Assessing the feasibility of using satellite date to predict understorey microclimate variation in the Brazilian Atlantic Forest Michaela Peterson

Background

- Accessing thermal refuges is an important way in which animals can behaviorally thermoregulate¹
- Tropical forest understoreys are typically though to have low microclimate variation, limiting options for behavioral thermoregulation¹
- However, some research shows that ecologically significant microclimate variation does exist^{2,3,4}
- Understorey microclimate is difficult to predict using remote sensing data, but may be associated with variables such as NDVI and NDMI⁵

Figure 1. Maps of Caetetus Ecological Station (green outline) with logger sites shown. a) Average temp. deviation at logger sites (warmer colors correspond to warmer sites). b) Difference between predicted and observed temp. deviation (larger difference indicated by larger size).

blue spectrum

green spectrum

red spectrum

near infrared (NIR)

short-wave infrared 1 (SWIR1)

short-wave infrared 2 (SWIR2

(NIR - Band 4) / (NIR + Band 4)

(NIR - SWIR1) / (NIR + SWIR1)

(NIR - SWIR2) / (NIR + SWIR2)

Landsat 8

Band 2

Band 3

Band 4

Band 5

Band 6

Band 7

DEM

NDVI

NVMI 1

NVMI 2

Aspect

Calculated Variables

Distance-to-forest-edge





Best-Fit Model for Mean Temp.			
Deviation:	Variable	Coefficient	P-value
	Intercept	-10.495	0.002
	NVMI 1	9.833	0.0046
	NIR	0.00215	0.0031
	Model R ²	0.559	

Figure 2. Histogram showing distribution of predicted mean temperature deviations from a Monte Carlo simulation run with ranges of NIR and SWIR similar to the study area.



Methods

- Understorey microclimate temperatures were recorded with data-loggers at Caetetus Ecological Station in June and July of 2019
- Landsat 8 bands for the study area were obtained from USGS, and were used to calculate NDVI and NDMI
- A DEM for the study area was also obtained from USGS
- Distance-to-forest-edge and aspect for each logger site were calculated in ArcMap
- The Exploratory Regression Tool was used to find best-fit models to predict measures of microclimate temperature from varying combinations of independent variables
- Best-fit models were used to generate ranges of predicted microclimate variation using Monte Carlo analysis

Discussion

- Of all the variables examined, only NIR and NVMI had a consistent significant effect on temperature deviation
- However, the model incorporating these two variables explained a substantial proportion of variation in average temperature deviation (R^2) = 0.559)
- The importance of NMVI is likely specific to the habitat type (semi-deciduous tropical forest) and season (dry) under study
- As NVMI incorporates NIR, it seems possible that a single metric based on NIR and SWIR could be used to predict understorey microclimate variation

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