Importance of vegetation structure for predicting evapotranspiration in a tropical mosaic landscape

Raunak Kirti, Alejandra Valdés-Uribe & Dirk Hölscher
Tropical Silviculture and Forest Ecology, University of Göttingen, Germany

Introduction

Tropical forest regions are undergoing significant transformations. Such transformations may affect evapotranspiration due to changes in vegetation structure.

Objectives of our study:

- to identify key biophysical variables significant for the spatial prediction of evapotranspiration.
- to better understand the role of vegetation structure in the spatial predictions of evapotranspiration.

Study Area

- Northeast Madagascar, SAVA region
- Tropical humid climate
- Rainfall 1255 - 3709 mm y^{-1}
- Main land-use
  - Forests
  - Forest fragments
  - Agroforests
  - Rice fields
  - Fallow lands
- Size: 20,133 km^2

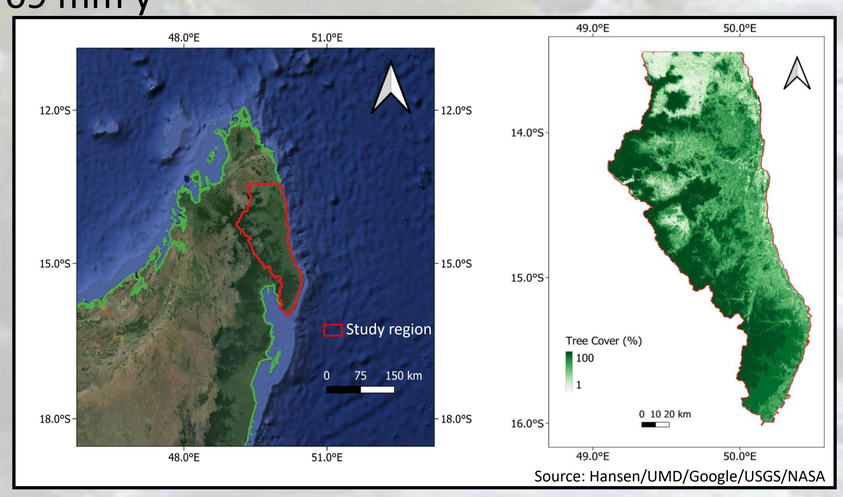

Fig: Location of study region (left); tree cover across study area (right)

Data Sources

- Daily Evapotranspiration: ECOSTRESS (70 m × 70 m)
- Predictor variables: ERA5, CHELSA, JAXA, ISRIC, GEDI, PROBA-V
- Variables in the ECOSTRESS L3 algorithm were avoided

Data Analysis and Workflow

- Forward feature selection of predictor variables
- Random forest model
- Model validation and feature importance

