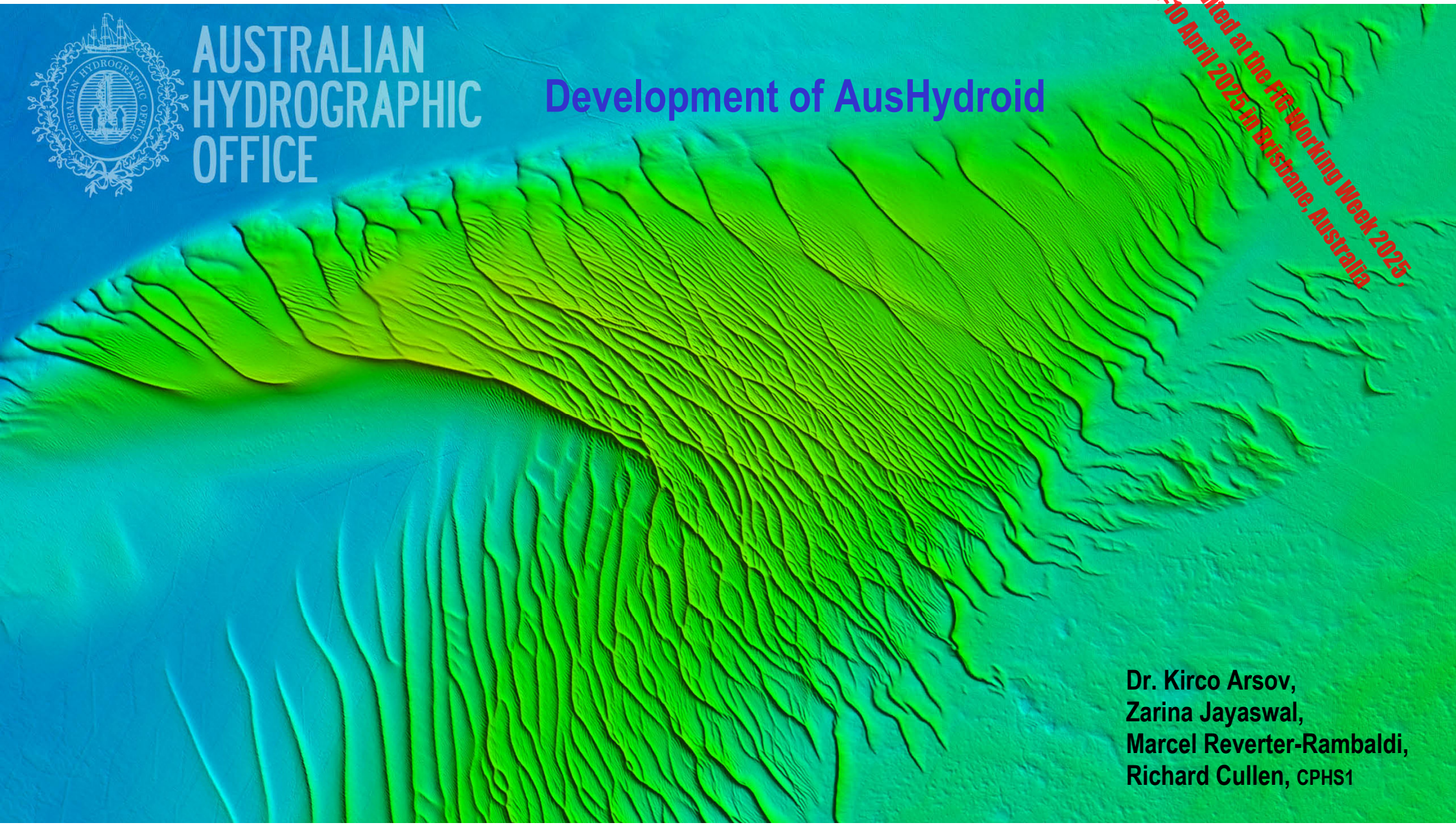

AUSTRALIAN HYDROGRAPHIC OFFICE

Development of AusHydroid

Presented at the FIG Working Week 2025,
6-10 April 2025 in Brisbane, Australia

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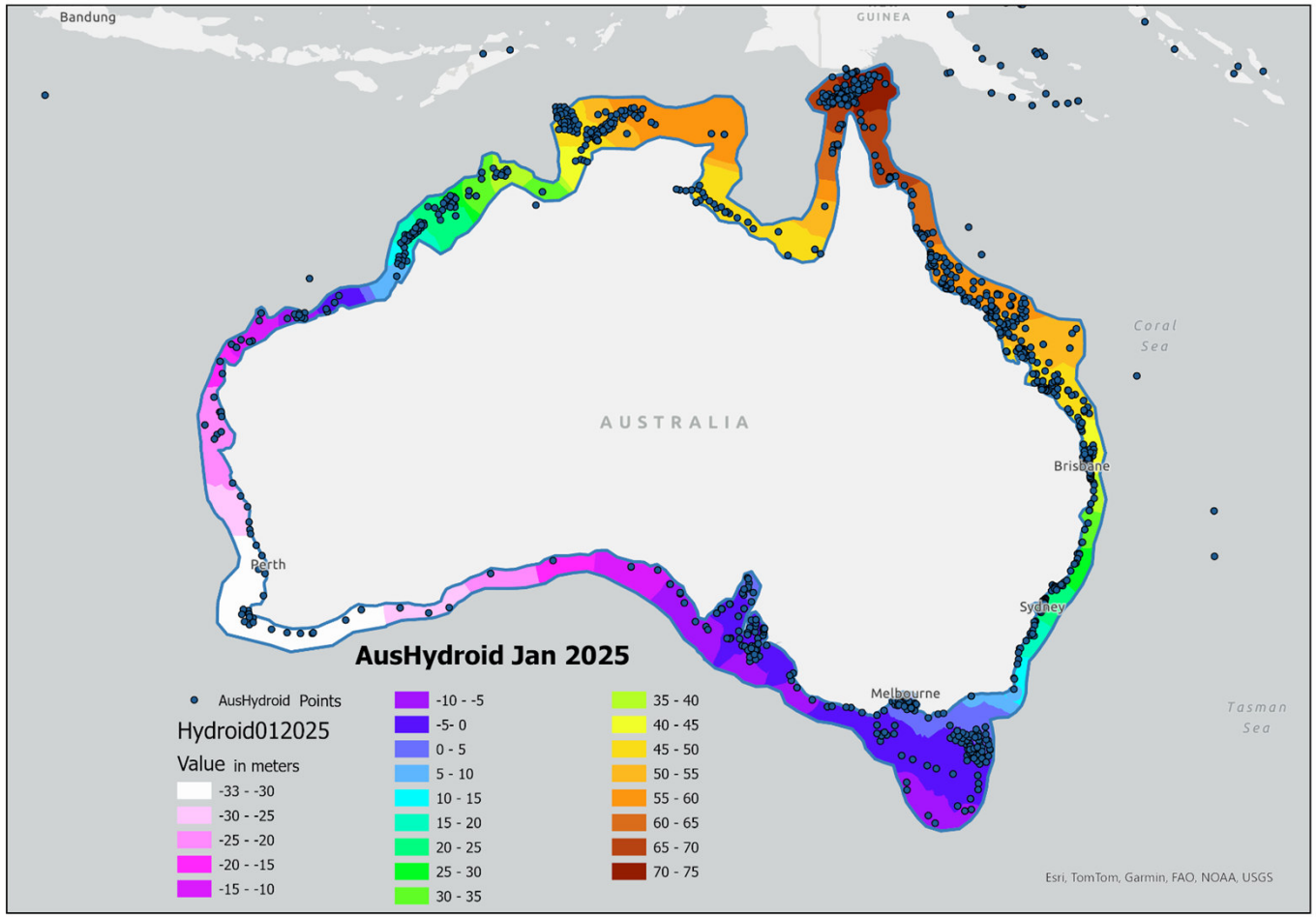
Overview

