

# CTCN Project Inception Working Session

University of Sydney School of Geoscience August 21 -22, 2019

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## Introduction

The CTCN project inception working session was held at the Sydney University from 21<sup>st</sup> -22<sup>nd</sup> of August 2019. The working session was organised and conducted by the partner organisations the University of Sydney, GRID-Arendal, and the Secretariat of the Pacific Community (SPC). Representatives from Palau, Solomon Islands, Marshall Islands and Kiribati participated as well as representatives from Geosciences Australia (GA) and Seabed 2030.

The working session aimed to clarify the goals of the project (acknowledging that the project focus may have shifted since the initial CTCN request); determine the current status of bathymetric information available within the EEZs of the four Pacific Island states; identify sources of additional data to be included in the development of the bathymetric products; identify the inputs and focus for the wave modelling exercise; and reach a consensus on the design and content of the 5-day training workshop.

Twenty-four participants met for the 2-day workshop. The four PICs presented an overview of their national bathymetric and wave information as well as plans for the collection of additional data. Technical presentations were delivered by GRID-Arendal, SPC, GA and Seabed 2030.

## Workshop Agenda

9.00 – 9.30 am	Introductions Project goals and activities	Elaine USYD
9:30 – 10:15 am	AUS Seabed	Kim Picard GA
10.15 – 11.00 pm	Seabed 2030	Geoffroy Lamarche NIWA Seabed 2030
11.00 -11.15 am morning tea		

11.15 -11.45 am	EMODnet	Debhasish Bhakta GRID Arendal
11.45 -12.30 pm	Existing bathymetric and wave data; additional sources of data; future plans	David Idip Palau
12:30- 2:00 pm lunch		
2.00 - 2.30 pm	Existing bathymetry/ additional sources of data	David Natogga Solomon Islands
2.30 - 3.00 pm	Existing bathymetry/ additional sources of data	Kabure Yeeting Kiribati
3.00- 3.30 pm	Existing bathymetry/ additional sources of data	Ben Yamamura RMI
3.30 – 4.00 pm afternoon tea		
4.00 – 5.30 pm	Discussion on training session	Led by Eleanor Bruce USYD
9:00 – 9:30	Cleaning and processing the bathymetric data and software options	Debhasish Bhakta GRID-Arendal
9:30 – 10:30 am	Wave model options	Herve Damlamian SPC
10:30- 11:00 am morning tea		
11:00 – 12:30 pm	Integration between the bathymetry and wave models; main priority for wave models	General discussion led by Herve SPC
12:30 – 2:00 pm lunch		
2:00 – 3:30 pm	Determine the priority goals for the project	Breakout PIC priority evaluation session
3:30 – 4:00 pm afternoon tea		
4:00 – 4.30 pm	Country presentations	Plenary
4.30 -5.00 pm	Working session evaluation; next steps; timeline	
Dinner Acre in Camperdown 6.30 pm		

## Project timeline

The workshop participants suggested that the training should be held in conjunction with the mid 2020 Maritime Boundaries Consortium meeting (2 weeks in July – August) in order to involve additional participants attending the MBC meeting. GRID-Arendal will seek approval with funder.

	year	2019		2020		
		3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter
Activity 2.3	Preparation of a data acquisition and a data catalogue (high resolution bathymetry data acquisition from data providers)					
Output 3	<b>Data standardization and grid development</b>					
Activity 3.1	Development of standardised metadata and bathymetric grids					
Activity 3.2	Technical manuals on the development of the grids					
Output 4	<b>Training</b>					
Activity 4.1	Review of wave models for case study areas and report					
Activity 4.2	Development of course material and training manual					
Activity 4.3	5-day training course for country experts					
Activity 4.4	Report on training					
Output 5	<b>Result dissemination and planning for further financing</b>					
Activity 5.1	Report informing a GCF proposal and the Pacific Resilience Program					
Activity 5.2	Report on best practices and lesson learned					
Activity 5.3	Dissemination of results through report targeted to SPC online communities					
Activity 5.4	1-day evaluation workshop					
Activity 5.5	development of a GCF proposal					

# Country Presentations

## Marshall Islands

lakwe!

### Marshall Islands

Capacity Development to Address Risks in the Coastal Zones Associated with Climate Change – Majuro Atoll

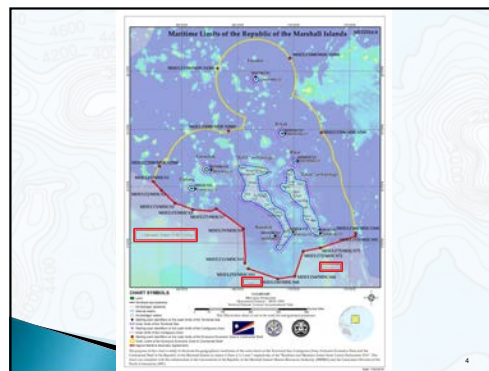
*Existing Bathymetry and Additional Sources of Data*

University of Sydney, Australia  
August 21–22, 2019

Bill Labija, Lee Jacklick, Mark Stege, Tuvuki Ketedromo, Benedict Yamamura

### Contents

- ▶ Background
- ▶ List of available bathymetry and other data
- ▶ Previous bathymetry data
  - Low & High
- ▶ Recent survey (data) available for Majuro
- ▶ Future dataset to acquire



### Marshall Islands

**Facts:**

- 2 Island Chains
- Number of islands: 1,226 (28 atolls and 6 table coral island)
- Total land area: 71 square miles (184 square kilometers)
- Population: 74,539 (July 2017 estimated)

### Marshall Islands

- Main Industries: Fisheries (tuna), coconut, & handcraft (amimono)
- Capital City: Majuro
- Elevation: 2m above sea-level

Majuro Bridge

## List of available bathymetry data

Dataset Notes	Date	Source	Projection/Coordinate System	Extent
14.25 m res GeoTIFF Satellite imagery for each atoll; the vector data appears to be the same as what is in the "Republic of Marshall Islands Data" folder but with the addition of a general bathymetry layer for all atolls and a Dive Survey spreadsheet and mapfiles	2007	Imagery-Source Unknown	WGS_1984_UTM_Zone_59N	MI
Same vector datasets as "Republic of Marshall Islands Data" and 2007 RMI Conservation GIS Data. I'm guessing Michael Donovan used this as a collection spot for all the best of the previous two folders, although he doesn't include some of the 14.5 m res imagery for some atolls, like Majuro or Kwajalein. Also includes bathymetry geoTIFF.	2007	Esri/Caleb McClelland	WGS_1984_UTM_Zone_59N	MI
General bathymetry dataset for MI, including nice poster map .jpg of MI from NOAA.	2007	EPA/MMMA	WGS_1984_UTM_Zone_59N	MI
Bathymetry raster and derivative geotiff file with lines and numbers. Undefined but appears to be UTM.	2010 ?	NOAA, ETOPO2	WGS_1984_UTM_Zone_59N	Majuro
Bathymetry point file for coastal areas near Majuro (doesn't include the lagoon).	2010 ?	2009 used for SONAC projects only	WGS_1984_UTM_Zone_59N	Majuro
Subfolder called "HighRes_OrthoPhoto" which contain 4 m imagery for Majuro, although the Readme file list imagery for other atolls too. There are various SONAC reports, map .jpg, GIS datasets etc on an ecological assessments, including dives trips and potential aggregate and sand sources. Many files are in MapInfo format that require conversion to be used in ArcGIS. Some bathymetry graphics that might have been generated by the MapInfo datasets. Some others are .tiff that is a CAD file format and may not be useful in GIS.	2009	SONAC/MMMA/NRCS (Readme file says "Obtained from MMMA -MI, supplied by (NRCS). To be used for SONAC projects only.	WGS_1984_UTM_Zone_59N	Majuro

Credit: Becker, 2015

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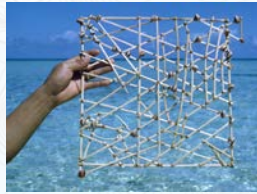
## Wave Observation

### Pacific Islands Ocean Observing System



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## Historical Chart



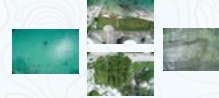
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## Drone and Topographic Profile Surveys



Equipment: DJI/eBee fixed wing

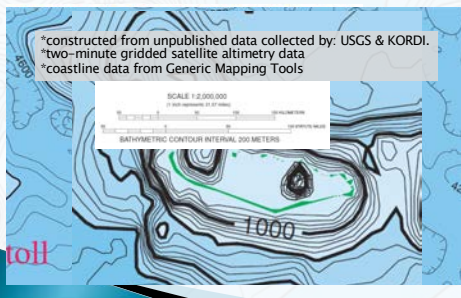
Post processing: AgriSoft System and Pix4D



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## Previous Bathymetry Data (med)

(James R. Hein, Florence L. Wong, & Mosier, 1999)



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## Previous Bathymetry Data (high)

### High-Resolution Bathymetry survey of Majuro (Kruger & Kumar, 2008)

investigate the seabed and provide information about water depths using a Multibeam echosounder.

acquisition of 752 high-resolution bathymetric (seafloor 10-70 m depths)

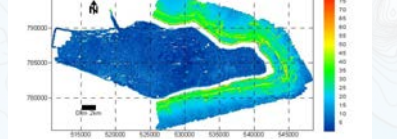


Figure 8. Gradient slope angle map of the Majuro seabed generated from 52 m (offshore) and 15 m (lagoon) gridded bathymetry. Red indicates higher slope angles and blue indicates near horizontal seafloor.

