

UNIVERSITY OF TWENTE.

INVESTIGATING DYNAMIC THERMAL PROCESSES TO OPTIMIZE GEOTHERMAL HOTSPOT DETECTION

“USING ECOSTRESS TO EMPOWER THE ENERGY TRANSITION”

AGNIESZKA SOSZYNSKA, CHRIS HECKER (PI), ROBERT
HEWSON, ROBERT REEVES, EUNICE BONYO,
THOMAS GROEN

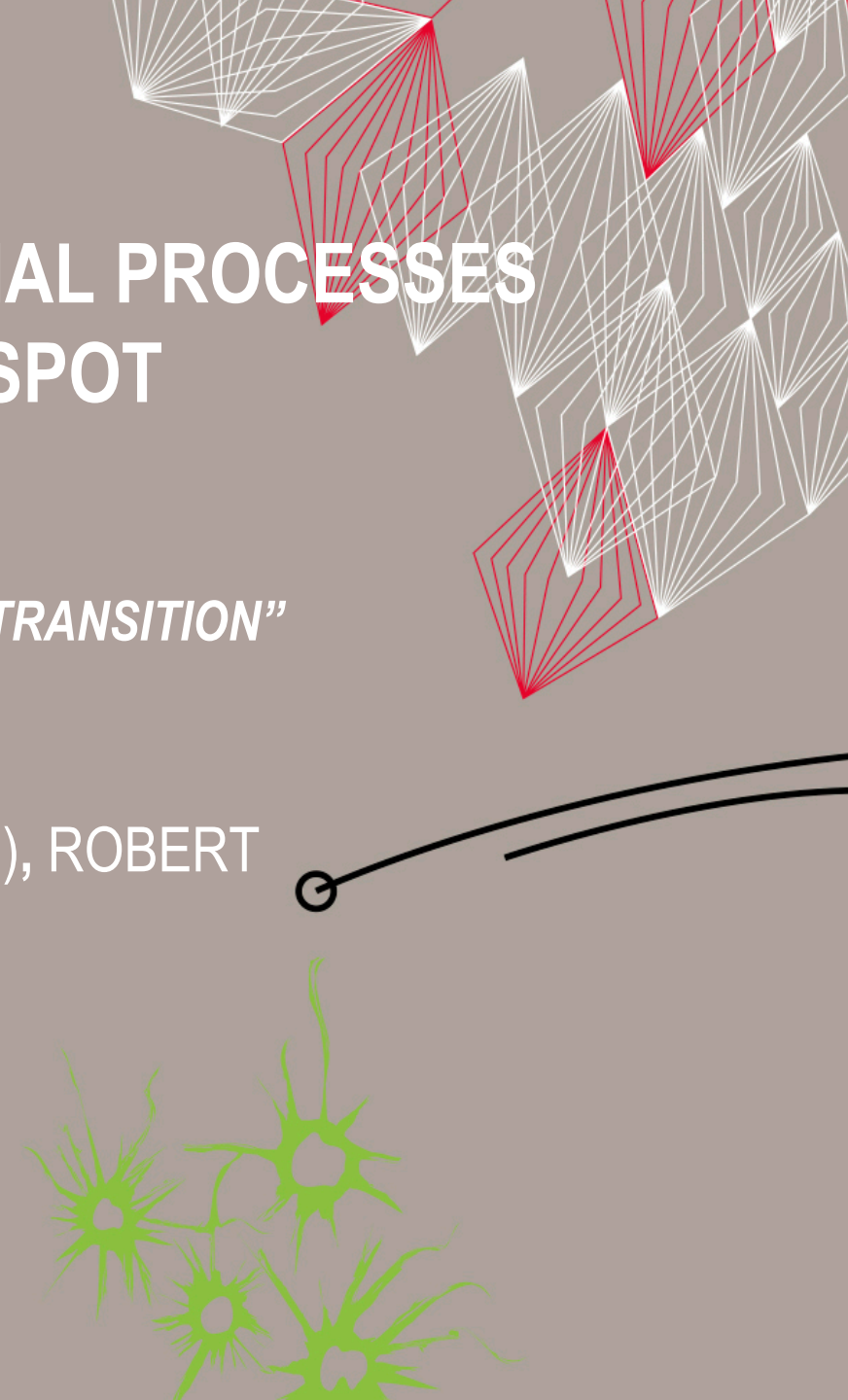
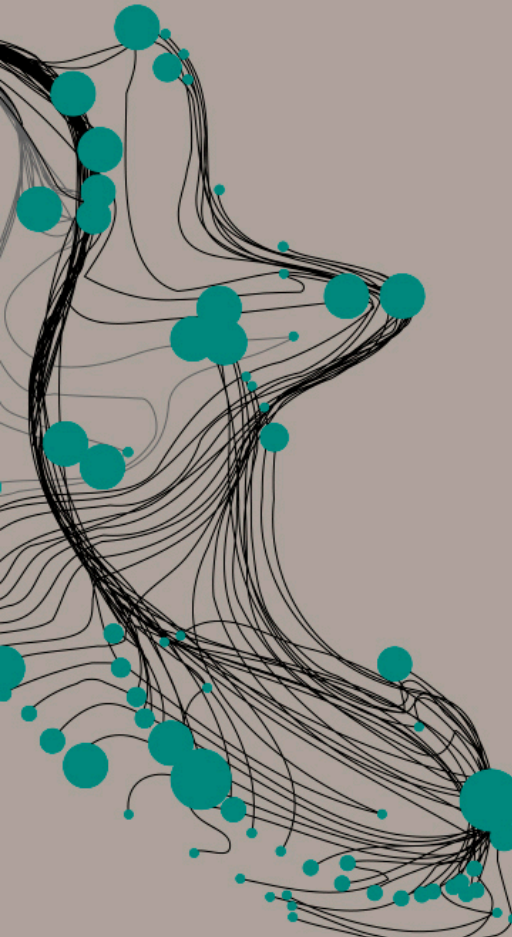
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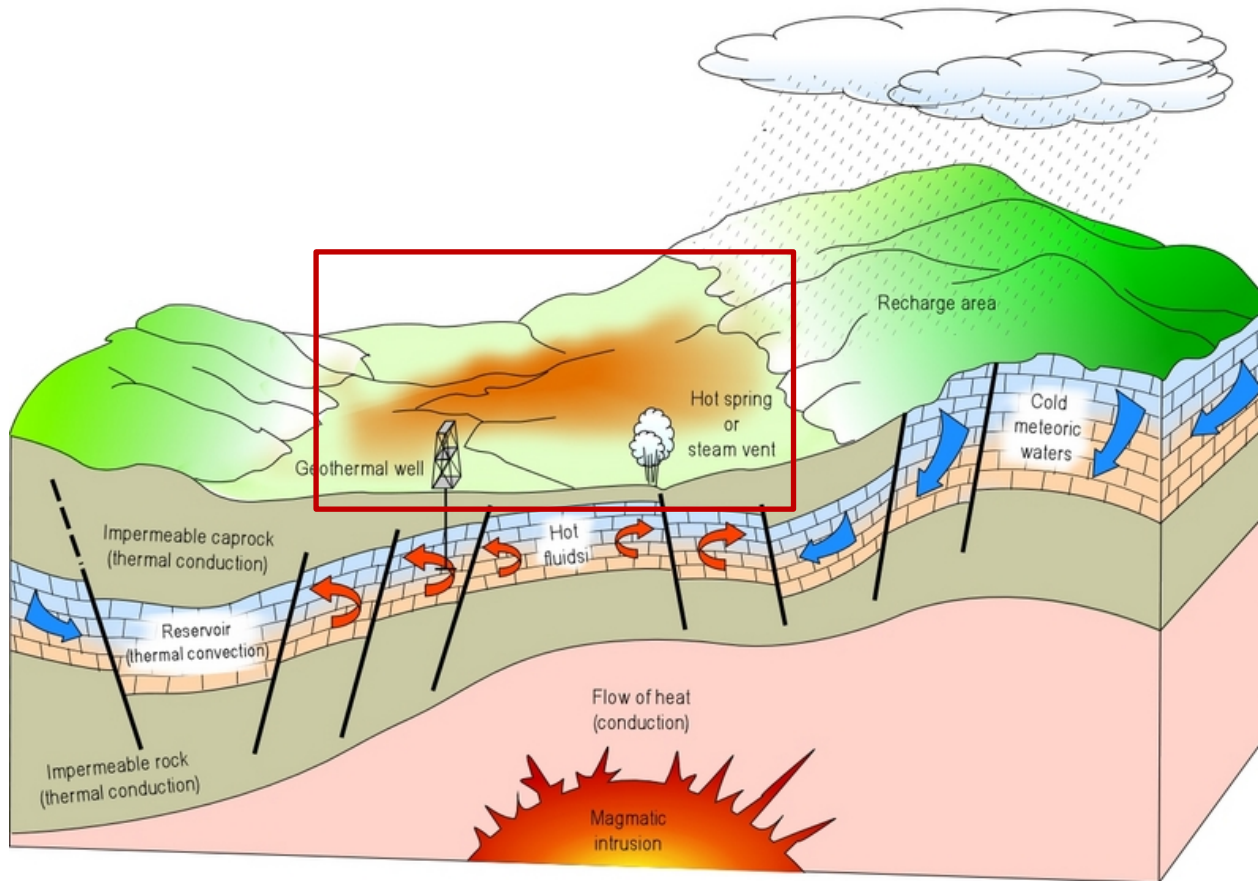
ECOSTRESS WORKSHOP AUGUST 19, 2021



FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION



DETECTING GEOTHERMALLY ACTIVE AREAS



- RS techniques typically focus on surface manifestation such as surface mineral alteration
- Usage of satellite thermal imagery is limited, due to pixel size, and time of overpass
- Using ECOSTRESS can be a solution

Conceptual geothermal system with steam extraction for electricity production and surface manifestations
source: Geothermal-energy.org



RESEARCH QUESTIONS

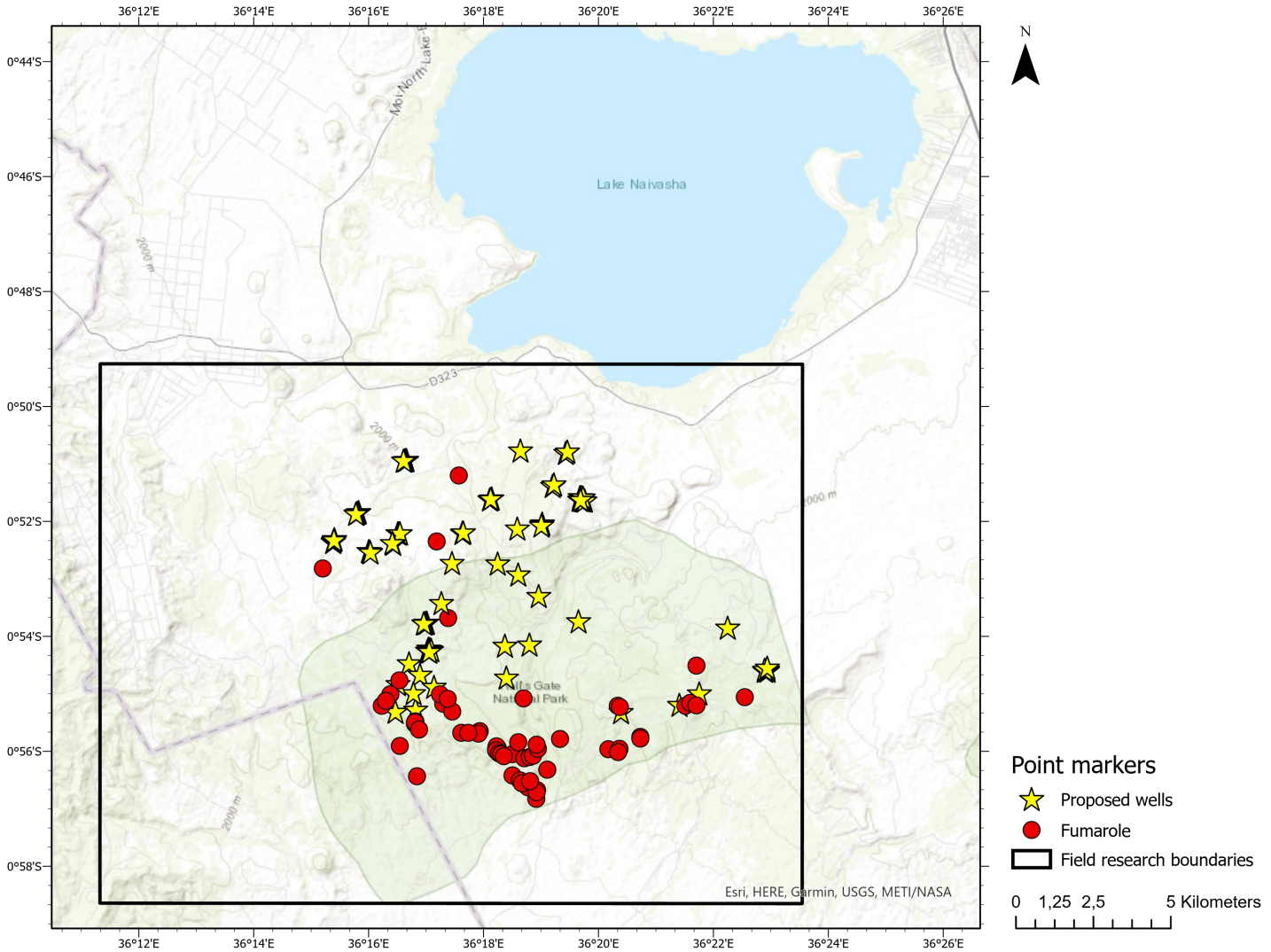
- What is the **diurnal thermal behaviour** of the geothermally active areas?
- What is the **perfect data acquisition time** for detecting geothermal areas?
- How does the **weather influence** the surface temperature?
- How does the **vegetation influence** the surface temperature?
- What are the **best methods** to detect geothermal areas using RS techniques?

