Center for Coastal and Ocean Mapping

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Combining angular and spatial information from multibeam backscatter data for improved unsupervised acoustic seabed segmentation

Alexandre C. Schimel
University of New Hampshire, Durham

Yuri Rzhanov
University of New Hampshire, Durham, Yuri.Rzhanov@unh.edu

Luciano E. Fonseca
University of New Hampshire, Durham, luciano@ccom.unh.edu

M Mayer
University of New Hampshire, Durham

Dirk Immenga
University of Waikato, Hamilton, New Zealand Aotearoa

Recommended Citation

Combining Angular and Spatial Information from Multibeam Backscatter Data for Improved Unsupervised Acoustic Seabed Segmentation

SCHIMEL Alexandre [1,2], RZHANOV Yuri [3],

FONSECA Luciano [3,4], MAYER Larry [3], and IMMENGA Dirk [2]

[1] School of Life & Environmental Sciences, Deakin University, Australia

[2] Department of Earth & Ocean Sciences, University of Waikato, Hamilton, New Zealand

[3] Center for Coastal and Ocean Mapping, University of New Hampshire, USA

[4] Faculty of Engineering at Gama, University of Brasilia, Brazil

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WAIKATO
Te Whare Wānanga o Waikato

Center for Coastal & Ocean Mapping
Joint Hydrographic Center
A Center for Expertise in Ocean Mapping and Hydrographic Sciences
CCOM JHC

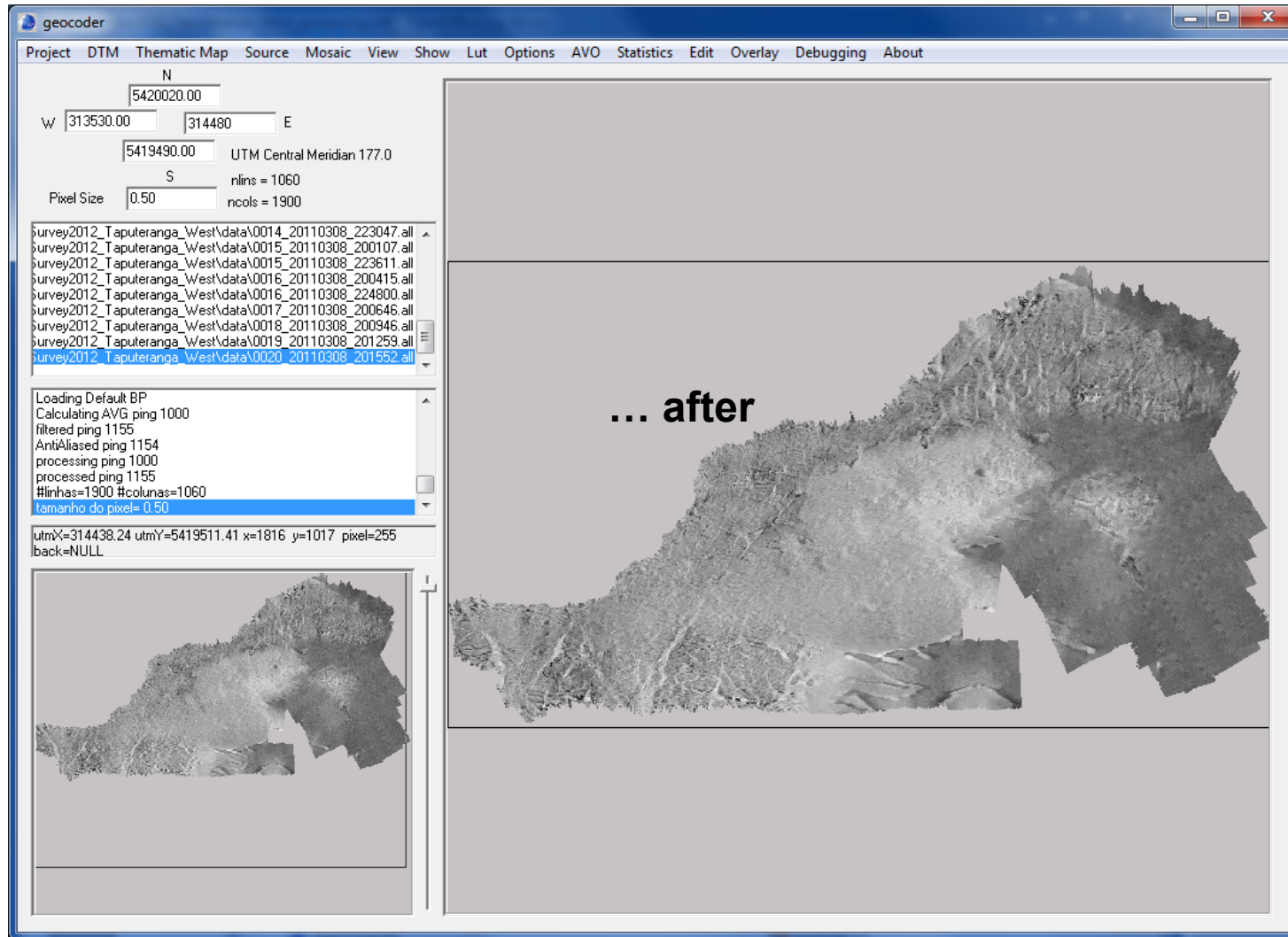DEAKIN
UNIVERSITY AUSTRALIA

Introduction: Geocoder

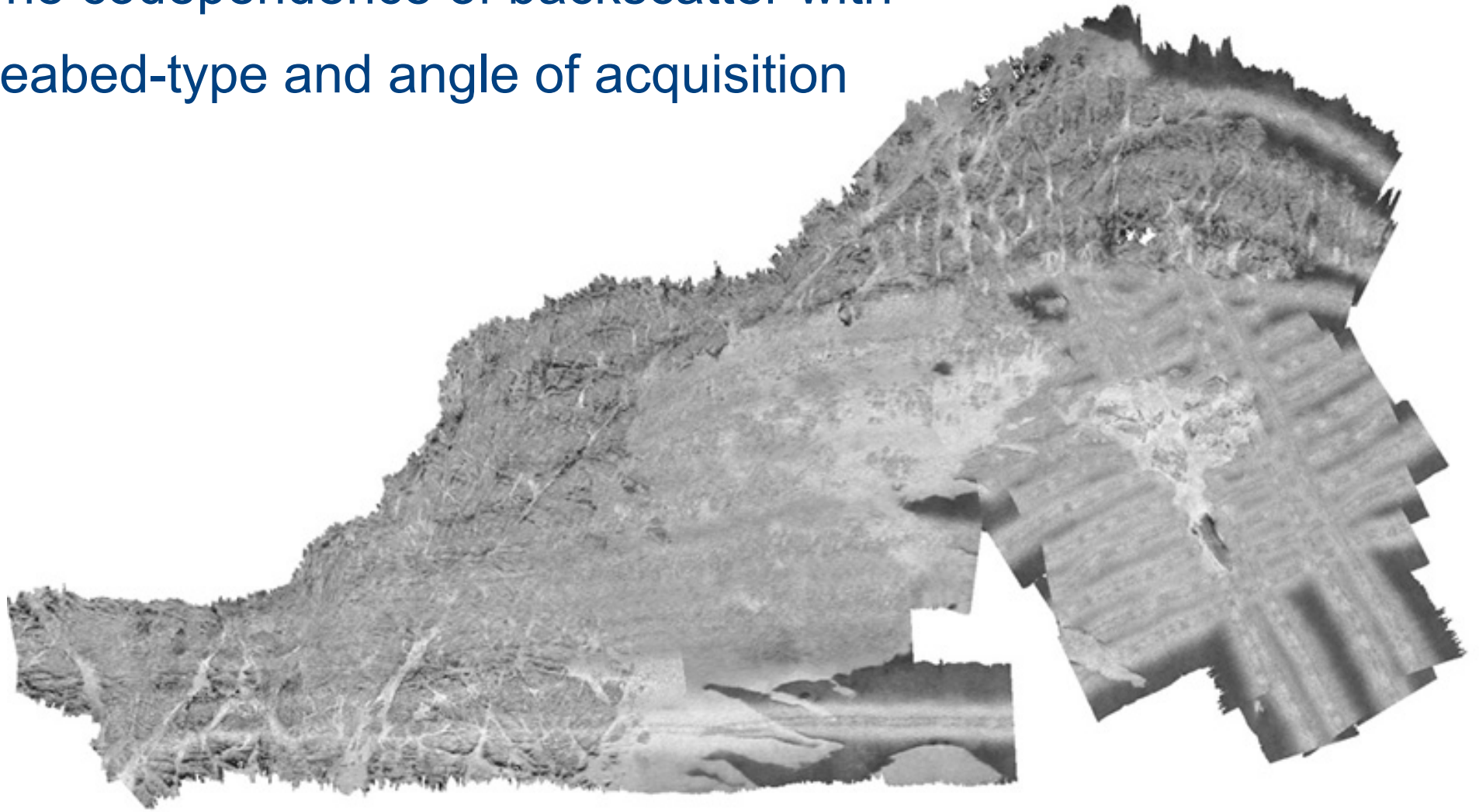A backscatter-data processing software by CCOM-JHC, UNH.
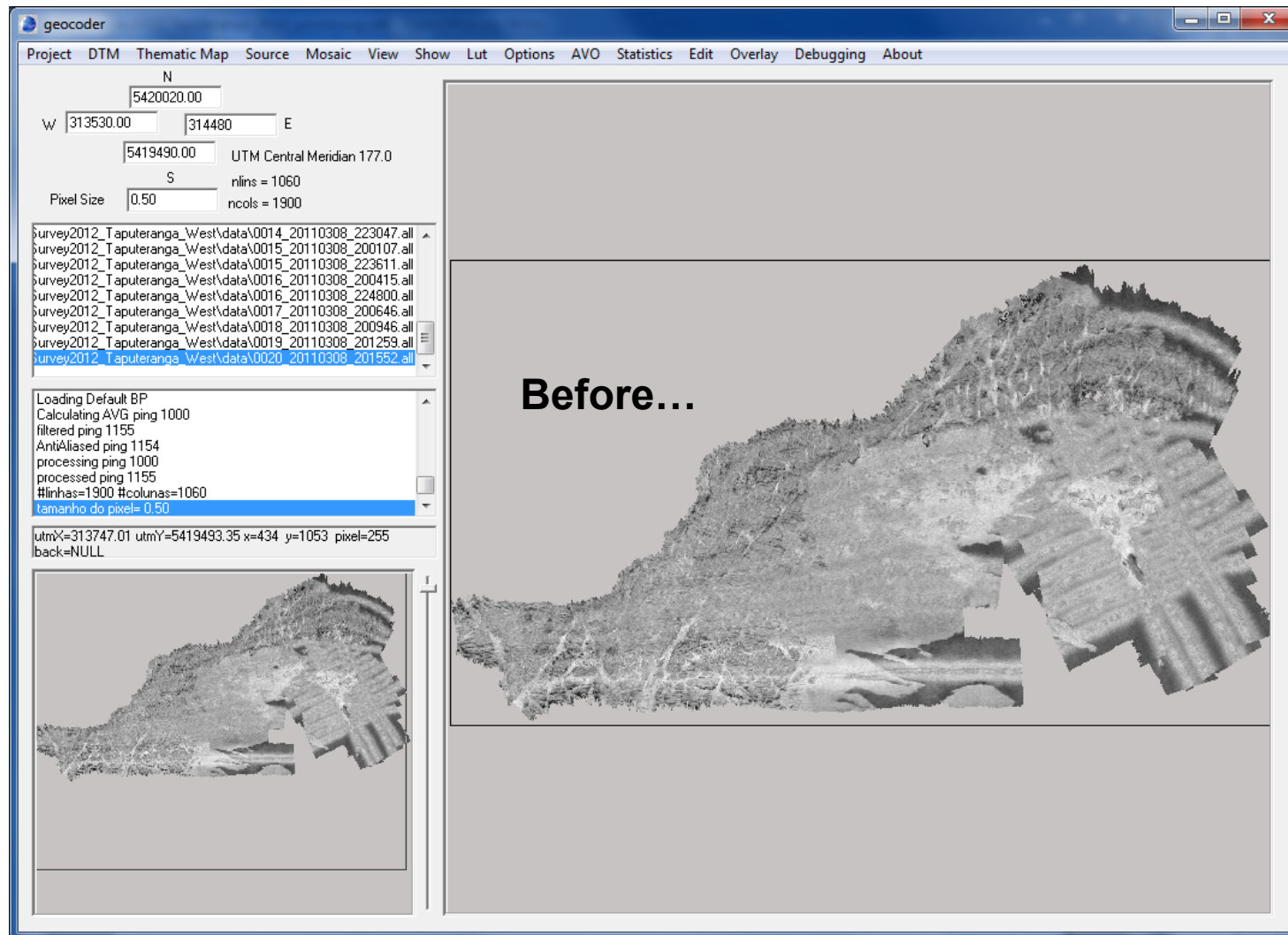
Introduction: Geocoder

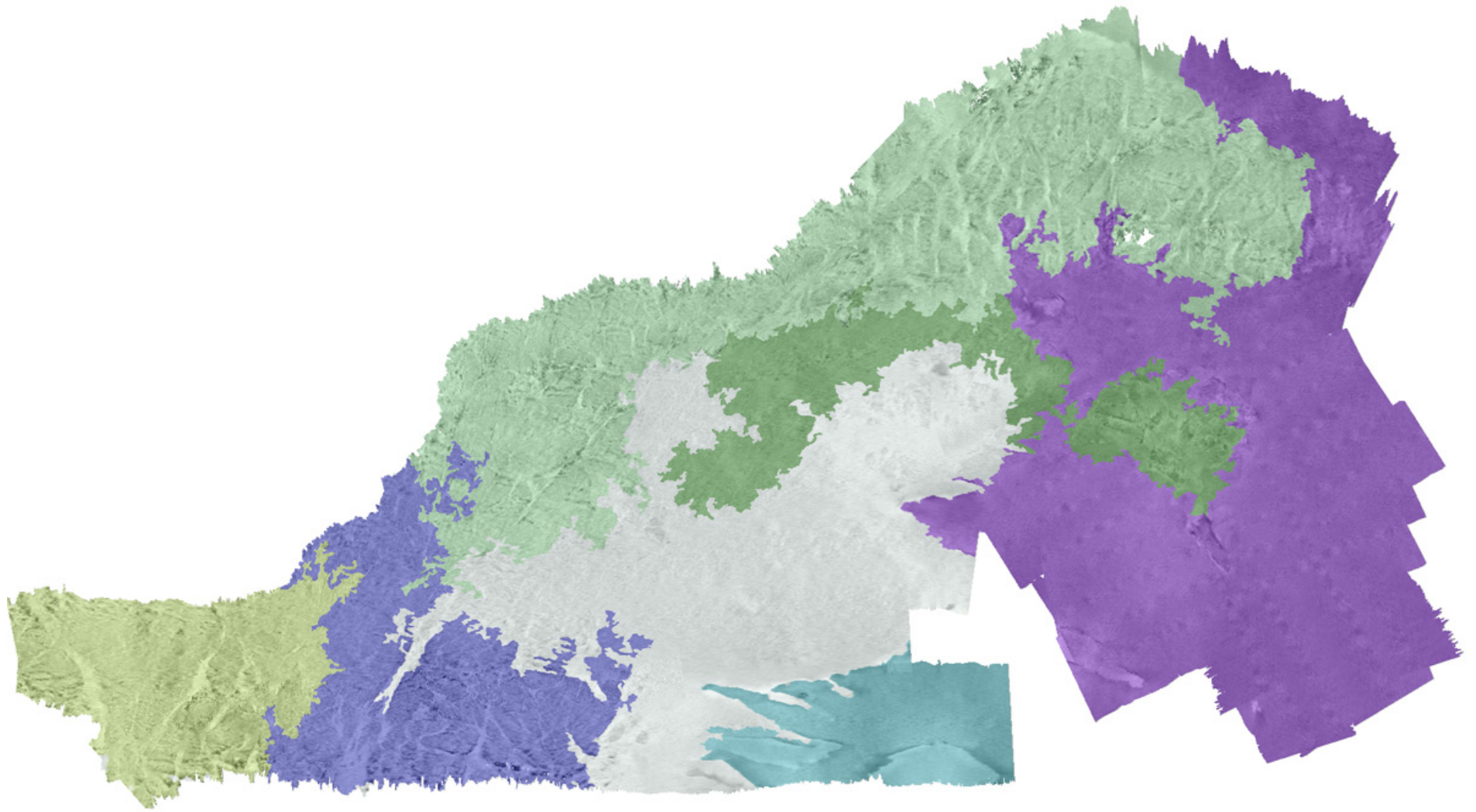A backscatter-data processing software by CCOM-JHC, UNH.