Figure 9. Three-dimensional perspective image of Majuro atoll looking west.

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## One Meter Topobathymetric DEM for Majuro Atoll RMI, 1944 to 2016

(Palaseanu-Lovejoy et al., 2018)

### Attached Files

Click on title to download individual files attached to this item.

Majuro_RTK_GNSS_Data.zip "RTK GNSS Survey Points"	4.65 MB
Majuro_Topobathy_DEM_Spatial_Metadata.zip "Majuro Topobathymetric Digital Elevation Model (TBDEM) Spatial Metadata"	898.66 KB
Majuro_TBDEM_Data.zip "Majuro Topobathymetric Digital Elevation Model (TBDEM)"	2.19 GB
majuro_tbdem_metadata.xml Original FGDC Metadata	56.07 KB View
Sep14_2016_Majuro.7z "Structure from Motion (SfM) Imagery"	5.31 GB
Sept15_2016_Majuro.7z	8.25 GB
Sept16_2016_Majuro.7z	9.67 GB

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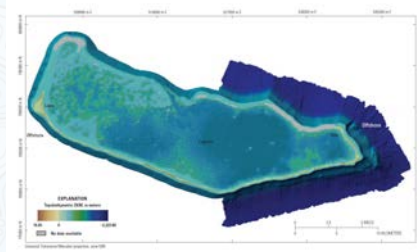
## Majuro Atoll TBDEM Spatial Data Extent



(Palaseanu-Lovejoy, et al., 2016)

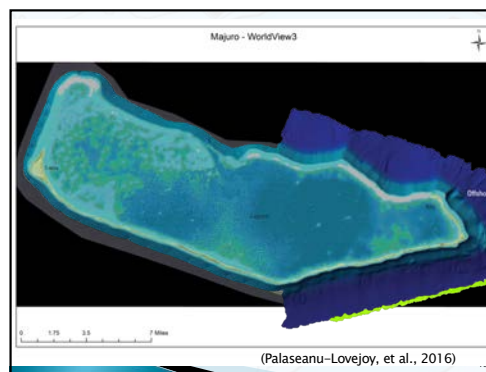
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## Majuro Atoll TBDEM Spatial Data Extent



(Palaseanu-Lovejoy, et al., 2016)

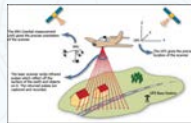
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(Palaseanu-Lovejoy, et al., 2016)

## Future: LiDAR Data

- ▶ Work Bank funded Pacific Resilience Program II (PREPII) – Majuro and Ebeye
- ▶ US National Geo-Spatial Agency in Majuro
  - Hydrography
  - Bathymetry
  - Charting and mapping
  - SOLAS



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## References

- Becker, J. (2015). *RMI GIS Datasets*. Majuro.
- James R. Hein, Florence L. Wong, & Mosier, D. L. (1999). *Republic of the Marshall Islands Federated States of Micronesia Kiribati*. Denver. Retrieved from <http://geopubs.wr.usgs.gov/data.html>
- Kruger, J., & Kumar, S. (2008). Republic of the Marshall Islands Technical Report High-Resolution Bathymetric Survey.
- Palaseanu-Lovejoy, M., Poppenga, S., Danielson, J., Tyler, D., Gesch, D., Kottermair, M., Barbee, M. (2018). One-Meter Topobathymetric Digital Elevation Model for Majuro Atoll, Republic of the Marshall Islands, 1944 to 2016 Scientific Investigations Report 2018 – 5047. <https://doi.org/https://doi.org/10.3133/sir20185047>
- SPC Geosciences, Secretariat of the Pacific Islands Applied Geoscience Commission (2008).

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**PALARIS**  
*Republic of Palau's National GIS*

**Palau Maritime Boundary (EEZ)**

- Palau and FSM Treaty Line
- Domestic Fishing zone
- Palau and Philippine EEZ Delimitation
- Palau and Indonesia EEZ Delimitation

**PALARIS**  
*Republic of Palau's National GIS*

**Palau Continental Shelf Claim (ECS)**

- Palau Kyushiu Ridge Claim (North Area)
- High quality Bathymetry Data

**PALARIS**  
*Republic of Palau's National GIS*

**Topographic Survey**

- Palau Digital Raster Graphic (DRG) Map 1984 by USGS
- Palau Digital Elevation Map
- Updating the Topographic map
  - Laser Scanning
  - Drone Survey
  - Lidar Survey
  - GPS Survey

**PALARIS**  
*Republic of Palau's National GIS*

**Bathymetry Data**

- Data was provided by Japanese Government to the Office of PALARIS specifically for Palau ECS Project
- SCUFN Underwater Feature Naming
- Offshore Multibeam Survey (SCRIPPS)
- Inshore Multibeam Survey (CRRF)

**PALARIS**  
*Republic of Palau's National GIS*

**Drone Survey**

Area was surveyed by Drone (Ebee RTK Drone)

**PALARIS**  
*Republic of Palau's National GIS*

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**FIELD SURVEY**

**PALARIS**  
*Republic of Palau's National GIS*

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**Survey Equipment's**

- Topcon GR3 GPS
- Topcon Hiper SR
- Ebee RTK Drone
- Laser Scanner
- Handheld Garmin GPS
- DJI Phantom 4 Pro Drone

**PALARIS**  
*Republic of Palau's National GIS*

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**Bathymetry Data**

**Current Data**

- Satellite Derived
- Nautical Charts
- SCRIPPS Data (Offshore)

**Planned Data Collection**

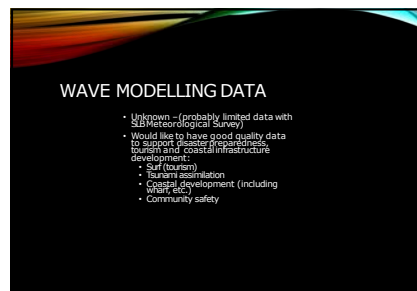
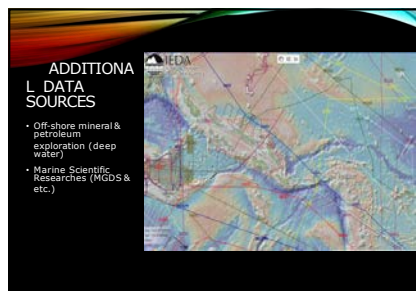
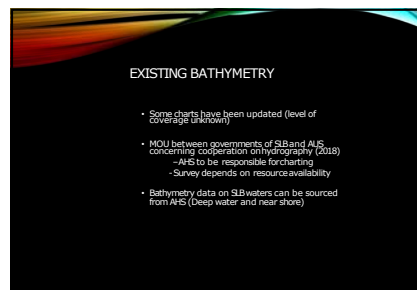
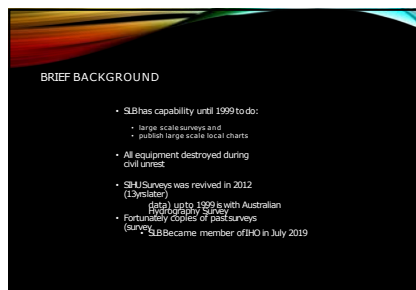
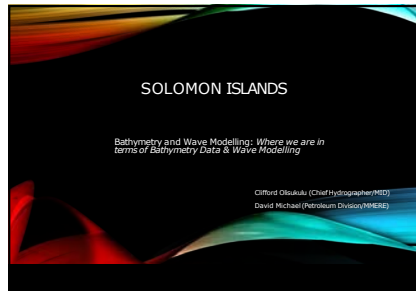
- Inshore Multibeam Survey
- Satellite/Drone Derived Bathymetry
- Lidar Survey

**PALARIS**  
*Republic of Palau's National GIS*

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**KOM KMAL MESULANG...**

# Solomon Islands



### SOME ISSUES

- Not Regulated - No single raw data depository in SLB (only information/processed data)
- Need to harmonize various legislation concerning Marine Research specifically on raw bathymetry data

### OPPORTUNITIES

- Implementation of Solomon Islands National Ocean Policy - SINOP (12 Government Ministries)
- MOU between SIS & Australian Government
- Marine Research



### CONCLUSION

- There is potential for sustainability of bathymetry and wave modelling financing in Solomon Islands (Implementation of Solomon Islands National Ocean Policy, & requirements for environment impact assessment and etc.)

# Kiribati

Pacific CTCN Project: Capacity Building to Address Risks in the Coastal Zone Associated with Climate Change.

