DRONES IN GEOTHERMAL EXPLORATION: THERMAL INFRARED IMAGERY, AERIAL PHOTOS AND DIGITAL ELEVATION MODELS

PRESENTATION FOR ARGEO – C6, 2016, ADDIS ABABA, ETHIOPIA

MARK HARVEY[1], COLIN HARVEY[1], JULIE ROWLAND[2] AND KATHERINE LUKETINA[3]

[1]HARVEY GEOSCIENCE LIMITED

[2]SCHOOL OF ENVIRONMENT, UNIVERSITY OF AUCKLAND, AUCKLAND, NEW ZEALAND,

[3]WAIKATO REGIONAL COUNCIL, PRIVATE BAG 3038, WAIKATO MAIL CENTRE, HAMILTON 3240

Introduction

Recent advances in technology:

- UAVs equipped with GPS, programmable flight controllers, and digital cameras have reduced cost of collecting imagery
- Desktop or cloud computing power for post-processing (photogrammetry)

Regulations covering the use of UAVs varies according to jurisdiction, UAV size and purpose (i.e. commercial or recreational):

- In New Zealand, relevant legislation is described in Civil Aviation Rules Part 101: drones weighing under 25kg fall under the rules for model aircraft and can be flown in most places under 120m, 4km away from airfields, and within the line of sight of the pilot

Introduction

Thermal aerial photos are expected to be useful at all phases of geothermal exploration and development:

- Maps for geological, geochemical and geophysical surveys
- Environmental baseline studies
- Civil works
- Steam field and plant design and construction

