The complexity of gathering high resolution, accurate geo-spatial datasets in the inter-tidal zones of a tropical urban coastal city-state.

UN Global Geospatial Information Management

17 May 2022

This research / project is supported by the National Research Foundation, Singapore, and Ministry of National Development, Singapore under its Cities of Tomorrow R&D Programme (CoT Award **COT-V4-2020-8***)*

The need …

- Nearshore topography / bathymetry data is important
  - A key parameter that influences nearshore wave evolution
  - Needed for engineering design of coastal protection structures
- Integrated models for coastal / pluvial flooding models can now easily incorporate the necessary high resolution data to model the run-up and incorporate far-field information e.g. wave / wakes

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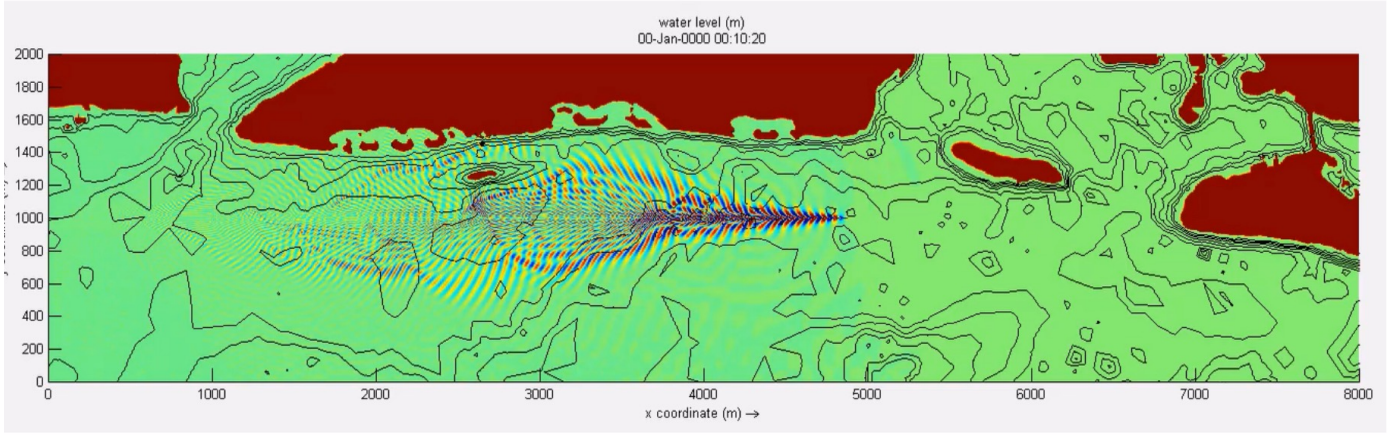
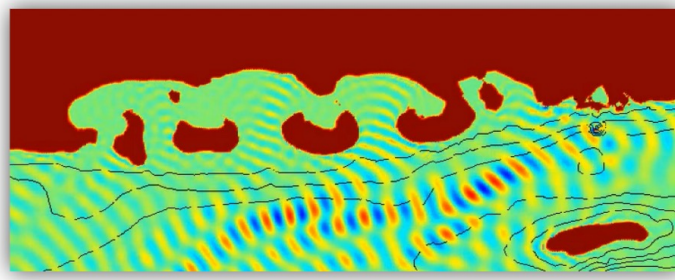
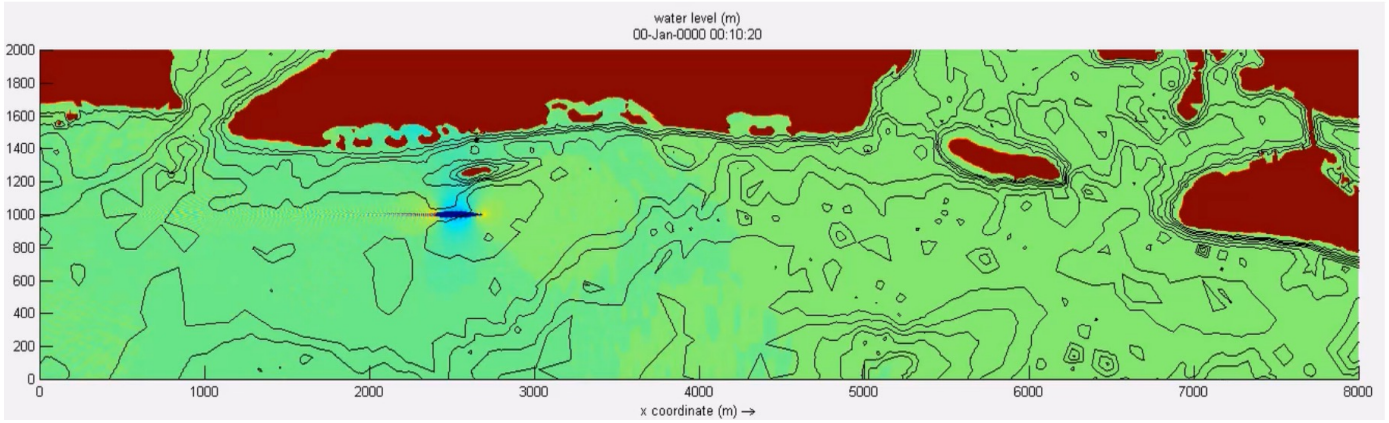
Models need the information …