INCEPTION MEETING: 21<sup>st</sup> TO 22<sup>nd</sup> AUGUST 2019  
SYDNEY UNIVERSITY, AUSTRALIA



1

Kiribati Team




Kabure Yeeling  
MFM&D



Ueneta Taorua  
MET Office



Catherine Tofireta  
GIS Officer



Ton Uram  
Hydrographer,  
Marine Division



Alistair Marula  
GIS Officer




Tentao Tekaaio  
Surveyor

2

Kiribati Bathymetric Dataset


1. Robert Smith, Simon Young and Naomi Birbo, 1995, Bathymetric, Seismic and Alternative Sand and gravel resource Survey, Tarawa, Kiribati, SOPAC report – 10m resolution



3

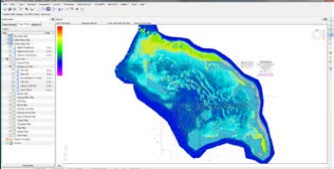
2. SOPAC 2008, Kiribati Technical Report High resolution Bathymetric Survey in Kiribati, SOPAC report

► Islands covered: Abaiang, Tarawa, Abemama, Banaba and Onotoa



4

Nonouti lagoon bathymetric data



- Single beam echo sounder
- University of Miami

5

Hydrodynamic model

► Tarawa Lagoon – conducted by Herve.

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### Kiritimati Island – port area

2012 Sounding survey by the British and Irish sounding team September 2012 used the same data as background in the port area from 2001-2004. The port area has been upgraded since 2004. The original design was on the basis of the background of the 2001 survey. Note from the text of the app is necessary. This may be a point in time.

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- Sounding survey from September, 2012

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### EEZ and ECS

- ▶ Data with SPC GSD

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### KI-GEONODE

Geomorphic data

Fishing Vessel Tracks

Catch Data - Purseinas

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### MACBIO project: GEBCO'S GRIDDED BATHYMETRIC DATASETS

Global bathymetric datasets

Global dataset for Kiribati seamounts

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### CME Programme

- ▶ March, 2019
- ▶ Common Wealth Marine Economies Programme
- ▶ Implemented by UK Hydrographic Office (UKHO)
- ▶ Covers all Island of Kiribati
- ▶ 2m resolution
- ▶ Derived from Satellite imageries
- ▶ Lagoon and outer reef edge

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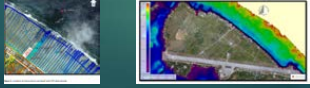
### Seabed Minerals Act 2017

- ▶ Mandate to regulate Marine Scientific Research within Kiribati EEZ
- ▶ Aim to obtain copies of data and information from MSR activities
- ▶ Most of the MSR datasets and reports are deposited in publicly available databases
- ▶ Data types, format
- ▶ Since 2017, there are 2 new bathymetric data source obtained from regulating the MSR:
  - ▶ saildron UAV as the US Flagged Unmanned Surface Vehicle (USV)
  - ▶ Nautilus - Saint Vincent and the Grenadines flagged vessel

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## DRONE Inundation Modelling

- ▶ Kirifimati Island inundation modelling – SPC GSD starting in 2014
- ▶ Herve and his team from SPC GSD were doing this work.
- ▶ Data is with SPC GSD, some of the data has been shared with GOK
- ▶ Wave data component is still needed to complete this inundation modelling package.
- ▶ BONRIKI INUNDATION MODELLING: Herve: SPC GSD



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## Future plans

- ▶ LIDAR proposal is still in development by Hydrographer and World Bank
- ▶ Updating of navigational charts – SPC GSD is assisting Kiribati

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- ▶ Kam raba

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# Technical Presentations

## Processing and software

**Cleaning and processing the bathymetric data and software options**

Sydney, Australia  
<http://www.emodnet.eu/>

**Bathymetric data type**

- Acoustic methods — using sound waves
  - Multi-beam echo sounder
  - Single-beam echo sounder
- Measuring bathymetry from space
- Data format: xyz.txt, netCDF, Esri ASCII raster or GeoTiff formats and many...

**Workflow**

```

    graph TD
      A["Data collection  
• Regional/National/International data coordinator  
• IOP/NAO sharing"] --> B["Metadata creation  
• Metadata xml editor"]
      B --> C["Data cleaning  
• Geocap  
• Geocap Seafloor toolbox"]
      C --> D["DTM creation  
• MMODnet specification  
• MMODnet data update"]
      D --> E["DTM integration  
• Geocap  
• Geocap Seafloor toolbox"]
    
```

**Geocap software**

- Visualization and manipulation of geologic and geospatial data.
- The software consists of four different modules

<https://www.geocap.no/products-and-services/geocap-desktop>

**Geocap interface**


□ Geocap has a very customizable interface.

**Geocap Seafloor toolbox**

□ Process survey data from multibeam echo sounders and create large high-resolution grids.

### Geocap Point Cloud Editor

□ Tool for 3D editing of multibeam and point cloud data.



	Add to selection		vctM-v'Y		unfile
	Remove from selection		vctM-v'Y		redo
	Rubber Band Select		Delete		Undo
	Lasso Select		Link		Extract selected points
	Threshold Select		remove flag		
	Flag Select				
	Expand selection to 3D				
	Clear Selection				

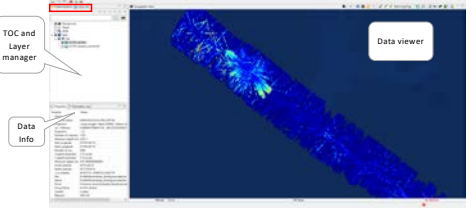
### Globe software

- Developed by French Oceanographic Fleet
- Processing, analysing and displaying oceanographic data.
- Free download after registration
- Data manipulating and creating digital elevation models.
- EDMONet TOOLS in Globe

<https://www.fleetoceanographique.fr/en/The-Fleet/Shipboard-software/GLOBE/Download>

### Globe software interface

□ Efficient data conversion- import/export




TOC and Layer manager

Data viewer

Data Info

### Interface component



Base Layer/map


Layer Detail

Layer cosmetics

Target file specific layer

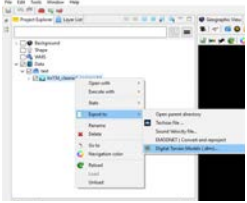
□ Tool set used specifically for EDMONet in Globe

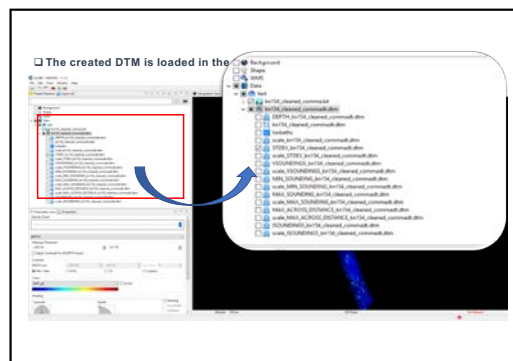
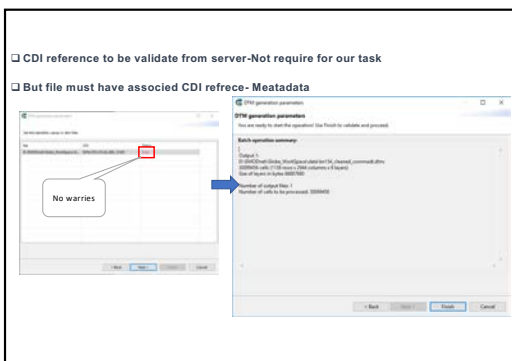
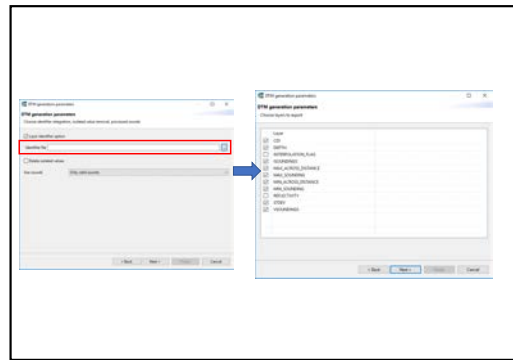
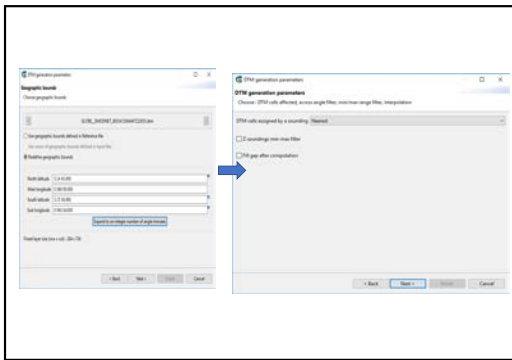
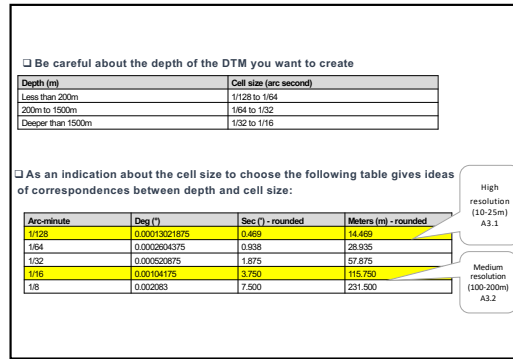
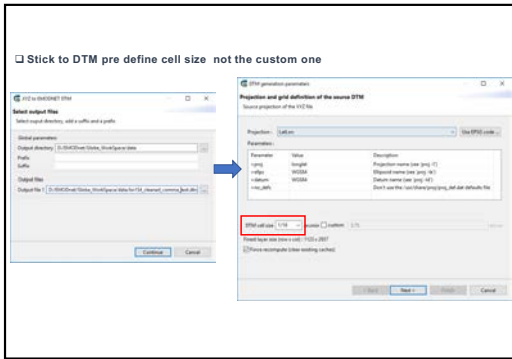
### Step 1: Import files