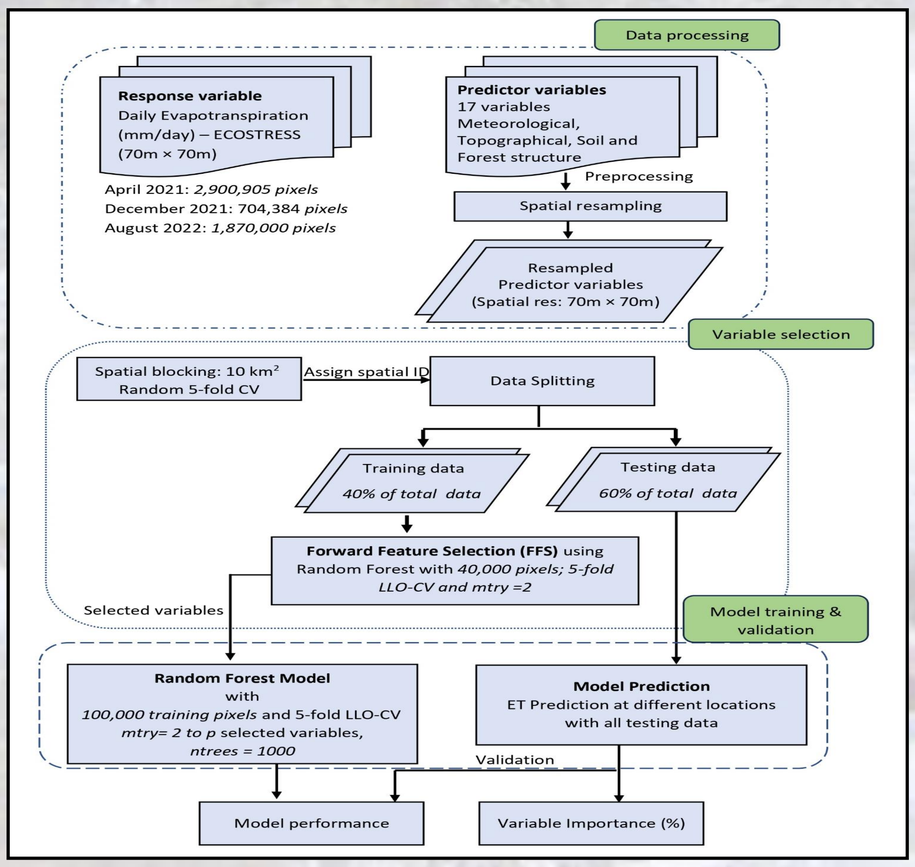

Fig: Methodology adapted from Ludwig et al. (2019)
Remote Sensing of Environment (https://doi.org/10.1016/j.rse.2018.12.019)

