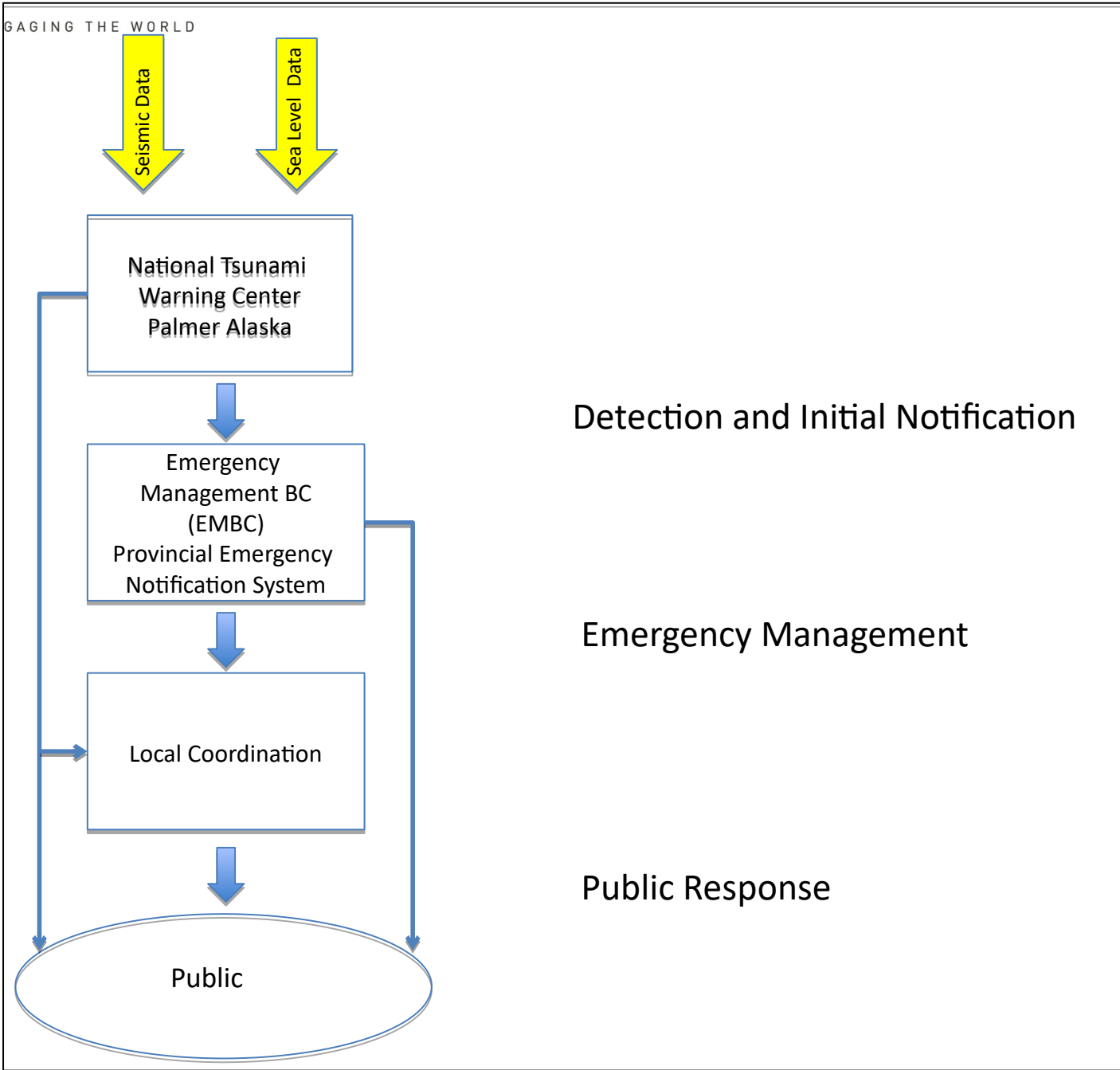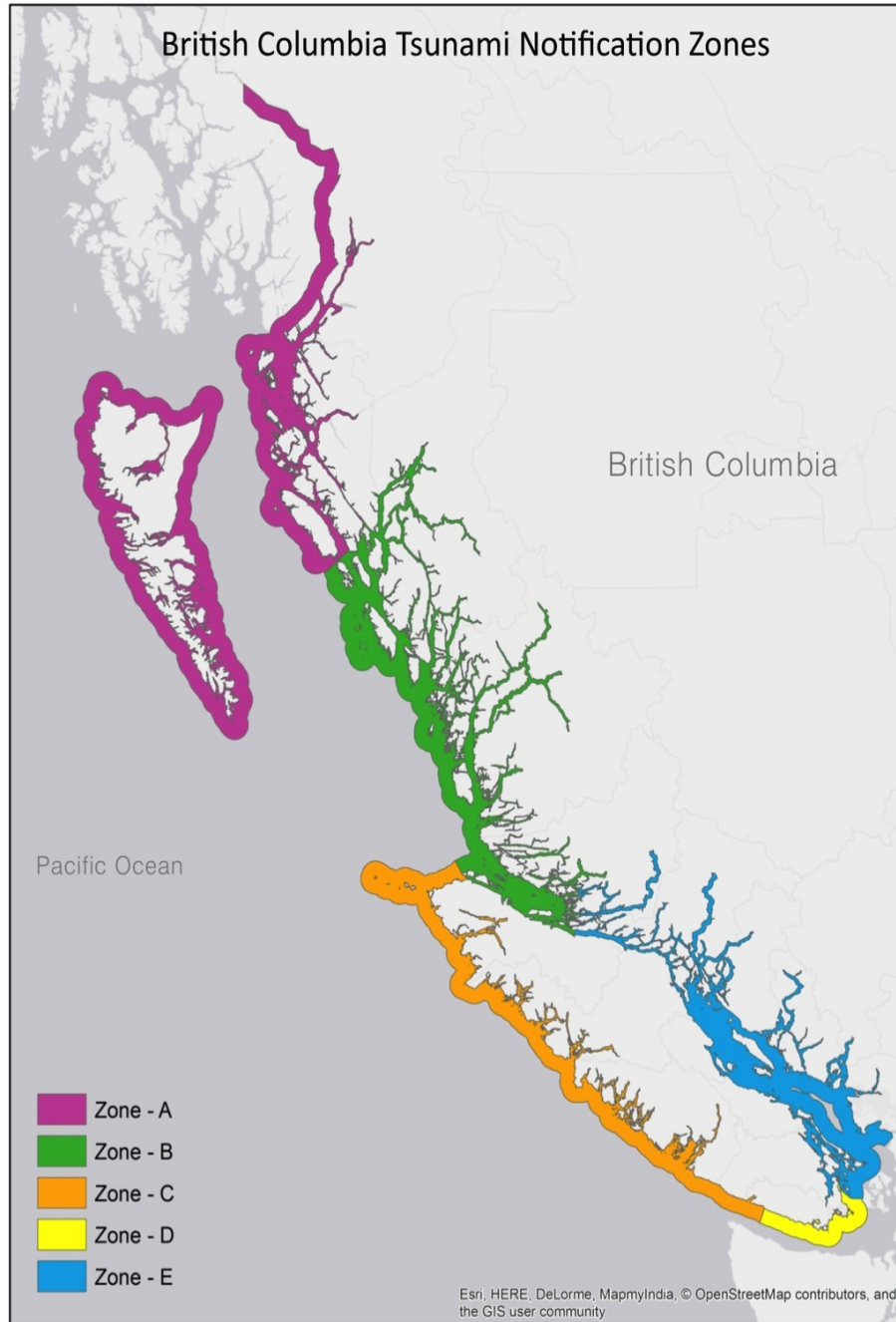
Zeballos   Zeballos

Image © 2019 DigitalGlobe
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Image Landsat / Copernicus

BC Provincial Emergency Notification System (PENS)

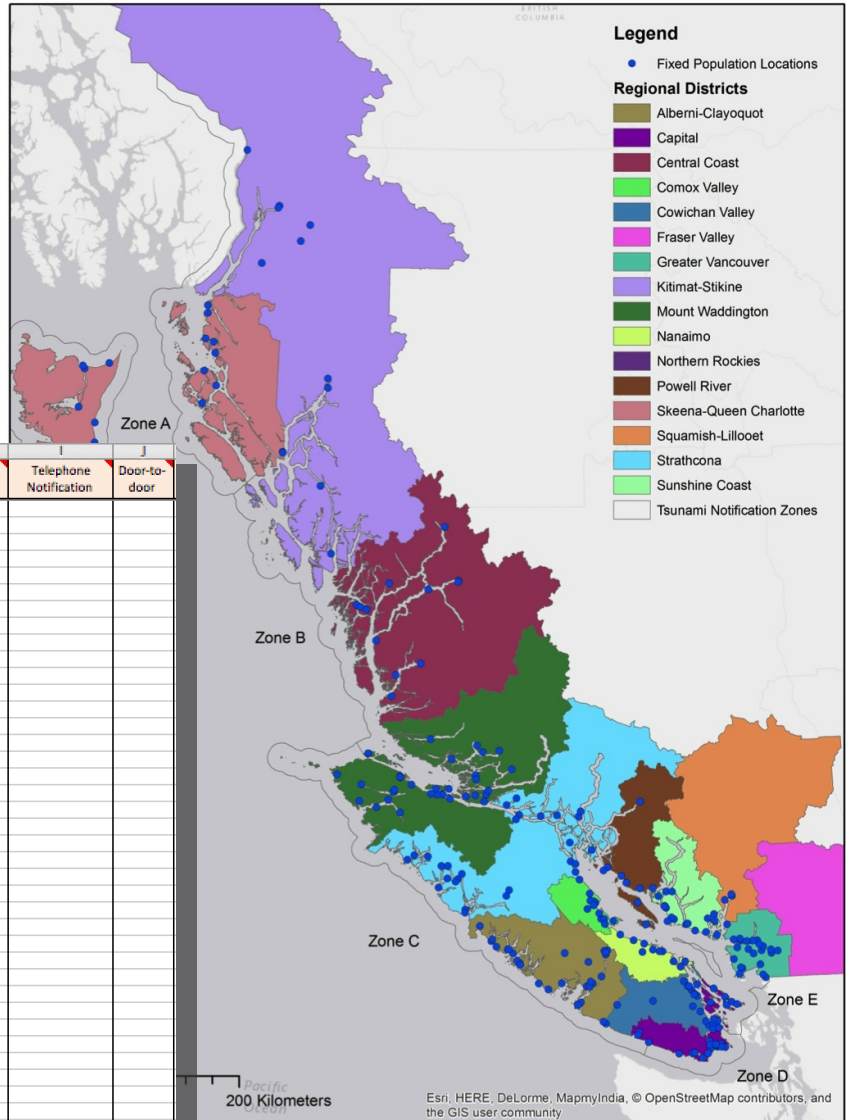British Columbia Tsunami Notification Zones

