

UNIVERSITY OF TWENTE.

# INVESTIGATING DYNAMIC THERMAL PROCESSES TO OPTIMIZE GEOTHERMAL HOTSPOT DETECTION

*“USING ECOSTRESS TO EMPOWER THE ENERGY TRANSITION”*

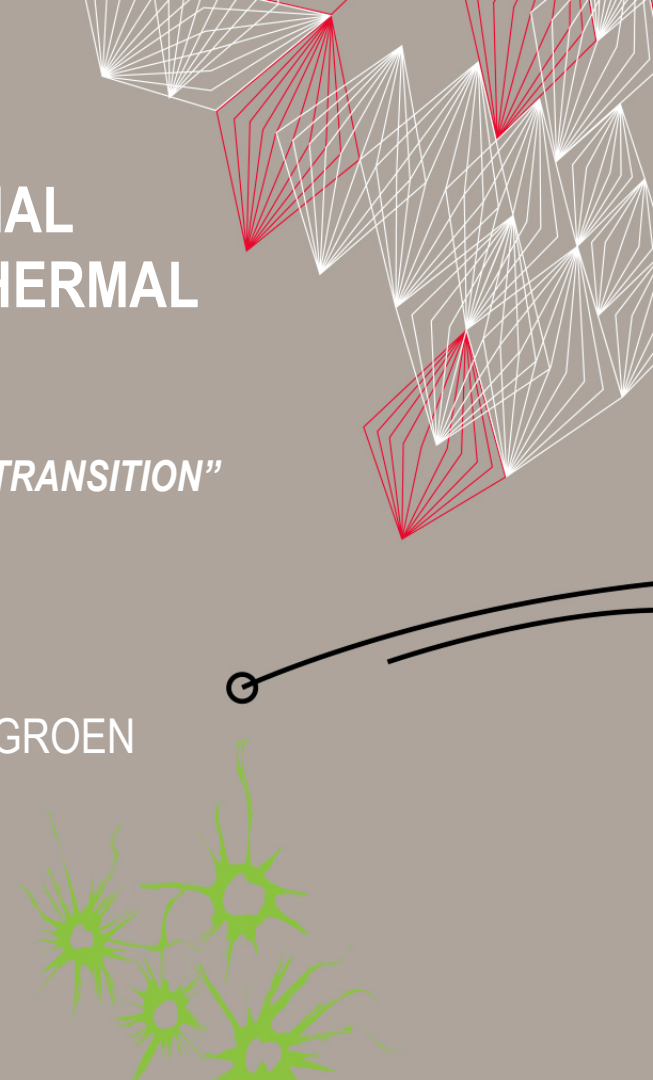
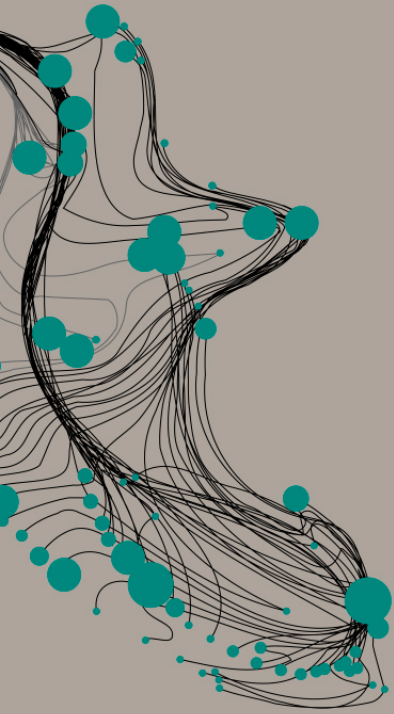
CHRIS HECKER, ROBERT HEWSON

