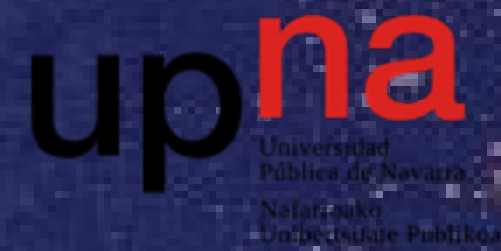


8th International
Conference on
BIG DATA
& Data Science for Official Statistics
BILBAO 2024

Analyzing climate change and health impacts with data science and alternative data sources :
Climate Change, Health and Vulnerable Groups

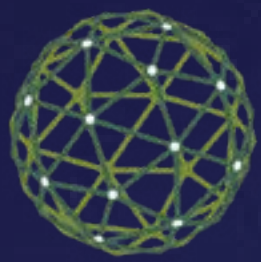
ASSESSING CLIMATE CHANGE INEQUALITIES AND HEALTH IMPACTS ON VULNERABLE POPULATIONS IN AFRICAN INFORMAL SETTLEMENTS

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angela.abascal@unavarra.es



SALLY SAMPSON, IGNACIO GARCIA RUIZ, JON WANG, STEFANOS GEORGANOS, SABINE VANHUYSSE & MONIKA KUFFER





■ **STUDY
AREA**

INFORMAL SETTLEMENTS IN SUBSAHARAN AFRICA CITIES

■ **PROBLEM**

**CLIMATE CHANGE & OTHER IMPACTS
ON VULNERABLE POPULATION**

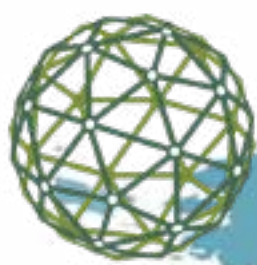
■ **RESEARCH
QUESTION**

**ASSESSING INTRA-URBAN INEQUALITIES
TOWARDS CLIMATE CHANGE IMPACTS**

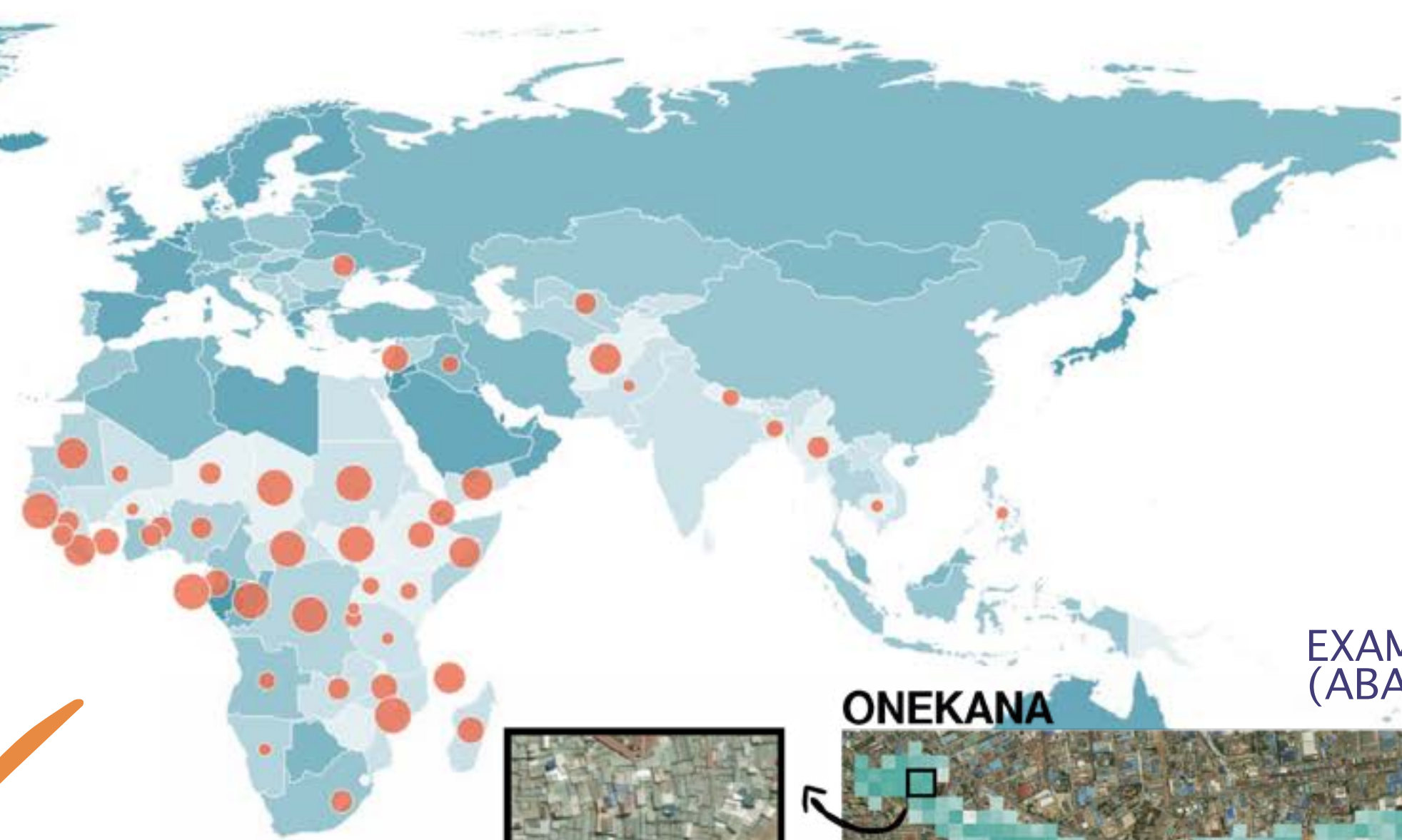
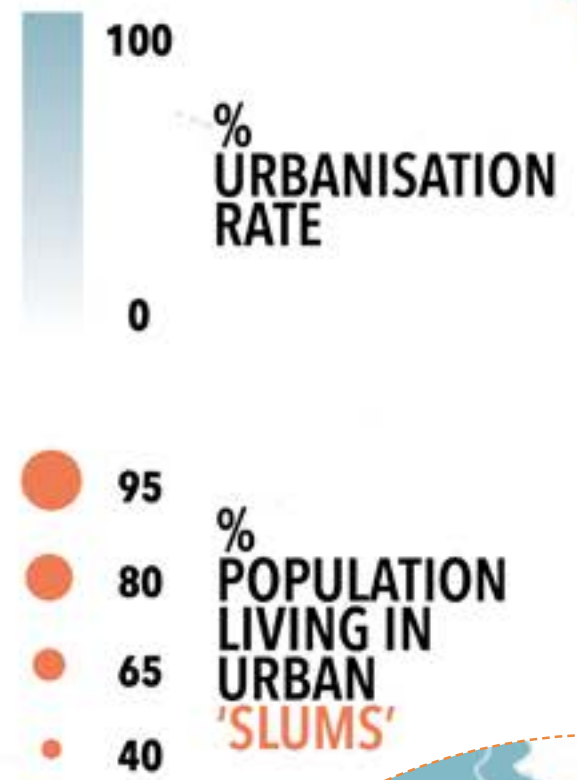
■ **METHODS**