IDEAS FOR SOLUTIONS

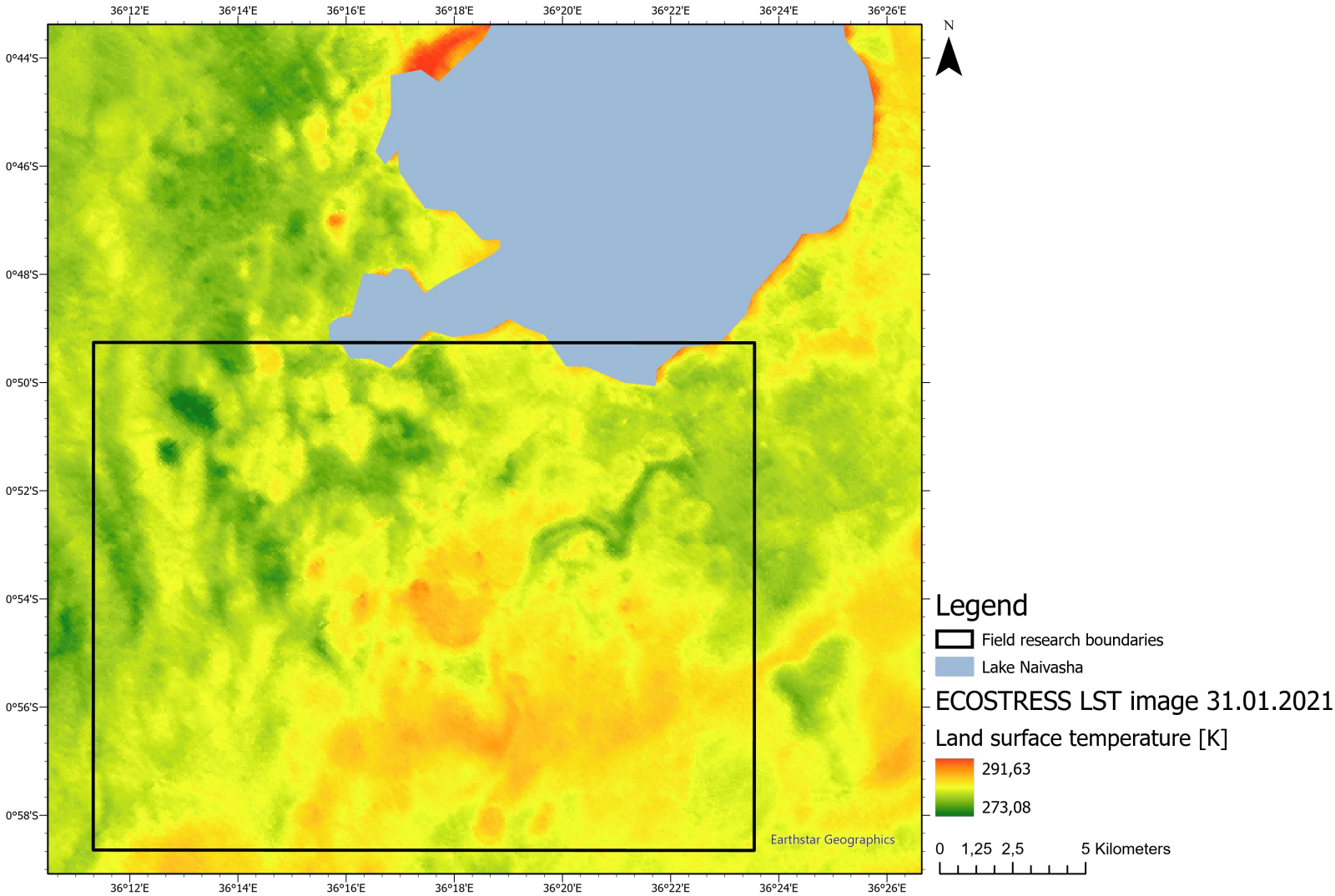
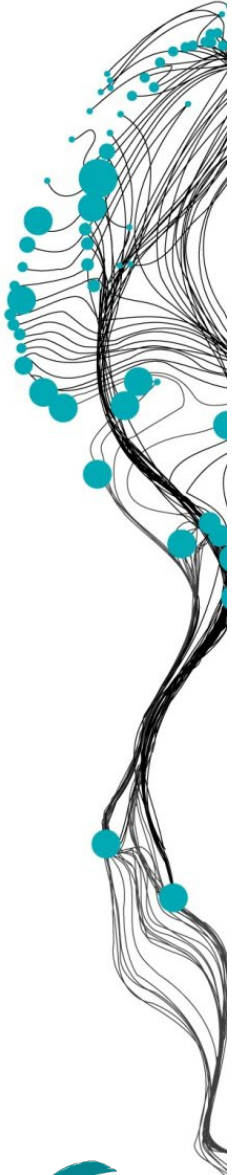
- Analysis of the data from different acquisition times
- Field research to provide ground truth on diurnal surface temperature
- Comparison of methods for GT areas detection in different study areas
- Analysis of land cover in different study areas



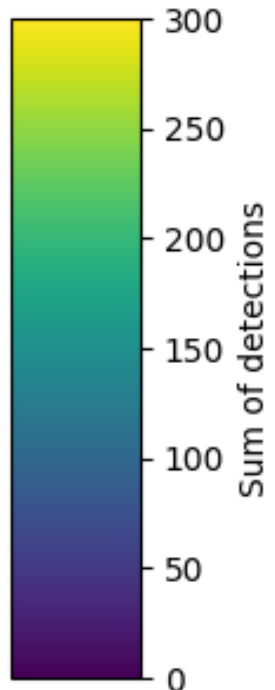
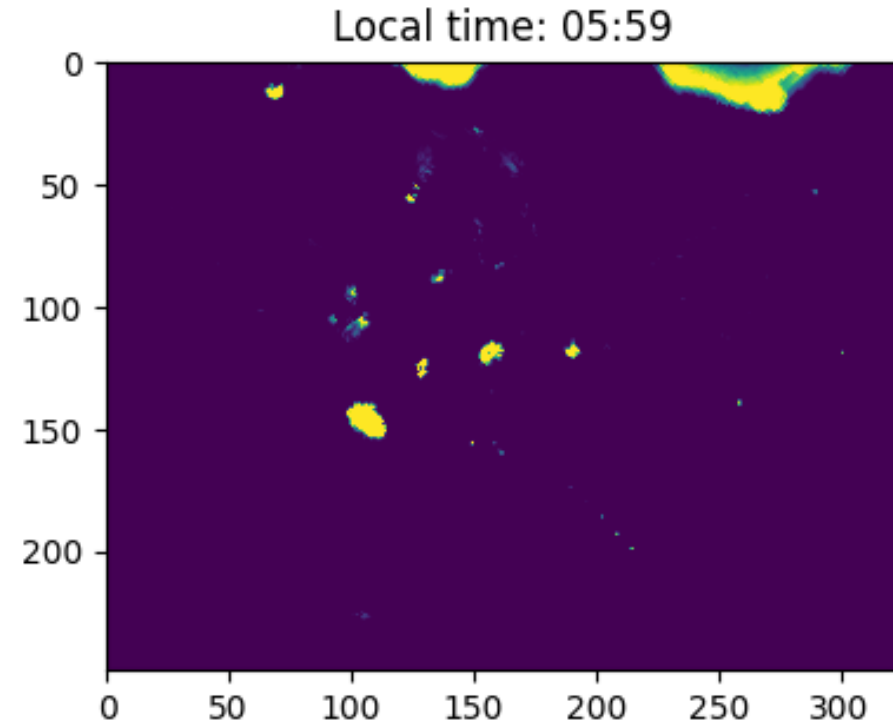
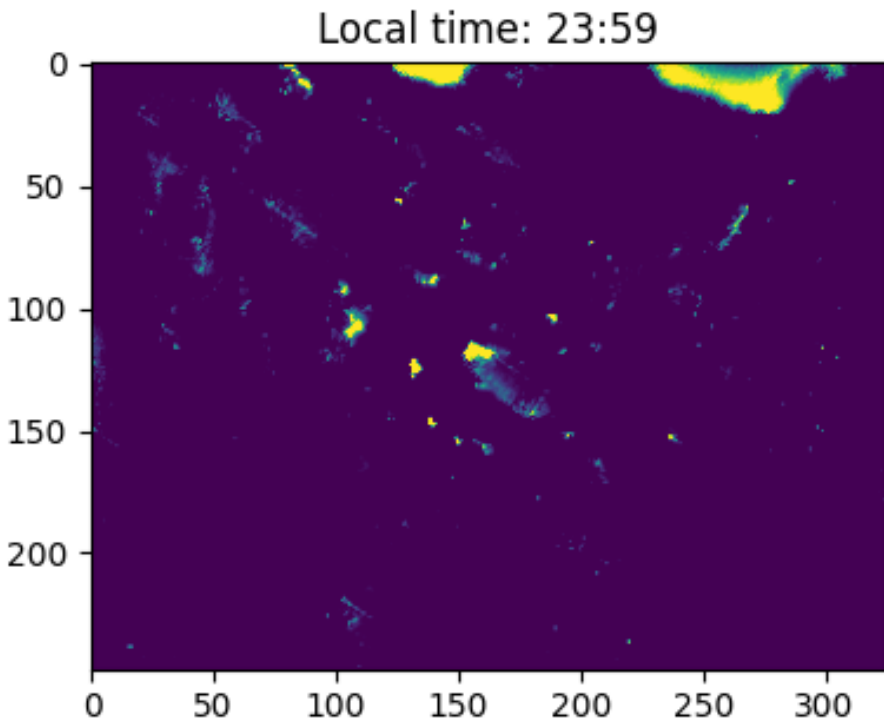
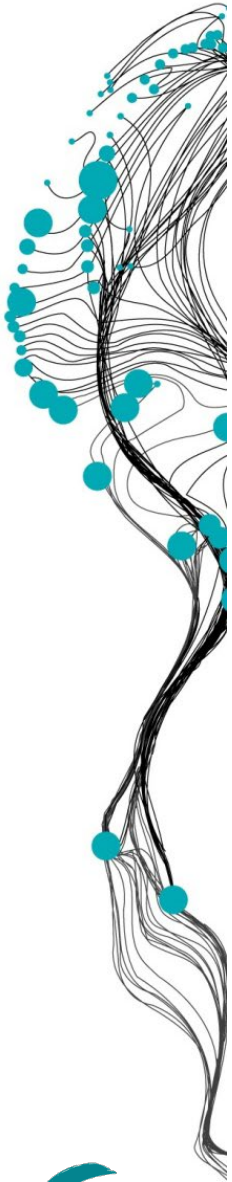
STUDY AREAS – OLKARIA, KENYA



