MAXENT species distribution modeling for *Metroxylon sagu*

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Introduction

For this exercise, I used GBIF data on the *Metroxylon sagu* crop, a palm tree which is cultivated for its starch-rich stem-marrow, useful as an ingredient in a lot of applications. The occurrence data is mostly spread around Papua New Guinea and Indonesia, with some outliers near the gulf of Mexico.

Methodology

The analysis in the MAXENT modelling program include extracting linear (variables closeness to observed values), quadratic (variance of variables closeness to observed values), hinge (linear feature cut off at threshold), and product (closeness of covariance of two variables to observed values) features.

Specific threshold features (proportion of model that has values above a threshold for a variable should be close to observed proportion) where left out, mostly because this is an experimental analysis to get a first big overview, so we do not focus on specific thresholds.

The chosen non-correlating bioclimatic variables used in this analysis include: 6 (min. temperature of coldest month), 8 (mean temperature of wettest quarter), 9 (mean temperature of driest quarter), 15 (precipitation seasonality) and 18 (precipitation of warmest quarter). While choosing, I tried to keep in mind that we are dealing with a tropical plant species, meaning you could expect that variables regarding cold and drought have the most impact.

The output in the following section are models for the current distribution of *Metroxylon sagu* and a prediction for the future, using the “ACCESS1-0” climate model, based on a representative concentration pathway (rcp45) emission scenario.

Model Output

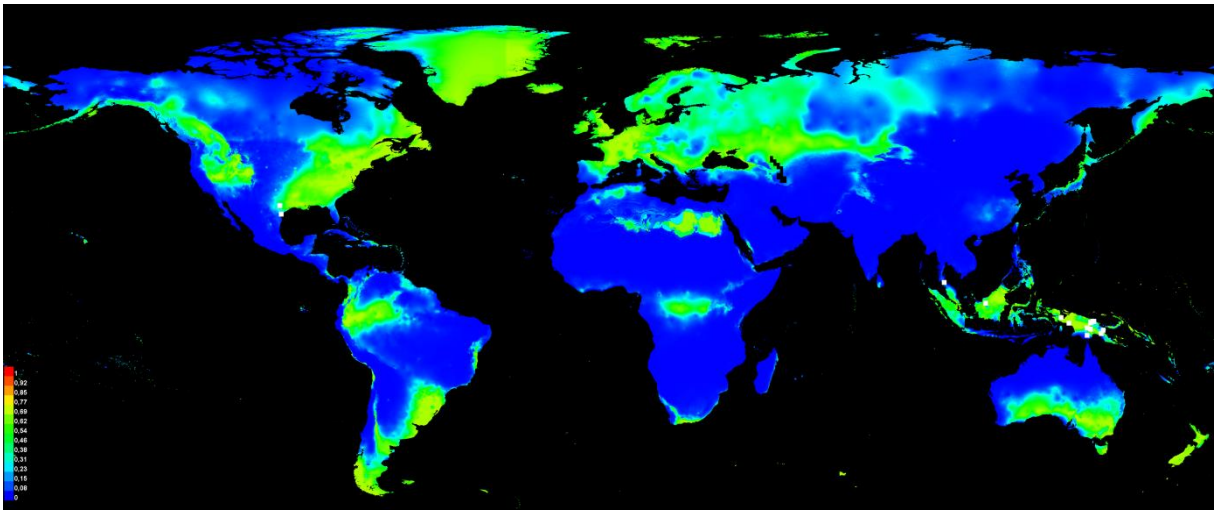

Figure 1. Present (representative of 1960-1990)