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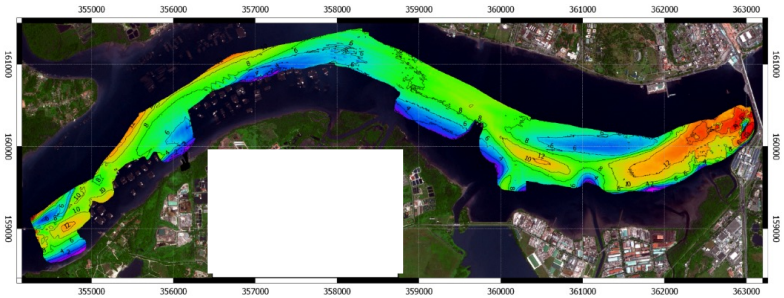
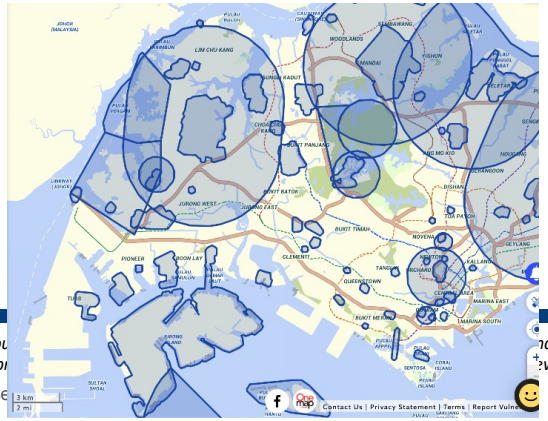
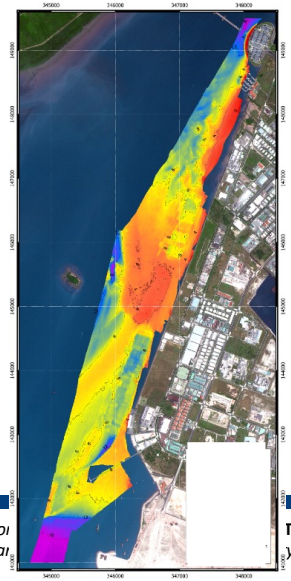
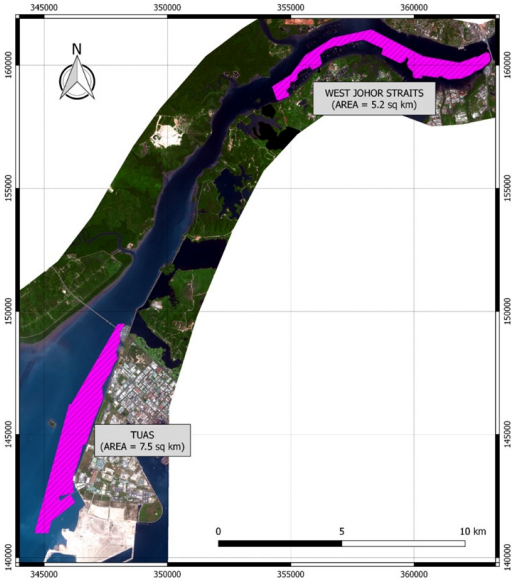
Local challenges …