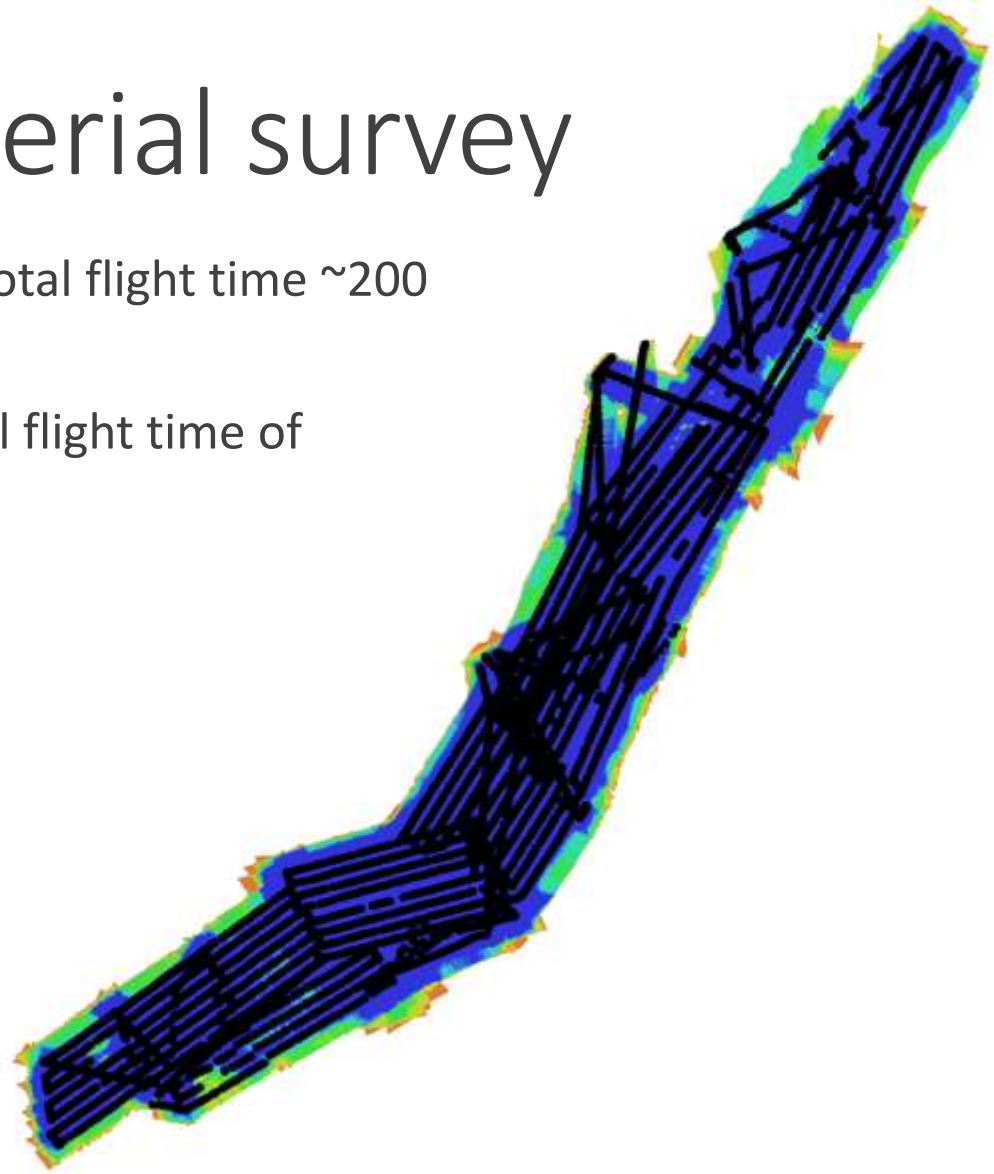
Methodology – aerial survey

Aerial survey using UAV at Waikite, New Zealand (2015)

- DJI Phantom Vision 2+ quadcopter
- ICI thermal camera (640x480 pixel sensor) plus Canon S100 (12MP)
- Capture images at ~2 sec intervals
- Pre-loaded flight plan
- Thermal images captured in the morning (first light till about 10am)
- Agisoft Photoscan® for post-processing of photos