Introduction: main issue

The codependence of backscatter with seabed-type and angle of acquisition

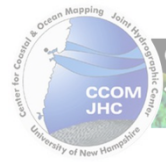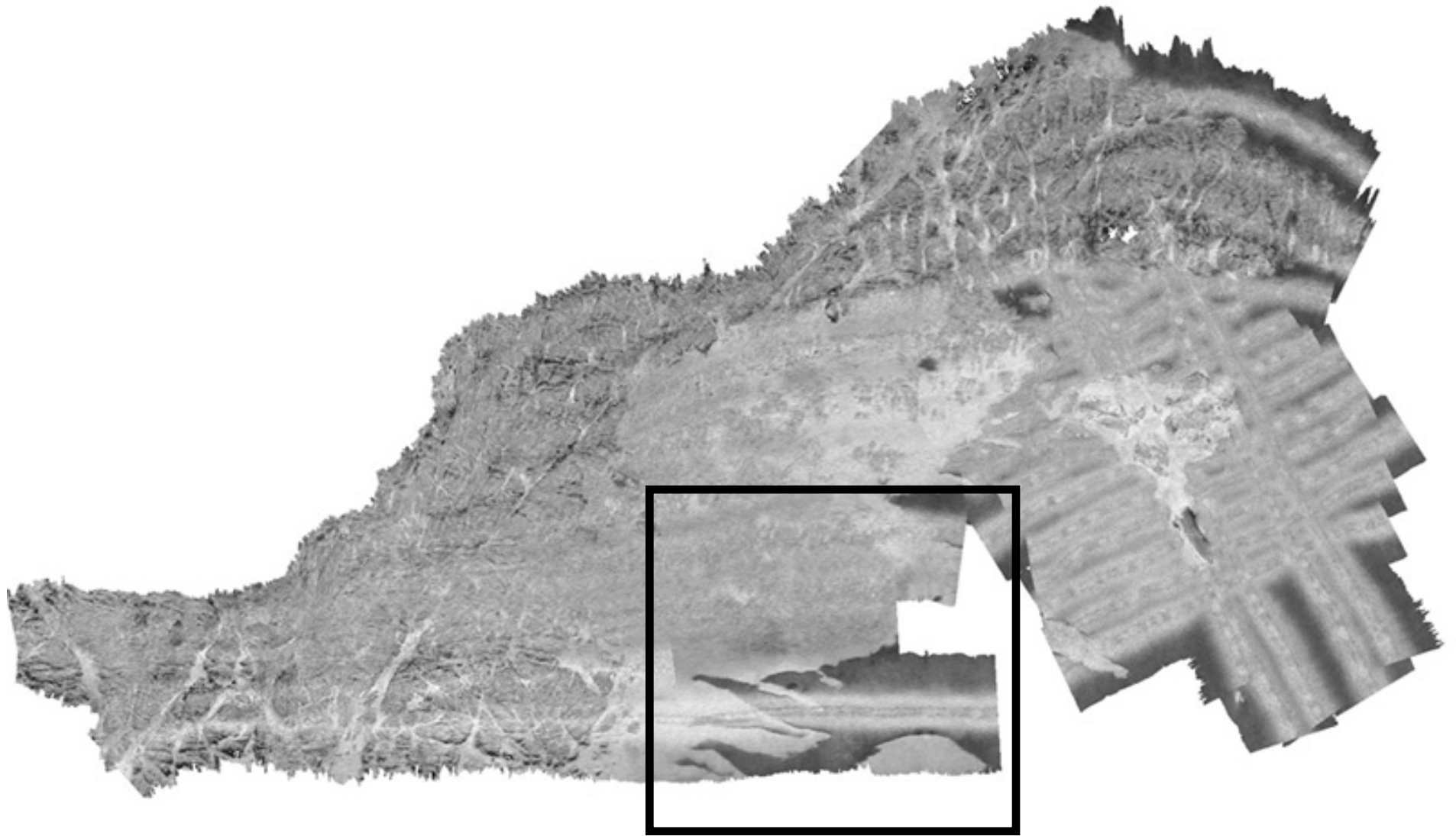# Solution #1: Image-based methodologies

Solution #1: Image-based methodologies
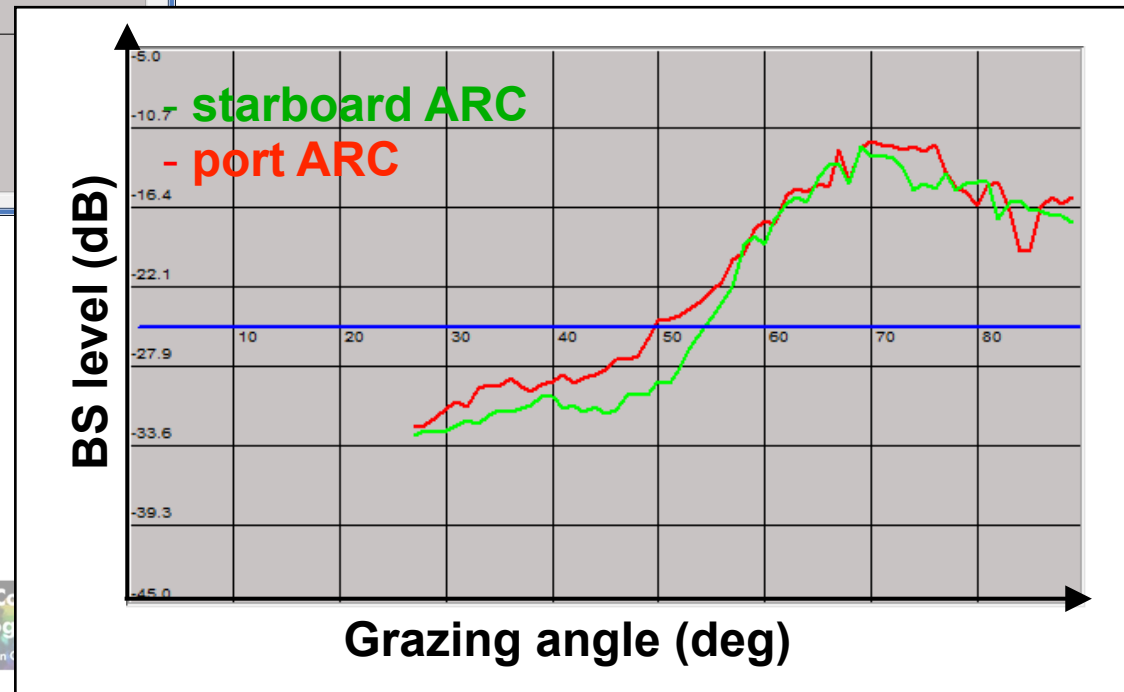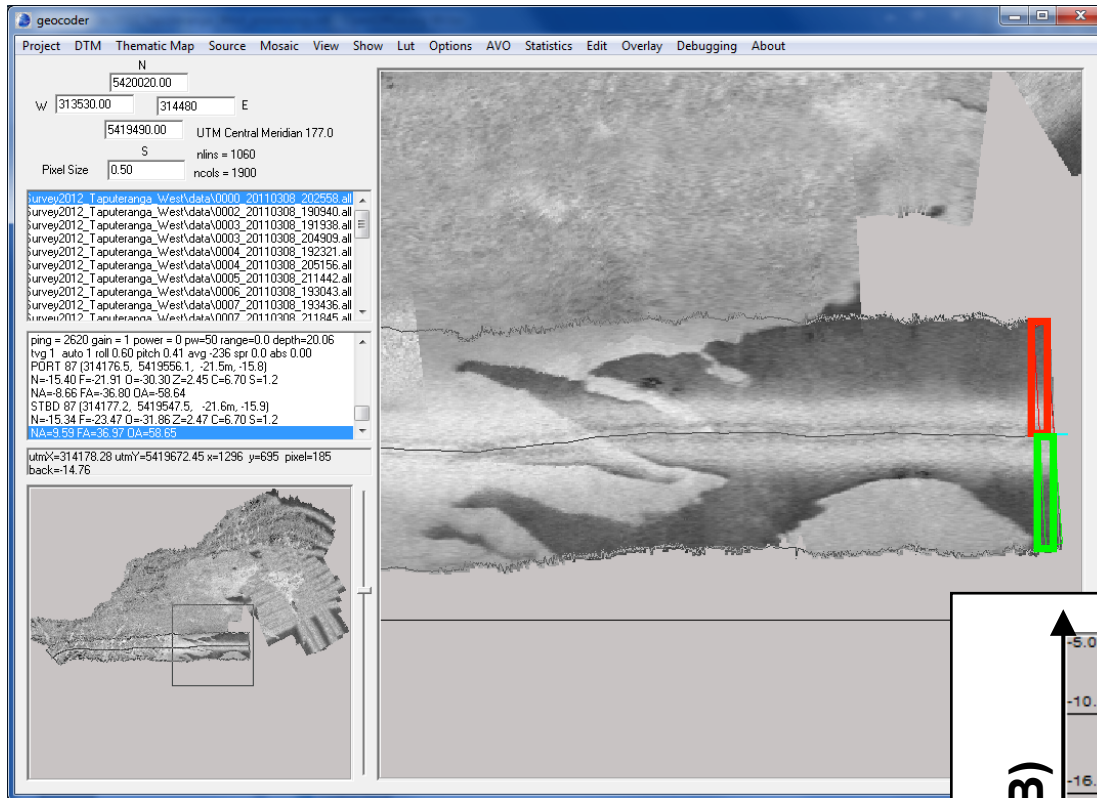
Mosaic segmentation possibilities:

- Manual or Automatic

- Variables:
  - Pixel amplitude
  - Statistics within neighborhood of pixels
  - Textures
  - Power spectra features
  - …

- Algorithms:
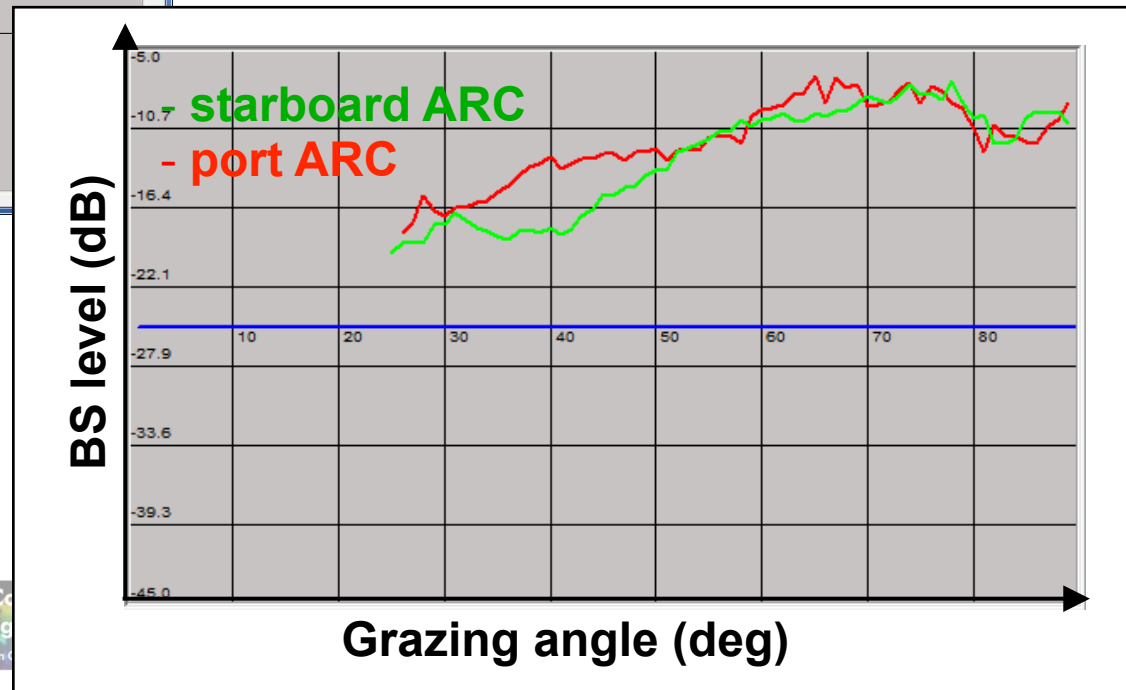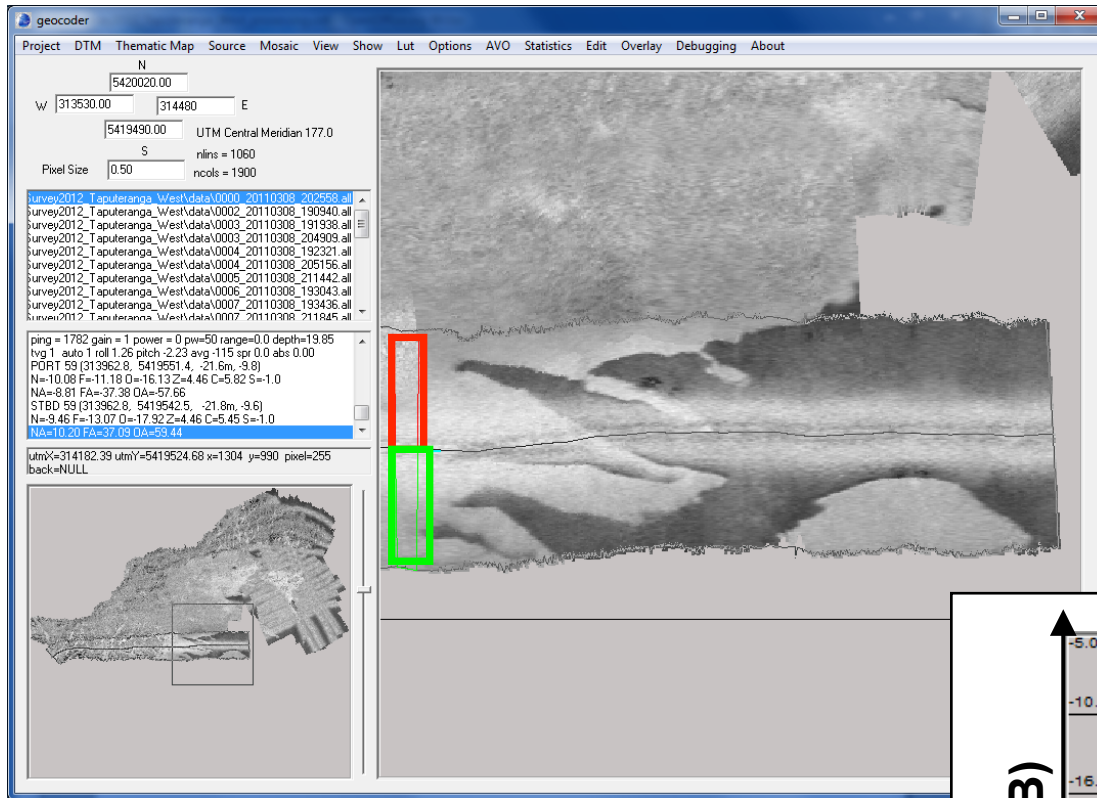 - k-means clustering
  - Decision trees
  - Neural networks
  - …

