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Workflow to evaluate potential lava flow thermal hazard to buried infrastructure

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DEVORA

Outline

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Background on the DEVORA scenarios

Update to the scenarios

Buried infrastructure hazard

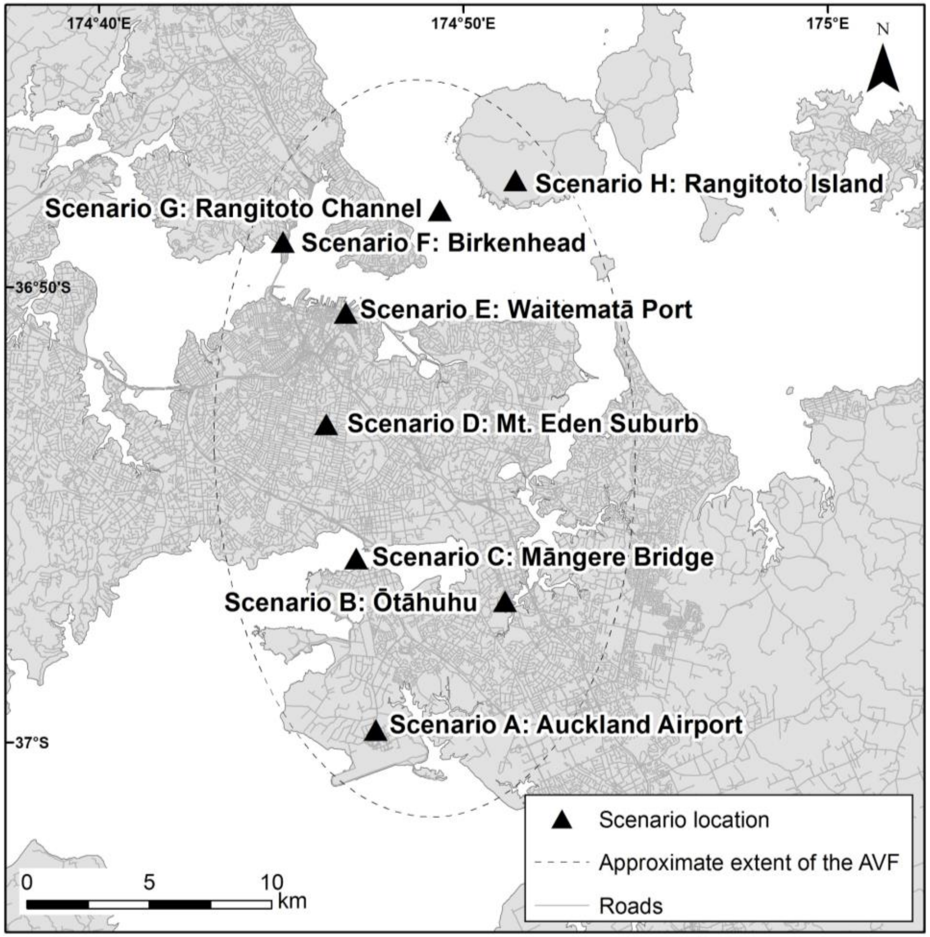
- Method to evaluate thermal hazard

Case study: Birkenhead

DEVORA Scenarios

- Eight hypothetical eruptive sequences
- Multi-hazard modelling undertaken
- Represent the full range of possible eruptive phenomena & hazard intensities
- Hazard occurrence based on how frequently they have previously occurred

N.B. Scenario C/Māngere Bridge is the Exercise Ruamoko sequence



From: Hayes et al. (2018; GNS report), Hayes et al. *in prep*

Updating the lava flow modelling

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Lava flows were included in four of the seven new sequences

Original modelling:

- Hand-drawn based on expert elicitation
  - On DSMs
- Outputs:
  - Flow footprint over time
  - Advancement rate

Lava flow modelling for three of the four sequences was quantitatively modelled

New modelling:

- MOLASSES
  - Undertaken on DEMs & DSMs
- Outputs:
  - Flow footprint
  - Flow thickness

