Investigating the influence of climate on the Surface Urban Heat Island (SUHI)

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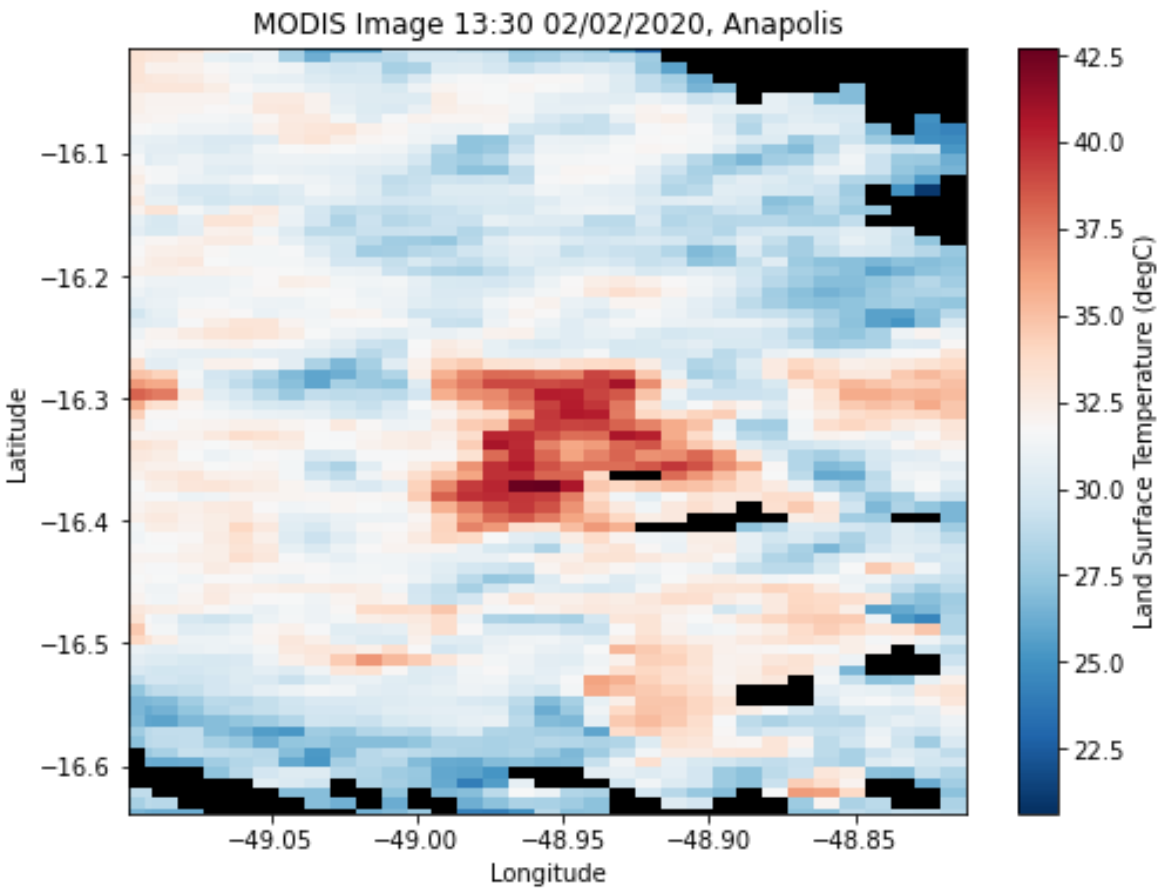
ARIES