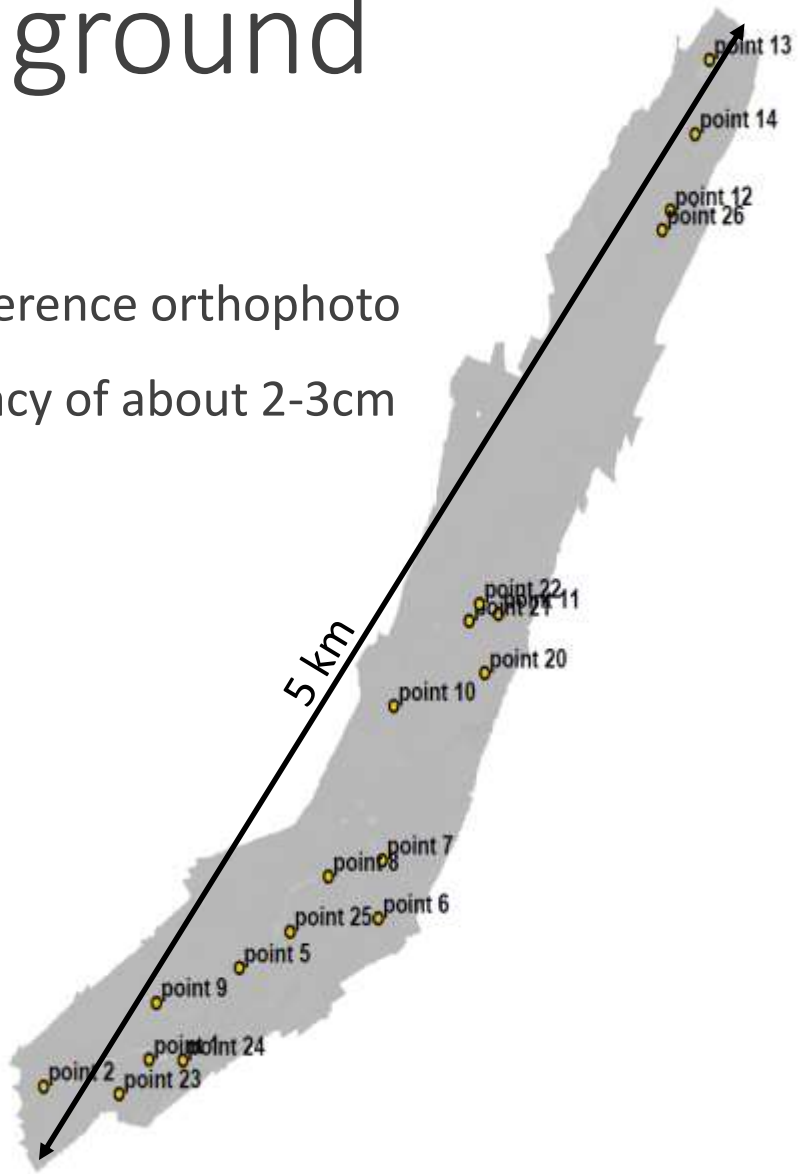
Methodology – aerial survey

- 5800 thermal images, 17 flights, total flight time ~200 min, 2.5 km^2 coverage
- 2000 visible images, 8 flights, total flight time of ~120min, 3 km^2 coverage
- Flight altitude was ~120 m