Comparison

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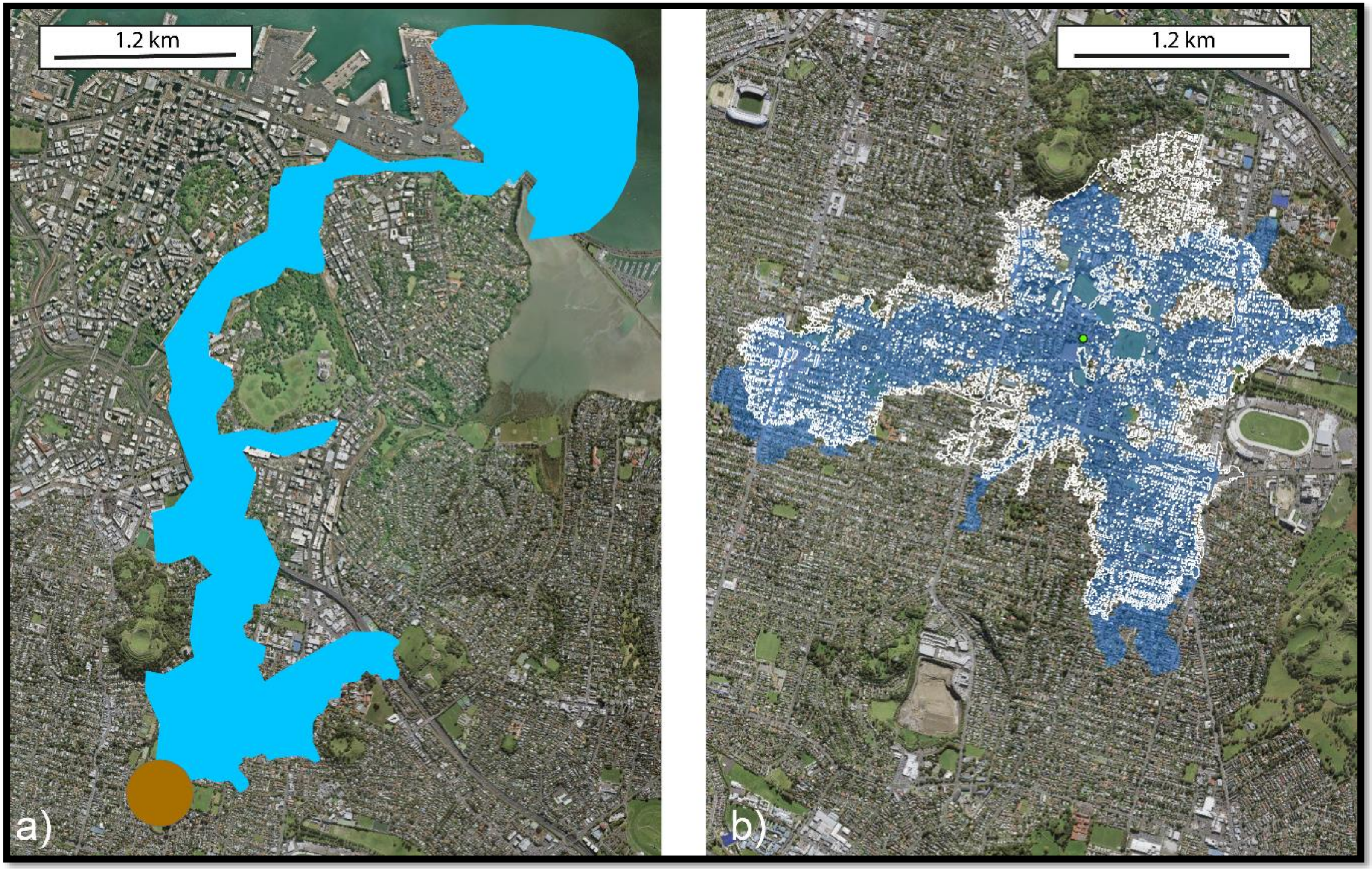
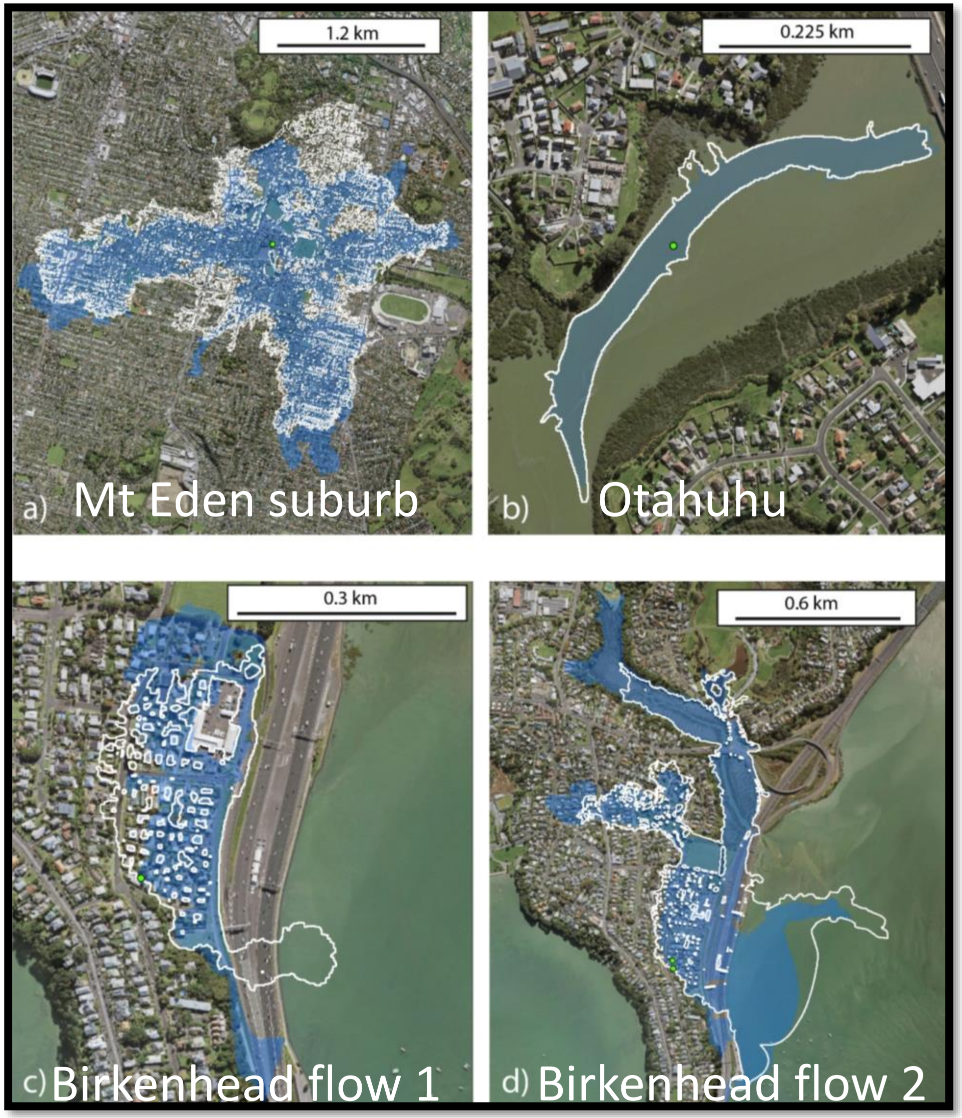