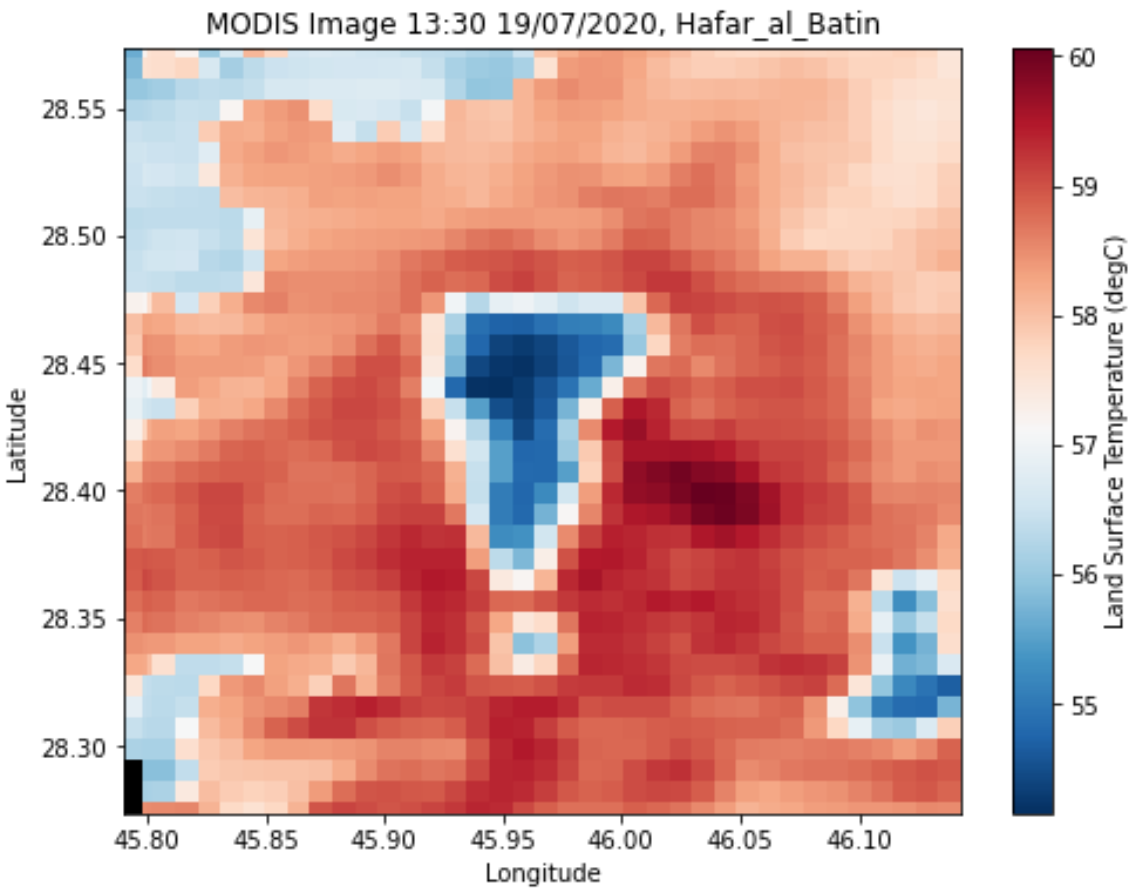
DOCTORAL TRAINING PARTNERSHIP

THE SURFACE URBAN HEAT ISLAND (SUHI)