REMOTE SENSING + AI + CITIZEN SCIENCE

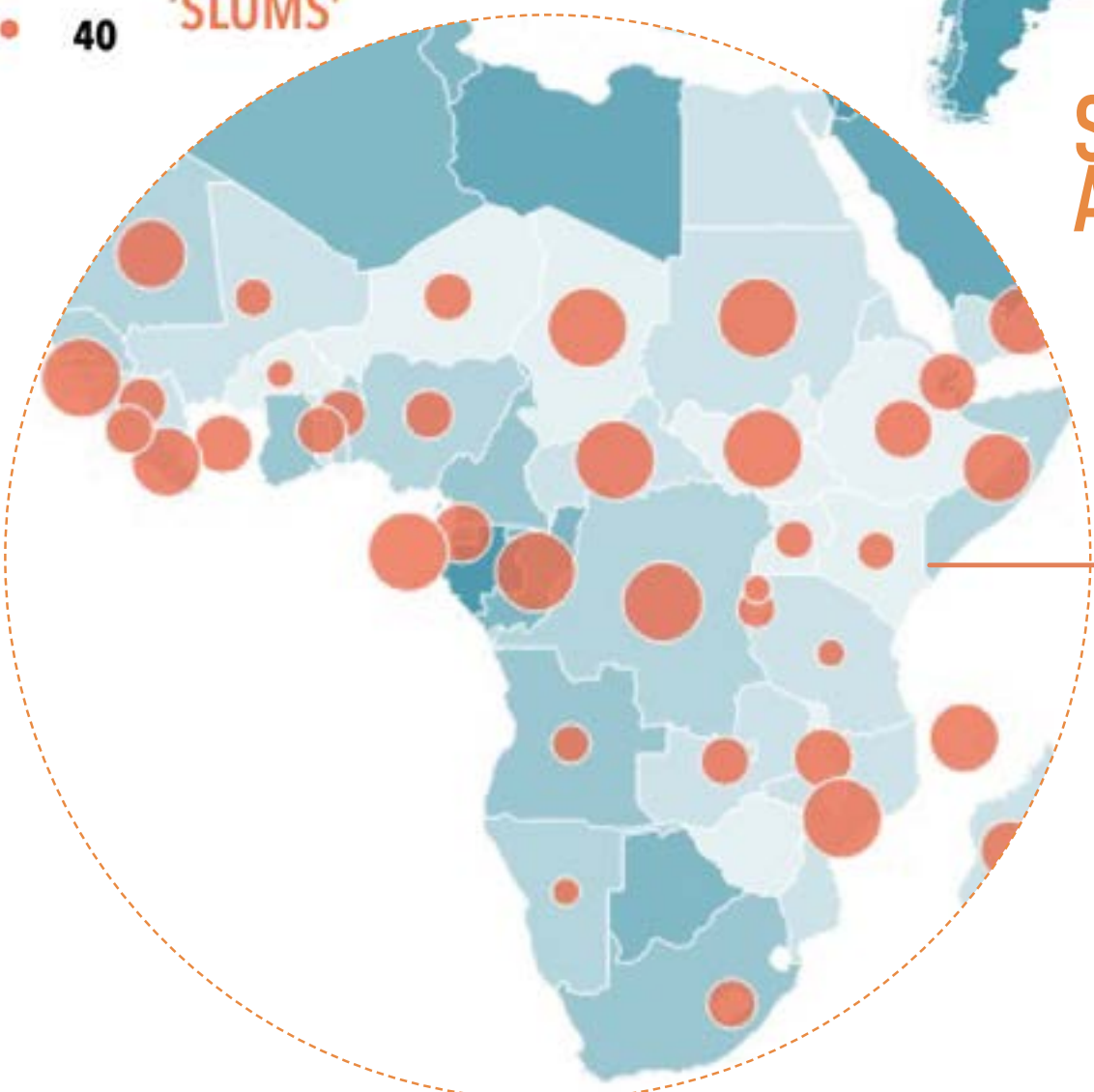
■ **RESULTS**



STUDY AREA



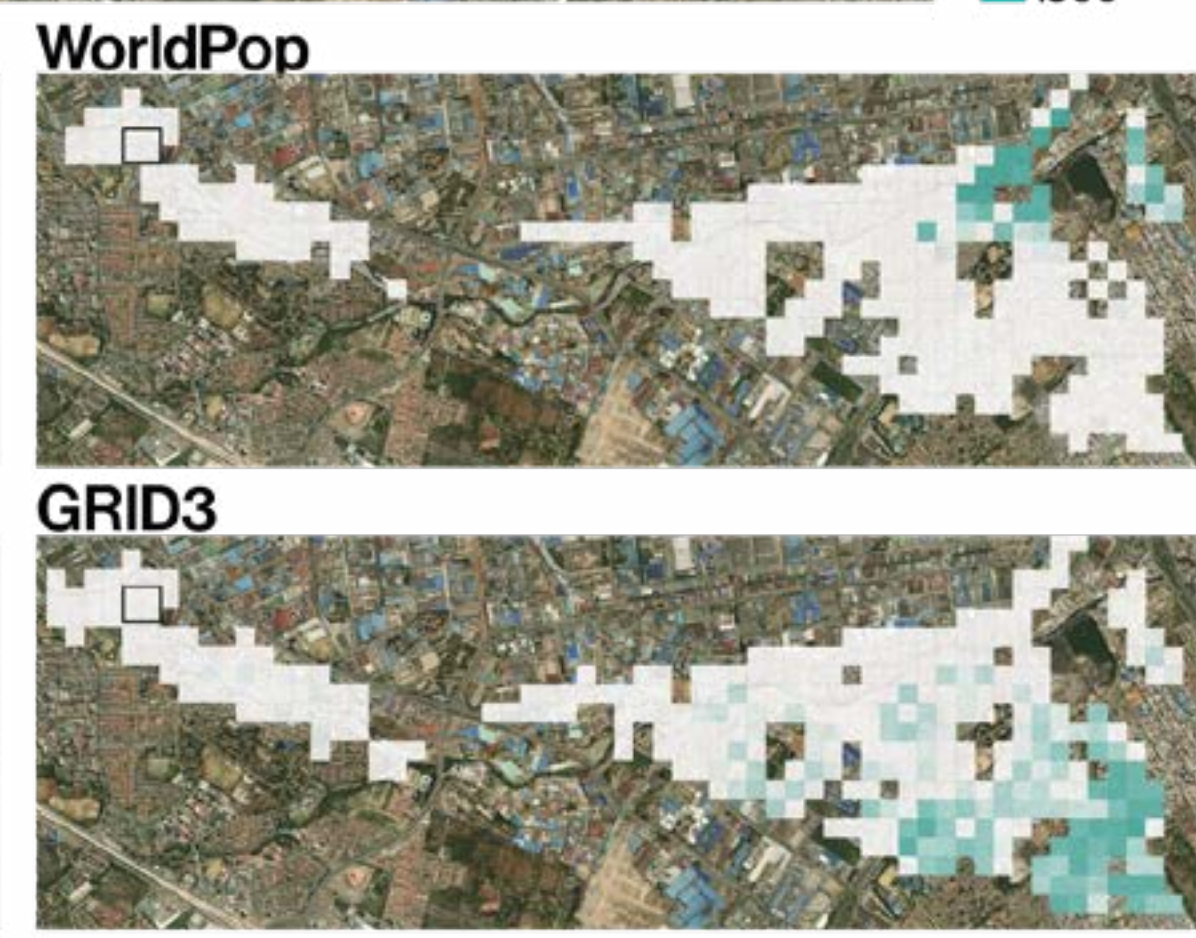
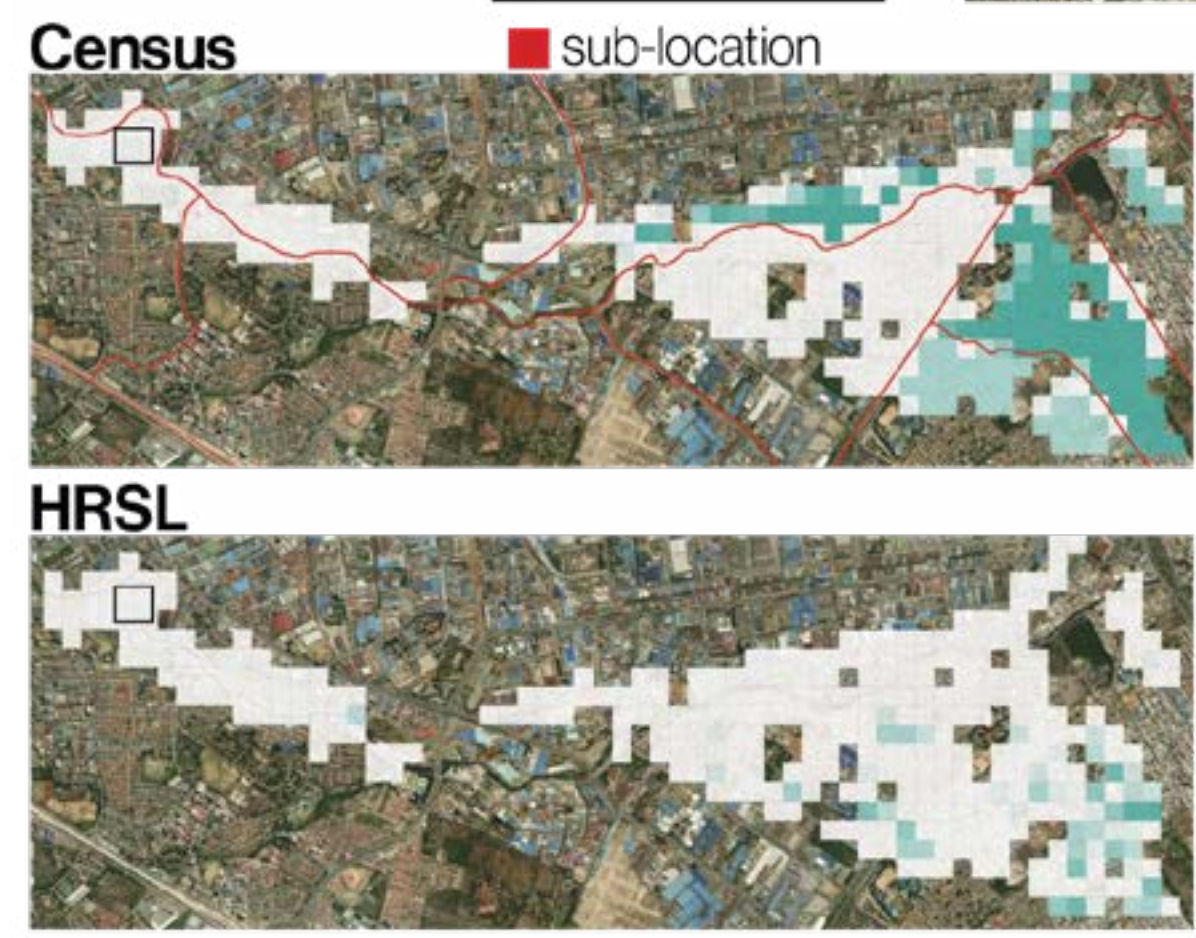
SUB-SAHARAN AFRICAN CITIES

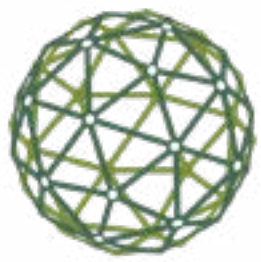


NAIROBI

UNDER-ESTIMATION BY 50% OF THE ACTUAL POPULATION

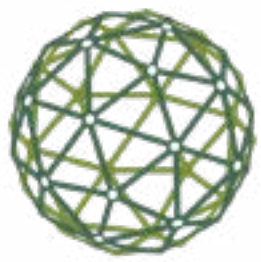
EXAMPLE 1
(ABASCAL ET AL., 2023)





PROXIMITY - DISTANCE BETWEEN BUILDINGS

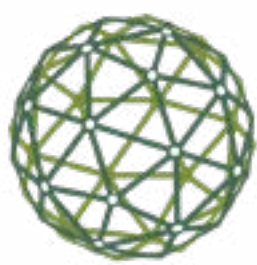
Descriptive Statistics	All grids	High Deprivation	Medium Deprivation	Low Deprivation
Min.	0.92	0.92 ●	1.07	6.95
1st Qu.	1.51	1.39	2.88	9.56
Median	2.18	1.80	3.39	12.17
Mean	2.93	2.02 ●	3.79	10.74 ●
3rd Qu.	3.37	2.38	4.62	12.64
Max	13.11	4.55	7.87	13.11



STUDY AREA

INTRA-URBAN DIVERSITY IN INFORMAL SETTLEMENTS



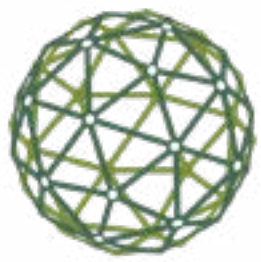


PROBLEM



They are more exposed to climate and other hazards like heat, flooding, pollution, fire, inadequate housing, health risks. They are acutely vulnerable and have limited capacity to cope.





PROBLEM




CLIMATE CHANGE

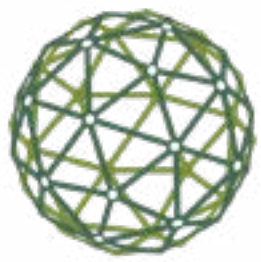
City-dwellers in **INFORMAL SETTLEMENTS** face daily significant challenges due to their living conditions.



They are more exposed to climate hazards like extreme heat. They are acutely vulnerable and have limited capacity to cope

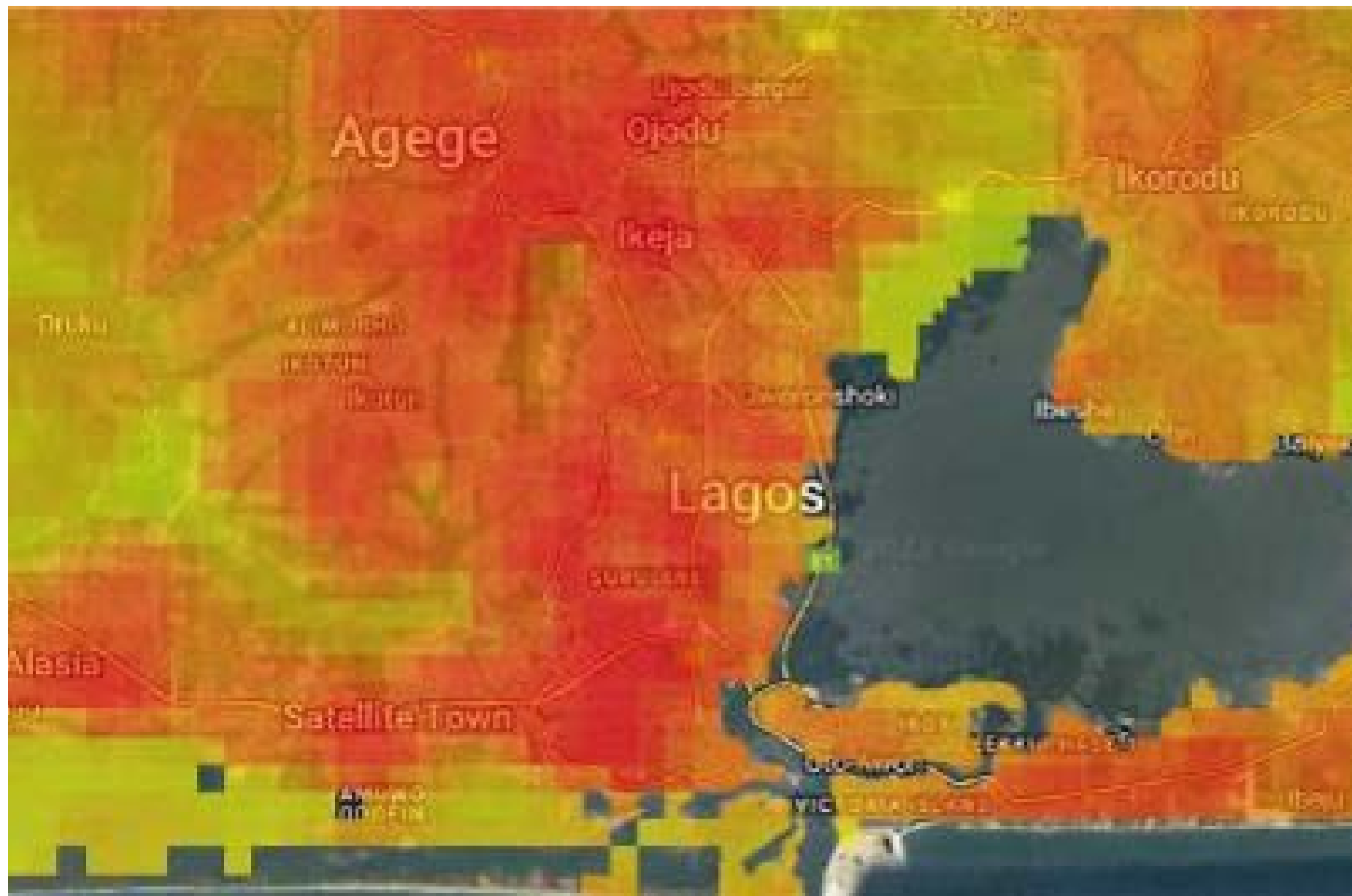


 The rate of surface temperature increase has generally been more rapid in Africa than the global average, with **human-induced** climate change being the dominant driver (*high confidence*).



PROBLEM

DATA GAPS



- Housing materials, such as roofing iron sheet
- Overcrowding



- Urban morphological patterns
 - * High built-up densities
 - * Irregular patterns that prevent ventilation

The **variability of heat exposure** and the **number of exposed vulnerable people** are absent from existing data, models and local dwellers' knowledge.

