

# Estimation of Evapotranspiration based on METRIC and SEBAL model using Remote sensing, near Al Jouf, Saudi Arabia

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## Introduction

Evapotranspiration (ET) has played a significant role in the field of Meteorological meteorological and hydrological studies [1-3]. Nowadays in advanced remote sensing technology, Landsat images perform a good estimation of ET in arid and sub-arid environments [4, 5]. Among remote sensing methods for estimation ET are METRIC and SEBAL models. The challenge of working with remote sensing images to estimate ET is to collect reliable weather data [6] in image format for the process of METRIC and SEBAL model in LandMODmapper in MATLAB software. The aim of the present analysis is to collect remote sensing Landsat 8 images to yield daily ET from METRIC and SEBAL models and compare them with different vegetation indices and land surface temperature.

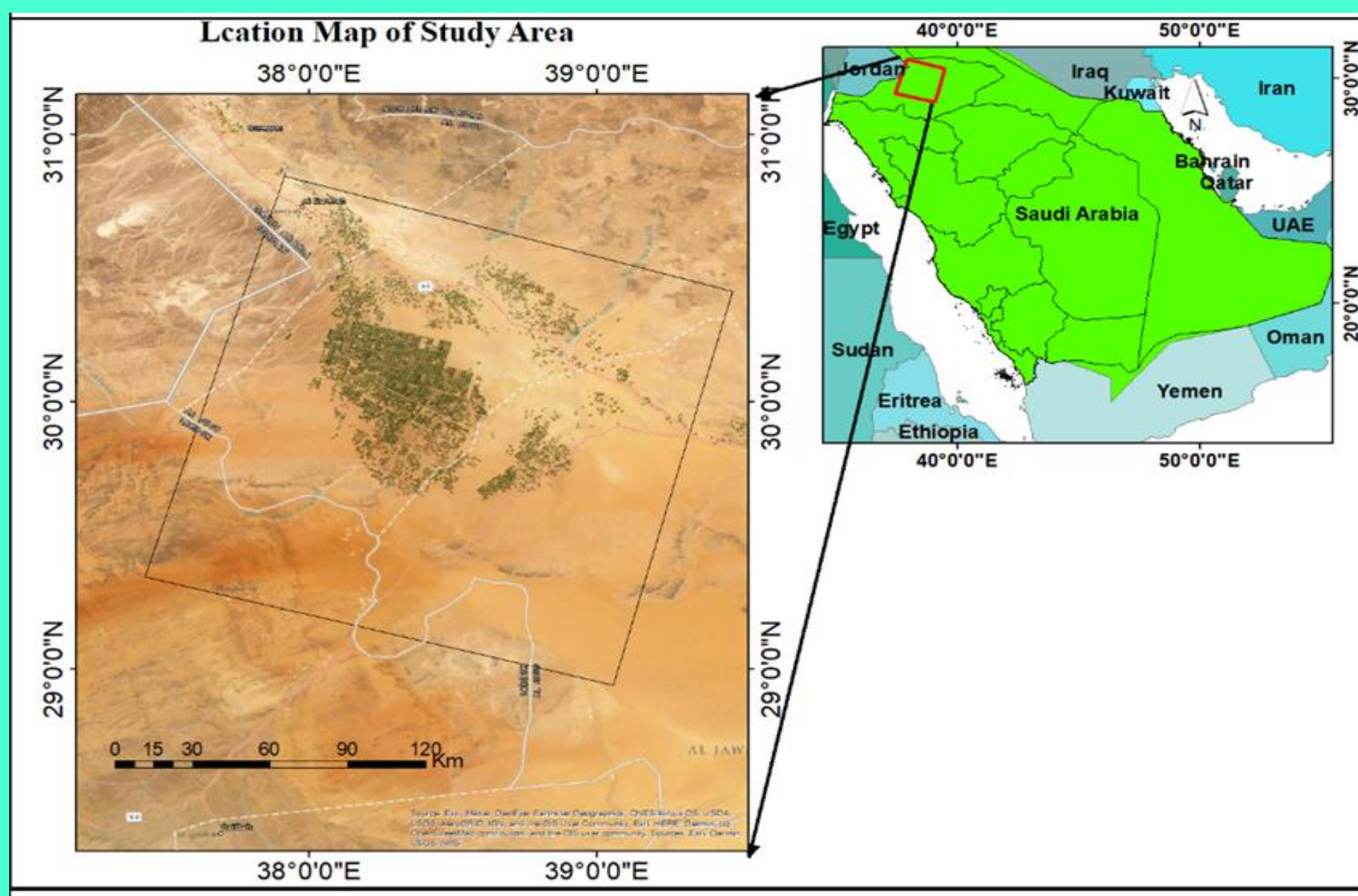


Figure 1. Map of the study area

## Material and Methods

- Northern part of Saudi Arabia between Latitude 29° 30' and 31° 30' N and Longitude 37° 00' and 39° 00' E
- covers 27,364 km<sup>2</sup>
- mountainous region, mostly composed of agricultural areas
- the rest part is plateaus and valleys
- highest measured elevation - about 1047 m

