



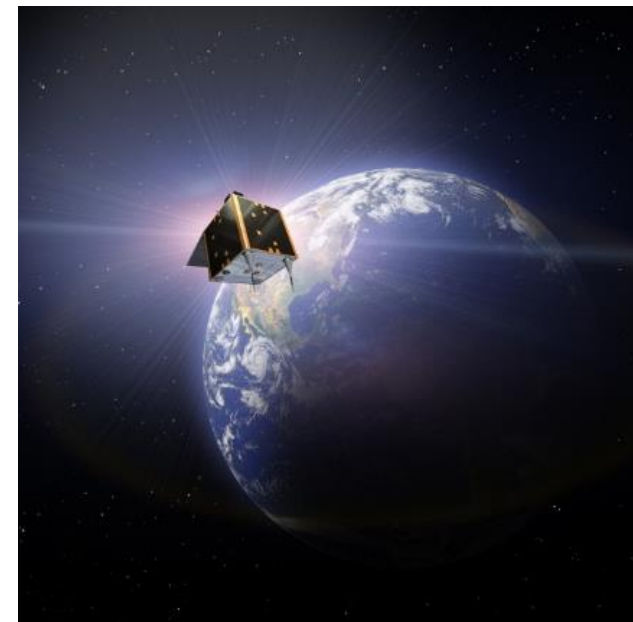
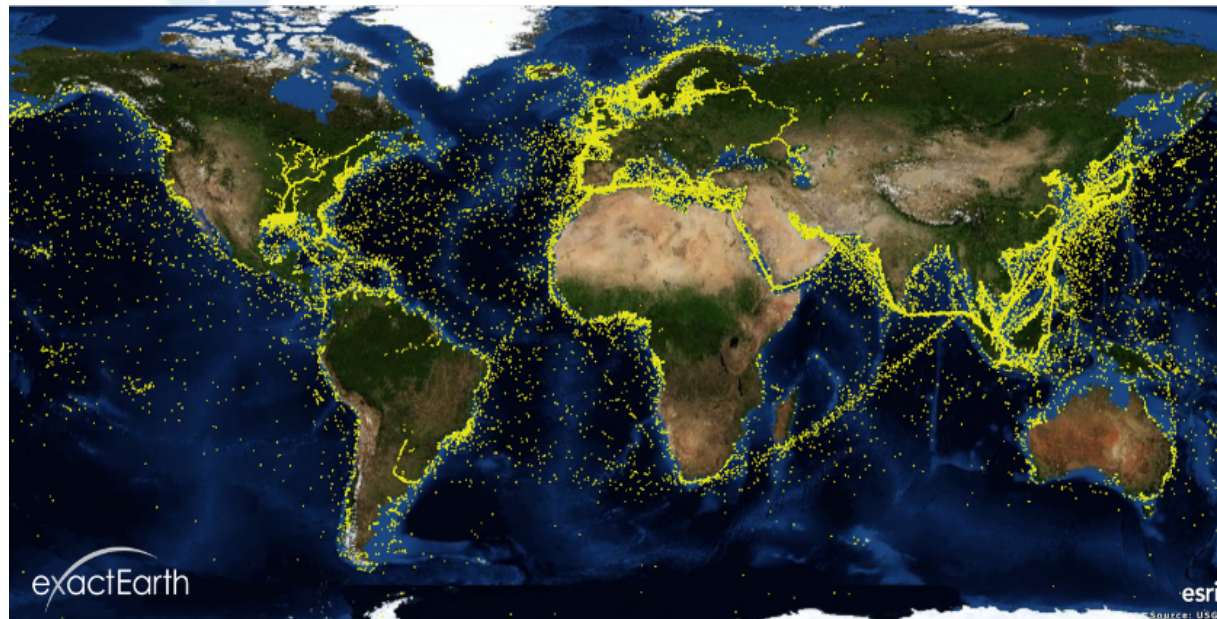
# Leveraging AIS to track small vessels

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(Norma Serra)

2<sup>nd</sup> December, 2019

# About exactEarth Ltd / exactEarth Europe Ltd

- Canadian (Cambridge, ON) and UK (Harwell) data services company specialising in spaced-based maritime domain awareness solutions
- Pioneered Satellite AIS market with commercial introduction of service in July 2010; tech dev program since 2005, and first satellite launch in 2008
- Over 100 government agencies in 50+ countries have adopted service
- Hundreds of commercial customers - financial services, shipping/brokering companies, fleet operators, etc.



# Class A and Class B AIS

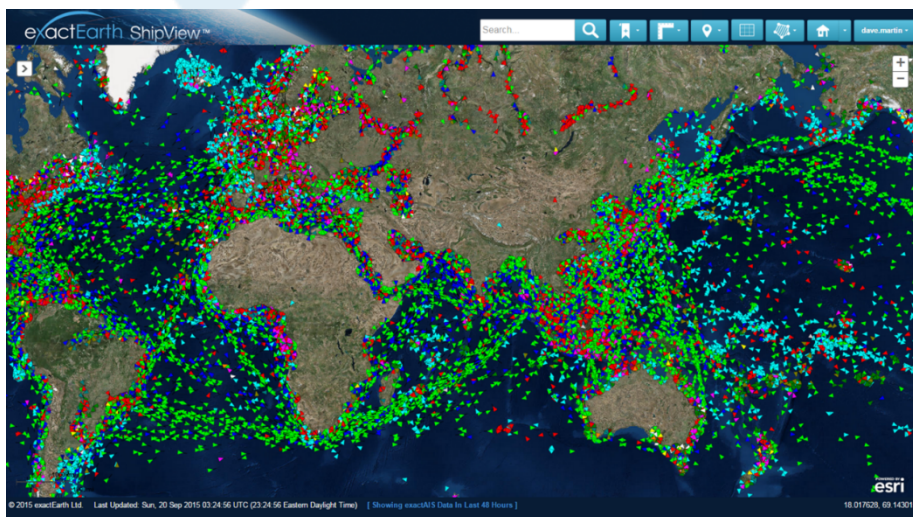
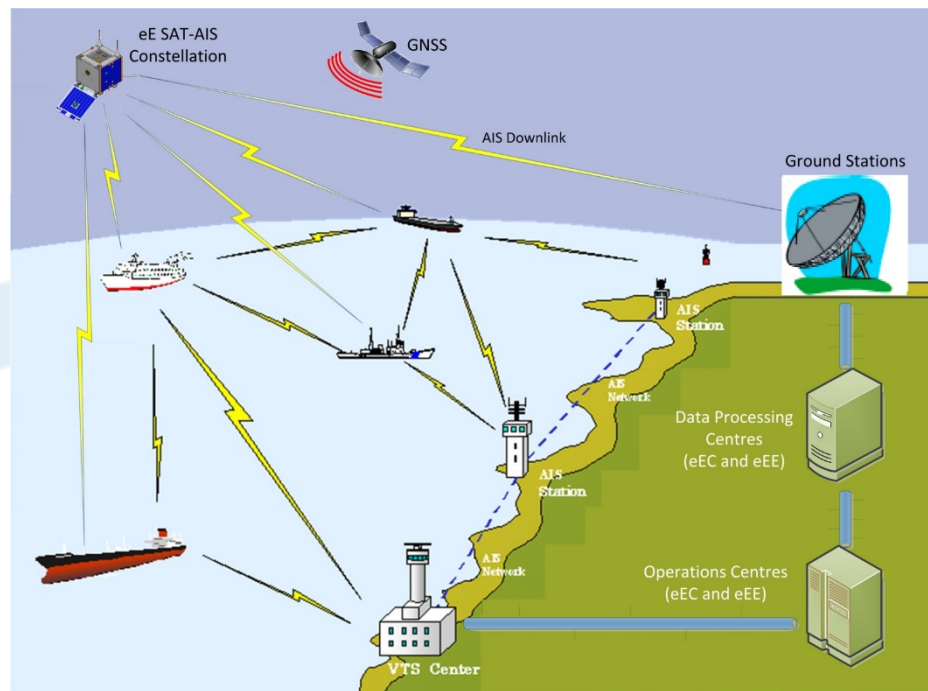
- Class A AIS mandatory for all SOLAS class ships – priority transmissions (SOTDMA), high power, very frequent transmissions of rich message types. Relatively expensive transceiver cost.
- Class B not mandated unless by national law, used for smaller ships, including fishing boats and leisure. Much less powerful signal and less frequent transmissions (CSTDMA\*). Much cheaper transceiver cost.
- As AIS is free to air, Class B can be more attractive to small vessel owners / operators than commercial satcom services.

