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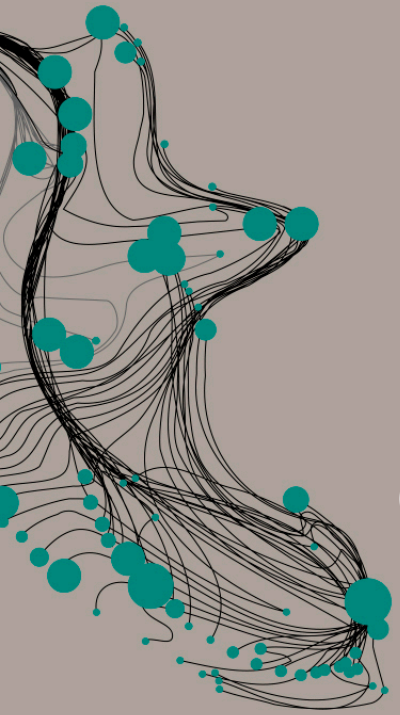

INVESTIGATING DYNAMIC THERMAL PROCESSES TO OPTIMIZE GEOTHERMAL HOTSPOT DETECTION

"USING ECOSTRESS TO EMPOWER THE ENERGY TRANSITION"

CHRIS HECKER, ROBERT HEWSON

ROBERT REEVES, EUNICE BONYO, THOMAS GROEN

ECOSTRESS WORKSHOP FEBRUARY 13, 2020

ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

EDUCATION IN A MULTICULTURAL ENVIRONMENT

UNIVERSITY OF TWENTE

- An entrepreneurial campus university established in 1961
- Over 10,000 students
- 3,300 staff members

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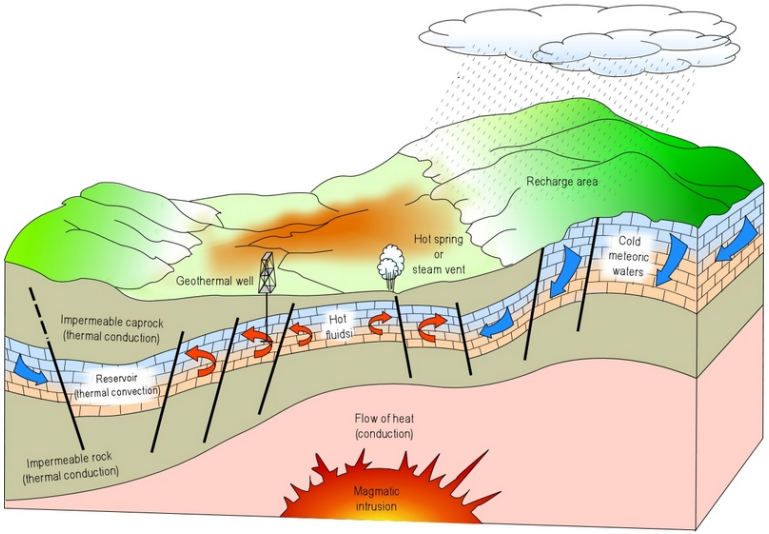
GEOTHERMAL SURFACE MANIFESTATIONS

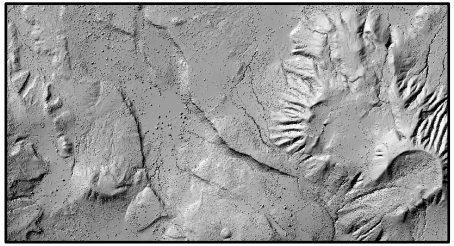


Conceptual geothermal system with steam extraction for electricity production and surface manifestations
source: Geothermal-energy.org

GT surface manifestations:

Clay alteration (SWIR hyperspectral)

Structures (LiDAR DEM)



Surface hotspots (TIR)

=> Starting point for detailed exploration

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ISSUES WITH STATE-OF-ART

- Spaceborne:
  - Size of anomalies small compared to pixel
  - Wrong overpass time
  - Effect of thermal inertia not captured

⇒ Anomalies due to insolation bigger than due to extra heat flux

⇒ Even at sunrise effect still measurable (Coolbaugh et al., 2007)

ECOSTRESS TO THE RESCUE

- Ideal to test new approaches:
  - Precessing orbit (different acquisition times)
  - Diurnal time series
  - Suitable pixel size (<100m)

