Advancing Cross-Disciplinary Frontiers in the Southern Ocean through Opportunistic MultiBeam Acquisitions
Laura Bassi Main Route and PNRA Activities in Antarctica

ISOBatA Project Overview

Some Results: Ross Sea (mooring B-G-H), Southern Ocean

Conclusions
IBCSO Cell size 500m x 500m:
22.32%: MBES coverage (datasets + transits)
1.47%: Other: echosounder, etc...

- Transits data “clusters” along Icebreakers main routes >> redundant acquisitions
- Opportunistic acquisitions during oceanographic expeditions in Antarctica are strategically important for advancing cross-disciplinary frontiers
- Achieving the goals of Seabed2030 requires a targeted approach to optimizing opportunistic acquisitions for every vessel operating in Antarctica
Icebreaker Laura Bassi & PNRA Activities in Antarctica

Laura Bassi Travel Back & Forth Italy - Antarctica

- 90 days It-NZ-IT
- 14 days NZ-MZS-NZ
- Antarctic activities (logistic and research)

Logistics:
- Provide logistical support and supply to MZS & Concordia
- Supply & Support to research activities in MZS & Concordia

Researches:
- Ross Sea – MORSEA Mooring Observatory Maintenance
- Research Projects
ISOBatA Project Overview (1)

- Acquisition planning based on prior metadata to fill critical bathymetric gaps (key study areas) and “PNRA recurrent areas” lacking mapping.

- Vessel Time => speed reduction (20%) and rerouting strategies.

Equipments (Acoustic)
- MB: Simrad EM304
- Topas PS 18
- ADCP 150 Khz

Equipments (Others)
- Mag. SeaSpy
- Sound Velocity: MORSEA CTD- XBT

Metadata Used For Planning:
- Previous PNRA MBES datasets.
- IBCSO Coverage (Dorschel et al 2022)
- MCS SDL Navigation
- Previous PNRA Cores-Box Cores
- Mooring Sites
ISOBatA Project Overview (2)


**Area in colors:** existing Ross Sea MBES bathymetric coverage

**Blue lines:** routes from NZ to MZS, passing across the eastern part of the MQ TJ *(Gasperini et al 2022)* and EFZ (East. black box)

**Red lines:** routes from MZS to NZ, passing across the western part of the Emerald Fracture Zone (West. black box).

**Purple and yellow lines:** XXXV & XXXVI R/V Laura Bassi ship-tracks.

**Red Rectangles:** Case Studies Area (MQ TJ & EFZ)

**Black areas:** 2017 OGS Explora bathymetric datasets.

**Green Stars:** active Italian mooring sites and Floaters.

**Red stars:** MZS Antarctic Stations.

Fifth Arctic-Antarctic and North Pacific Mapping Meeting, Bremen 27-29 November 2023
**ISOBatA acquisition Challenges & Opportunities**

**Southern Ocean:**
- QC & speed reduction to 8.5/9 Kn (-30%)
- Mainly Time Consuming
- EM304 is a 30 KHZ

**Ross Sea:**
- Good Data
- Mainly Opportunistic

4000m depth EM304 (30 kHz)
- swath is = 1 x depth

**Interferences:**
- multibeam priority

**EA600 - TOPAS–MBES–EK80**

**MBES Titanium Ice Shields**
- -20% signal strength

**Sound Velocity correction:**
- MORSea XBT & CTD

**Ice along the route:**
- No: EM2040 & SV pole deployment

**Tests Opportunities**

**XXXVII: Seapath & Topas Break-down**

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Activities on board went beyond ISOBatA data collection:

- Realtime data sharing: (ISOBatA Open Data Policy) increased onboard collaborative approach and results:
  - LASAGNE–Edisto Bay (data collection, merge of ISOBATA, LASAGNE and GLEVORS data)
  - GRETA (data collection & use of ISOBATA dataset for planning)
  - COLLAPSE (data collection & use of ISOBATA dataset for planning)
  - BOOST (data collection and onboard QC)
  - DISGELI (data collection along MCS Line use of ISOBATA dataset for planning)
- ISOBATA team shared its expertise and engaged scientists on board fostering a culture of collective exploration and knowledge sharing as well as the Seabed 2030 initiative preventing data dispersion

Thanks to:
- IIM: thanks for 1° Leg night shifts & Knowledge exchange
- MORSea observatory projects for XBTs & CTDs!!!
Ross Sea: Mooring B Area

MOORING Areas:
- MZS, Moor L
- Moor G
- Moor B
- Moor H
- Edisto B.

Metadata:
- Previous PNRA MBES datasets
- IBCSO Coverage
- SDL Navigation
- IT Cores & BoxCorers

- MB: Simrad EM304
- Topas PS 18
- ADCP 150 KHz
- Sound Velocity: CTD MORSEA

IT Corers
- ANTA91-14C
- ANTA95-15C1
- ANTA95-15C2
- ANTA99-C12
- ANTA99-C14
- ANTA99-C16
- ANTA99-C11
- ANTA99-CJ4
- ANTA99-CJ5
- ANTA99-CJ6
- ANTA99-CJ7
- ANTA99-CJ11
- ANTA02-J15
- XXXII_TR17-002PC

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Ross Sea: Mooring B Area

- MB: Simrad EM304
- Topas PS 18
- ADCP 150 Khz
- Sound Velocity: CTD MORSEA

**IT Corers**
- ANTA91-14C
- ANTA95-15C1
- ANTA95-15C2
- ANTA99-C12
- ANTA99-C14
- ANTA99-C16
- ANTA99-CJ4
- ANTA99-CJ6
- ANTA99-CJ11
- ANTA99-CJ12
- ANTA98-J15
- XXXII_TR17-002PC