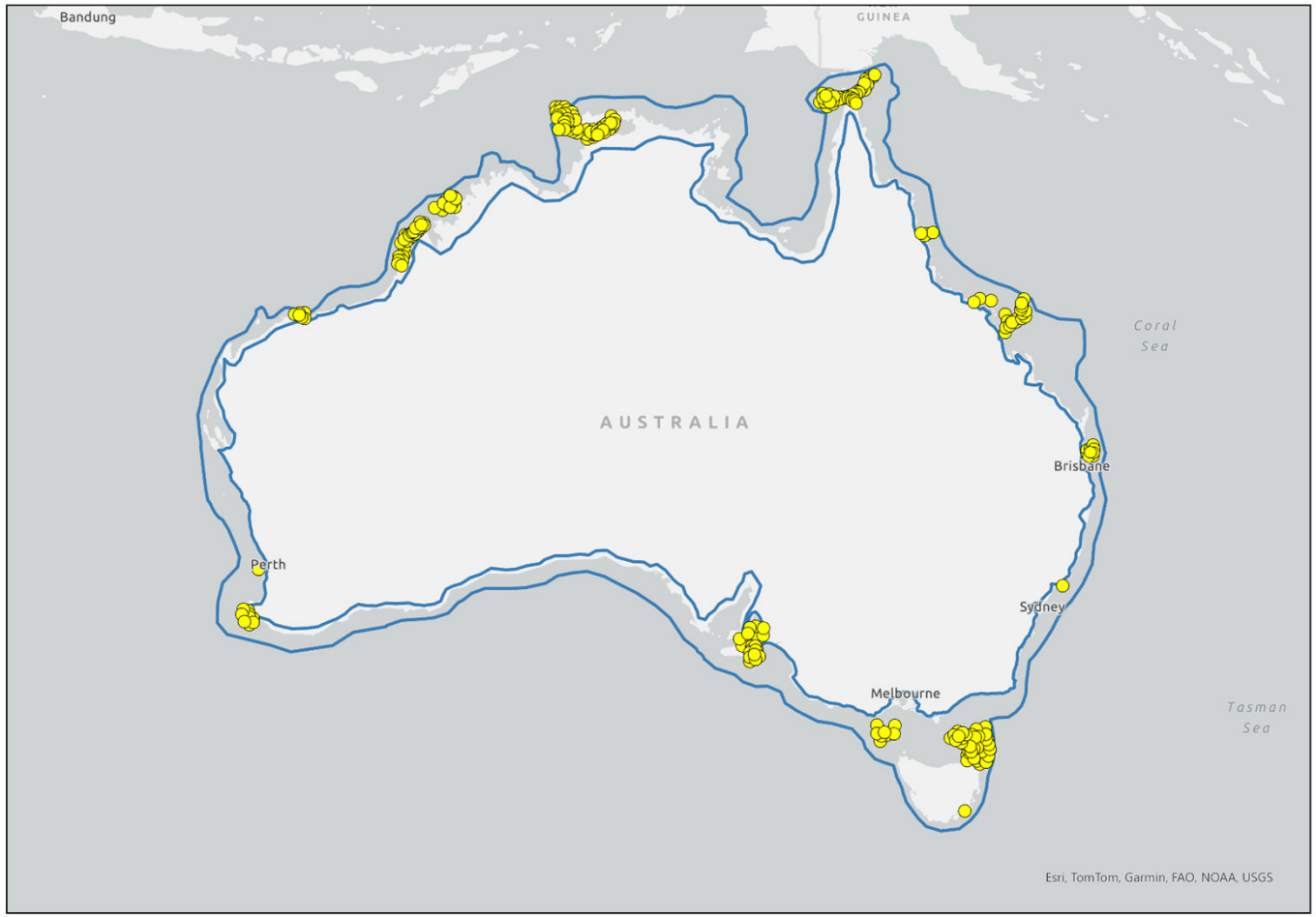
- Intro
- Current status
- Future activities
- Challenges

AusHydroid latest model 01/2025



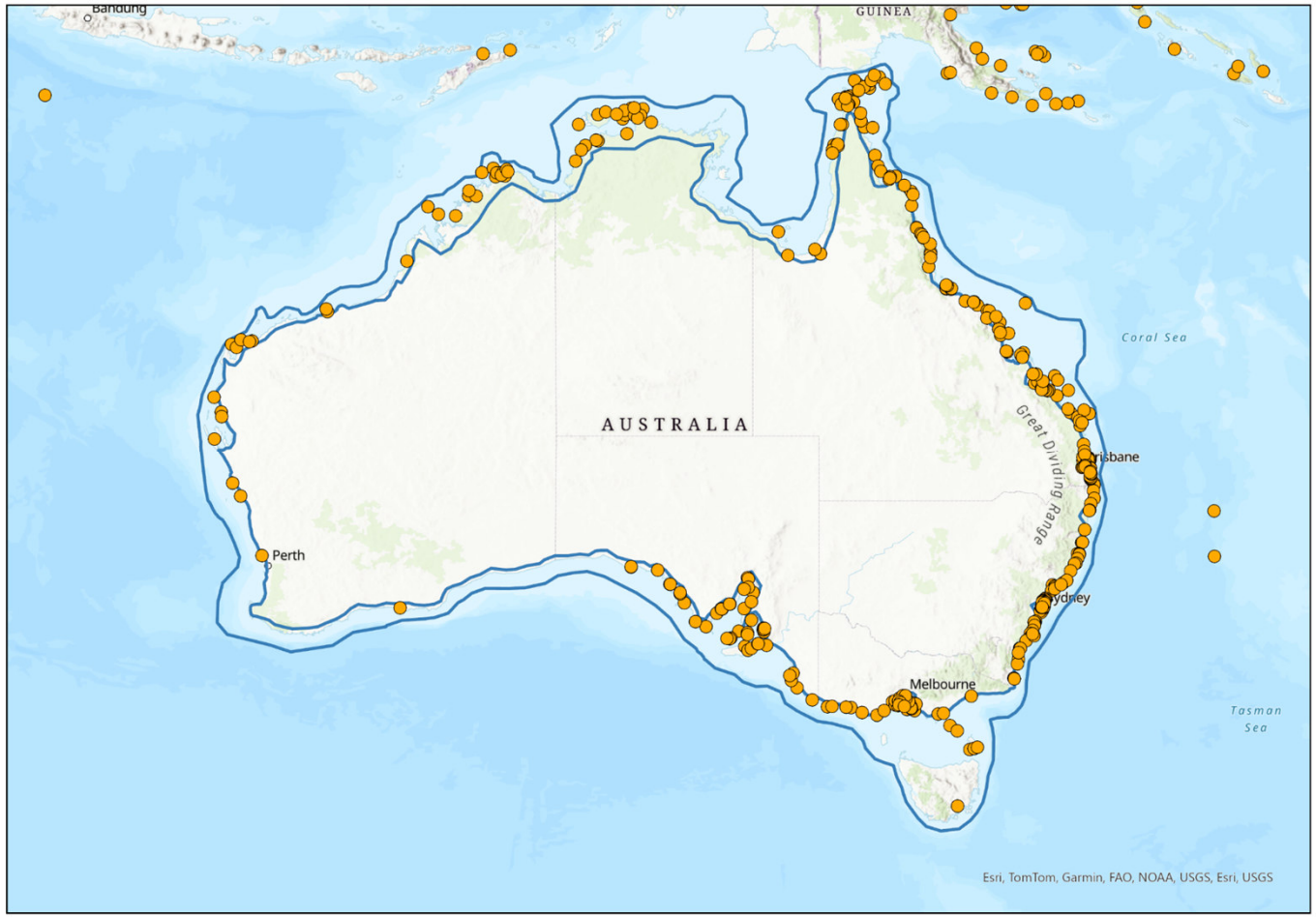
- 806 points based on TIS and HIPP data
- AusGeoid2020 and GGM05 for testing correlations between new observations
- Work in progress
- Vertical Uncertainty <0.1m – Validation to follow (For GGM and AusGeoid Points 0.2m-0.5m
- Mainly 2D surface
- Very good starting point; compatibility with geoid values
- For hydrographic survey, needs densification and accuracy verification
- Very low spatial resolution – work in progress