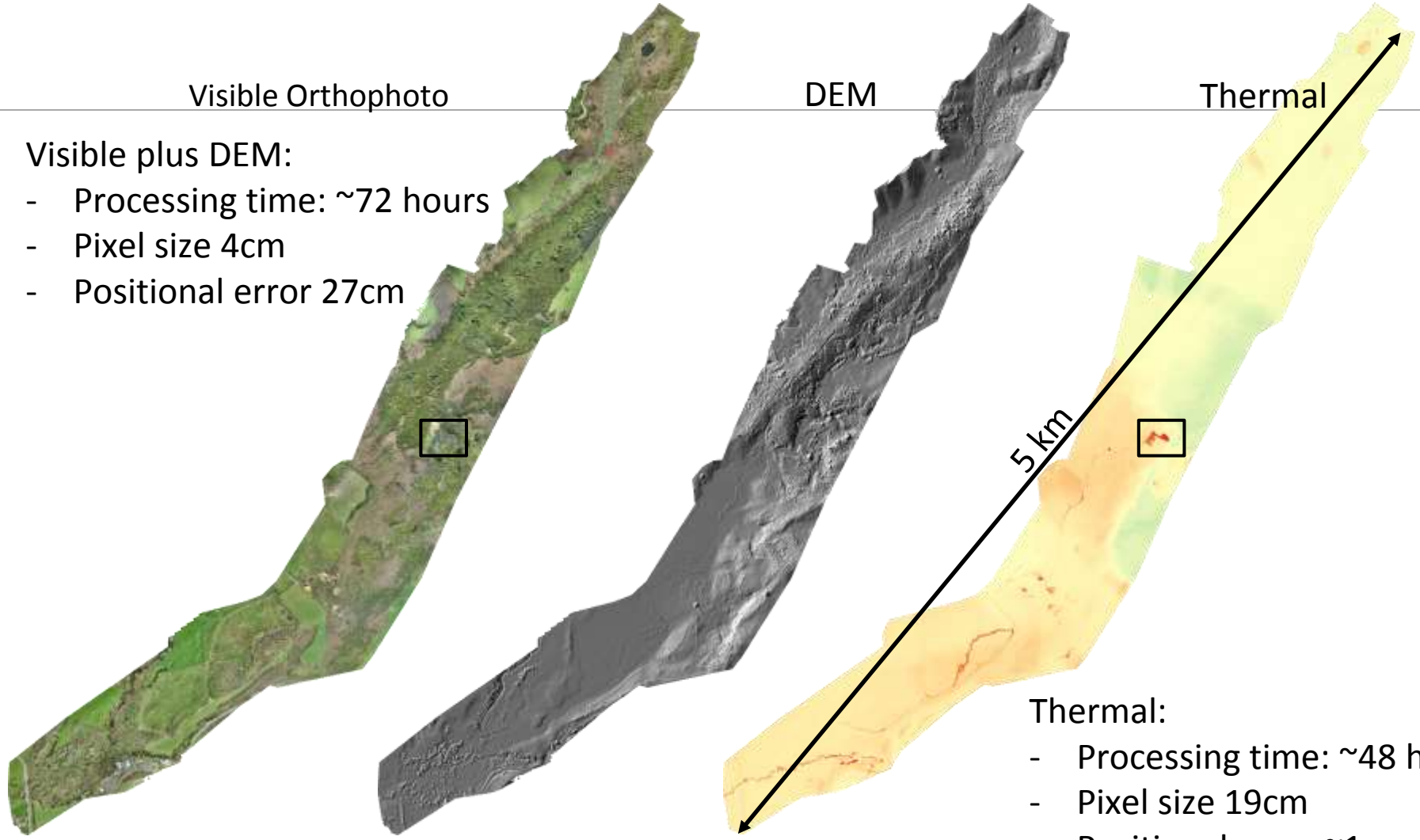


Methodology - ground control points

- 20 ground control points to georeference orthophoto
- RTK GPS provides positional accuracy of about 2-3cm
- 2.5km^2 coverage area



Results



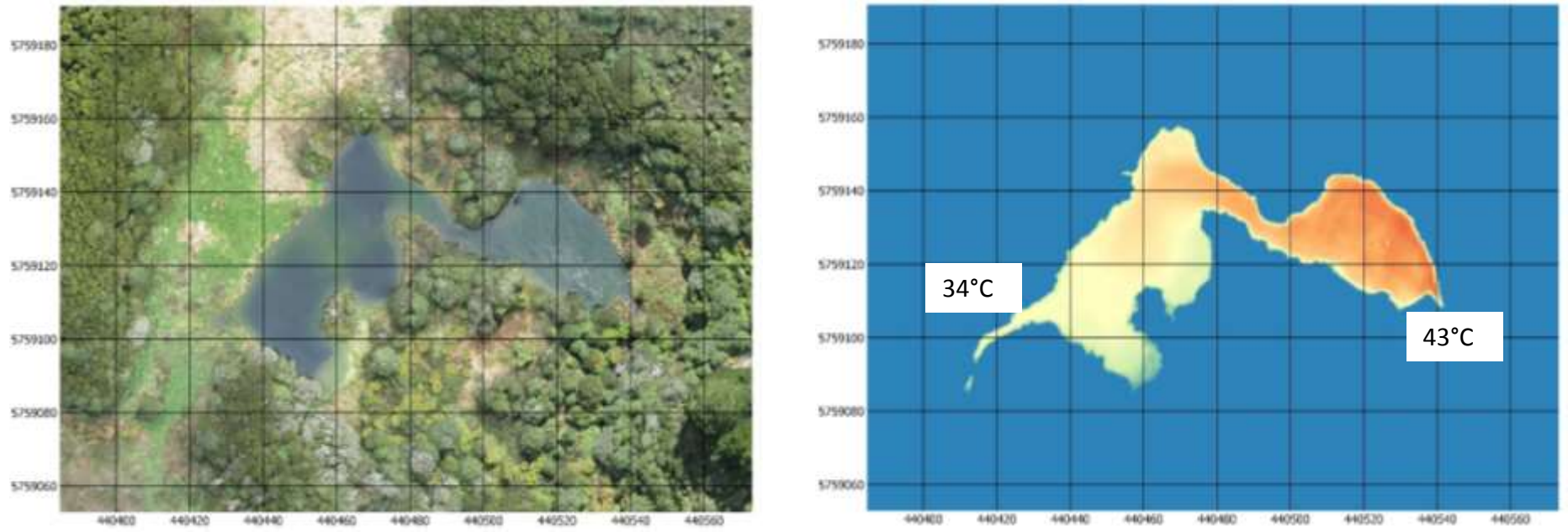
Visible plus DEM:

- Processing time: ~72 hours
- Pixel size 4cm
- Positional error 27cm

Thermal:

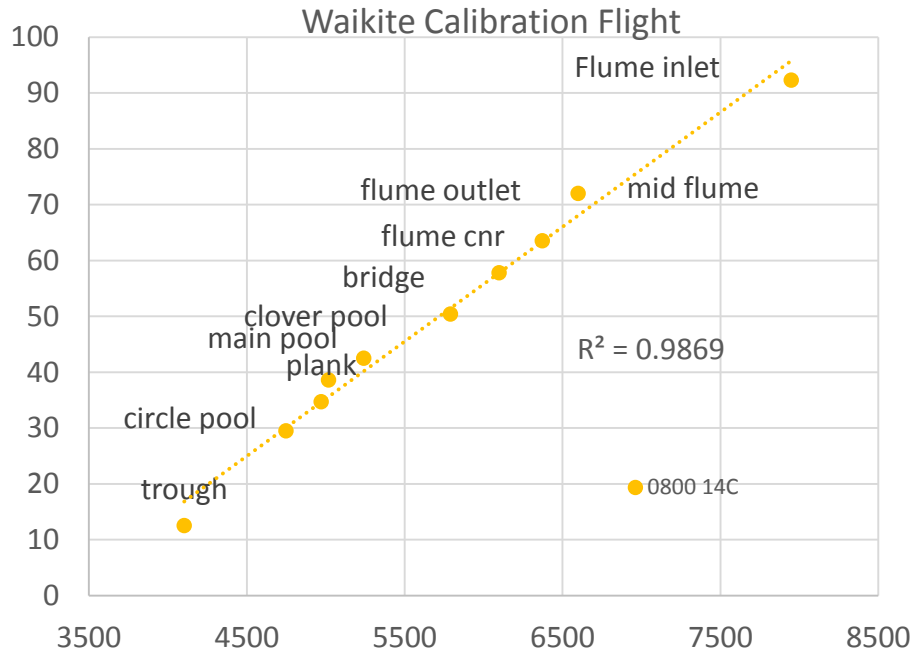
- Processing time: ~48 hours
- Pixel size 19cm
- Positional error ~1m