Current Warning Methods – EMBC/NTWC to Communities and Remote Populations

- Telephone notification (dial-down) systems
  - Fixed telephone
  - Mobile telephone
  - Satellite telephone
- Facsimile
- Electronic mail
- Social media- Twitter @emergencyinfobc, @NWS_NTWC
- SMS @NWS_NTWC gateway and @emergencyinfobc
- Canadian Coast Guard Marine VHF Channel 16 and MF 2182 kHz
- Environment Canada Weatheradio and Weather website
- Agency/aviation radio
- Local and regional broadcast stations
- Cable TV and satellite TV
- Cellular smartphone broadcast
- Amateur Radio
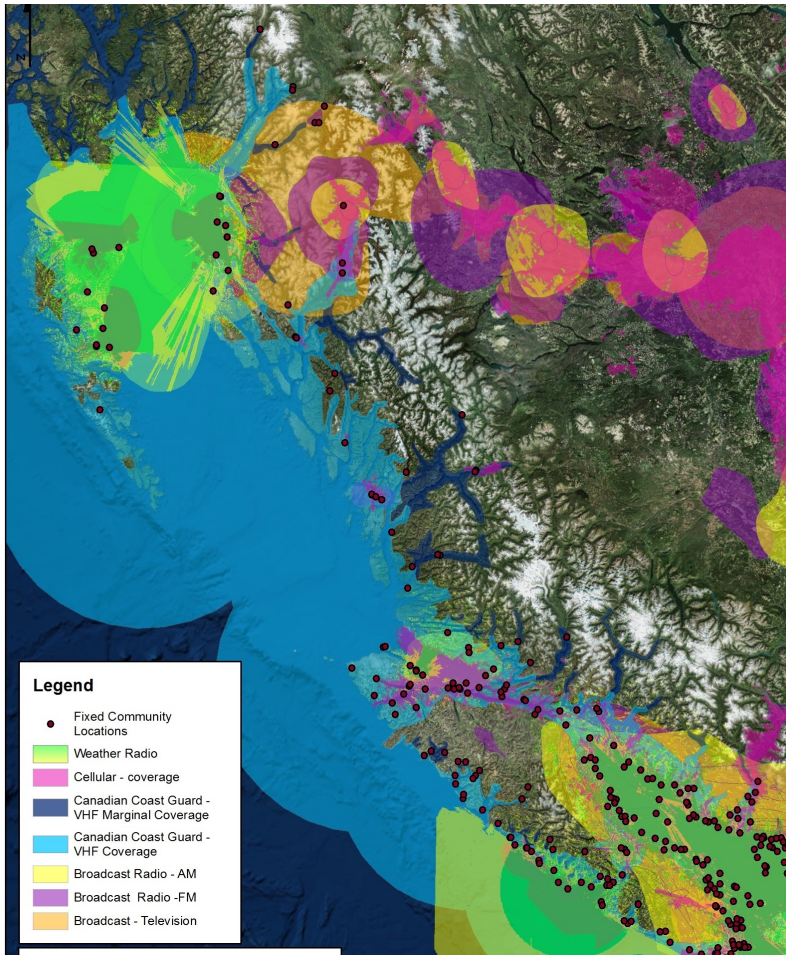
Current Local Community Warning Methods

- Fixed sirens, speakers and horns
- Local and regional broadcasting stations
- Vehicle and boat sirens and public address systems
- Telephone notification (dial-down) systems
- Indoor public address systems
- Outdoor mobile electronic signs
- Fixed signage with flashing lights and instructions (e.g., "Emergency Info when Flashing: Proceed Inland and Away from Water")
- Door-to-door verbal notification and leafleting
- Marine and local two-way radio
- SMS – text messaging
- Social networks- Twitter, Facebook, etc.

Table 1 (partial):

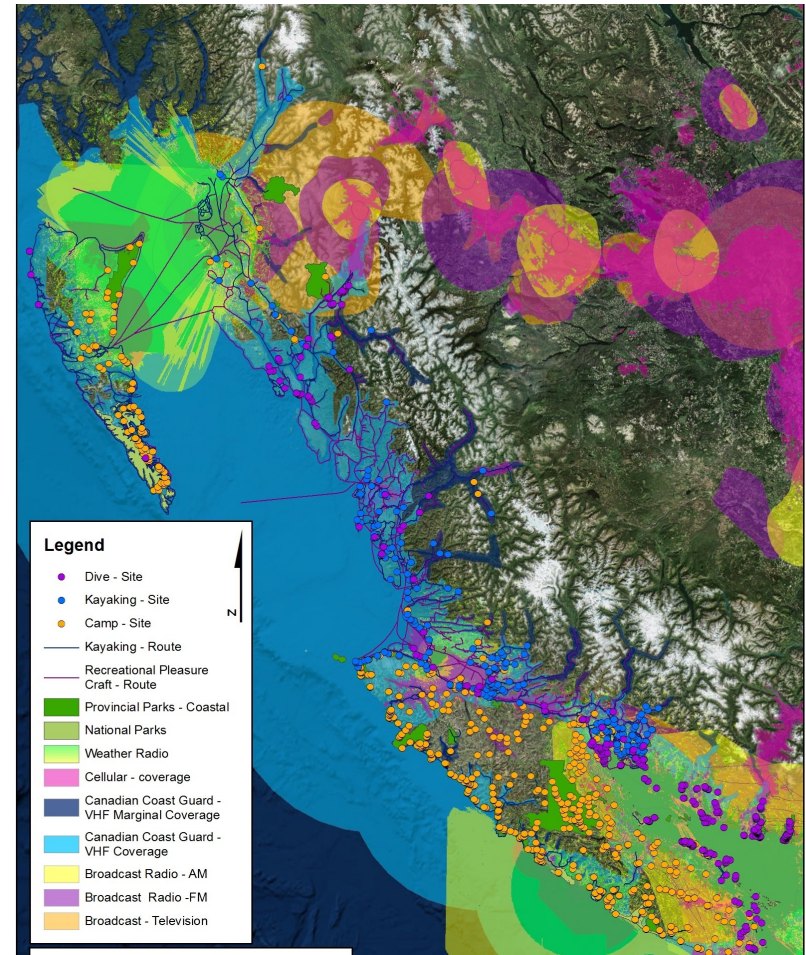| Tsunami Notification Zone	Fixed Locations	Regional District	PREOC Email	ECC Email	IVR Tel	Fax	Email	Telephone	Email	Other	RCMP	FD Dispatch	CCG Ch16	BCAS	EC Alert Email	Weather Radio
			EMBC		EMBC - PENS			Regional District			First Response				Environment Canada	
B	Alert Bay	MWRD														
B	Bull Harbour	MWRD														
B	Da'Naxda'xw (Awaetlala) FN	MWRD														
B	Gwa'Sala-'Nakwaxda'Xw FN	MWRD														
B	Gwanaenuk (Kwa-wa-aineuk) FN	MWRD														
B	Hyde Creek	MWRD														
B	Kincome	MWRD														
B	Kincome - Dzawada'enuxw FN	MWRD														
B	Kincome - Tsawataineuk FN	MWRD														
B	Kwakiutl FN	MWRD														
B	Kwicksutainseuk-Ah-Kwaw-Ah-Mish FN	MWRD														
B	Mamalilikulla-Qwe'Qwe'Sot'Em FN	MWRD														
B	Mitchel Bay	MWRD														
B	Namgis FN	MWRD														
B	Port Hardy	MWRD														
B	Port McNeil	MWRD														
B	Sointula	MWRD														
B	Sullivan Bay	MWRD														
B	Telegraph Cove	MWRD														
B	Tlatlasikwala FN	MWRD														
B	Warner Bay	MWRD														
C	Mount Waddington Regional District	MWRD														
C	Cape Scott	MWRD														
C	Coal Harbour	MWRD														
C	Holberg	MWRD														
C	Mahatta River	MWRD														
C	Port Alice	MWRD														
C	Quatsino	MWRD														
C	Quatsino FN	MWRD														
C	Winter Habour	MWRD														
E	Mount Waddington Regional District	MWRD														
E	Bones Bay	MWRD														
E	Cracroft	MWRD														

Table 2:

	Tsunami Notification Zone	Fixed Locations	Regional District	Siren	Pager	Marine Radio	Local Broadcast Radio	Local Broadcast TV	Telephone Notification	Door-to-door
2	B	Mount Waddington Regional District	MWRD							
3	B	Alert Bay	MWRD							
4	B	Bull Harbour	MWRD							
5	B	Da'Naxda'xw (Awaetlala) FN	MWRD							
6	B	Gwa'Sala-'Nakwaxda'Xw FN	MWRD							
7	B	Gwanaenuk (Kwa-wa-aineuk) FN	MWRD							
8	B	Hyde Creek	MWRD							
9	B	Kincome	MWRD							
10	B	Kincome - Dzawada'enuxw FN	MWRD							
11	B	Kincome - Tsawataineuk FN	MWRD							
12	B	Kwakiutl FN	MWRD							
13	B	Kwicksutainseuk-Ah-Kwaw-Ah-Mish FN	MWRD							
14	B	Mamalilikulla-Qwe'Qwe'Sot'Em FN	MWRD							
15	B	Mitchel Bay	MWRD							
16	B	Namgis FN	MWRD							
17	B	Port Hardy	MWRD							
18	B	Port McNeil	MWRD							
19	B	Sointula	MWRD							
20	B	Sullivan Bay	MWRD							
21	B	Telegraph Cove	MWRD							
22	B	Tlatlasikwala FN	MWRD							
23	B	Warner Bay	MWRD							
24	C	Mount Waddington Regional District	MWRD							
25	C	Cape Scott	MWRD							
26	C	Coal Harbour	MWRD							
27	C	Holberg	MWRD							
28	C	Mahatta River	MWRD							
29	C	Port Alice	MWRD							
30	C	Quatsino	MWRD							
31	C	Quatsino FN	MWRD							
32	C	Winter Harbour	MWRD							
33	E	Mount Waddington Regional District	MWRD							
34	E	Bones Bay	MWRD							
35	E	Cracroft	MWRD							
36	E	Echo Bay	MWRD							
37	E	Karlukwees	MWRD							
38	E	Ministrel Island	MWRD							
39	E	Thompson Sound	MWRD							