HIPP Survey Current status 2020-2025



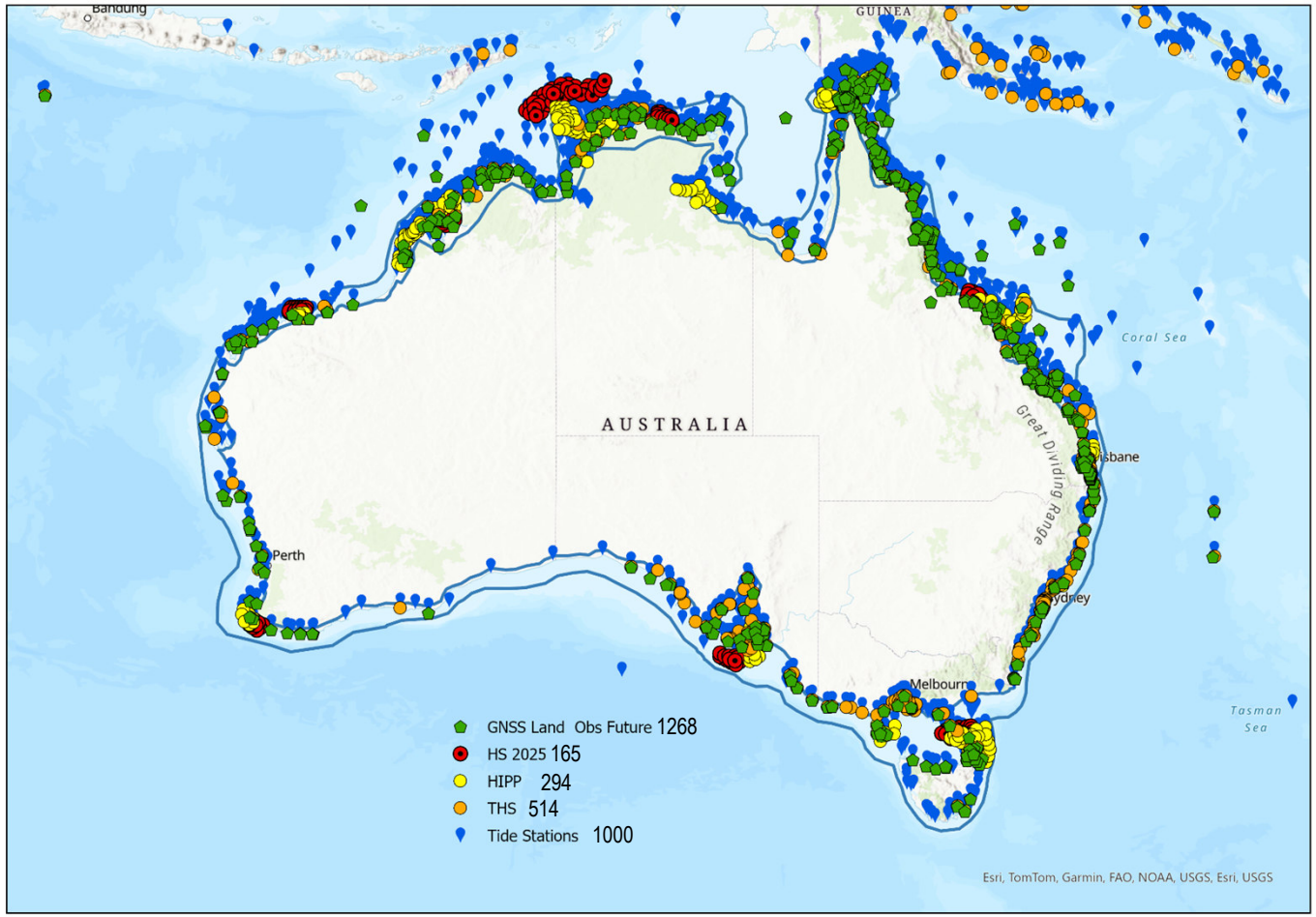
- 294 Points
- ~ 0.1m vertical accuracy
- Well defined methodology, described in the HIPP Statement of Requirements – widely implemented by industry
- Automated tidal and GNSS data processing, filtering, tidal processing and AusHydroid estimation
- Automated Python script for Buoy data analysis etc. Reach Subsea; work in progress
- GNSS Hardware development (e.g. Sharkbuoy freoceans, SparBuoy, Metocean Buoy)
- Not at desired pace for AusHydroid development
  - investigating methods to speed up development
- Large data gaps
- Increase in TG and GNSS Buoys to densify grid
- Assume 15km and smaller spatial resolution required
- Geoid, MSL and tidal stream input into planning
- Methodology and Hardware not critical