Results

Spatial Predictions of Evapotranspiration

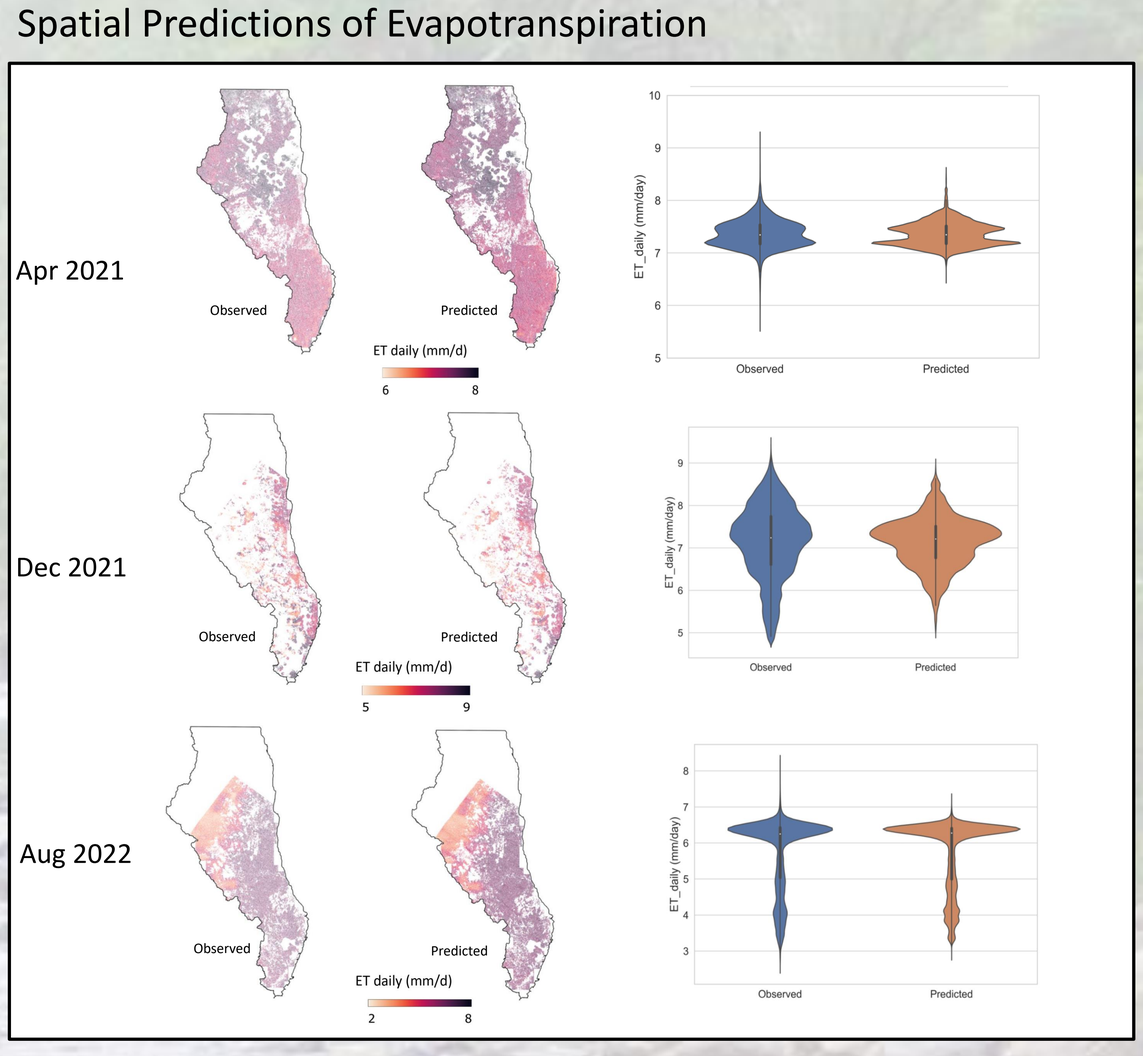

Fig: Spatial distribution of observed and predicted evapotranspiration (1,160,362, 422,630 and 1,122,000 pixels, respectively). Model prediction accuracy (R^2) 0.77 to 0.95.

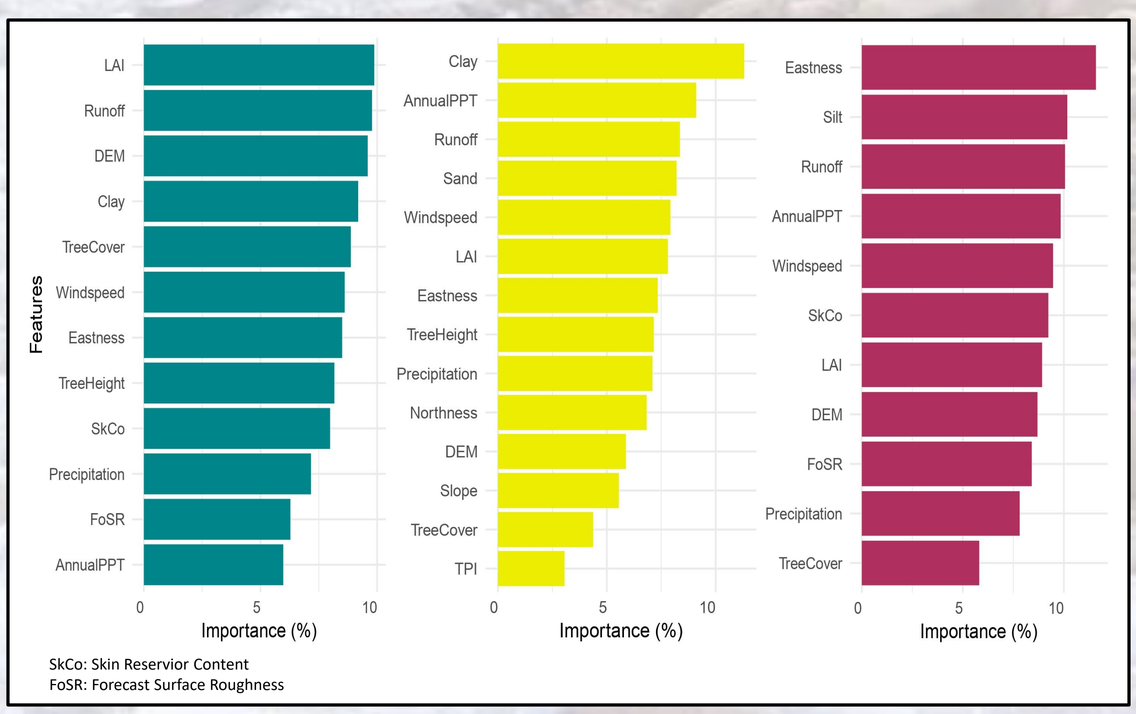

Fig: Feature importance of the selected variables for spatial predictions of evapotranspiration using random forest model.

Summary and Conclusions

- The models achieved high accuracy for the spatial prediction of evapotranspiration for different days.
- Besides other biophysical variables, leaf area index, tree cover and tree height were important variables.
- Our findings thus underscore the crucial role of vegetation structure for evapotranspiration.

Acknowledgment
DAAD (German Academic Exchange Services)

Contact: Raunak Kirti
raunak-kirti.raunak-kirti@forst.uni-goettingen.de