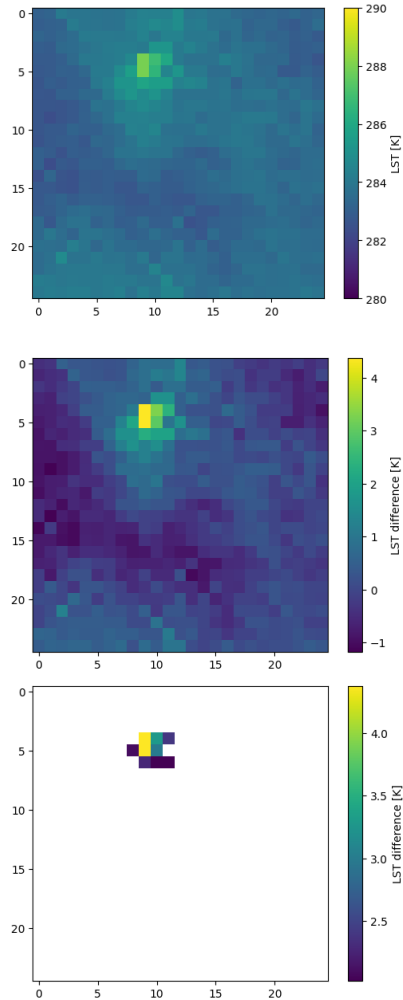
DETECTING GEOTHERMAL ACTIVITY IN ECOSTRESS DATA



ACQUISITION TIME

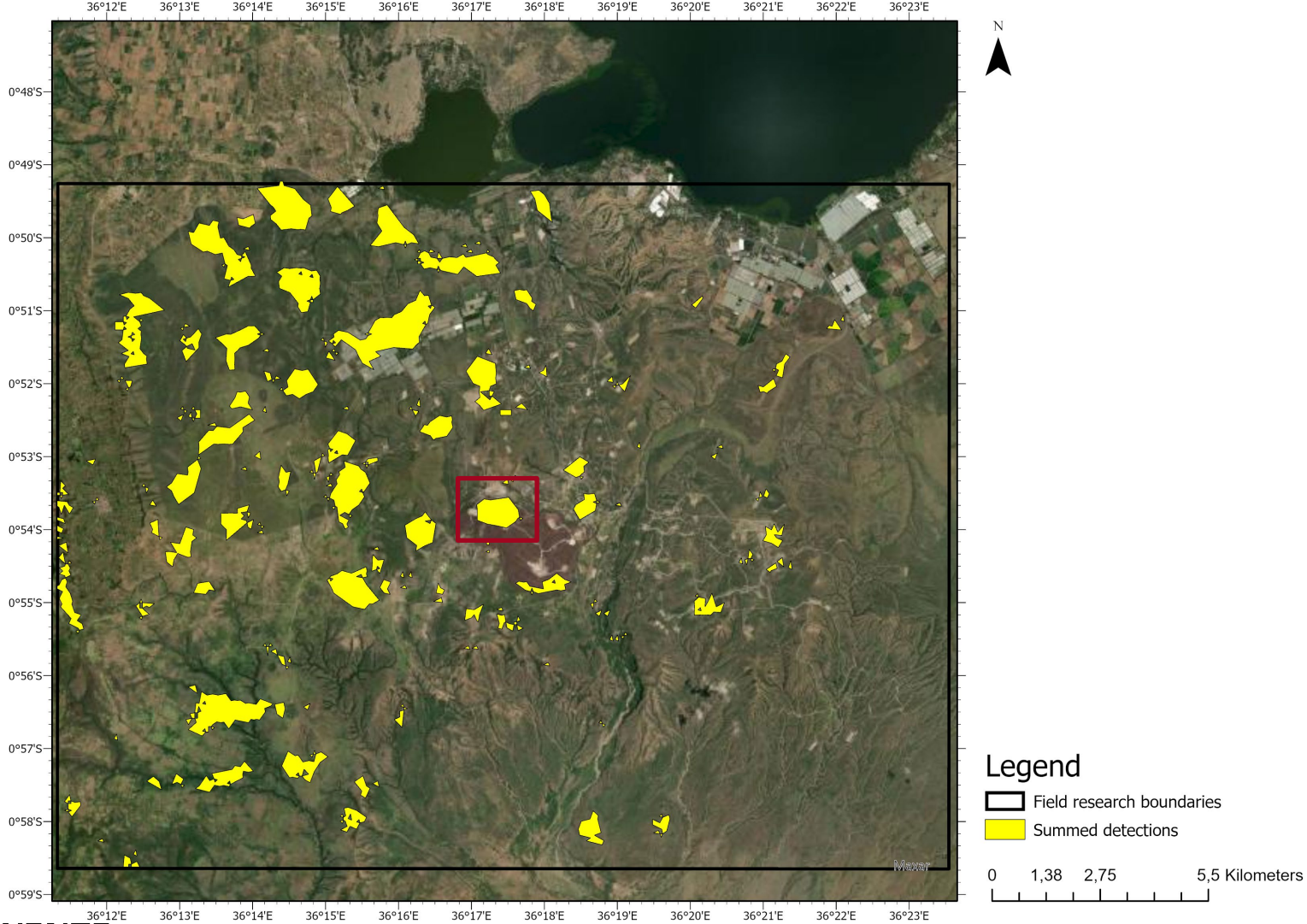
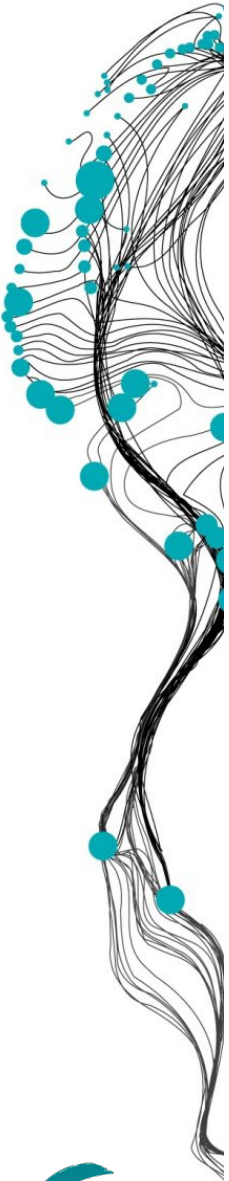


