

Geometric absolute Cal/VAL

An Australian point of view.

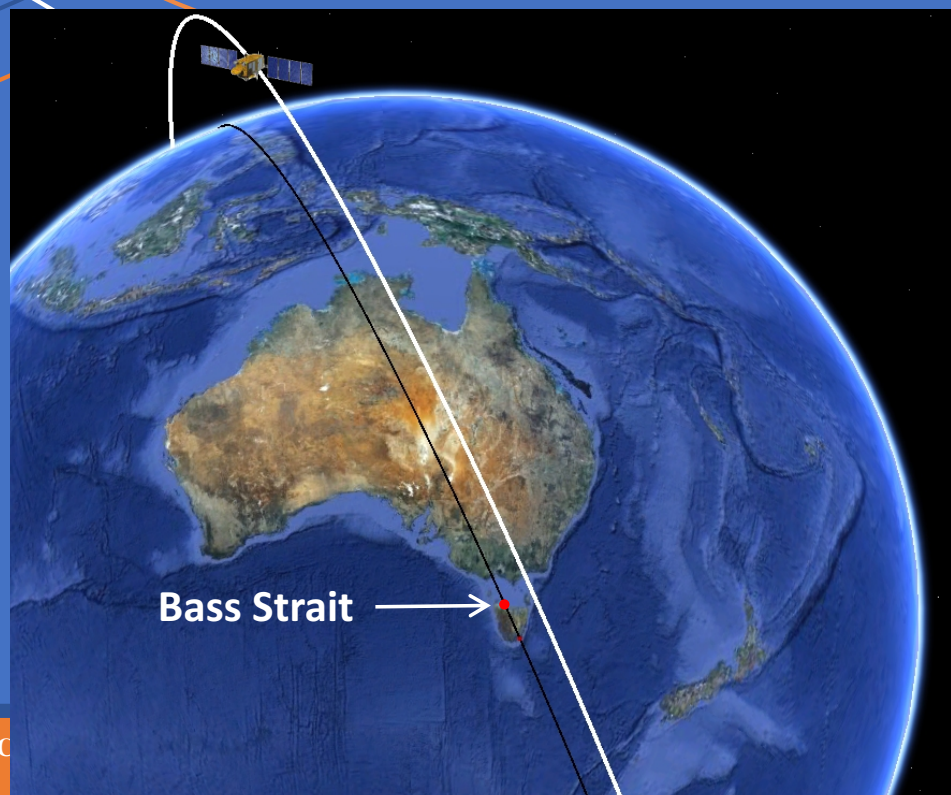
Benoit LEGRESY^{1,3,4}, Christopher WATSON^{2,4}

1, CSIRO Climate Science Centre

2, Geography and Spatial Sciences, University of Tasmania

3, Antarctic Climate and Ecosystems CRC

3, Australia's Integrated Marine Observing System IMOS

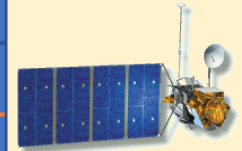
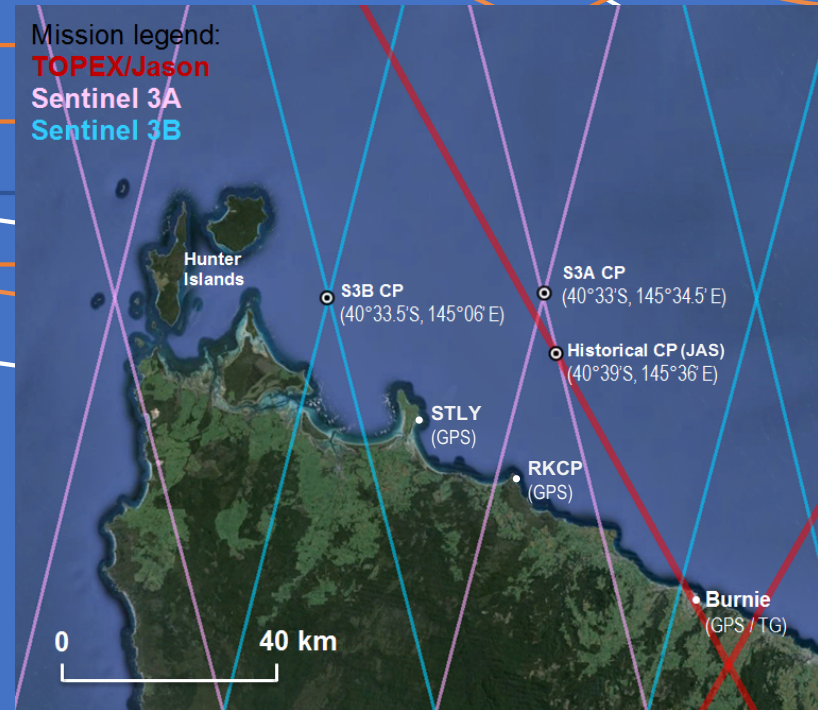


BENOIT LEGRESY 06/2018 SWOT SC
www.csiro.au

The IMOS Satellite altimetry calibration facility

In situ instrumentation includes :

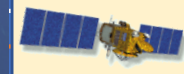
- moored oceanographic instruments at various comparison points,
- episodic GPS buoy deployments for absolute datum.
- Reference Tide gauge
- Land reference GPSs
- Meteorologic observations and regional models



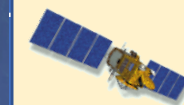
TOPEX / Poseidon
Aug 1992 -



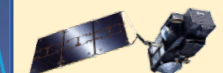
Jason-1
Dec 2001 -



OSTM/Jason-2
June 2008 -



Jason-3
Jan 2016 -



Sentinel-3A
Feb 2016 -



Sentinel-3B
Launching soon!

The IMOS Satellite altimetry calibration facility

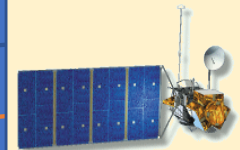
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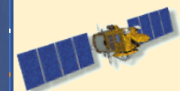
Mission legend:
TOPEX/Jason
Sentinel 3A

OSTST 2017

| Mission | Cycles | Std Dev |
|------------------|------------|--------------------------------------|
| TOPEX-A | 1 -> 235 | 24 mm (TG) |
| TOPEX-B | 236 -> 365 | 27 mm (TG) |
| Jason-1 GDR-E | 1 -> 259 | 30 mm (TG) |
| Jason-2 GDR-D | 1 -> 298 | 32 mm (TG) 25 mm (Mooring) |
| Jason-3 GDR-D | 1 -> 55 | 29 mm (TG) 26 mm (Mooring) |
| S-3A SAR | 6 -> 23 | 22 mm (Mooring) |
| S-3A PLRM | 6 -> 23 | 36 mm (Mooring) |



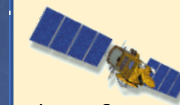
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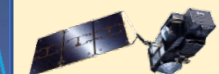
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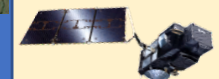
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Sentinel-3A
Feb 2016 -

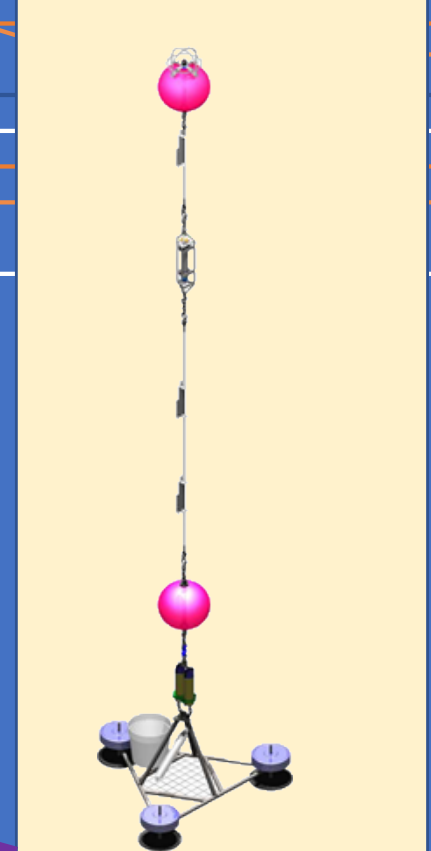
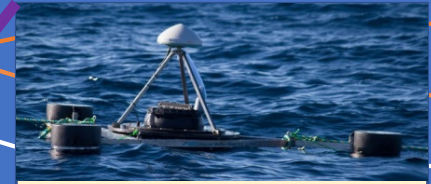
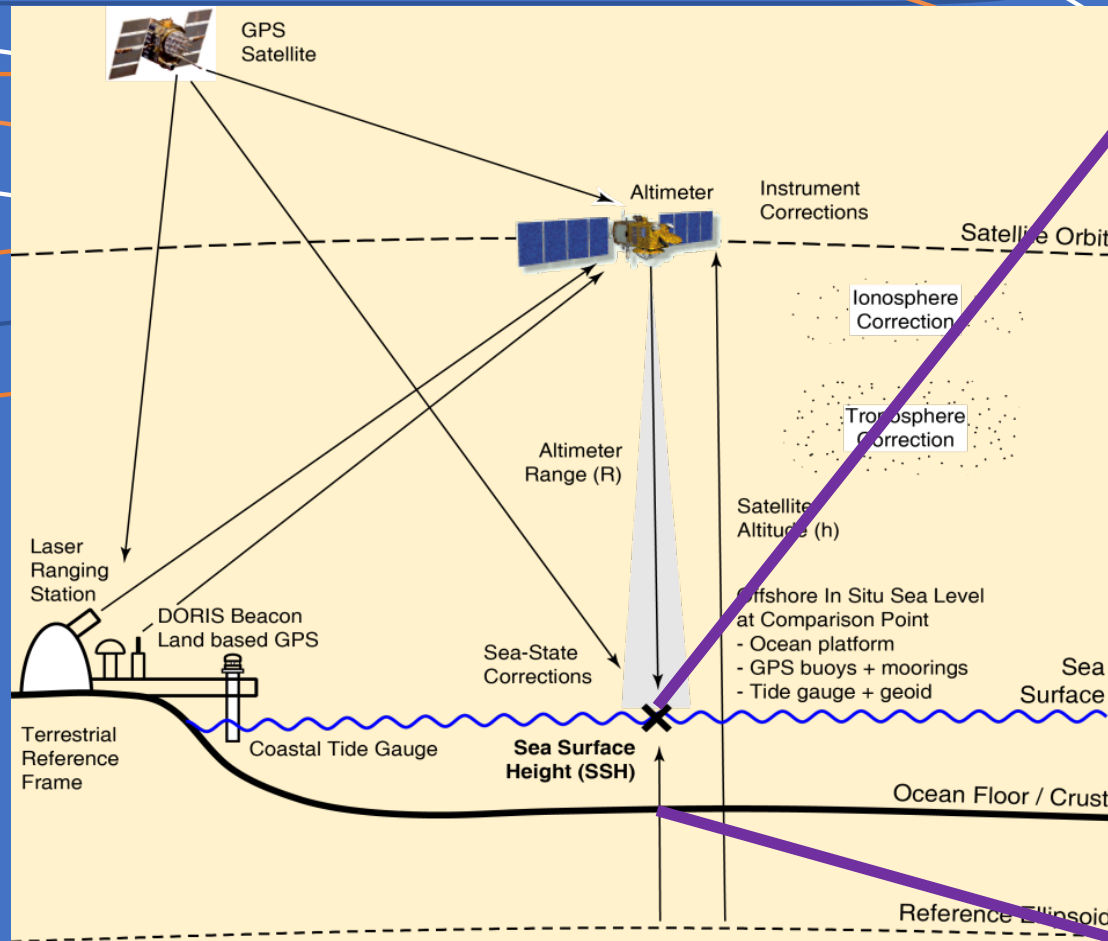