- Difficult for a marine survey vessel to safely come in
- Inability to safely walk out from the shore to utilize land survey equipment effectively
- No-fly zones …









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Present state / methodology

- Separate data gathering methods and times for landward and seaward data
- This could potentially result in large differences in the measured value at the same location if
  - the data gathering windows for both landward and seaward are separated over a large period of time particularly if separated by a spring tide.
  - the bed is particularly mobile
- At some points this can potentially result in data gaps as well

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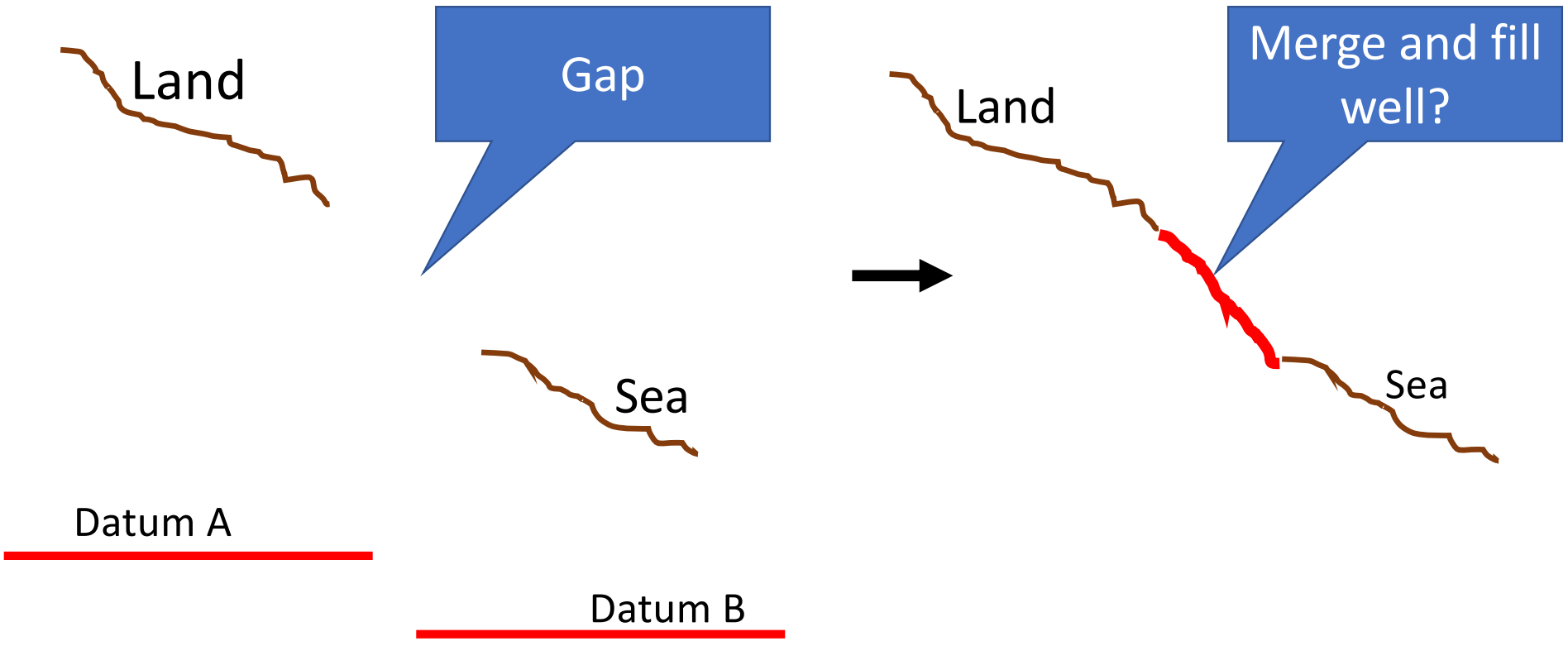
Some times …