### Step 2: Import files

1. Single DTM (1/64, 1/32 or 1/16 arc of minute)





### Step 3: DTM - Reduction

Downscale to 1/16 DTM resolution from a 1/32 DTM

### Step 4: Merge DTMs

- All the DTMs have been generated and/or reduced to the common 1/16 arcminute resolution.
- They will then be regionally merged together
- into a single 1/16 DTM
- Fill missing values
- Upscaling but no downscaling

### Metadata creation- CDI file system

- Common Data Index - CDI
- The CDI was initiated in the EU Sea-Search project and is further developed in the EU SeaDataNet and SeaDataNet II projects
- MIKADO is a software tool, written in Java
- Enables data centres to prepare XML metadata files for the SeaDataNet directories EDMED, CSR, EDMERP, CDI and EDIOS.
- Start editing sample xml file

<https://www.seadatanet.org/Software/MIKADO>

### Norwegian Sea DTM Data sources

- Spatial extent N59 52.5 and E-26 7.5 to N75 7.5 and W33 7.5
- DTM are merged into 8 different tiles with name convention
- Majority of data providers supplied their data composite DTM
- List of data contributor

Sl.No.	Data contributor	Country	Type of data
1	SU	Sweden	multibeam
2	NGDC	US	multibeam
3	NHS	Norway	composite DTM

- Average depth for the dataset (1/8th of a minute)

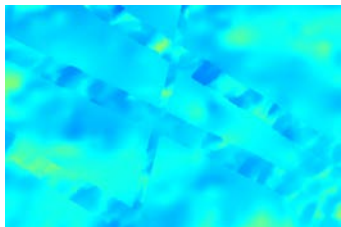
- Bathymetric depth filled by GEBCO data and smoothed through a spline function

### Data Quality assessment

- Standard deviation calculated from the Norwegian Sea DTM (0 to 50m from blue to red)
- Number of soundings per cell for Norwegian Sea DTM (0 - 100 from blue to red)

### Data artefacts

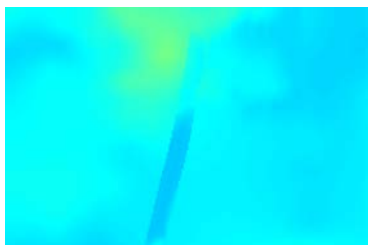
- ❑ Mismatch between overlapping multibeam surveys



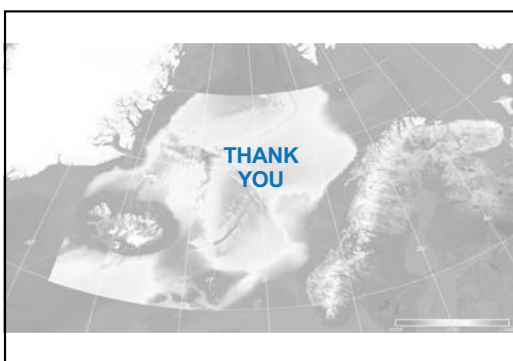
- ❑ Artefacts between high resolution multibeam data and GEBCO grid



- ❑ Edge of track issue between multibeam data and GEBCO data



- ❑ Artefact between edge of Norwegian Hydrographic Service composite DTM (right) and GEBCO (left)



# Seabed 2030

Geoffrey J. Lawrence  
Seabed 2030 South and West Pacific Centre  
National Institute of Water and Atmospheric Research

The Nippon Foundation-GEBCO Seabed 2030 Project

Logos: NIWA, Nippon Foundation, and other project partners.

### Bathymetry as an enabler

- Storm surge / Tsunami modelling
- Habitat mapping and management
- Ecosystem identification and management
- Emergency response
- Satellite verification models
- Ocean prediction models
- Coastal/Marine Spatial Planning
- Coastal Hazard Assessment
- Ocean Exploration
- Coastal Change Analysis
- Sea Level Rise Mitigation
- New Energy Siting
- Marine heritage
- Nautical charts

### GEBCO (General Bathymetric Chart of the Ocean)

1<sup>st</sup> Edition - 1903

3<sup>rd</sup> Edition - 1982

### The GEBCO global terrain model grid

### All Grid-Cells were not born equal!

- Appearance of global coverage is fundamentally deceptive
- Grid size dependence
- 30 arc-second grid-cells → 18% GEBCO-2014 cells have depth measurements
- The rest is interpolated or modelled!

Legend: Red circle = 30 arc-second grid-cells with depth measurements; Blue circle = Interpolated depth values; Green circle = Derived from combination of other depth values.

### The Nippon Foundation - GEBCO Seabed 2030 Project

2010: Nippon Foundation Ocean Charter Fund, Shell Global Discovery (2010)

2010: GEBCO Global Connectivity

2010: GEBCO Technical Centre-Bases (SCSIB, SCJPN, ISCOM)

2010: GEBCO Project Team (Director + Leads of regional centres)

2010: GEBCO Science Panel

The UN Decade of Ocean Science for Sustainable Development (2021-2030)

UN Sustainable Development Goal 14

CONSERVE AND SUSTAINABLY USE THE OCEANS, SEAS AND MARINE RESOURCES FOR SUSTAINABLE DEVELOPMENT

**A Vision for the Decade**  
Develop scientific knowledge, build infrastructure and foster partnerships for a sustainable and healthy ocean.

R&D Priorities

- 1 - Comprehensive digital atlas of the Ocean
- 2 - Ocean data and information portal

Seabed 2030 Strategy

Today

1. Share

2. Optimize

3. Expand

4. Innovate

Tomorrow

Four Pillars of Seabed 2030

- Data Assembly and Coordination
- Global Community Engagement
- Consolidate Technical and Human Capacity
- Cross-cutting area of Corporate Governance

How much of the ocean is mapped?

$X + Y + Z = 100\%$

X: Data in GEBCO 2014 **X = 6%**

Y: Data that exists but not yet in GEBCO

- Public
- Embargoed

Z: Data that must be measured (map the gaps)

Data point

6% of GEBCO 2014 cells have data  
94% interpolated data

Seabed 2030 working concept

From GEBCO 2014 to GEBCO 2019, and on to the target GEBCO grid

Depth Range	Resolution	% of the Ocean
0-200m	200x200m	13.7
200-3000m	300x300m	1.1
3000-5750m	400x400m	72.6
5750-11000m	800x800m	2.7

Climate, Freshwater & Ocean Science

Seabed 2030: Regional Data Centers

Climate, Freshwater & Ocean Science


### Seabed 2030 data work flow

**Data Sources**

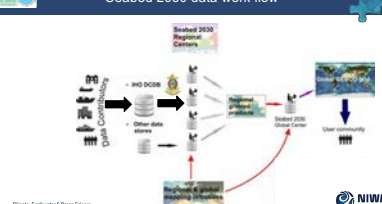

- Raw & Processed Seabed Plans
- ENC xyz
- Single-beam
- Gridded data

Submitting data Seabed 2030

- 1) Public data access (preferred)**  
Data forwarded to IHO-DCDB for archive and public access
- 2) Restricted data access**  
Data forwarded to IHO-DCDB for archive and restricted access
- 3) Private data access**  
Data not forwarded to IHO-DCDB, archived at Seabed 2030 Center  
Usage restricted to only inclusion in GEBCO Products; no distribution of data



### Seabed 2030 data work flow

### How to complete the GEBCO Grid?

- ✓ Coordinate and inspire mapping expeditions/surveys
- ✓ Global ocean mapping **community**
- ✓ Vast amounts of **data collected** but yet **NOT** available for the GEBCO Grid (\*)
- ✓ Build on **SCRUM** as GEBCO regional mapping model
- ✓ Build on **TSCOM** for technical advances
- ✓ **Technology innovation**
- ✓ Human **capacity development**



### Seabed 2030 Strategy



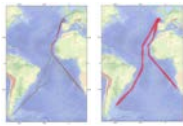
**2. Optimize**

Repeated tracks of RV Polarstern

- Collect in-transit data
- Offset to ship track – map the gaps


Potential coverage  
26x161km = 416 sq km

Modest incremental cost → major returns  
c.f. investment in ship & equipment

### A strong start

- Fugro will donate all transit data
- Ocean Exploration Trust will donate all data to Seabed 2030
- Geoscience Australia as a Partner organisation provided all MH370 data
- ESRI is closely involved in the gridding and data management
- Grid Arendal, NOAA, NASA, NERC... actively support the project
- Google, Ocean Infinity, e-marine, Statoil are interested to provide data
- Benefit from the GEBCO-CCOM Alumni (87 specialist, 37 countries)
- The South West Pacific Hydrographic Commission Member States are encouraged to become active participants of Seabed 2030
- In 2 years, Seabed 2030 will gather as much data as GEBCO has collected over 115 years.