Solution #2: Angular-Response-based methodologies

Solution #2: Angular-Response-based methodologies
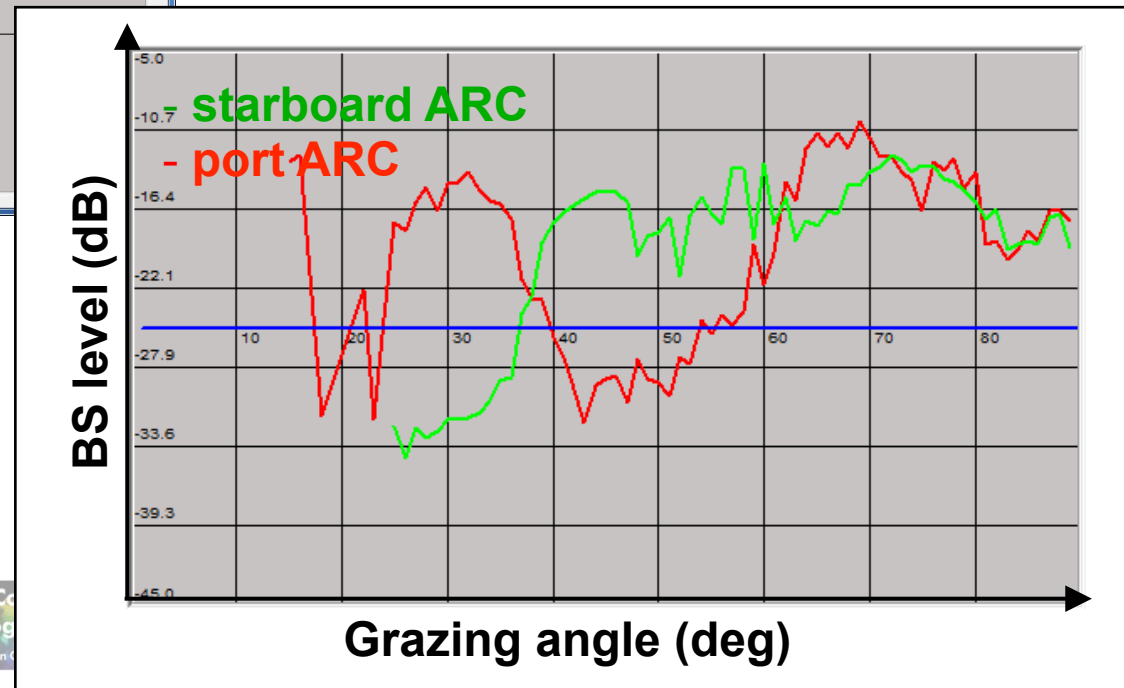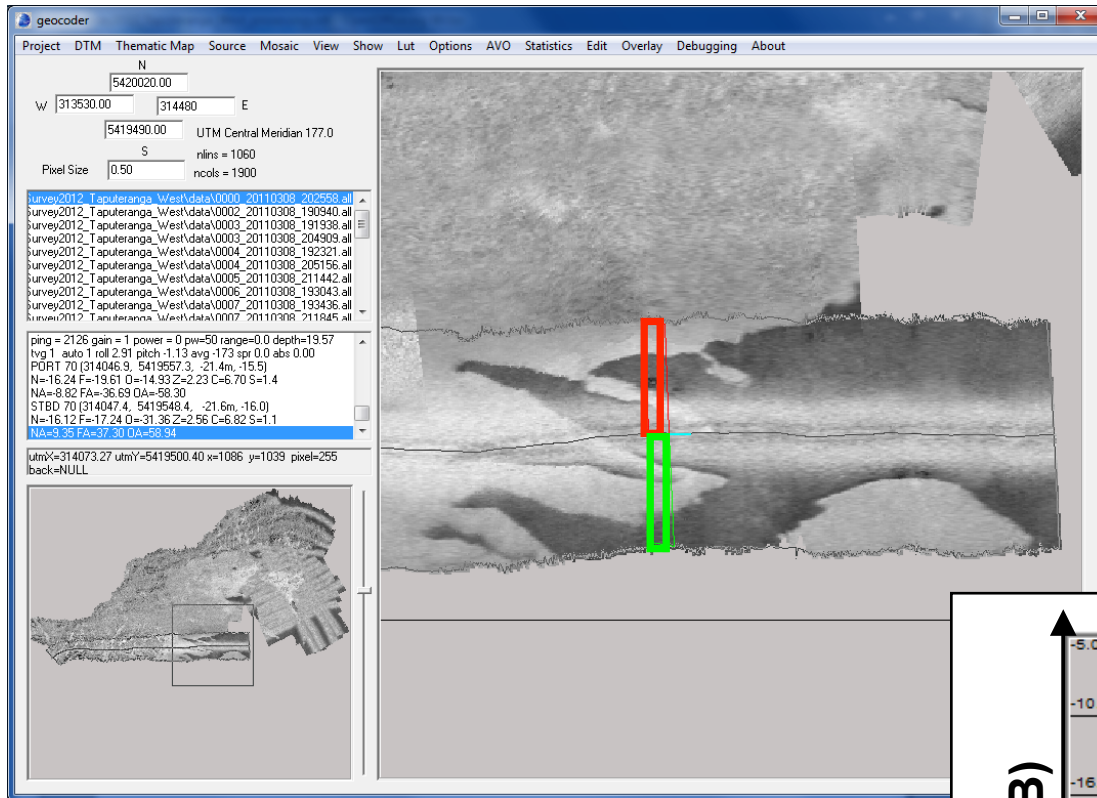
Solution #2: Angular-Response-based methodologies

Solution #2: Angular-Response-based methodologies

Image-based vs AR-based methodologies

Image-based approach:

To empirically **compensate for angular variation,** so that remaining variations are approximately only due to **change in seabed-type.**
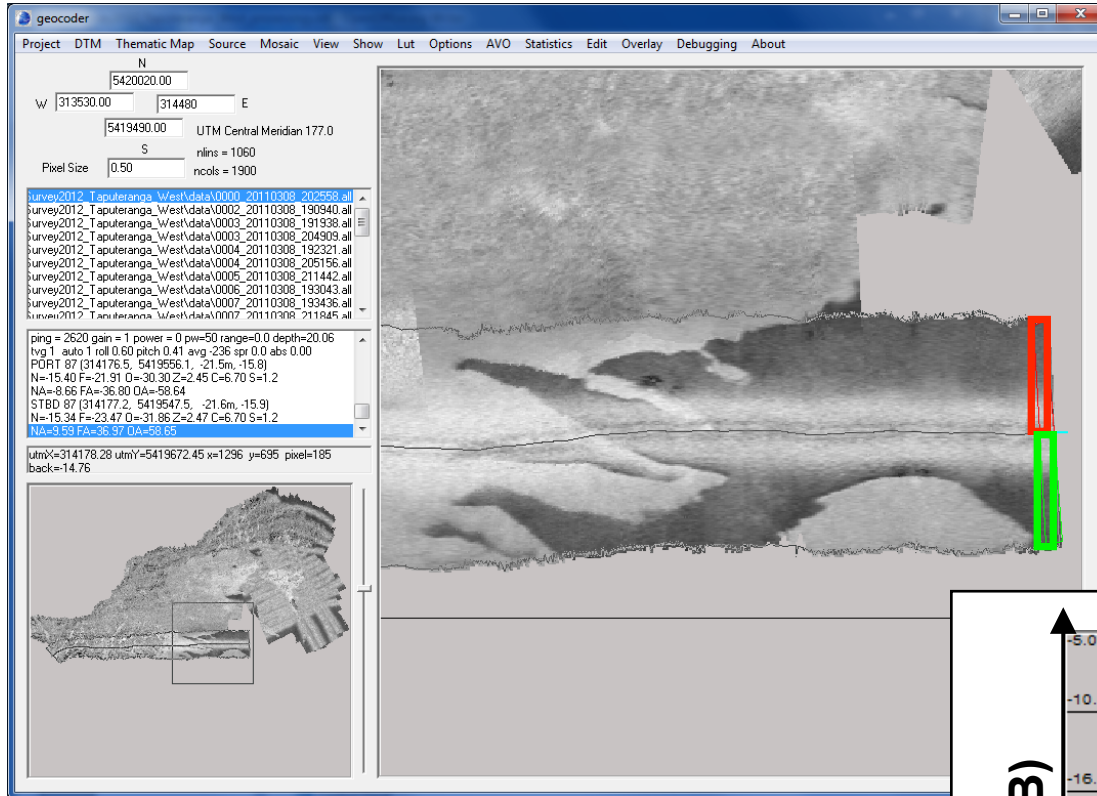
AR-based approach:

To attempt avoiding **variation in seabed-type,** so that remaining variations are approximately only due to **change with angle.**
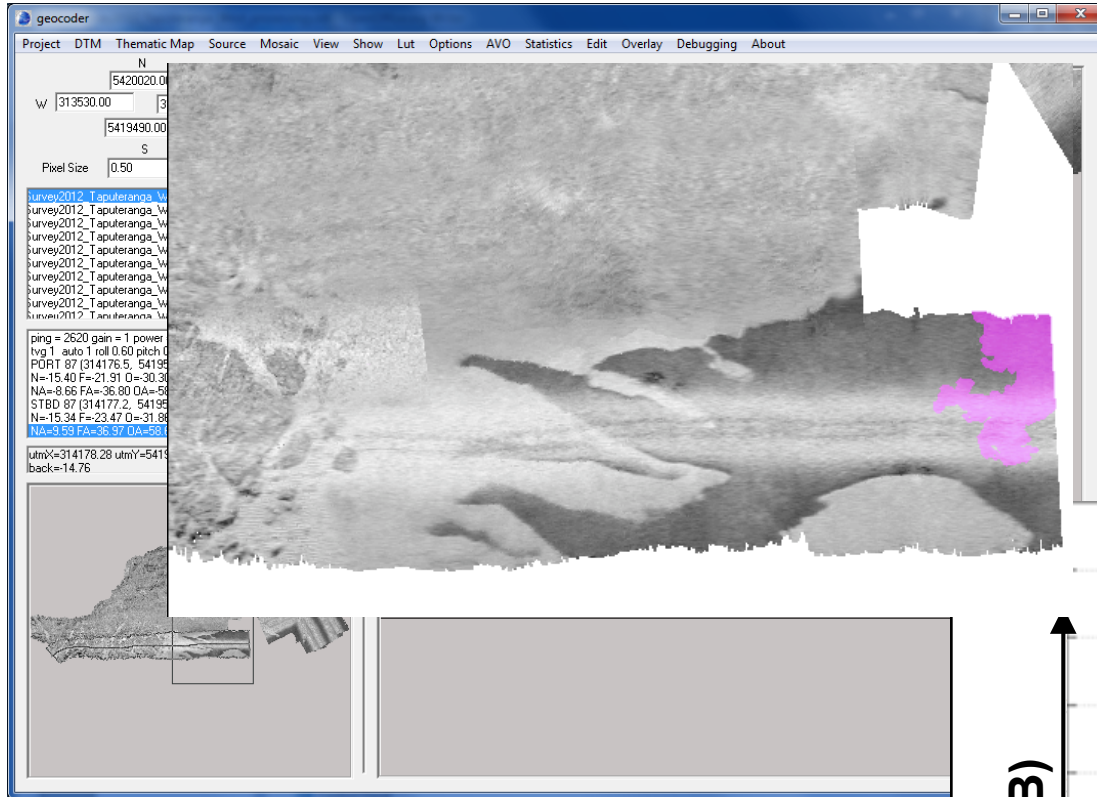
+ Full use of data spatial information

- Discard angular information
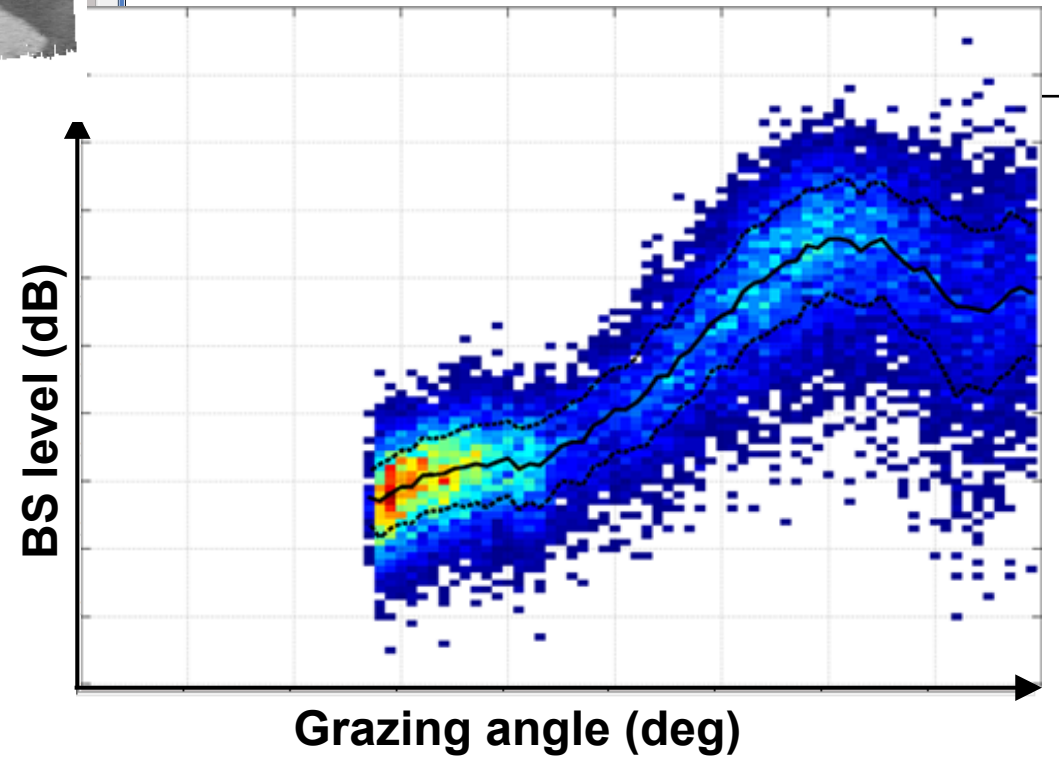
+ Full use of data angular information

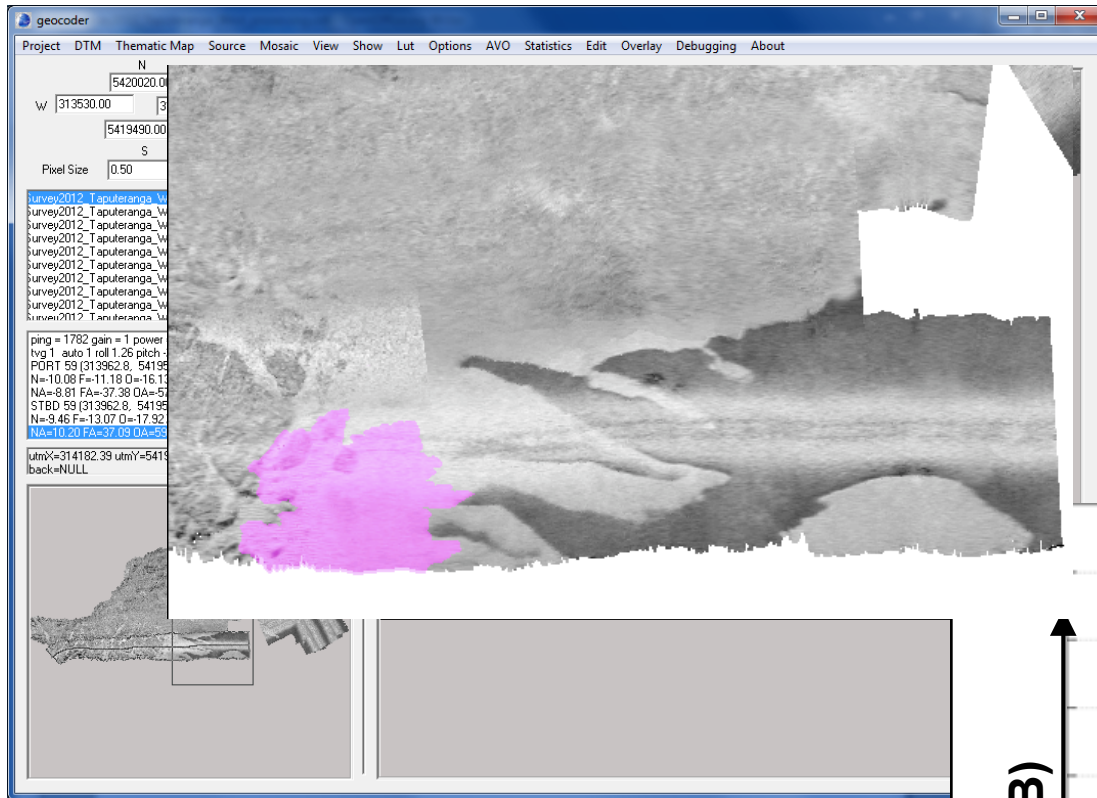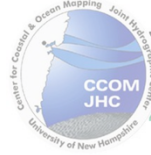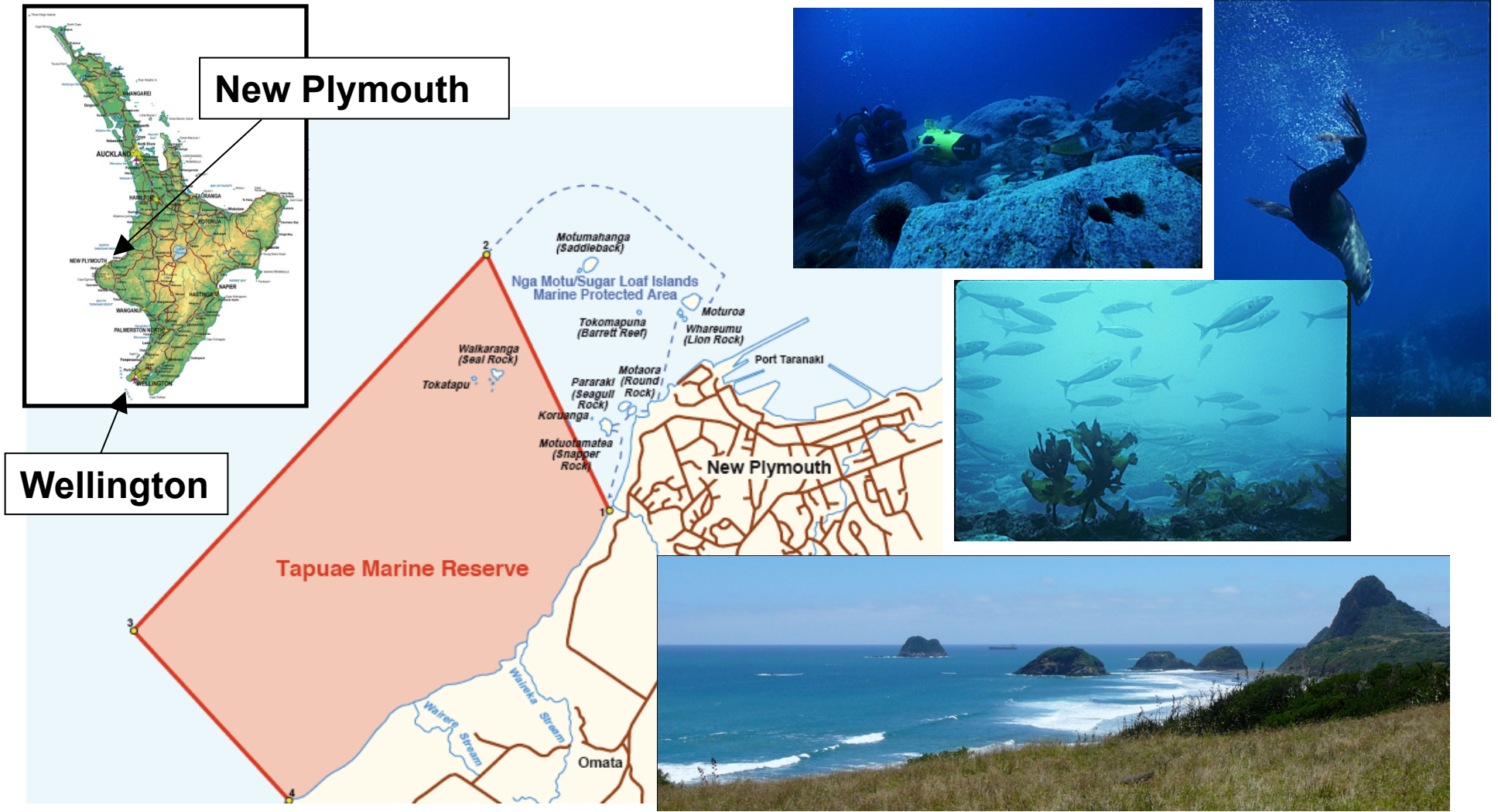**- Discard data spatial information**