Example: **Thermal inequalities in SSA cities are invisible.**

- Increase in LST over the last decade (recent study)
- No distinction between formal and informal areas



Remote Sensing of Environment
Volume 280, October 2022, 113181



Evaluating global and regional land warming trends in the past decades with both MODIS and ERA5-Land land surface temperature data

~1km to 9km spatial resolution

You-Ren Wang^a, Dag O. Hessen^a, Bjørn H. Samset^b, Frode Stordal^a

PLANETA FUTURO >

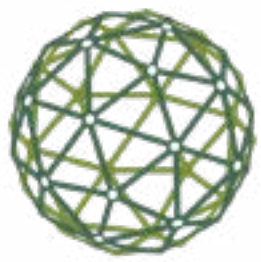
Huir del calor, un lujo que no todos se pueden permitir en Nairobi

En los barrios marginales, el hacinamiento, la falta de zonas verdes y la falta de medidas de adaptación condenan a los vecinos a pasar el día buscando sombra. Unos investigadores buscan evidencia científica para ofrecer soluciones baratas y eficientes ante el cambio climático



Dos vecinos del barrio de Korogocho sujetan el palo al que va atado un termómetro y un GPS con el que miden el calor. DAVID SOLER





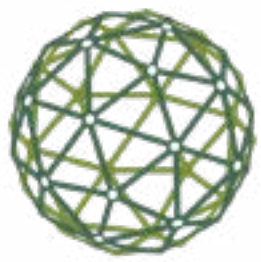
RESEARCH QUESTION



CITIZEN SCIENCE

REMOTE SENSING-BASED METODS

AIM Quantify the number and susceptibility of slum dwellers exposed to extreme heat



METHODS

REMOTE SENSING- ANALYSIS LST

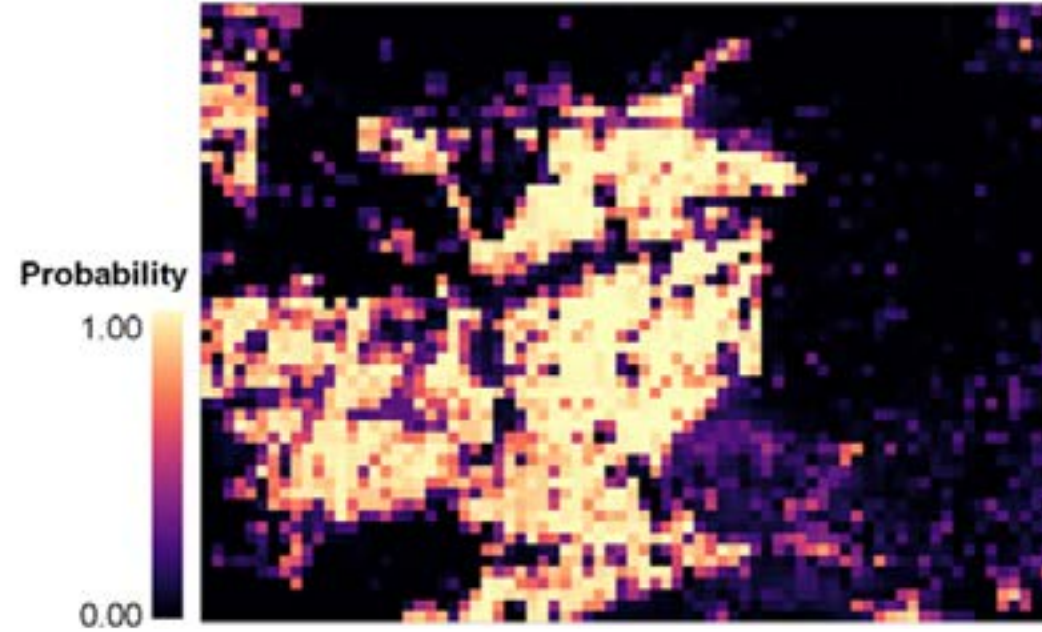


**WARUKU
KAWANGWARE**

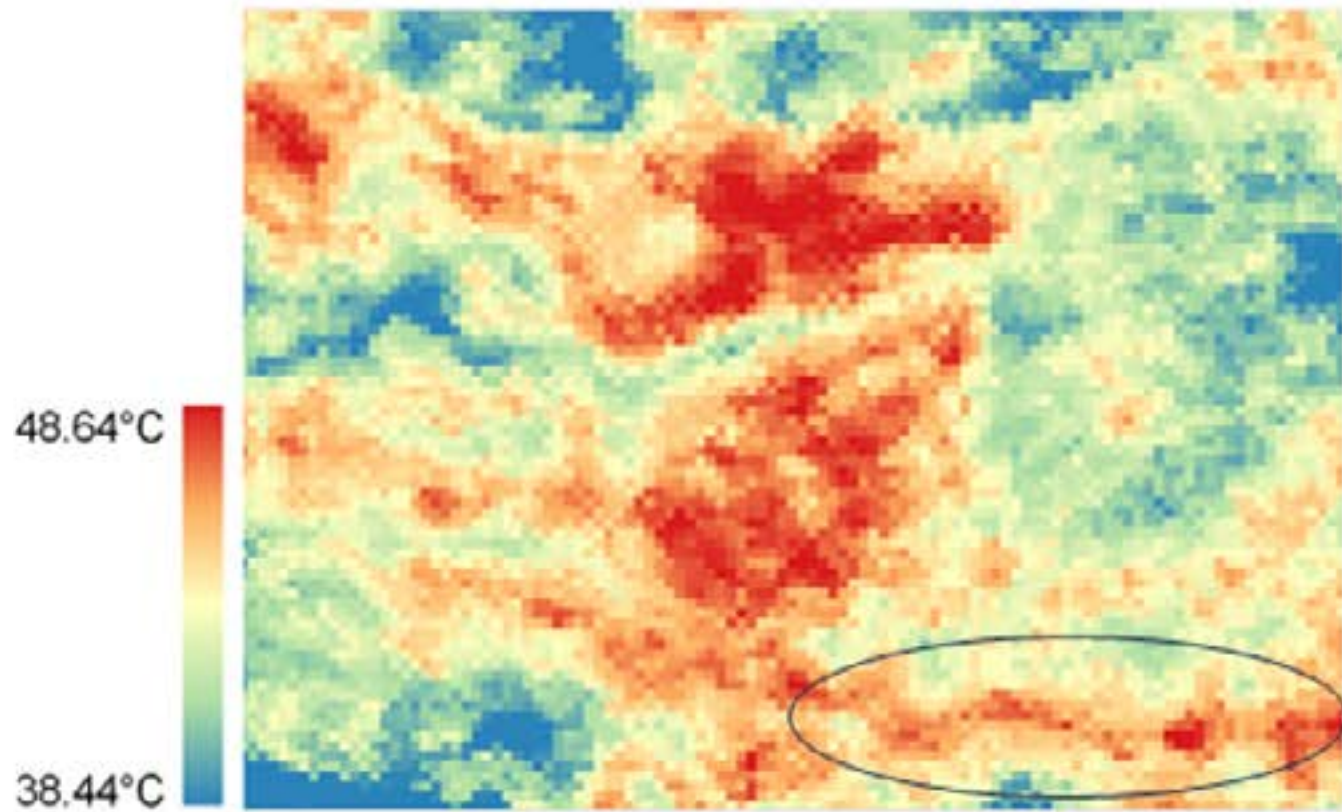
SENTINEL-2 RGB



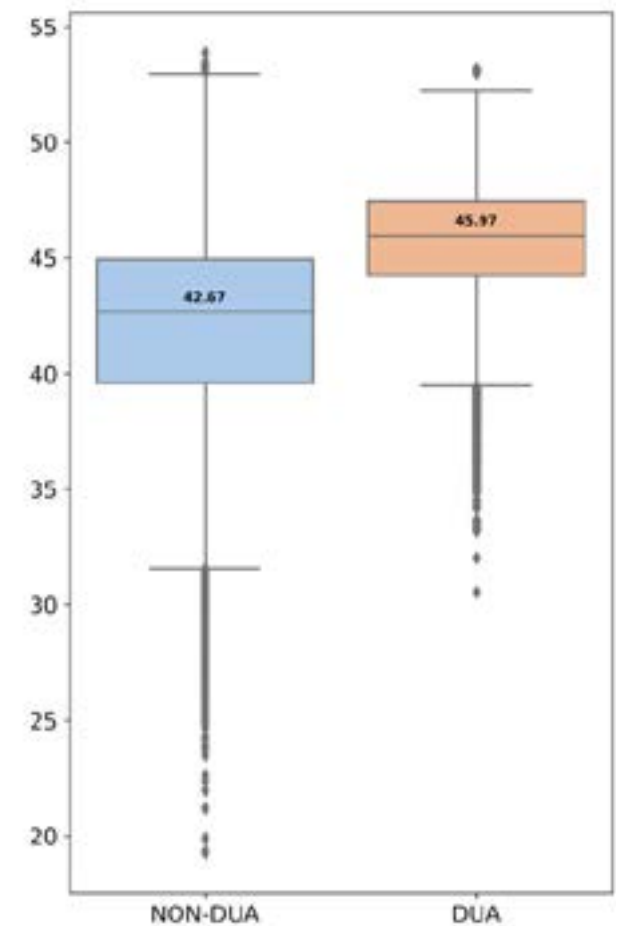
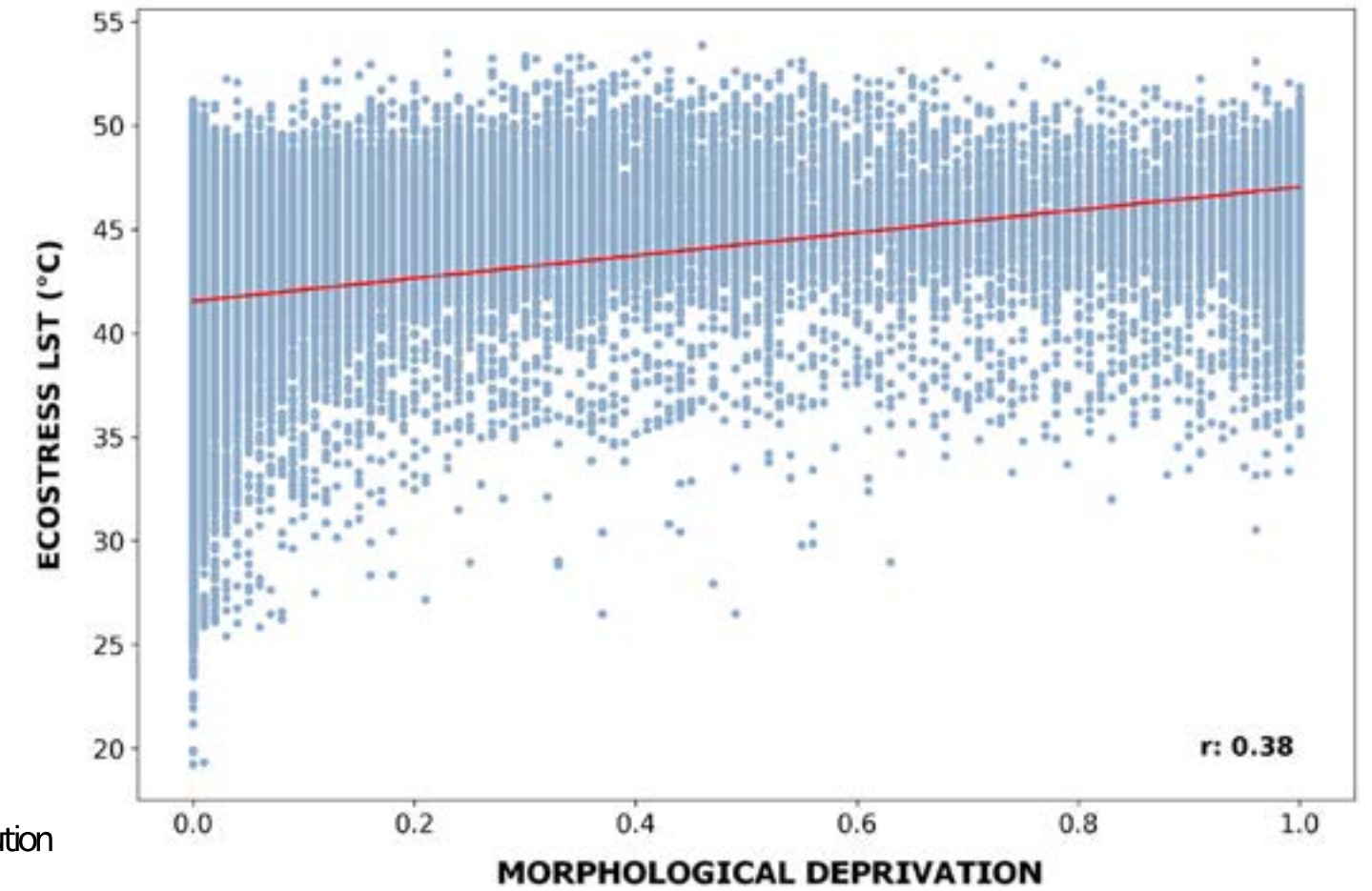
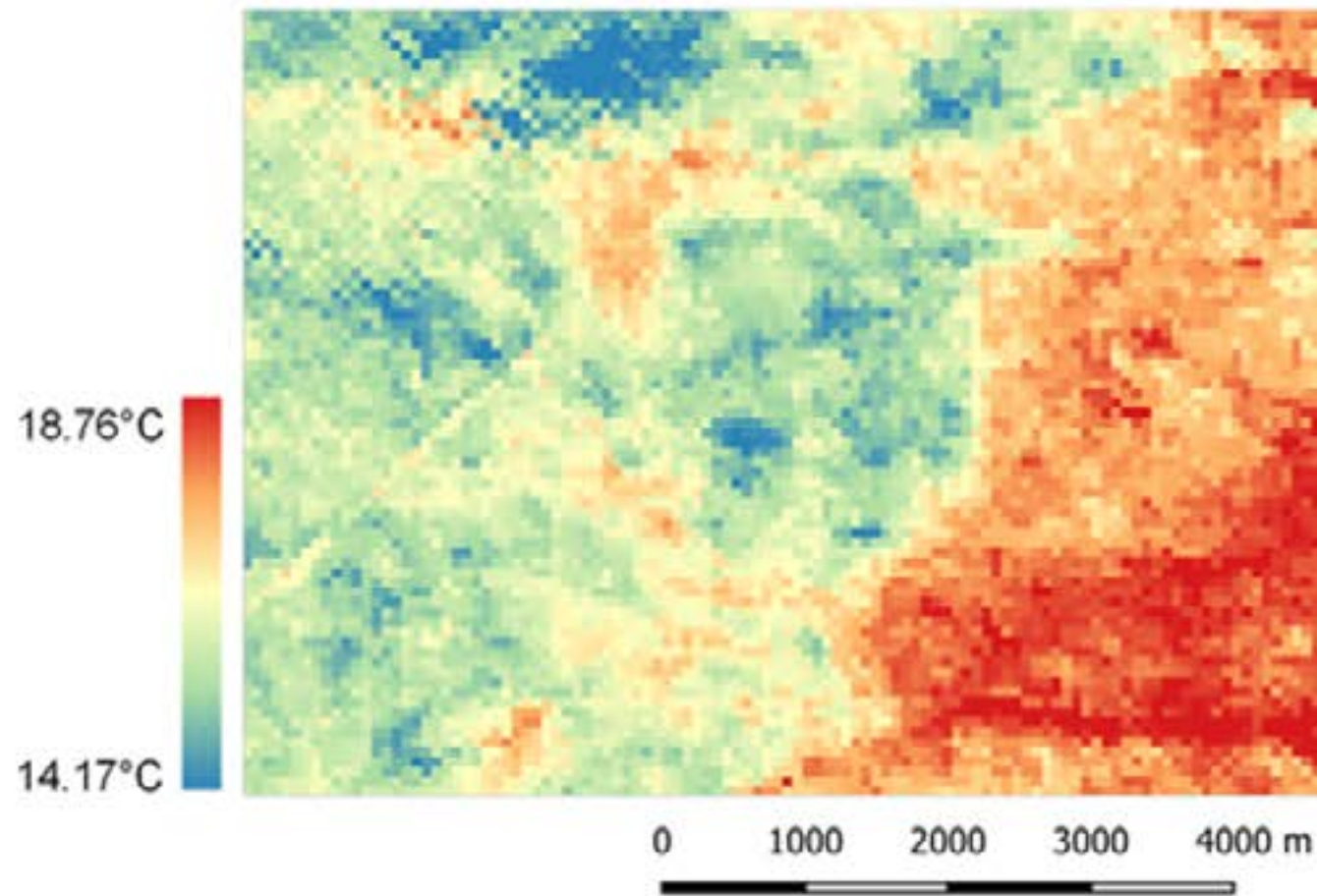
MORPHOLOGICAL DEPRIVATION