### Progress to date – GEBCO 2019

$X + Y + Z = 100\%$


GEBCO 2014:  $X = 6\%$

32,000,000 square kilometres


GEBCO 2019:  $X = 15\%$

X: In GEBCO  
Y: Exists, not in GEBCO  
Z: The gaps  
X+Y = mapped

[https://www.gebco.net/data\\_and\\_products/gridded\\_bathymetry\\_data/](https://www.gebco.net/data_and_products/gridded_bathymetry_data/)



### Seabed 2030 South and West Pacific Centre



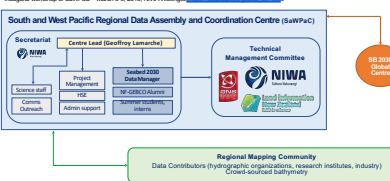
- 123,515,000 km<sup>2</sup> of ocean
- 67,000,000 km<sup>2</sup> outside national jurisdiction
- 33 countries and territories
- ~80% deeper than 3000 m
- Includes the two deepest ocean trenches:
  - Mariana Trench (10,984 m)
  - Kermadec Trench (10,047 m)

**NIWA**

### Seabed 2030 South and West Pacific Centre

Inaugural workshop of SaWPAC – March 3-6, 2019, NIWA Wellington <https://seabed2030.org.au/seabed2030/>

#### South and West Pacific Regional Data Assembly and Coordination Centre (SaWPAC)



**Centre Lead (Scientific Lead)**

- Science staff
- Project Management
- Public Outreach

**Seabed 2030 Data Manager**

- IT & GIS
- NIWA/DOC/NIWA
- Technical Management
- Science

**Technical Management Committee**

- NIWA
- Land Information New Zealand
- Seabed 2030 Centre


**Regional Mapping Community**

Data Contributors (hydrographic operations, research institutes, industry)

Cross-sector bathymetry

### SaWPAC data processing workflow

Gap analysis (using the 2018 delivery coverage, online viewers)



**Data assembly**

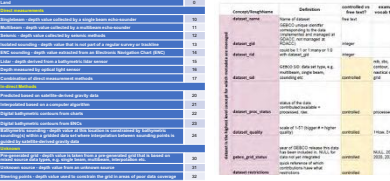
- NIWA related assets (Backup copies on external hard drive)
- AcGIS Bathymetry extension (populate 3D database (hosted on SQL server))
- AcGIS Desktop/Pro (publish services to NIWA/DOC/NIWA account)
- AcGIS Online

**Processed soundings**

Grated data (Lat, Long, etc., gnd, int, ut)

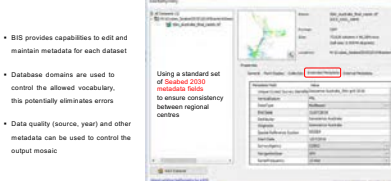
- AcGIS 3D database only supports raster datasets
- Conversion: XYZ - point feature classes - rasters

### Seabed 2030 data management



Name	Date	Description	Category	Example
AcGIS Online	2019	AcGIS Online	AcGIS Online	AcGIS Online
AcGIS Desktop/Pro	2019	AcGIS Desktop/Pro	AcGIS Desktop/Pro	AcGIS Desktop/Pro
AcGIS Bathymetry extension	2019	AcGIS Bathymetry extension	AcGIS Bathymetry extension	AcGIS Bathymetry extension
AcGIS 3D database	2019	AcGIS 3D database	AcGIS 3D database	AcGIS 3D database
AcGIS 2D database	2019	AcGIS 2D database	AcGIS 2D database	AcGIS 2D database
AcGIS 1D database	2019	AcGIS 1D database	AcGIS 1D database	AcGIS 1D database
AcGIS 0D database	2019	AcGIS 0D database	AcGIS 0D database	AcGIS 0D database
AcGIS 3D database	2019	AcGIS 3D database	AcGIS 3D database	AcGIS 3D database
AcGIS 2D database	2019	AcGIS 2D database	AcGIS 2D database	AcGIS 2D database
AcGIS 1D database	2019	AcGIS 1D database	AcGIS 1D database	AcGIS 1D database
AcGIS 0D database	2019	AcGIS 0D database	AcGIS 0D database	AcGIS 0D database


### BIS: bathymetric metadata management



- BIS provides capabilities to edit and maintain metadata for each dataset
- Database domains are used to control the allowed vocabulary, this potentially eliminates errors
- Data quality (source, year) and other metadata can be used to control the output mosaic

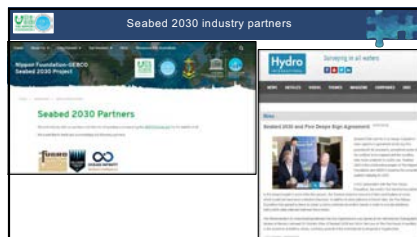
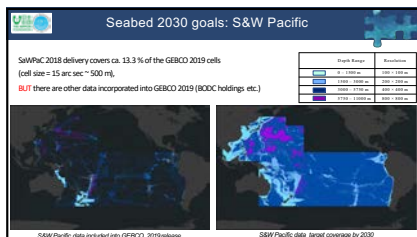
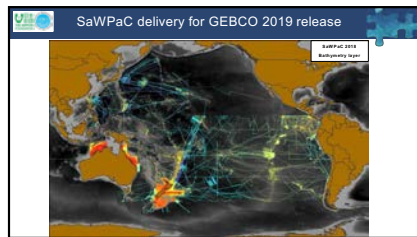
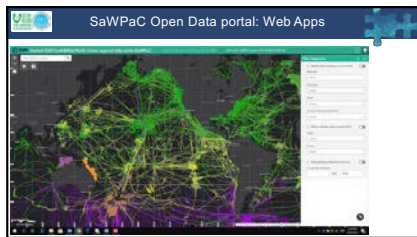
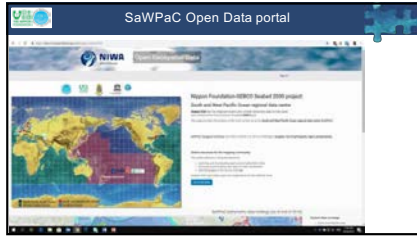
Using a standard set of Seabed 2030 metadata fields to ensure consistency between regional centres

### BIS: bathymetric data management



Export

- Footprint
- Metadata
- Mosaic



**Crowd-sourced bathymetry**

*IMO Guidance on Crowdsourced Bathymetry*

- Log/depth position and soundings
- High-density single-beam data
- Fishing, leisure ships

**ROSE POINT**

**Olex** Bathymetric data

- assembled from commercial fishing vessels
- collected using standard commercial single-beam echosounders and GPSs
- corrected with predicted tides and use local chart datum as their reference level
- shared with GEBCO at 400m resolution

**NIWA**

**Parting words**

Seabed 2030 provides Member States with a mechanism to respond to

**UN General Assembly Resolution A/RES/72/73**

"85. Encourages Member States to consider contributing to mechanisms that encourage the **widest possible availability of all bathymetric data**, so as to support the sustainable development, management and governance of the marine environment."