Geocoder improvements:
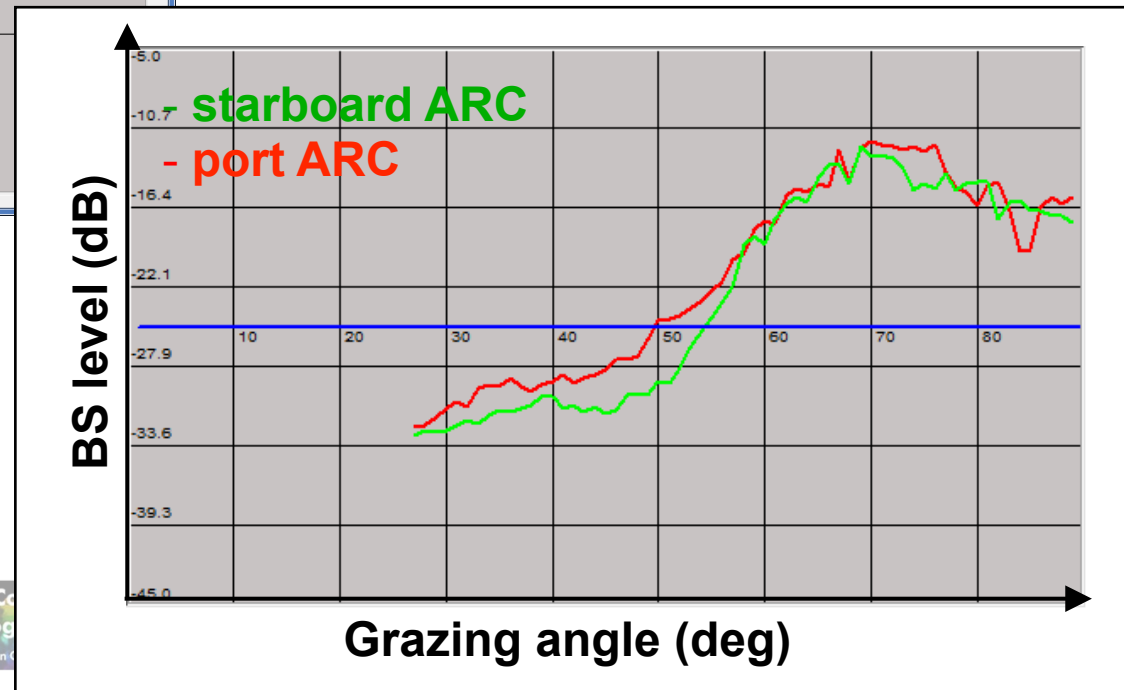
Geocoder improvements:

- **Themes**

- **2D histograms**

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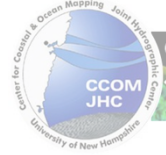*Te Whare Wānanga o Waikato*
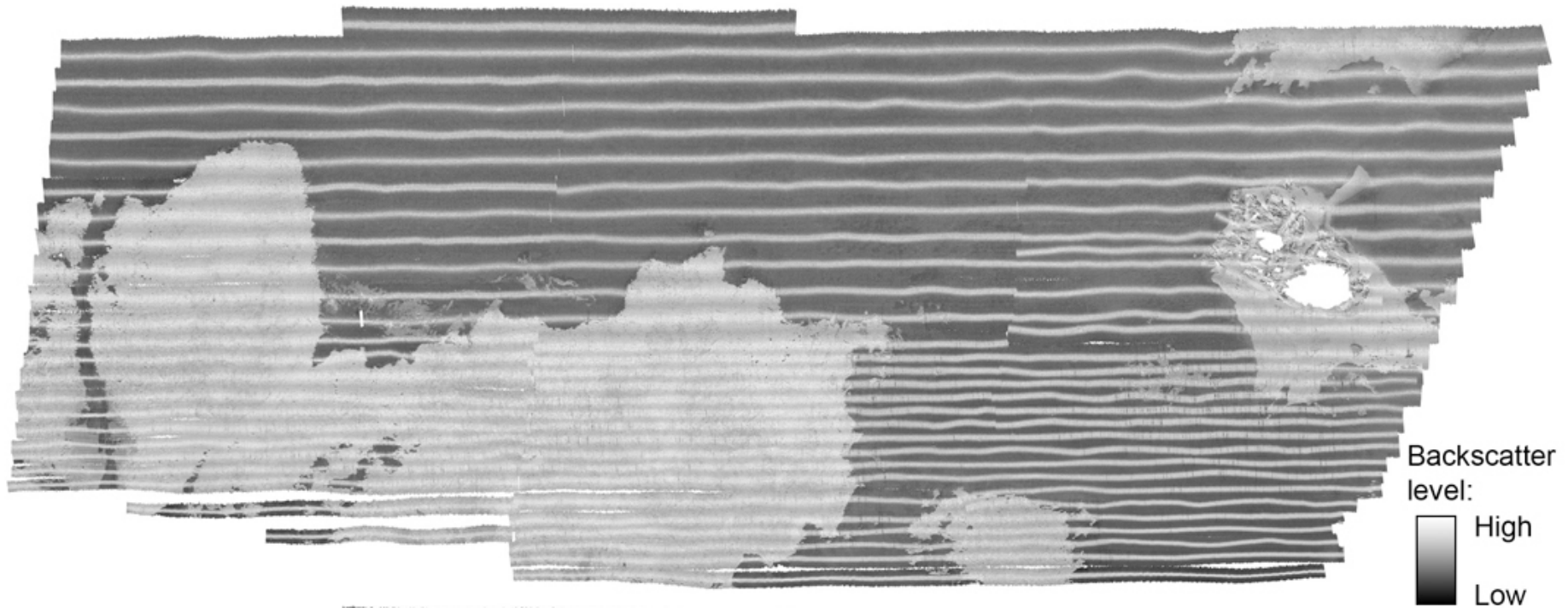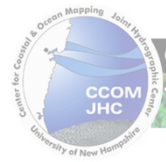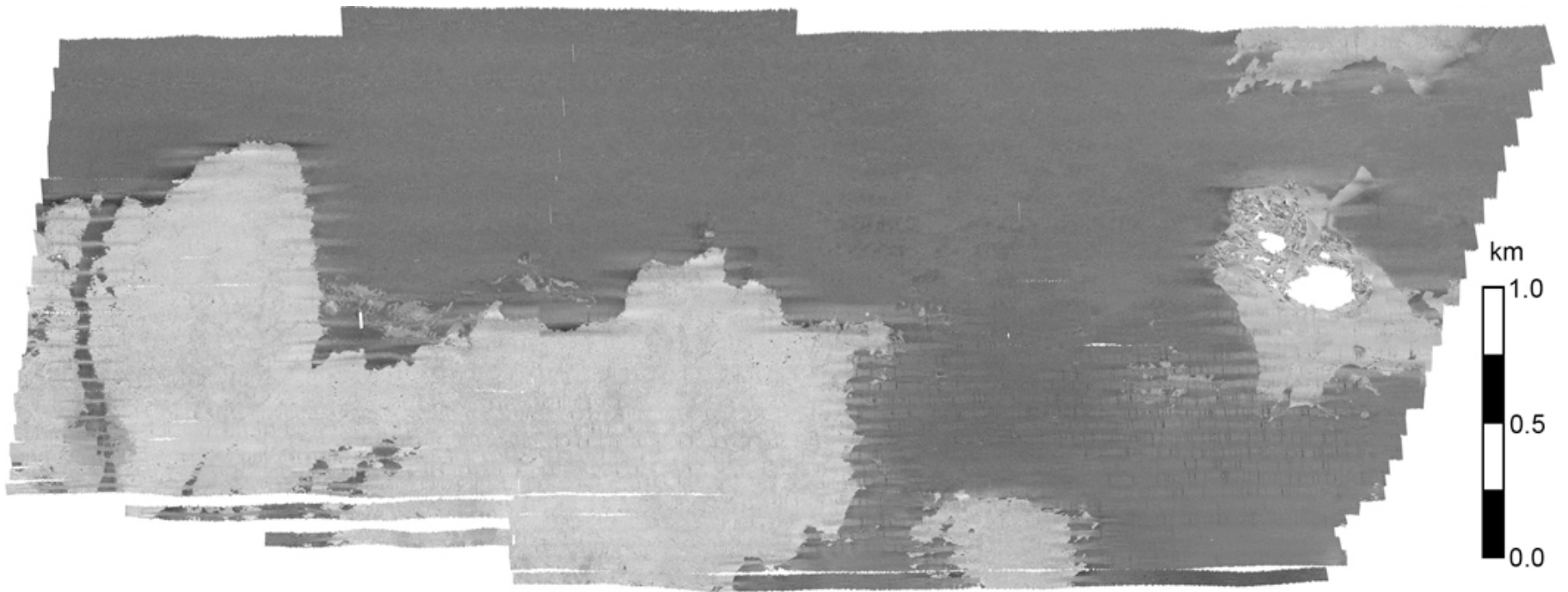
Geocoder improvements:
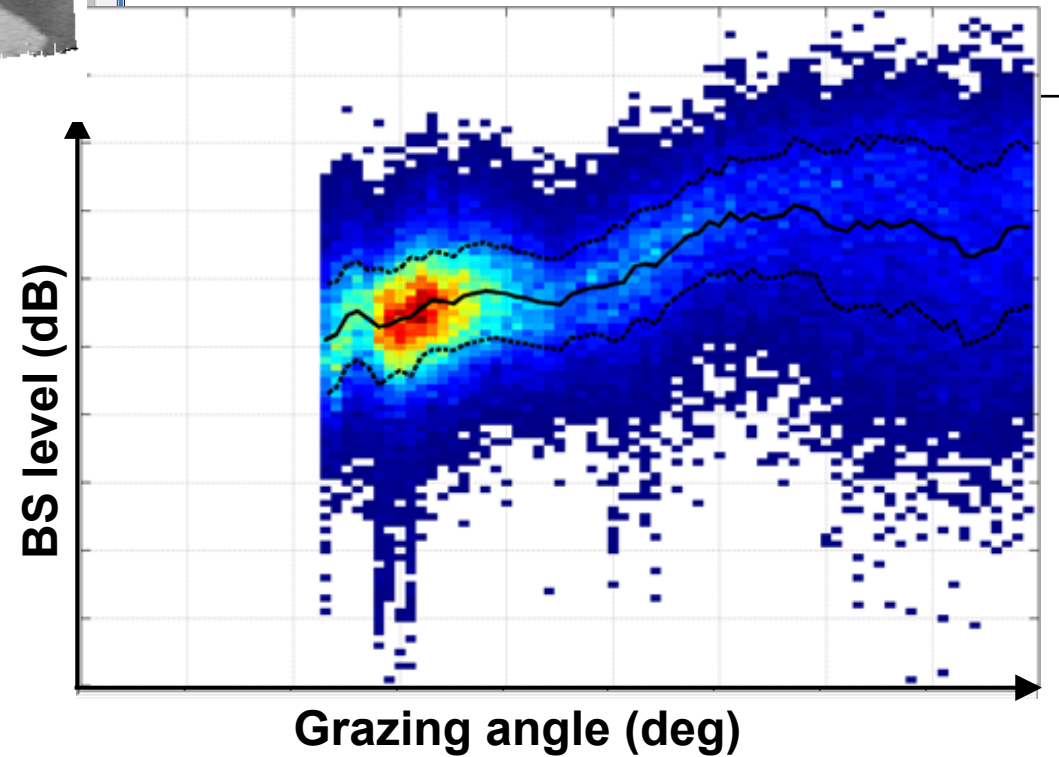
A possible combined approach

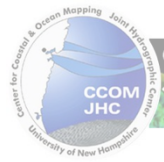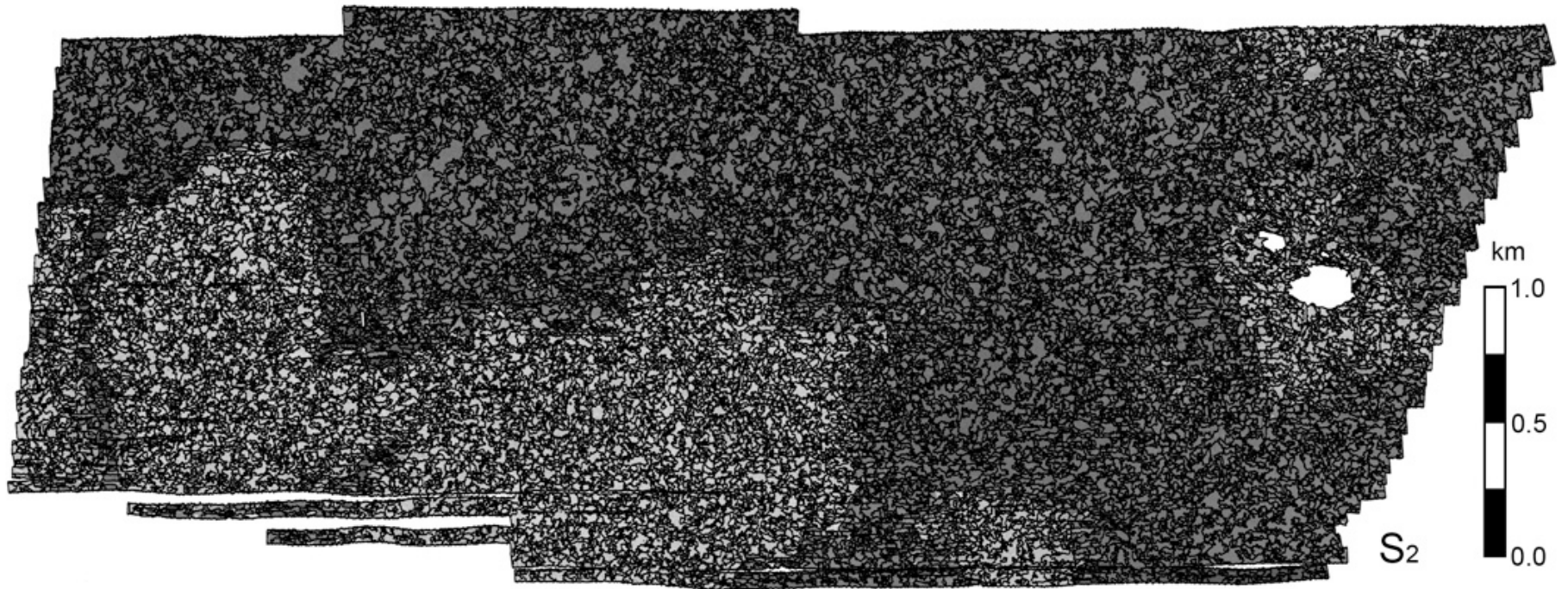# A possible combined approach