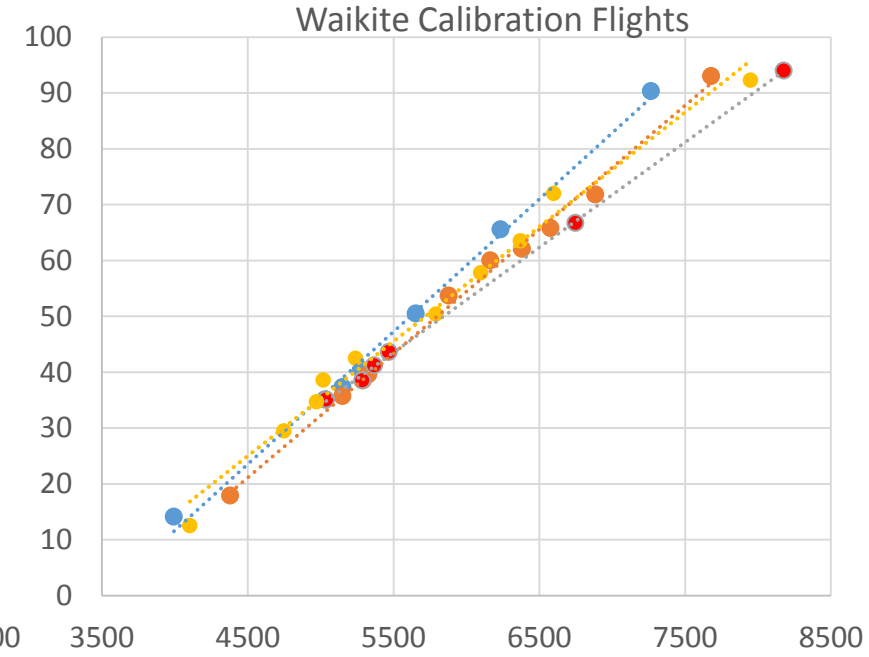
Results – visible and thermal



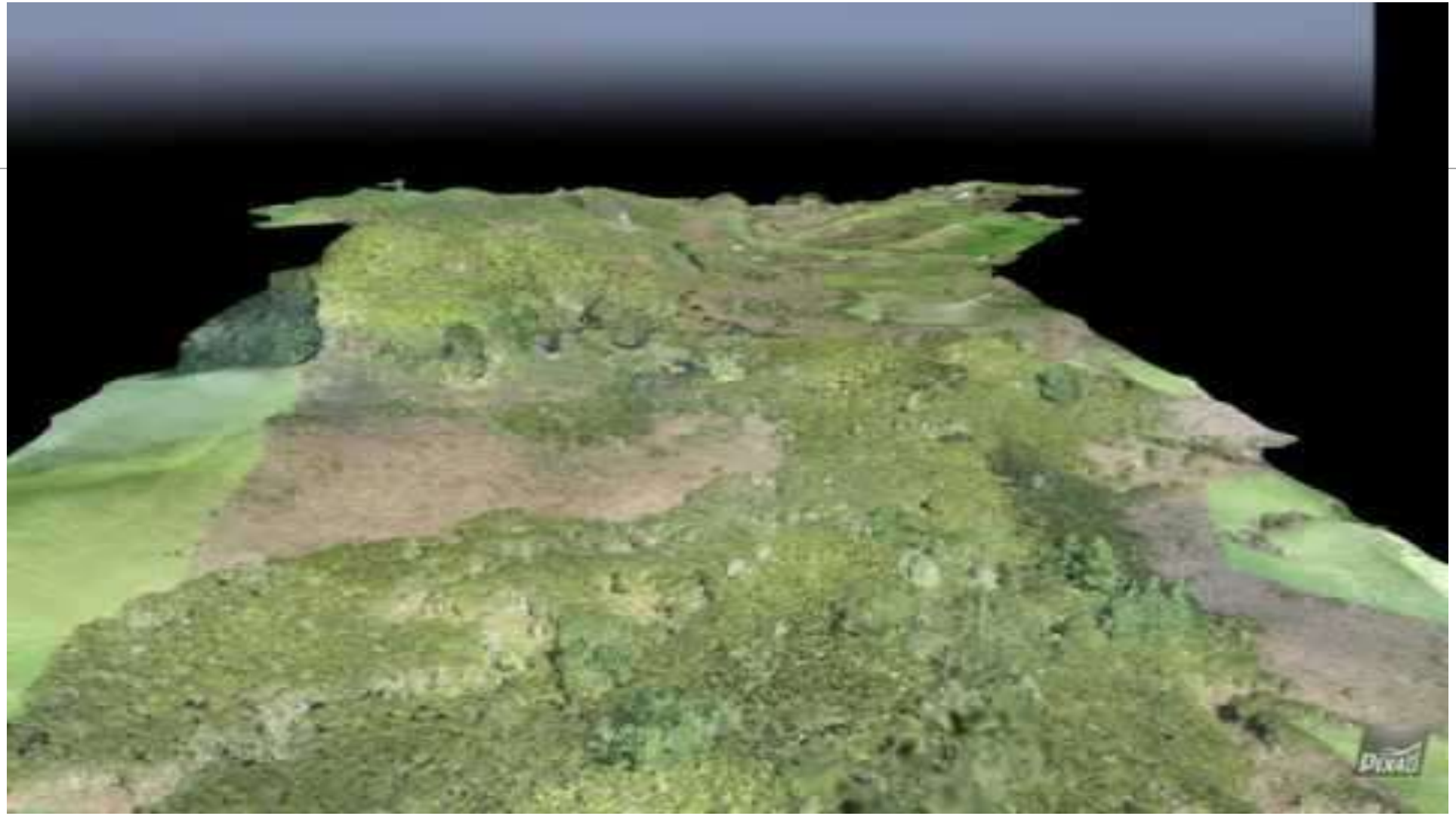
Visible orthophoto (on left) and thermal (on right). Length of horizontal axis is about 180 m.