METHODOLOGY

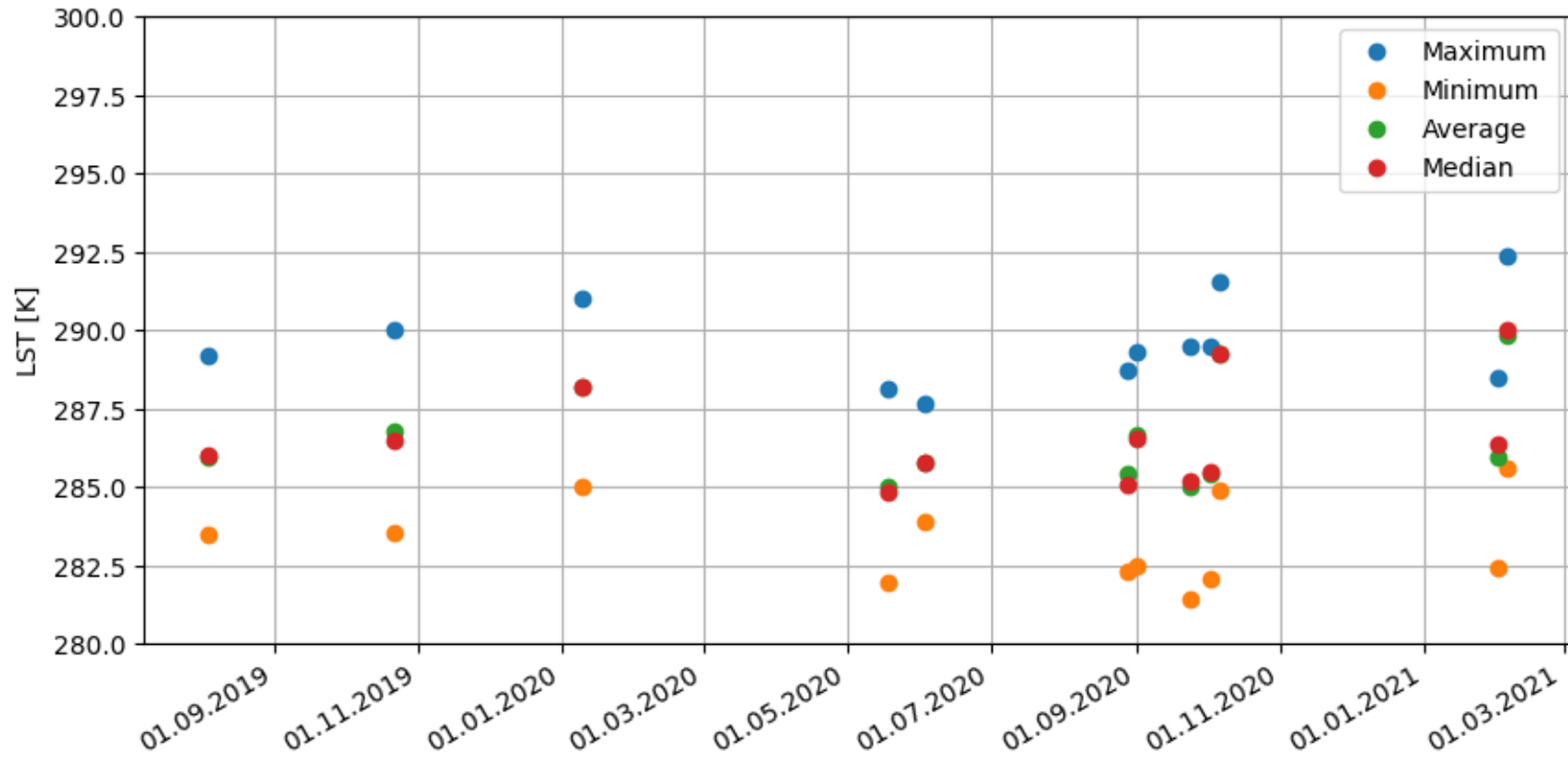


1. Chose a 25x25 pixels window
2. Calculate median for the window
3. Subtract median from the whole window
4. Mark pixels exceeding given threshold
5. Sum detections from many images

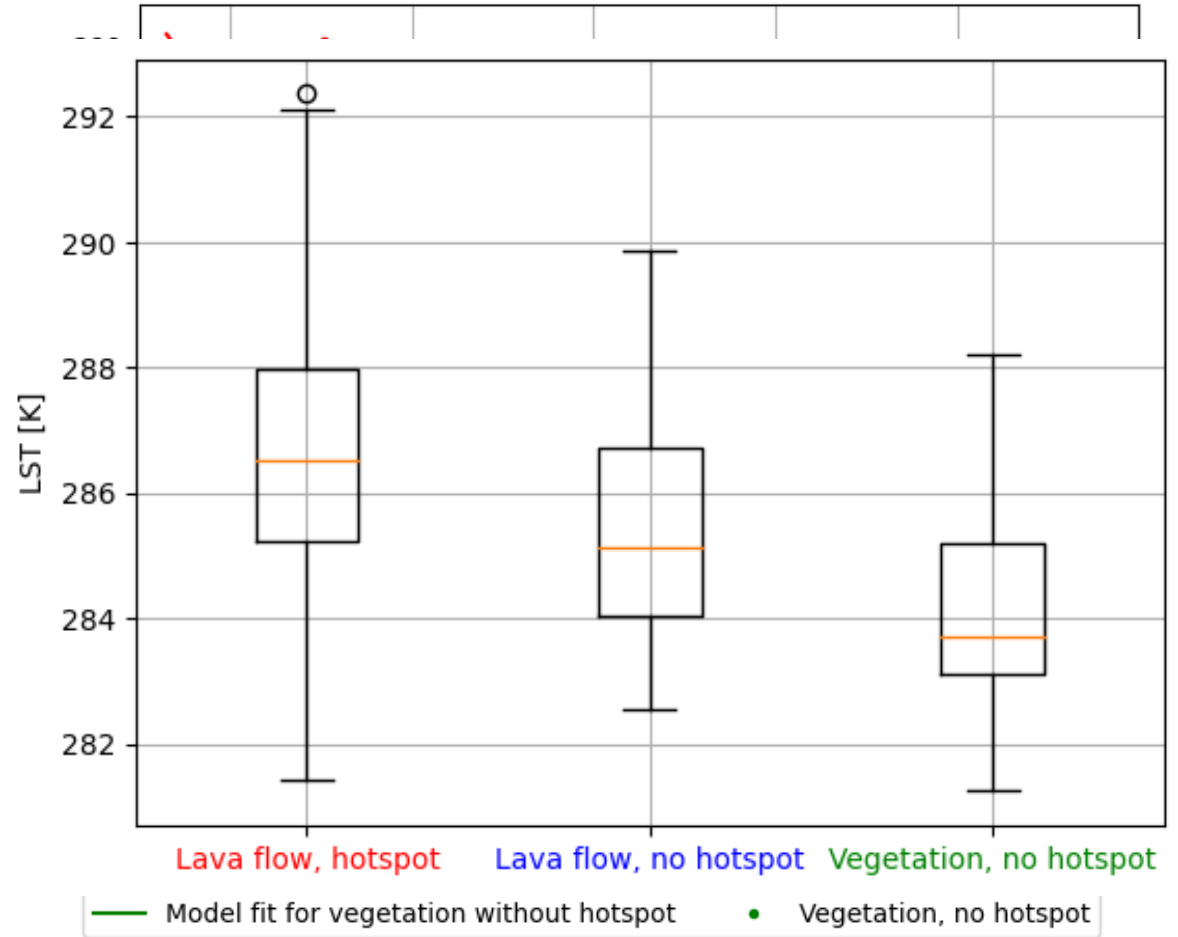
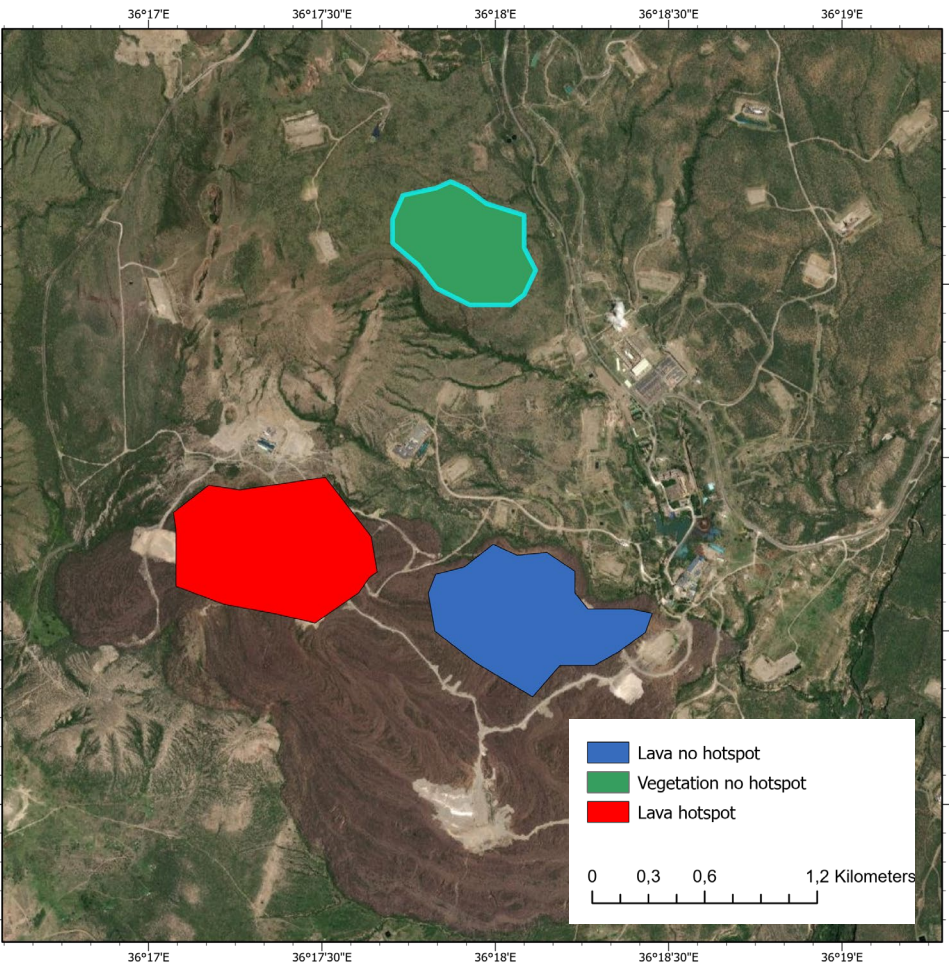
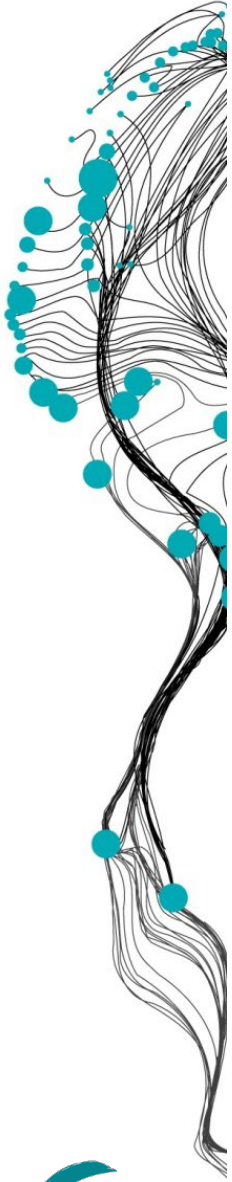
RESULTS, MAP OF HOTSPOTS DETECTED IN NIGHT ECOSTRESS IMAGES