Tsang et al. *in prep (1)*

Footprints

DEM run (blue)
DSM run (white outline)
Vent (green circle)



Tsang et al. *in prep (1)*

Buried infrastructure hazard

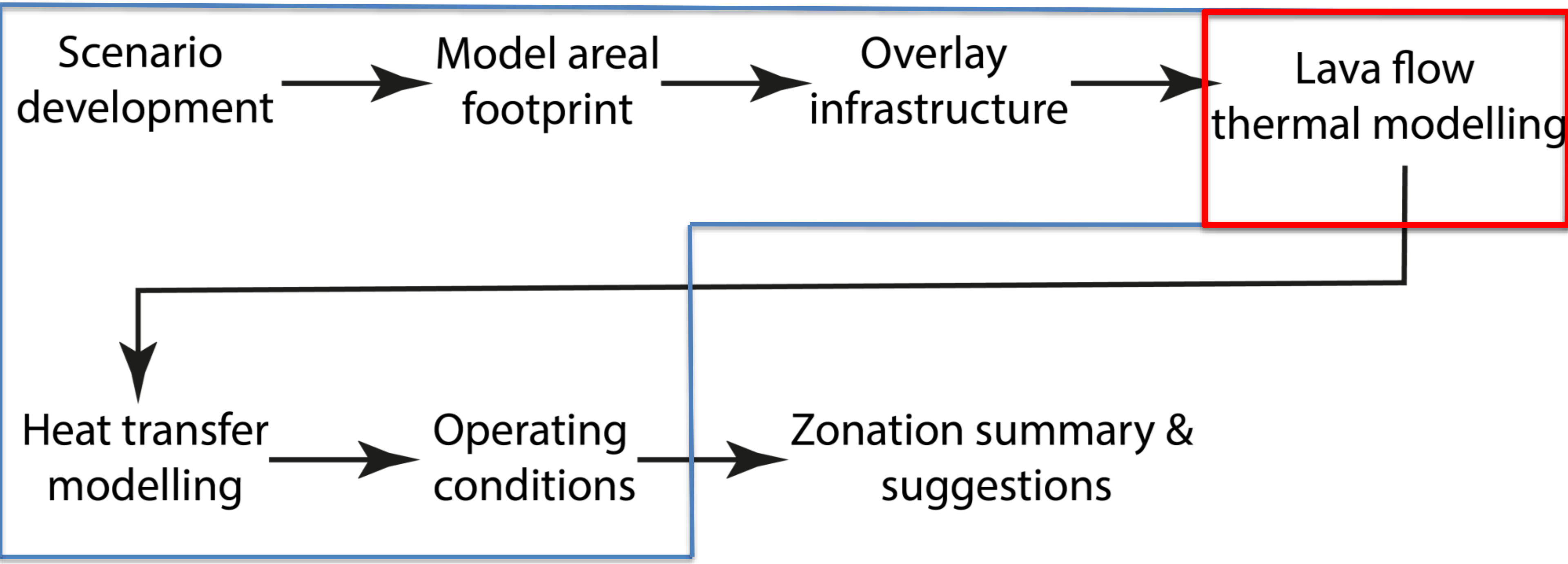
- Spoken with representatives at:
  - Hawaiian Electric Light Company (Hawaii, USA)
  - Hawai‵i County Department of Water Supply (Hawaii, USA)
  - Auckland Council
  - Auckland Emergency Management
  - Transpower

•All voiced concerns about how much heat lava flows transfer into the substrate and if conditions will continue to be operable

•Most defined operable temperatures as substrate temperatures of 100°C or below

Tsang et al. *under revision,* GNS Science Report

Overview of method



Tsang et al. *in prep (2)*

Heat transfer modelling

- Used Ansys APDL to model the heat transfer from a lava flow to the substrate below

- Created a training data set at the Syracuse University Lava Project
    - Axisymmetric, so assuming the temperatures were being measured below the centre of the flow
    - Data set equivalent to coring through the lava flow into the substrate below, not as if lava had gotten into pipes