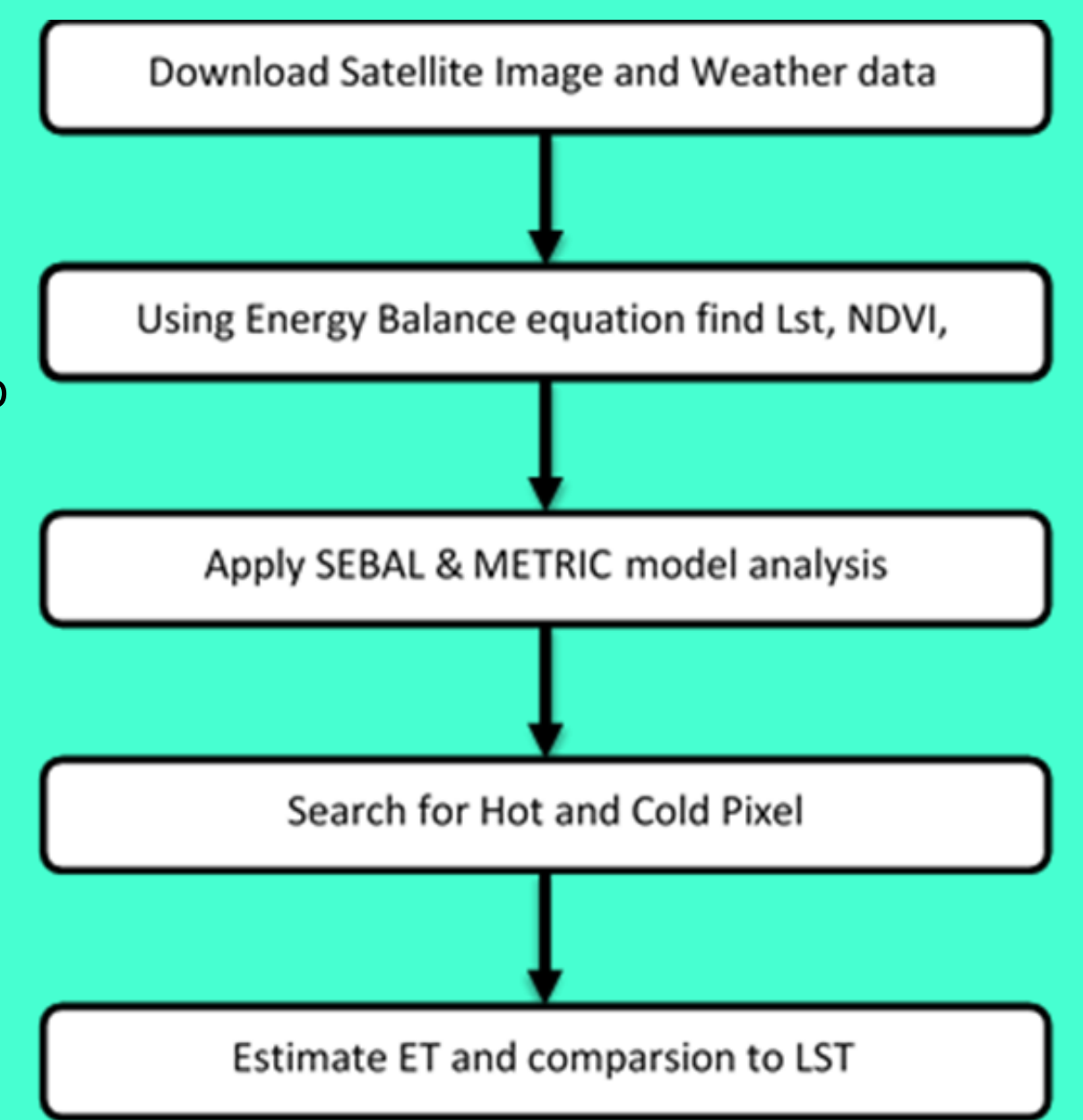


Figure 2. General flow chart for the methodology

## Results and Discussion

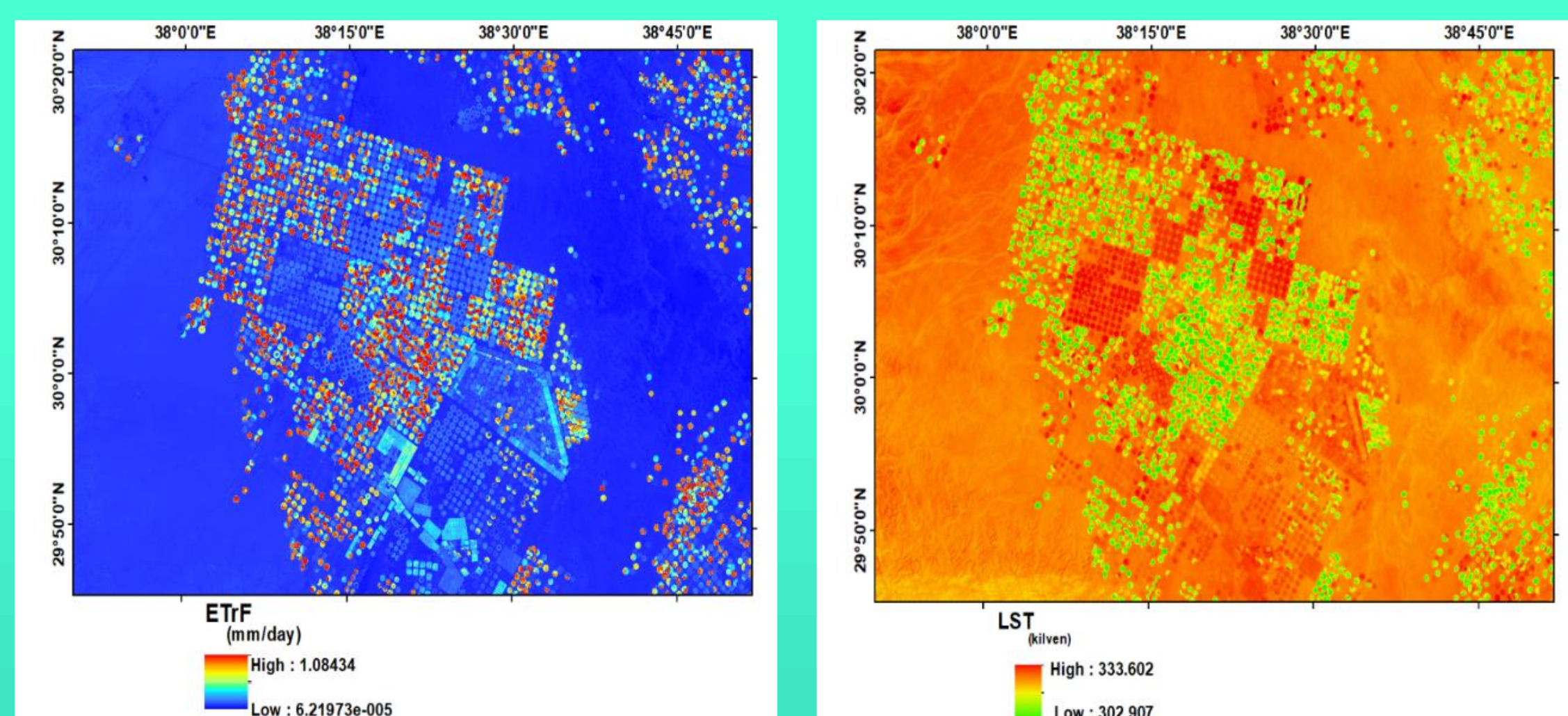


Figure 3. Daily Reference Evapotranspiration maps of the study area (mm/day) during 2019/07/07. The high mountain and agriculture part showed the highest amount of ET while the low elevated region showed low value of land surface temperature, which covers most of the north eastern part of the region. Good correlation has been seen between fractional ET and land surface temperature,  $R^2=0.8$  for the two satellite images.