Seabed 2030 allows Member States to make a cost-effective contribution to:

- ✓ UN Decade activities
- ✓ completing the GEBCO Ocean Map,
- ✓ producing the 'comprehensive digital atlas of the ocean' (R&D Priority 1)

**NIWA**

**Questions?**

**NIWA**

Seabed2030  
South and West  
Pacific Centre

[NIWA multibeam surveys - interactive dashboard](#)  
[SAWPac Open Geospatial Data](#)

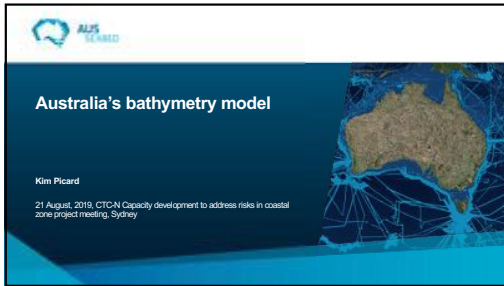
<https://seabed2030.gebco.net>  
E-mail: [pacific@seabed2030.org](mailto:pacific@seabed2030.org)  
[@seabed2030](#)

**NIWA**

**Thank you**

**NIWA**

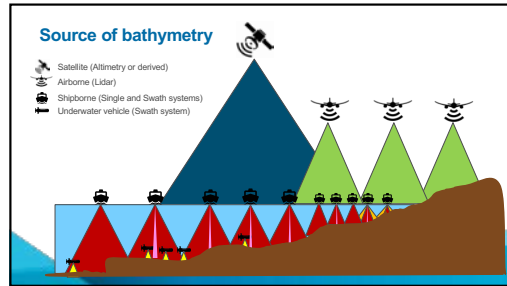
# Geoscience Australia AUS SEABED



**Australia's bathymetry model**

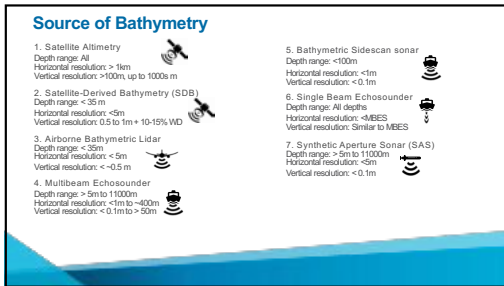
Kim Picard

21 August, 2019, CTCN Capacity development to address risks in coastal zone project meeting, Sydney



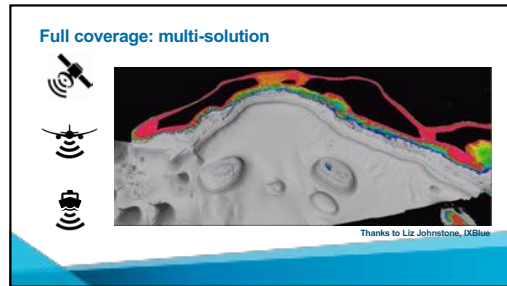
**Source of bathymetry**

- Satellite (Altimetry or derived)
- Airborne (Lidar)
- Shipborne (Single and Swath systems)
- Underwater vehicle (Swath system)



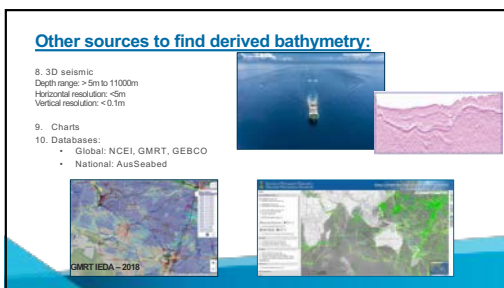
**Source of Bathymetry**

- Satellite Altimetry**  
Depth range: All  
Horizontal resolution: > 1km  
Vertical resolution: >100m, up to 1000s m
- Satellite-Derived Bathymetry (SDB)**  
Depth range: < 35 m  
Horizontal resolution: < 5m  
Vertical resolution: 0.5 to 1m + 10-15% WD
- Airborne Bathymetric Lidar**  
Depth range: < 50m  
Horizontal resolution: < 5m  
Vertical resolution: < 0.5 m
- Multibeam Echosounder**  
Depth range: > 5m to 11000m  
Horizontal resolution: < 1m to ~400m  
Vertical resolution: < 0.1m to > 50m
- Bathymetric Sidescan sonar**  
Depth range: < 100m  
Horizontal resolution: < 1m  
Vertical resolution: < 0.1m
- Single Beam Echosounder**  
Depth range: All depths  
Horizontal resolution: ~MBES  
Vertical resolution: Similar to MBES
- Synthetic Aperture Sonar (SAS)**  
Depth range: > 5m to 11000m  
Horizontal resolution: < 5m  
Vertical resolution: < 0.1m



**Full coverage: multi-solution**

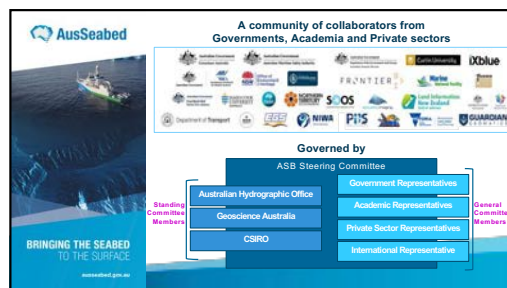
Thanks to Liz Johnstone, IXBlue



**Other sources to find derived bathymetry:**

- 3D seismic**  
Depth range: > 5m to 11000m  
Horizontal resolution: < 5m  
Vertical resolution: < 0.1m
- Charts**
- Databases:**
  - Global: NCEI, GMRT, GEBCO
  - National: AusSeabed

GMRT IEDA – 2016



**AusSeabed**

A community of collaborators from Governments, Academia and Private sectors

**Governed by**  
ASB Steering Committee

- Australian Hydrographic Office
- Geoscience Australia
- CSIRO
- Government Representatives
- Academic Representatives
- Private Sector Representatives
- International Representative

BRINGING THE SEABED TO THE SURFACE

### Our Vision

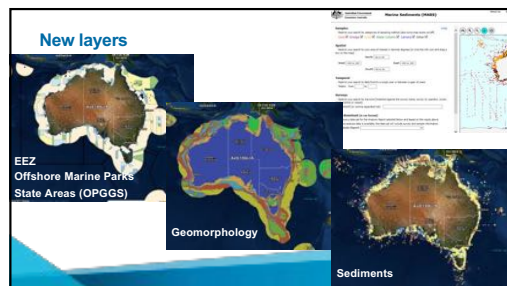
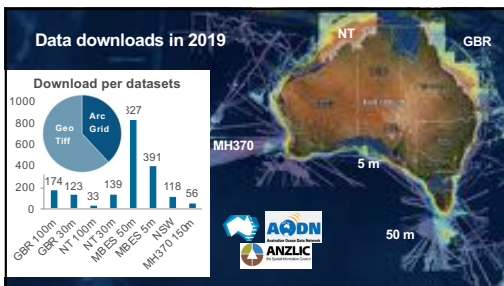
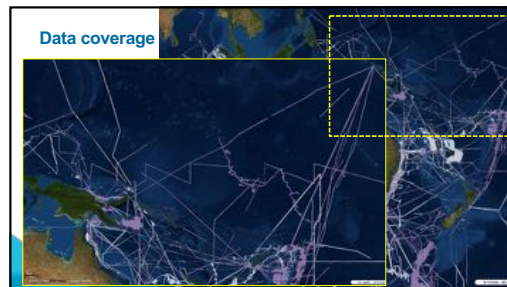
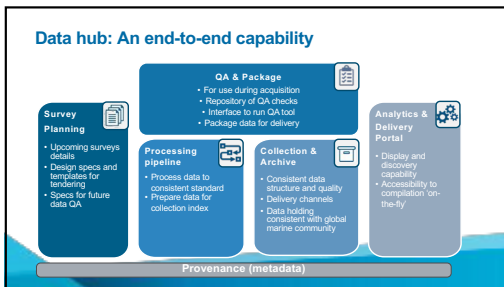
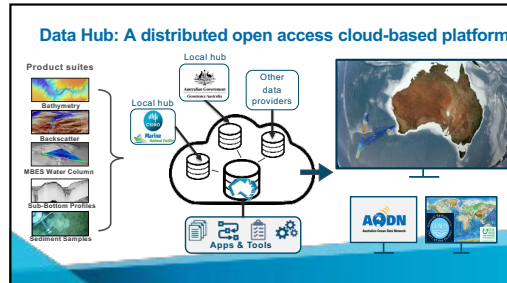
By 2030, all available seabed mapping data within the Australian Marine Estate will be readily and openly available, and new data acquisition will take into account the needs of a wide range of users.

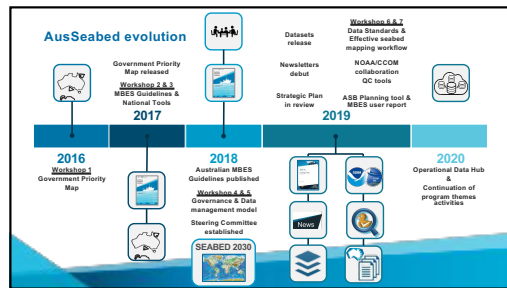
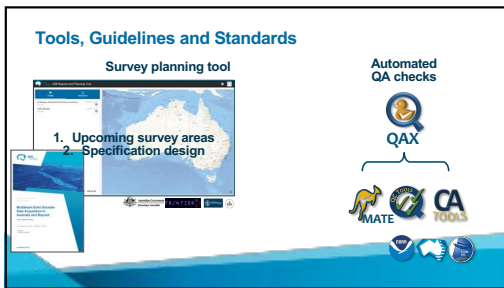
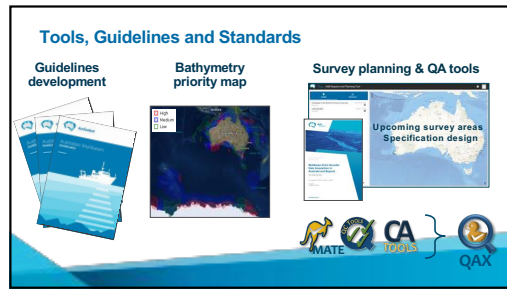
### Our Mission

To improve the coverage, awareness, quality, discoverability and accessibility of seabed mapping data for the Australian community.