Tsang et al. *under revision,* Bulletin of Volcanology

Validation

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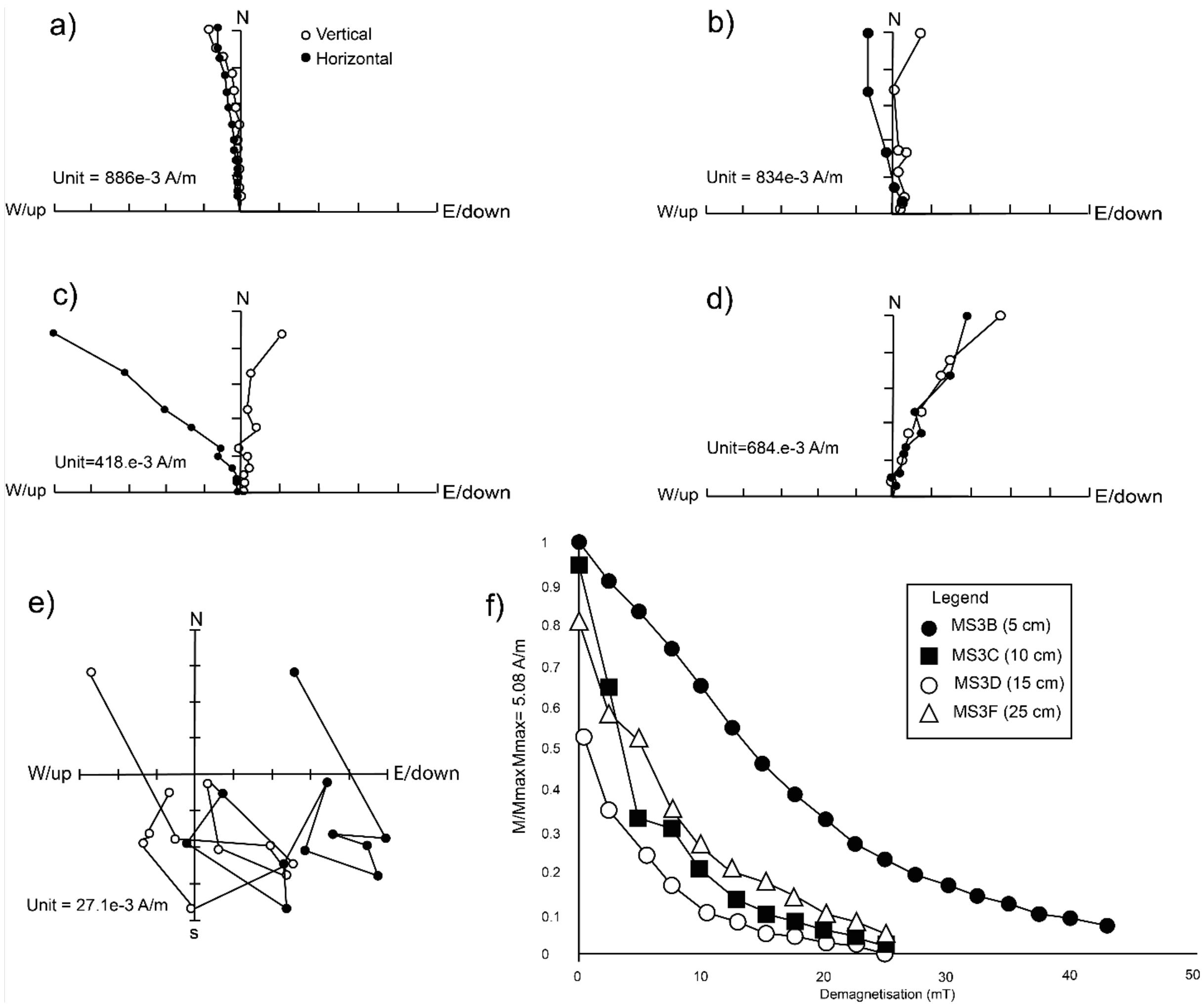
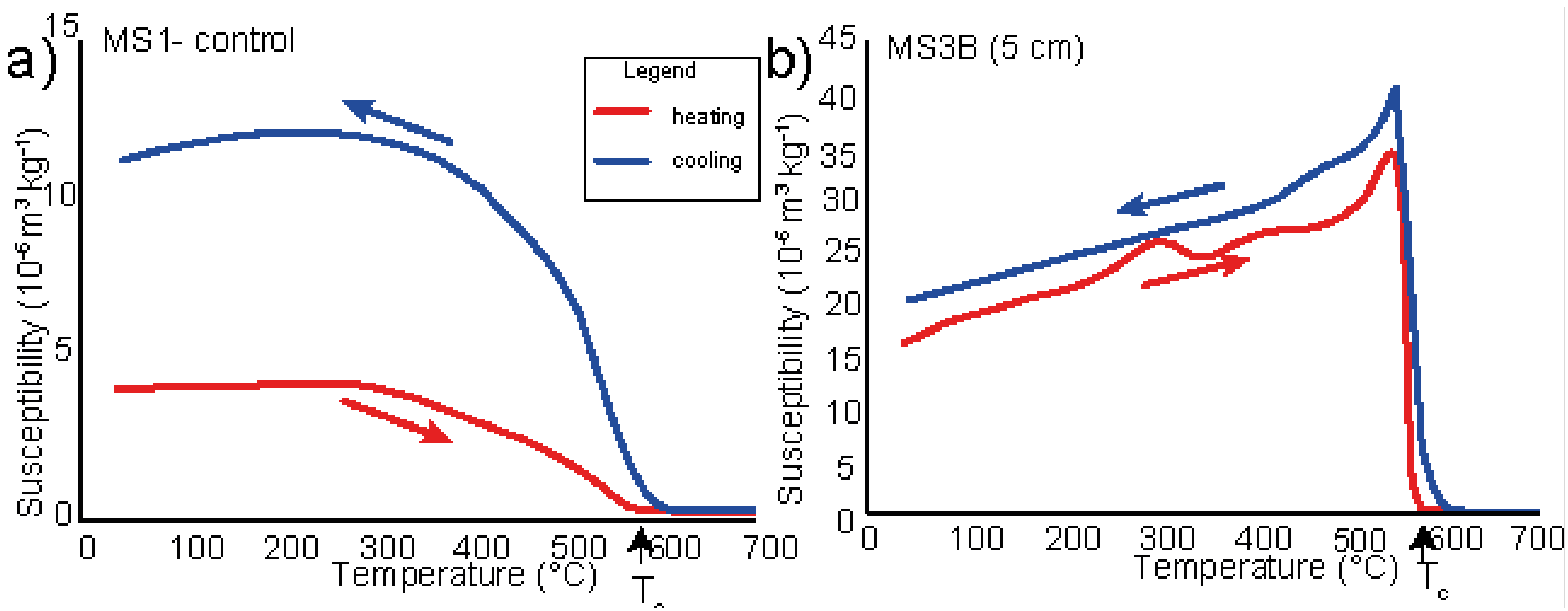