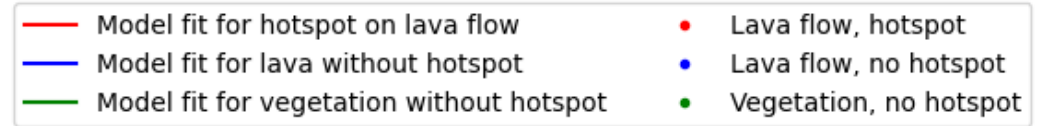
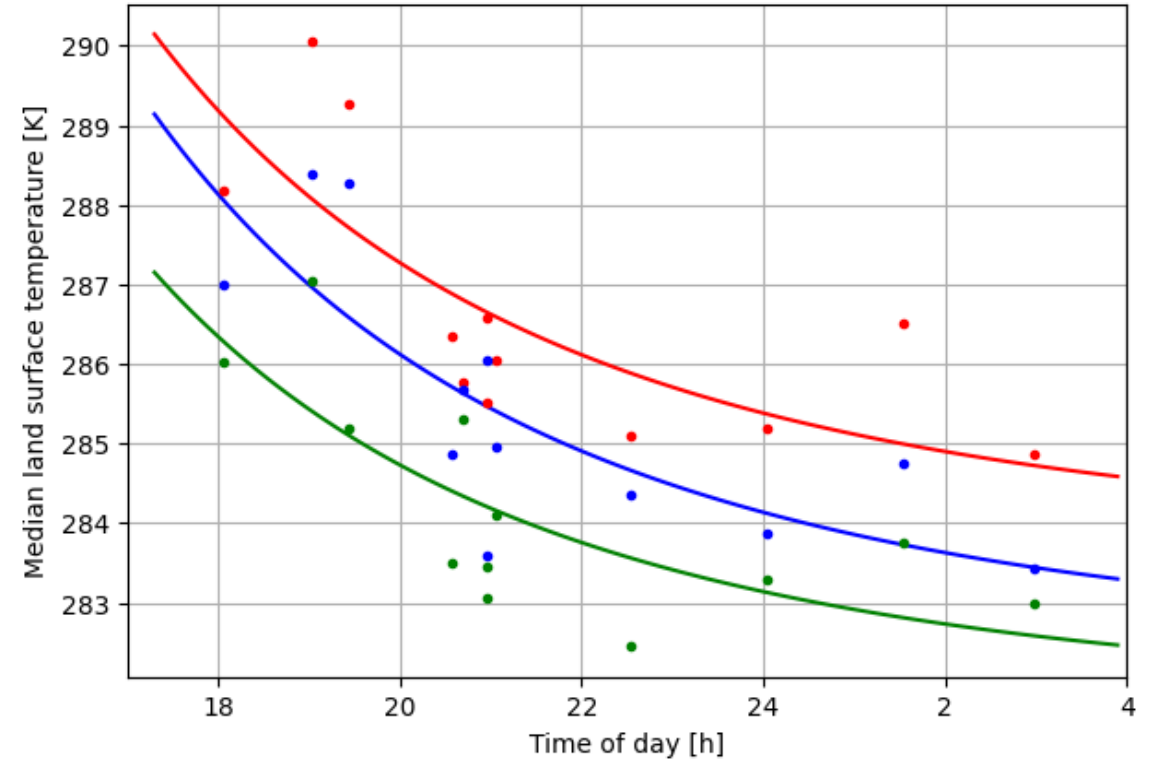
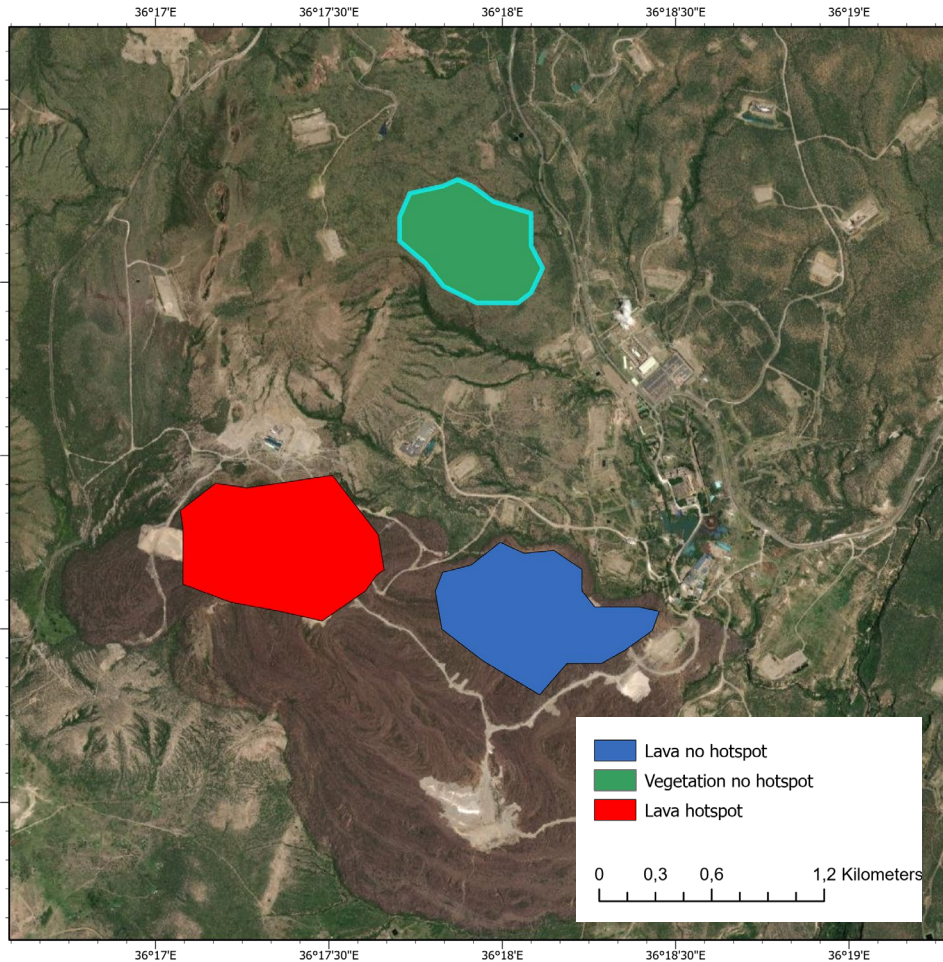
RESULTS, LST STATISTICS FOR THE LAVA HOTSPOT