Sentinel-3B
Launching soon!

**Given systematic contributions, formal error likely
 ~15 mm, marginally less for recent missions.**

SSH @ Tide Gauge + datum (GPS)

$$\text{SSH} = \text{Bot Pressure} / [\rho(T,S) g] + \text{datum (GPS)} - \text{IBE}$$



SSH @ Tide Gauge + datum (GPS)

SSH = Bot Pressure / $[\rho(T,S) g]$ + datum (GPS) - IBE



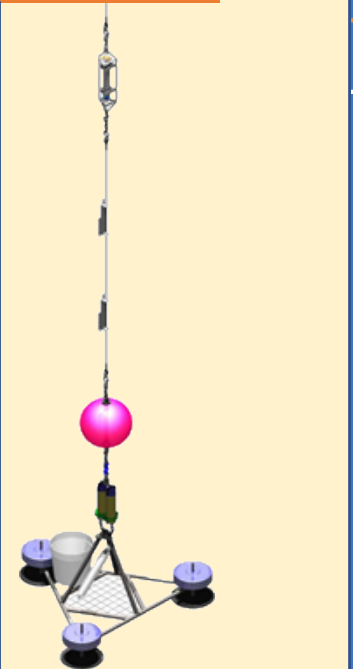
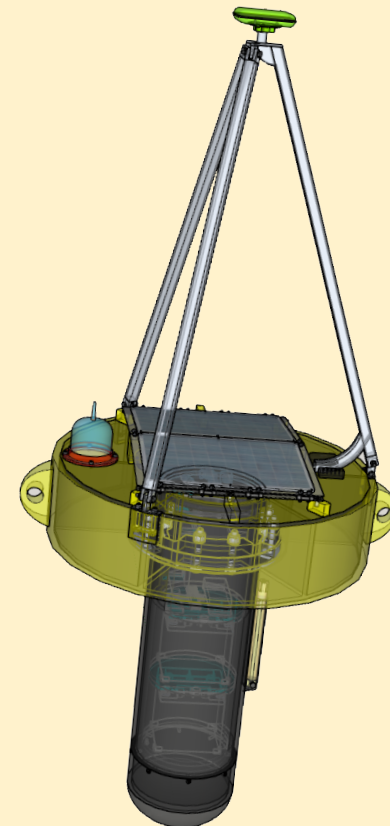
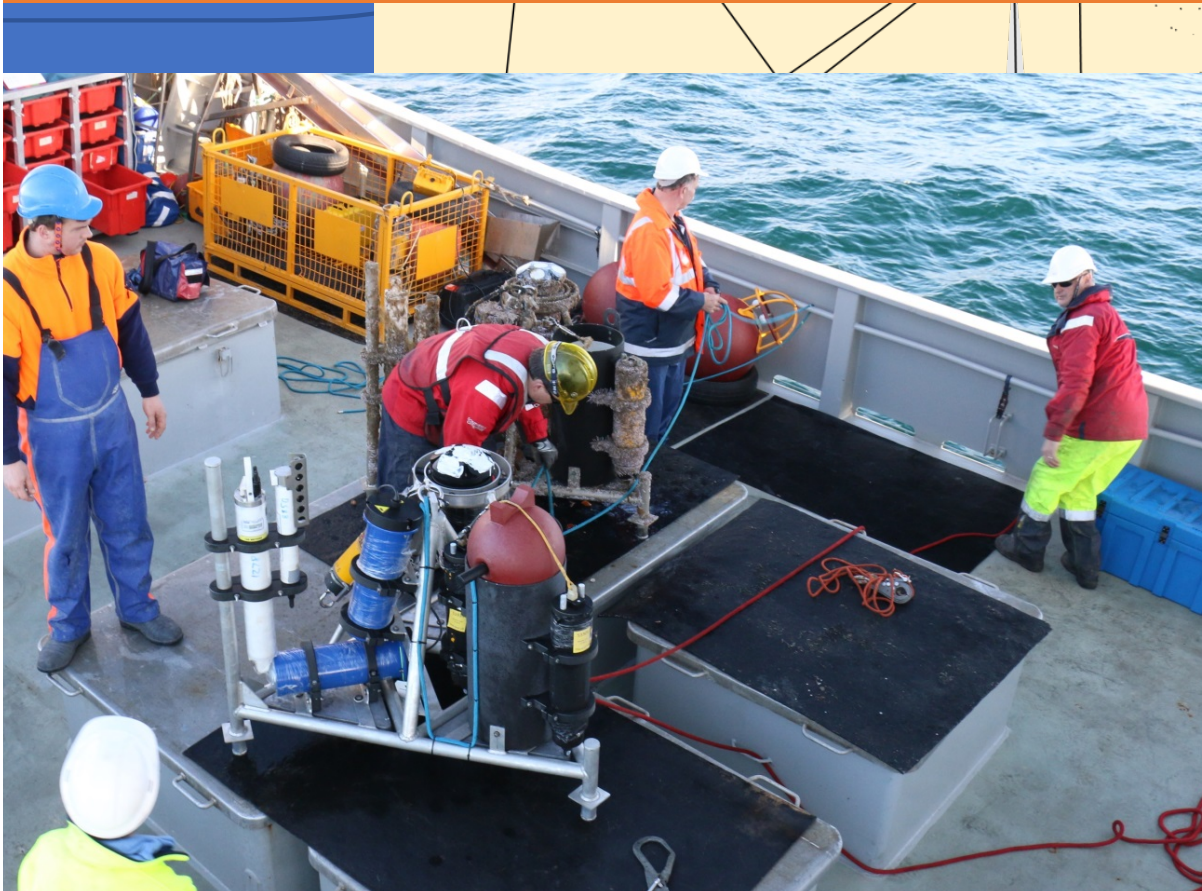
GPS



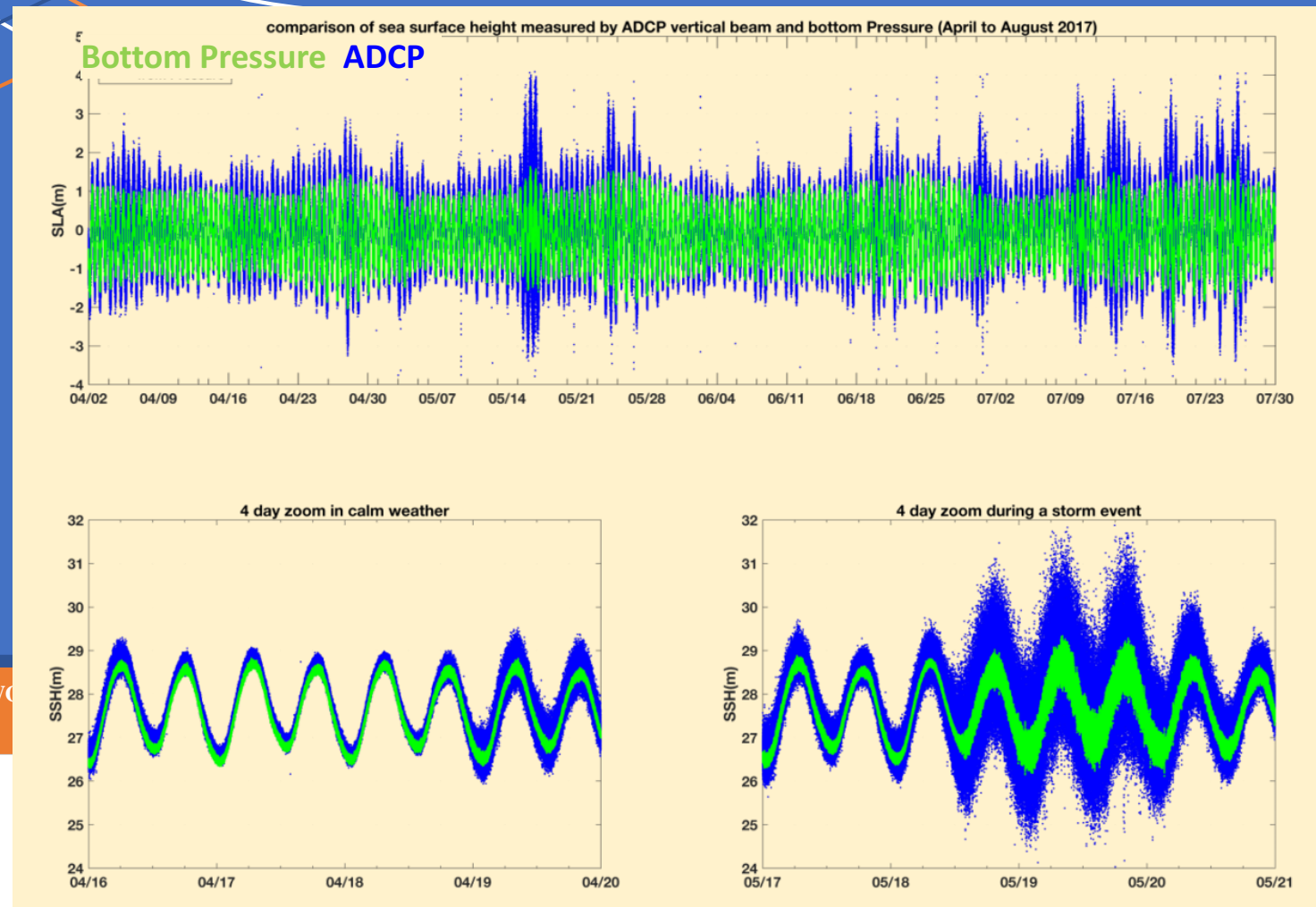
New developments :