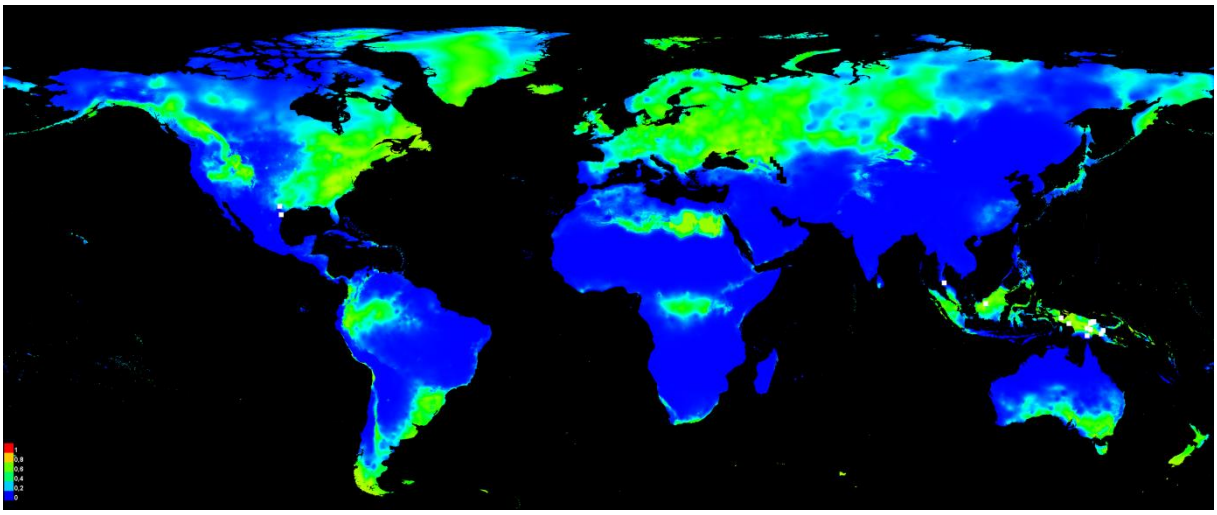

Figure 2. Future (2070, ACCESS1-0 model, rcp45)

