Detection of geothermal anomalies using night-time spaceborne thermal data from ECOSTRESS sensor

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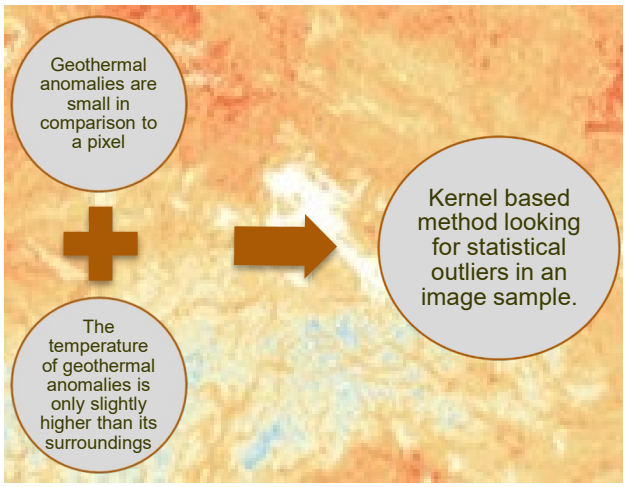
Introduction

Geothermal systems provide a renewable energy source that can be used throughout the day and night. Remote sensing techniques allow automated detection of areas having potential for geothermal energy production, expressed as Land Surface Temperature anomalies.
In our research, we decided to test the feasibility of using ECOSTRESS data for detection of geothermal surface temperature anomalies. The study was conducted in Olkaria region, Kenya, which is administered by KenGen, a company owning geothermal power plants in this area.

Spectral bands	8.3 µm, 8.6 µm, 9.1 µm, 10.6 µm, 12.1 µm
Spatial resolution	70 m
Revisit time	Variable, due to precessing orbit of the ISS
Products used	27 night-time Land Surface Temperature products

ECOSTRESS sensor on the International Space Station. Credits: NASA.

Challenges and method



To validate the results, we used data obtained during field research conducted in March 2022, as well as auxiliary layers (fumarole locations from geologic map and location of power plants) (see the figure on the right).

Results and sources of error in the anomaly map

Overall accuracy (geothermal and non-geothermal)	68%
Producer's accuracy (geothermal)	82%
User's accuracy (geothermal)	48%


Terrain features masking anomalies

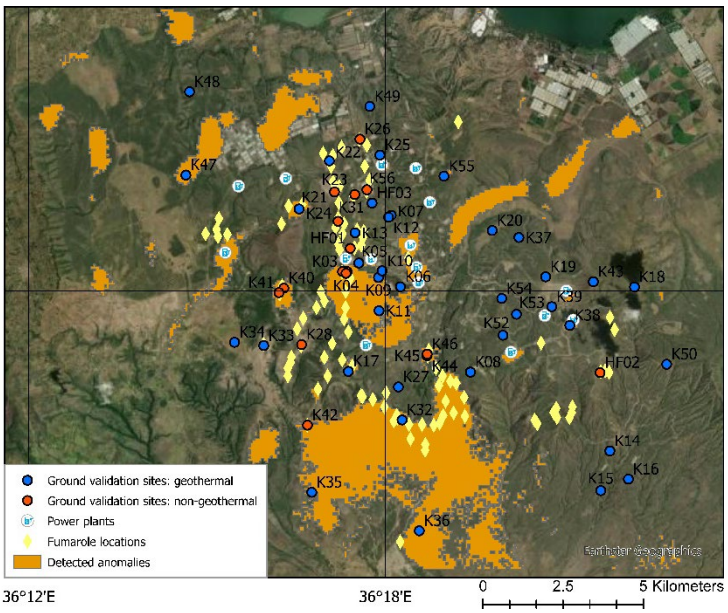

Weak temperature of the anomaly


Small size of the anomaly


High heat capacity of rock formations

Conclusions

We conclude that ECOSTRESS data has potential for use in early exploration of geothermal systems. Geothermal surface temperature anomalies are resolved and visible in ECOSTRESS Land Surface Temperature images, and we achieved 68% overall detection accuracy with night-time data. Next steps include analysis of different variables influencing detection accuracy, such as vegetation cover, terrain aspect, and time of acquisition.



Geothermal anomaly map and reference data.

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