\* Class B SOTDMA devices also now available



# Satellite AIS

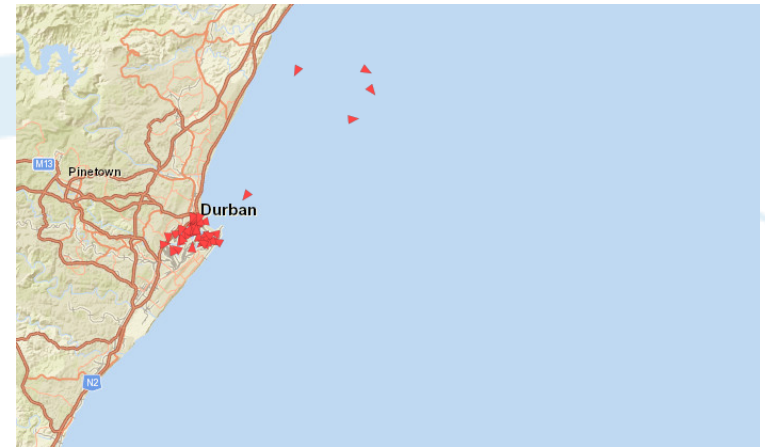
- Since 2008, it has been possible to receive ships' AIS transmissions in space (SAT-AIS)
- Ships can now be tracked in the open ocean, rather than just within ~40 nautical miles of a receiver as with terrestrial / coastal AIS.



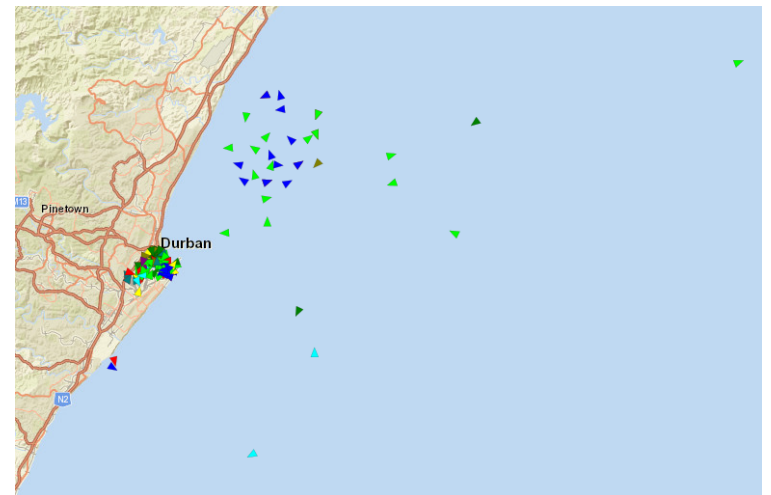
# Terrestrial and Satellite AIS

- AIS transmissions from AIS devices can be detected by neighbouring ships carrying AIS transceivers, AIS satellites and also terrestrial AIS base stations / coastal receivers.
- The range at which a terrestrial AIS receiver / base station will pick up a transmission from an AIS device on-board a boat depends on a range of factors, not least the transmit power of the on-board device.
- This means that typically a Class A device can be seen up to ~40 nautical miles away from a shore receiver, a Class B transceiver slightly less and a Class B transponder less again.
- The advantage of satellite AIS is that an AIS-equipped boat can be located anywhere in the world – 10 metres from shore, or 1,000 miles. This in some way negates the need for terrestrial AIS networks – leastways certainly in remote areas where installing and operating a T-AIS network would be prohibitively expensive.