  - O1: Quantify effect overpass time on detections
  - O2: Optimize detections through use of time series

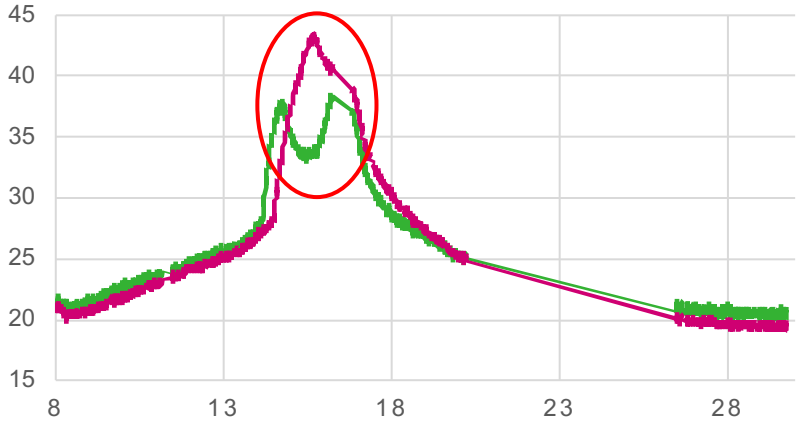
  - => proposed work: 3 steps with increasing complexity

STEP 1: FIND IDEAL TIMING

- Look at individual time slices
- Assess effect of overpass time on anomaly detection
  - Compare to airborne / ground data
  - Find optimal timing
  - Quantify what we miss at other times

STEP 2: SHORT TIME SERIES

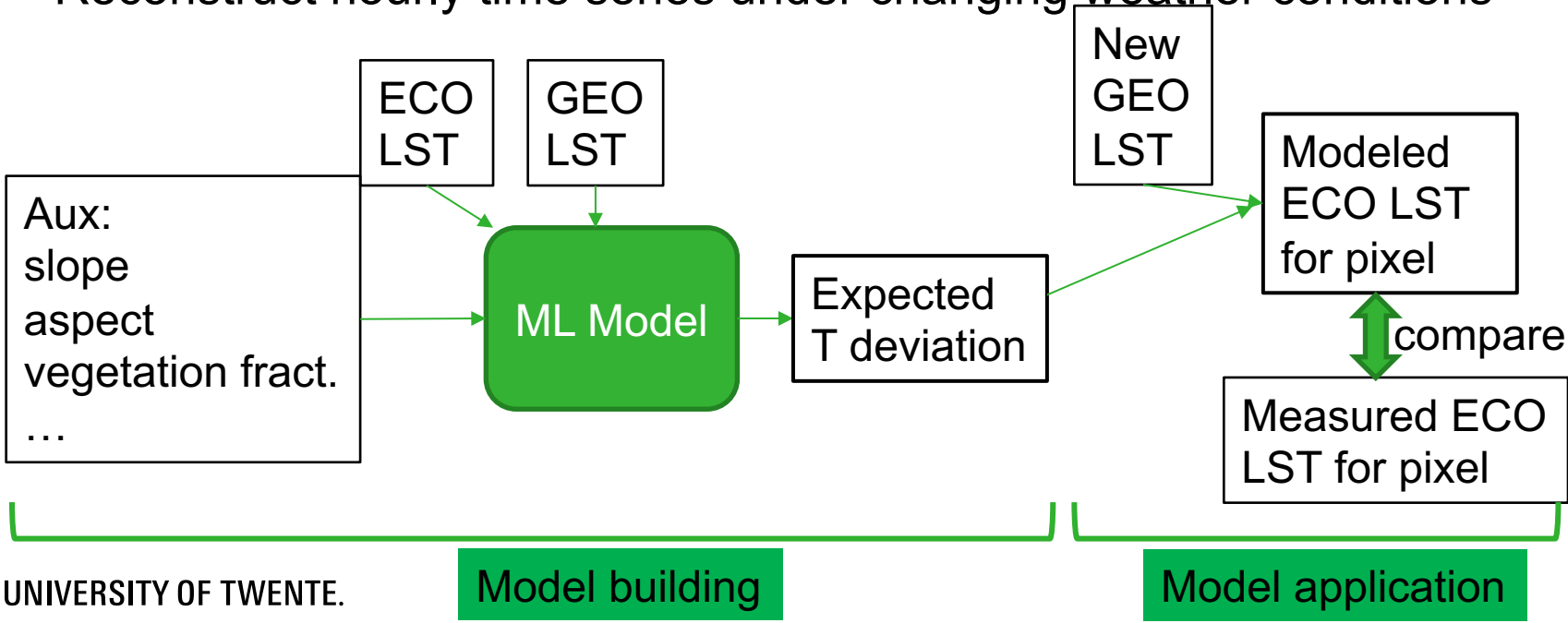
- Look at temperature decay after sun sets
- Short time series with stable conditions (day 1, 5, 9)
- Results independent of starting temperature and thermal inertia