RESULTS, COMPARISON OF GT AND NON-GT AREAS



RESULTS, COMPARISON OF GT AND NON-GT AREAS



FIELD WORK PLANNING

Temperature measurement

- 60 temperature loggers
- buried at 20 cm depth
- 2 weeks measurement time
- 15 minute interval

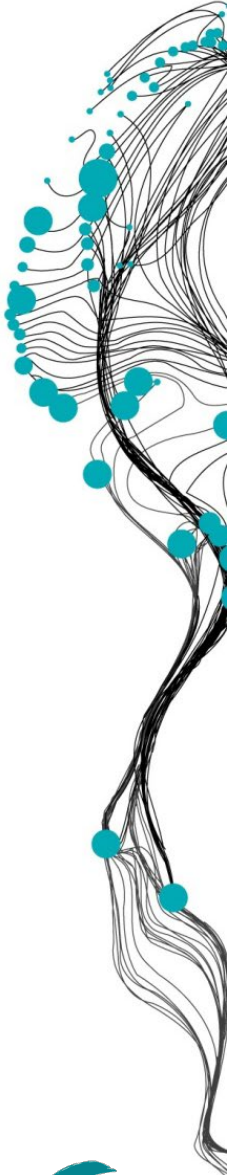
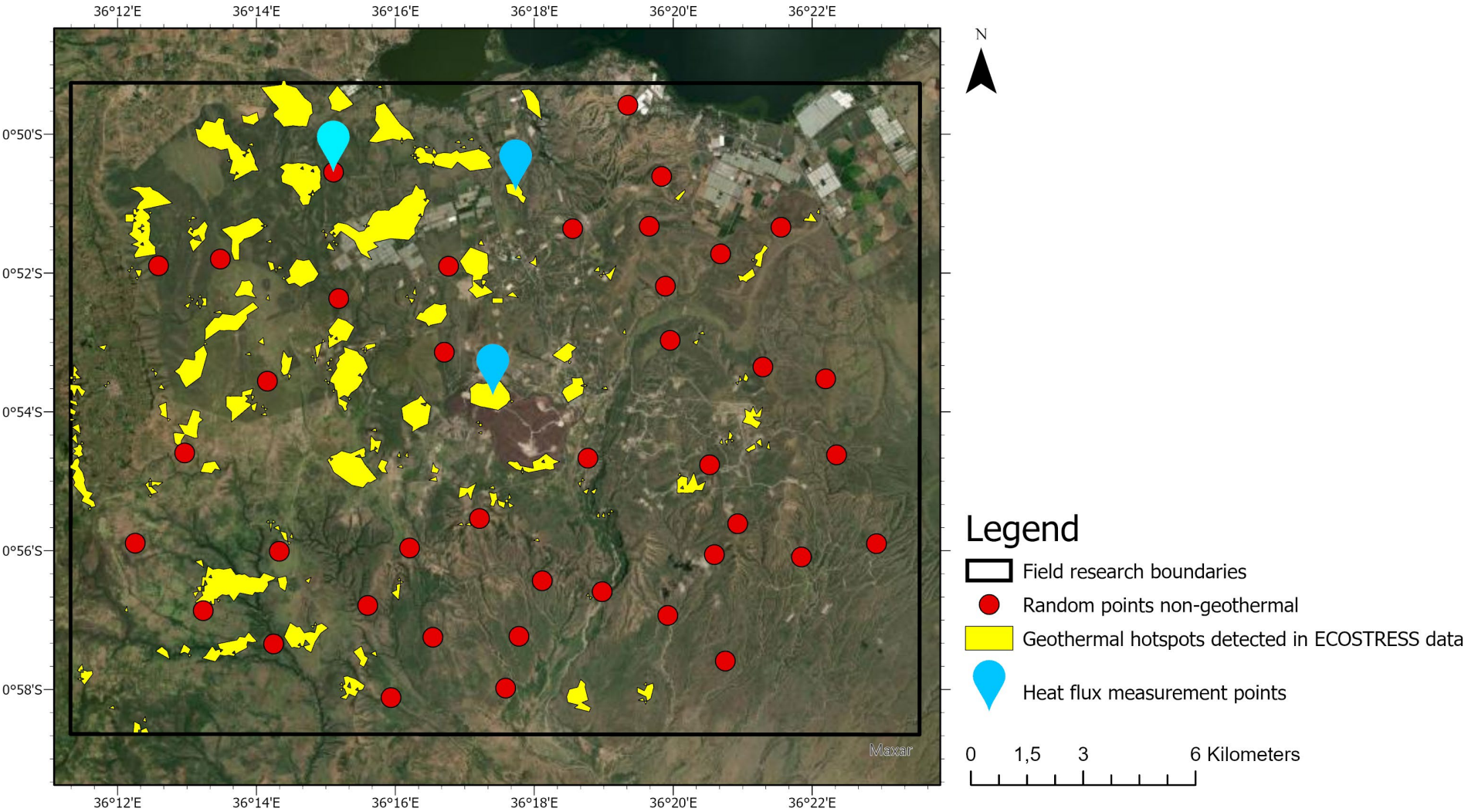