Tsang et al. *under revision,* Bulletin of Volcanology

Validation, continued



Tsang et al. *under revision,* Bulletin of Volcanology

Overview of method

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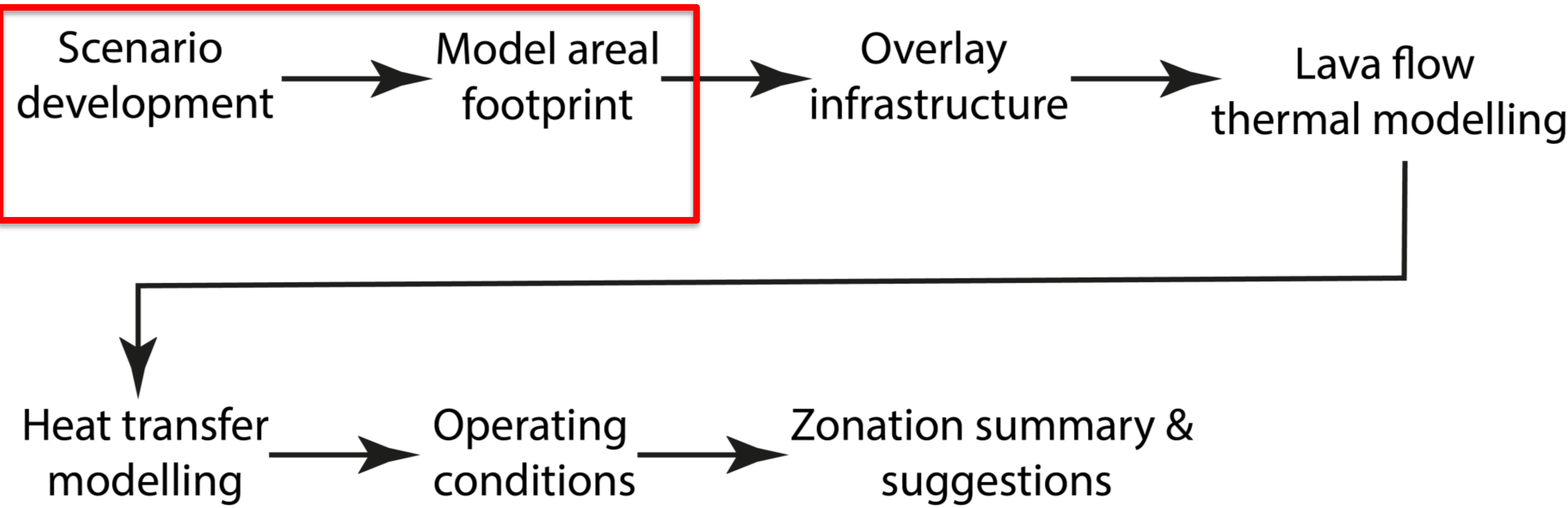

Tsang et al. *in prep (2)*

Case study: Birkenhead

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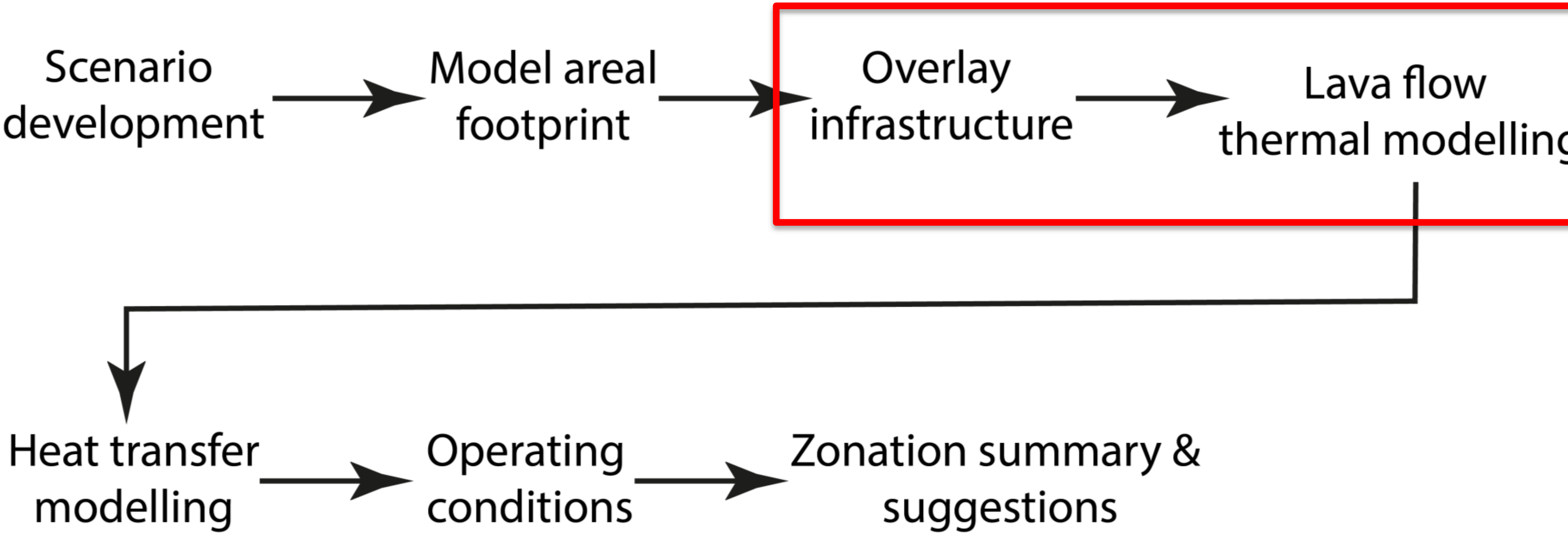
- Using the DSM footprint (white outline)
- Flow advances across SH 1 at the northern end of the Harbour Bridge
    - Would affect the North Shore & Northland's power