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The Project's problem statement

- Evaluate and demonstrate the feasibility of developing a cost-effective high resolution single operation method(s)
  - That can be used across the entire country's coastlines to obtain the required intertidal vertical data given the different water turbidity and complexity of topography across the country.
- Due to the non-uniform variation of the chart datum across Singapore island a need arises which this proposal intends to fill by developing a translation method to convert the single operation collection data efficiently between the SHD and CD for use in both marine and land charting across the island

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Approaches in play

- Total station on land in combination with survey vessel mounting Multi-Beam Echo Sounder [Baseline]
- Shallow draft unmanned surface vessel (USV) mounting LiDAR with Single Beam Echo Sounder (SBES) array
- Drone with multi-spectral camera (RGB, R, B, G, RE, NIR, NR)
- Multi / hyper-spectral satellite imagery e.g. Worldview-3 or equivalent (8 band minimum)

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Methodology

- Carry out comparison of 4 different survey methods at 3 different locations over 3 different time periods
  - Survey methods
    - Total station on land in combination with survey vessel mounting Multi-Beam Echo Sounder [Baseline]
    - Shallow draft unmanned surface vessel (USV) mounting LiDAR with Single Beam Echo Sounder and / or inferometric sonar
    - Drone with 8 Band multi-spectral camera (RGB, R, B, G, RE, NIR, NR)
    - Multi-spectral satellite imagery e.g. Worldview-3 or equivalent (8 band)
  - Locations (Kranji, East Coast Park, Lazarus Island)
  - Time periods (NE monsoon; SW monsoon; 1 Inter-monsoon)

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Why 3 locations?

Maps powered by streetdirectory

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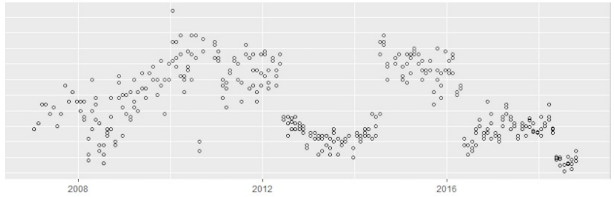
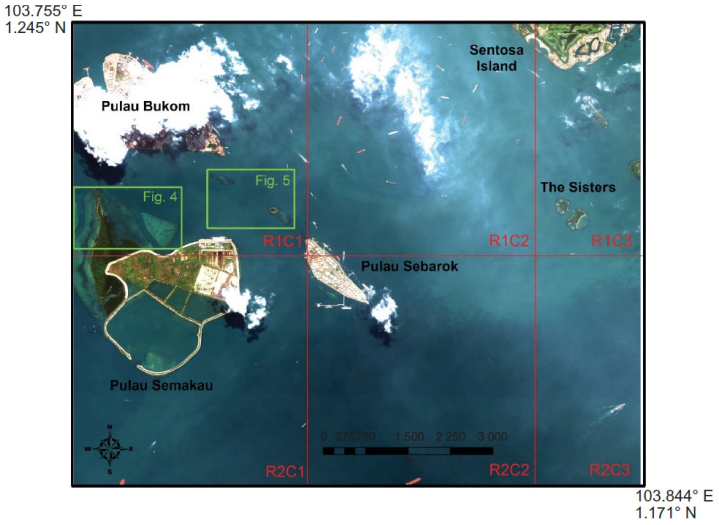
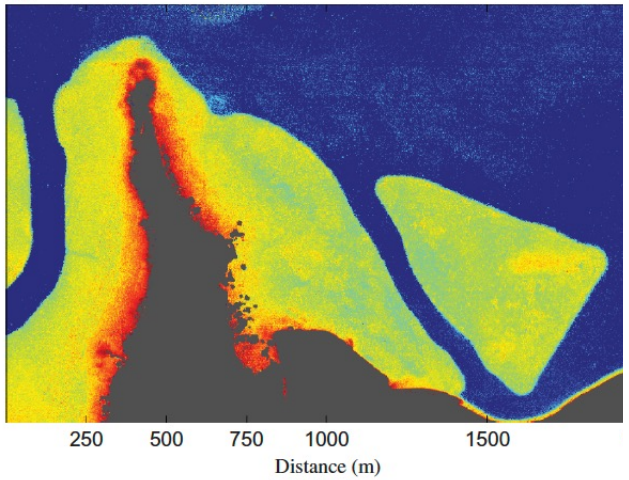
Why 3 seasons?