SSH from 5 beam ADCP Inverted Echo Sounder + U,V,W + Waves

SSH from GPS buoys longer term deployments



New developments :
SSH from 5 beam ADCP based Pressure Inverted Echo Sounder
+ U,V,W + Waves
At the Sentinel3-B Crossover site. (+GPS buoy for Datum)

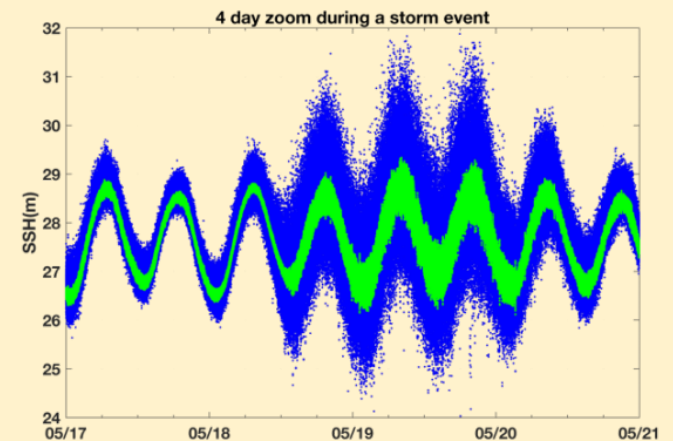
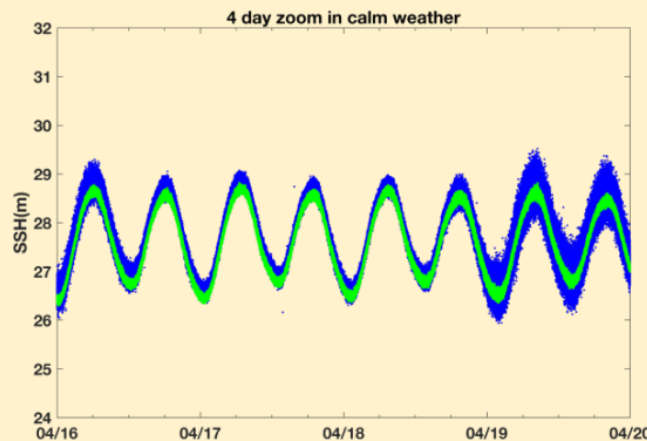
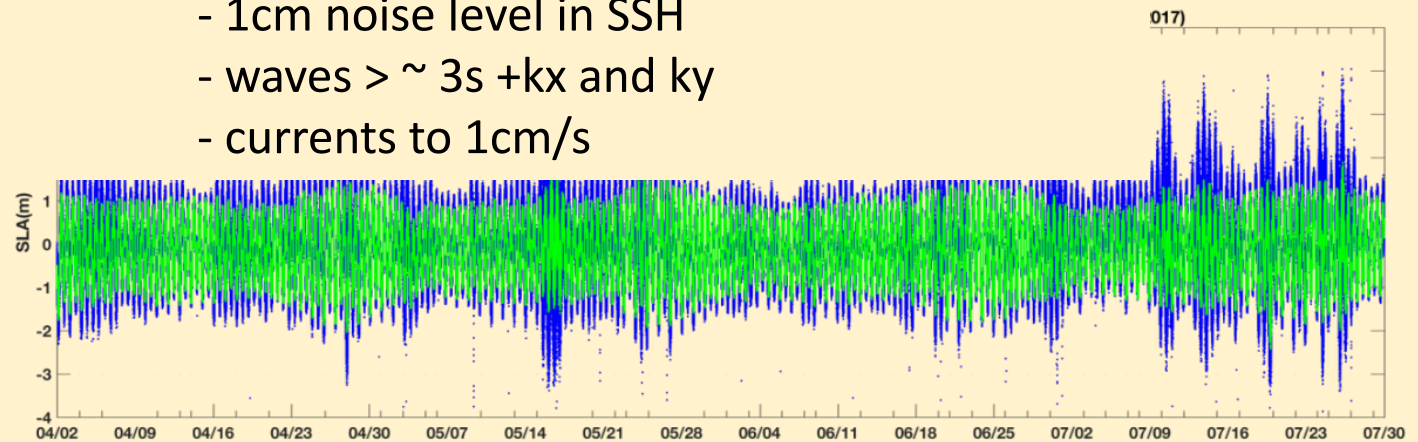


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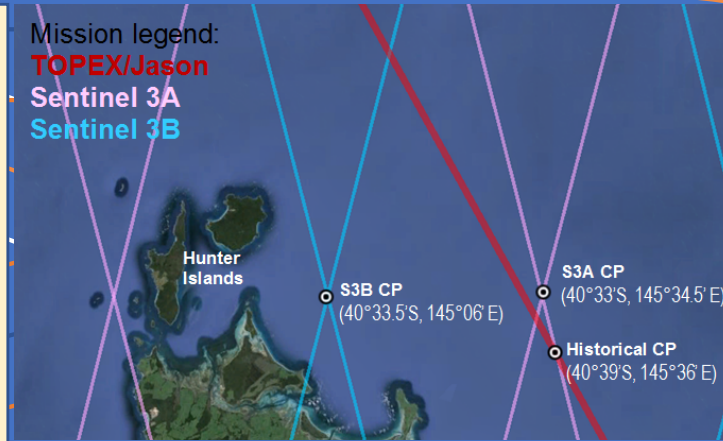
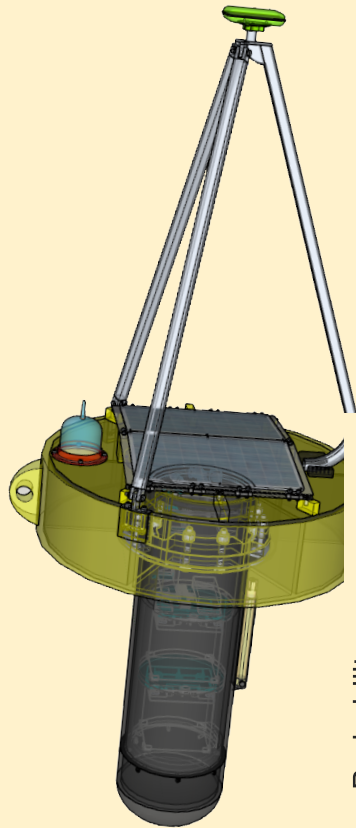


Updated version ready and in position for Sentinel-3B

- next service in August 2018
- 1cm noise level in SSH
- waves $> \sim 3s$ +kx and ky
- currents to 1cm/s