ROBERT REEVES, EUNICE BONYO, THOMAS GROEN

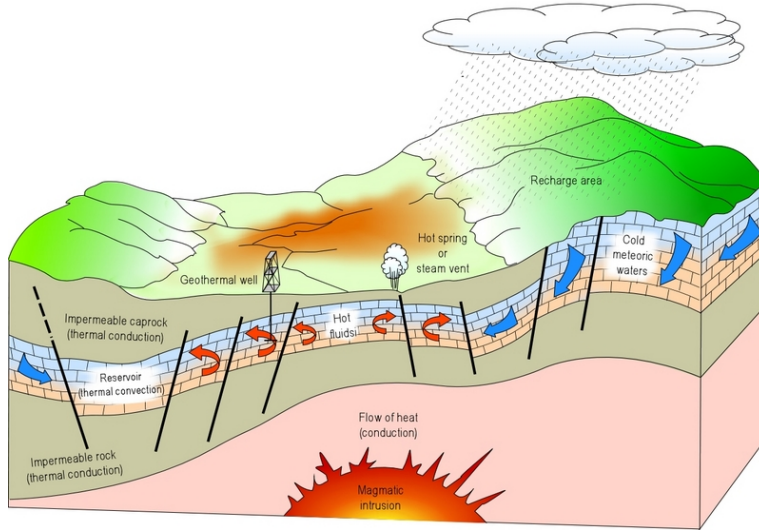
ECOSTRESS WORKSHOP DECEMBER 1, 2020



FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION



# GEOHERMAL SURFACE MANIFESTATIONS



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

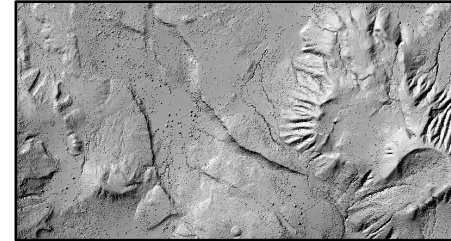
GT surface manifestations:

Clay alteration  
(SWIR hyperspectral)

Structures  
(LiDAR DEM)

Surface hotspots  
(TIR)

=> Starting point for detailed exploration



# ECOSTRESS TO THE RESCUE



- Ideal to test new approaches:
  - Precessing orbit (different acquisition times)
  - Diurnal time series
  - Suitable pixel size (<100m)
  - Swath
- Objective 1: Quantify effect overpass time on detections
- Objective 2: Optimize detections through use of time series



# STUDY AREAS

Three areas with ground information, airborne TIR surveys and ground-based fumarole monitoring.

Olkaria, KE

Mataloko, ID

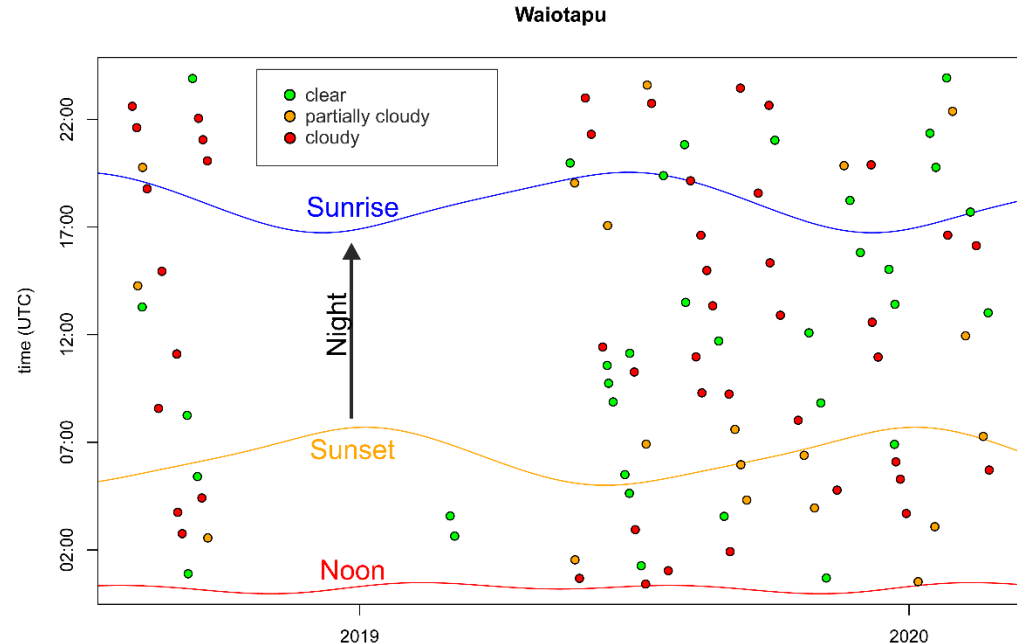
Waiotapu, NZ





# PROGRESS?

- COVID-19: Universities prioritize education
- Post-doc position funding (3 years; starting 2021)
- Study areas defined and acquiring data