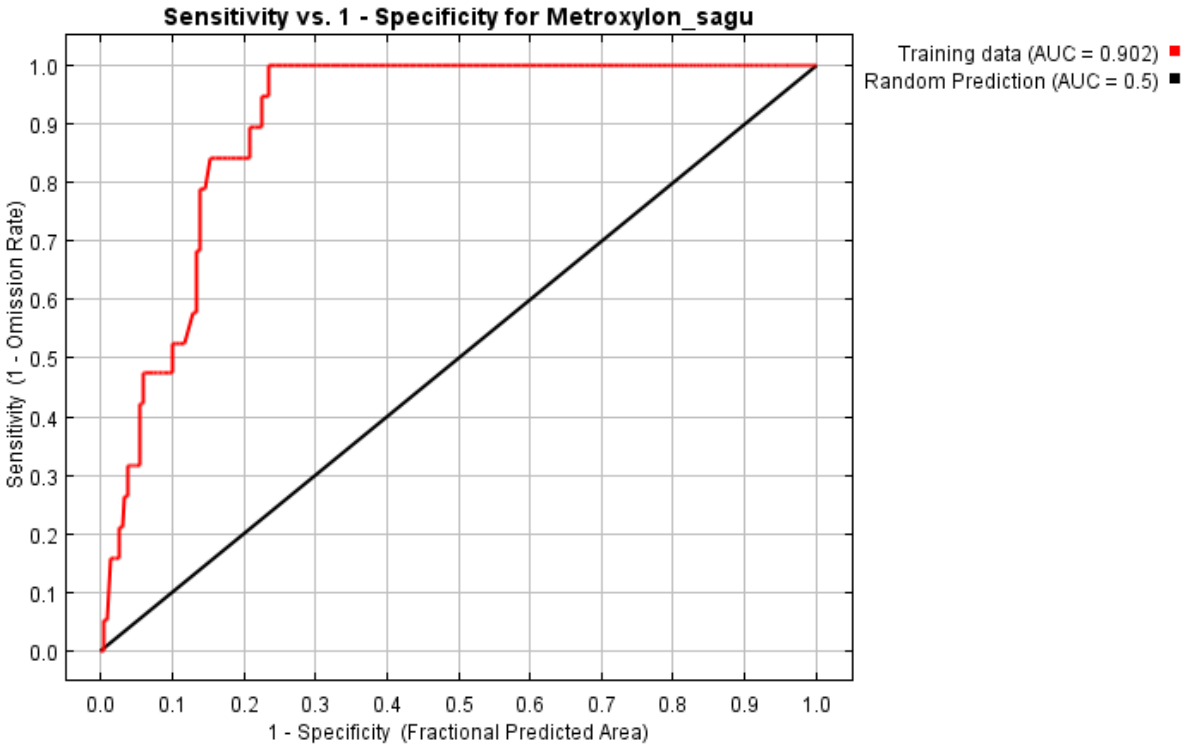

Figure 3. Receiver operating characteristic (ROC) curve

With an AUC of 0.902 it seems that the program constructed a reliable model based on the training data. AUC = Probability of correctly predicting (higher then random chance) if a species is present on a certain site.

Variable	Percent contribution	Permutation importance
bio15	91.8	9.2
bio18	6.5	82.1
bio8	1.2	8.5
bio6	0.5	0
bio9	0	0.2

Figure 4. Variable importance table

Precipitation seasonality and precipitation of warmest quarter are mostly driving the modeled distribution pattern, indicating that precipitation and warm temperatures are important for a tropical plant species to thrive (which seems logical).

Response to future scenario

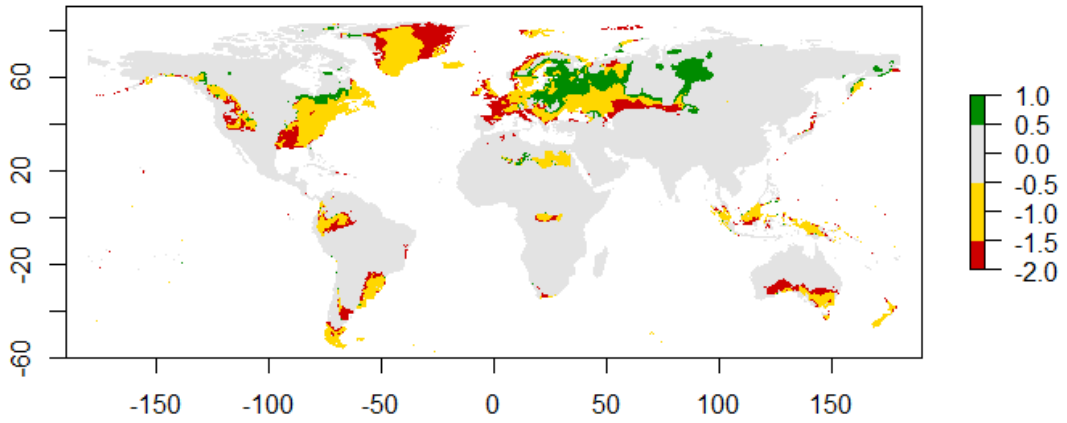

Figure 5. Occurrence area change maps map, showing a high occurrence probability in red for the present, green for the future, and yellow in between

Biological interpretation

Especially in the Northern hemisphere, the *Metroxylon sagu* palm is expected to have a higher change of thriving. In short this could mean that, in the future, the species could thrive / be cultivated in areas which are considered too dry and cold in the present (given there will be no big evolutionary changes in the species that changes the adaptability).

Of course you need to keep in mind that this type of distribution model only focusses on abiotic factors, while biotic factors can also have a big influence on species distribution (predation, food availability, specific interactions between species that might need each other to survive). Also, my dataset was relatively small (74 observations) from which some did not contain all environmental variables used during the making of the model. Finally it is good to note that the AUC is not a solid number you can accept blindly, mostly because it treats background as “pseudo-absences” (although this could be corrected by testing against a null-model).