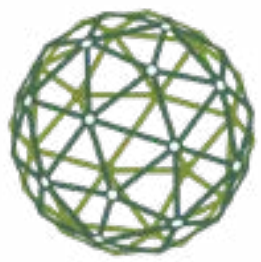
ECOSTRESS LST 28/02/2021 DAYTIME



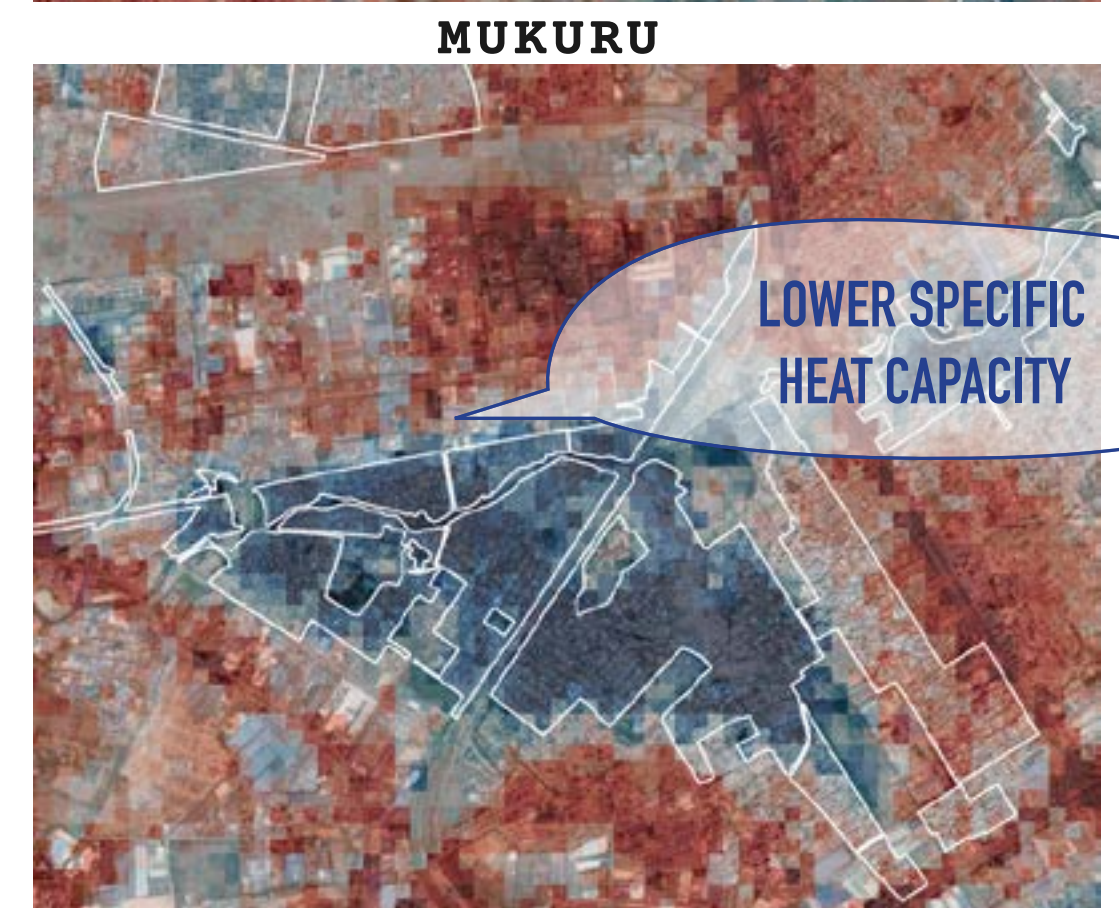
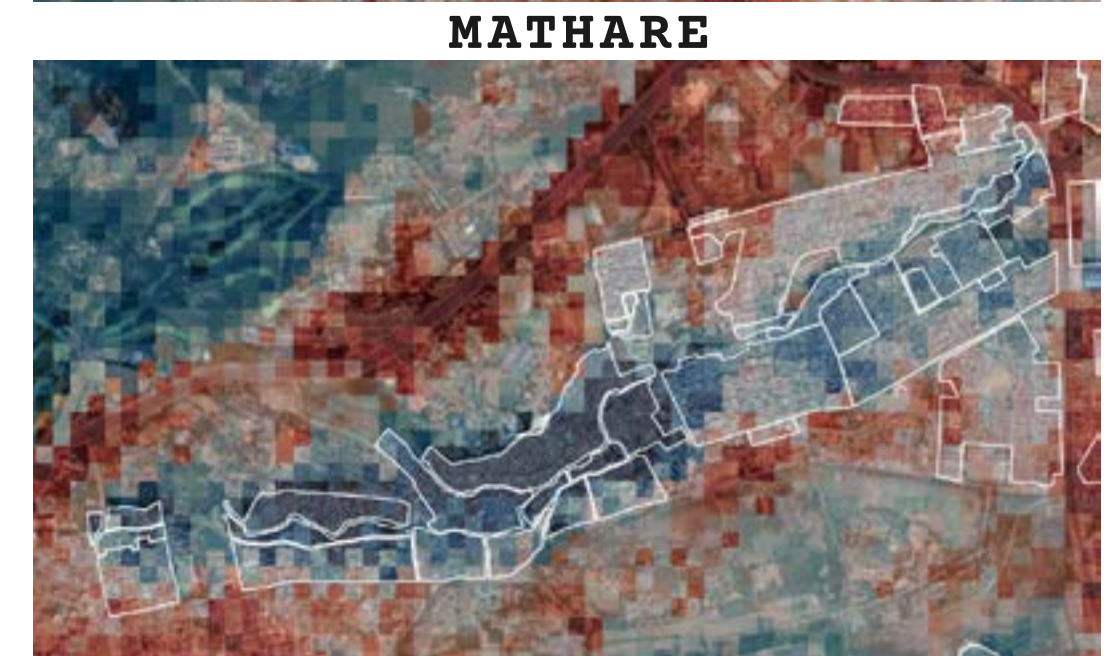
ECOSTRESS LST 04/02/2021 NIGHTTIME ~70 m spatial resolution



+ 3,5 °C



ECOSTRESS LST 04/02/2021 NIGHTTIME



METHODS

FIELD COLLECTION- METEOROLOGICAL STATIONS - FIXED SENSORS



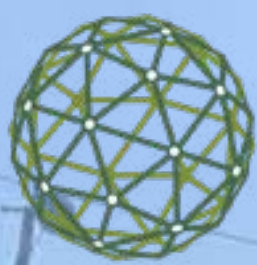
RADIATION SENSOR



WIND SENSOR

TEMP, HUMIDITY
SENSOR

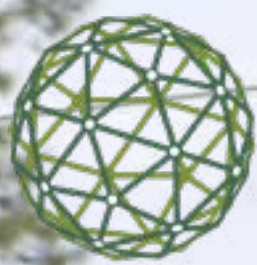
Resolution ± 0.1 °C
Accuracy ± 0.5 °C
Settings 10 sec log