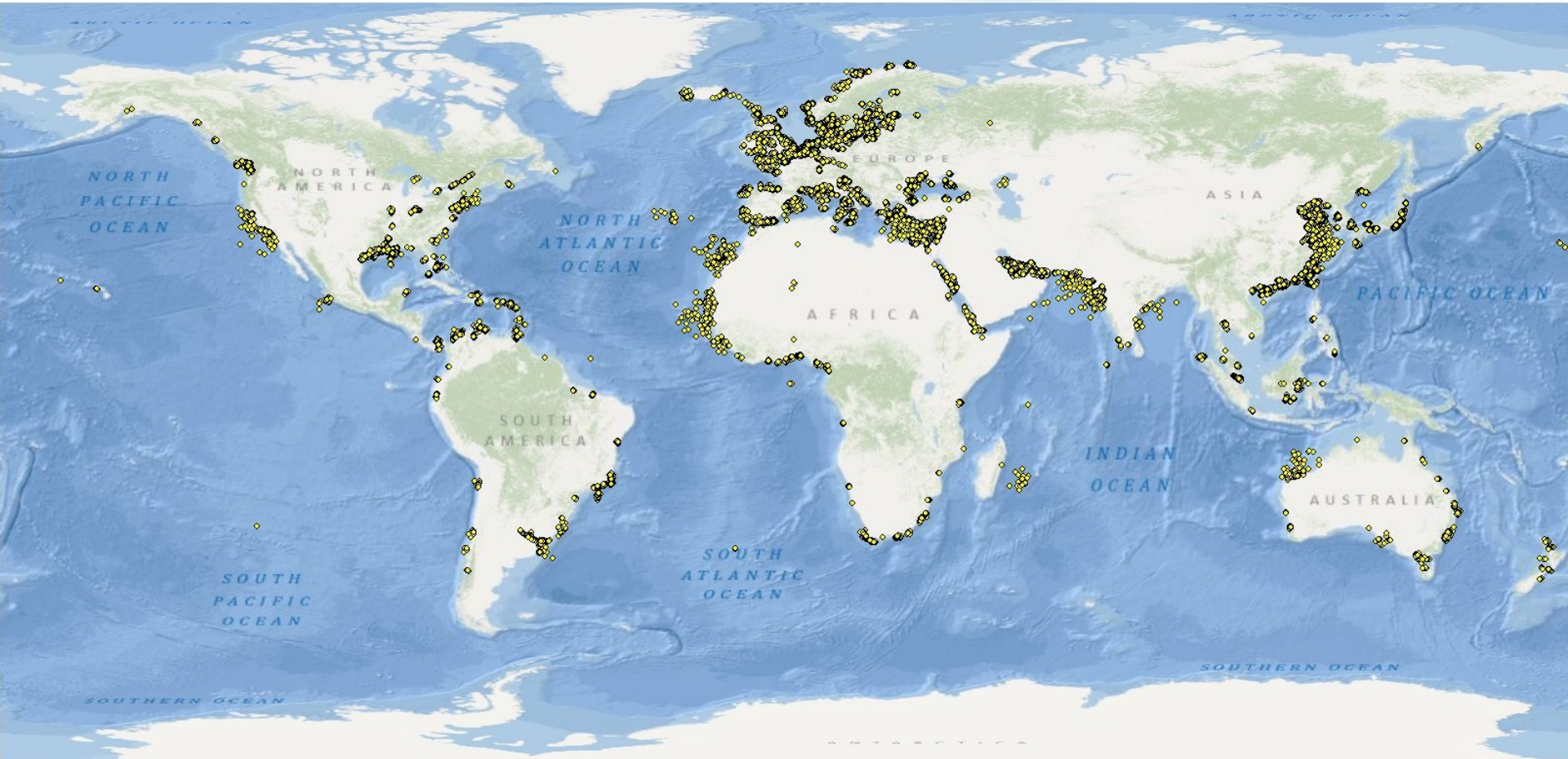
T-AIS Only



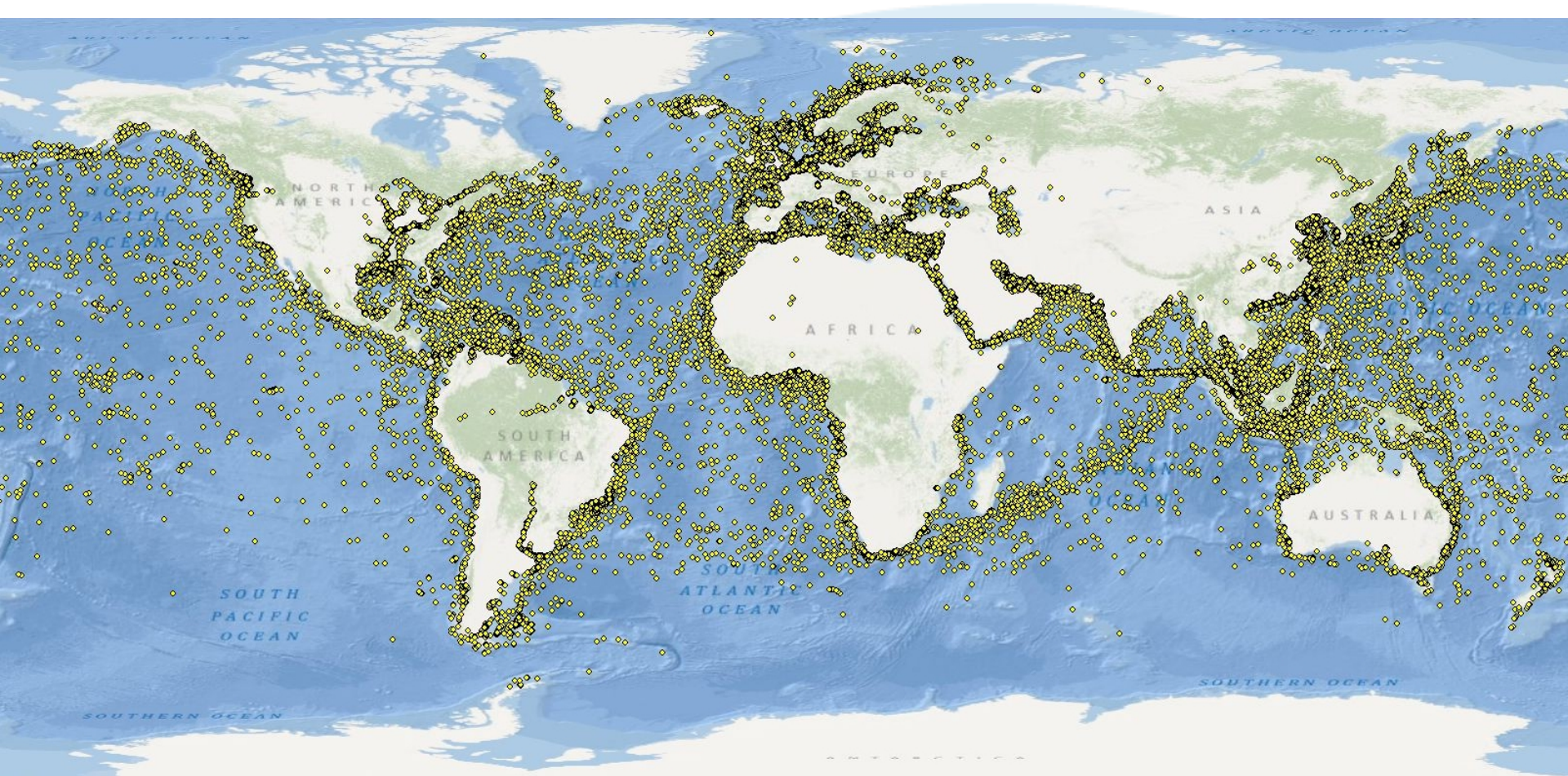
T-AIS & S-AIS



# Coastal AIS



# Satellite AIS



# AIS on Iridium NEXT

**58**

Satellites with  
7 in-orbit  
spares

**25 million+**

Satellite AIS  
position reports  
daily

**200,000+**

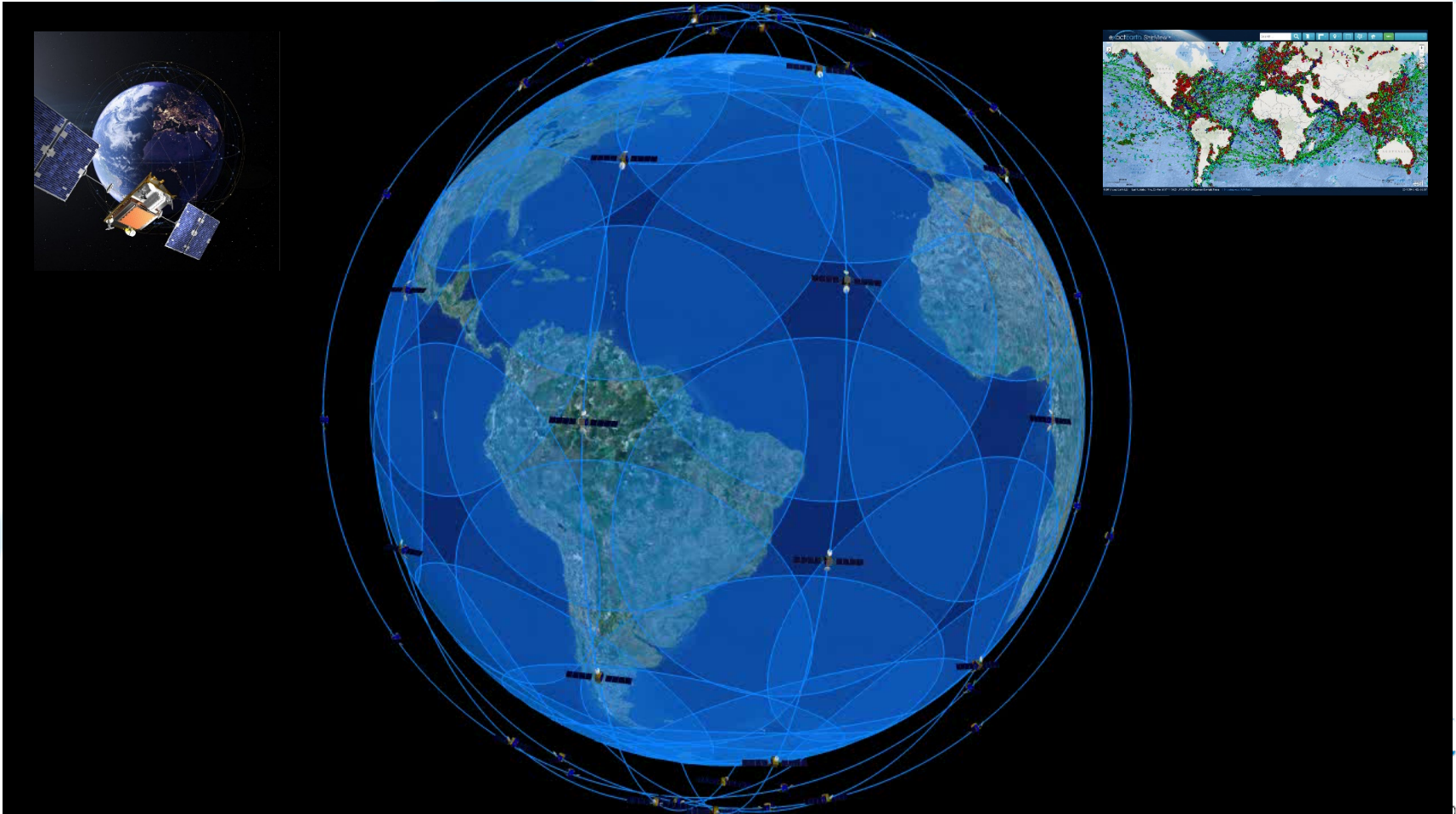
unique vessels  
detected every  
day

**Less than 2**

minute avg.  
global revisit

**Less than 1**

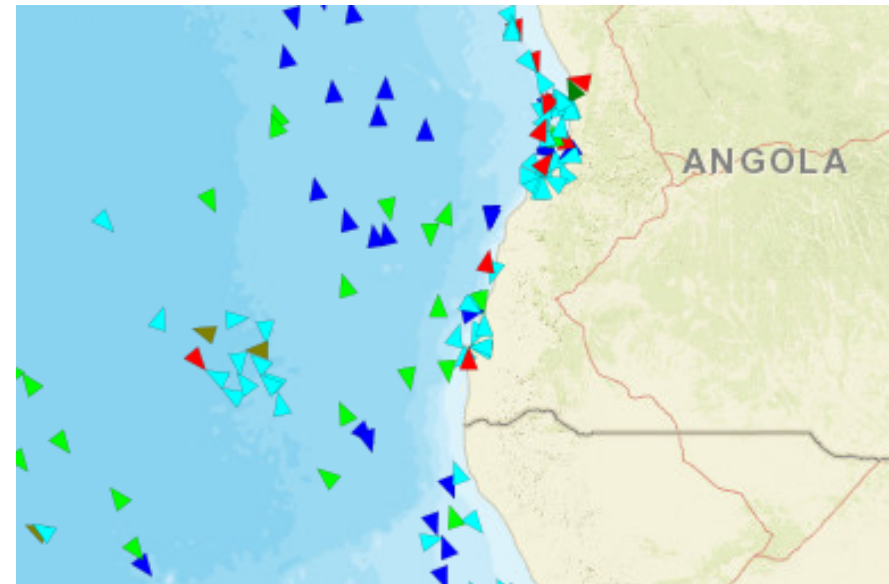
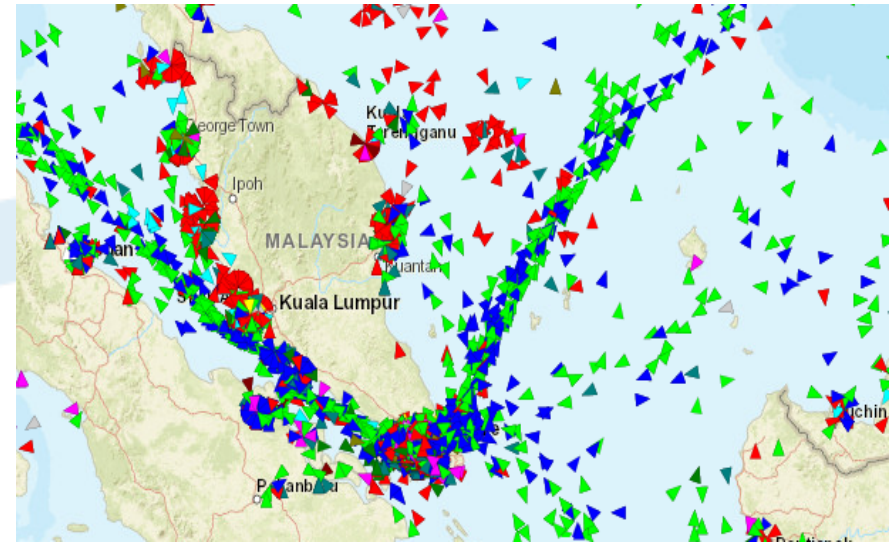
minute  
customer data  
latency





# Satellite AIS Detection

- Satellite AIS is a complex system and detection of an AIS device in Space will depend on a combination of transmission power, background RF noise, and the local density of AIS-equipped shipping
- Nominally the lower a transceiver's transmission power, the lower the detection rate, especially by satellite AIS. This means Class B devices are more affected than Class A devices



# exactTrax Service

- There are a plethora of Class A and Class B AIS terminal manufacturers around the world
- Class A and Class B devices nominally transmit and receive (i.e. they are transceivers)
- Transmissions from Class A and Class B devices can be detected by satellite AIS, terrestrial AIS systems and other boats
- The stronger a terminal's transmission power, the better the detection rate (by satellite, shore, other boats), e.g. detection rates / range of a Class A AIS device (12W) will be better than a Class B AIS device (e.g. 2W)