### Program themes

- AusSeabed Data Hub
- Tools, Guidelines and Standards
- Outreach, Education, and Training





**Thank you**

Further information  
AusSeabed: [www.ausseabed.gov.au](http://www.ausseabed.gov.au) and [ausseabed@pfa.gov.au](http://ausseabed@pfa.gov.au)

QCoastOps 18  
Forum, 18 Sept

CIERCO workshop  
COOM USA, 9 Nov

AusSeabed Steering Committee  
Nov 19

AGU Fall meeting 2019  
San Francisco, 11 Dec

### Outreach, Education and Training

- Community engagement tracking
- SSSI accreditation by participating to AusSeabed events
- Lecture to Royal Australian Navy Hydrography School: raise awareness of other data type and applications
- CSIRO MNF – Collaborative Australian Postgraduate Sea Training Alliance Network (CAPSTAN)

### Conclusion: Build a complete picture



### Conclusion: It's possible

To map 0-200 m (shelf edge only no external territories):

**Common methodology:**  
 ~ 190 yrs (1 ship/24hrs) @ 200k line mi/yr  
 (Credit for these calculations: IX Blue -Thanks)

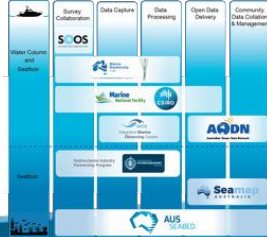
**Recent methodology:**  
 ~25 yrs (based on MH370 experience)

#### It's possible

2015 120,000 km<sup>2</sup> in 2 yrs → 2018 120,000 km<sup>2</sup> in 3mths



### Australia seabed data system



### Goals of the Program

1. Improve the **curation and delivery** of seabed mapping products and data
2. Improve the **standards and quality** related to seabed mapping procedures and data
3. Nationally **coordinate** seabed mapping activities and objectives
4. **Demonstrate the value** of seabed mapping data for decision-making



### Tools, Guidelines and Standards

#### Survey planning tool



#### Automated QA checks



### Conclusion

AusSeabed is an open community of seabed mappers and users from various sectors.

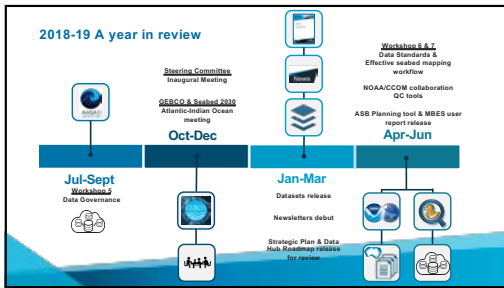
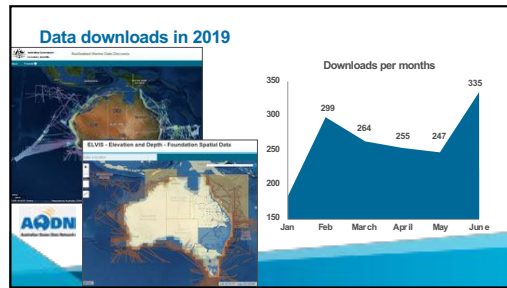
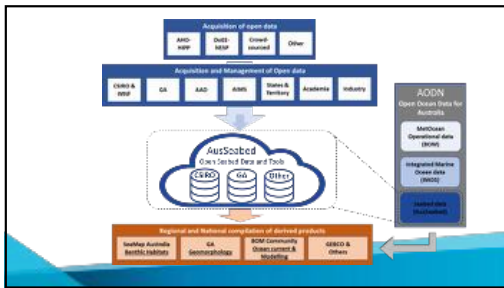
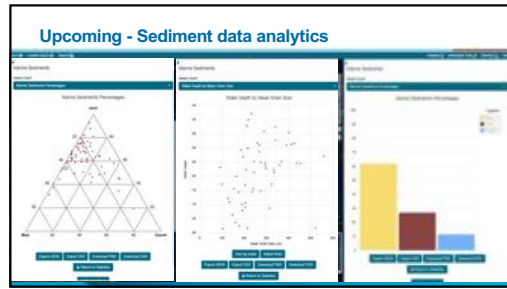
AusSeabed aims to improve coverage, awareness, quality, discoverability and accessibility of seabed mapping data for the Australian community.

AusSeabed is focused on multiple products (bathymetry, backscatter, water column, sub-bottom profiles, sediment samples).

AusSeabed builds and complements existing national or global initiatives.



Spare slides



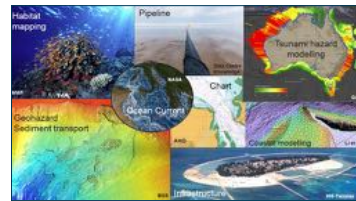
### Outline

- What is and Why AusSeabed?
- Where is AusSeabed at?
- What's in it for SBD communities?
- Where to next?

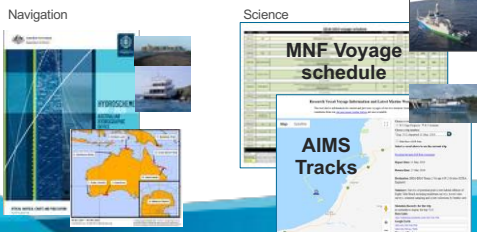
**Current state: Coverage (< 25% of marine jurisdiction)**



**Current state: Awareness (mapping for multiple purposes)**



**Current state: Awareness (many mapping plans)**



**Current state: Quality (multiple sources, sensors, formats)**



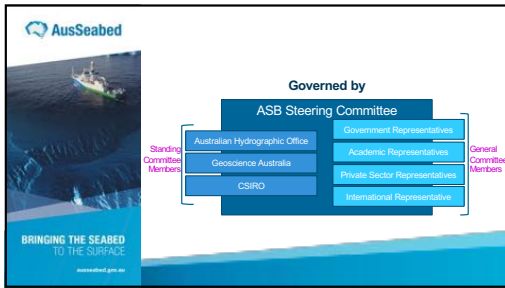
**Current state: Discoverability & Accessibility (Fragmented)**



**Drivers for AusSeabed**

- National Marine Science Plan 2015-2025  
Undertake systematic collection of environmental social and economic baseline data of Australia's marine estate
- Hydroscheme Industry Partnership Program  
Enhance safety of navigation and deliver a nation building program
- Nippon Foundation – GEBCO Seabed 2030  
Produce the definitive map of the world ocean floor by 2030 and make it available





### 2019-2021 AusSeabed Steering Committee

Sectors	Organisation	Representative
<b>Standing Members</b>		
Standing Members (Commonwealth)		
		Kim Picard (Chair), Wendy Stewart, Tara Martin
<b>General Members</b>		
Government (Commonwealth)		Johnathan Kool
Government (State)		Tim Ingleton, Ralph Talbot-Smith, Daniel Ierodiakonou*
Academia		James Daniell, Vanessa Lucier
Private		Paul Kennedy, Hugh Parker, Nathan Quadros (Vice-chair)
International		Geoffroy Lamarche

\*Daniel Ierodiakonou from Deakin University is representing the State of Victoria for matters that concern AusSeabed, by request from CELEP

### Programme theme: AusSeabed Data Hub

**Aims**

- Become the national point for submission, storage, discoverability and accessibility of seabed data from the region of interest.
- Contribute data to the Nippon Foundation - GEBCC Seabed 2030 project
- Complement existing Australian marine data initiatives

**Product suites**

- Bathymetry
- Backscatter
- MBES Water Column
- Sub-Bottom Profiles
- Sediment Samples

### Data Hub: Data Discovery & Accessibility

Survey by survey and Compilations Point cloud

### Programme theme: Tools, Guidelines and Standards

**Aims:** Develop community-ready resources that enhance the quality, consistency, and ease of seabed data acquisition and processing.

**Theme streams:**

**Tools:** online tools and databases enabling easier workflows from survey planning through to data processing and analysis.

**Guidelines and standards:** documents outlining current best practice for various aspects of seabed mapping.

[AusSeabed.gov.au](http://AusSeabed.gov.au) 1-stop shop for seabed mapping information


### Australia's blue economy

- 3<sup>rd</sup> largest EEZ in the world
- Most of us (85%) live within 50 km of the coast
- Marine industries contribute over \$74 b/yr to economy
- By 2025, marine industries will contribute \$100 b/yr
- Oil & gas, fisheries, marine tourism expected to continue growing

National Marine Science Committee 2015-2025 Factsheet

### The mapping and study of the sea floor

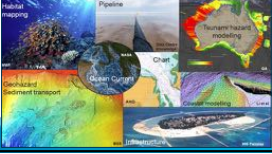
**Charting**



**Baseline data and Scientific analysis**

Coastal and marine planning, development and management of marine estate

- Marine reserves, heritage areas, coastal & resource development
- Operational oceanography
- Understanding and management of marine fauna
- Territorial claims



### We need a plan - Actually 2 plans - that fit together

**Charting**



**National coordination of other government priorities**



### Programme theme: Outreach, Education and Training


**Aim:** Provide a consistent message across Australia and internationally regarding the benefits of the AusSeabed initiative to the community.