ANAPOLIS, BRAZIL

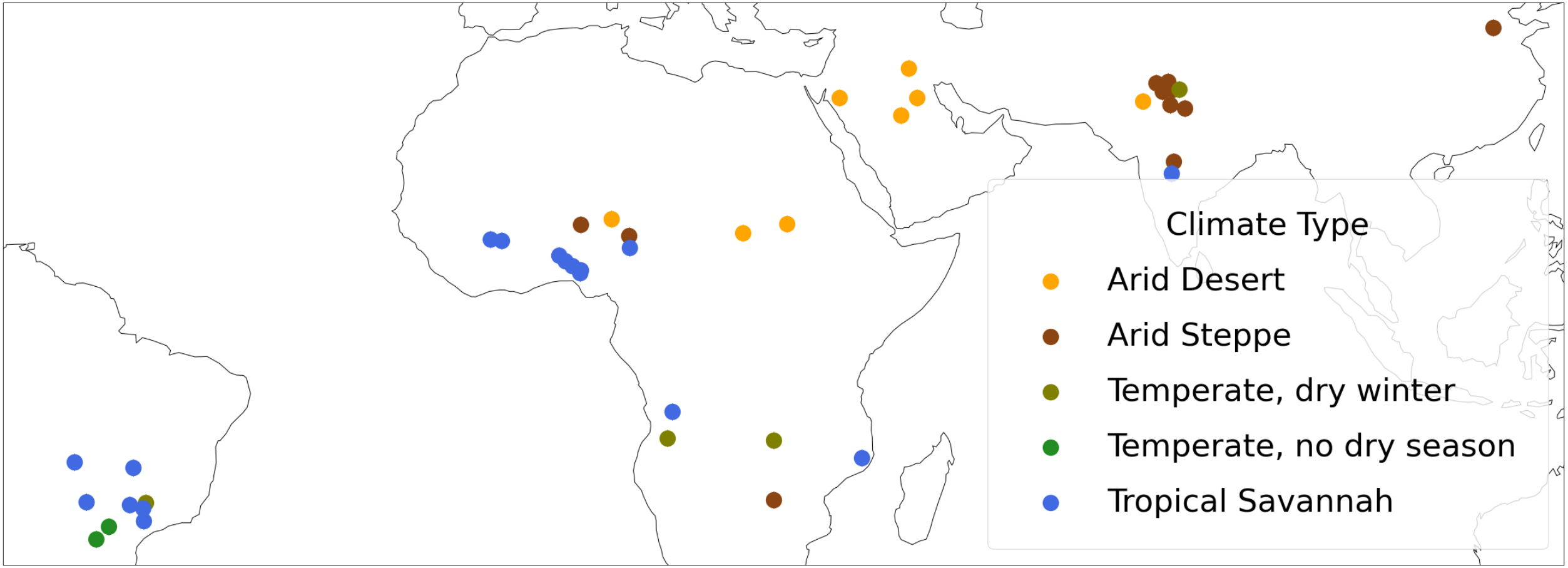


HAFAR AL BATIN, SAUDI ARABIA

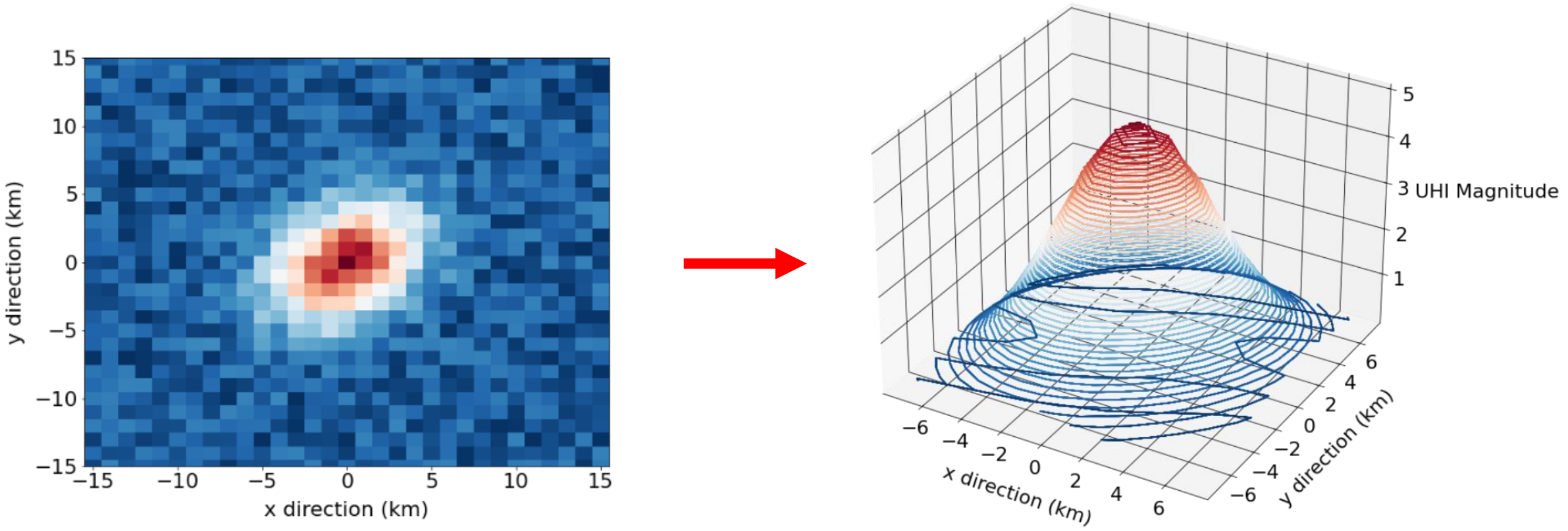


CITY SELECTION

CITY POPULATION: 300,000 TO 1 MILLION



THE GAUSSIAN SURFACE APPROXIMATION



Anniballe, R., & Bonafoni, S. (2015). A Stable Gaussian Fitting Procedure for the Parameterization of Remote Sensed Thermal Images. *Algorithms*, *8*(2), 82–91. https://doi.org/10.3390/a8020082