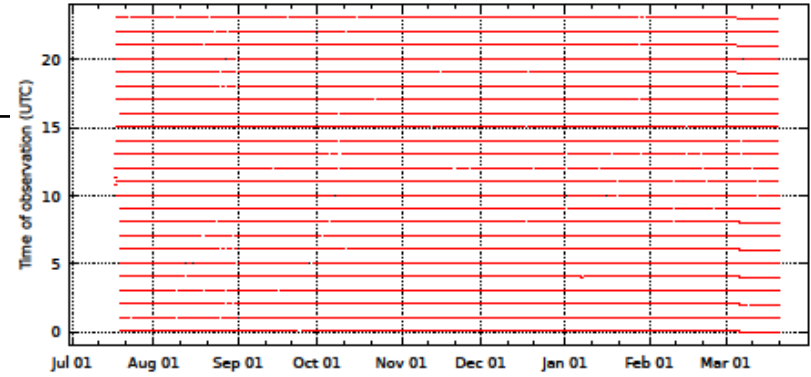


Example of acquired scenes for Waiotapu until March 7, 2020;  
their quality and relation to local sunrise/sunset

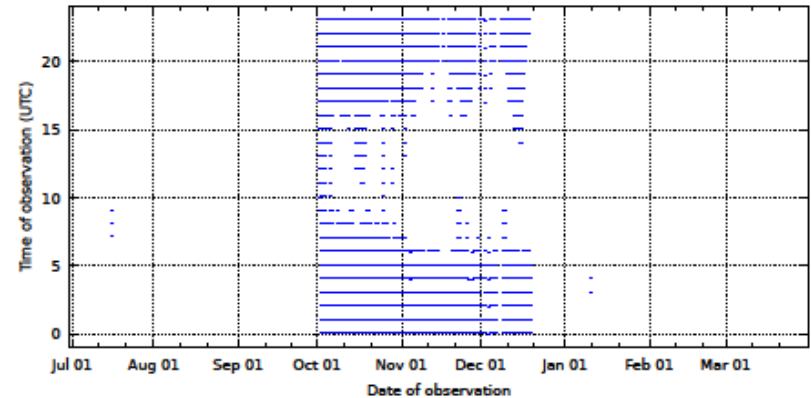
# FUMAROLE MONITORING



Remote fumarole monitoring without telemetry / without remote system health info



Working example



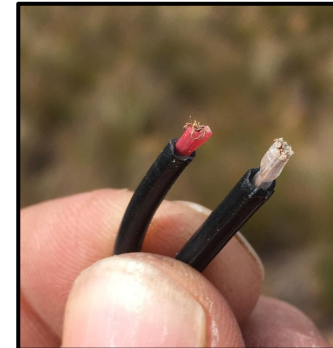
(intermittently) working example

# FUMAROLE MONITORING – HARDWARE UPGRADE



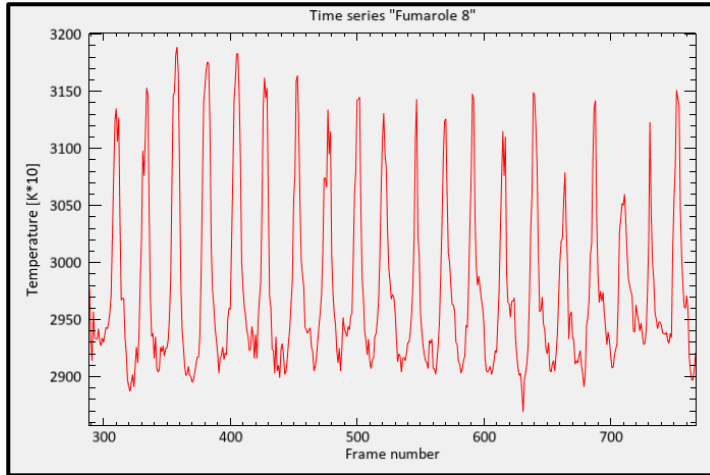
Upgraded control units prepared and shipped