Example from MSc Megerssa (2010) radiant temperatures of two rock faces:
Oval indicates influence of sun and shadow.
After sunset: more predictable behavior
(and some missing data)

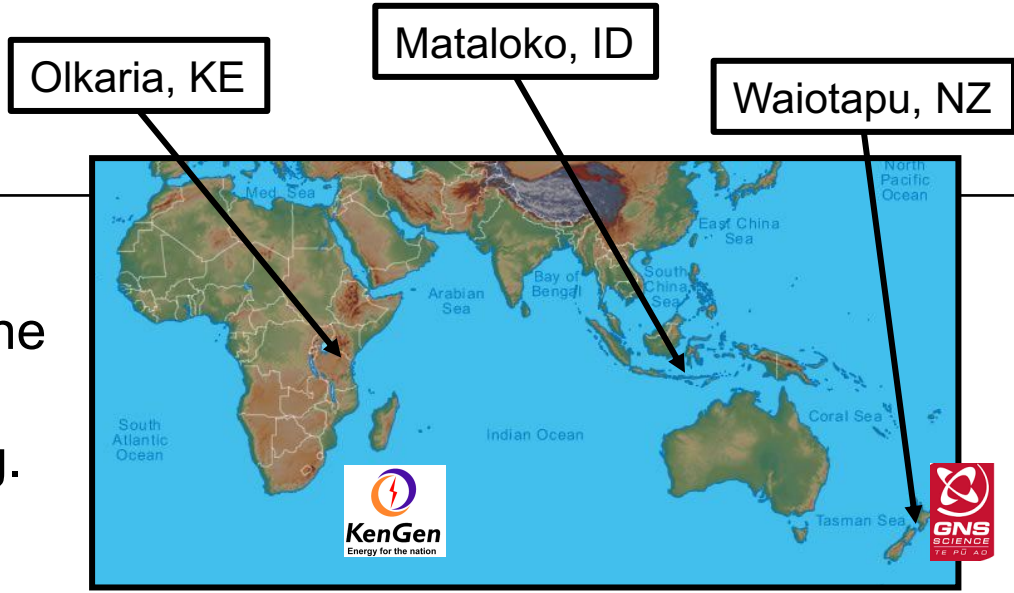
STEP 3: FUSION WITH GEOSTATIONARY

- Super-resolution image (high temporal, high spatial)
- Reconstruct hourly time series under changing weather conditions



STUDY AREAS

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



COLLABORATIONS WITH OTHER TEAMS?

- Possible collaborations with other ECOSTRESS research teams:
  - Best practice: reconstructing diurnal time series
  - Thermal inertia / heat capacity issues
  - Shared interest in particular study area (Kenya, Indonesia, New Zealand)

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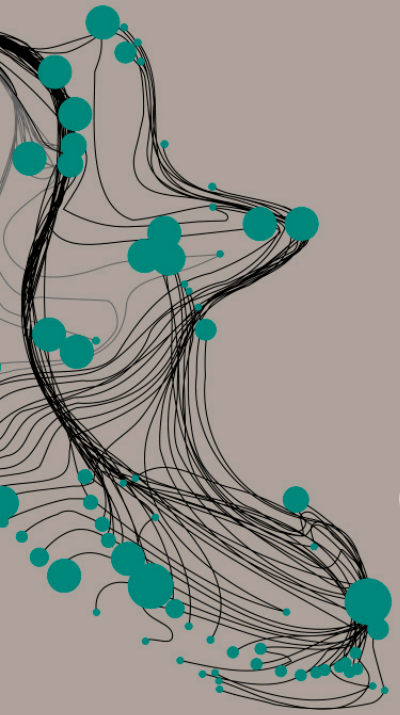

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