VARIABLES

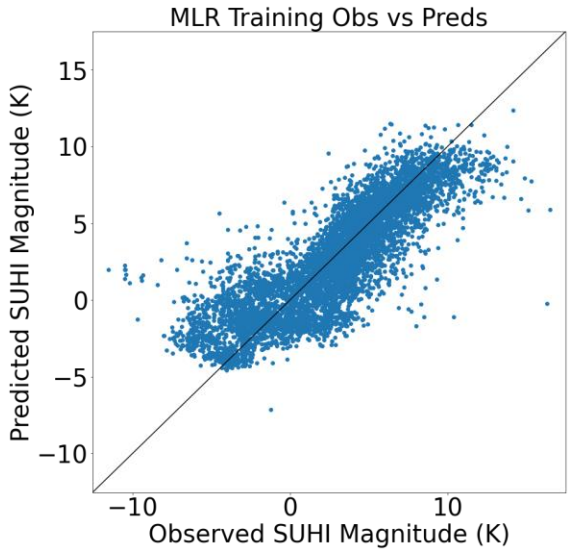
INPUTS

- Enhanced Vegetation Index (EVI)
- Evaporative Fraction
- Function of Area and evaporative fraction
- …..

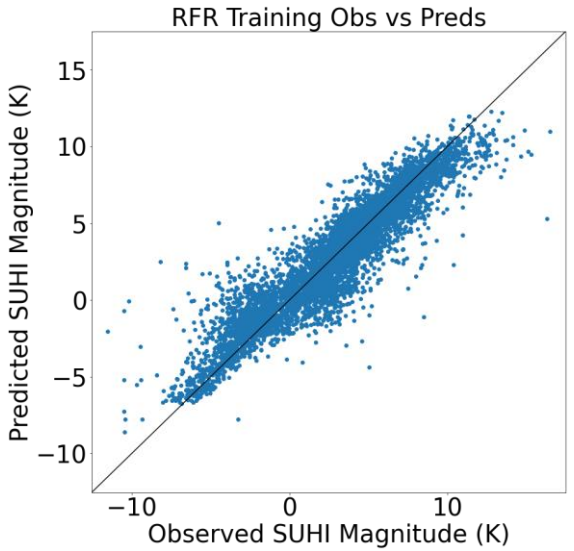
OUTPUT

- Peak Magnitude of SUHI at 13:30

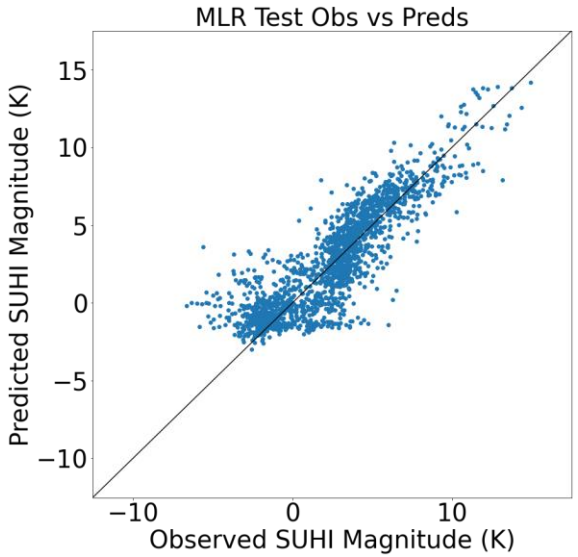
MODEL PERFORMANCE: SUHI at 13:30



Multiple Linear Regression Train
$R^2 = 0.71$
RMSE = 2.25K



Random Forest Regression Train
$R^2 = 0.87$