**Theme streams:**


**Outreach:** enable engagement of potential contributors by demonstrating value proposition to their businesses

**Education:** provide information, raise awareness, and build cooperation and relationships within the marine community

**Training:** provide user training regarding provision, discovery, and accessibility of seabed mapping data



**Further information**



# Summary Presentation



**Project deliverables:**

- Development of medium resolution grids
- Development of high resolution grids
- Technical manuals on the bathymetric grids
- Wave model case studies
- Training manual and course material
- 5-day training course
- Report on best practices and lessons learned
- Report informing a GCF proposal and Pacific resilience programme

**Outcomes from workshop:**

- Plan for the collection of bathymetric data
- Plan for the wave model case studies
- Plan for the 5-day training workshop
- Monitoring and evaluation report
- Inception meeting report
- Ideas for the GCF and Pacific resilience programme

Summary Day 1

**Seabed 2030**

- May be able to provide the data and Seabed 2030 construct the medium res bathymetric grid
- Use the metadata format from Seabed 2030

**Emodnet**

- Use methodology of Emodnet to make the high res grid

**PICS – all have data, some planned surveys**

- Need to decide deadline for data deposit
- Didn't really confirm if we were going to look for additional data
- Can we get data from mining (Sam Smith) and petroleum companies, US Spatial Agency

Summary day 1

**Wave models**

- Still to be confirmed today
- global models available/ do we utilise local data?
- How to we integrate with the request for risk assessment from DFAT for SI

**Training to consider**

- combine with boundaries workshop
- extend to 2 weeks if we want to have 1 week bathymetry, 1 week wave modelling (will need to look at budget)

Summary day 2

**Training outcomes wish list**

- At the end of the training what should you be able to do?
  - Understand the method to develop the model
  - Interpret model results
  - Construct bathymetry grids (add in additional data)
  - Understand the complete work flow
  - Assess quality
  - Hazard and risk
  - Coastal processes and hazards – additional information on these
  - Climate projections – what can we expect with SLR
  - HYCREWS (RUEGA 2018)

Summary day 2

**British perspective**

- Training – combined training – one on bathy and one on wave modelling
- Bathy training:
  - want to understand and improve the data, how to interpret the dataset, need the connection between bathy and land
  - Want to identify a specific island to focus on in the training
  - Want to understand how to make better data, to have better modelling
  - Want to understand how the processing will work and the work flow
  - Want to be able to utilise the knowledge and skills to expand to other islands after the training
- Wave modelling:
  - want to broaden it out to other types in subsequent projects
  - Want to be able to utilize the bathy to some kind of wave modelling
  - Terrain contours and combination with bathy data
  - Site specific coastal processes, more details of what have already shared
  - Tide predictions and the connection to bathymetry
  - Wave runup/foundation – for sea life
- Open source software is a requirement so they can utilize after the project
- Results of training: enable participants to understand quality of bathy, coastal processes, tide predictions and wave modelling tools
- Overall outcome: ability of participants to expand what they have learnt to other islands in Palau – with a focus on better advice to government

Summary day 2

**RMI Perspective**

- Already have inundation models that have been provided but not used
- What RMI lacks is the luxury of land, 0.5m of run-up is a huge risk for the whole island
- What RMI really needs out of this is wave modelling
  - A basic version will suffice to begin with
  - They can build on that later if need be
- Will be getting 3 new buoys which will assist in the future
- What they lack at the moment is good bathymetry data
- There is LIDAR which they hope to be able to incorporate in the near future
- Hazard from wave is a priority in early warning system in – this is the priority of the government
- Training:
  - Bathymetry training
  - Training on wave models

Summary day 2

**Palau Perspective**

- Interested in INCREW
- Have gridded and non-gridded bathy data
- Have some LIDAR data
- Have been some localised wave modelling studies around Palau as well
- Will be getting some wave buoys as well
- Want to start with whatever they have now and be able to incorporate new data themselves when it is available
- Northwestern fringing reef that is fairly close to the shoreline, 1<sup>st</sup> project
- Islands within the lagoon – 2<sup>nd</sup> project. Interested in longshore currents and sand movement between the islands. Islands are very important for the economy (tourism). Need to understand the processes that are going on.
- Wave modelling is important as an initial starting point, but they need to take it further and want to be able to get to run-up/foundation
- Want to have a partnership that can build upon after this project

Summary day 2

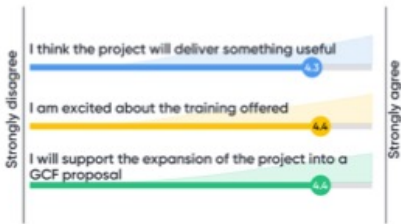
**Solomon's Perspective**

- This training is complimentary to the development and implementation of their National Ocean Policy (which involves 12 ministries)
- There is a focus on data and products to be used to provide advice to government, particularly for infrastructure decisions
- Want to focus on gaining knowledge and understanding of different types of models and the input data and parameters in each model
  - Want to look at a comparison of models, data requirements (and resolutions), outputs and what the outputs can be used for
- Want to focus on one location in the workshop where they already have good data e.g. Honiara
  - Storm surge model
  - Show end to end modelling process
  - Look at the outputs and interpret them
- Want to gain knowledge from the workshop to gain better understanding and use to inform what they need for various activities in line with the ocean policy
- Will send 4 people to the training that are technical staff (from 4 different gov organisations/departments)
- Want to have a future program (partnership) after this to expand knowledge into other areas such as extreme events and tsunamis

## Workshop evaluation

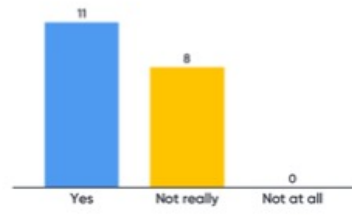
During the last session, a simple workshop evaluation was carried out using the interactive software Mentimeter. It was the first time we have used the software and the question formulation could have been improved. However, evaluating the responses to the questions indicates that participants considered the project to be valuable. Most people felt fully engaged in the working session although some participants require additional clarification on the goals of the project (this response appears to be due to different priorities of each of the four countries and whether the project has the scope to deliver all of the priority areas).

### Scales



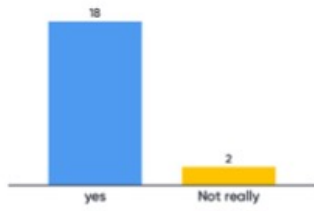
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### The inception workshop clarified the project goals



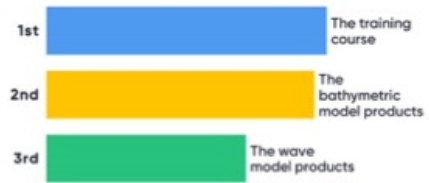
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### I feel I had real input into what we plan to do



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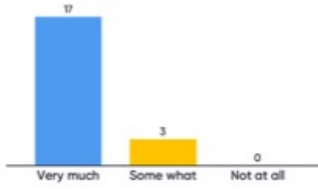
### The most important aspect of the project for me is



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The content of the inception meeting was relevant to my needs

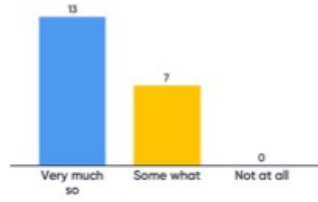
Mentimeter



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After the meeting I feel more confident in explaining the project to others

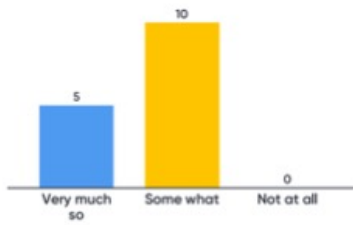
Mentimeter



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The inception meeting lived up to my expectations

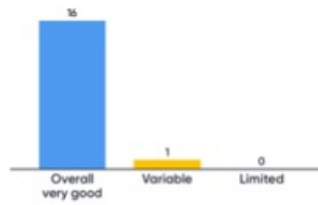
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How would you rate the presenters knowledge of the subject

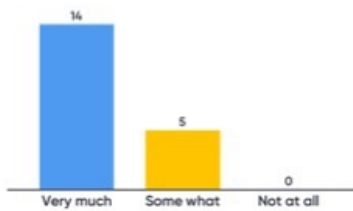
Mentimeter



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Overall are you satisfied with the meeting outcomes

Mentimeter



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## Participant list

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Unable to attend

## Gender Evaluation

Twenty-four participants – 17 men and 7 women - attended the working session.