- However, Class A AIS terminals are much more expensive to purchase than Class B terminals



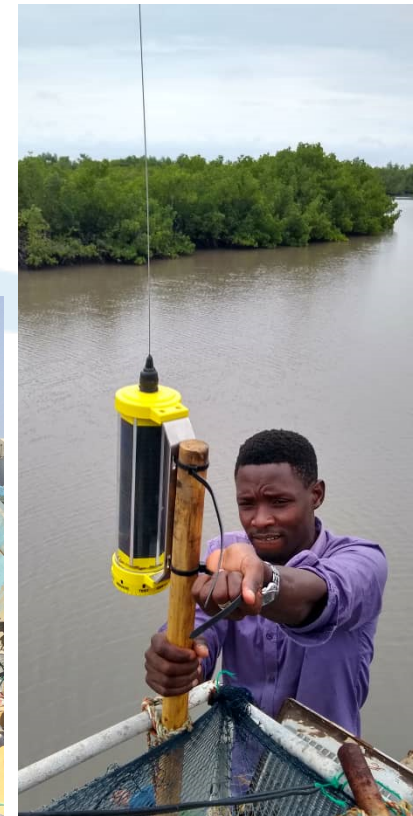
# exactTrax Service

- Detection for Class B devices can be problematic in space due to the weak nature of the signal.
- This means that tracking of small vessels outside terrestrial AIS range can be problematic.
- exactTrax is a special service for tracking small vessels that cannot easily use standard AIS equipment and/or operate in areas where standard satellite AIS is challenging
- Partnered with key AIS equipment manufacturers to provide a range of battery / solar-powered AIS transponders and enhanced Class B transceivers
- Supports local fisheries management and local maritime security / surveillance
- Global, real-time tracking via exactEarth's exactAIS satellites

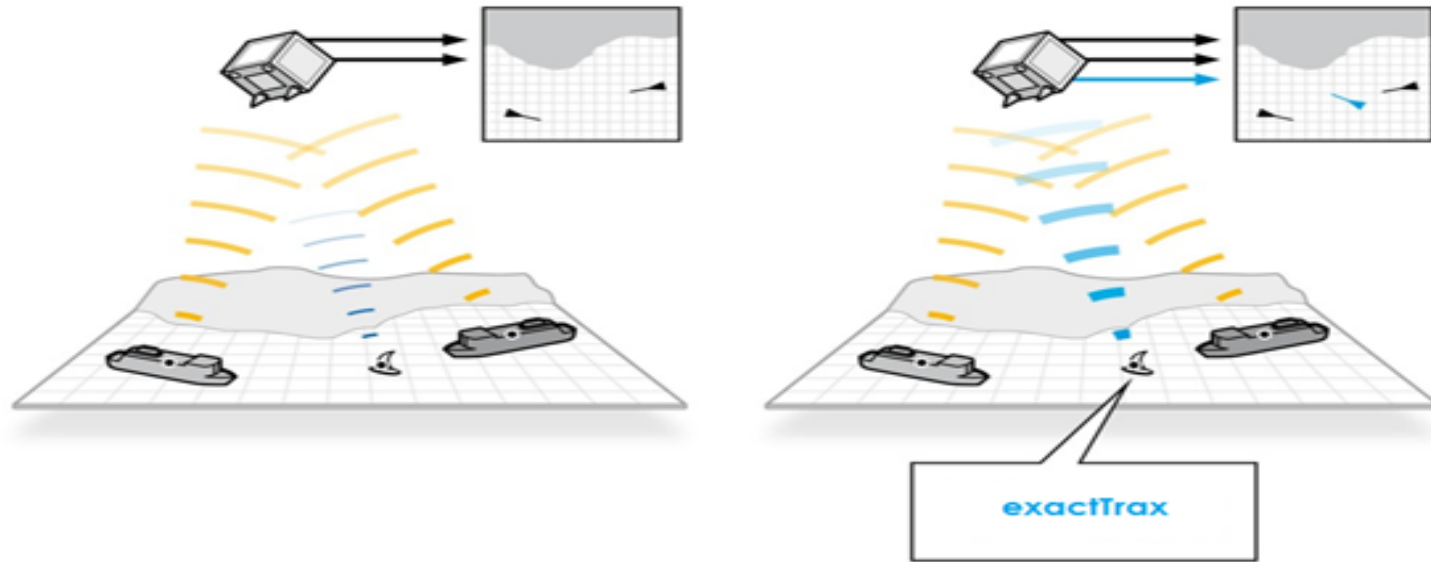


# exactTrax Transponders

- For small boats which cannot easily accommodate typical Class A or Class B transceivers, various AIS manufacturers have produced battery-operated AIS devices that can be easily and simply be deployed on any boat
- Such devices tend to:
  - transmit only to save battery life (i.e. they are transponders)
  - cheaper to purchase than a Class B AIS device
  - are 'all-in-one', with no need to install separate antennas
  - transmit at low power levels (typically 2W)
- Many can be solar-powered, meaning they can be treated as 'install and forget'