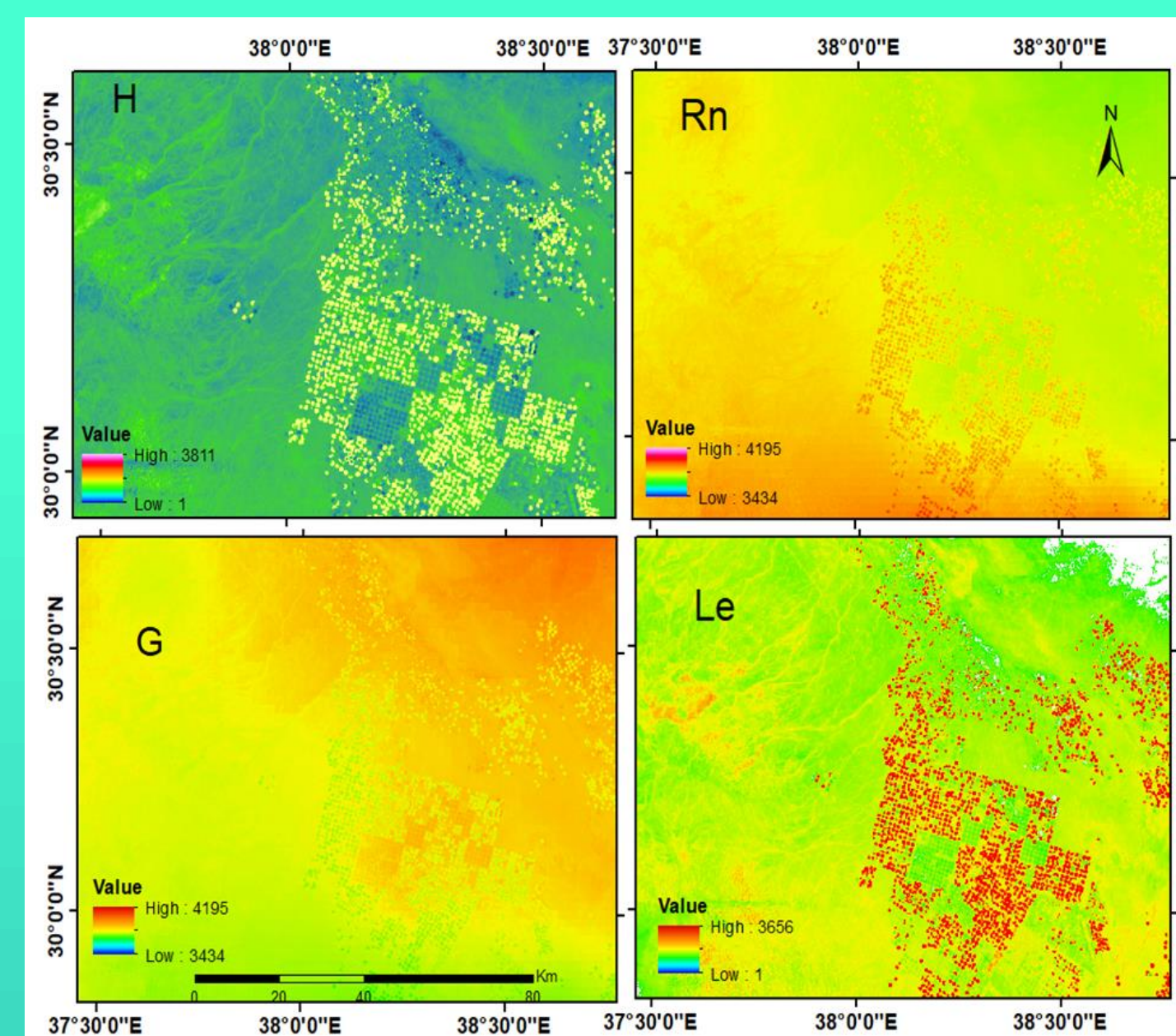


Figure 4. Daily flux ( $W m^{-2}$ ), Latent heat flux (Le), Sensible heat flux (H), Net radiative flux (Rn), and soil heat flux (Gi). The relatively high value of daily evapotranspiration was obtained due to sensible heat flux, which is the main portion of energy, whereas the latent heat flux dominated only in the vegetable and agricultural area.