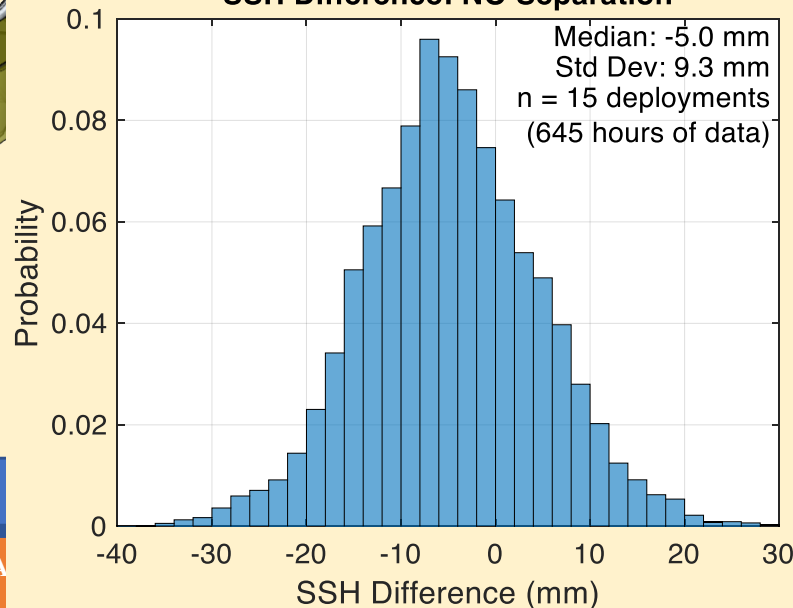


New developments : SSH from GPS buoys longer term array deployments

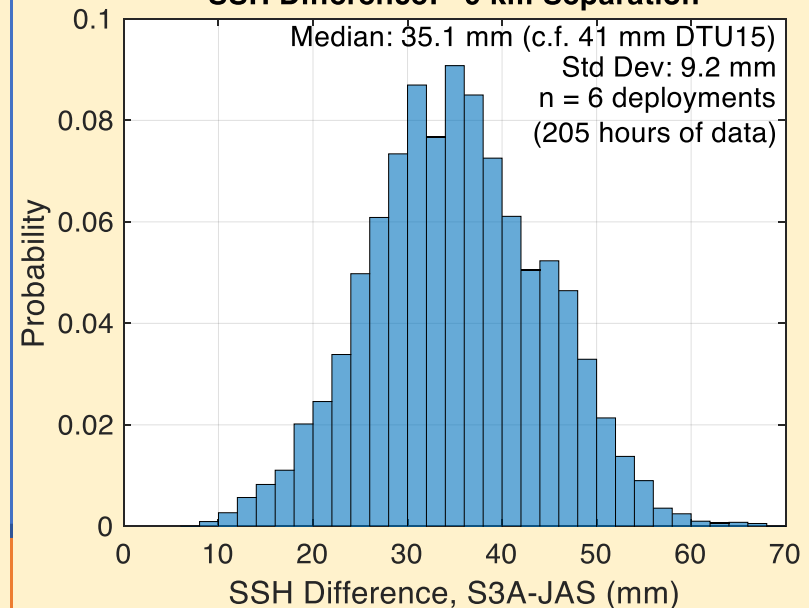


2 buoys experiments :
<100m separation both at JAS
~9km separation JAS-S3A

SSH Difference: NO Separation



SSH Difference: ~9 km Separation



The IMOS Satellite altimetry calibration facility Plan :

Finalising next week funded July 2018 - June 2022.

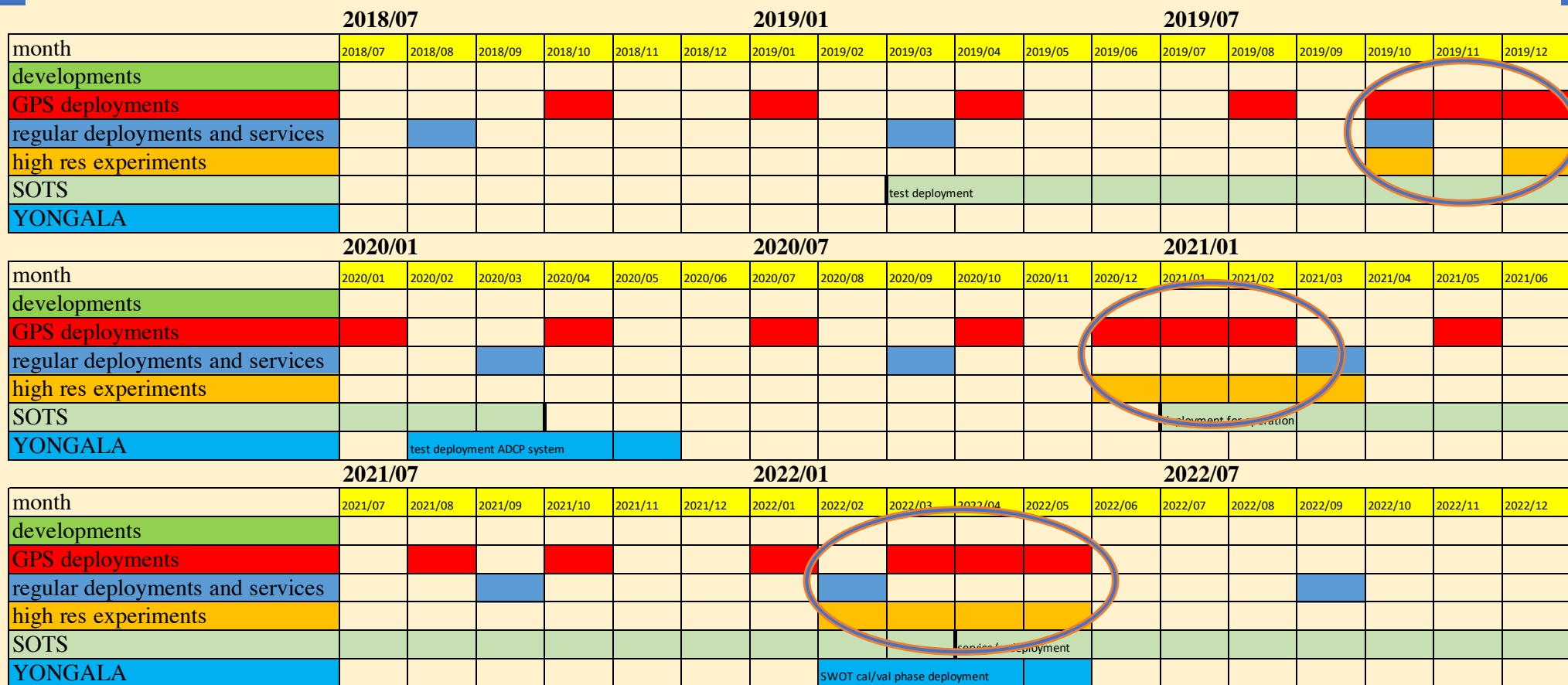
1. Continuity of Jason, Sentinel-3A and Sentinel-3B absolute Cal.
2. Additional program in view of SWOT and HR altimetry

| | 2018/07 | | | | | | 2019/01 | | | | | | 2019/07 | | | | | |
|----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
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| high res experiments | | | | | | | | | | | | | | | | | | |
| SOTS | | | | | | | | | | | | | | | | | | |
| YONGALA | | | | | | | | | | | | | | | | | | |
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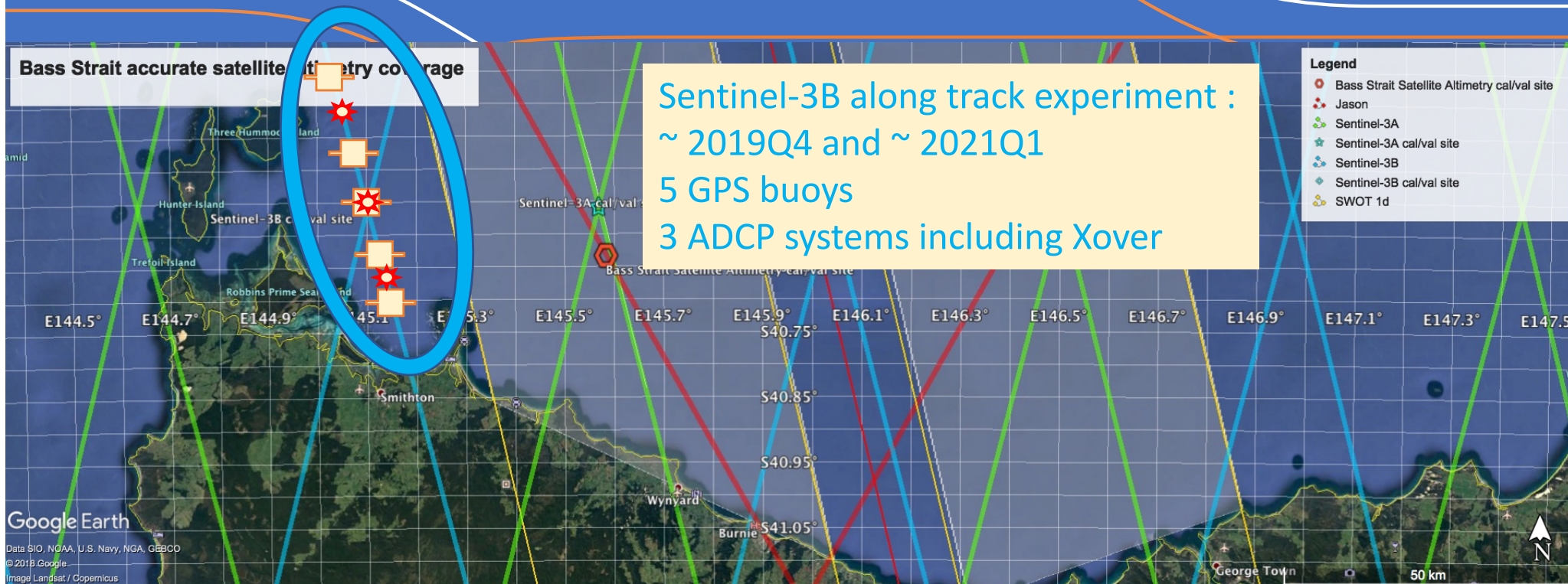
High Resolution Experiments :

- Sentinel-3B along track while developing the longer term GPS array capability
 - (~2019Q4 and ~2021Q1)
- SWOT 1d (2022)