RMSE = 1.49K



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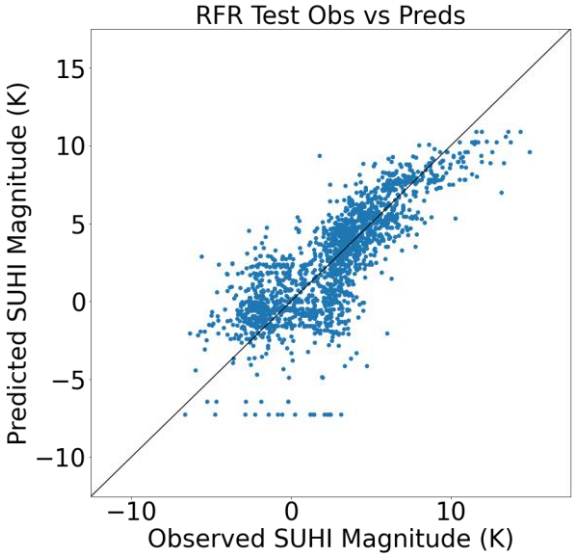
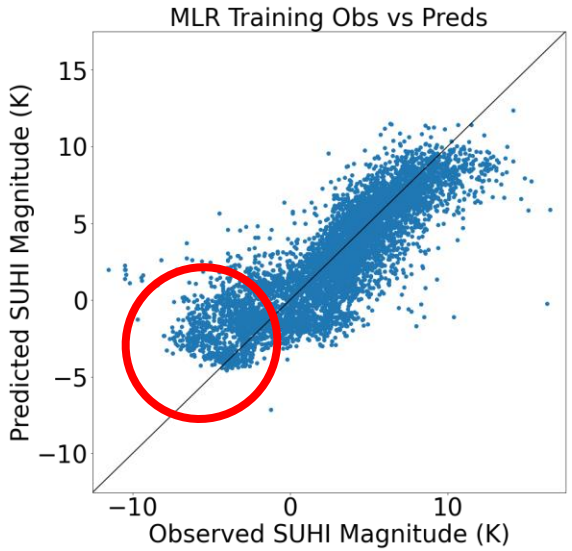


Random Forest Regression Test
$R^2 = 0.58$
RMSE = 2.21K

MODEL PERFORMANCE: SUHI at 13:30



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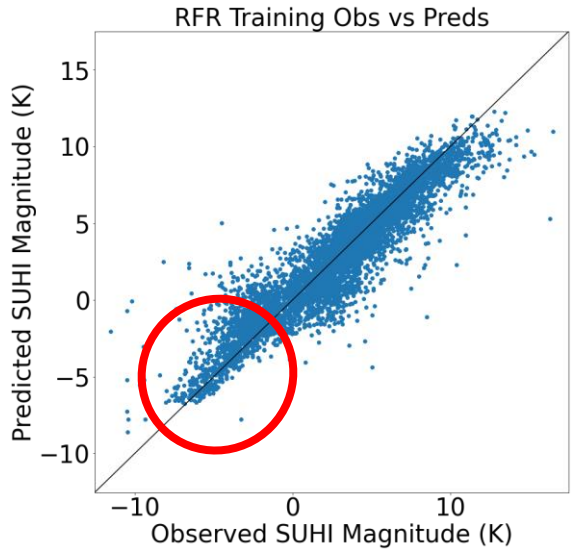

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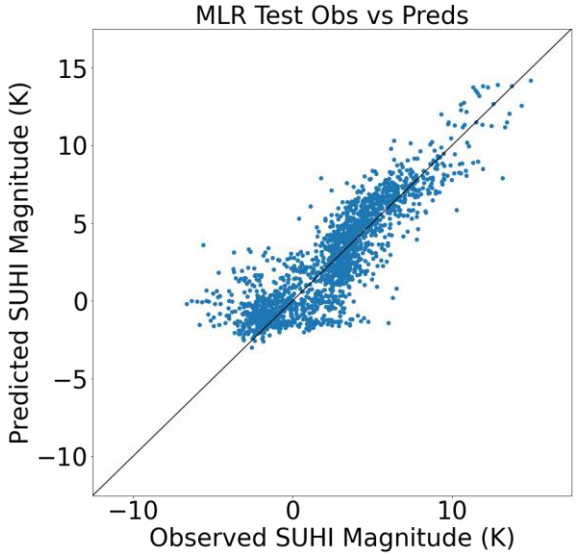

