INVESTIGATING DYNAMIC THERMAL PROCESSES TO OPTIMIZE GEOTHERMAL HOTSPOT DETECTION

“USING ECOSTRESS TO EMPOWER THE ENERGY TRANSITION”

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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
DETECTING GEOTHERMAL ACTIVITY IN ECOSTRESS DATA
ACQUISITION TIME

Local time: 23:59

Local time: 05:59

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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

Method adapted from Zhang, 2004
RESULTS, MAP OF HOTSPOTS DETECTED IN NIGHT ECOSTRESS IMAGES
RESULTS, LST STATISTICS FOR THE LAVA HOTSPOT

![Graph showing LST statistics over time.](image-url)
RESULTS, COMPARISON OF GT AND NON-GT AREAS
RESULTS, COMPARISON OF GT AND NON-GT AREAS

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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

Temperature difference between depths

Delay between peaks

Rainfall event

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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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