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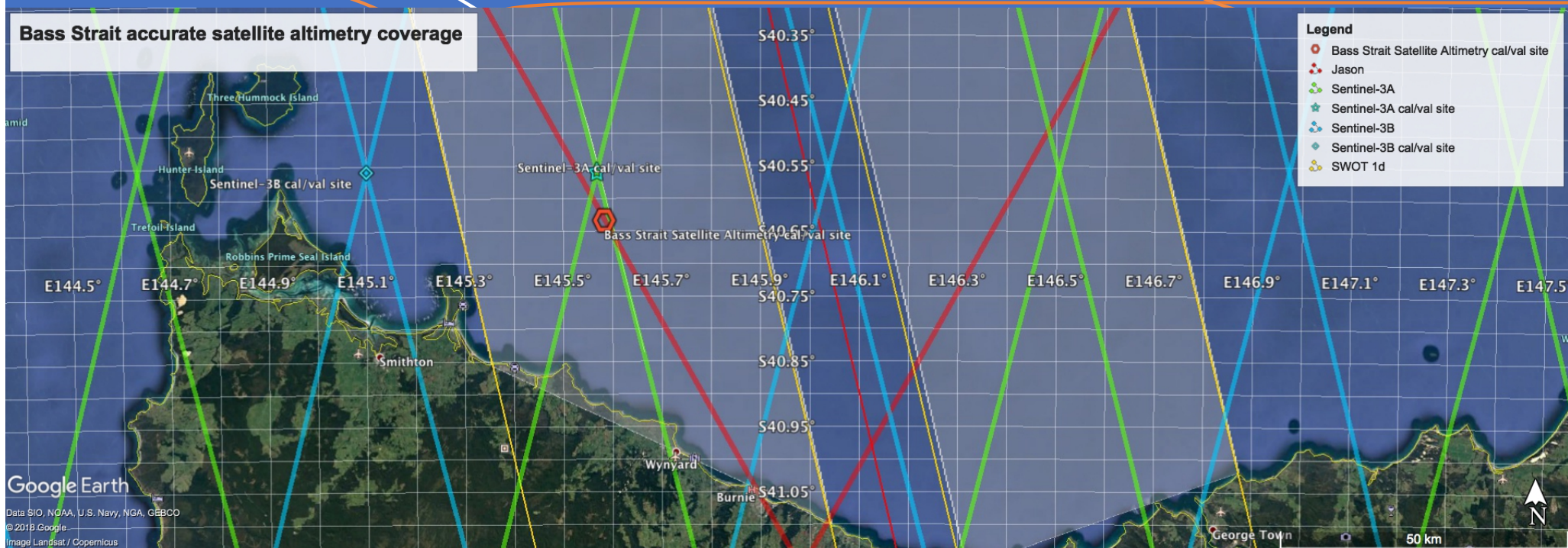
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High Resolution Experiments SWOT 1d (2022) : ???

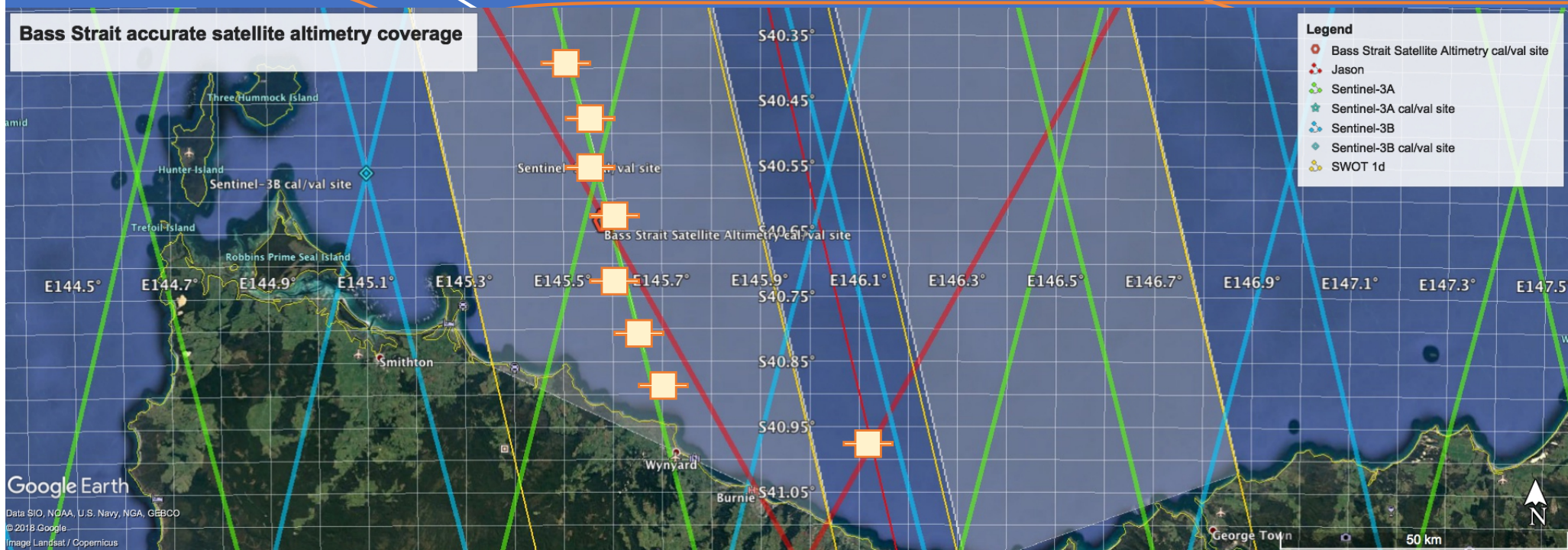
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- Australia will have 5 GPS buoy for 3 month deployment + 2 ADCP systems
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- What design for the experiment ?



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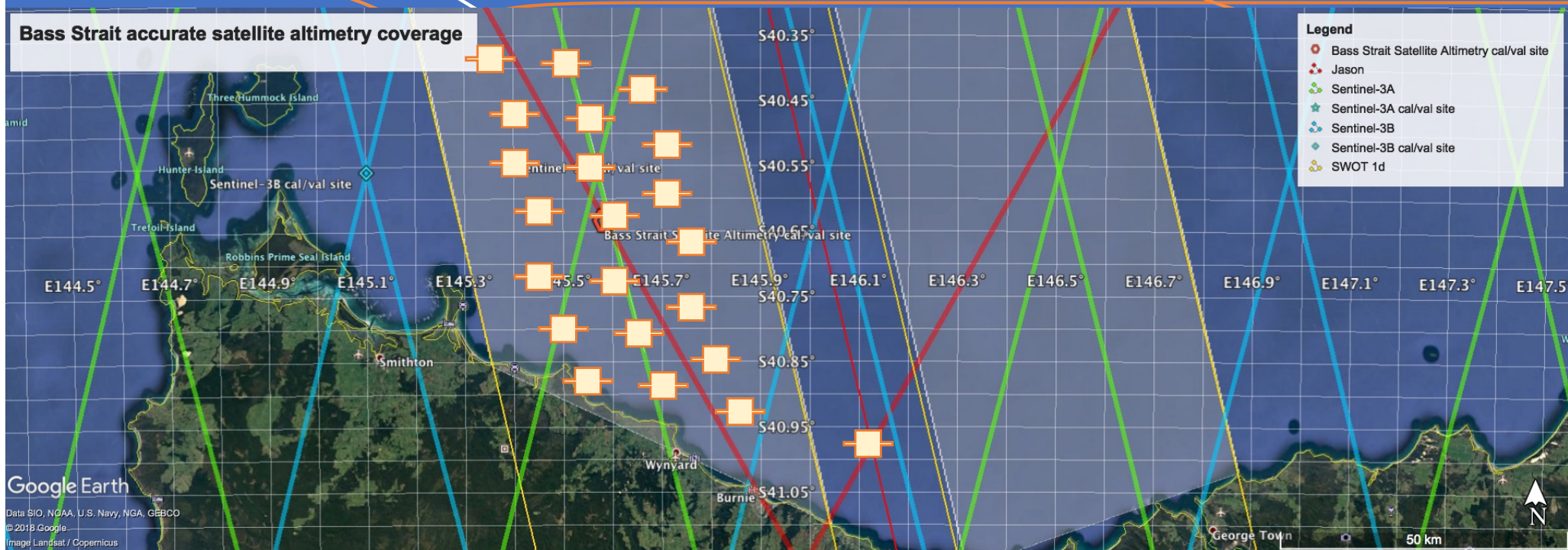
Along Sentinel-3A track ?



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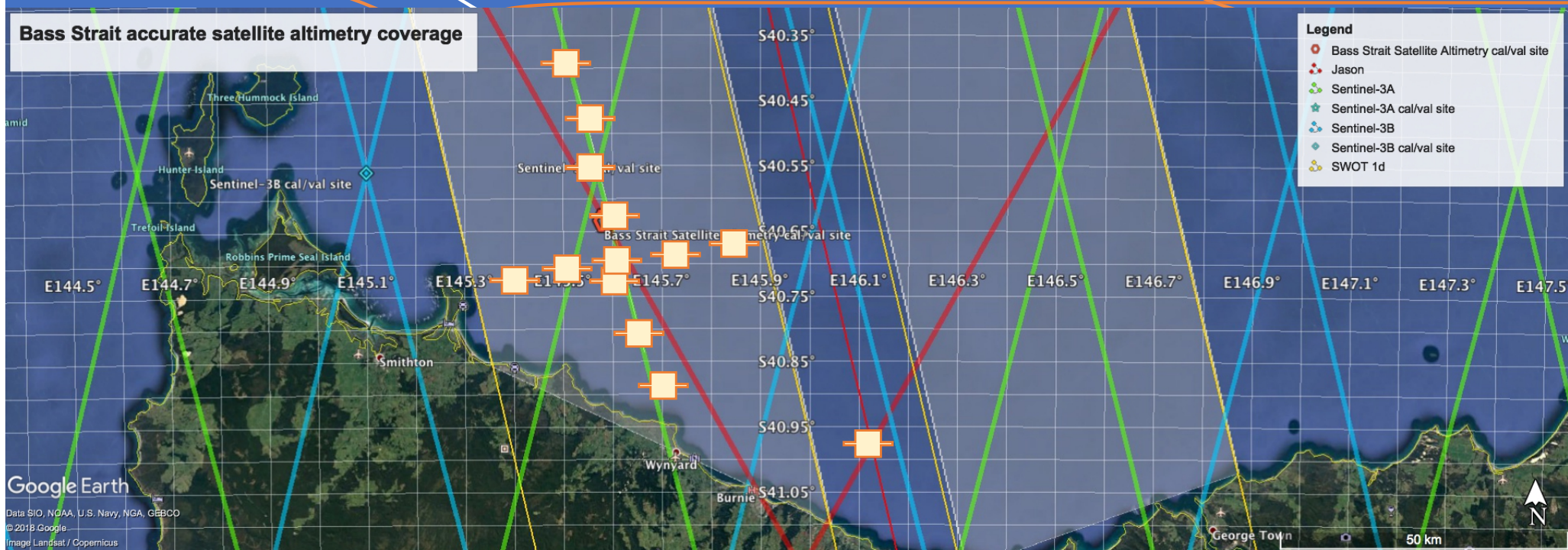
Along Sentinel-3A track ? With parallel lines?