Raw backscatter data

Backscatter level:

High

Low

A possible combined approach

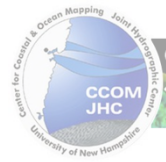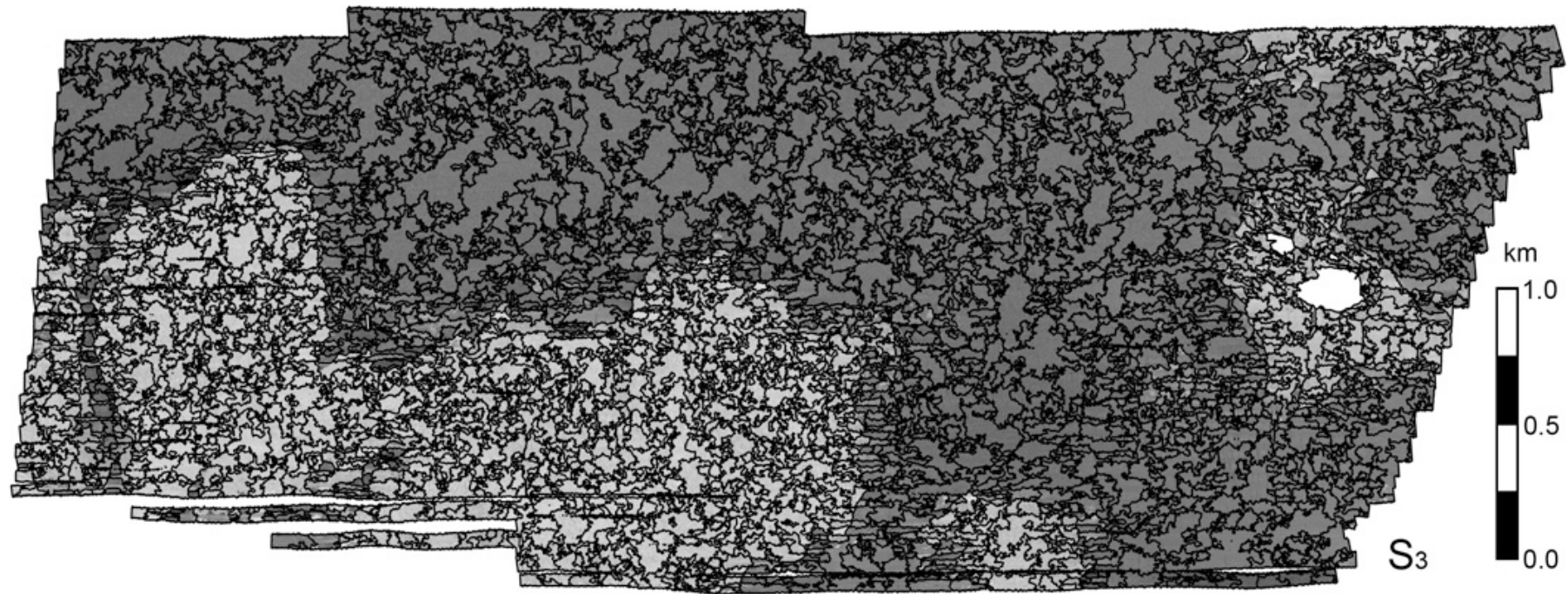Mosaic (AVG flat, 300 pings)

km
1.0

0.5

0.0

A possible combined approach

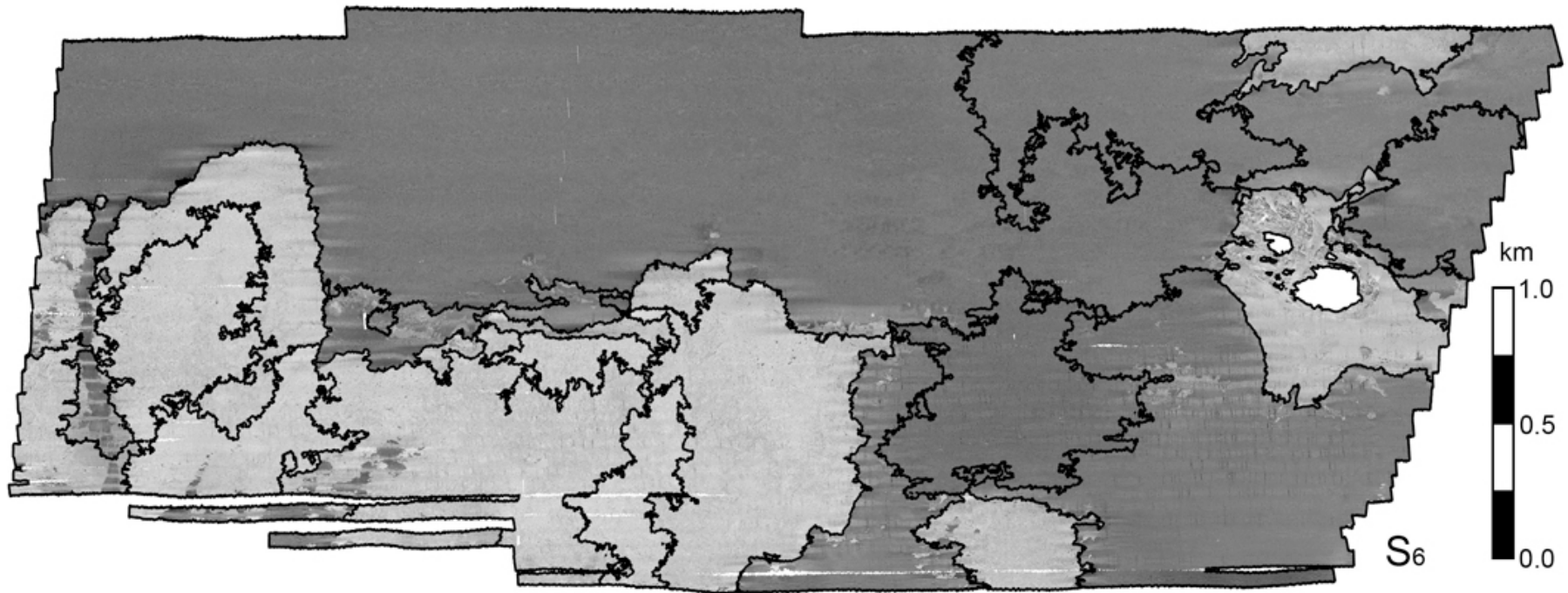Mosaic segmentation through aggregation (level 2)

A possible combined approach

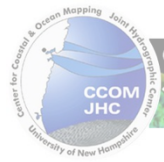Mosaic segmentation through aggregation (level 3)

A possible combined approach

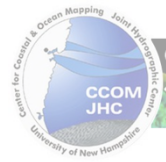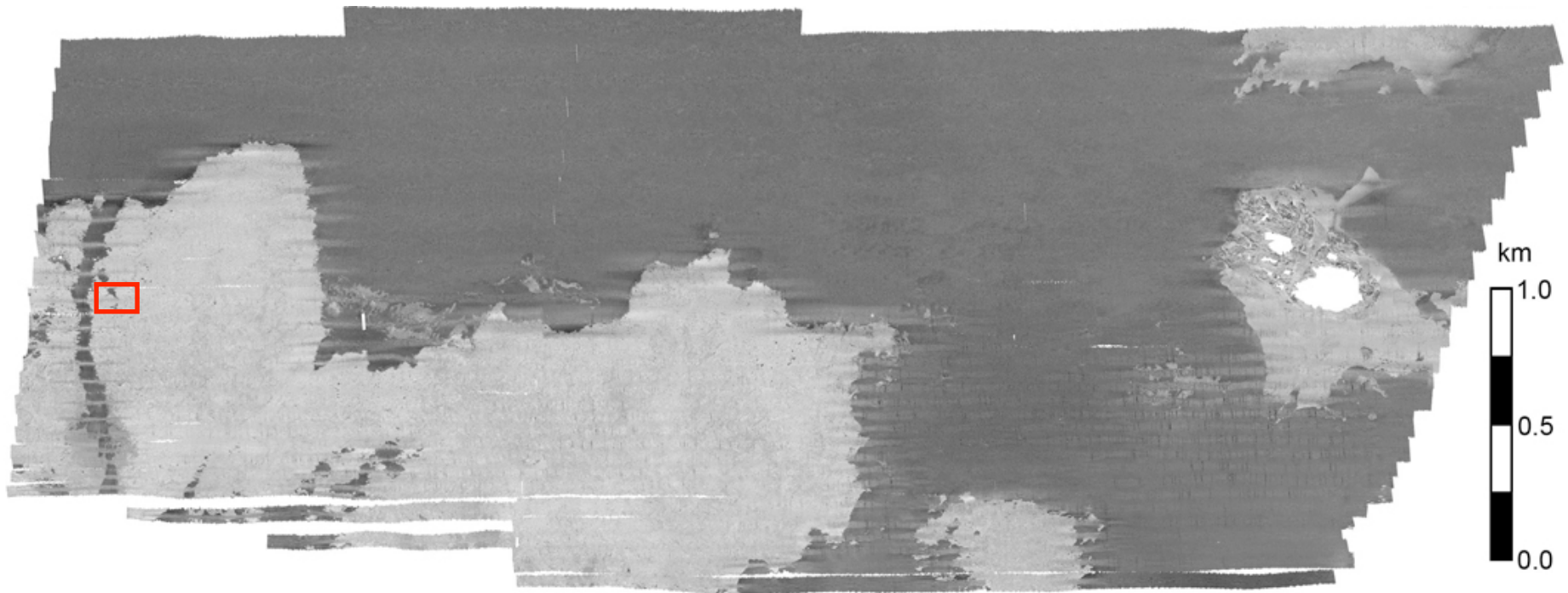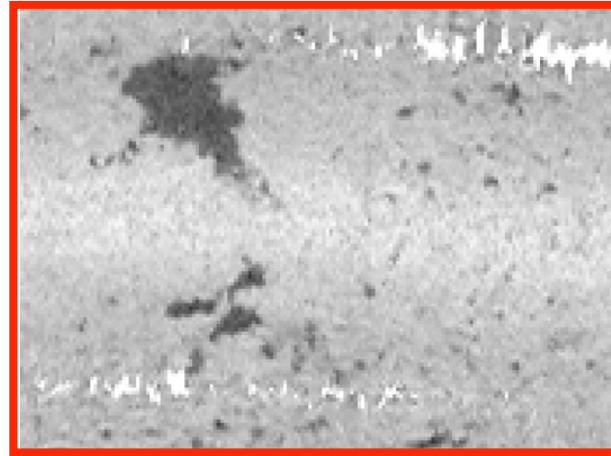Mosaic segmentation through aggregation (level 6)

km
1.0

0.5

S6   0.0

A possible combined approach
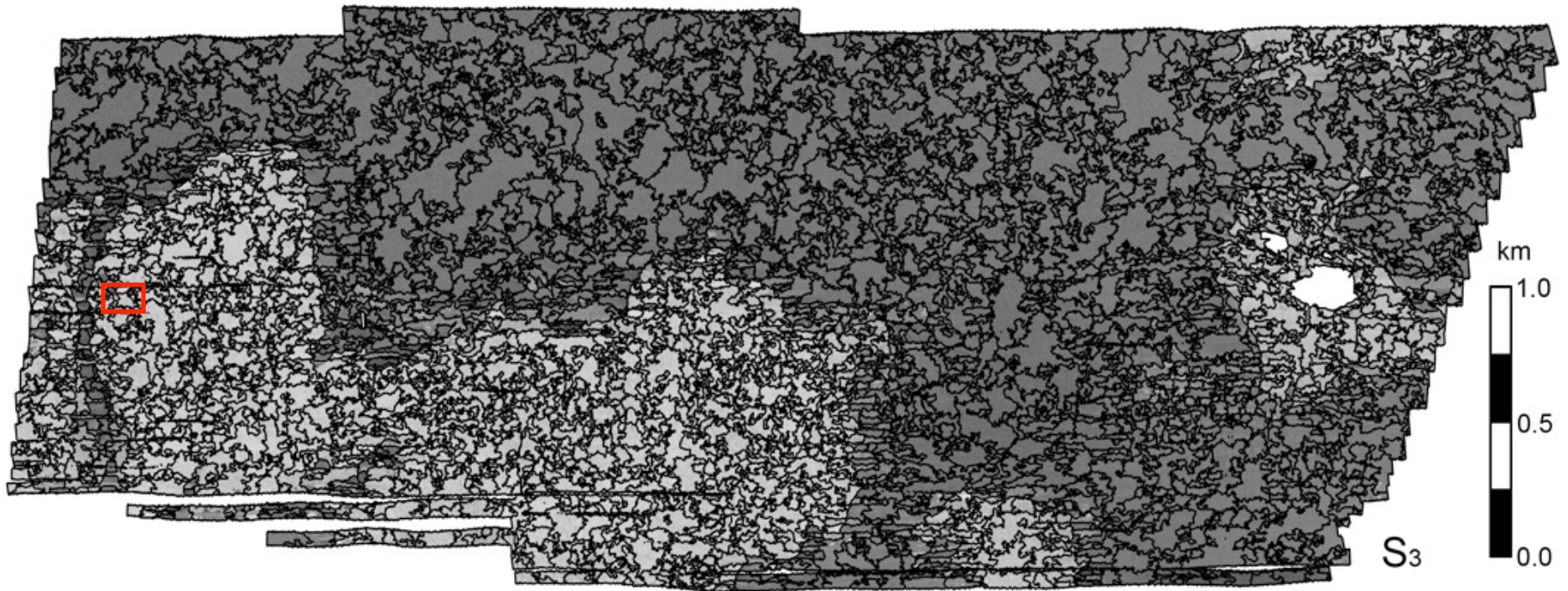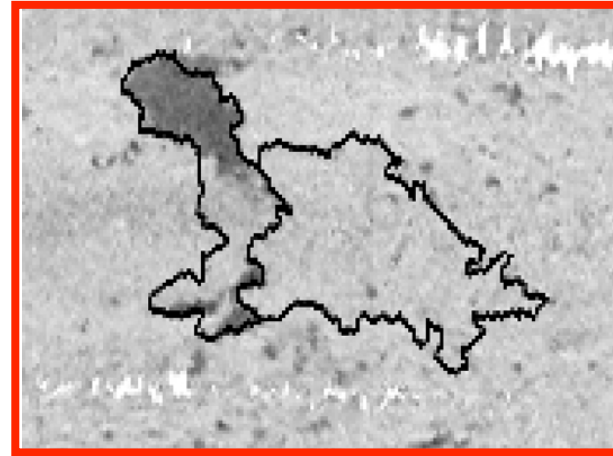
Mosaic segmentation through aggregation (level 7)