Thermal image calibration

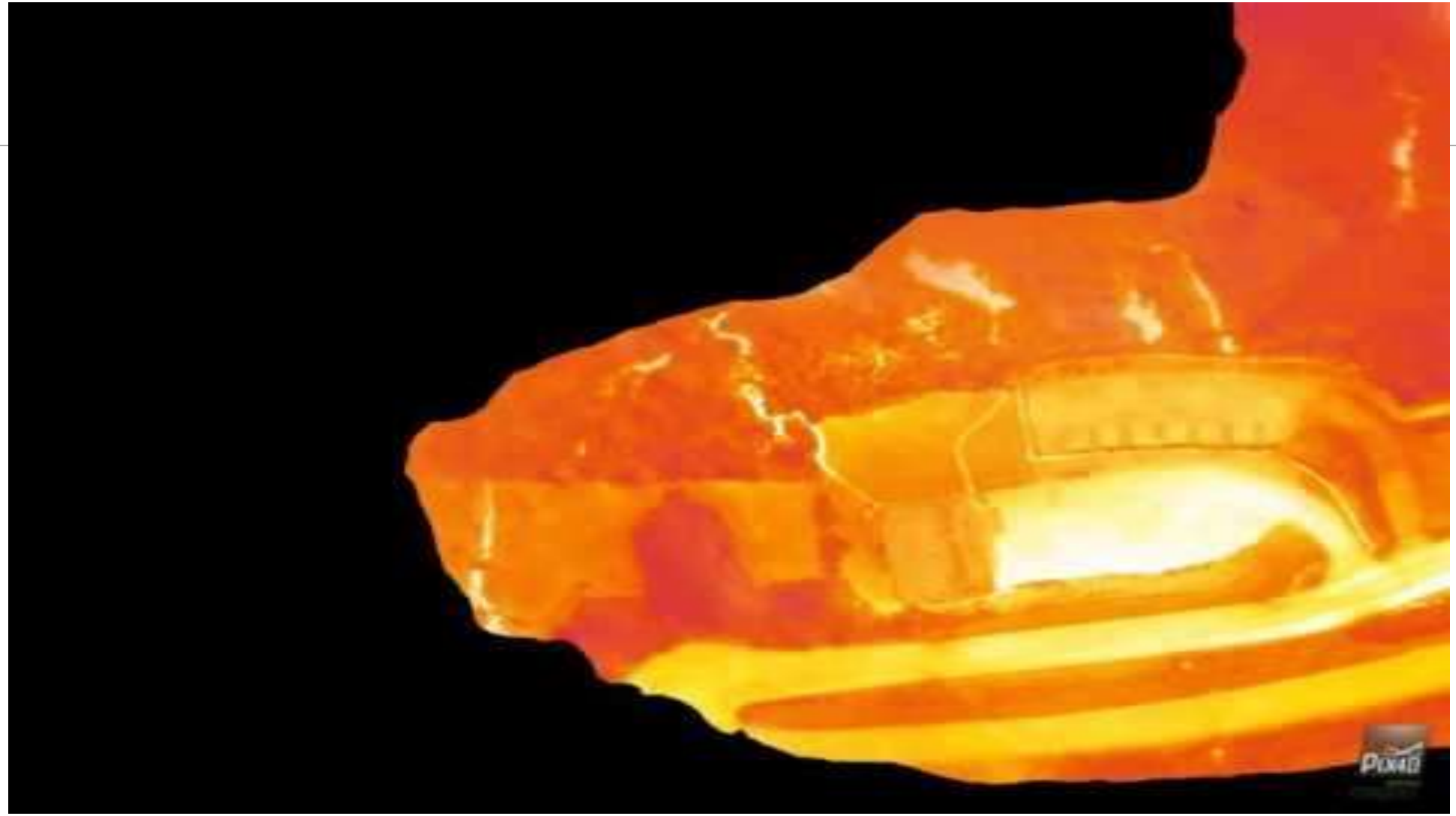




3D models



3D models



Conclusions

- Low cost approach to producing high accuracy georeferenced aerial images, including DEM, visible and calibrated thermal orthomosaics
- Maps for geological, geochemical and geophysical surveys
- Environmental baseline studies and ongoing environmental monitoring
- Geotechnical studies
- Civil works
- Steam field and plant design and construction

Acknowledgements

The authors would like to acknowledge GNS and the University of Auckland for providing financial, technical and logistical support to this project, and ICI thermal cameras for their support.