METHODS

FIELD COLLECTION- MOBILE SENSORS





METHODS

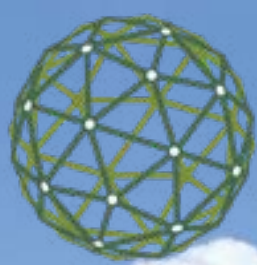


TEMP, HUMIDITY
SENSOR
GPS

Resolution ± 0.01 °C
Accuracy ± 0.9 °C
Settings 10 sec log

RADIATION SENSOR

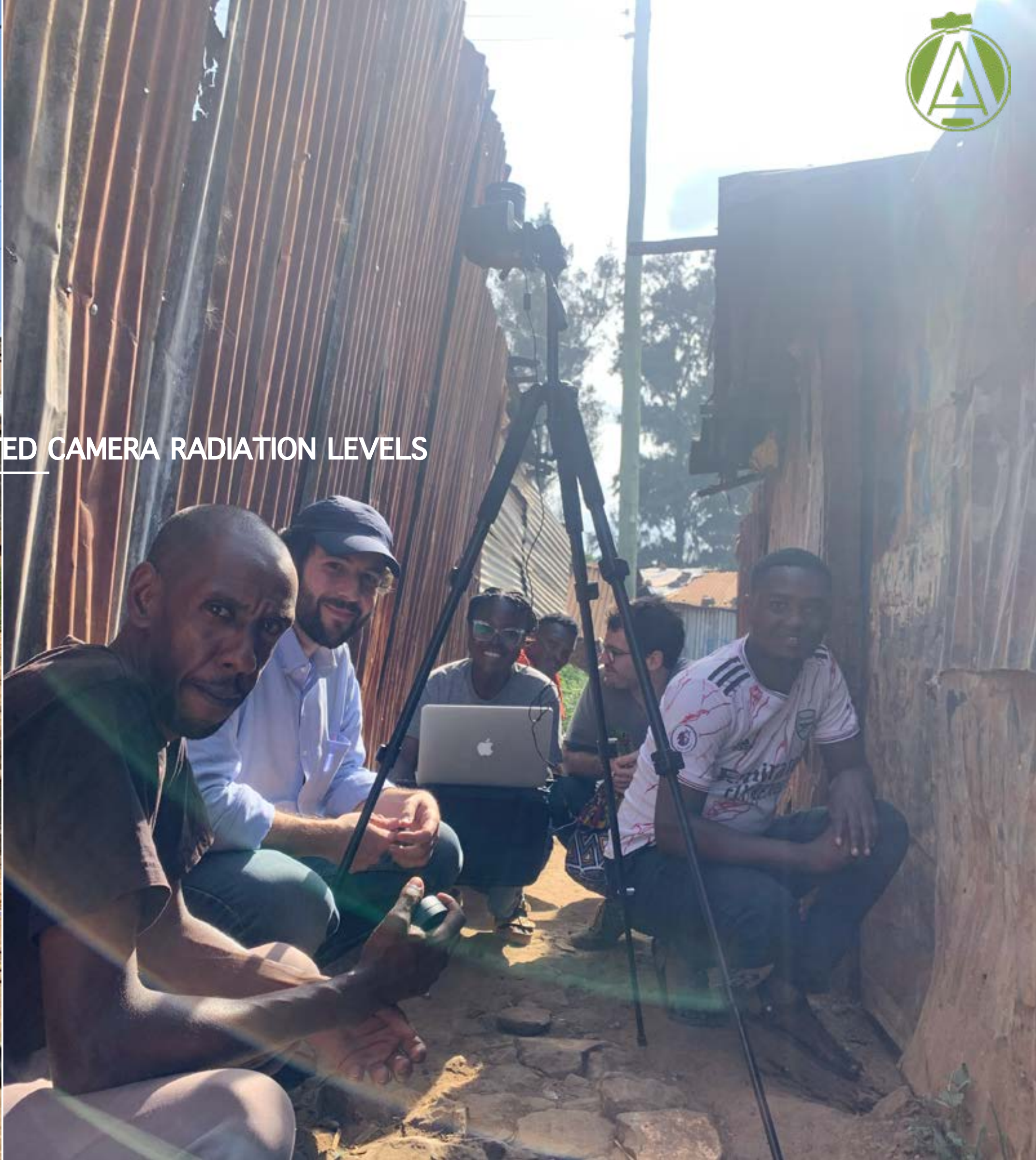


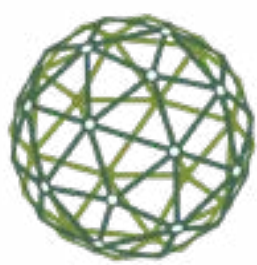


METHODS



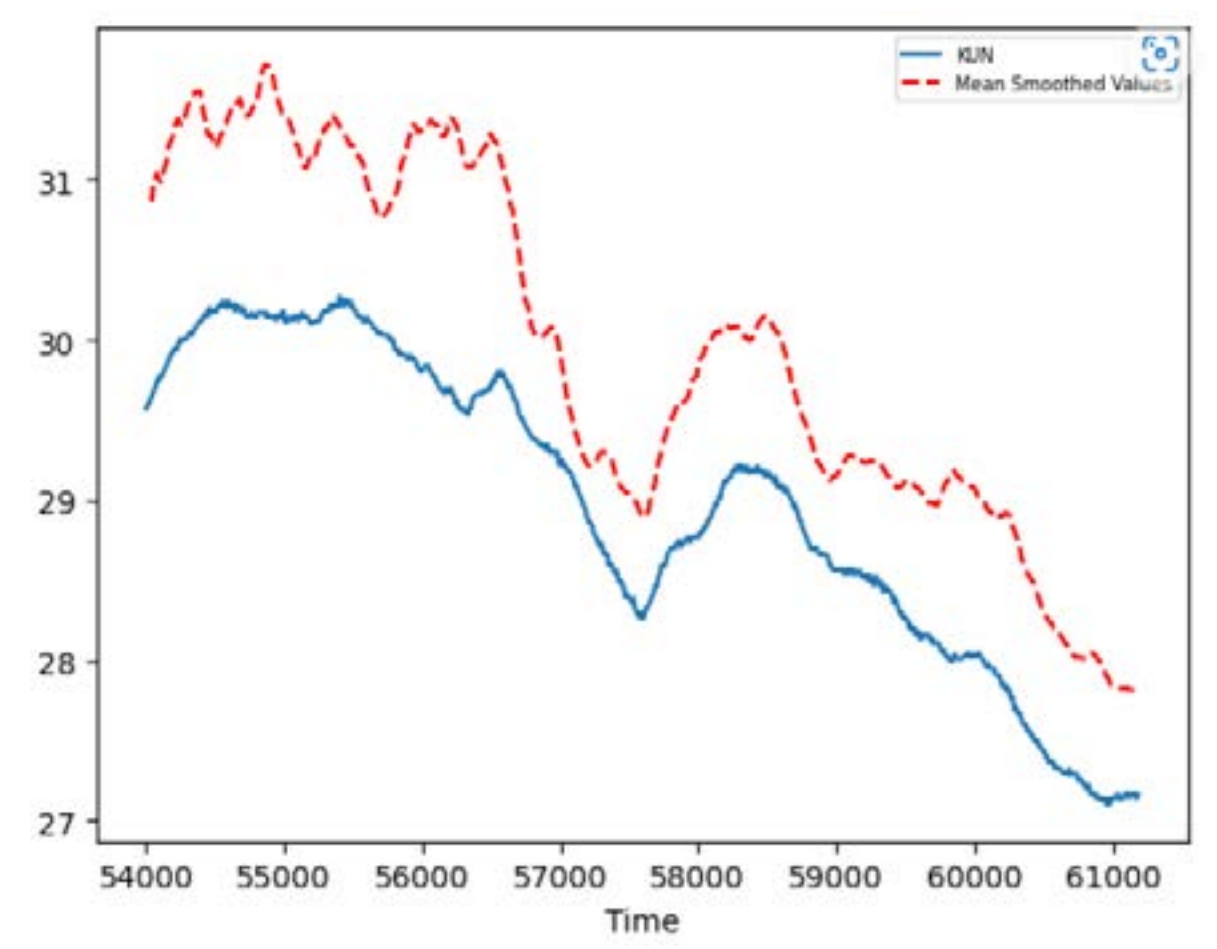
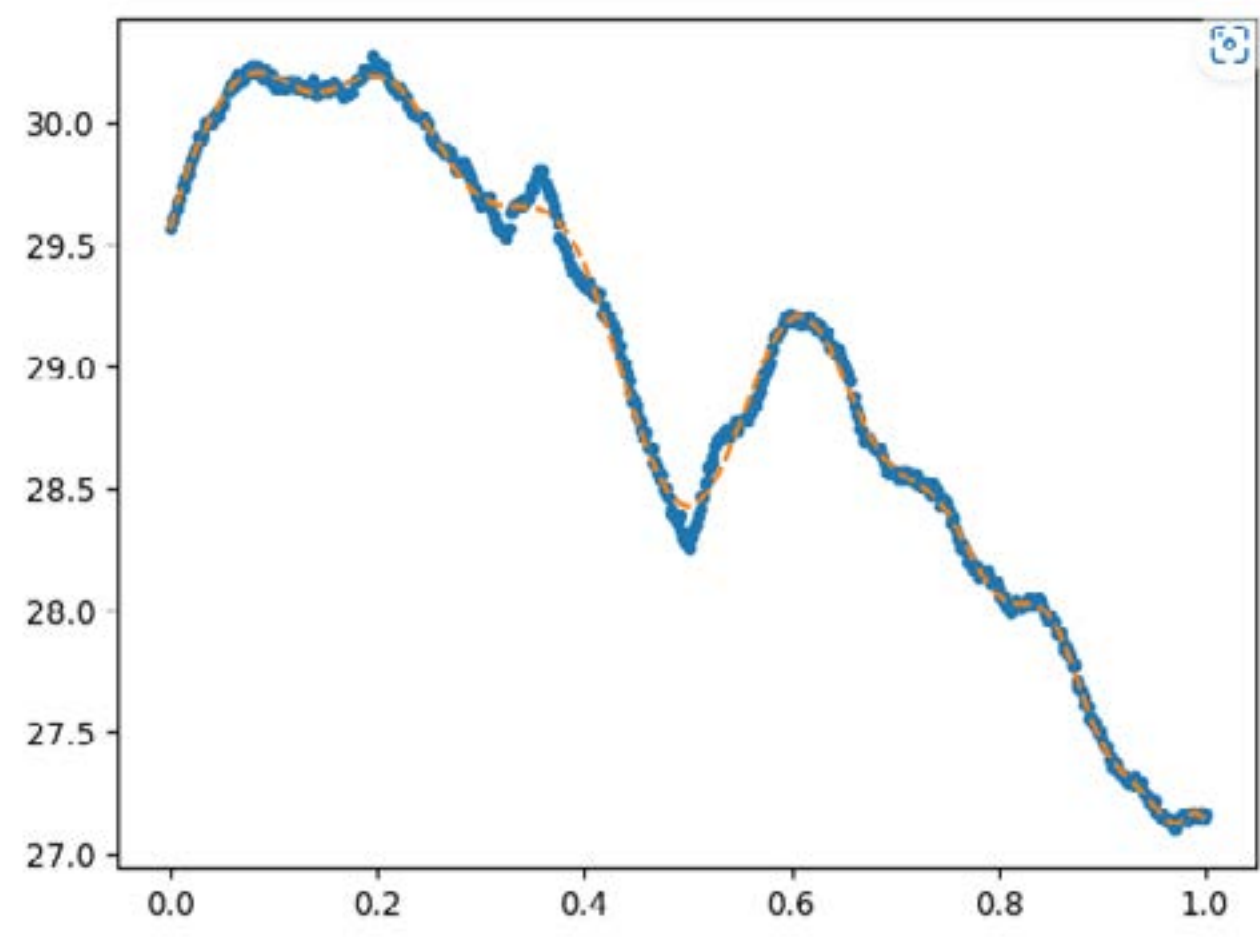
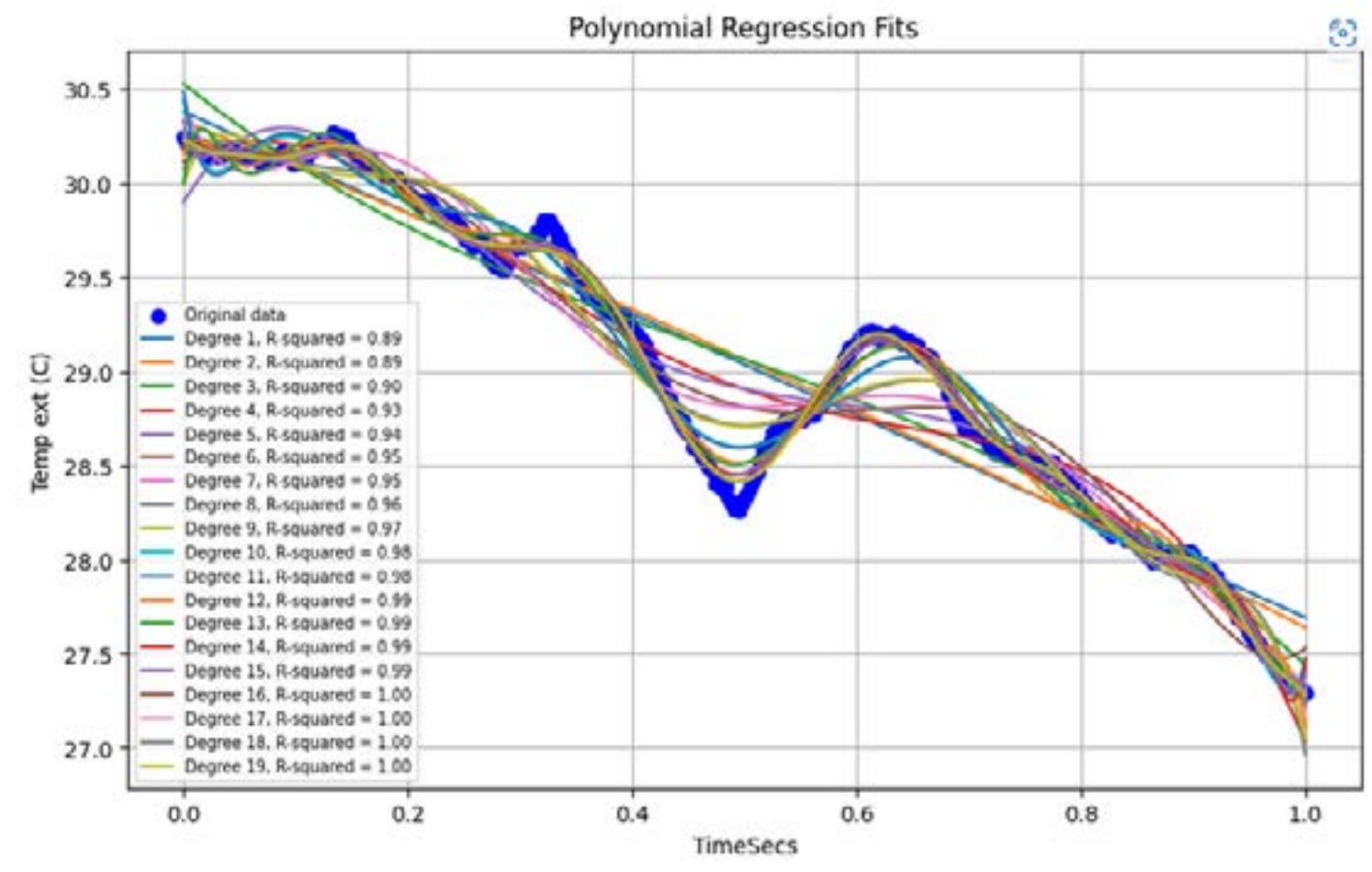
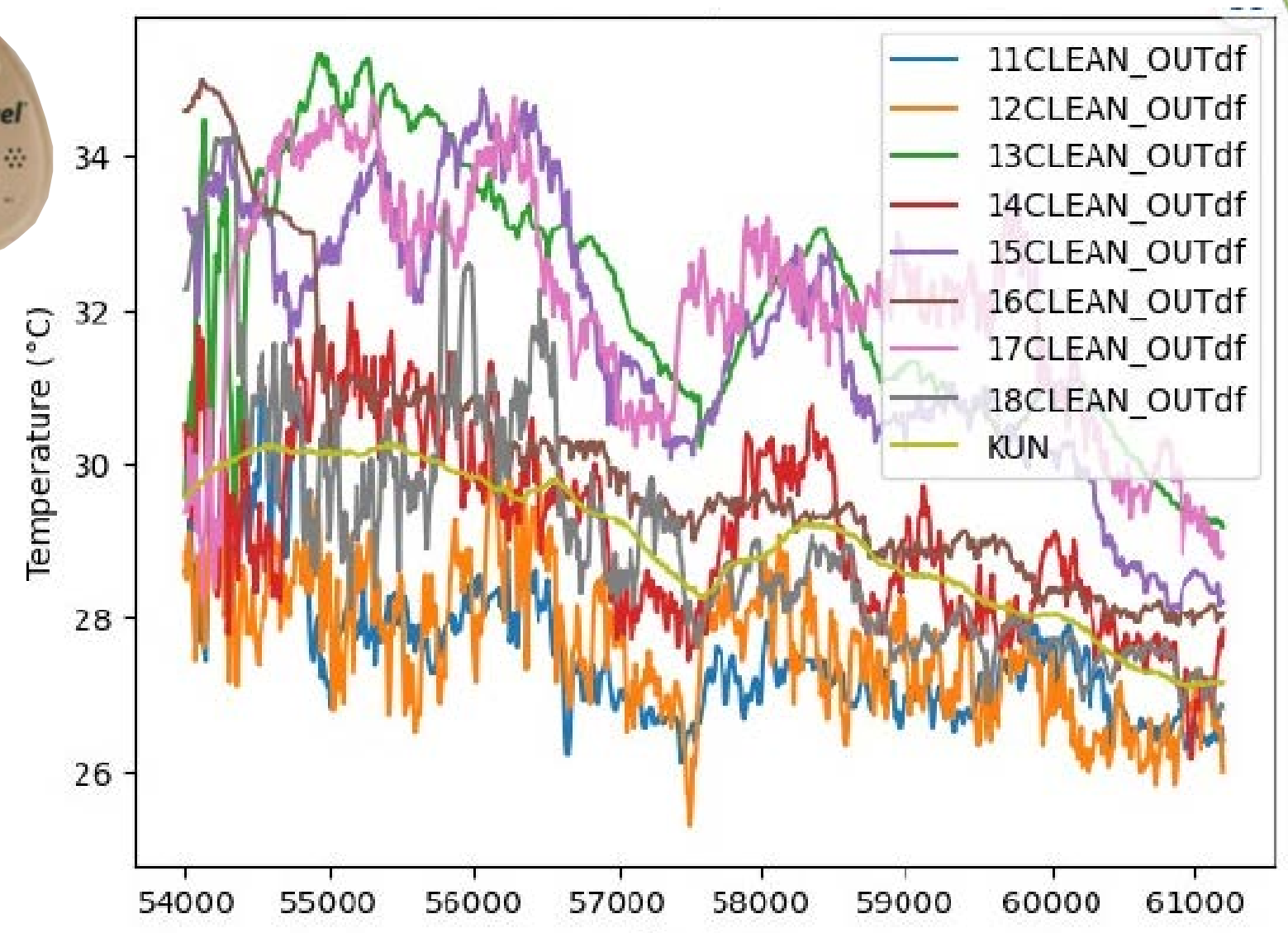
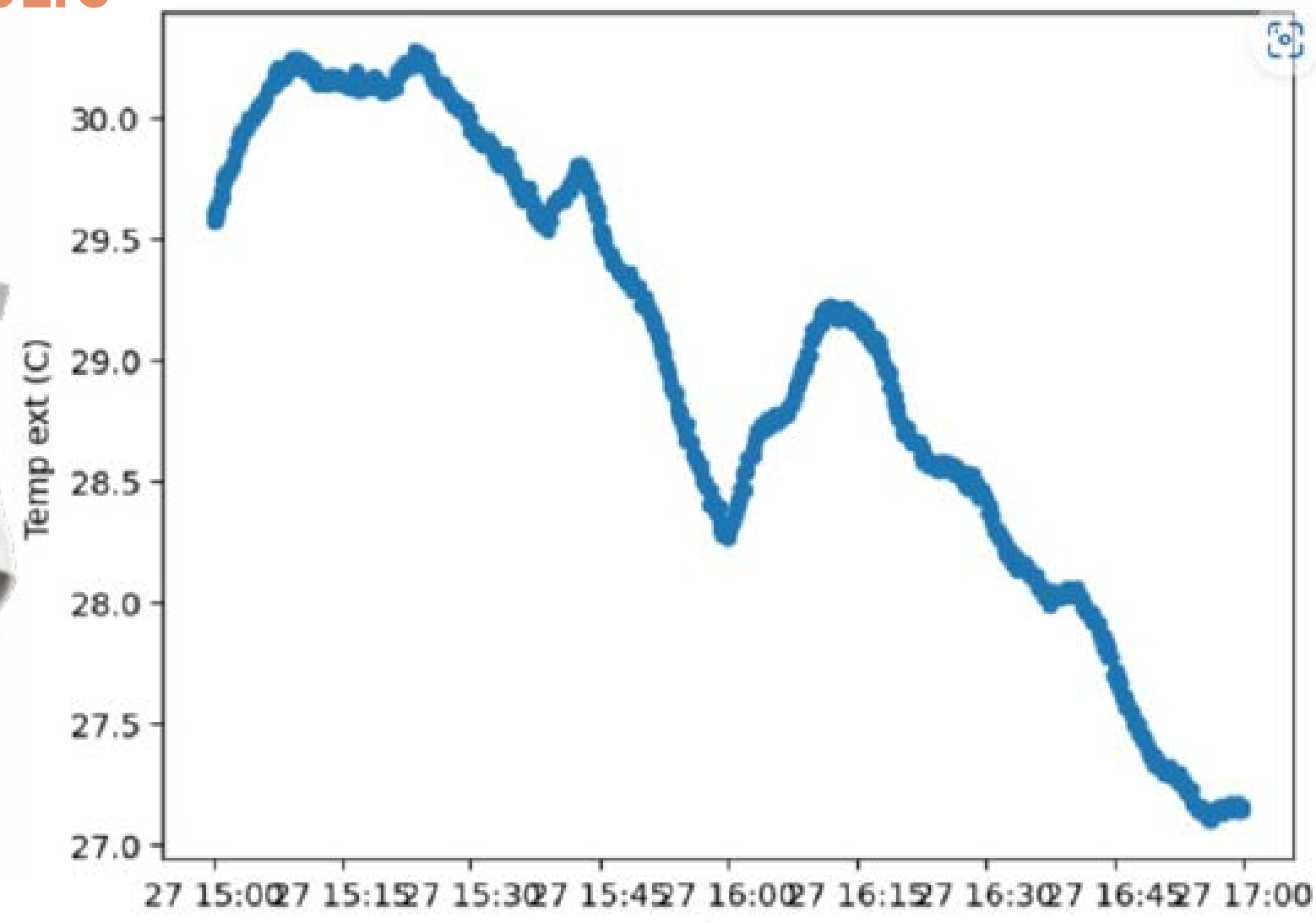
CALIBRATED CAMERA RADIATION LEVELS