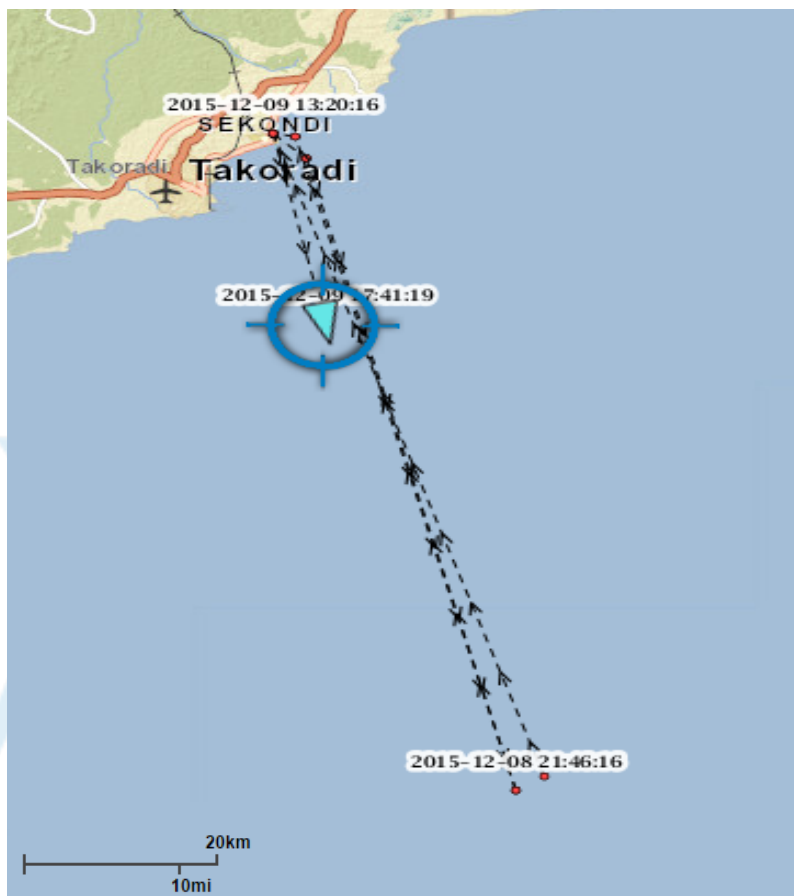
# Enhanced Detection



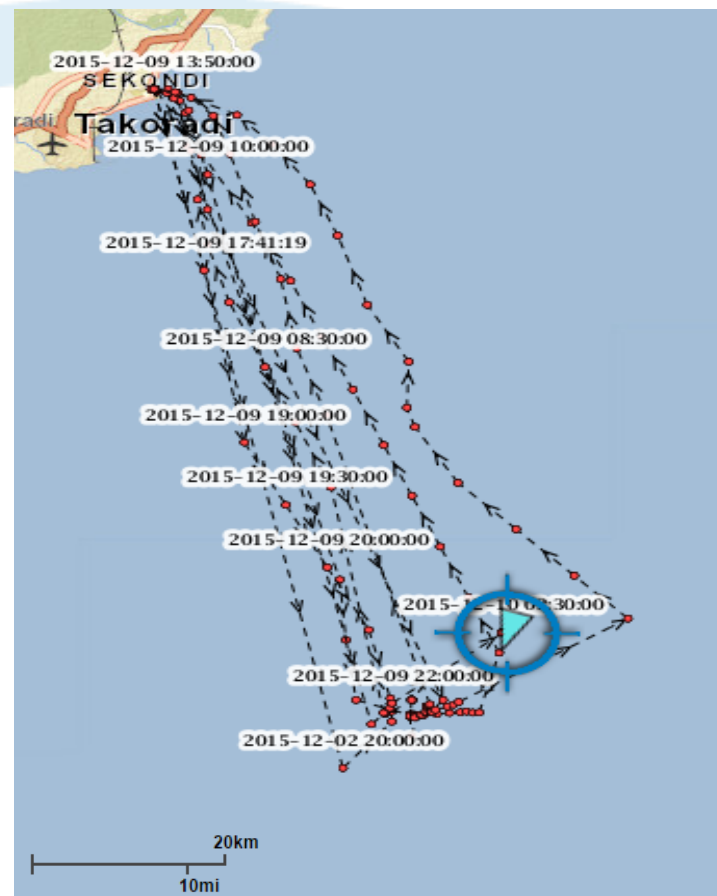
- exactTrax uses advanced RF signal processing techniques resident in the firmware of an AIS device to effectively ‘boost’ the apparent transmission power of a device.
- exactTrax also uses the ASM maritime VHF frequency rather than AIS – typically less noisy in most areas of the world than AIS
- As such, exactTrax dramatically improves satellite AIS detection rates, particularly from low powered Class B transceivers and low powered Class B transponders

# Detection Improvement Example

Traditional Class B AIS Detection



exactTrax Enabled Vessel Tracking



Illustrations above are extracts from ShipView screenshots – both show the same boat on the same voyage