- Previous satellite post-processing work to determine bathymetry around Singapore required detailed knowledge of turbidity that was provided through the team's monitoring program.

Yearly Open-water TSS







Reference - https://doi.org/10.1080/01431161.2012.734934

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Where are we at this point?

- Purchasing of equipment

Looking at small,
Man-portable,
Yet fully integrated
USVs

- Sourcing of surveyor to conduct baseline survey
- Gathering supplementary data
- Testing the alternative gap fill methods

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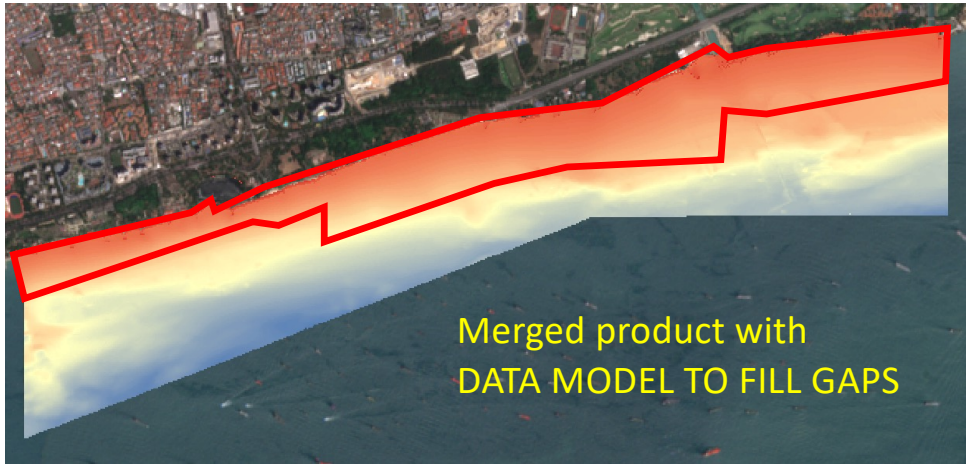
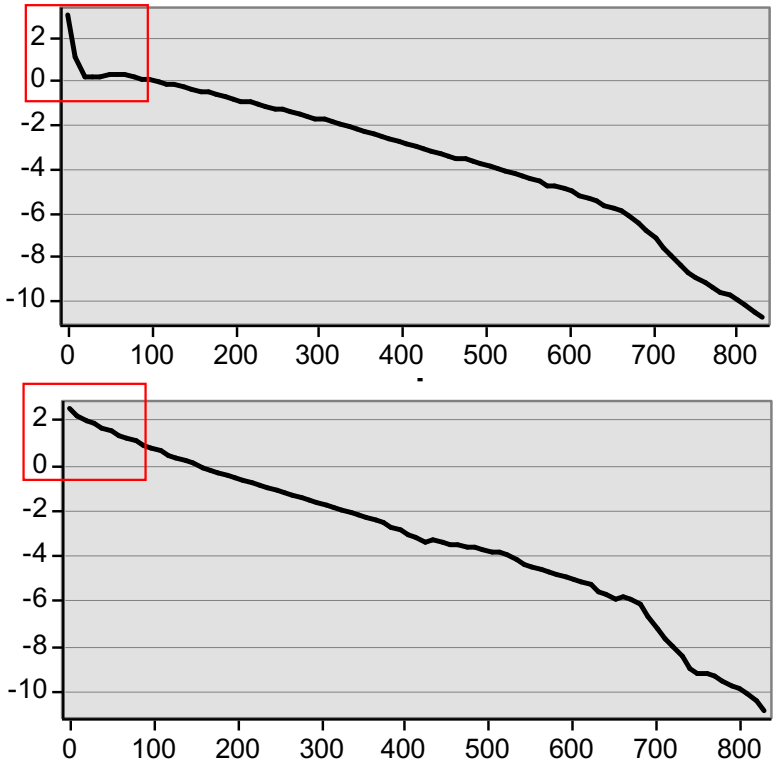
Alternative gap fill methods?