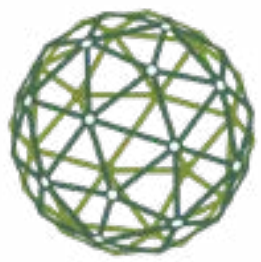




RESULTS

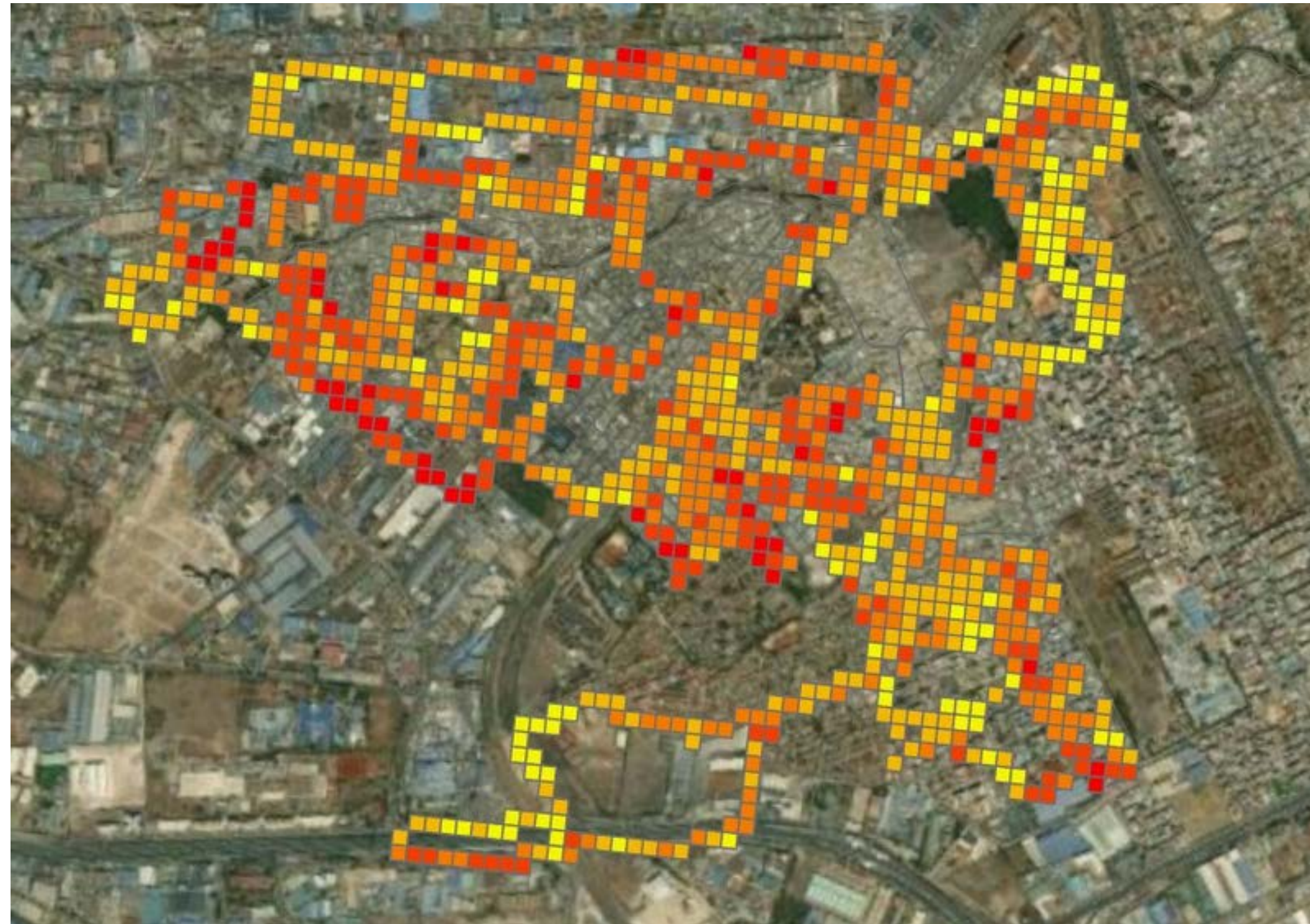
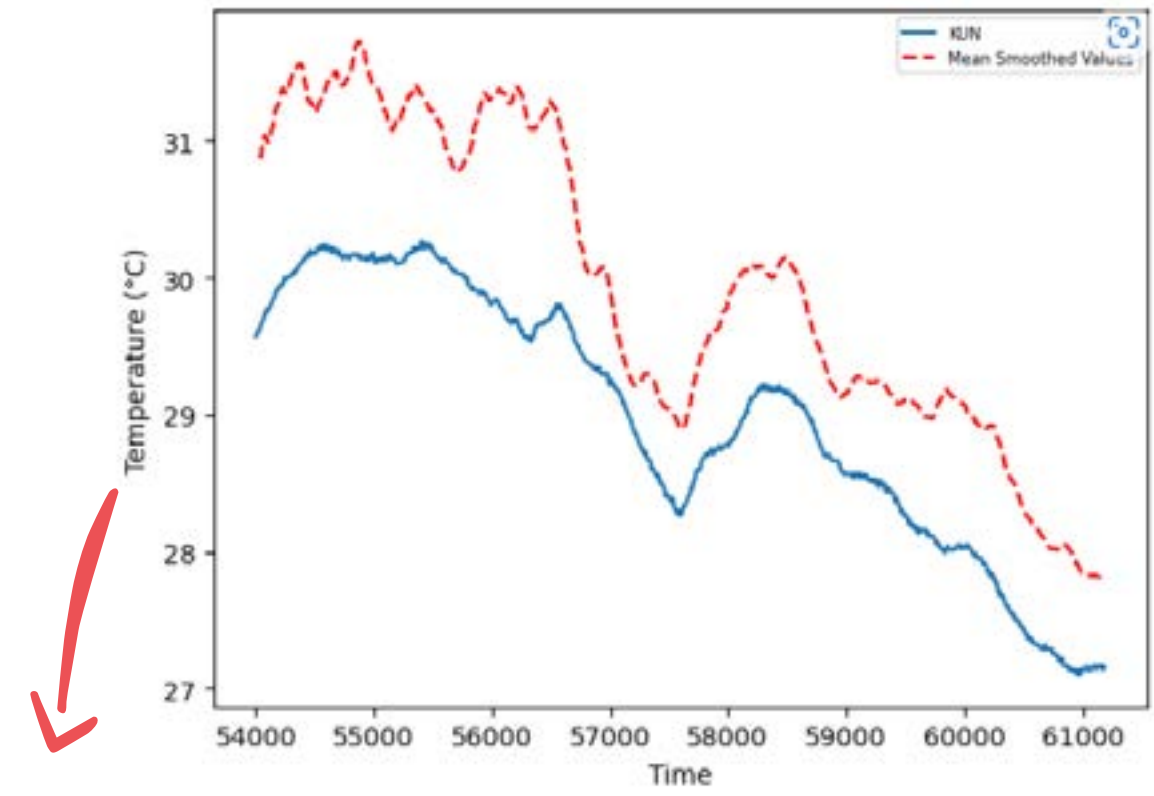
AIR TEMPERATURE PREPROCESSING