Tsang et al. *in prep (2)*

Overview of method

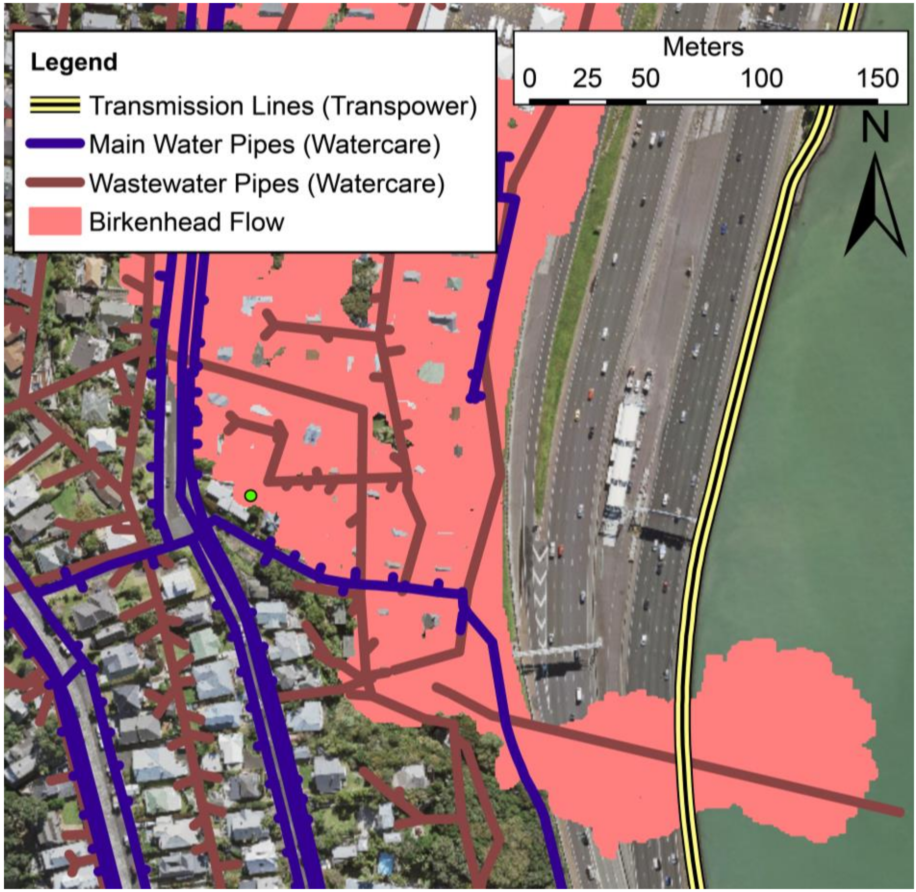


Tsang et al. *in prep (2)*

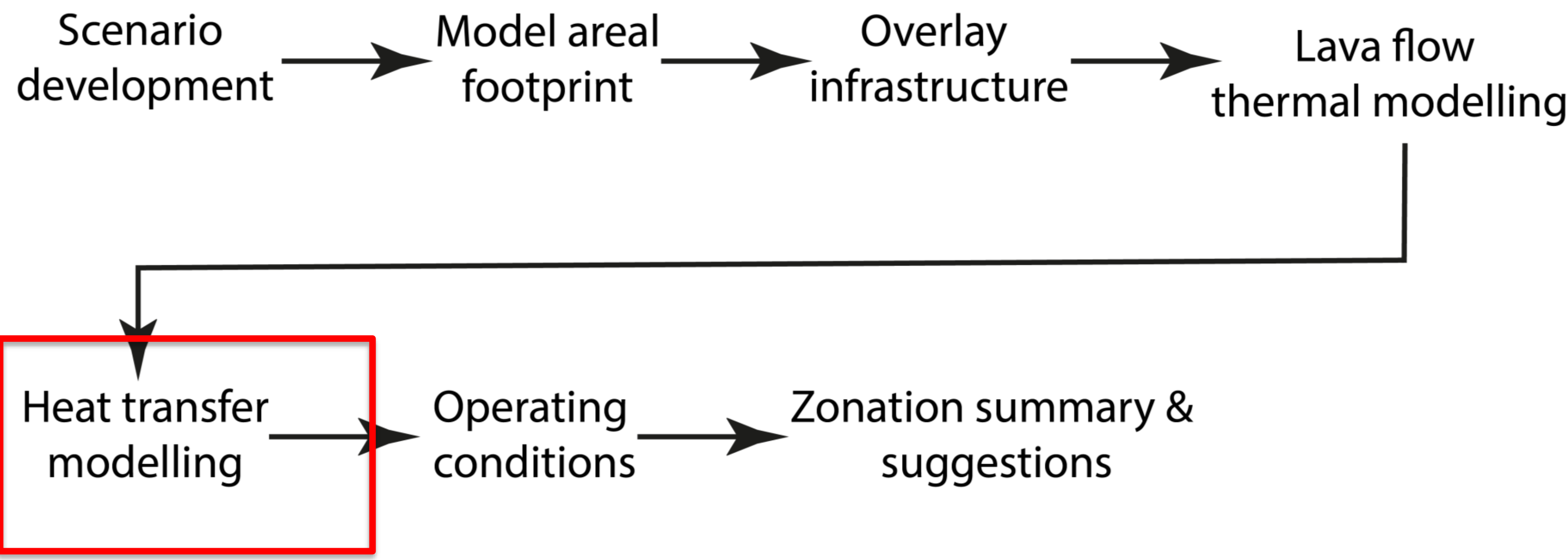
Infrastructure in Birkenhead

- Flow advances across SH 1 at the northern end of the Harbour Bridge
    - Transpower's main transmission line runs under the bridge & SH1