Legend

- Fixed Population Locations

Regional Districts
- Alberni-Clayoquot
- Capital
- Central Coast
- Comox Valley
- Cowichan Valley
- Fraser Valley
- Greater Vancouver
- Kitimat-Stikine
- Mount Waddington
- Nanaimo
- Northern Rockies
- Powell River
- Skeena-Queen Charlotte
- Squamish-Lillooet
- Strathcona
- Sunshine Coast
- Tsunami Notification Zones

Zone A

Zone B

Zone C

Zone D

Zone E

200 Kilometers

Pacific Ocean
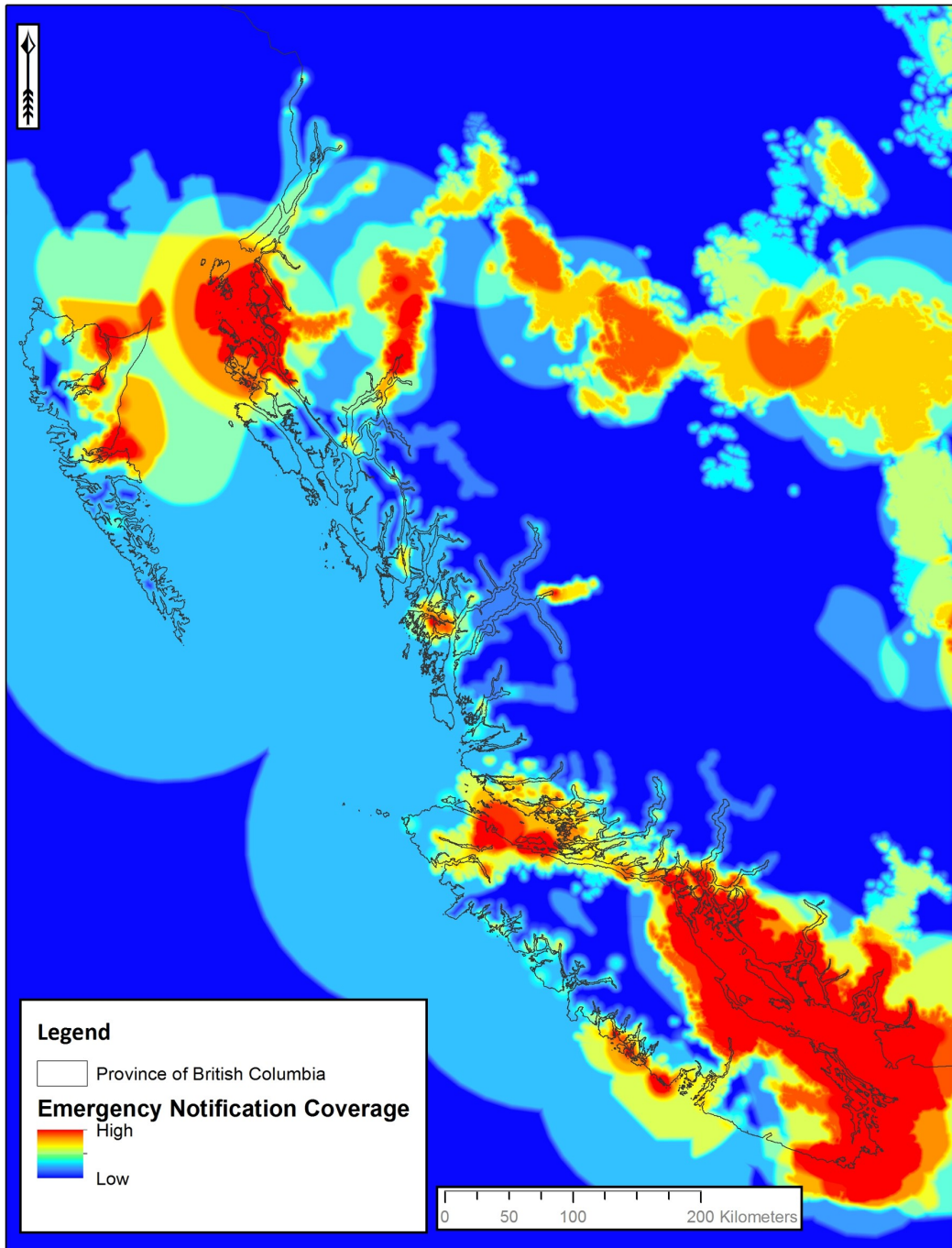
BRITISH COLUMBIA

Coastal Communications coverage
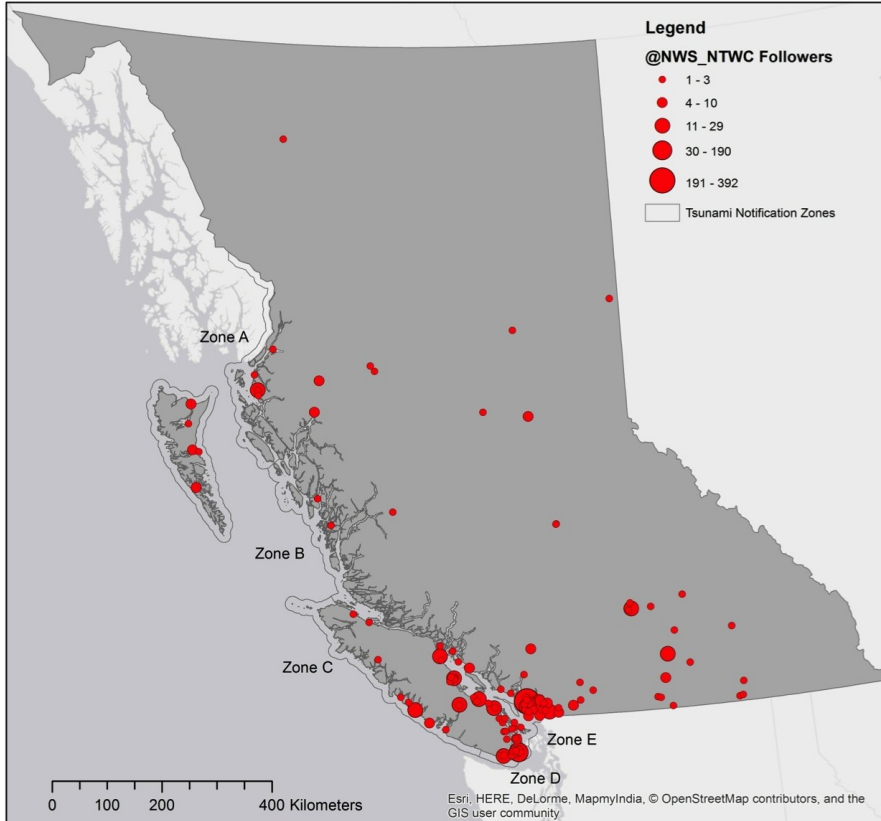

Fixed Populations

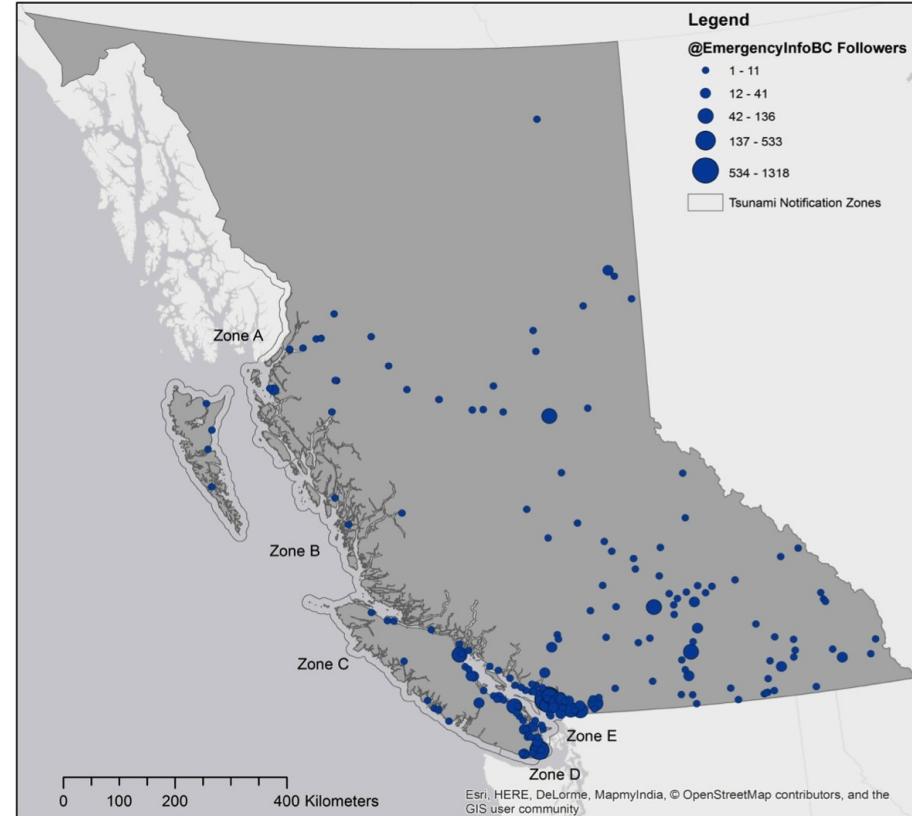Transient/mobile Populations

Emergency Notification Densities

Role of Social Media - Twitter
@NWS_NTWC and @emergencyinfobc

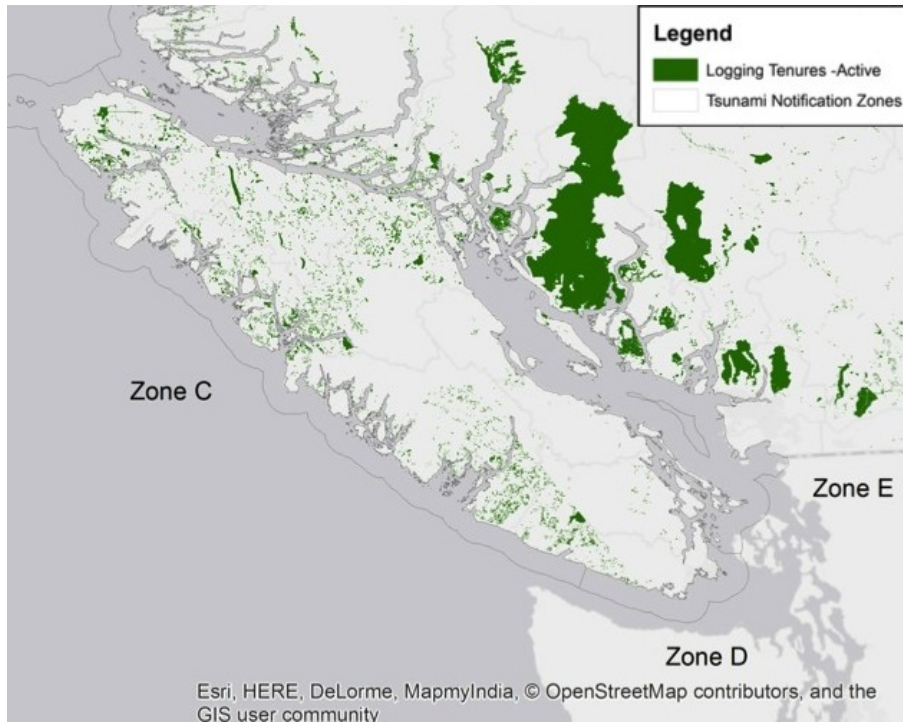# Locations of Sampled BC @NWS_NTWC and @EmergencyInfoBC Twitter Followers