On-site hardware upgrade done with the support from partner KenGen

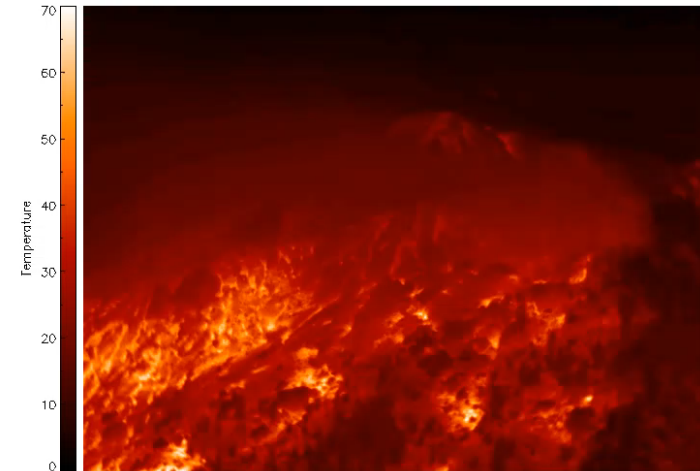




# FUMAROLE MONITORING – DATA COMING IN



Olkaria Fumarole 8: time series of single pixel



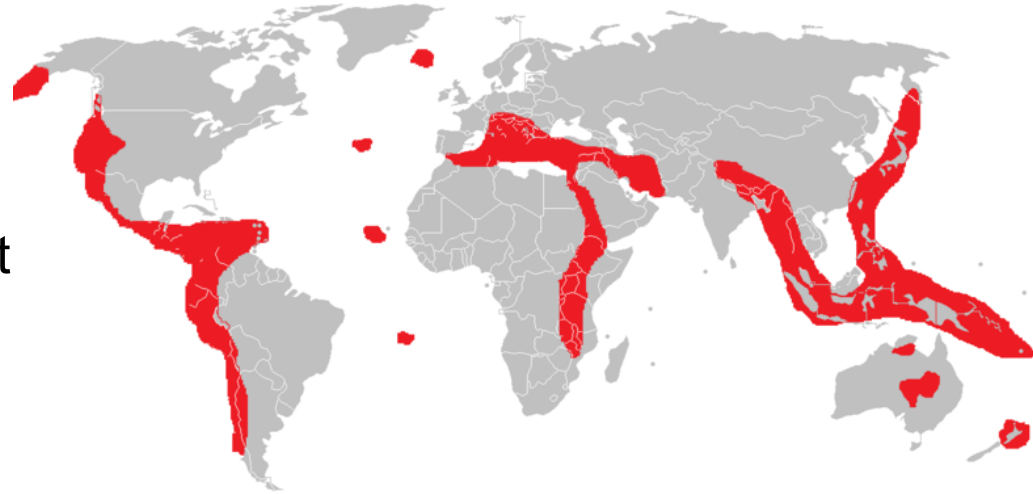
FLIR01-A655sc-20200801-000014

Olkaria Fumarole 8: first 3 days of 2020

MSc student Benard Omwenga working on data

# TO BE DISCUSSED

- Plan: rollout of results to (near-) global scale
- Needed: acquisition of sufficient (night) data until end of mission
- Question: is it feasible?



Global distribution of high enthalpy geothermal energy potential

Source: [energyeducation.ca](http://energyeducation.ca)

## SPIN-OFF: THERMAL INERTIA

## Study areas

- Namibia – Haib & **Omaheke** areas

## Aim

- investigate the **surface and sub-surface geological influences** on multi-temporal thermal acquisitions

## Methodology :

- **Compare changes in surface temperature** with time over different outcropping and sub-surface geology.
- Calculate the Apparent Thermal Inertia from **optimal and proximal day / night ECOSTRESS pairs** of surface temperature observations.