•FLOWGO at intersection point



Overview of method



Tsang et al. *in prep (2)*

Heat transfer modelling

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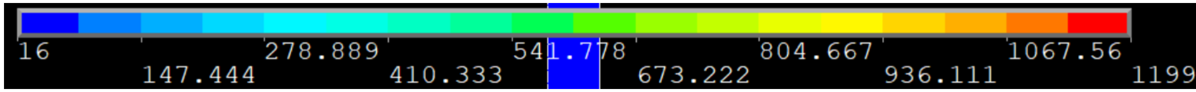
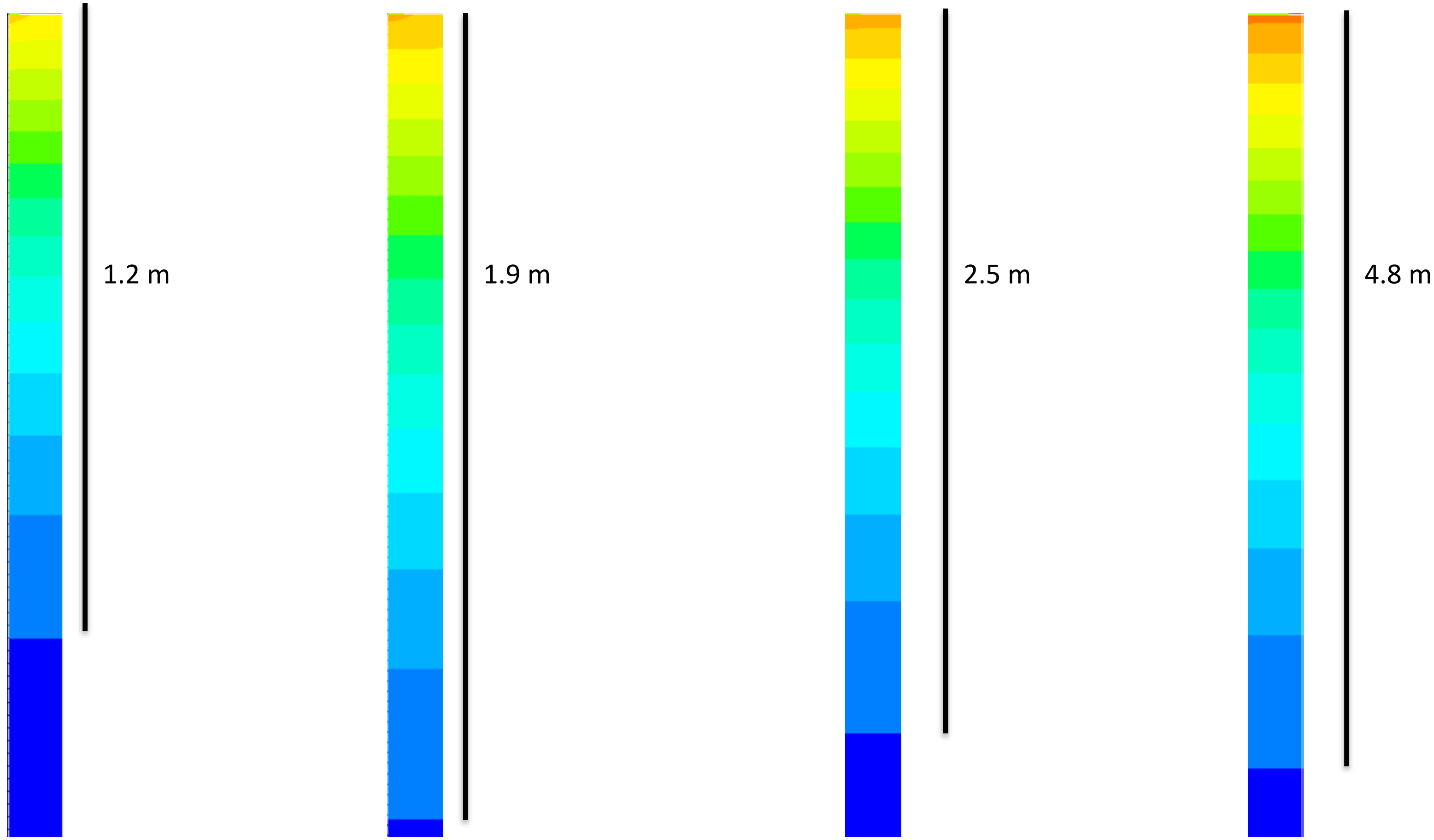


Temperature Scale (°C)

Increasing time =>



Thermal profile after: 4 days
(No more lava supplied after this)

Thermal profile after: 7 days
(Time lava was supplied + 3 days)
100°C contour at 1.8 m

Thermal profile after: 11 days
(Time lava was supplied + 1 week)
100°C contour at 2.4 m
Potentially up to 7 cm erosion

Thermal profile after: 34 days
(Time lava was supplied + 1 month)
100°C contour at 4.5 m
Potentially up to 35 cm erosion