@NWS_NTWC

@EmergencyInfoBC

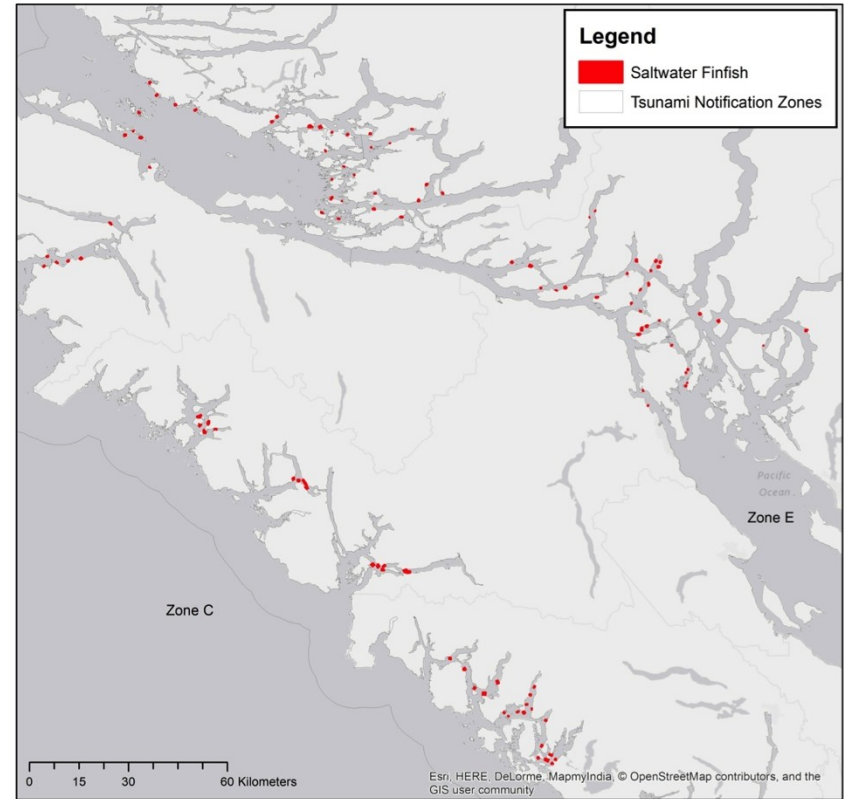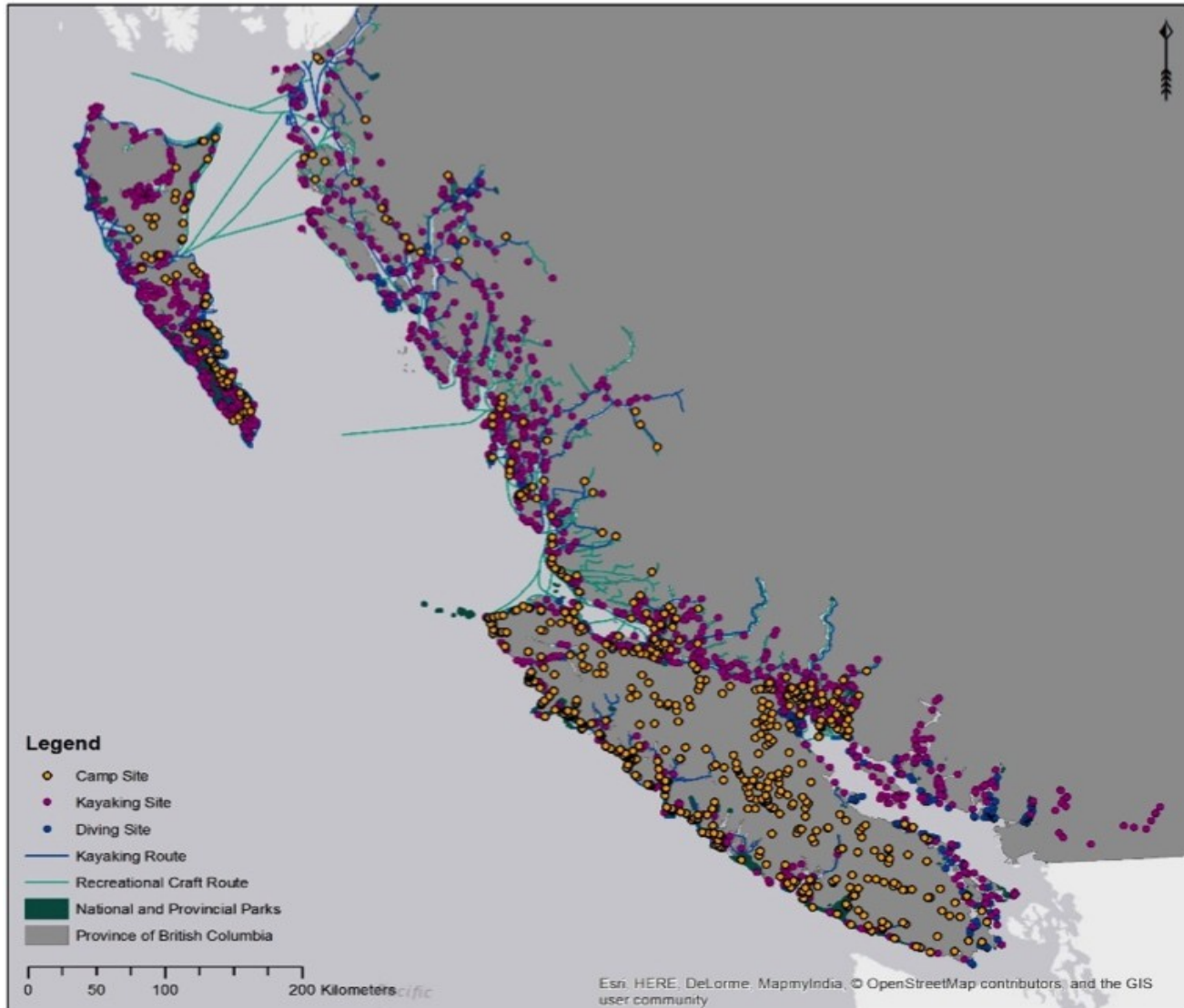# Identification of Transient Populations

Coastal Logging

Aquaculture

Legend

- ◉ Camp Site
- ● Kayaking Site
- ● Diving Site
- — Kayaking Route
- — Recreational Craft Route
- ■ National and Provincial Parks
- ■ Province of British Columbia

0   50   100   200 Kilometers

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

	Total Visits			
Year	Gwaii Haanas	Pacific Rim	Gulf Islands	Provincial Parks
2010	1,721	844,217	NA	4,166,604
2011	1,717	904,929	14,064	3,845,861
2012	1,760	880,813	14,502	4,321,870
2013	1,703	887,611	15,177	4,760,111
2014	1,785	926,453	16,307	4,625,044

Annual total visitation numbers for coastal Provincial and National Parks from 2010 to 2014

Total Visits for Gwaii Haanas (2010-2014)

Total Visits for Pacific Rim (2010-2014)

Total Visits for Gulf Island (2010-2014)
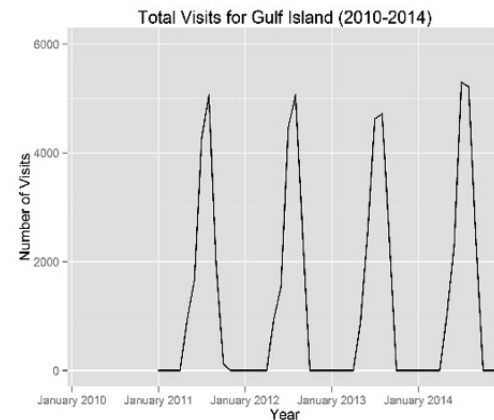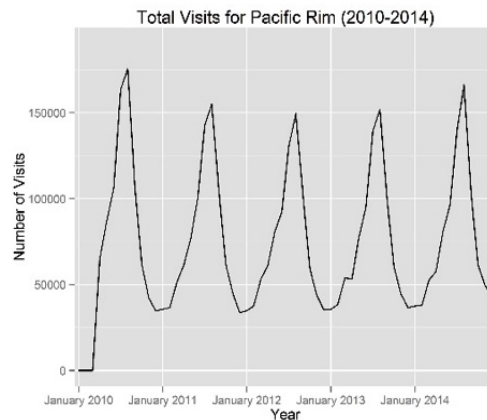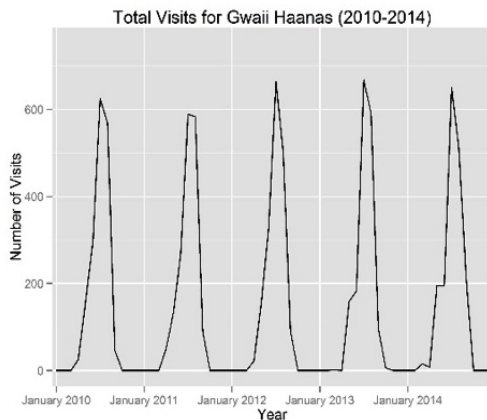
Monthly total visitation trends for coastal National Parks from 2010 to 2014
Note, no data is available for Gulf Islands in the year 2010