# Example exactTrax-enabled powered Class B AIS Transceivers

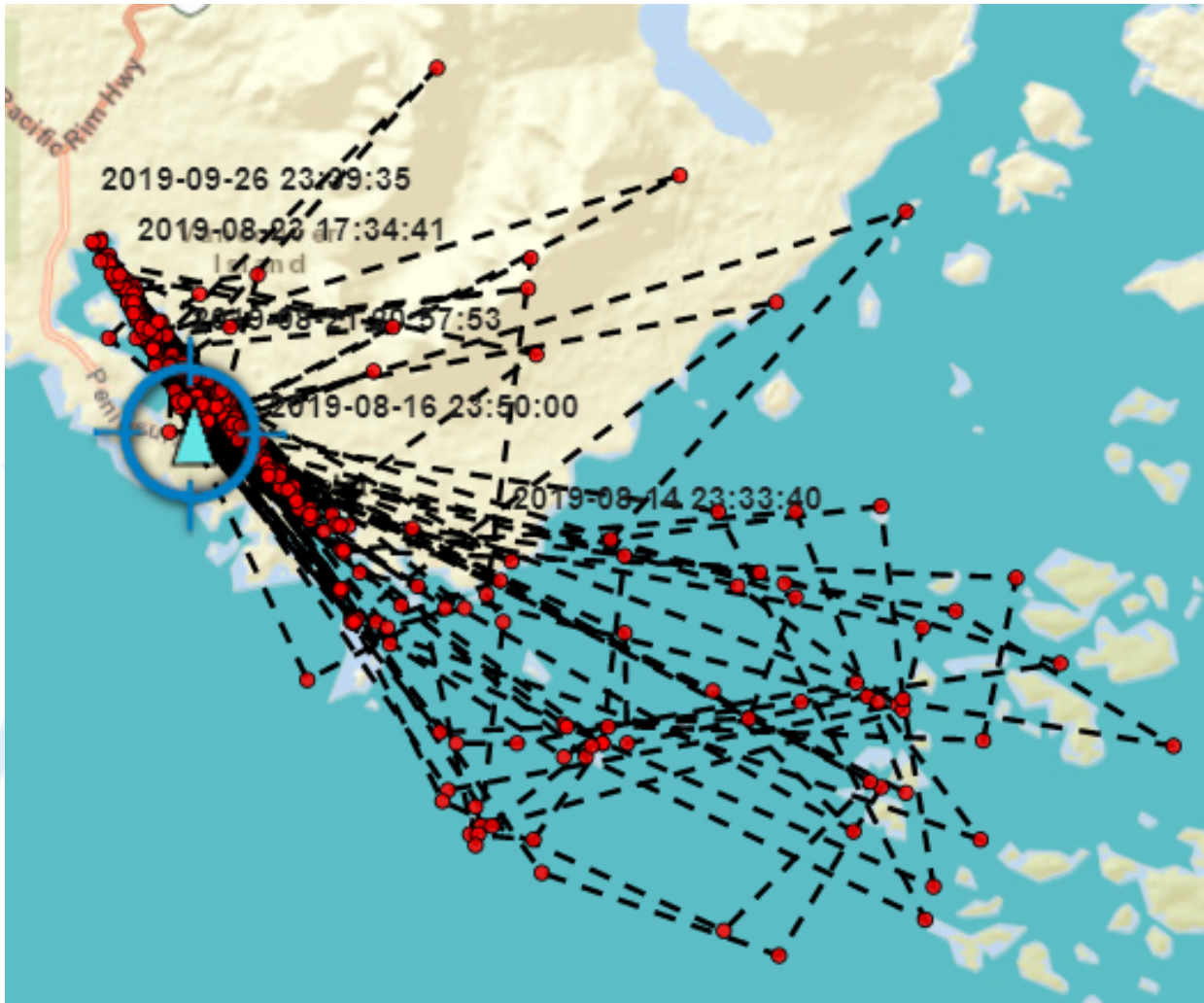


**B2**



**Widelink B600 / Camino 108**

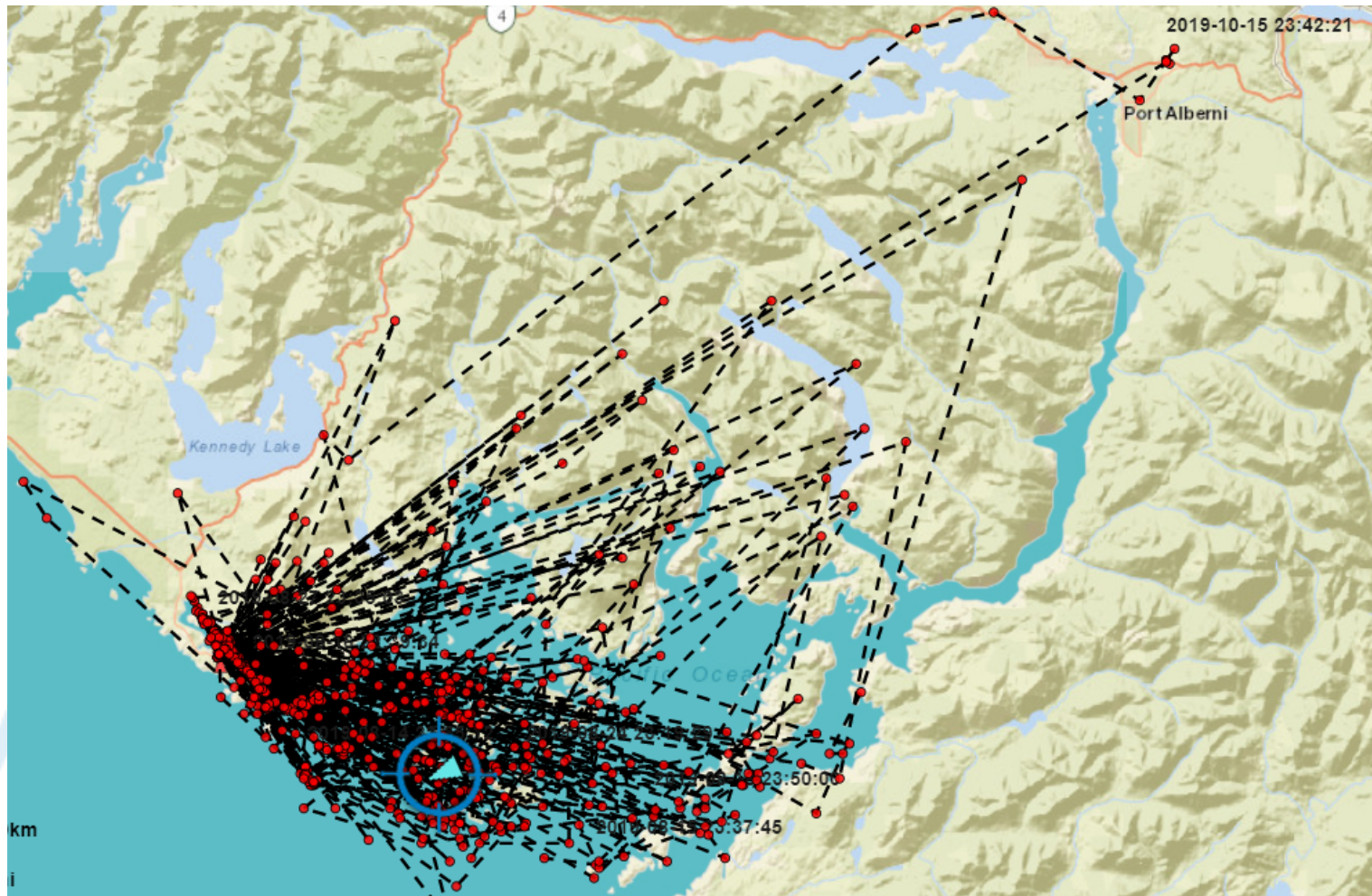
# The Dixie IV - 316004535 – 90 Days Data



Camino - 108 w/exactTrax (2W); hourly T-AIS



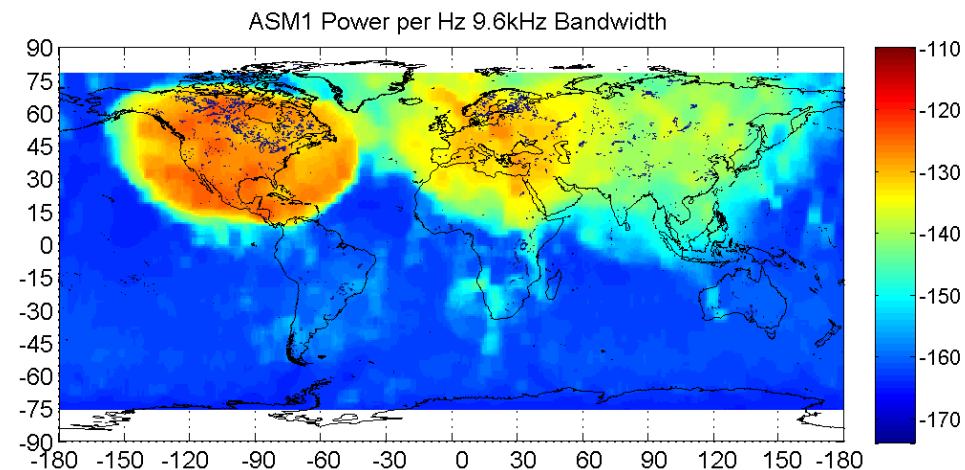
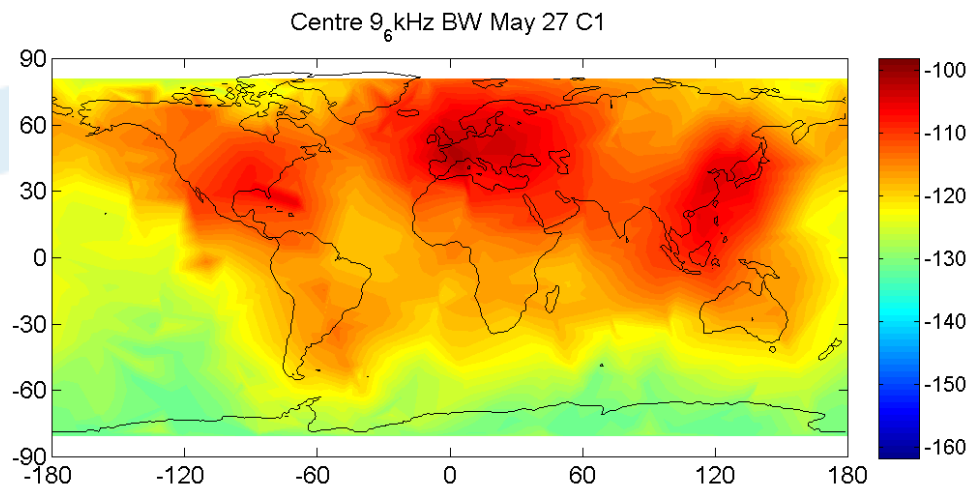
# The Discovery - 316004536 – 90 Days Data