- Data models



Cross-section profile



Data models require guidance

Work previously carried out under MSRDP P46

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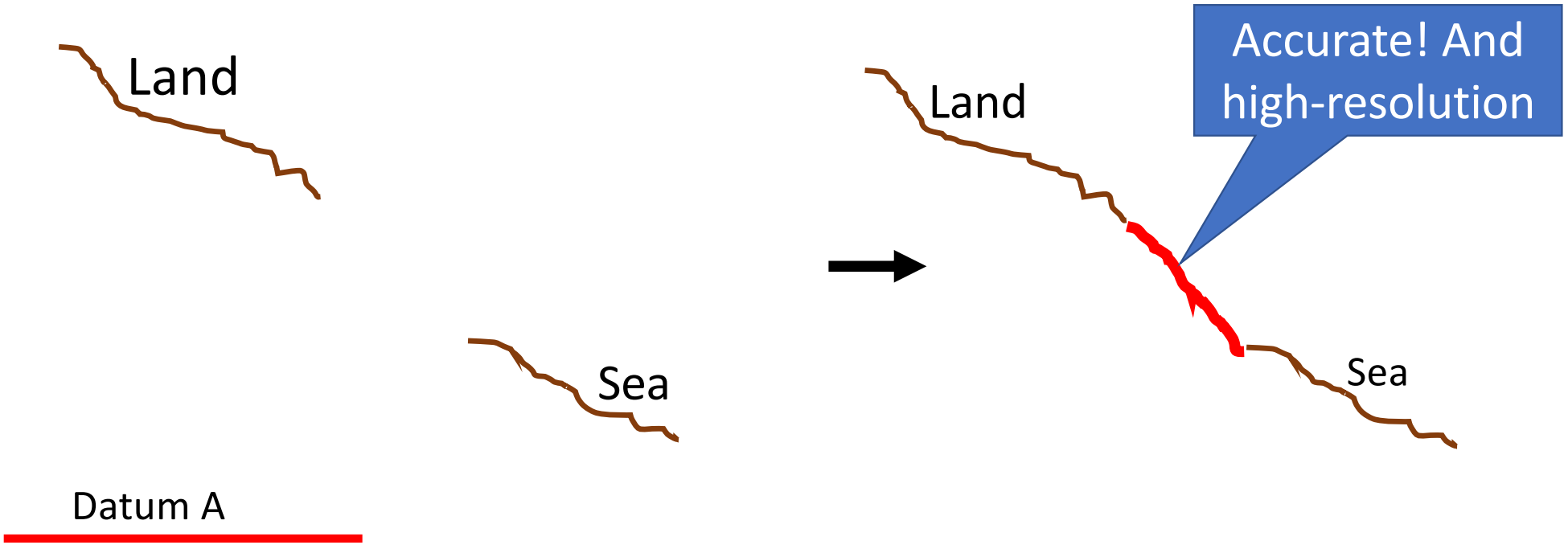
In the end …



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Thank you!

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