**MOORING Areas:**
- MZS, Moor L
- Moor G
- Moor B
- Moor H
- Edisto B.

**Metadata:**
- Previous PNRA MBES datasets
- IBCSO Coverage
- SDL Navigation
- IT Corers & BoxCorers

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**LINE BGR 80_009B**  MCS line collected in 1980: SDL

<table>
<thead>
<tr>
<th>SP</th>
<th>SOL LAT LONG</th>
<th>SP</th>
<th>EOL LAT LONG</th>
<th>LENGTH (KM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>009</td>
<td>-74.76111 179.17545</td>
<td>7040</td>
<td>-77.97342 179.21161</td>
<td>352</td>
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<tr>
<td>009B</td>
<td>-74.77881 179.13794</td>
<td>11036</td>
<td>-72.98681 178.99428</td>
<td>199</td>
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</tbody>
</table>

**LINE TRACE RANGE (SP) :**

009B -22 to 3961 SDLS-4

**MCS Line BGR80_009B**

BGR80_009B shots covered by ISOBatA MBES & TOPAS

**Ross Sea: Mooring B Area**

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Ross Sea: Mooring B-G Area

Sub-bottom seismic profile

Moor. G-B 3D
MBES data Collected in Mooring G Area: spiral geometries generated by gouging icebergs illustrate the interplay of tidal rise and geostrophic currents.

Newman et. al 2016
Ross Sea: Hillary Canyon

ISOBatA Mooring H dataset acquired in 2 years complementary to OGS-Explora XXXII PNRA Expedition

Past OGS-Explora datasets:
- Whispers (XXXII)
- ODYSSEA (XXXII)
- ANTSSS (Jennifer Gale)
- WISE (XXI)

Future Project: IOPPERS Area

150 Nm
Rerouting Time 0.5 h

Hillary Canyon

Gullies
Southern Ocean:

XXXVII PNRA Expedition: unmapped volcano along the route back to NZ. Depth difference between IBCSO map and ISOBatA profile is 600m.

J. Gevorgian, D. T. Sandwell1 et al 2023, Global Distribution and Morphology of Small Seamounts -Not detected-
NZ Waters Acquisition:

NSF-USA Antarctic Internet Cable NZ- McMurdo

ISOBatA Data Along NSF-USA Cable  →  NFS-USA

ISOBatA Data acquired in NZ Water

GEBCO Seabed 2030 South and West Pacific Regional Map (Project’s)
### ISOBATA in Numbers

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Area</th>
<th>XXXVII (kmq)</th>
<th>XXXVIII (kmq)</th>
<th>XXXVII+XXXVIII (kmq)</th>
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</thead>
<tbody>
<tr>
<td>MBES</td>
<td>RossSea</td>
<td>7590</td>
<td>7920</td>
<td>15510</td>
</tr>
<tr>
<td></td>
<td>S. Ocean</td>
<td>9495</td>
<td>8490</td>
<td>17985</td>
</tr>
<tr>
<td>MAG</td>
<td>S. Ocean</td>
<td>1120</td>
<td>EMZ 715 km</td>
<td>MQ 270</td>
</tr>
<tr>
<td>TOPAS</td>
<td>Moor. B-G</td>
<td>176</td>
<td>MZ 129 km</td>
<td>RossSea 300 km</td>
</tr>
<tr>
<td>ADCP 150 kHz</td>
<td>SO-Ross Sea</td>
<td>III leg</td>
<td>I-II Leg</td>
<td>Tot. XXXVIII: 8450 km</td>
</tr>
</tbody>
</table>

### XXXVIII ISOBatA Vessel Time: Speed Reduction and Rerouting Acquisition

<table>
<thead>
<tr>
<th>SOL (UTC)</th>
<th>EOL (UTC)</th>
<th>Speed</th>
<th>Area</th>
<th>Acq. nm</th>
<th>Rerouting</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023.01.09 10:50</td>
<td>2023.01.10 19:35</td>
<td>8.5 - 9 kn</td>
<td>EMZ</td>
<td>390 nm (280 SpeedR.)</td>
<td>Routing also due to bad weather</td>
<td>~ 12 h</td>
</tr>
<tr>
<td>2023.02.27 07:03</td>
<td>2023.02.27 23.18</td>
<td>8.5 - 5 kn</td>
<td>MQ</td>
<td>147 nm (99 nm Speed R)</td>
<td>Shared with NSF Cable</td>
<td>16h+ ~X</td>
</tr>
<tr>
<td>2023.01.121 02:30</td>
<td>2023.02.21 20:40</td>
<td>No speed Reduction</td>
<td>Ross Sea</td>
<td>7920 kmq</td>
<td>Yes</td>
<td>~4 h</td>
</tr>
</tbody>
</table>
Conclusions:

- ISOBatA collected relevant datasets in PNRA key areas.
- Underway acquisition along planned corridors, speed reduction and the use of coverage maps are key to improving knowledge of the seafloor.
- Underway acquisition needs vessel time.
- Laura Bassi Underway data acquisition are possible only in the framework of PNRA approved projects (ISOBatA end: 2024).
THANK YOU

Thank you in various languages:

- Arigato
- DO je
- Spasibo
- Shukriya
- Dankie
- ASANTE
- KIA ORA
- Toda
- MAAKE
- salamat
- Kamsa hamnida
- Achiv
- Grata
- Tertul
- Vinaka
- Grazie
- Arigato
- Efcharisto
- Mahalo
- Obrigado
- Asante