October 27, 2012 8:04 PM PDT
Haida Gwaii M7.7

PTWC RIFT forecast using
the USGS automatic W-phase CMT
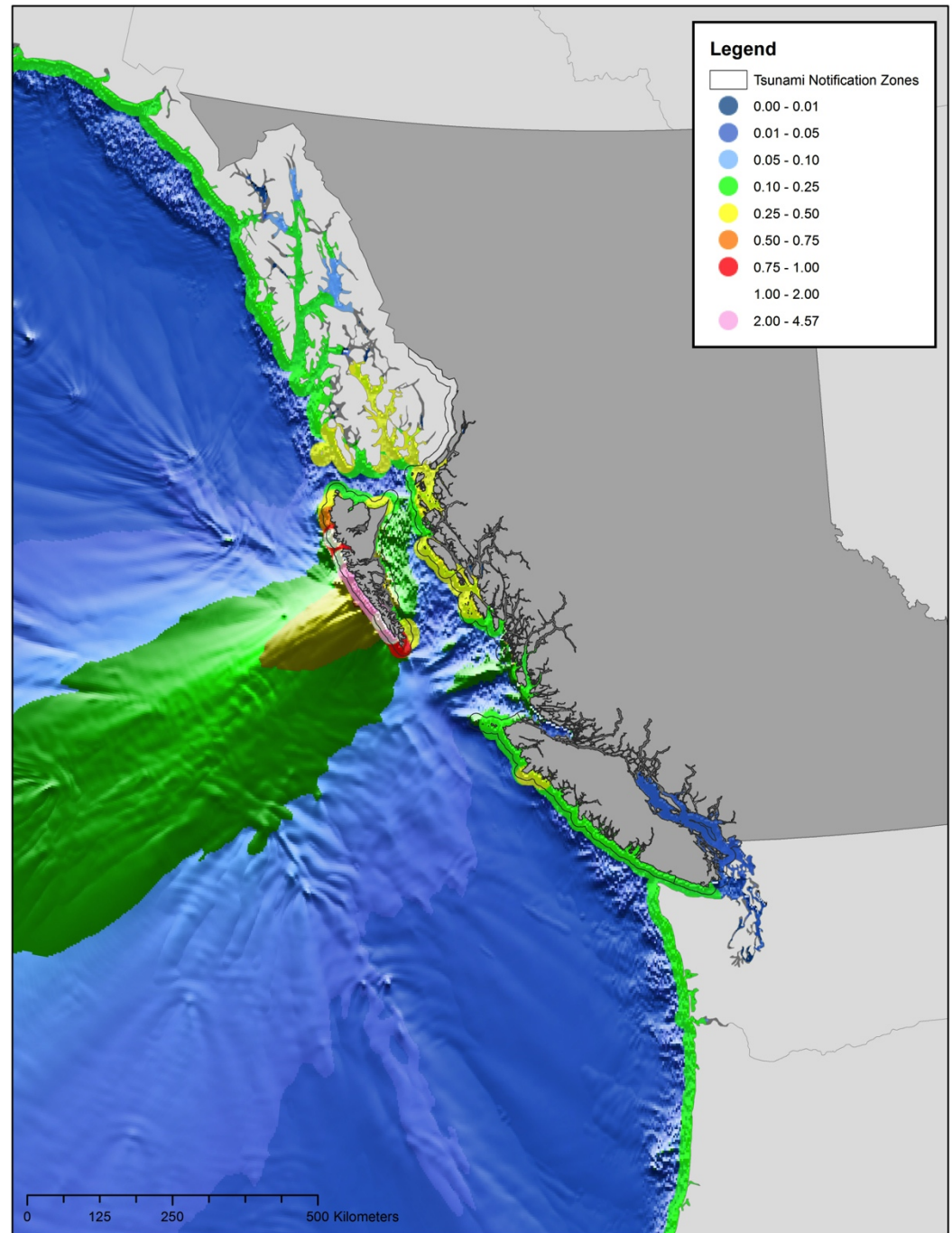
PTWC Initial Wave
Forecasts and
NRCAN Post-event Field
Reconnaissance Measurements

Reference: LEONARD, L.J., and BEDNARSKI,
J.M. (2014), Field survey following
the 27 October 2012 Haida Gwaii tsunami,
Pure Appl. Geophys.,
171, doi:10.1007/s00024-014-0792-0.
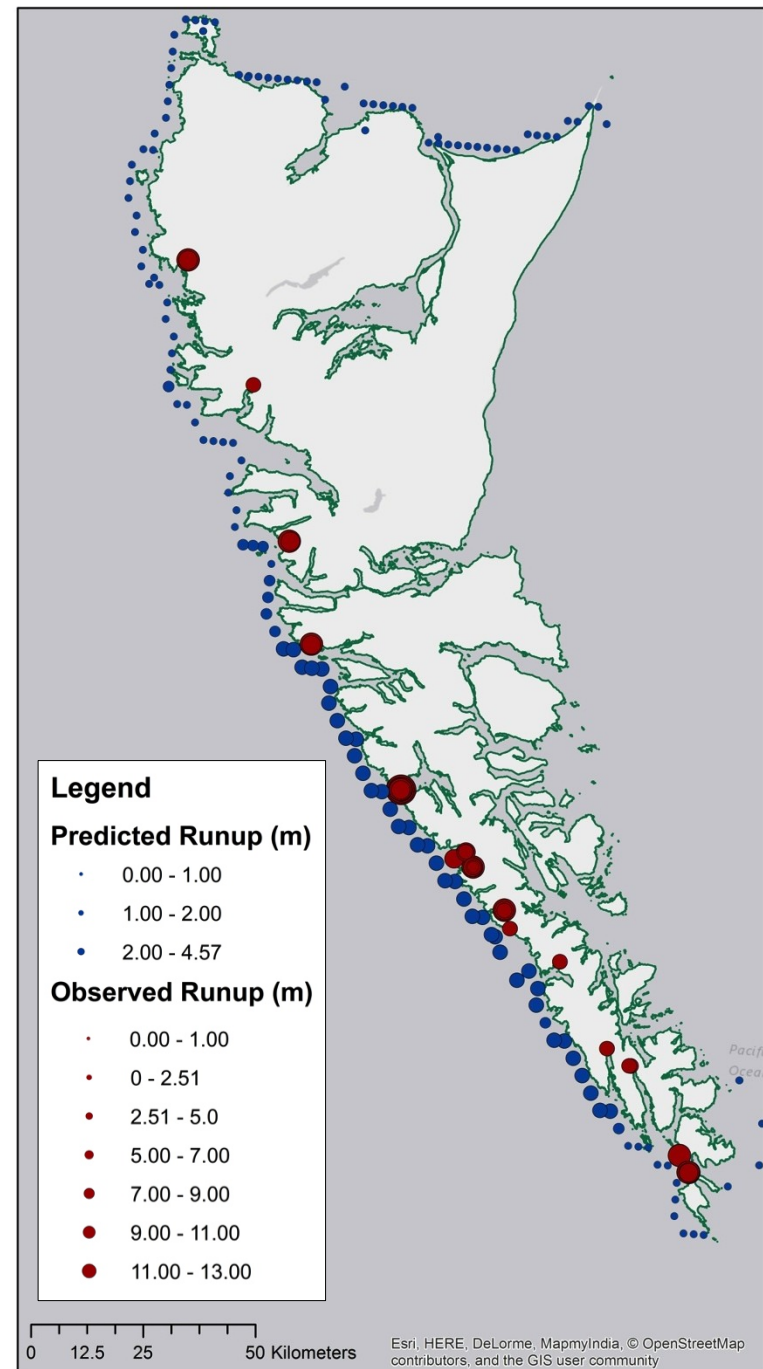
Who might have been at risk had the event occurred two months earlier?
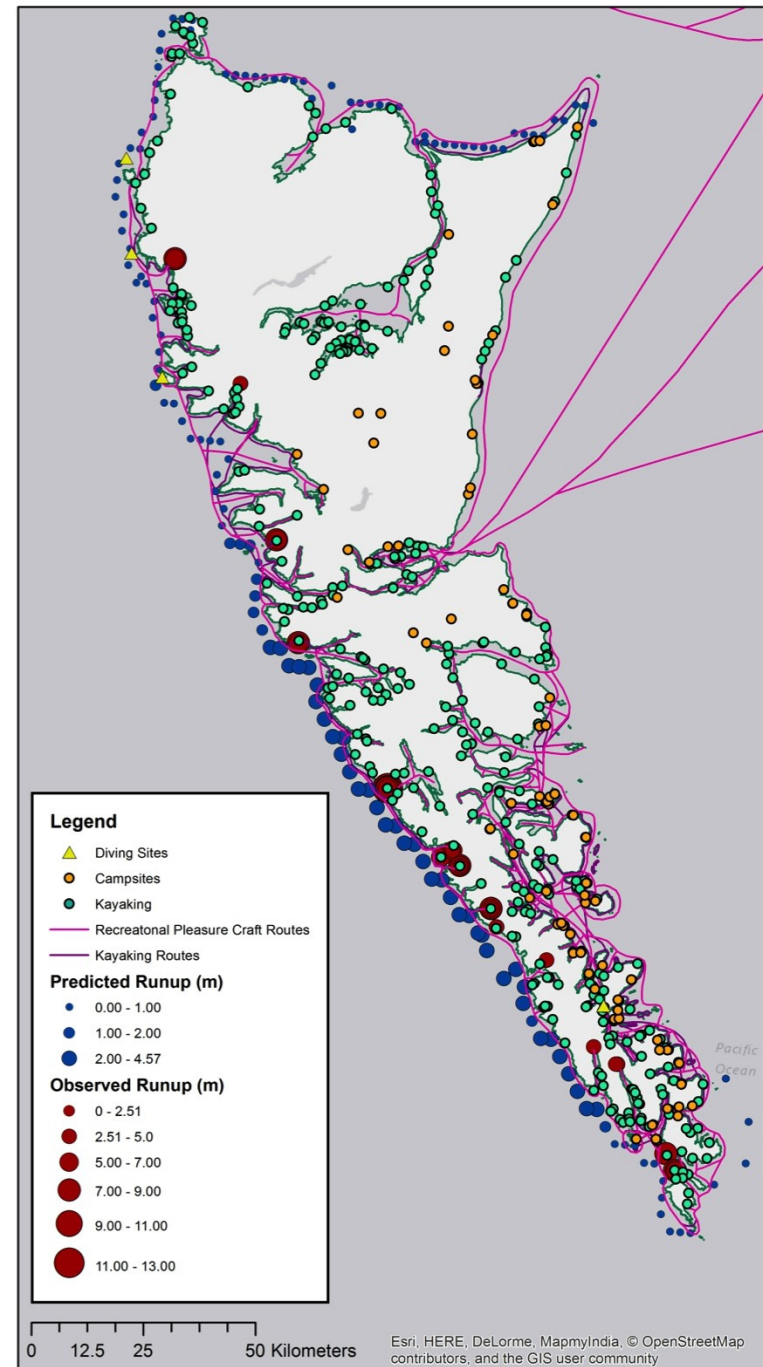
Last Mile Ground Truthing