Heat flux measurement

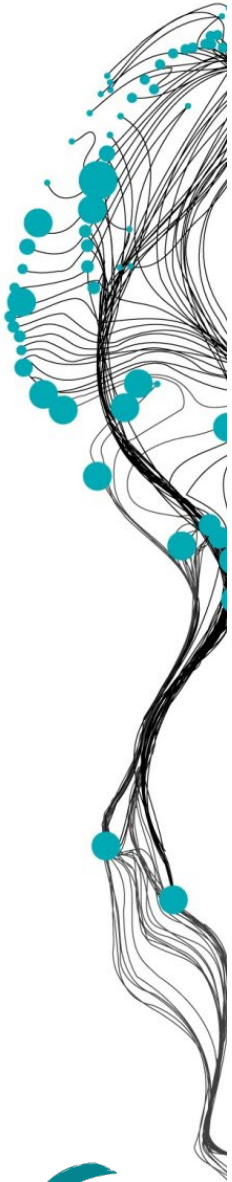
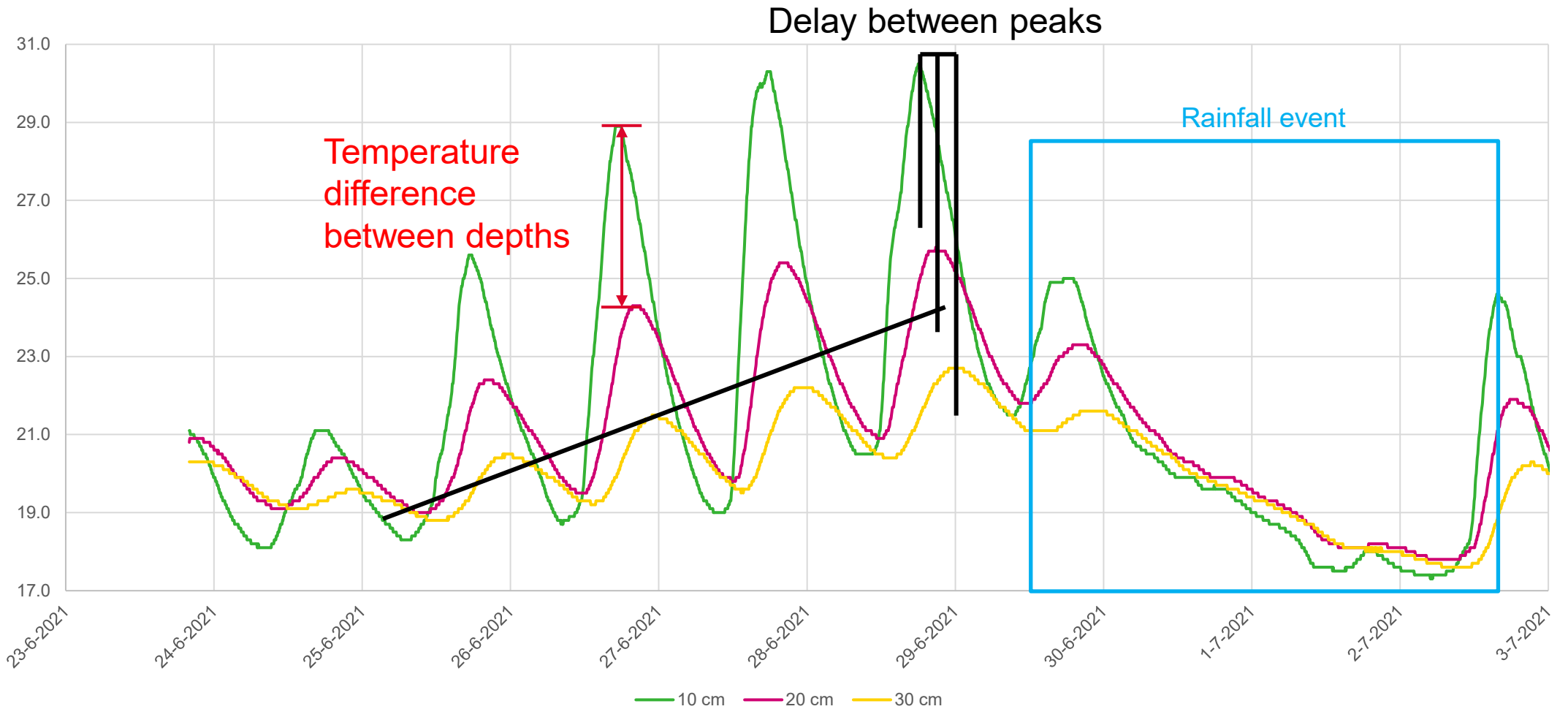
- 3 heat flux plates:
 - at strong geothermal hotspot
 - at weak geothermal hotspot
 - at non-geothermal area
- buried at 40 cm depth
- with a temperature logger above and below



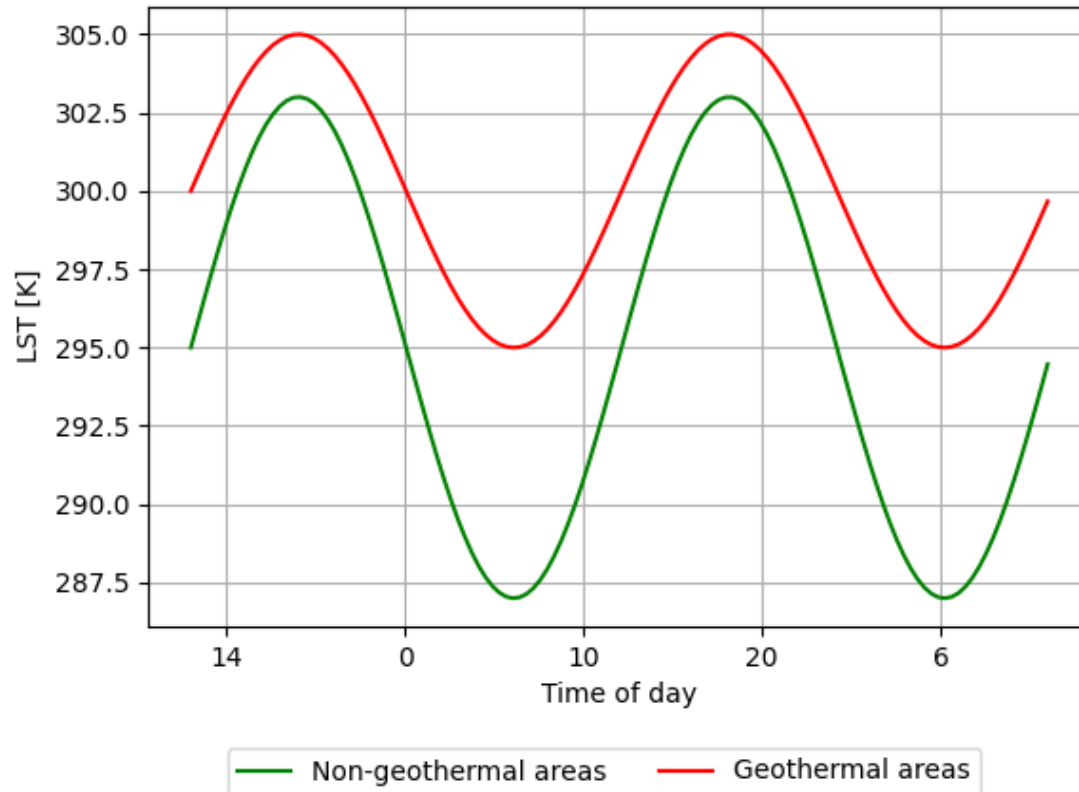
FIELD WORK PLANNING



EXPERIMENTS WITH TEMPERATURE LOGGERS



EXPECTATIONS ON THE MEASUREMENTS



What do we expect:

- Overall temperature is higher
- The minimum temperature is higher
- The amplitude is lower



SUMMARY AND NEXT STEPS

- Preliminary analysis proves that we can detect geothermally active areas using ECOSTRESS data
- The most suitable time of day to detect the geothermal hotspots is shortly before the sunrise
- Further analysis of the ECOSTRESS data
- Analyse the influence of the land cover on the detections
- Analyse the weather influence on the detections
- Prepare and conduct field work

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Presentation from
December 2020