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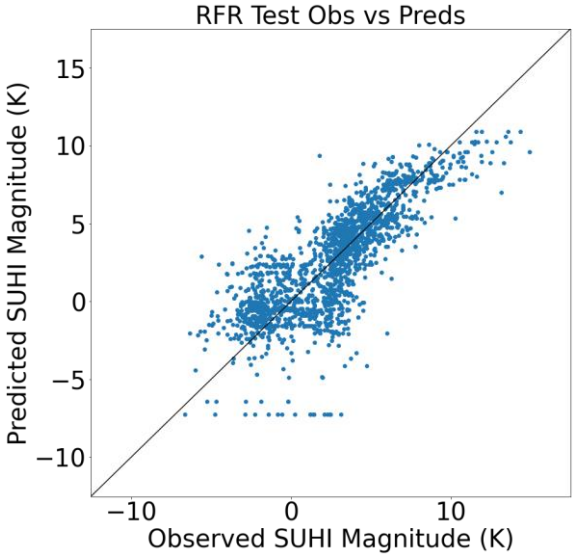

Random Forest Regression Test
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SUMMARY

- The constructed models based on satellite data are globally applicable, capturing SUHI behaviour in both arid and humid regimes
- This has implications for climate change as evaporative fraction and EVI may change in time
- The Multiple Linear Regression model captures the SUHI magnitude better in terms of test statistics, but Random Forest Regression is better able to capture the negative SUHI in arid regions

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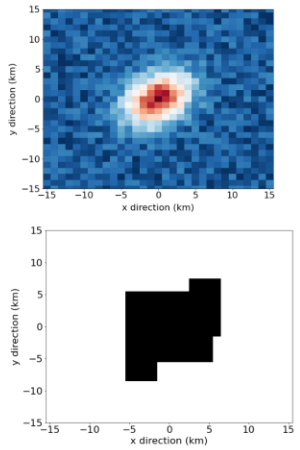
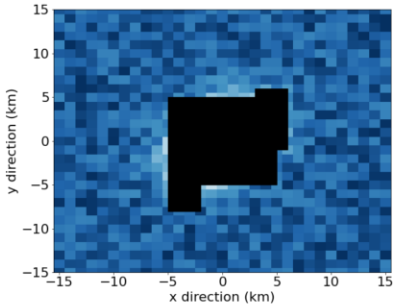
BACK UP SLIDE: THE GAUSSIAN SURFACE APPROXIMATION

1

Re-grid the LST and LULC data to the same grid

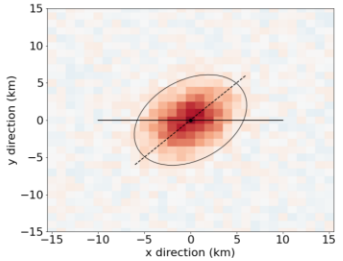


2 Use LULC information to mask the city



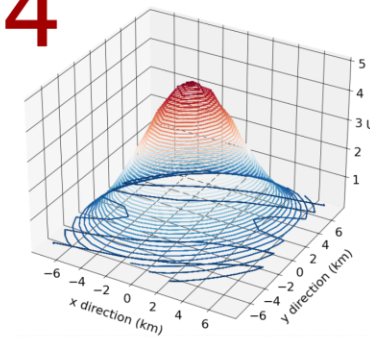
Use linear regression to model the rural temperature

3



Subtract modelled LST from actual LST to reveal SUHI signature

4 Fit a Gaussian Surface



$$SUHI(x,y) = a_0 \times \exp[-\frac{((x-x_0)\cos\varphi + (y-y_0)\sin\varphi)^2}{0.5a_x^2} - \frac{((y-y_0)\cos\varphi - (x-x_0)\sin\varphi)^2}{0.5a_y^2}]$$

BACK UP SLIDE: AREA AND EF FUNCTION