A possible combined approach

Estimating the **homogeneity**

of a given segment

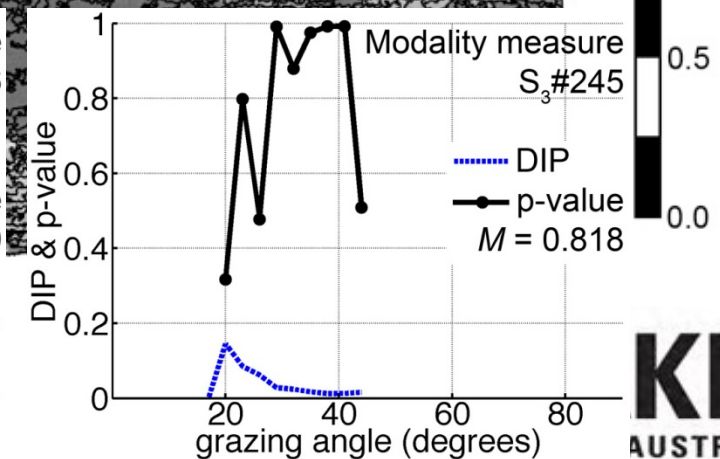# A possible combined approach

Estimating the **homogeneity**

of a given segment

A possible combined approach
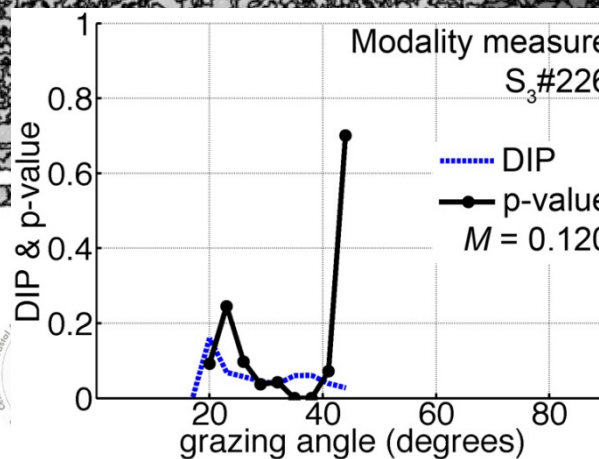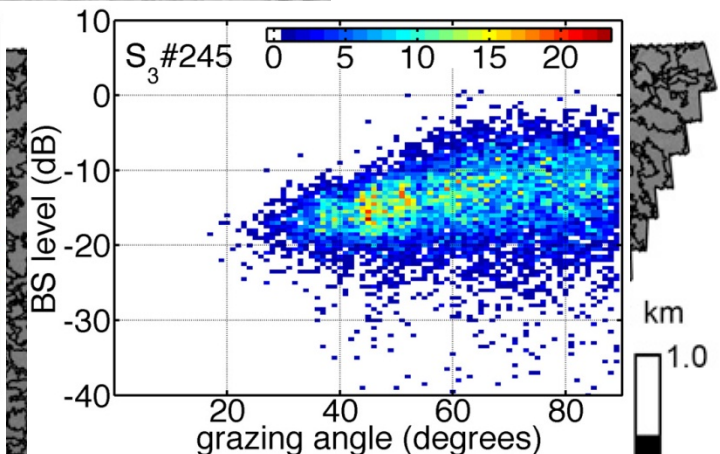
Estimating the **homogeneity**

of a given segment
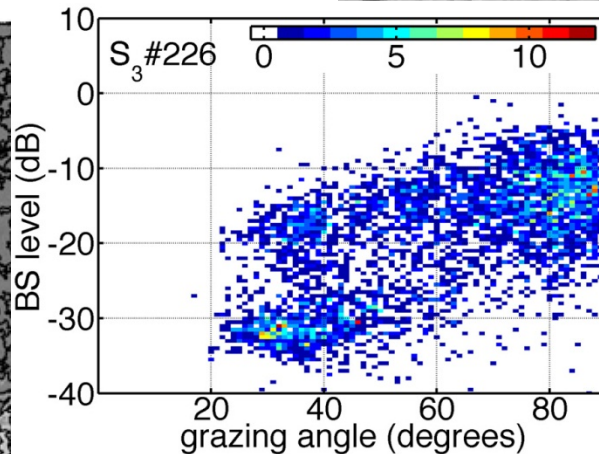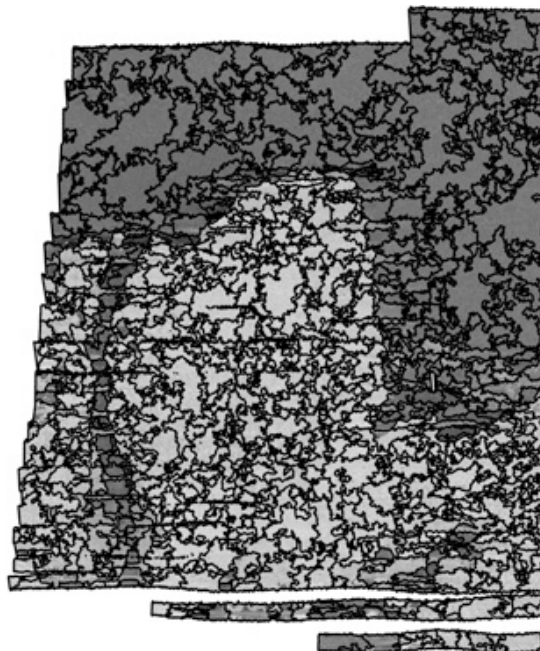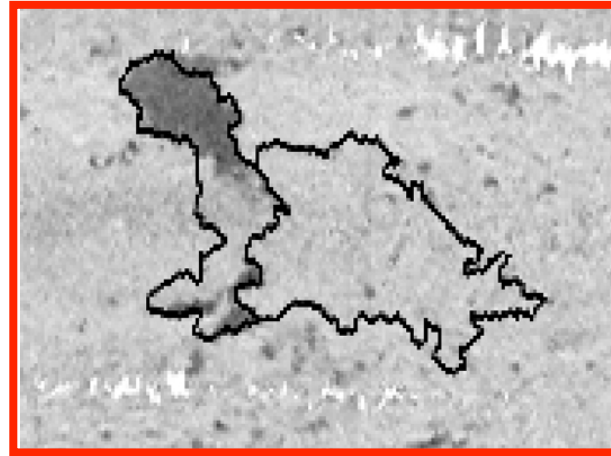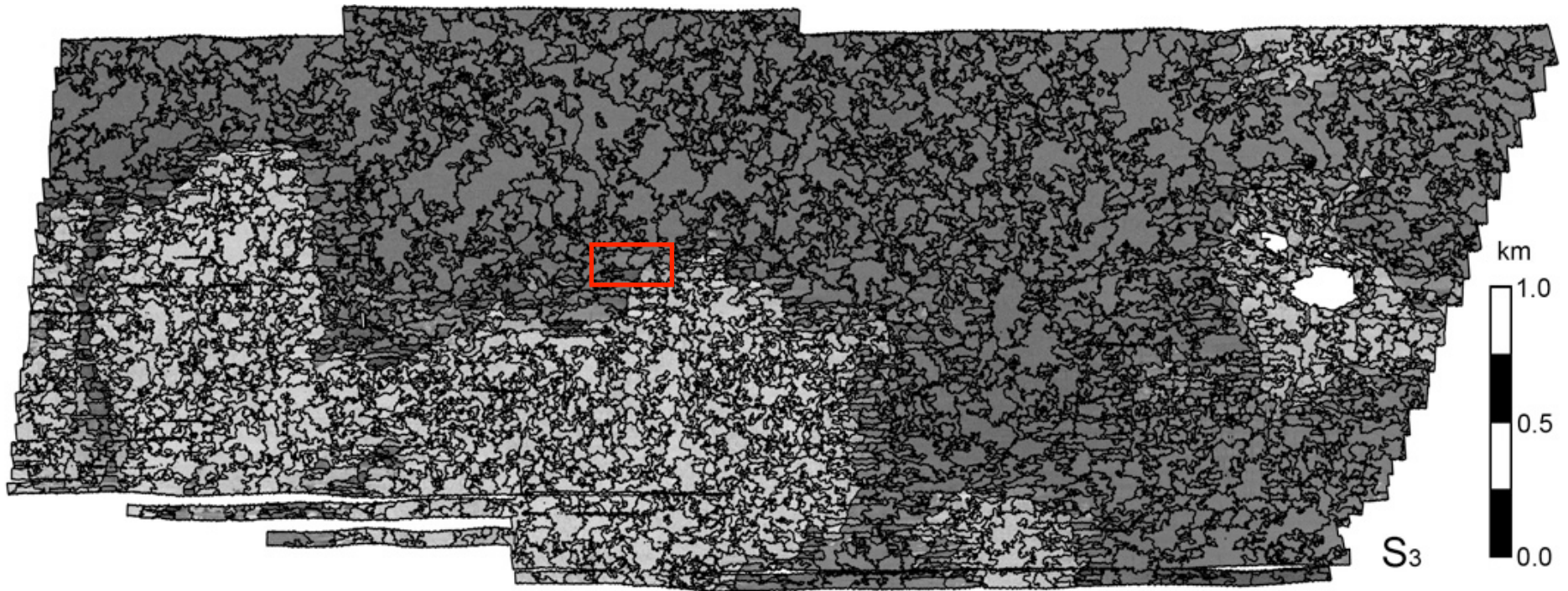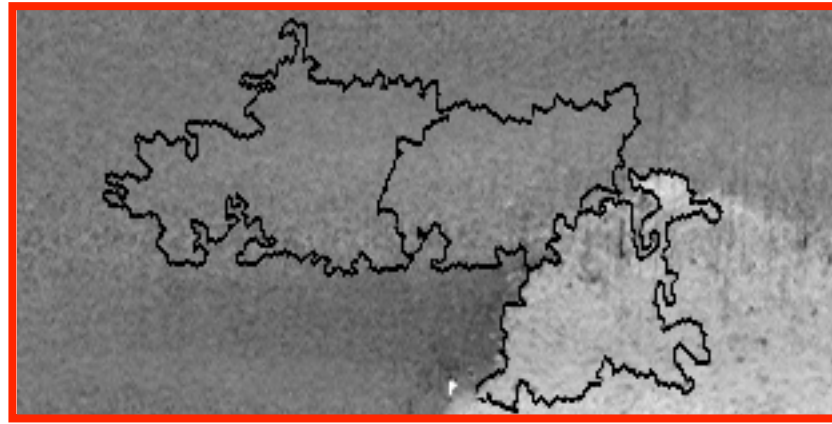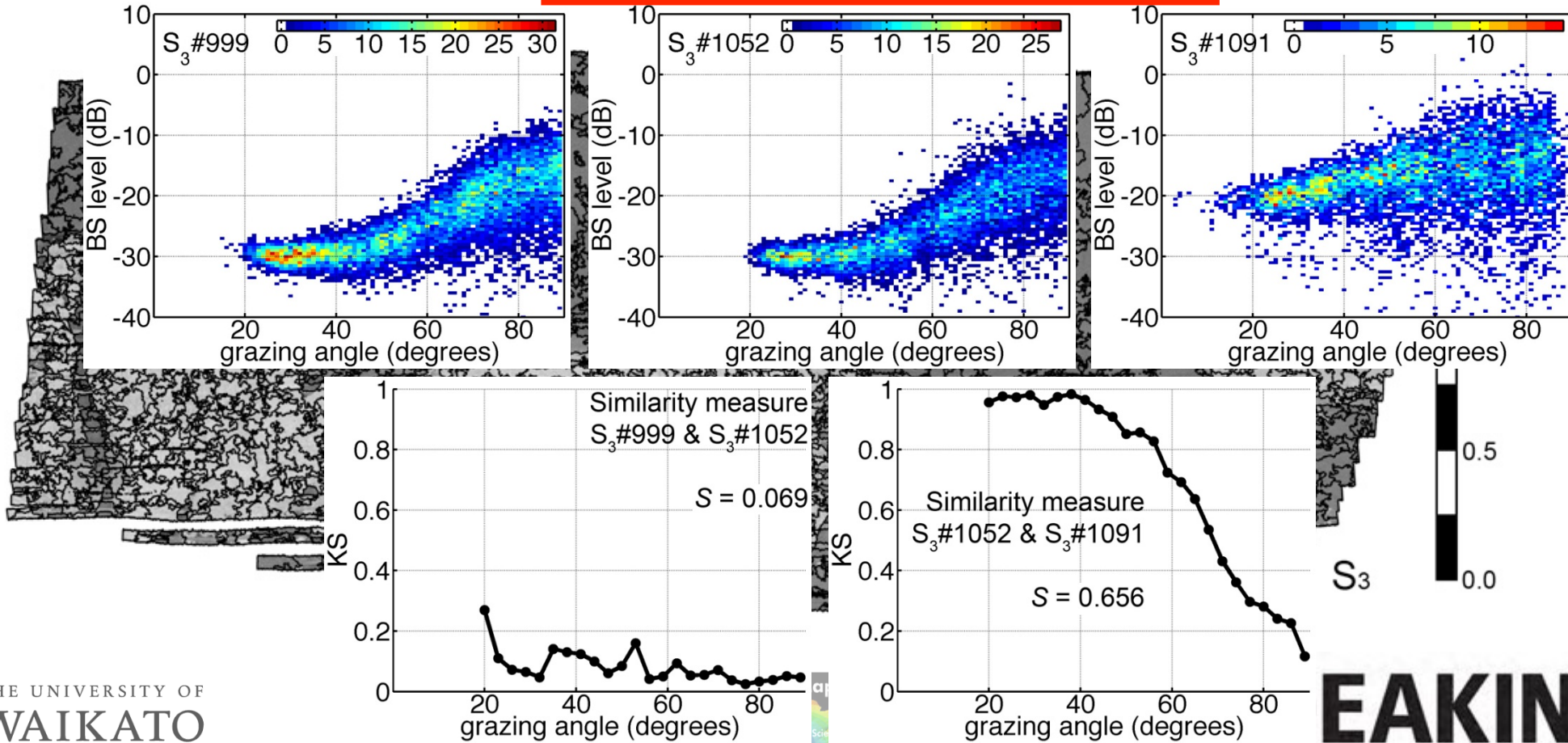
A possible combined approach

Estimating the **similarity** between two segments

A possible combined approach

Estimating the **similarity** between two segments

A possible combined approach

Procedure:

Mosaic

km
1.0

0.5

0.0

A possible combined approach

Procedure:

A possible combined approach

Procedure:

A possible combined approach

Procedure:

Mosaic

aggregation

S2

aggregation

S3

HOM threshold

identify heterogeneous segments in S3 & split them using S2

MAP

S3'

km
1.0

0.5

0.0

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A possible combined approach

Procedure:

A possible combined approach

Procedure:

Similarity matrix

Mosaic

aggregation

HOM threshold

measure similarity between neighboring segments

find most similar pair of segments & aggregate them

S2

MAP

identify heterogeneous segments in S3 & split them using S2

aggregation

S3

S3'