Overview of method

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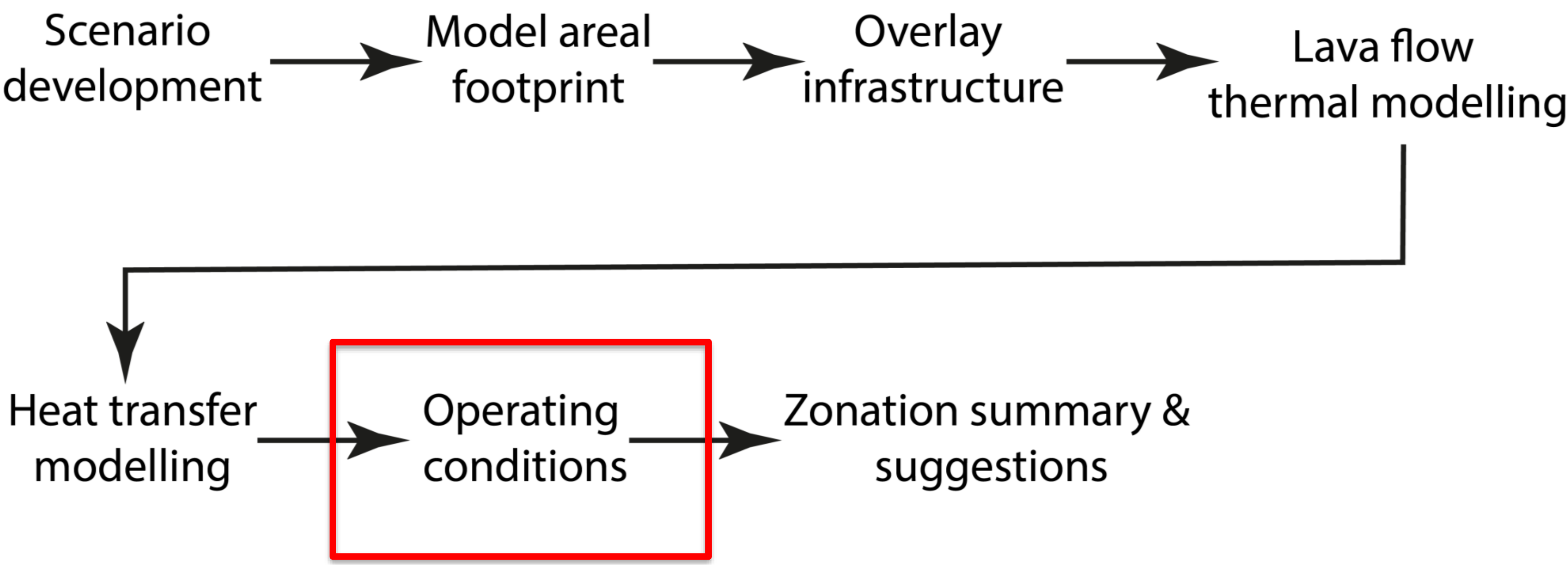

Tsang et al. *in prep (2)*

Results

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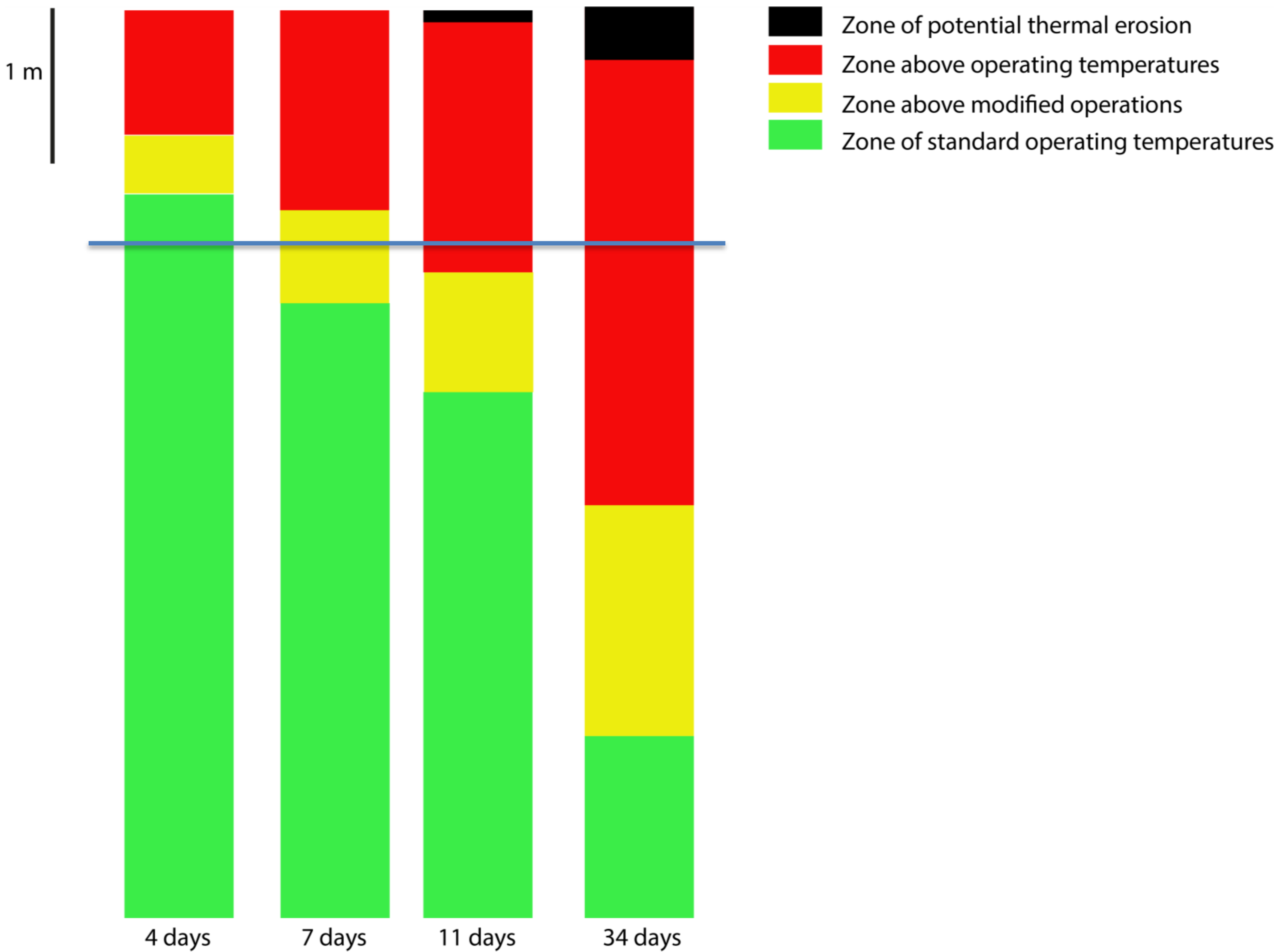

Thank you