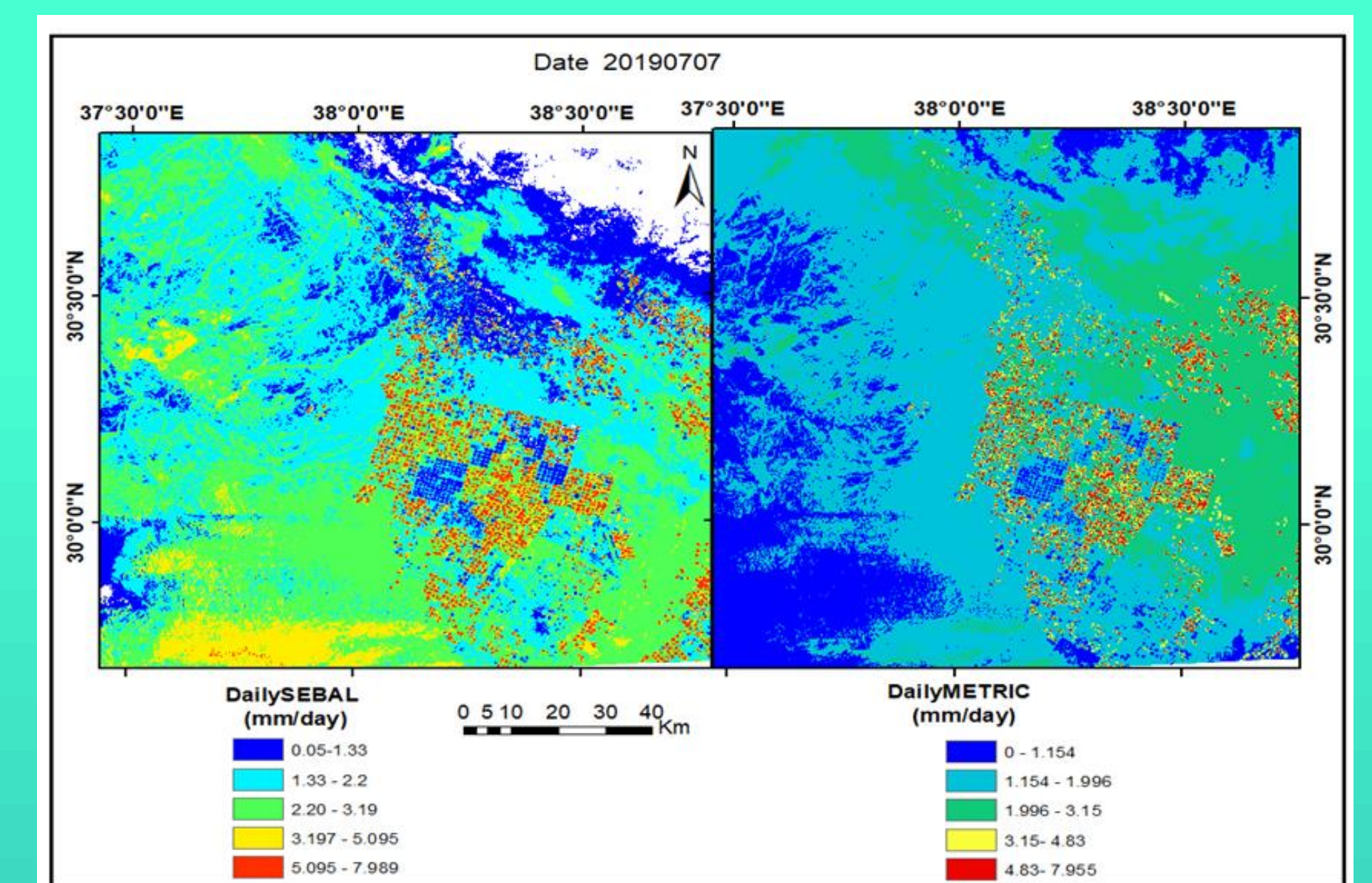


Figure 5. Daily Evapotranspiration maps of the study area (mm/day) during 2019/07/07. This highly elevated and agricultural area shows a high value of ET ranging from 5 to 8 mm/day. This indicates that agricultural and hilly terrain specifically in arid and semi-arid environment results in a high value of ET.