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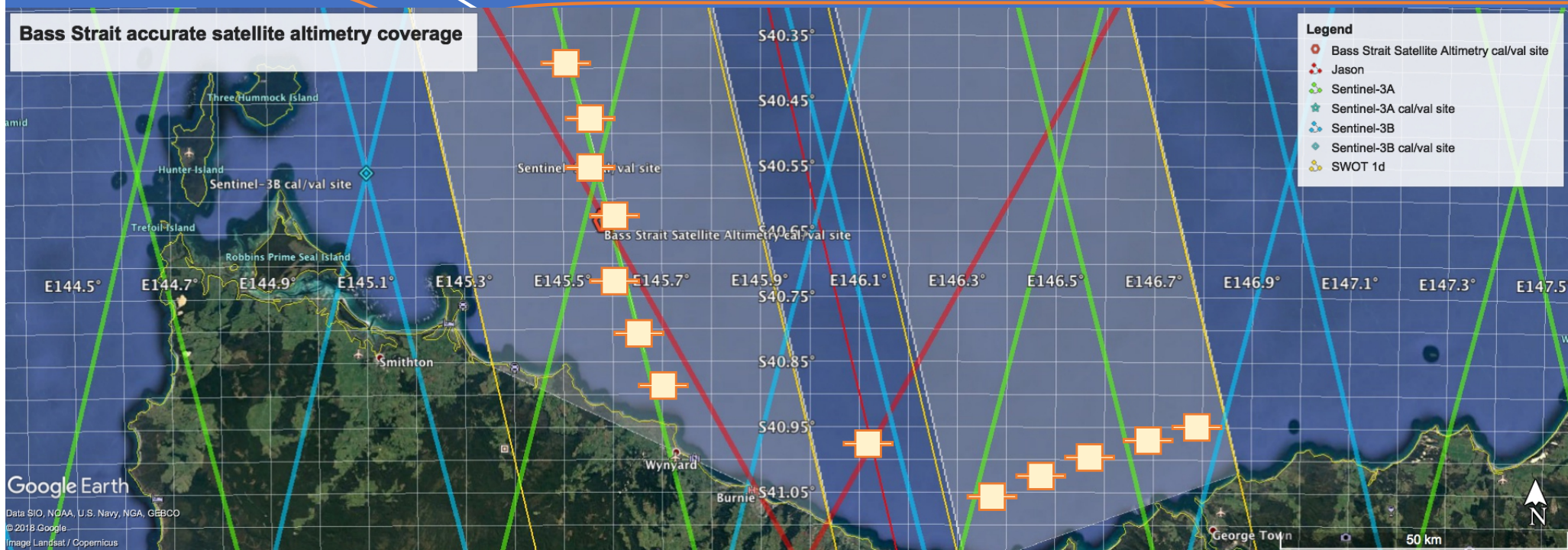
Along Sentinel-3A track ? With Cross track line?



High Resolution Experiments SWOT 1d (2022) : ???

- What design for the experiment ?

Along Sentinel-3A track ? With Cross track line on East Swath?

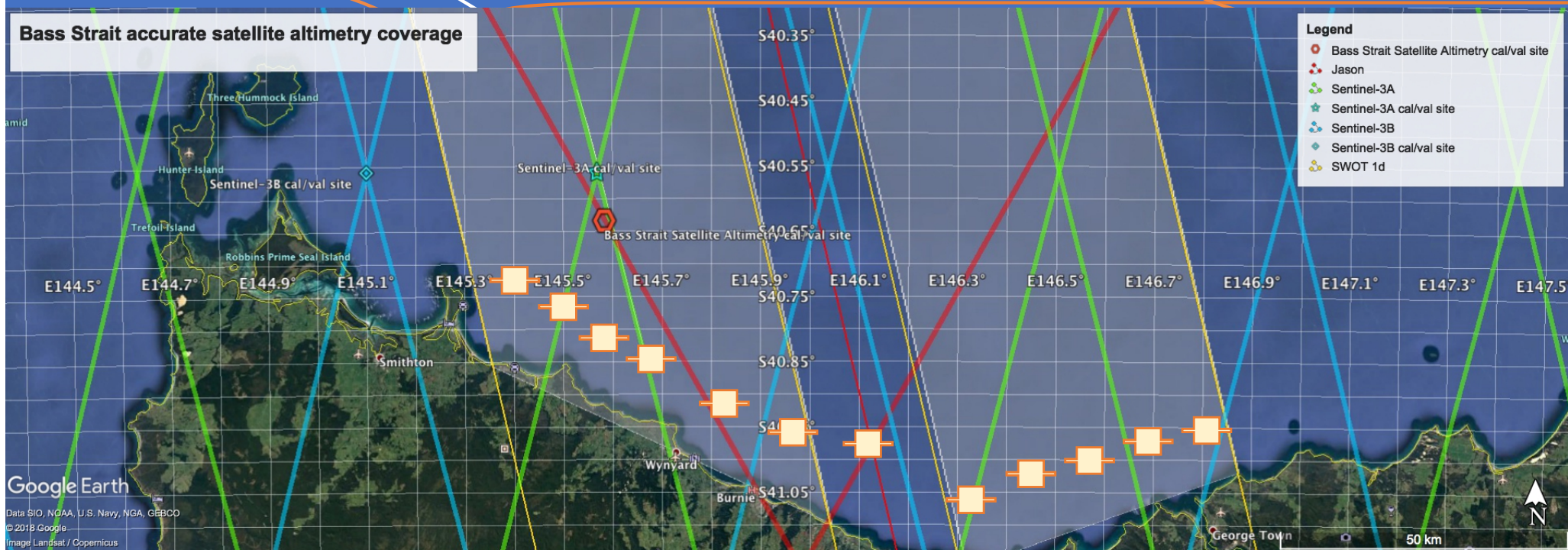


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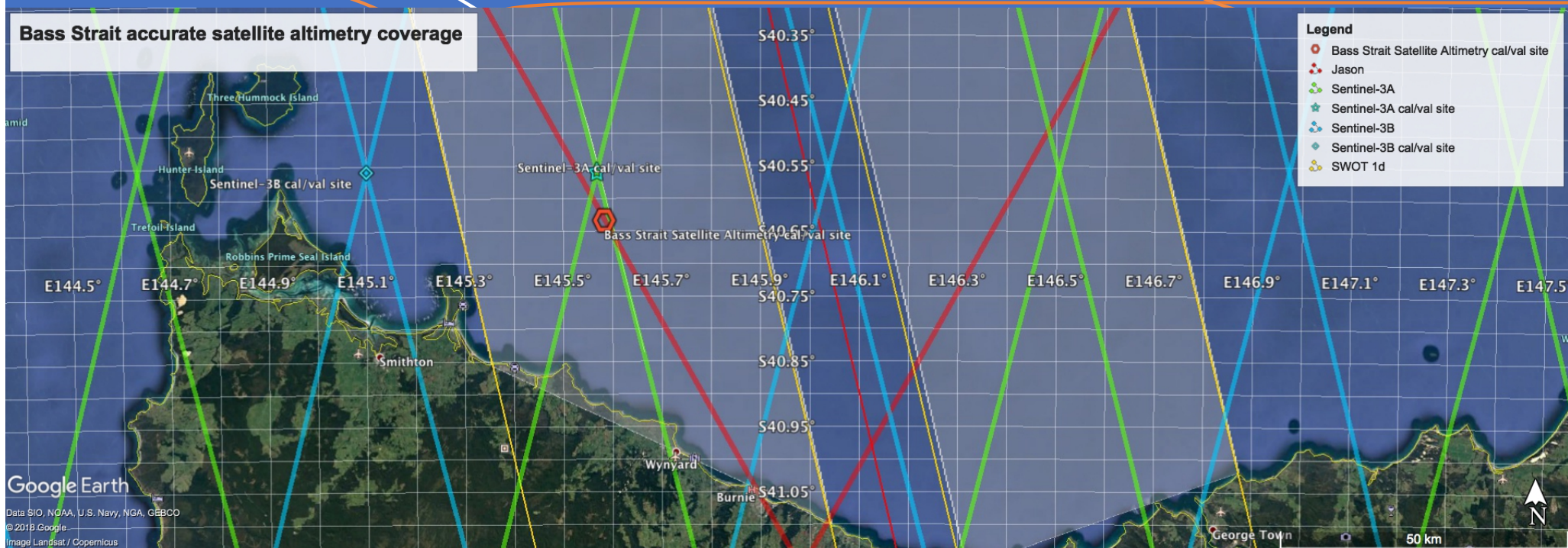
Along Sentinel-3A track ?