km
1.0
0.5
0.0

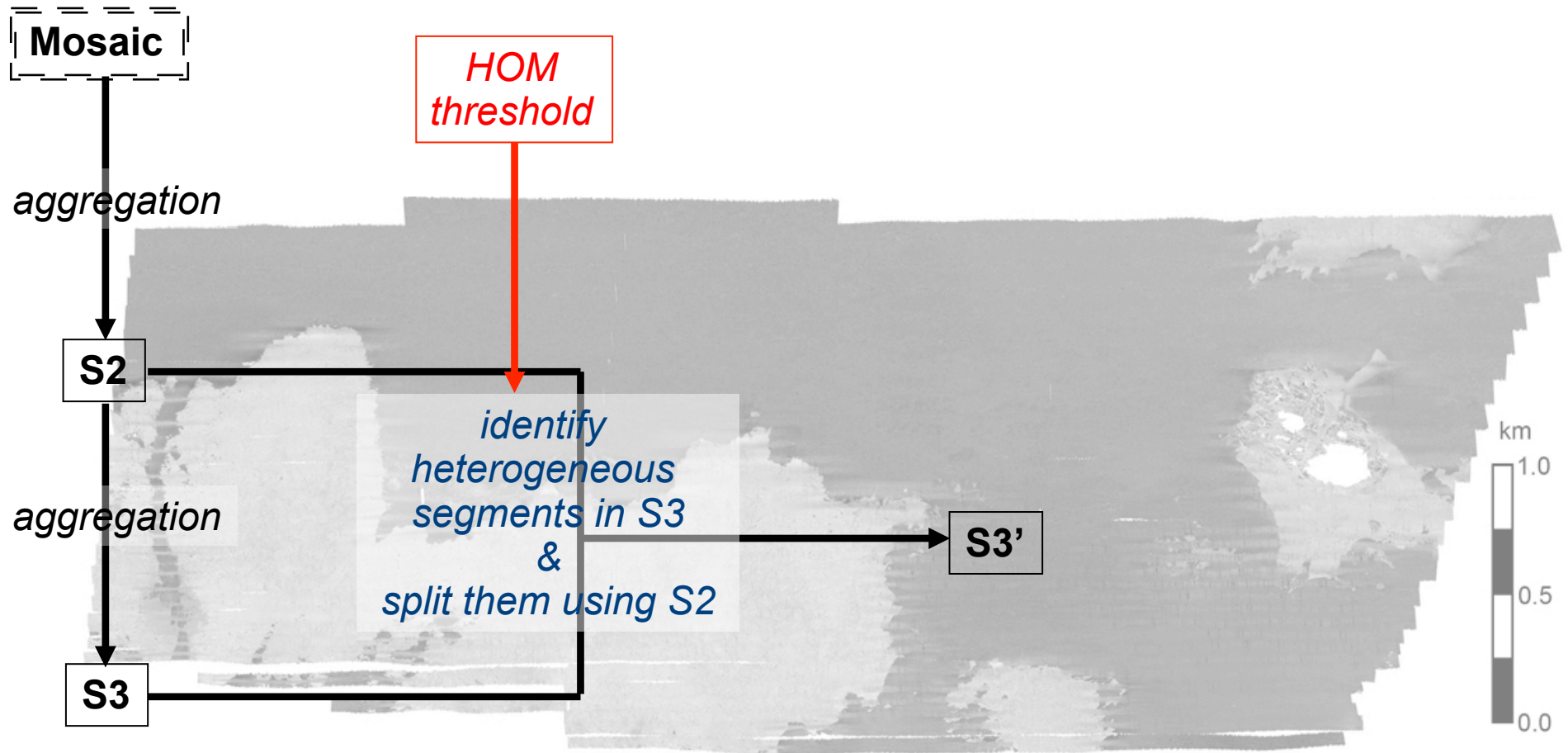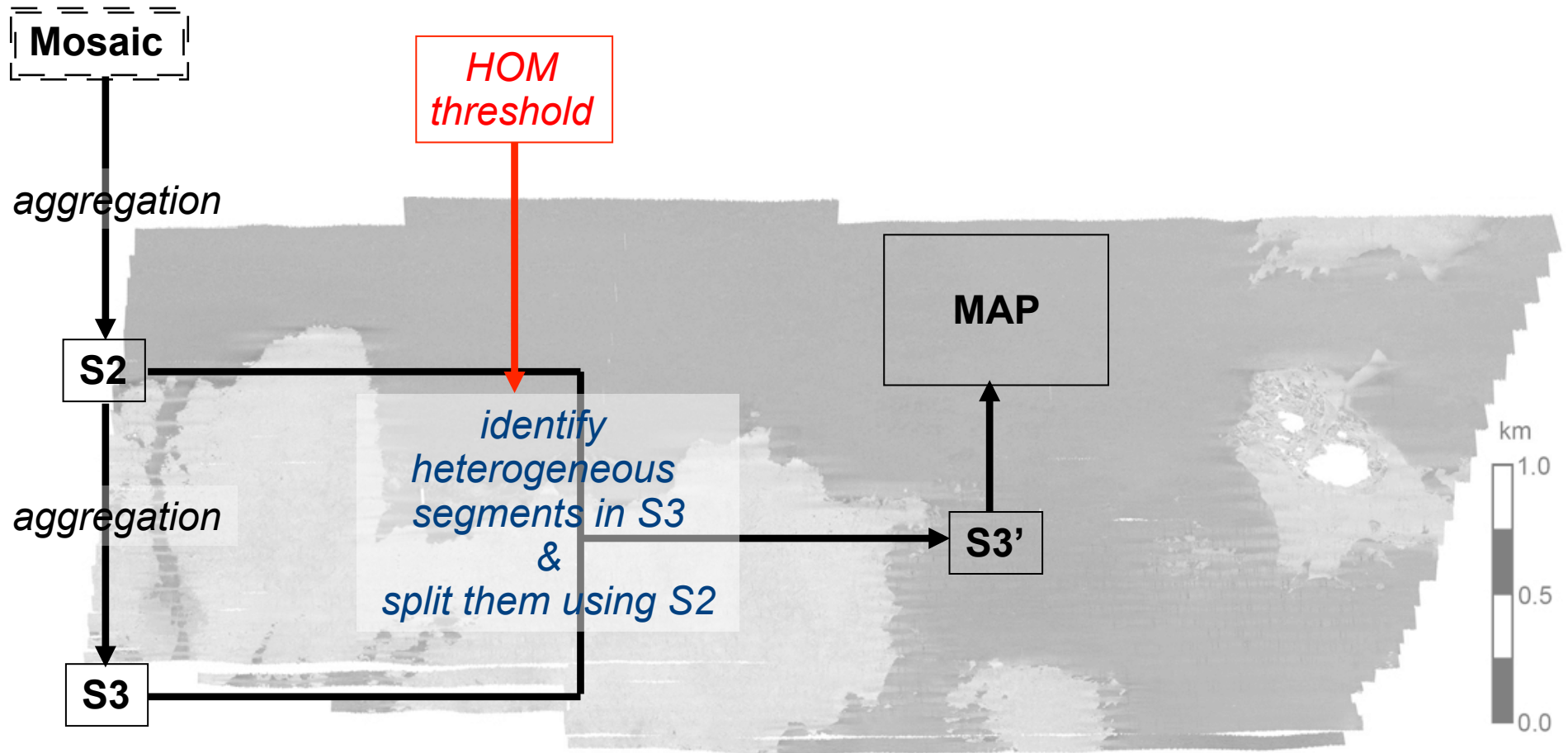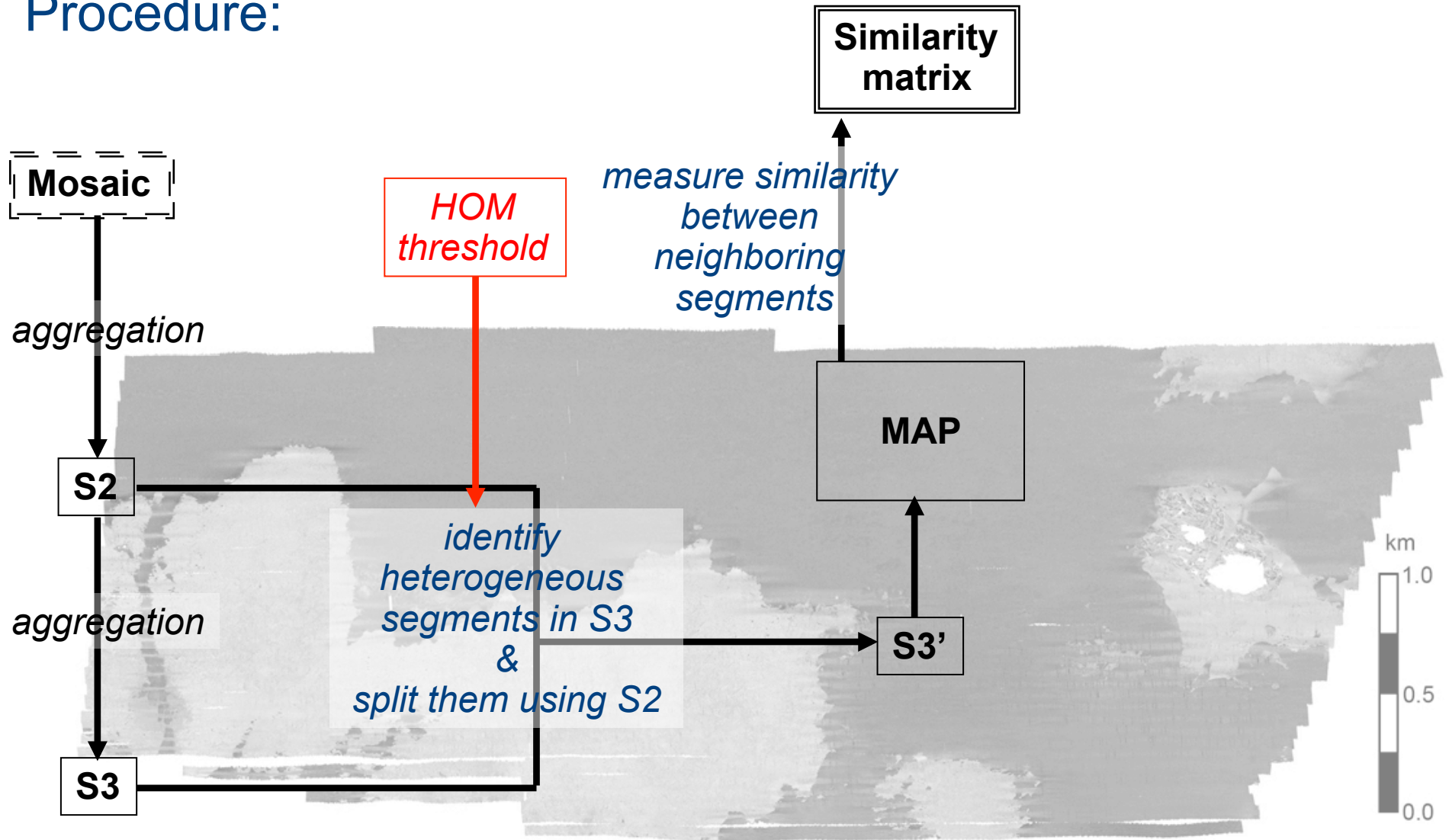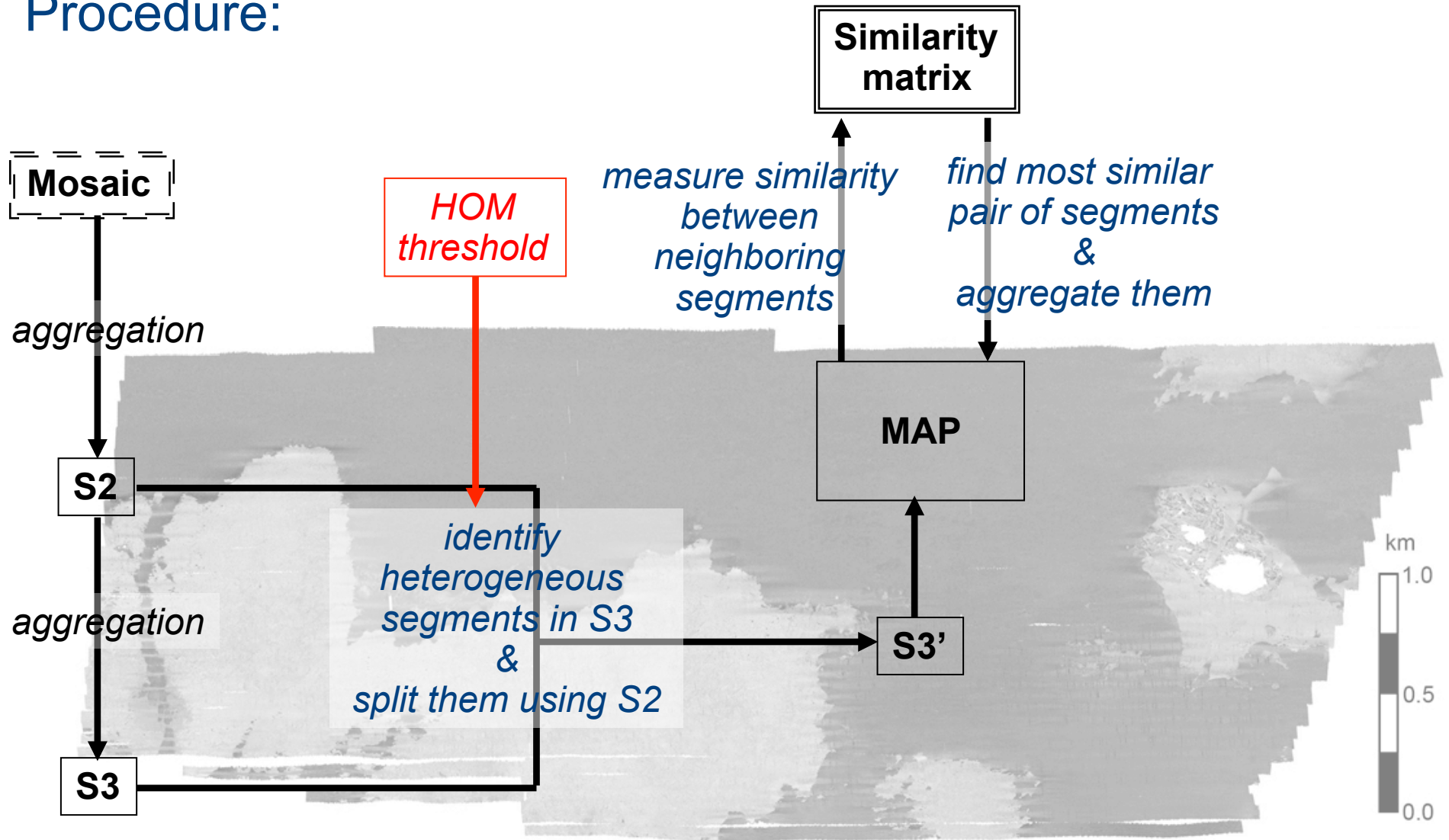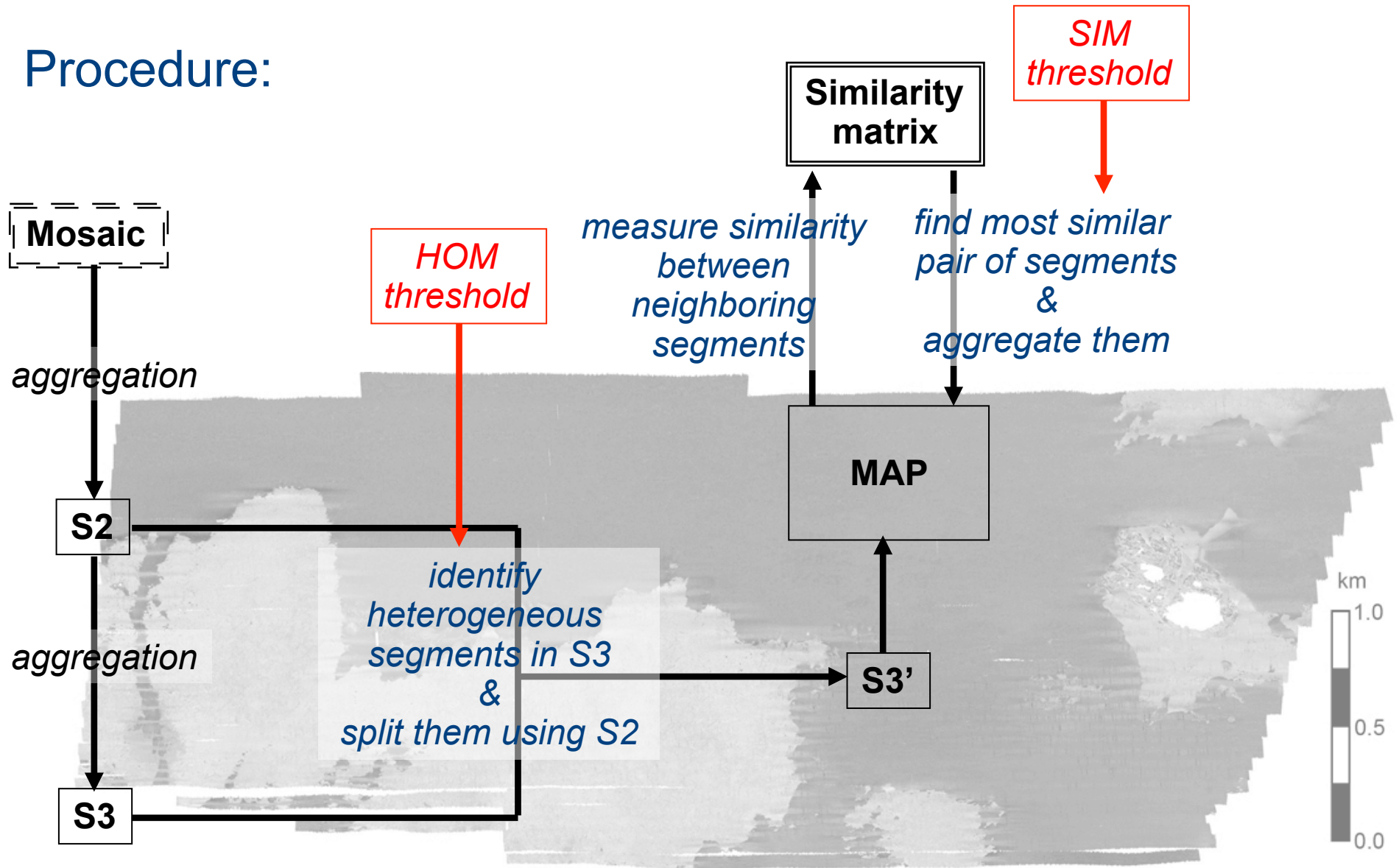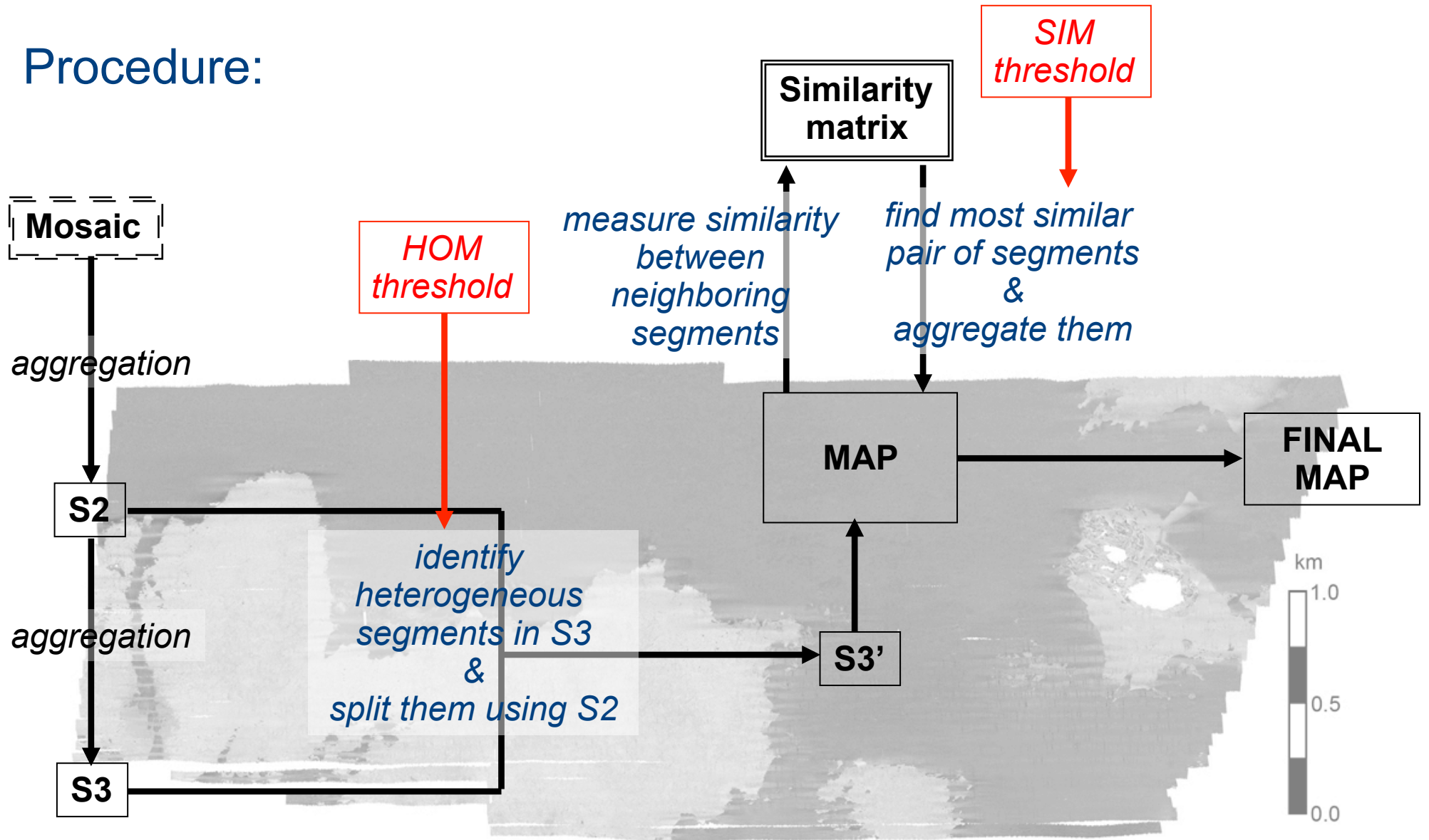# A possible combined approach