=> faults, outcrops, sand covered geology

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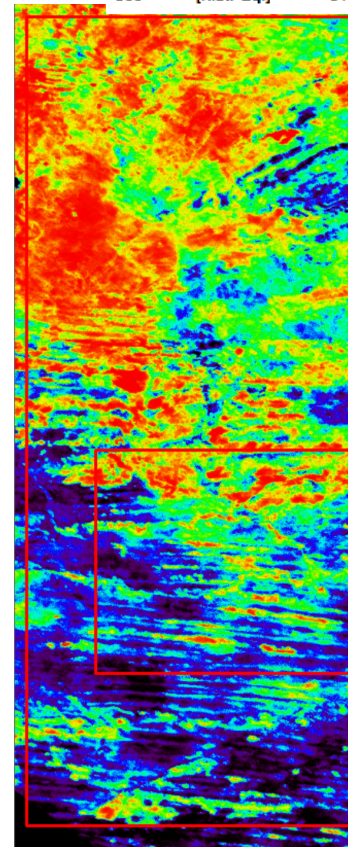
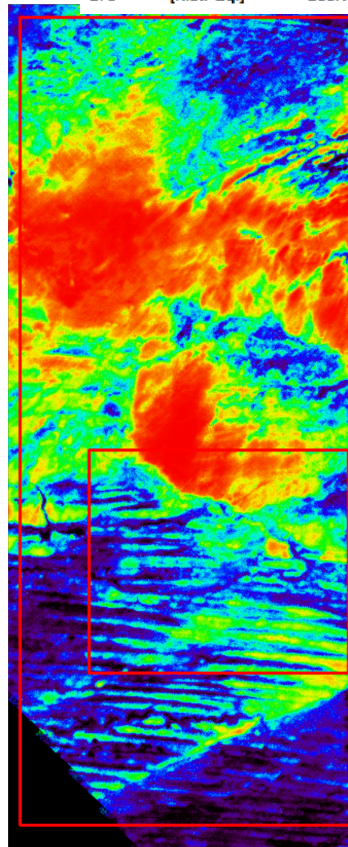
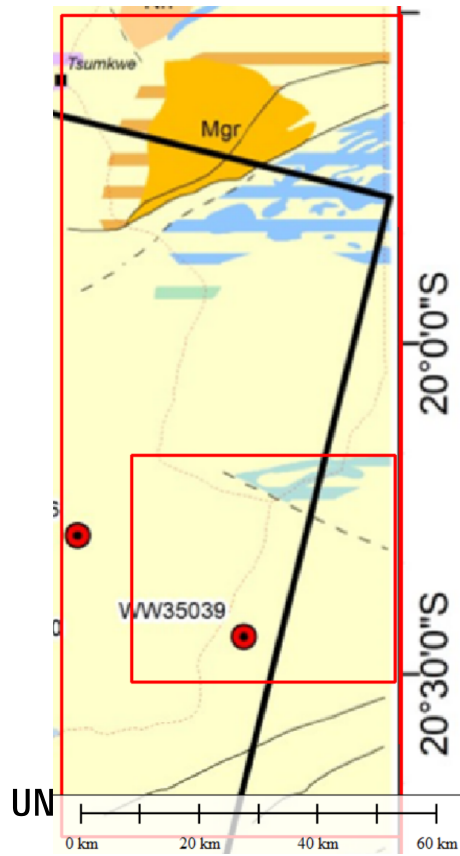




# Omaheke Geology

ECOSTRESS : 20190602T000142  
2 June 2019,  
Local time 02: 01 am

ECOSTRESS : 20190602T095220  
2 June 2019,  
Local time 11: 52 am

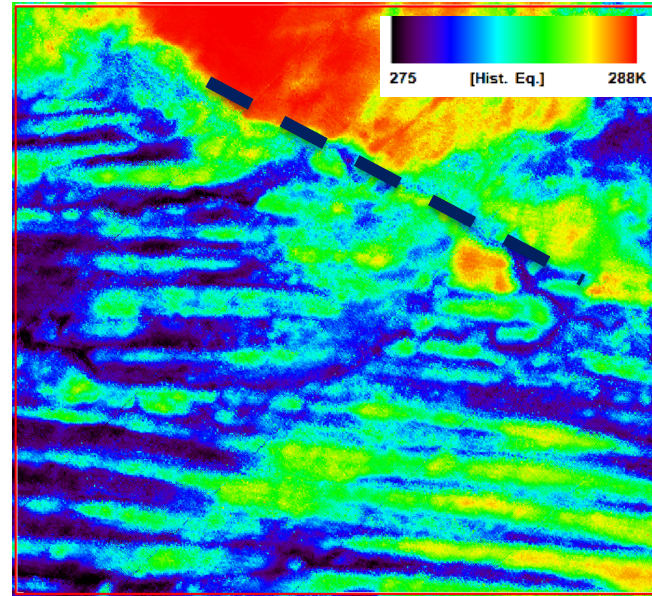


# SPIN-OFF: THERMAL INERTIA

Omaheke Geology



ECOSTRESS : 20190602T000142  
2 June 2019, Local time 02: 01 am



Result:

Give a glimpse at physical properties at shallow subsurface  
Link between surface rem sens and subsurface geophysics

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