Bass Strait accurate satellite altimetry coverage



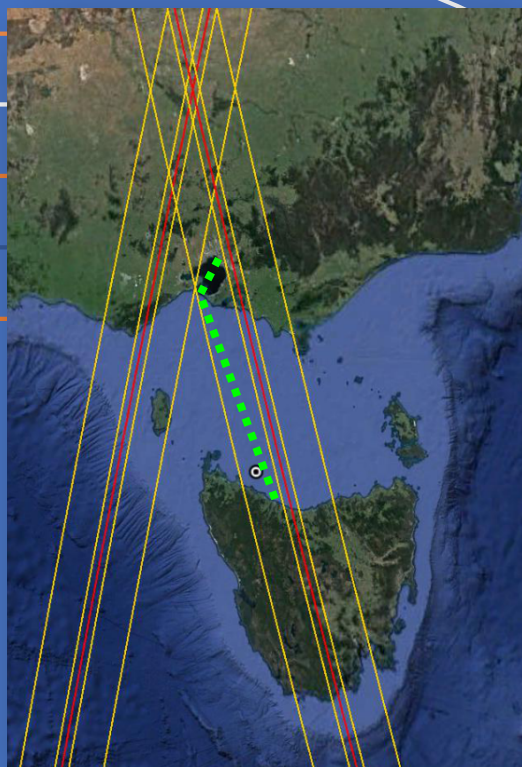
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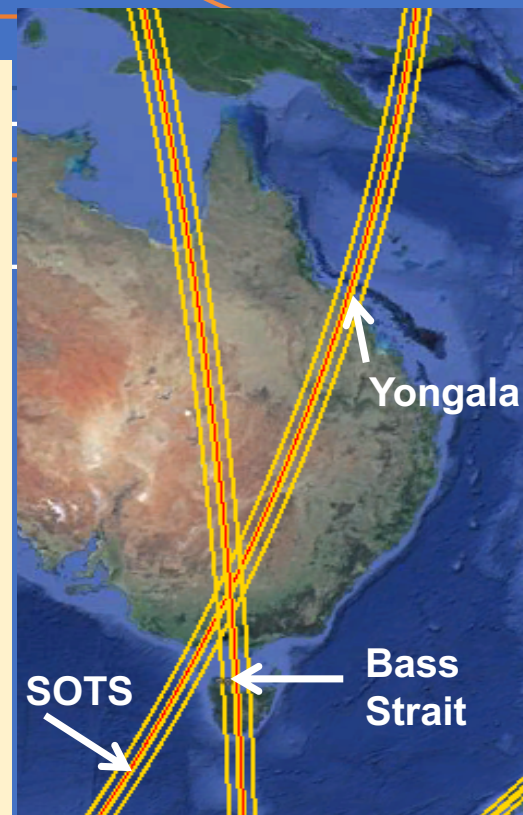


High Resolution Experiments SWOT 1d (2022) : additional geometric calval opportunities

- Devonport-Melbourne Ferry crosses Bass Strait Daily with a path contained within a SWOT swath.-> adopt a ferry.
- Australian National Reference Stations Moorings



- Yongala and SOTS Moorings have surface buoy which can support a GPS installation
- Yongala on the Great Barrier Reef. ~30m depth. Also an ADCP mooring which could be transformed into PIES++
In the west swath of pass 22
- SOTS Southern Ocean Time Series >300km offshore, >4000m depth, >8m waves, full set of instruments T,S,O,UV,waves,+++ 8km off nadir.



Experiments SWOT 21d (≥ 2022) what should we do???

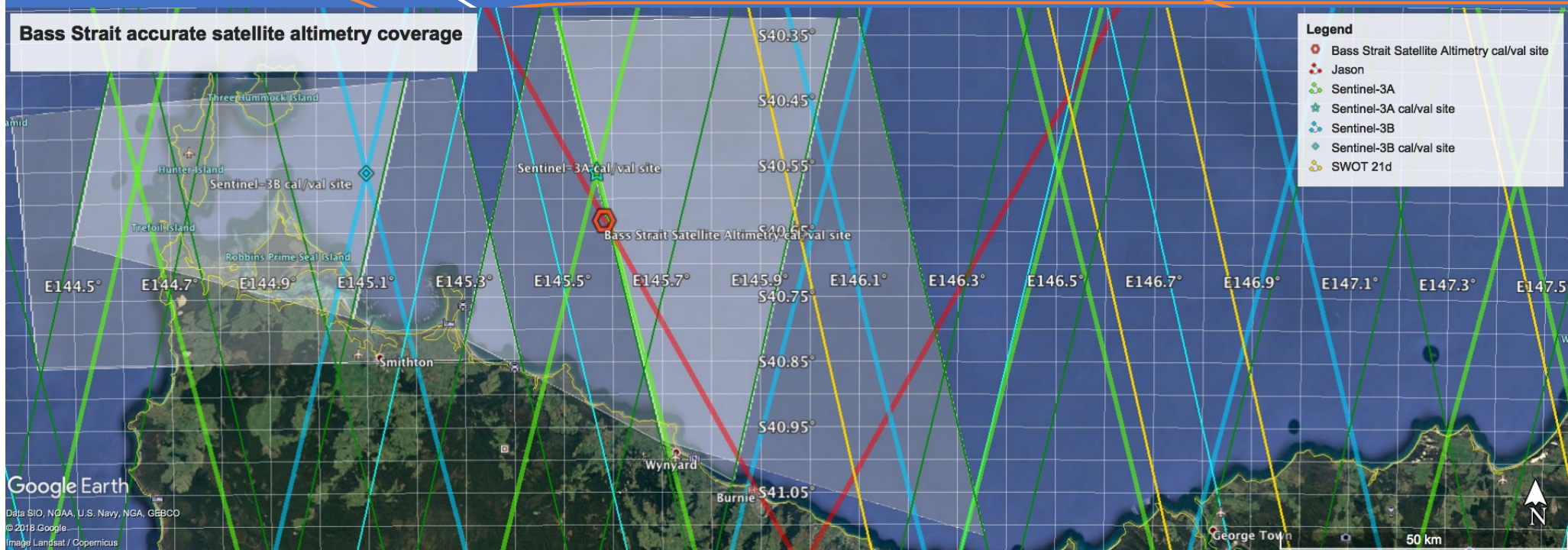
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Experiments SWOT 21d (≥ 2022) what should we do???

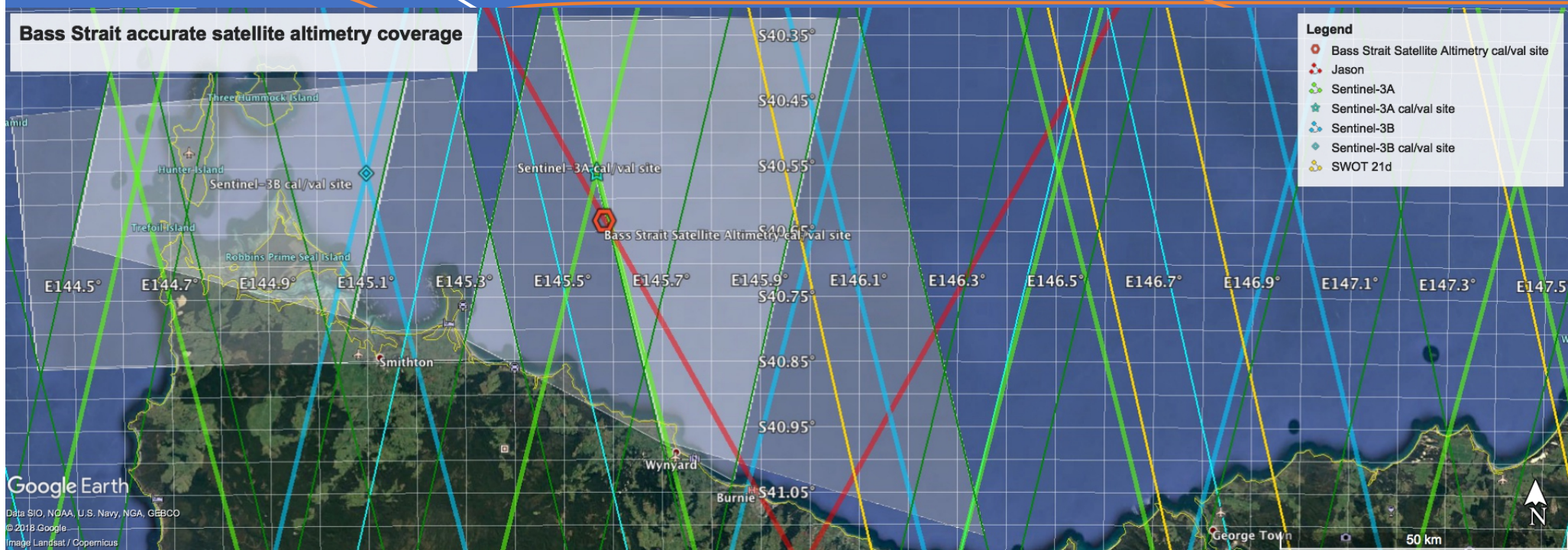
Bass Strait accurate satellite altimetry coverage



Experiments SWOT 21d (≥ 2022) what should we do???

- Nadir track?
- Use other satellites sites (S3B in 2 swaths, JAS and S3A in 1 swath)

Bass Strait accurate satellite altimetry coverage



Experiments SWOT 21d (≥ 2022) what should we do???