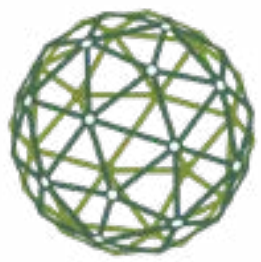




RESULTS

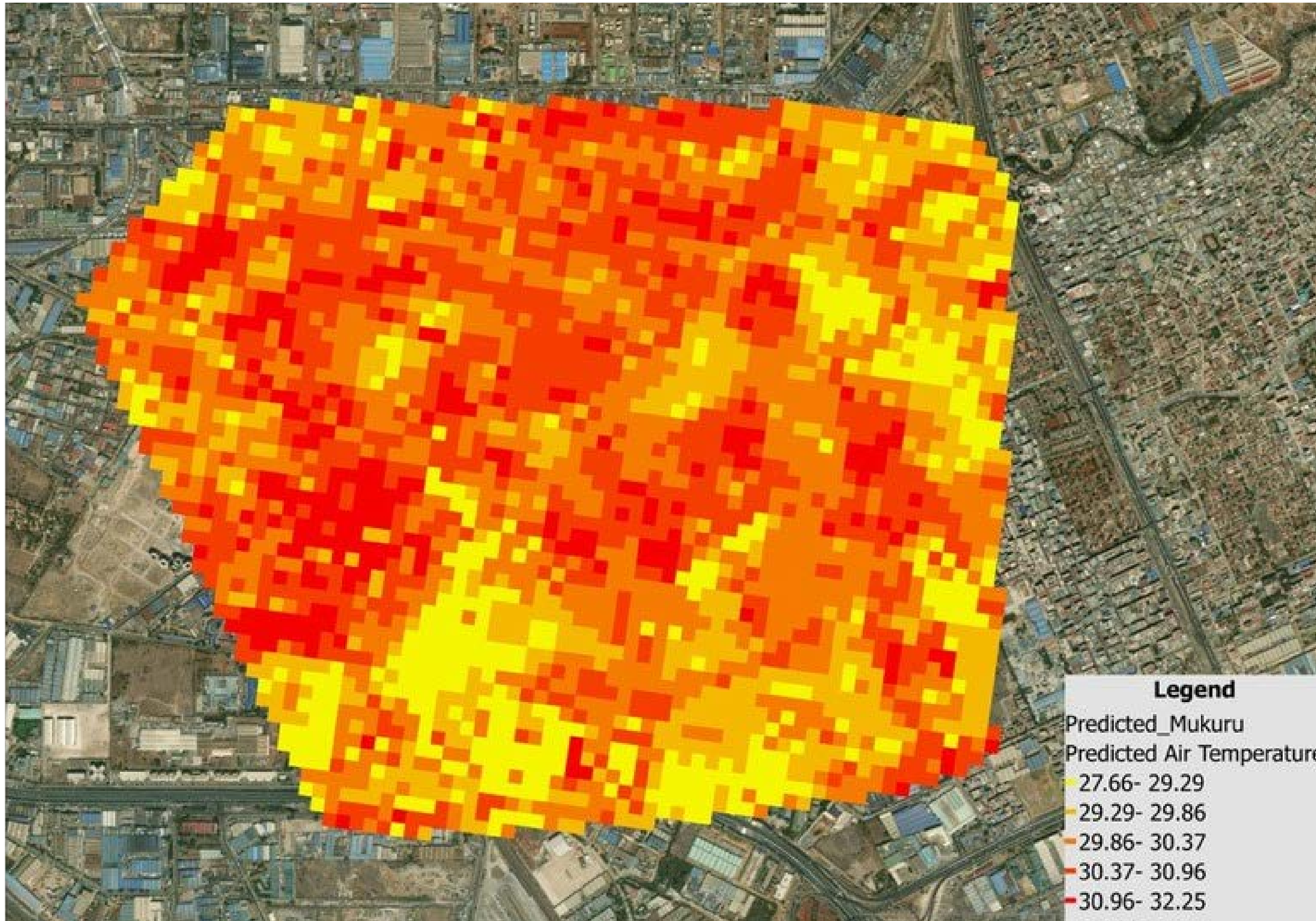
AIR TEMPERATURE PREPROCESSING





RESULTS

AIR TEMPERATURE MODELLING – Multiscale Geographically Weighted Regression (MGWR)



+ 3 °C
DIFFERENCES
WITHIN
INFORMAL
SETTLEMENTS

R-squared 0.76
Feature importance
- Building volume
- NDVI
- Distance between buildings

Legend	
Predicted_Mukuru	Predicted Air Temperature
Yellow	27.66- 29.29
Light Orange	29.29- 29.86
Orange	29.86- 30.37
Dark Orange	30.37- 30.96
Red	30.96- 32.25

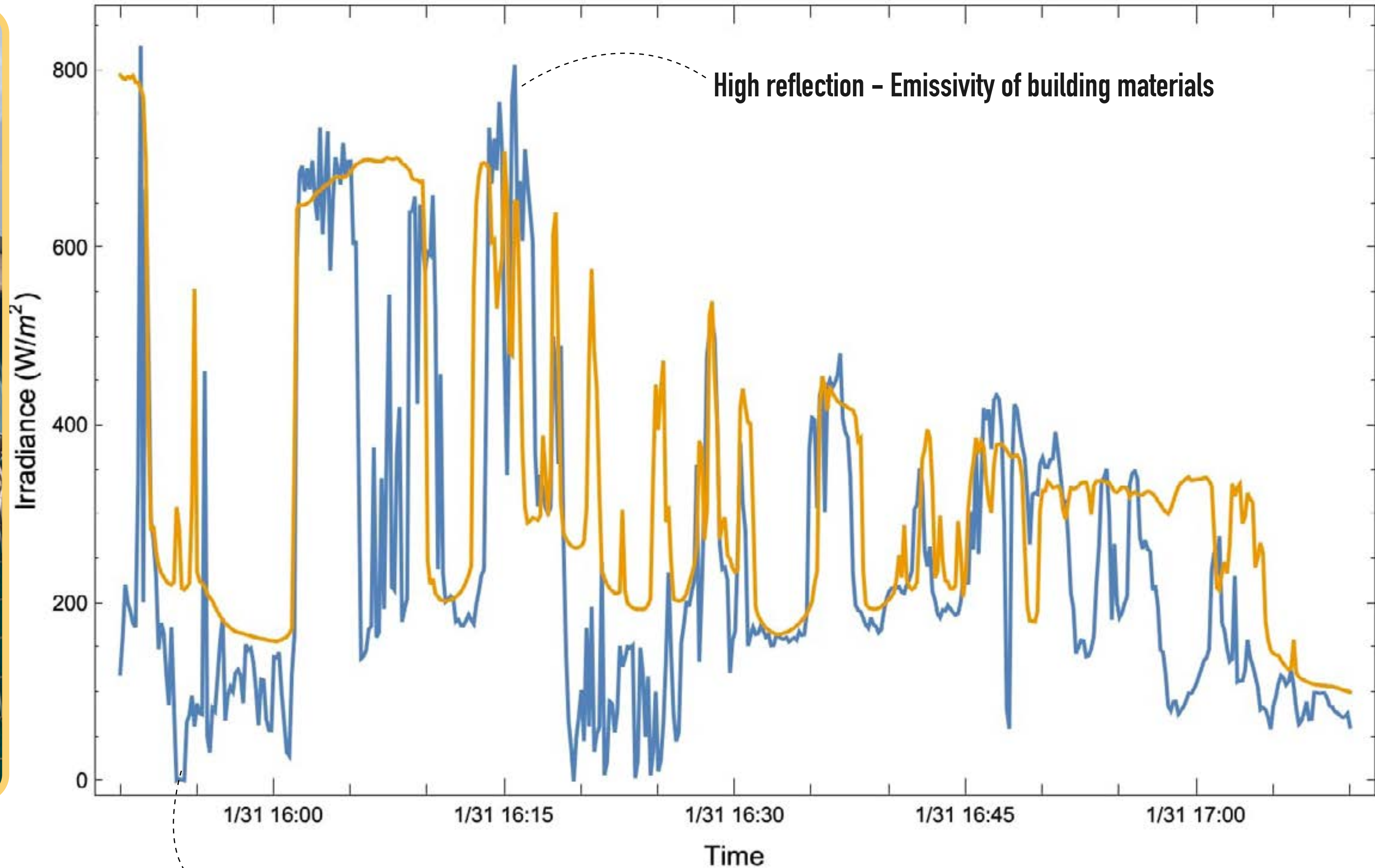
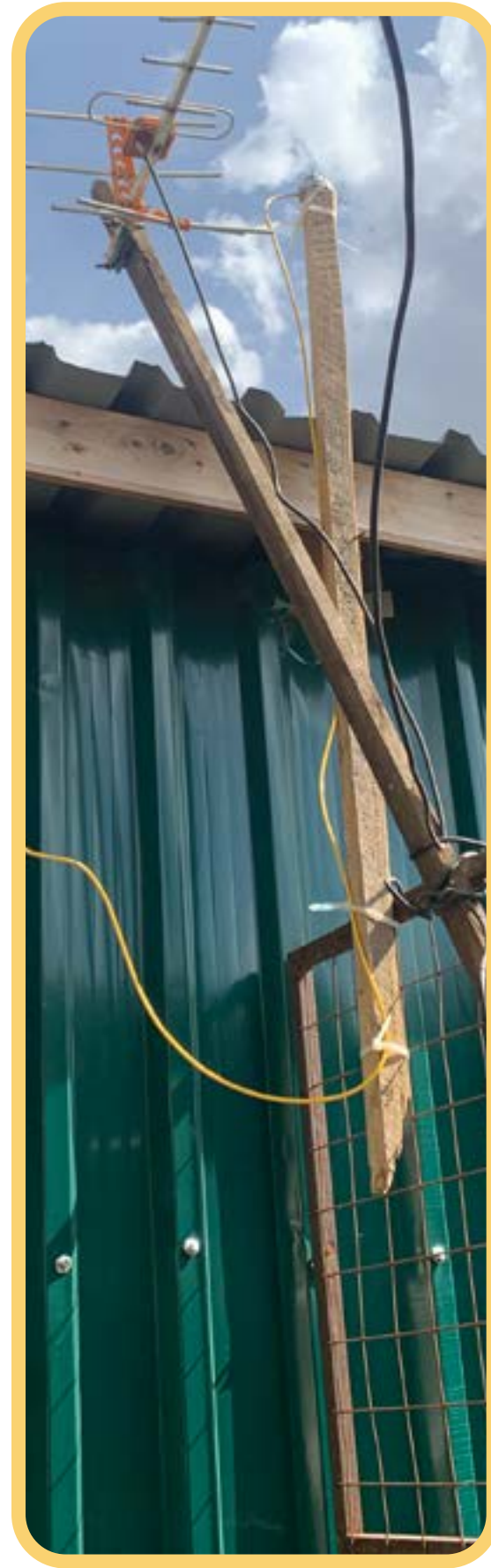
DIRECT RADIATION
INDIRECT RADIATION