TIS database



- 514 Points
- Analysed tide and geodetic information
- Identified shore Stations close to TG with good geoid and GNSS coordinates (or levelled to TG)
- Almost double the points from HIPP
- TIS is critical to the AusHydroid development
- TIS has decades of historic and current data
- TIS is very robust, having been maintained and developed over years
- Large data gaps
- Survey marks close to TG, many come from State / Territory databases
- Cooperation with State surveys
- Excellent results in NSW, but only 1D solution along a single line
- Very poor coverage WA, SA, NT
- Requires further analysis for planning purposes

AusHydroid: Using existing data



- TS: less than 1000 points with good tidal data
- They have good TG data and MSL to LAT separation, but many lack ITRF2020 connections (cf. blue points)
- AusHydroid requires unifying data to ITRF2020
- Observation plan: if a TG benchmark has been levelled to a TG, then use static GNSS on BM
- Check by TIS analysis where we have good TG Benchmarks with good levelling data but no GNSS
- Make GNSS ground observation plan
- Do not observe points that are within proximity to existing, validated AusHydroid points
- When these points are exhausted, use GNSS Buoys on appropriate Tide Stations (blue)
- More than 1200 GNSS ground points (green) identified by TIS analysis
- Where no Tide stations or GNSS ground points available, deploy full TG over 35 days and GNSS Buoy for 75 hours