- Mobile Satellite Emergency Notification Devices - short text - email and SMS
- MSAT EMERGNET – Coastal subnet
- Alert Ready rollout

MSAT EmergNet

Community/Regional Small Pilots

- Gitga'at Nation (Hartley Bay)
- Wuikiunxv Nation (Rivers Inlet)
- Ehattesaht/Chinehkint First Nation
- Zeballos
- Ucluelet
- Tseshaht First Nation (Port Alberni)
- Regional District of Mount Waddington
- Strathcona Regional District

CCGS Bartlett Voyage
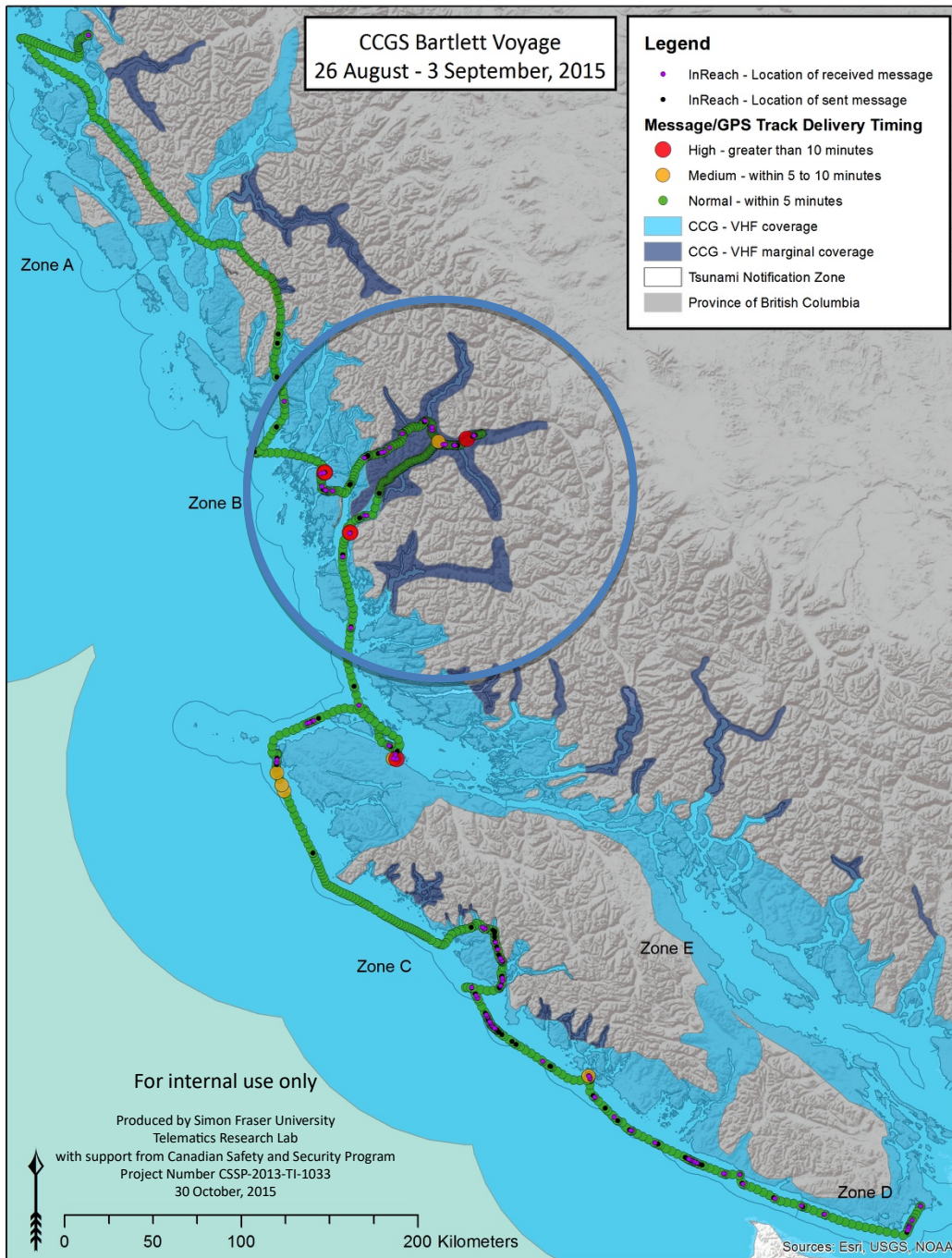**26 August - 3 September, 2015**

Legend

- InReach - Location of received message
- InReach - Location of sent message
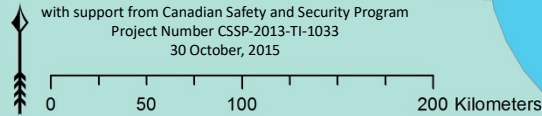
Message/GPS Track Delivery Timing

- ● High - greater than 10 minutes
- ● Medium - within 5 to 10 minutes
- ● Normal - within 5 minutes
- CCG - VHF coverage
- CCG - VHF marginal coverage
- Tsunami Notification Zone
- Province of British Columbia

Zone A

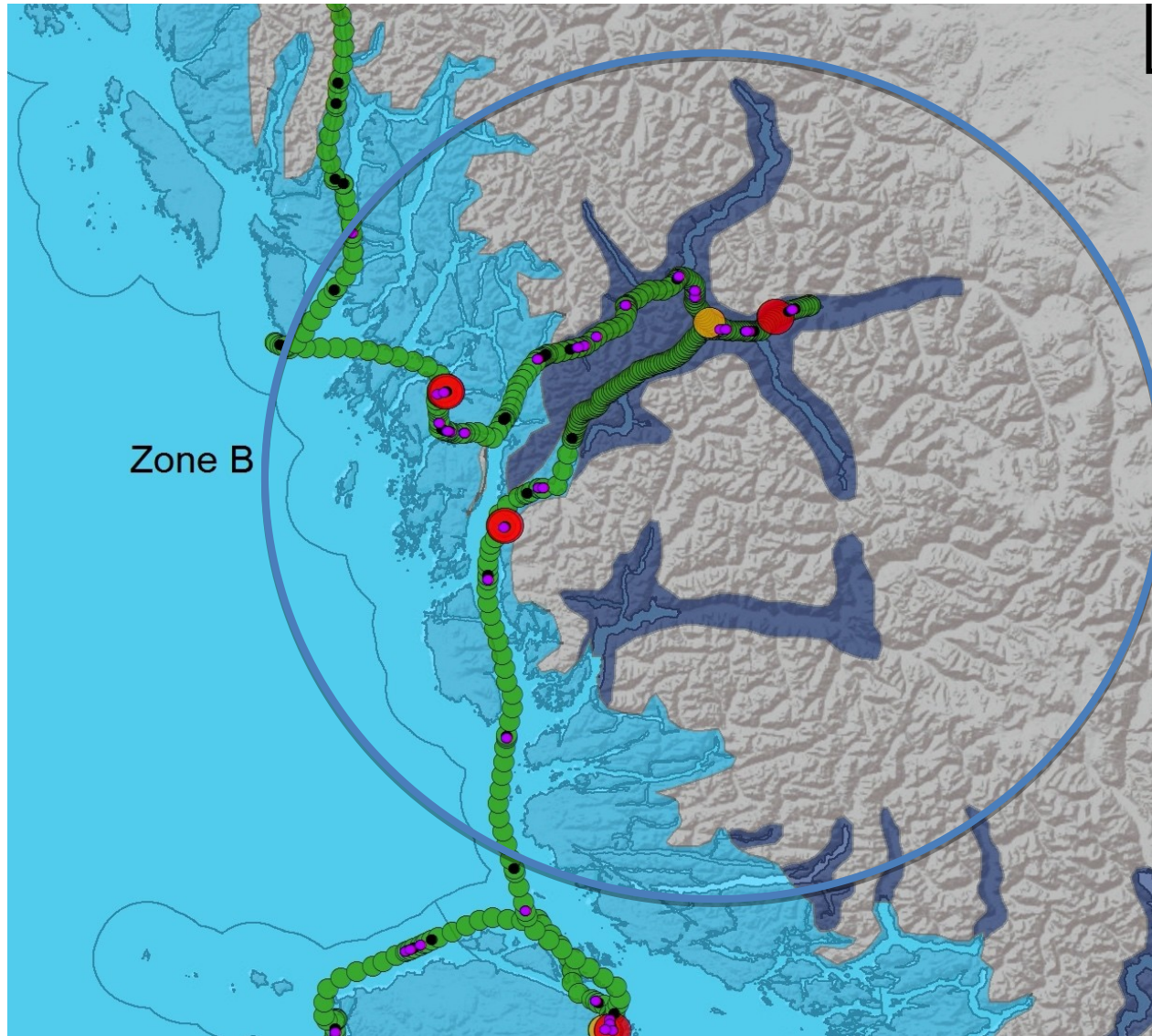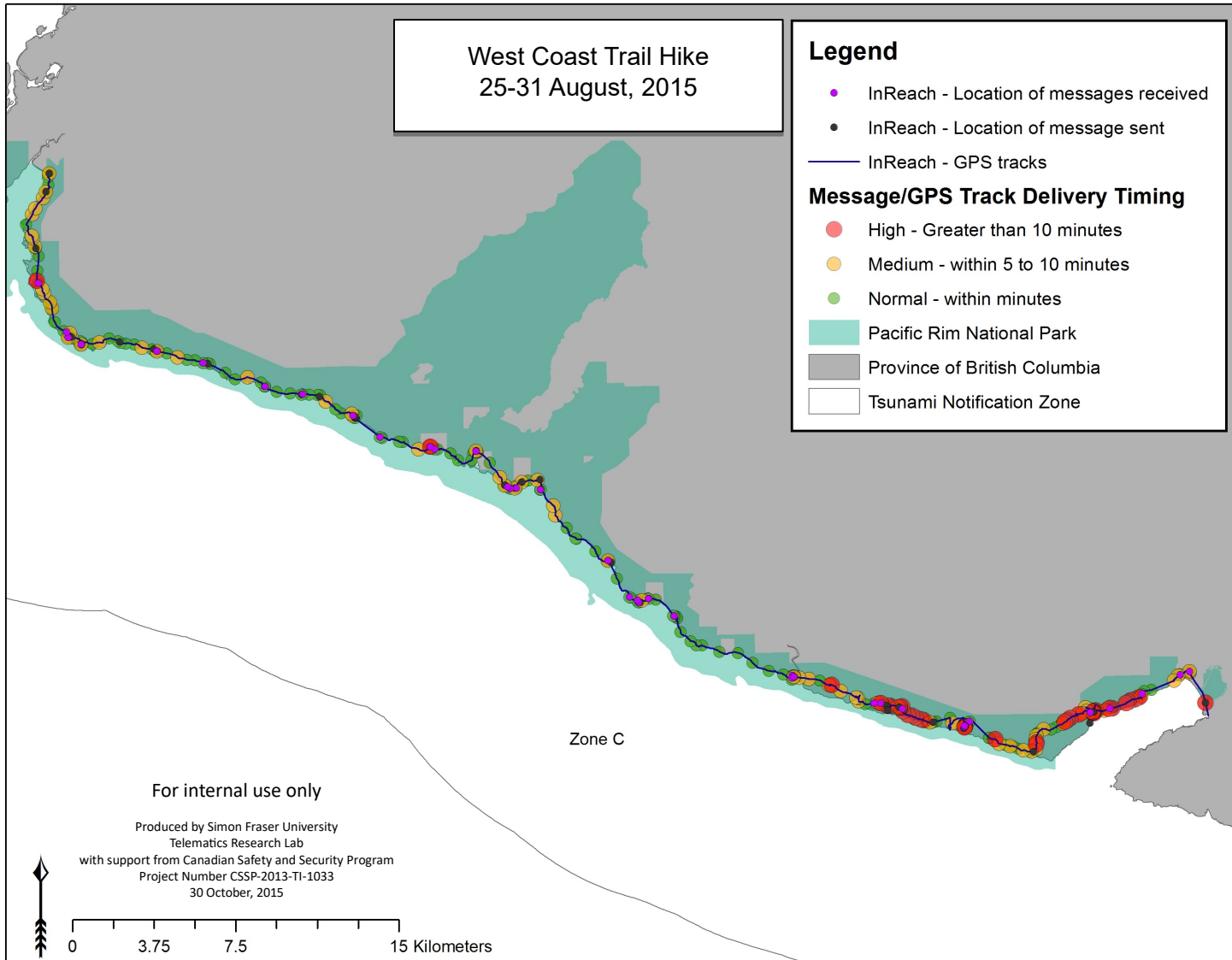Zone B