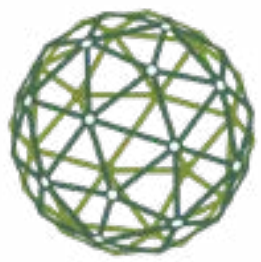
DIRECT RADIATION
INDIRECT RADIATION
REFLECTED RADIATION



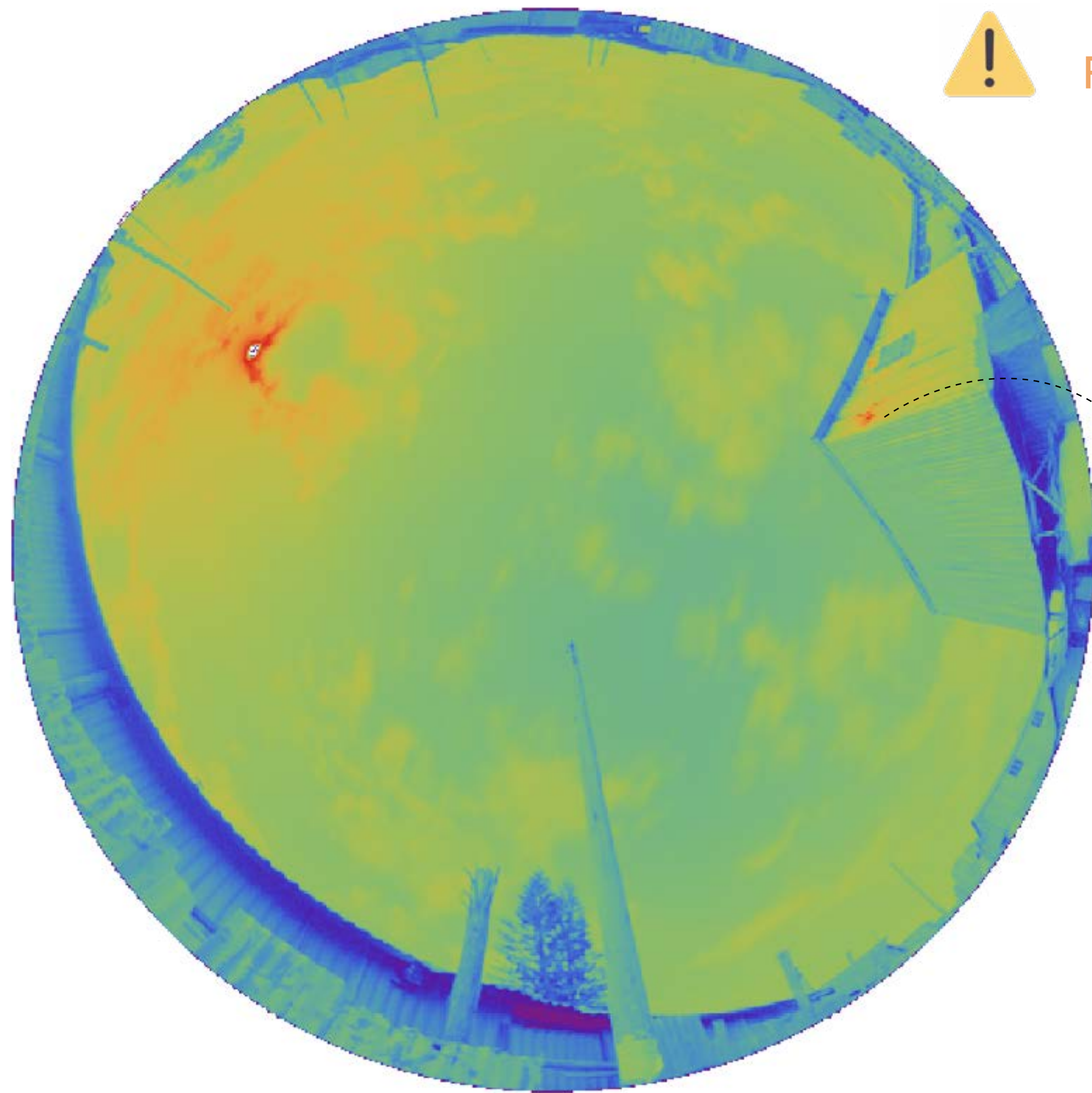
FIXED RADIATION SENSOR

MOBILE RADIATION SENSOR



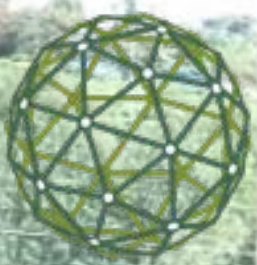


REFLECTED RADIATION



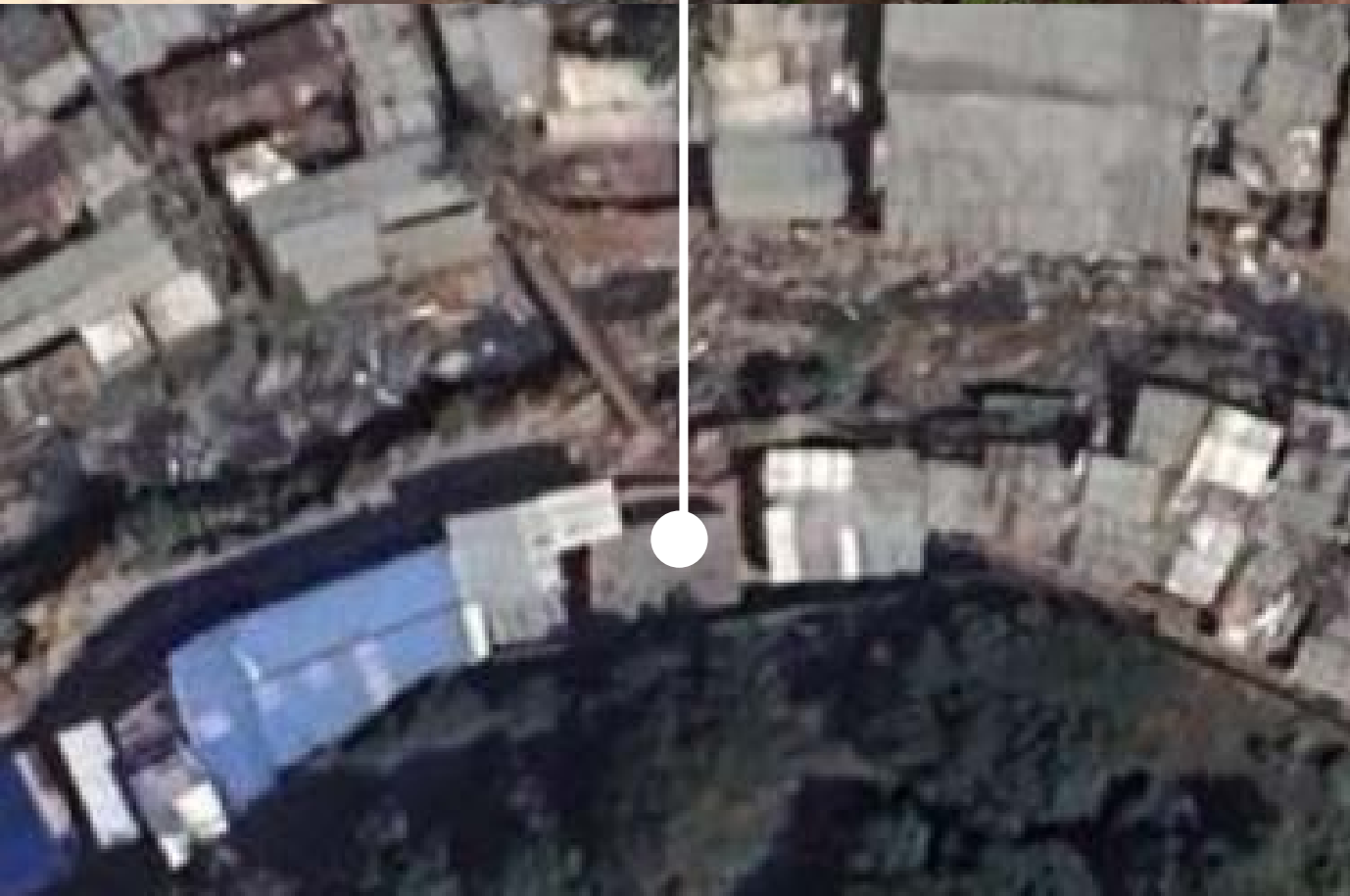
High reflection -
Emissivity of building materials



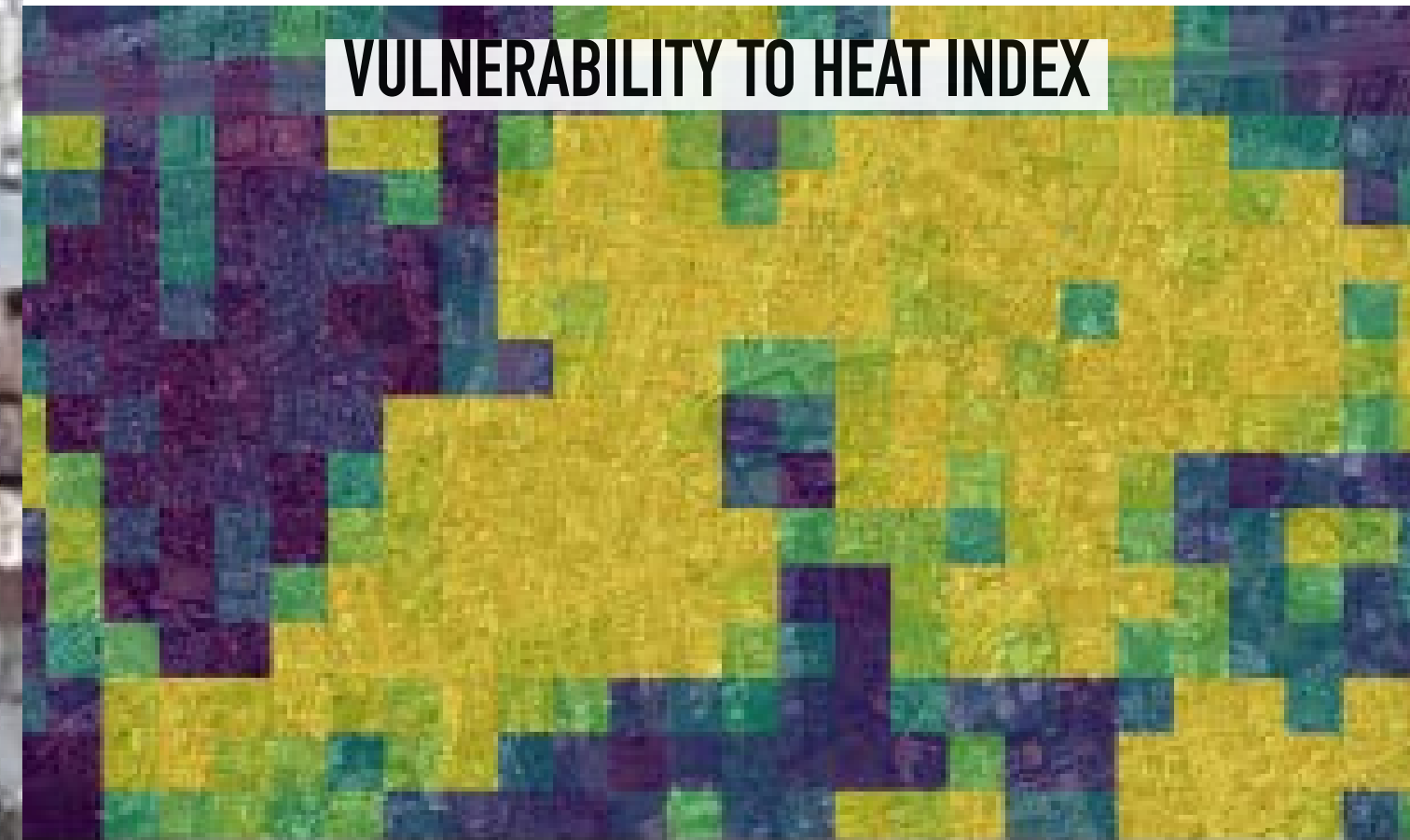


RESULTS

VULNERABILITY TO HEAT



VULNERABILITY TO HEAT INDEX



March 2024

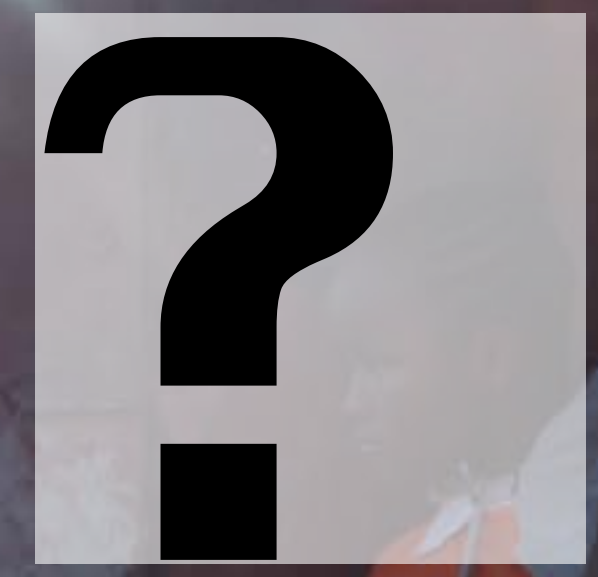
“Climate change further worsens urban inequity [...], due to the increase in extreme weather events such as heat waves”
- Intergovernmental Panel on Climate Change (IPCC)



May 2024:
brown area shows
the zone of
destruction
(eviction)

**THE URBAN POOR SHOULD BE AT
THE CENTRE OF ADAPTATION PROCESSES**
NOT BE BUT MOSTLY AFFECTED, DIRECTLY AND INDIRECTLY

THANK YOU!



**ANY
QUESTION?**

G

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c

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s

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angela.abascal@unavarra.es

upna
Universidad
Pública de Navarra
Nafarroako
Unibertsitate Publikoa