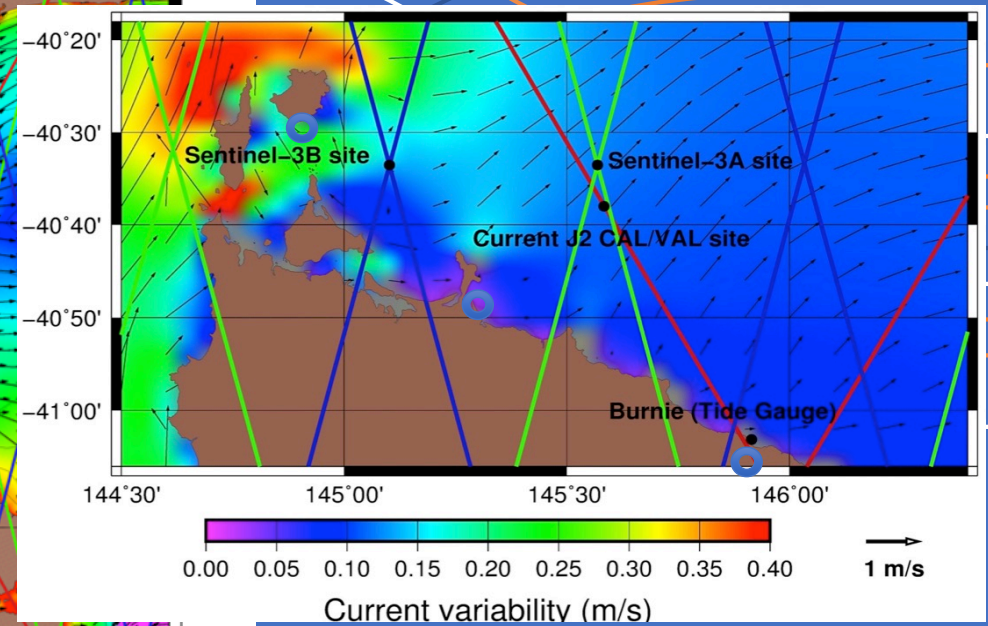
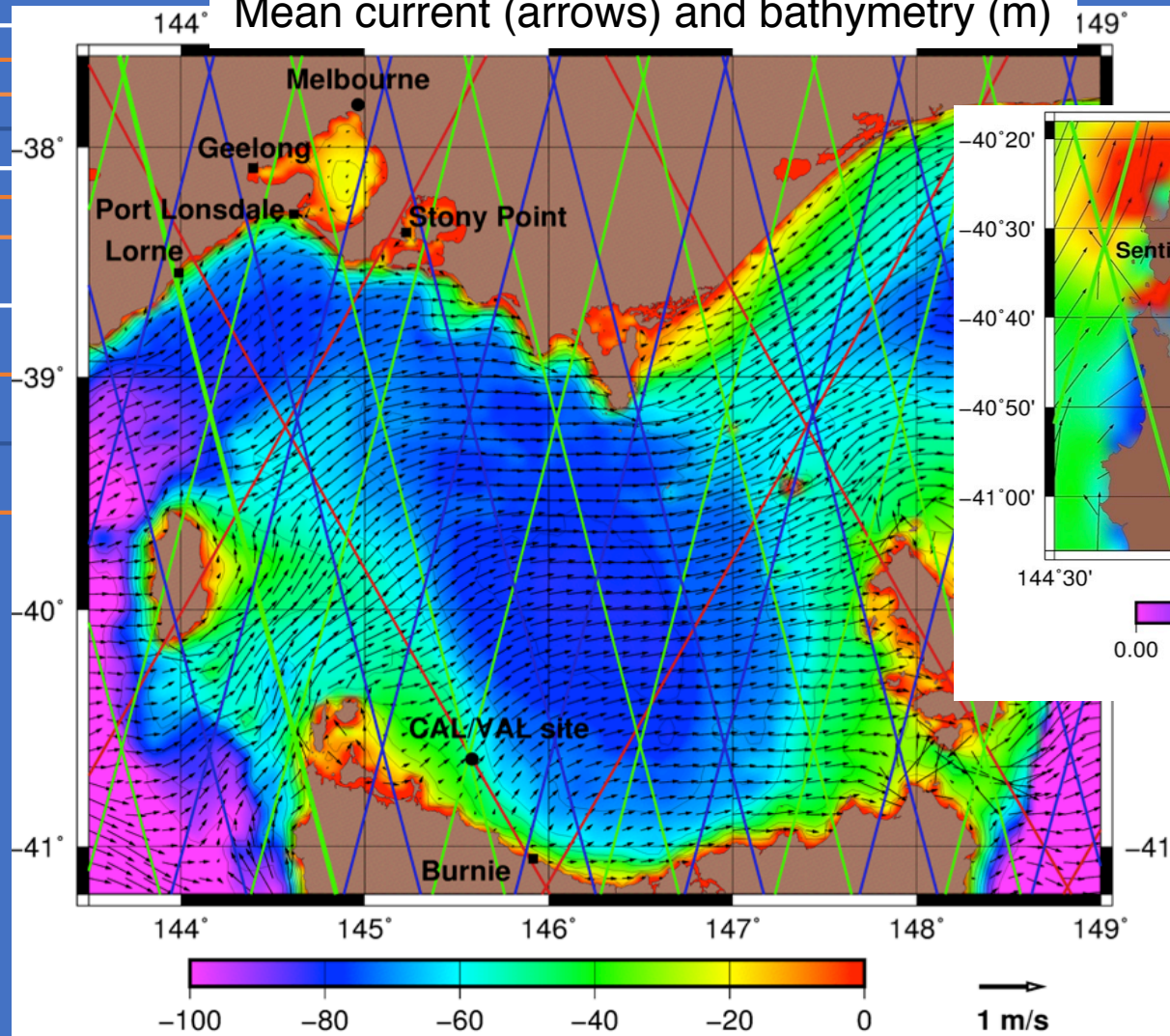
- Yongala : 1.3km from nadir 298; within 507 west swath
- SOTS : within swaths of 91, 298, 369, 576.



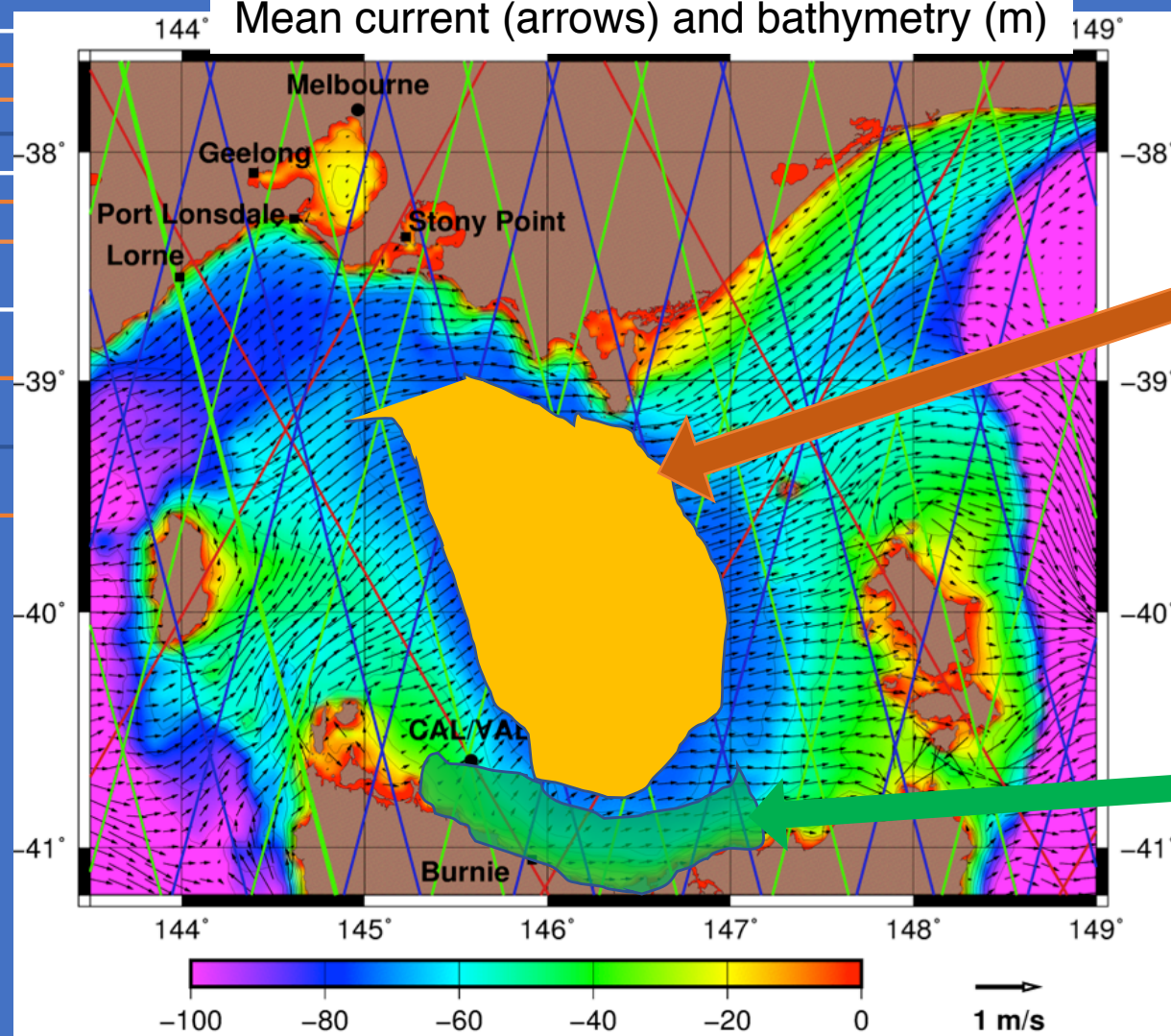
Australian geometric CalVal plan summary

- Sentinel-3B Along track experiments 2019-Q4 and 2021-Q1
 - Longer term (3month) GPS buoy development and PIES++
 - 5 Australian GPS buoys will be built.
- Adopt GPS buoys and join us to make the post-launch CalVal a success
- Feedback welcome on the buoys array design
- Moorings of opportunity
- Ferry idea to be tested deeper over the coming year.
- 21d phase plan, feed back wanted
 - Nadir ? Not convenient in Bass Strait, interesting in Great Barrier Reef
 - Swath in Bass Strait at other satellites site + addition of PIES++
 - Swath in SOTS very well covered and promise interesting validation.

Mean current (arrows) and bathymetry (m)



Mean current (arrows) and bathymetry (m)



Unstable mud ground
i.e. no mooring

GSM reception
i.e. NRT data possible