Procedure:

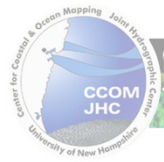# A possible combined approach

Procedure:

A possible combined approach

Result:

- HOM threshold: 0.5

- SIM threshold: 0.5

A possible combined approach

Result:

- HOM threshold: 0.5

- SIM threshold: 0.5

Backscatter level:

High

Low

Application to the common dataset

Kongsberg EM2040 data over West Taputeranga (Area 3) +
HMNZS Wellington wreck (Area 2).

Application to the common dataset

Kongsberg EM2040 data over West Taputeranga (Area 3) + HMNZS Wellington wreck (Area 2).

Application to the common dataset

Kongsberg EM2040 data over West Taputeranga (Area 3) +
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Application to the common dataset

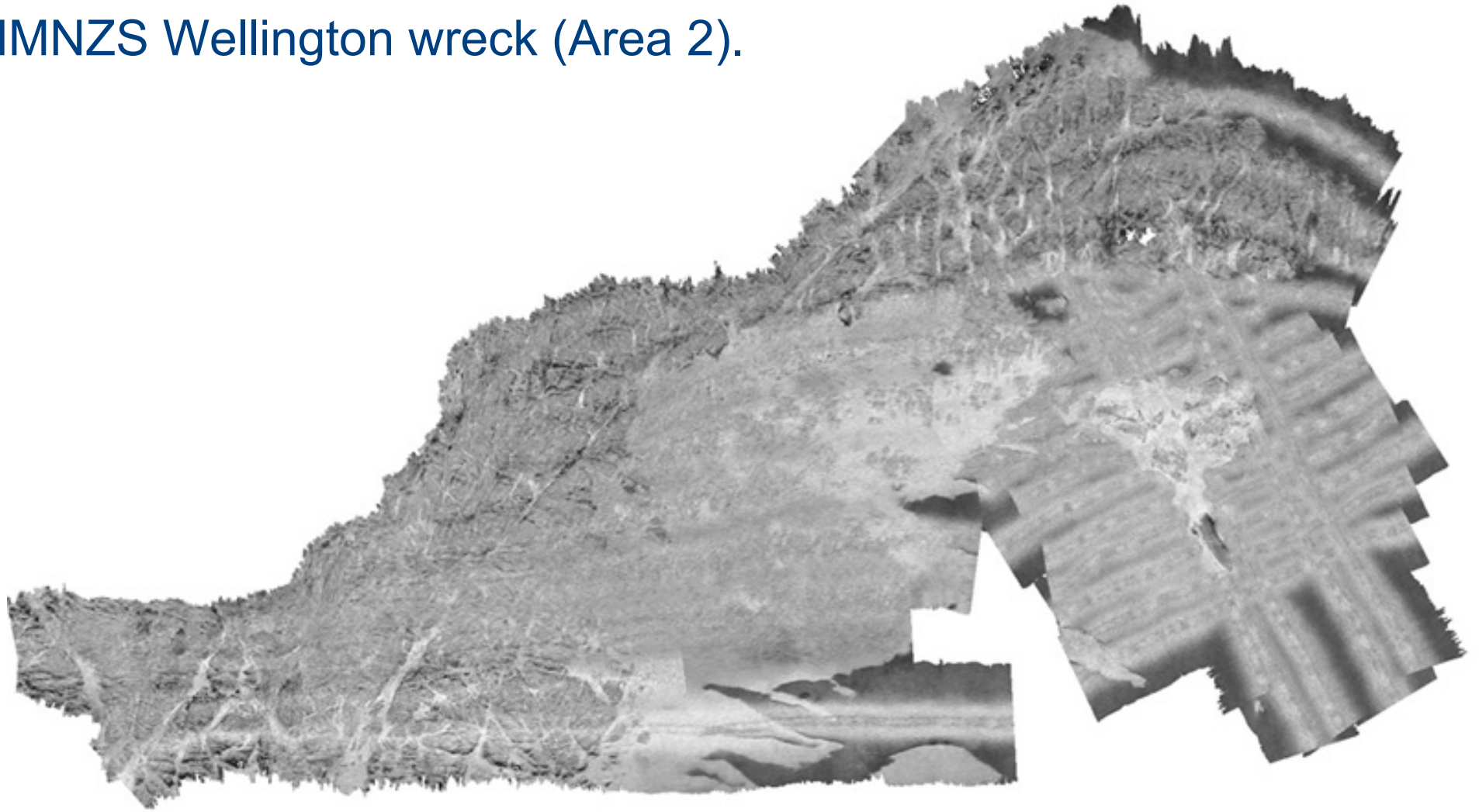Kongsberg EM2040 data over West Taputeranga (Area 3) +
HMNZS Wellington wreck (Area 2).

- HOM threshold: 0.6
- SIM threshold: 0.3

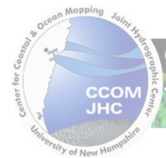# Application to the common dataset

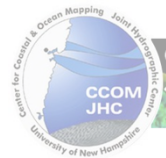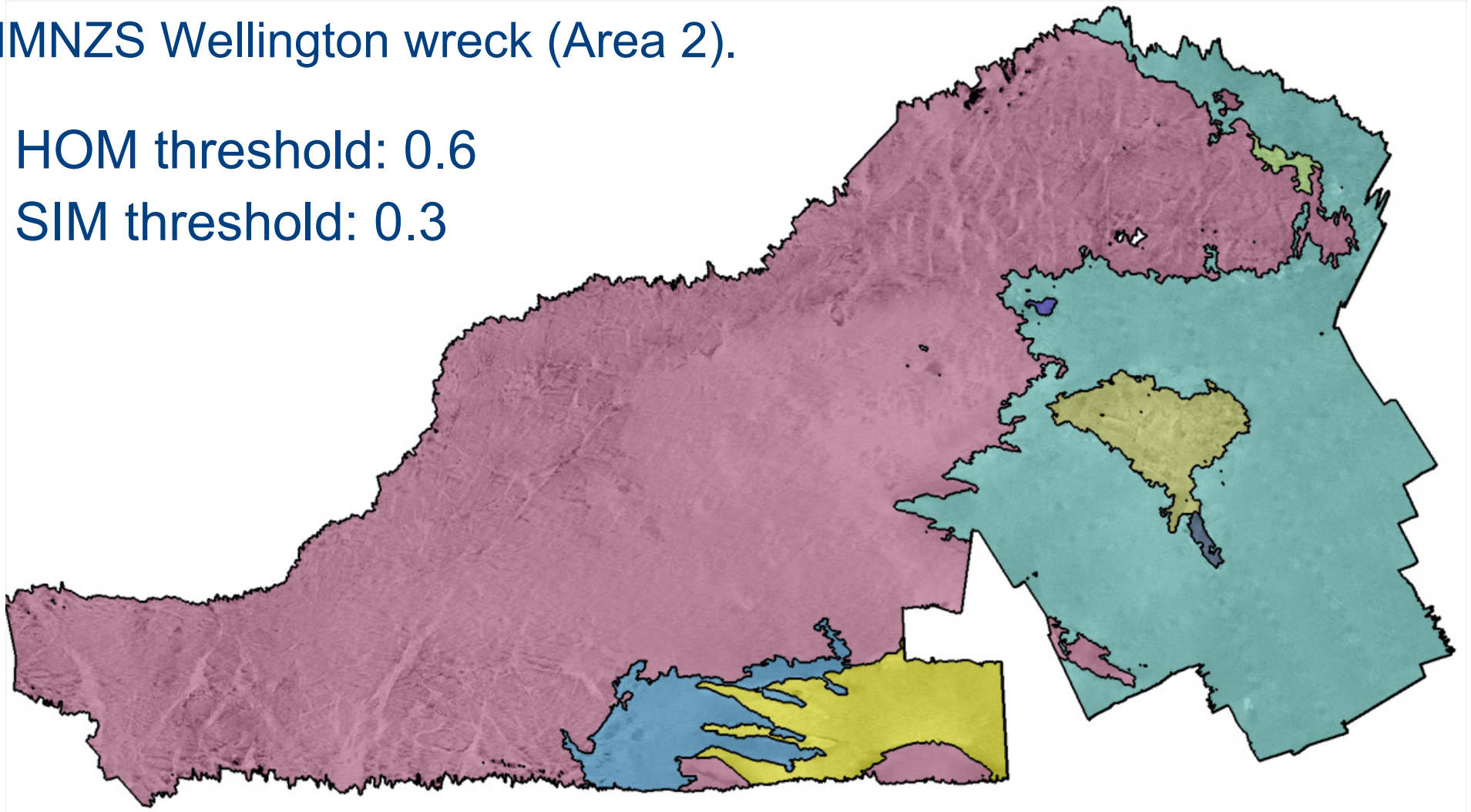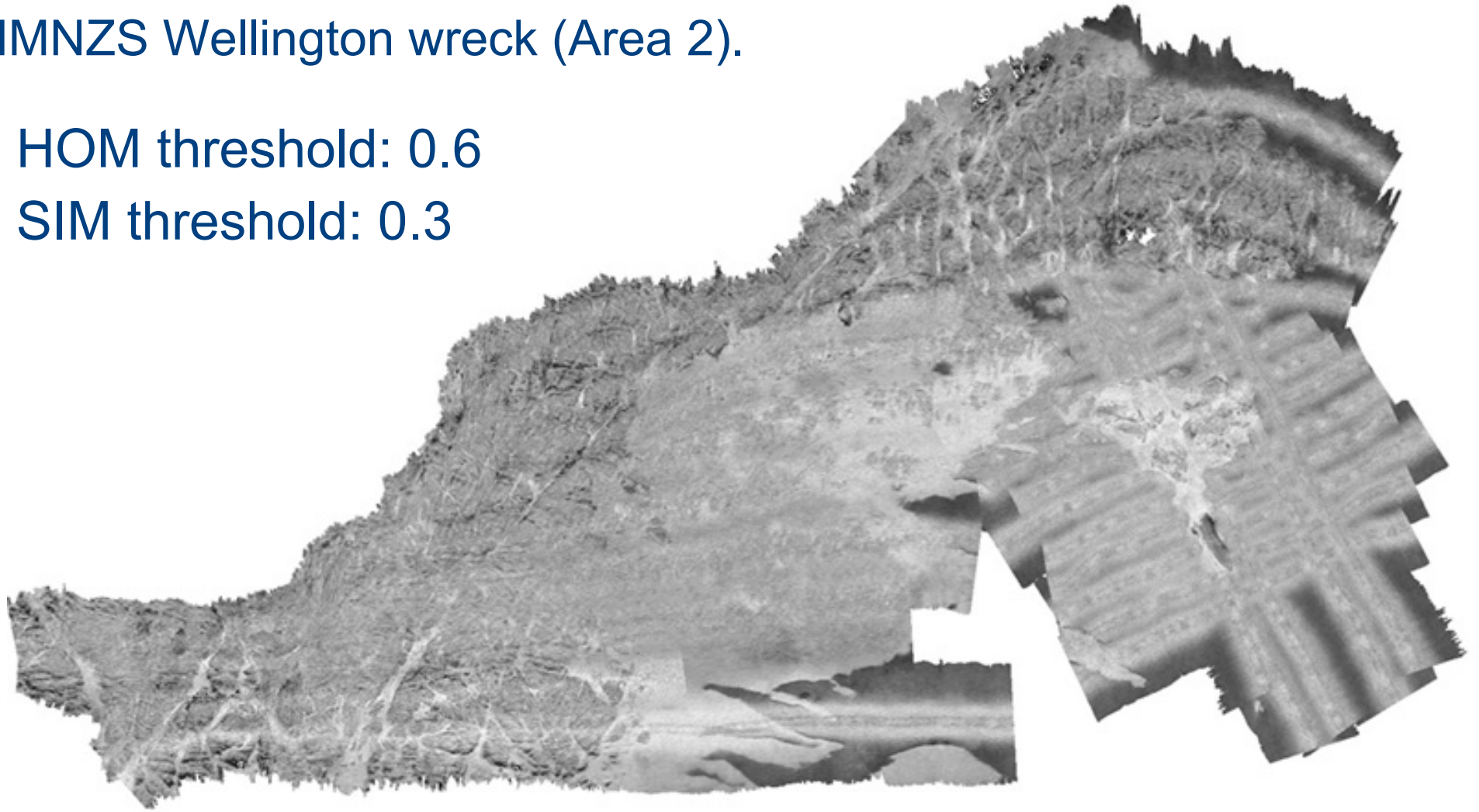Kongsberg EM2040 data over West Taputeranga (Area 3) + HMNZS Wellington wreck (Area 2).

- HOM threshold: 0.6
- SIM threshold: 0.3

Conclusion

"A possible approach". Work still **in progress**. Other research in development.

- Che-Hasan R., Ierodiaconou D., Laurenson L. 2012. *Combining angular response classification and backscatter imagery segmentation for benthic biological habitat mapping.* Estuarine Coastal and Shelf Science 97, 1-9.

- Rzhanov Y., Fonseca L. & Mayer L. 2012. *Construction of seafloor thematic maps from multibeam acoustic backscatter angular response data*. Computers & Geosciences 41, 181-187

- …

Looking forward to exploit **frequency information** as well...

Acknowledgments

- The **Foundation for Research, Science and Technology** (Technology in Industry Fellowship, contract number METO0602).

- The **George Mason Charitable Trust**.

- **NOAA Grants** No. NA10NOS4000073 and NA0NOS4001153.

- **Professor Terry Healy** of the University of Waikato department of Earth and Ocean Sciences.