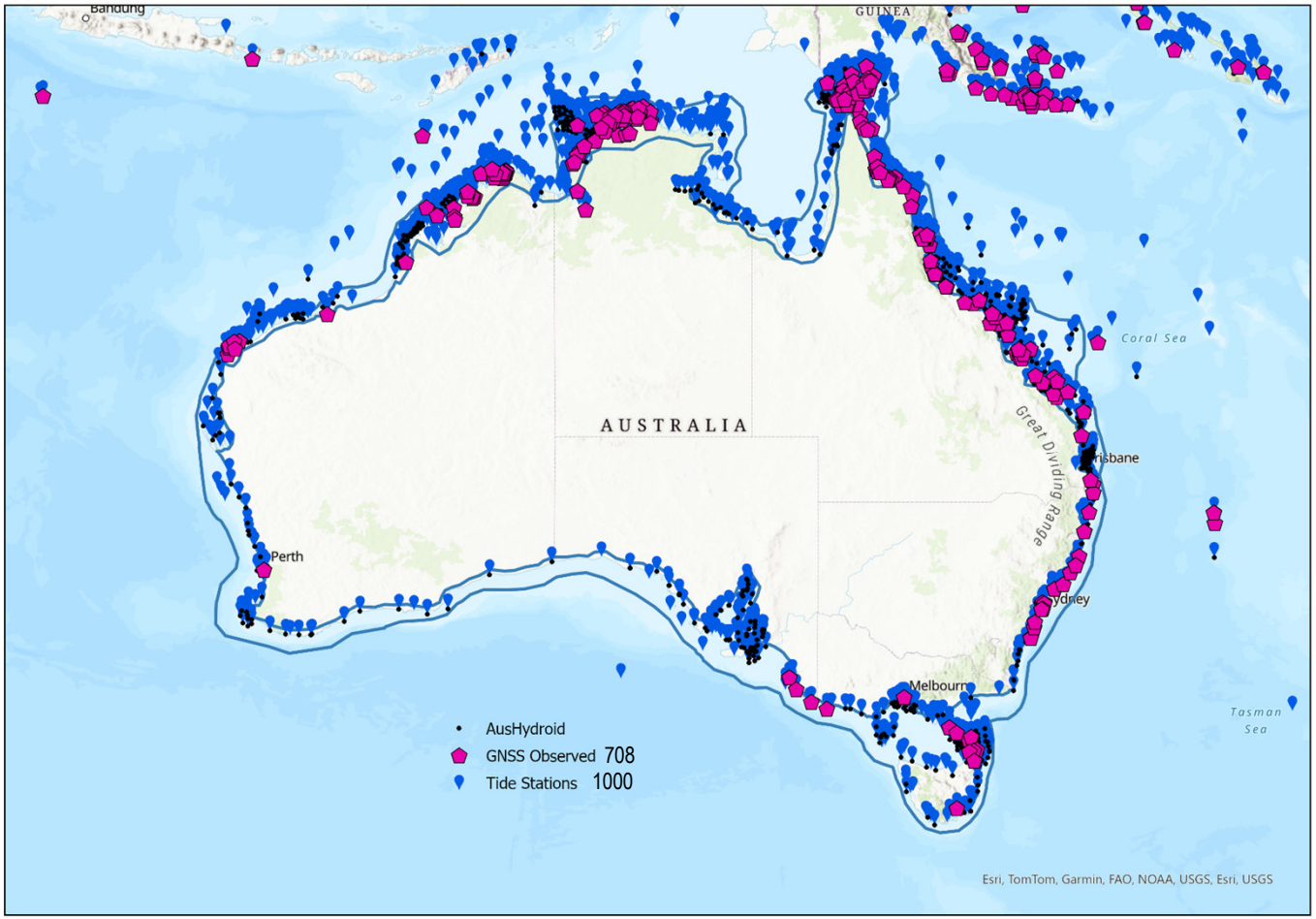
AusHydroid Proposed Build Methodology Given Existing Data

- **Static GNSS on land** mainly TG benchmarks that have levelling data to TG but no GNSS information (green points)
  - 1268 points Australia wide by examining TIS database; 1.5Y still missing

- **GNSS Tide Buoy** observations on Tidal Stations with known tidal information
  - 1000 points Australia wide - fitting predicted tide to GNSS observation; 75 hour observations by GNSS buoy

- **Tide Gauge and GNSS Buoy** new points to be established by deploying both TG and GNSS. Will be the longest observations, most arduous and expensive.
  - For the whole of Australia, close to 3000 points needed if we follow 1m geoid slope distances.
  - Average grid may vary between 10-40km
  - Each TG requires 35 days observation with concurrent 75 hour GNSS buoy

Existing Data Analysis



- TG and TIS data fully utilised
- Validate tidal station data and ensure that tidal predictions are of acceptable quality
- Finish the TIS analysis and check sets of points for GNSS only observations: where height accuracy is acceptable
- Check the levelling data, and ensure its accuracy and methodology satisfies the AusHydroid standards
- Recover or establish tidal benchmarks or survey marks
- Large data gaps in southern parts
- Revise HIPP program and identify possible areas that can be combined, e.g. HIPP + AusHydroid enroute activities
- Explore satellite data (e.g. SWOT, global gravity, Altimetry, Ocean models etc.)
- Identify points with GNSS Observation that need levelling to TG