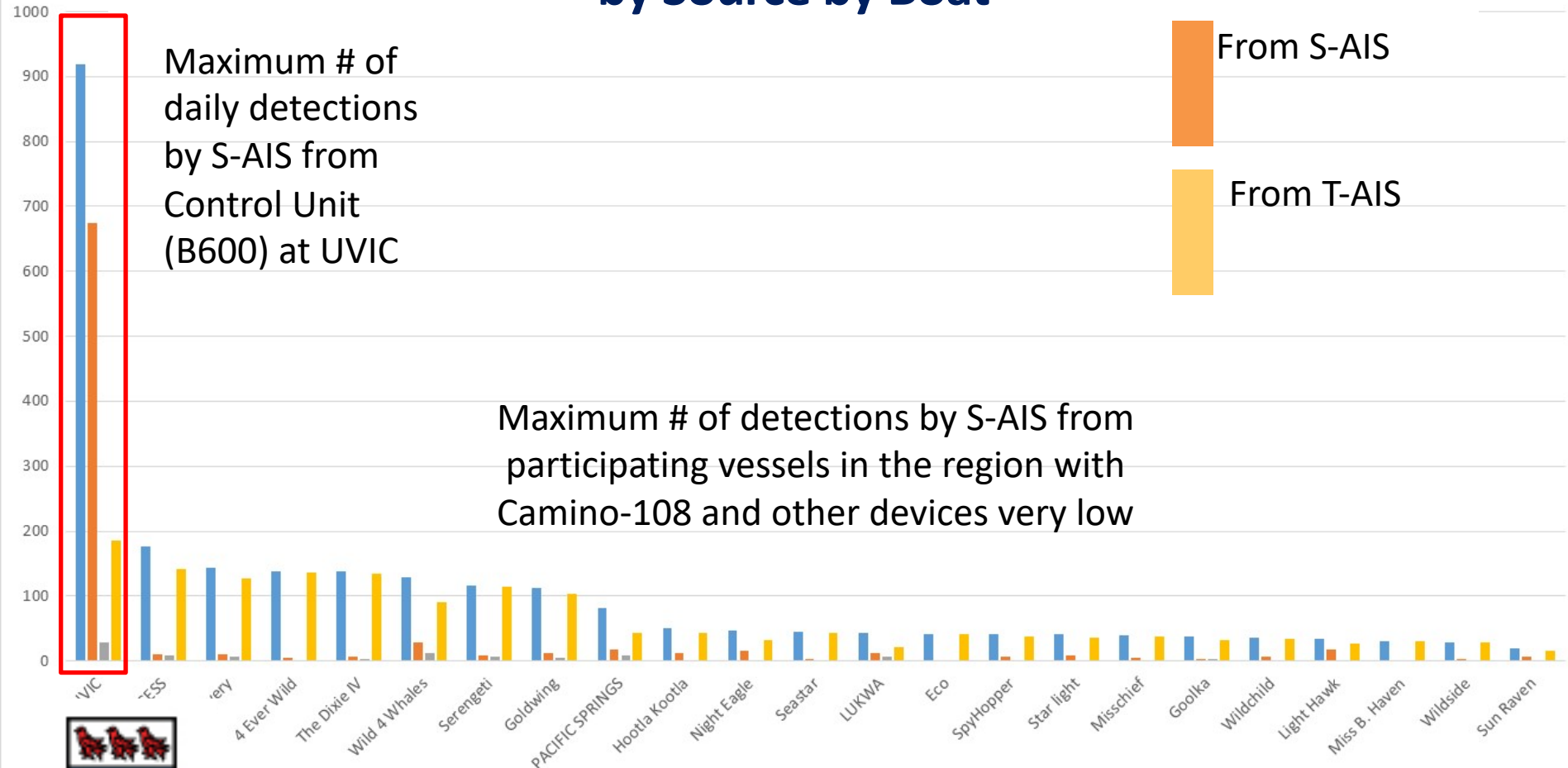
Camino - 108 w/exactTrax (2W); hourly T-AIS

# Satellite Detection Performance in Canada

- exactTrax works extremely well in Australia, Africa and Latin America – often >20 position reports an hour from battery transponders
- Unfortunately, Canada is a real challenge – mostly because the Canadian Coast Guard broadcasts weather data on ASM frequencies at a very high power
- Detection is also a factor of transmit power and antenna deployment – the VHF antenna must be:
  - As high as possible
  - Have an all-round clear view of the sky, horizon to horizon
  - Not be close to any other transmitting antennas



# Maximum Daily Detections from exactEarth by Source by Boat



# Thoughts

- However, in general it is clear that exactTrax on ASM and exactAIS on AIS 1-2 frequencies are not being detected at all well. The number of hits and the update rate are both very poor from a satellite point of view.
- This is mostly due to the high noise floor on these frequencies in Canada, particularly on ASM, and also the low transmit power of the trial units (all 2W devices).
- The control unit (a B600) at UVIC is therefore of interest from an analysis PoV – it is a 5W unit, has an excellent deployment location and is on 24/7.
- The control, as an SOTDMA device, also transmits ‘Message 27 Long Range’ position reports. These are transmitted on AIS channels 3 and 4 and we get good detection of these.
- Note however, the positional resolution in a Message 27 is less than a Message 18, i.e. more like ~123 metres at Victoria’s latitude as opposed to ~<10 metres