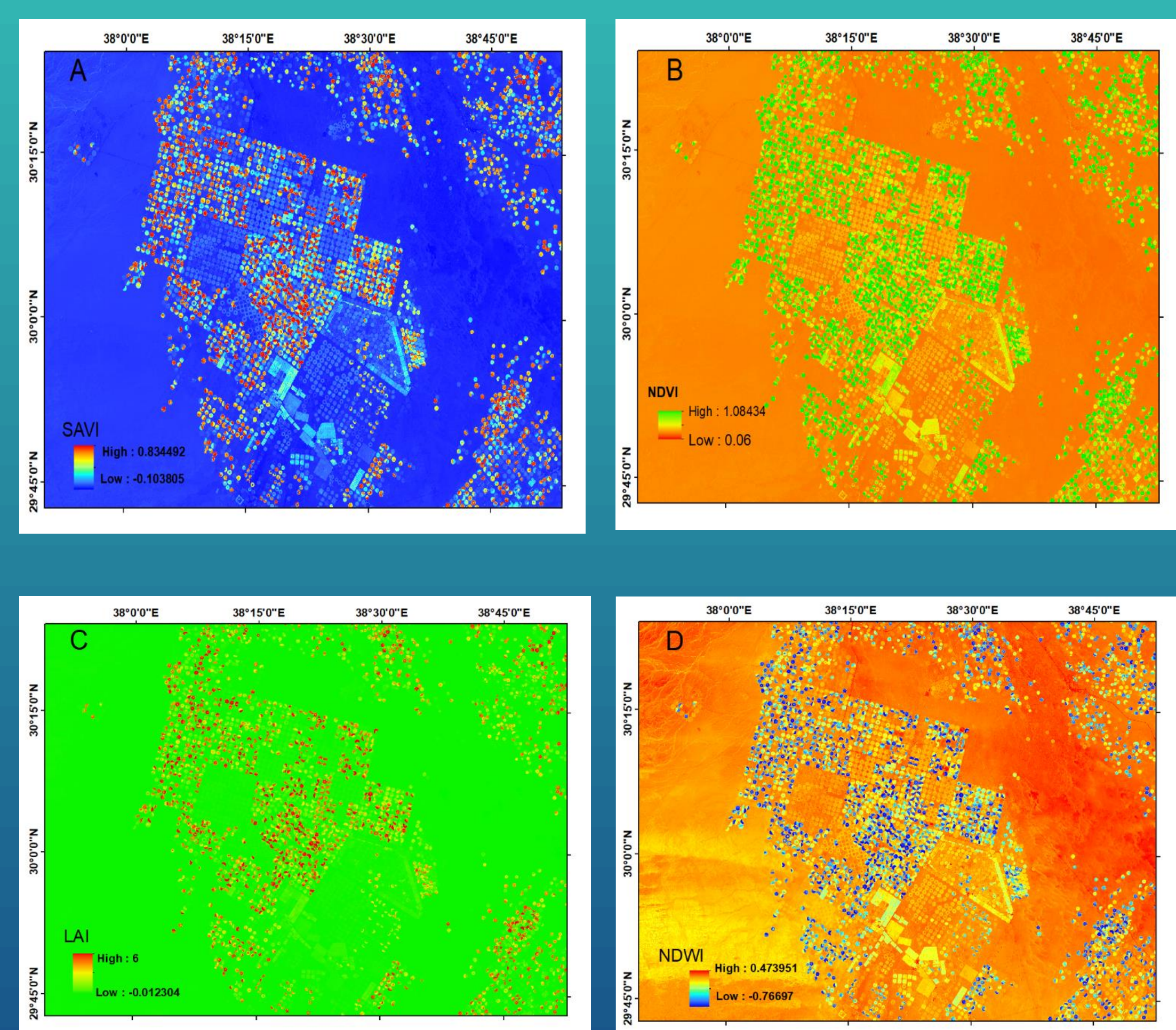


Figure 6: Vegetation Indices, (A) SAVI-Soil-Adjusted Vegetation Index, (B) NDVI-Normalized Differential Vegetation Index, (C) LAI-Leaf Area Index, and (D) NDWI-Normalized Difference Water Index. A good correlation has been seen ( $R^2 > 0.81$ ) for ET from the SEBAL model, whereas for the METRIC model the value ranges between 0.7 to 0.86. Generally, the ET value from the SEBAL model is better compared to the METRIC model based on  $R^2$  of different vegetation indices. A linear relationship has been seen between ET and NDVI and SAVI index. Higher  $R^2$  was obtained for NDVI and SAVI compared to the other. Exponential relation between LAI and ET was observed whereas for NDWI and ET inversely relation has been seen due to arid and sub-arid environment because NDWI shows the water body feature of the land surface.

## Conclusions

- ✓ There is a highly inversely relation between fractional ET values and LST.
- ✓ The advantage of satellite remote sensing in the study and characteristic of ET is typically important to irrigation, hydrology, and water resource management.
- ✓ Results showed that automated METRIC and SEBAL models can perform different energy flux such as Latent heat flux (Le), Sensible Heat flux (H), Net radiative flux (Rn), and soil heat flux (Gi).
- ✓ Estimation of ET from the SEBAL model has higher  $R^2$  and better estimation than ET from the METRIC model.
- ✓ SEBAL model is much more related to the vegetation index compared to the METRIC model.

## References

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