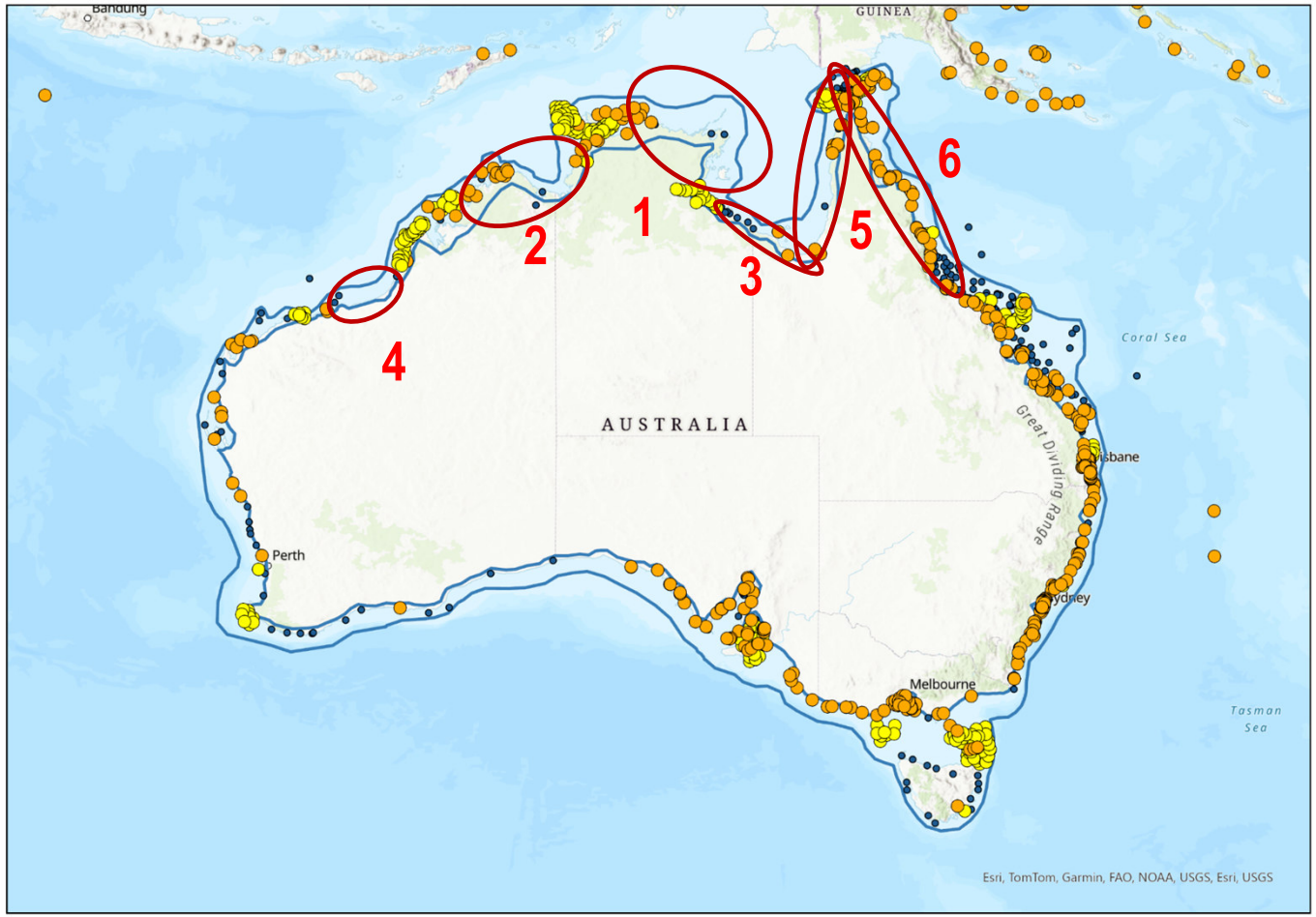
AusHydroid Observations

1. GNSS connection required on land only, 3 x 12h static GNSS sessions
2. Where Tidal Stations with good tidal data exists, 75 hours GNSS buoy observations
3. GNSS and TG combined deployment – most time consuming. Deployment of new TG over 35 days with 75 hours of GNSS buoy.
   - *Possible GNSS buoy deployment only for 35 days to enable harmonic analysis*

➢ Industry research and development into new GNSS buoys, launch and recovery methods are ongoing.