Zone C

Zone E

Zone D

For internal use only

Produced by Simon Fraser University
Telematics Research Lab
with support from Canadian Safety and Security Program
Project Number CSSP-2013-TI-1033
30 October, 2015

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0   50   100   200 Kilometers

Sources: Esri, USGS, NOAA

CCGS Bartlett Voyage
26 August - 3 September, 2015

Legend
- InReach - Location of received message
- InReach - Location of sent message

Message/GPS Track Delivery Timing
- High - greater than 10 minutes
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- Normal - within 5 minutes
- CCG - VHF coverage
- CCG - VHF marginal coverage
- Tsunami Notification Zone
- Province of British Columbia

Zone A

Zone B

Zone C

Zone E

Zone D

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Project Number CSSP-2013-TI-1033
30 October, 2015

0   50   100   200 Kilometers

Sources: Esri, USGS, NOAA

SFU   ENGAGING TH

Zone B

West Coast Trail Hike
25-31 August, 2015

Legend

- • InReach - Location of messages received
- • InReach - Location of message sent
- — InReach - GPS tracks

Message/GPS Track Delivery Timing

- ● High - Greater than 10 minutes
- ● Medium - within 5 to 10 minutes
- ● Normal - within minutes
- Pacific Rim National Park
- Province of British Columbia
- Tsunami Notification Zone

Zone C

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30 October, 2015

0   3.75   7.5   15 Kilometers

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TSUNAMI NOTIFICATION METHODS

"A Toolkit for Community Planning"

Canadian Safety and Security Program
Project Number CSSP-2013-TI-1033

National Public Alerting System
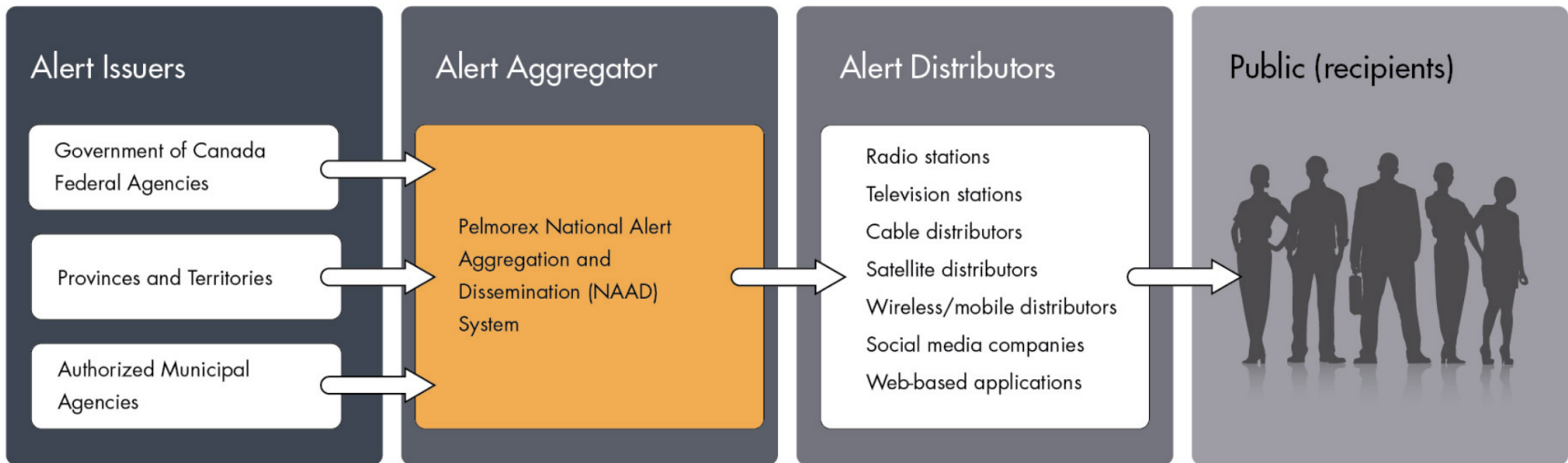
Alert Ready and
BC Emergency Alerting System
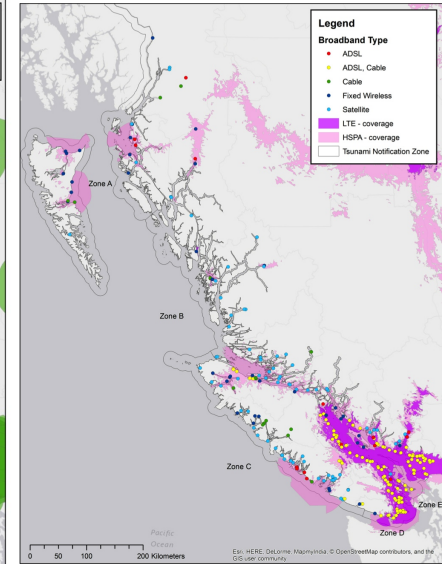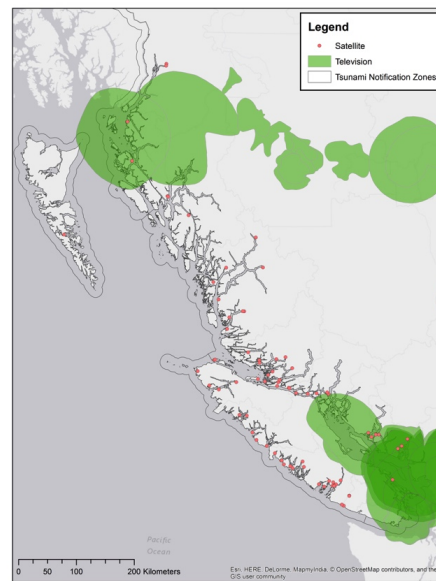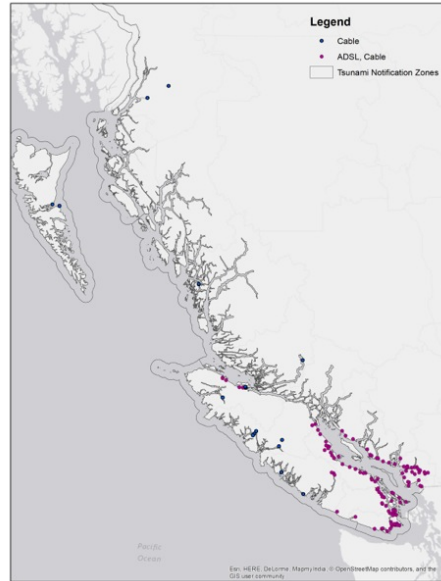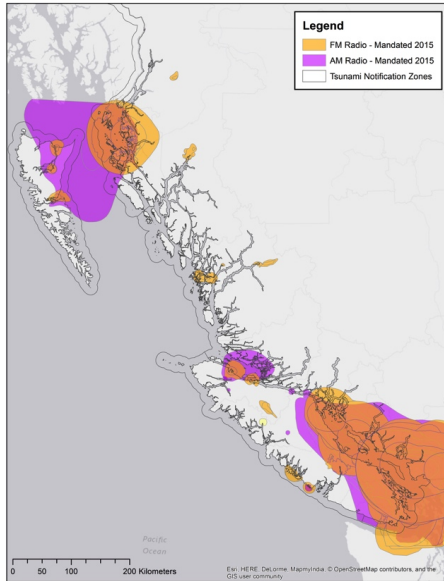
Alert Ready Coverage

The Connected Coast Project

- Marine fibre network along the BC coast from north of Prince Rupert, to Haida Gwaii, south to Vancouver, and around Vancouver Island

- Will bring new or improved high-speed internet accessibility to 154 rural and remote coastal communities, including 56 Indigenous communities representing 44 First Nations.