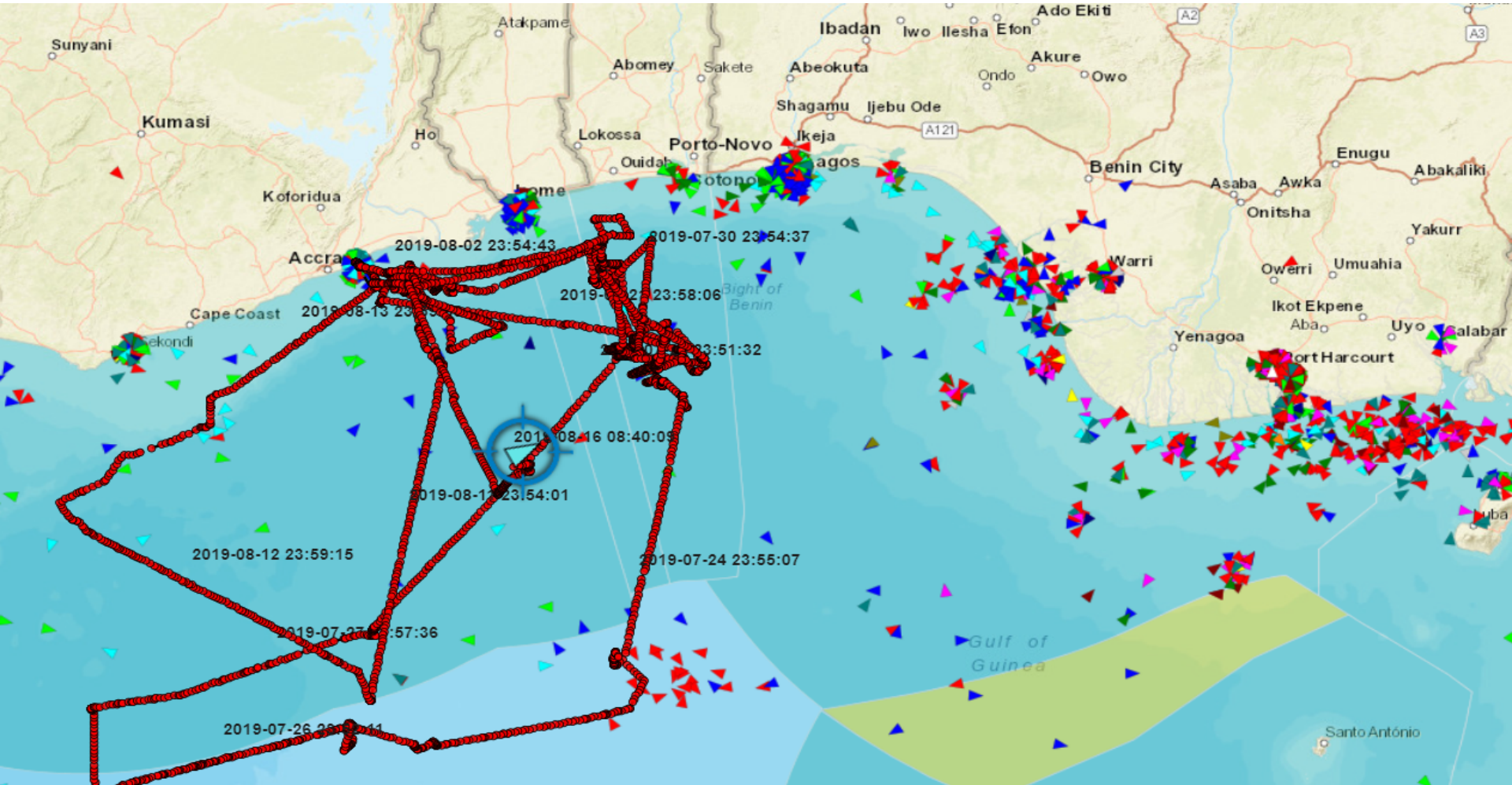
# Thank You

**Richard Proud**

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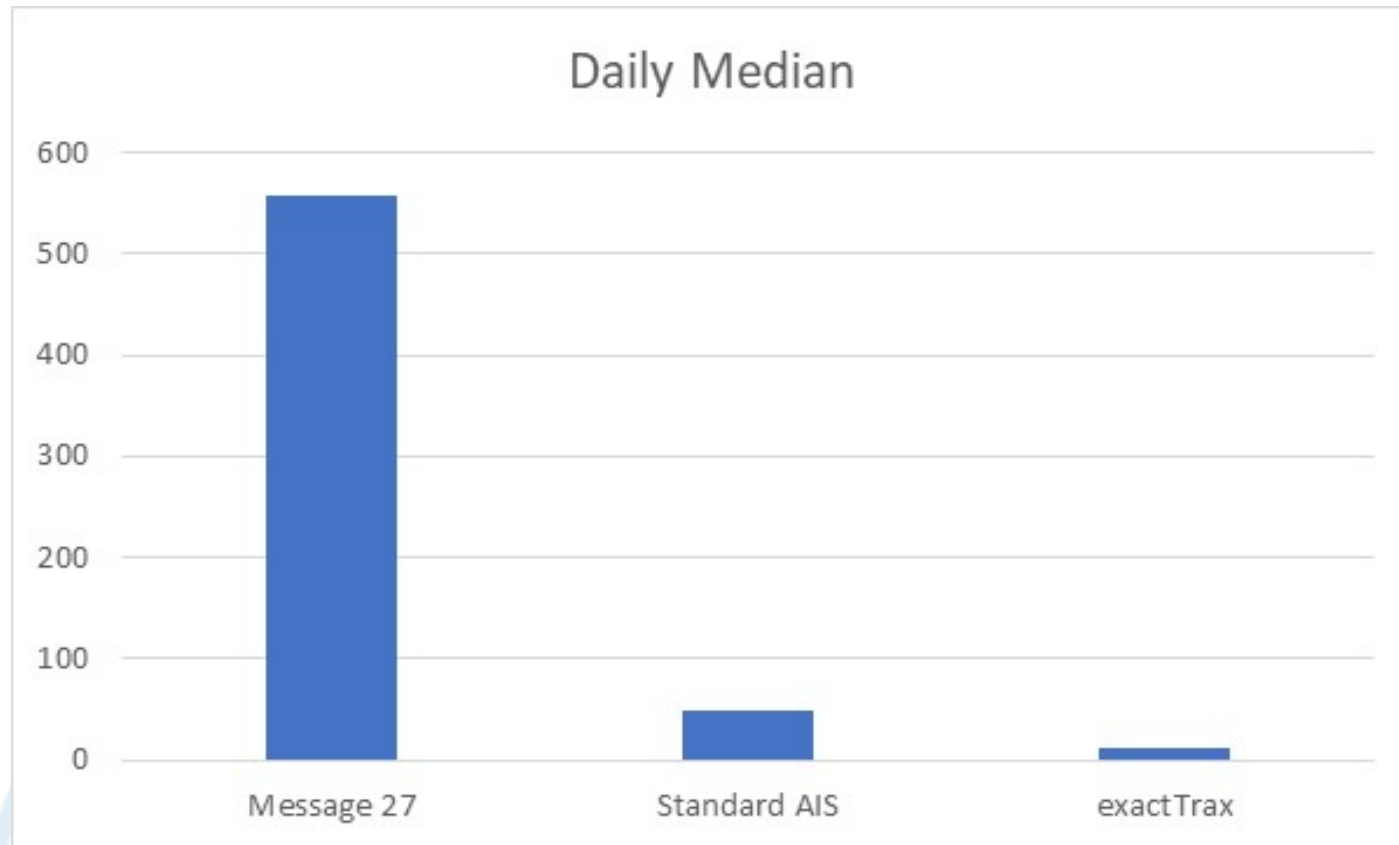
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[www.exactearth.com](http://www.exactearth.com)

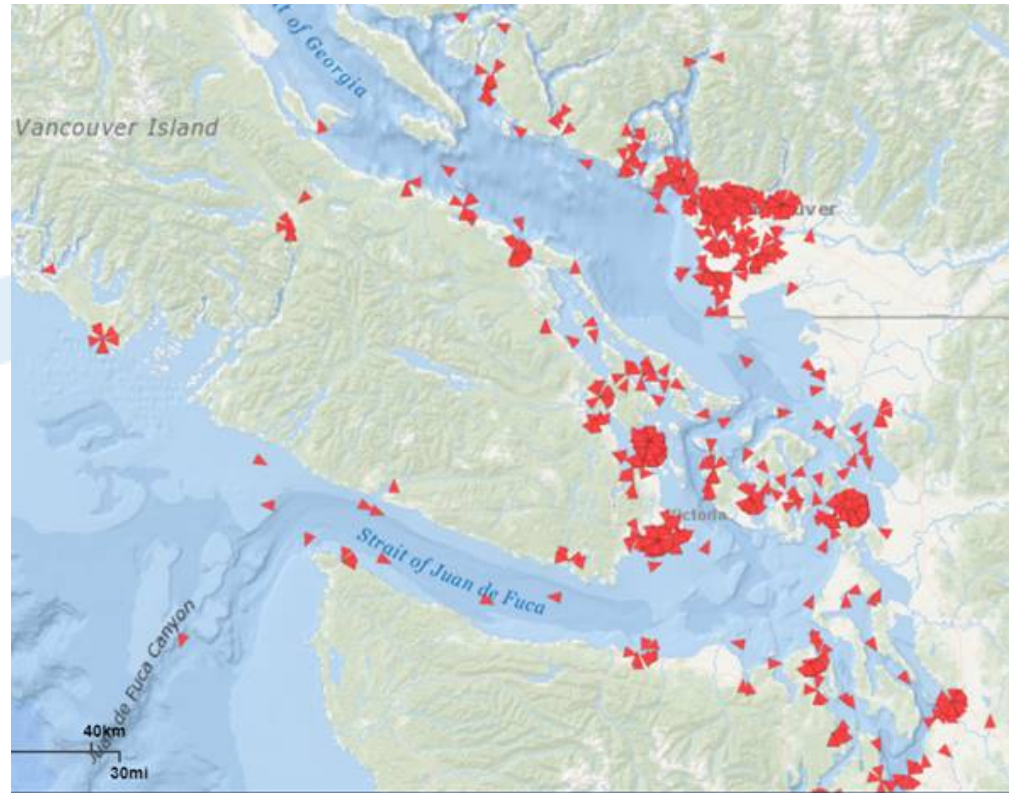
# WAVE Control Analysis



Hourly Average for Msg 27= 23.20833333, for S-AIS = 2 and for exactTrax = 0.5

# T-AIS via exactEarth

- As all the devices supplied (and existing non-exactTrax ones being used too) are standard AIS transmitters, they will be picked up by local T-AIS receivers.
- However, exactEarth does not have access to local T-AIS networks – we partner with a German company, FleetMon, who install receivers in locations all round the world (like MarineTraffic) and who do have some in your area. But if you want to see more T-AIS data, you would either need to put up your own receivers or access local third-party feeds.
- Note that T-AIS data for exactTrax boats was sampled down to hourly intervals, but for non-exactTrax boats it was always provided at 10-minute intervals.



# Thoughts

- The Canadian Coast Guard is supposed to stop transmitting on ASM, which would make a massive improvement to exactTrax detections. However, although they are supposed to have done this by now, unfortunately they show no sign of doing so
- When the B600's are deployed on the boats next season, we should get a much better QoS at sea – not so much from exactTrax, but from normal S-AIS and particularly Message 27s
- 10-minute T-AIS data is now available for exactTrax units, as is for 3<sup>rd</sup> party Class B devices.
- Message 27 data is available for those devices that transmit them (e.g. B600s, or any newish Class B SOTDMA transceiver)
- Conclusion:
  - 10-minute T-AIS data will help Camino exactTrax users going forward
  - Message 27 will help boats using B600 devices (or SOTDMA Class B units) next season

	T-AIS	S-AIS	Msg-27	exactTrax
AllTek Camino	✓ (10 minute*)	✓	✗	✓
AllTek B600	✓ (10 minute*)	✓	✓	✓
Third-Party Class B	✓ (10 minute)	✓	✗	✗

\* ten-minute T-AIS data available for exactTrax devices from 19/11; previously was only hourly updates