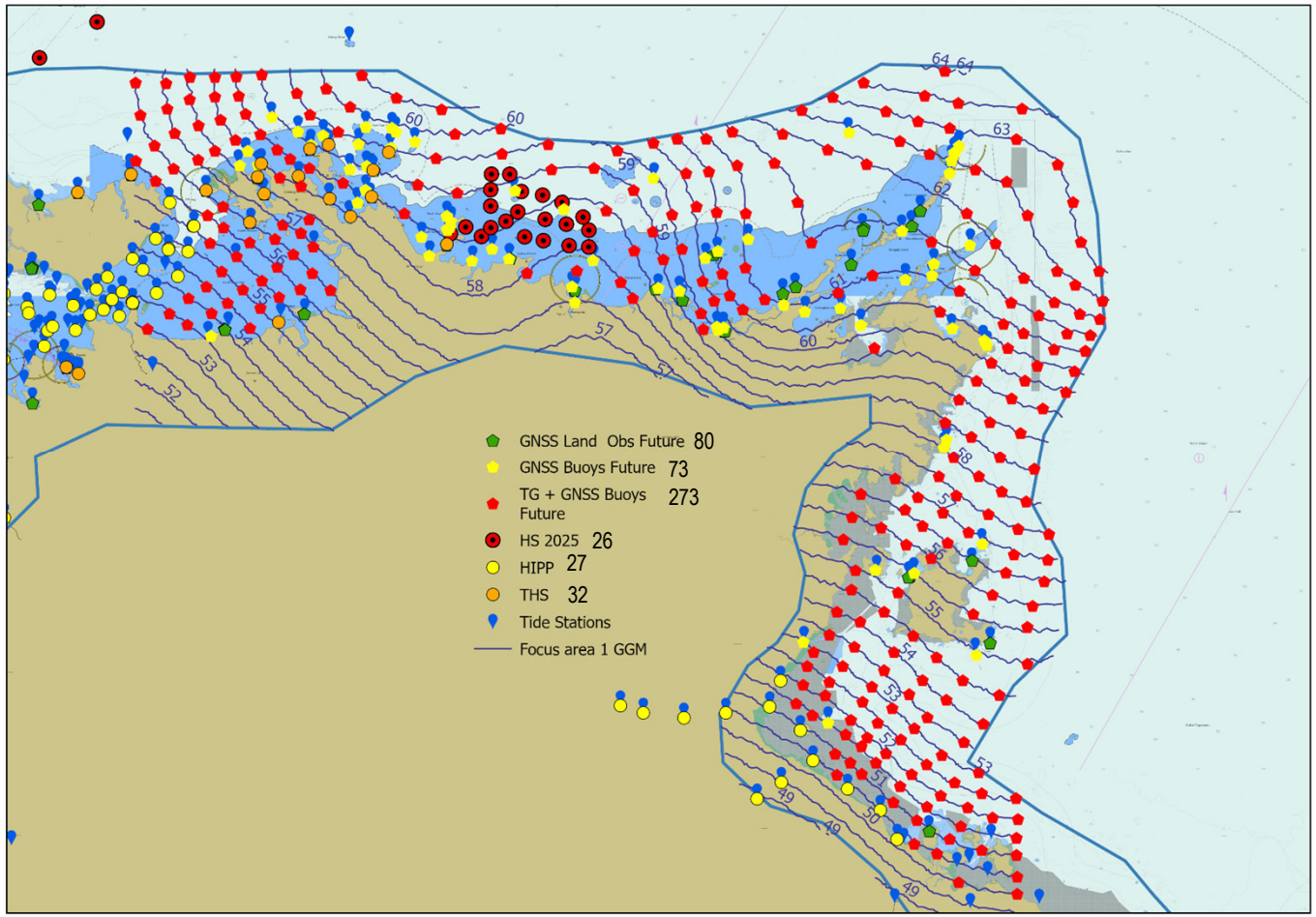
➢ ITRF2020 connection is important.

AusHydroid Scheme: Focus Areas



- Mostly northern parts of Australian coast where hydrographic survey will be required
- Areas with very little data in terms of TG stations or GNSS data
- HIPP areas excluded due to good spatial resolution and data collection continuity
- Planned connection to adjacent HIPP data
- Areas (e.g. area 4) where high density of ship traffic is present
- Areas with large tidal ranges and/or complex regimes (e.g. Torres Strait, Northern WA)
- Good connection to land data

AusHydroid Scheme Example - Focus Area 1



Requirement:

- **273** TG+GNSS – 35 days Obs.
  - If restricted to < 20m depth = **174** points
- **80** points GNSS only – 3 x 12h Obs. **Land**
- **73** GNSS Buoys on TG stations 75 hr Obs. **Offshore**
- Biggest effort in deploying new TG + GNSS
- Logistics very important

Timeframe estimate: 250 offshore points (red ones)

HIPP current setup

- 1 x ship, TG and GNSS Buoys deployment
- 20 TG in the ship, 4 GNSS receivers
- Complicated setup needs 1-1.5 years time with 1 ship

AusHydroid possible setup:

- 1 x ship, only GNSS Buoys deployment
- 45+35+45 days = 125 days with avg. 80days Obs.
- 5 GNSS Buoys per day
- 4 months duration with 80d Obs avg. per site !!

Slide nummer 11

RCC9 Recalc to one vessel. Needs to be realistic. I can assist.
Cullen, Richard 2; 11-03-2025

Challenges

- Initiate AusHydroid Project
- Historical data validation
- Develop dataflow and estimation process
- Datum harmonisation with ITRF2020
- AusHydroid planning tool
- Third party data (e.g. port Authorities)

Challenges cont…

- Better ways to deploy/automate the TIS database
- Areas without TG data (data gaps); TG prediction quality
- Stand alone GNSS Buoys, can TGs be fully replaced by GNSS Buoys?
- Optimising TG observations (length, sensors etc)
- Reflectometry tests
- Independent accuracy assessments

Thank you for your attention
Questions / Comments / Remarks

Join the AHO at
World Hydrography Day in Wollongong
Friday, 20 June 2025