CONNECTED COAST

Landing Site Names

North Coast Regional District
0 City West Interconnect (Ridley Island)
1 Dodge Cove
2 Hartley Bay (Gitga'at First Nation)
3 Kitkatla (Gitxaala Nation)
4 Lax Kw'alaams
5 Metlakatla First Nation
6 Old Massett (Old Massett Village Council)
7 Oona River
8 Prince Rupert Airport
9 Prince Rupert South Interconnect
Kitimat-Stikine Regional District
10 Klemtu (Kitasoo)
Central Coast Regional District
11 Bella Bella (Heiltsuk)
12 Bella Coola
13 Duncanby Landing
14 Martin Valley
15 Ocean Falls
16 Oweekeno (Wuikinuxv Nation)
17 Denny Island-Shearwater
Mount Waddington Regional District
18 Alert Bay
19 Bull Harbour (Tlatlasikwala)
20 Cape Scott
21 Coal Harbour--ref,Quatsino IR 50633
22 Da'naxda'xw First Nation
23 Echo Bay
24 Gwa'Sala-Nakwaxda'xw
25 Gwawaenuk Tribe
26 Health Bay (Kwikwasut'inuxw Haxwa'mis)
27 Holberg
28 Hyde Creek
29 Kains Island
30 Kingcome (Dzawada'enuxw First Nation)
31 Kwakiutl
32 Mahatta River
33 Mamalilikulla-Qwe'Qwa'Sot'Em
34 Mitchell Bay
35 Namgis First Nation
36 Port Hardy
37 Port McNeill
38 Quatsino
39 Quatsino
40 Rumble Beach
41 Shawl Bay
42 Sointula
43 Telegraph Cove
44 Winter Harbour
Strathcona Regional District
45 Blind Channel
46 Bloedel
47 Bold Point
48 Campbell River (FN+City)
49 Ceepeecee
50 Ehattesaht
51 Ehatteseht
52 Elk Bay
53 Esperanza
54 Gold River Landing
55 Granite Bay
56 Heriot Bay
57 Kijahoose First Nation
58 Kyuquot (Ka'yu:'k'th'/Che:k:tles7et'h')
59 Mansons Landing
60 Mowachaht/Muchalaht
61 Nuchatlaht
62 Port Neville
63 Quathiaski Cove
64 Read Island
65 Refuge Cove
66 Rock Bay
67 Sayward
68 Seaford
69 Surge Narrows
70 Tahsis
71 Whaletown
72 Yaculta
73 Yuquot
Regional District of Alberni-Clayoquot
74 Ahousaht (ref, Marktosis 8592)
75 Bamfield
76 Haggar Lake
77 Hesquiat

78 Hesquiat
79 Huu-ay-aht
80 Huu-ay-aht First Nations
81 Marktosis (+50659 Ahousaht)
82 Opitsat (Tla-o-qui-aht First Nations)
83 Poett Nook
84 Salmon Beach
85 Tla-o-qui-aht
86 Tofino
87 Toquaht
88 Toquaht
89 Uchucklesaht
90 Ucluelet
91 Ucluelet
92 Ucluelet First Nation
Capital Regional District
93 Beecher Bay
94 Deep Cove
95 Fernwood
96 Fulford Harbour
97 Ganges
98 Musgrave Landing
99 Pacheedaht First Nation
100 Port Renfrew
101 Port Washington
102 River Jordan
103 Saseenos
104 Saturna
105 Shirley
106 Sidney
107 Sooke
108 Tseycum
109 T'Sou-ke
110 T'Sou-ke First Nation
111 Victoria
Cowichan Valley Regional District
112 Chemainus (Stz'uminus First Nation)
113 Ditidaht
114 Lyackson
115 Malahat First Nation
116 Penelakut (Penelakut Tribe)
Regional District of Nanaimo
117 Bowser
118 Nanaimo
119 Nanoose First Nation
120 Qualicum Beach
Comox Valley Regional District
121 Comox
122 Williams Beach
Metro Vancouver Regional District
123 Gambier Harbour
124 Snug Cove
125 Vancouver Interconnect
Sunshine Coast Regional District
126 Earls Cove
127 Egmont
128 Gibsons
129 Halfmoon Bay
130 Langdale
131 New Brighton
132 Pope Landing
133 Roberts Creek
134 Sechelt
135 Secret Cove
136 Welcome Beach
137 Williamsons Landing
138 Wilson Creek
Powell River Regional District
139 Barney's Bar
140 Black Point
141 Blias Landing
142 Brew Bay
143 Gillies Bay
144 Lang Bay
145 Lasqueti
146 Lund
147 Myrtle Point
148 Pinetree
149 Powell River
150 Sallery Bay
151 Sliammon (Tla'amin Nation)
152 Stillwater
153 Van Anda
154 Westview

*Green text denotes First Nations joining one

Legend

● FN Landing Sites

● nonFN Landing Sites

— CityWest Proposed Sub-Sea Cable

— Strathcona RD Proposed Sub-Sea Cable

0 25 50 100 Km

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Created By: Network BC, SP
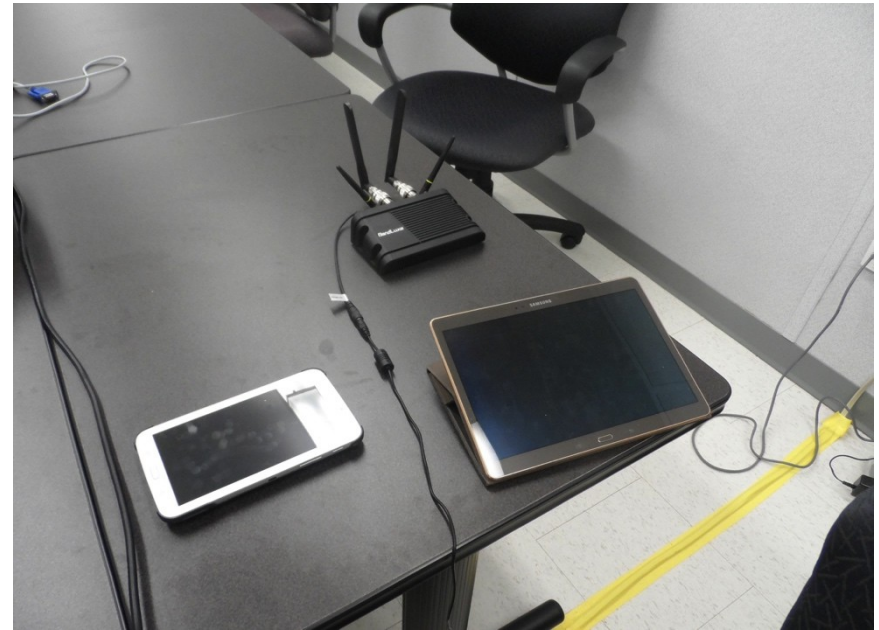Projection/Datum: BC Albers/NAD 83

Canadian Public Safety Broadband Network

Complete 700 MHz LTE PSBN Cellular System
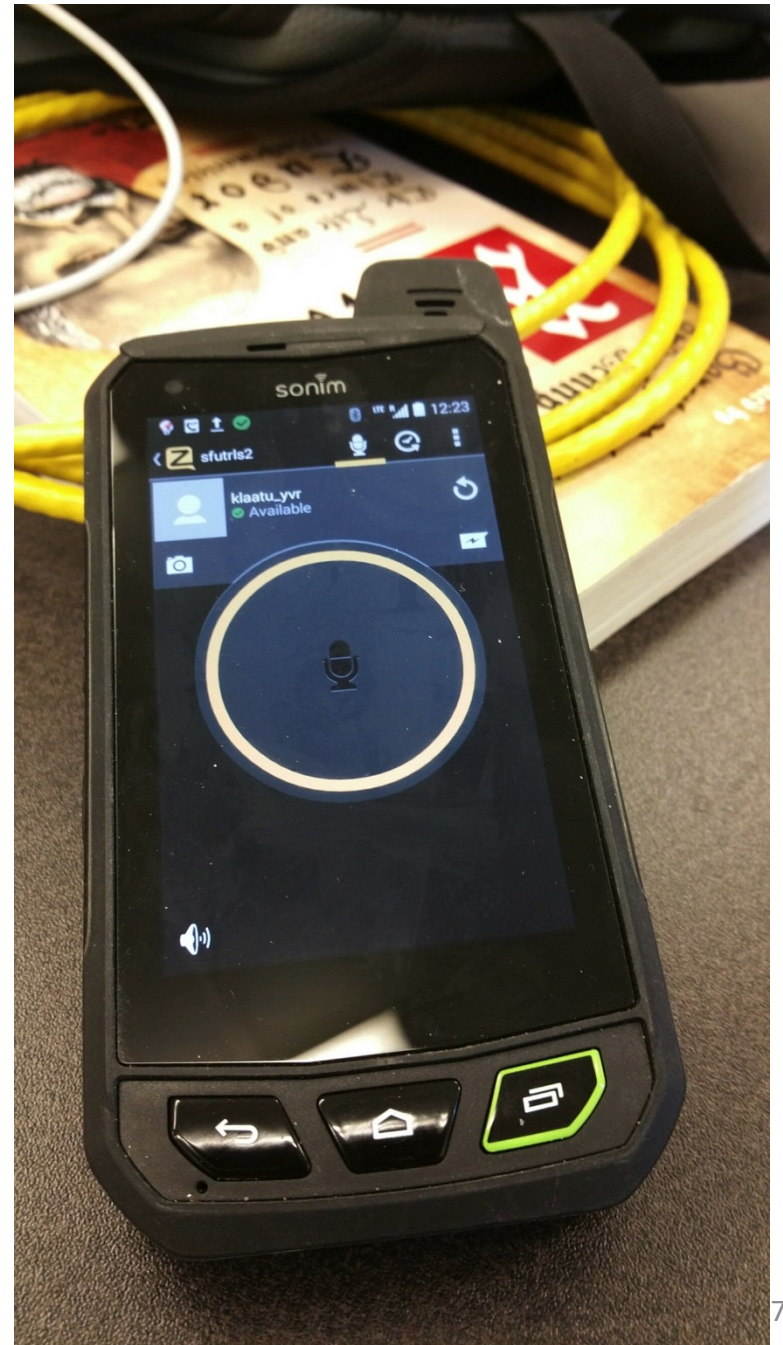
In-vehicle/on-board 700 MHz modem with Wi-Fi

In-building 700 MHz modem with Wi-Fi

Thank You

anderson@sfu.ca