Potential of LiDAR for species richness prediction at Mount Kilimanjaro

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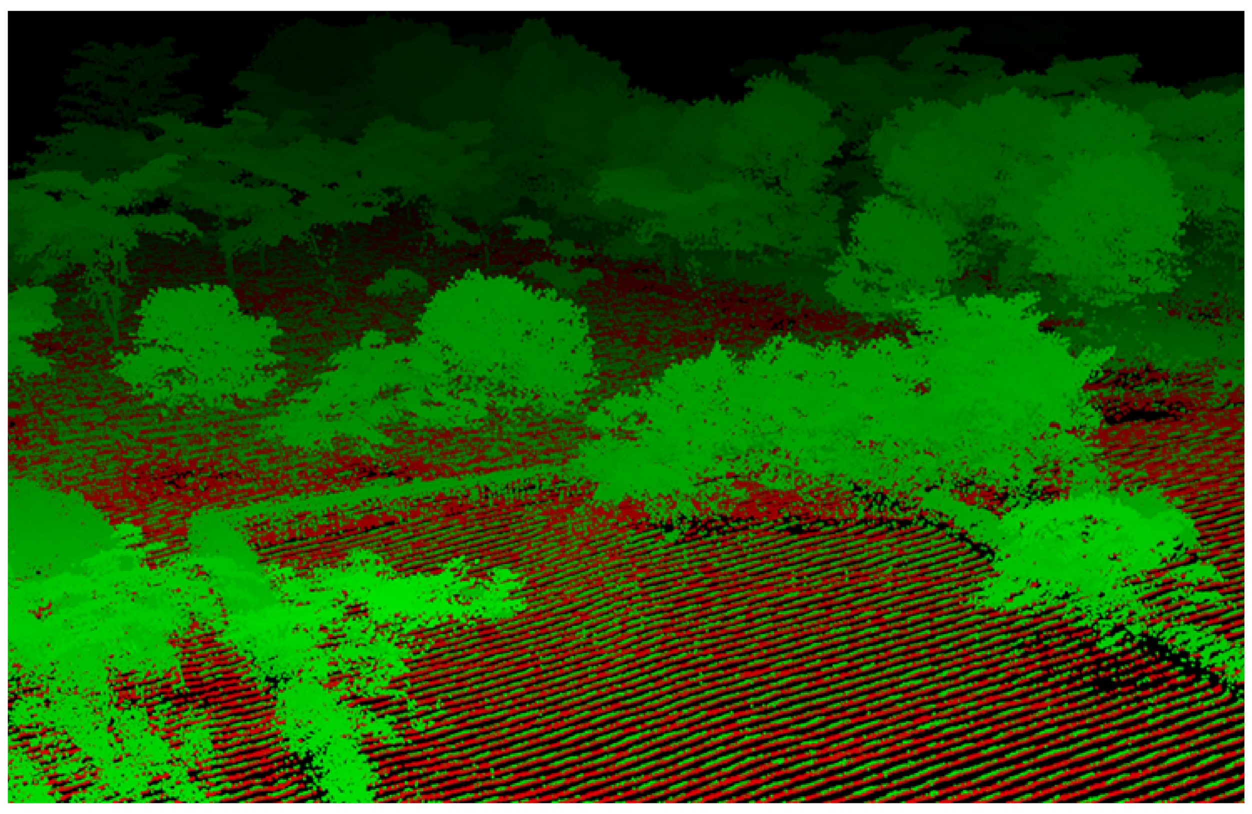
Abstract

This study aims at predicting animal species richness (17 taxa and four trophic levels collected across 59 sites) for the Mount Kilimanjaro (Tanzania) using structural variables of the vegetation derived from LiDAR data (90 variables). The data were collected along an elevation gradient of about 4000 meters within the DFG-Research Unit 1246 KiLi. This study aims at assessing the predictive potential of structural variables versus elevation in mountainous areas.



Methods

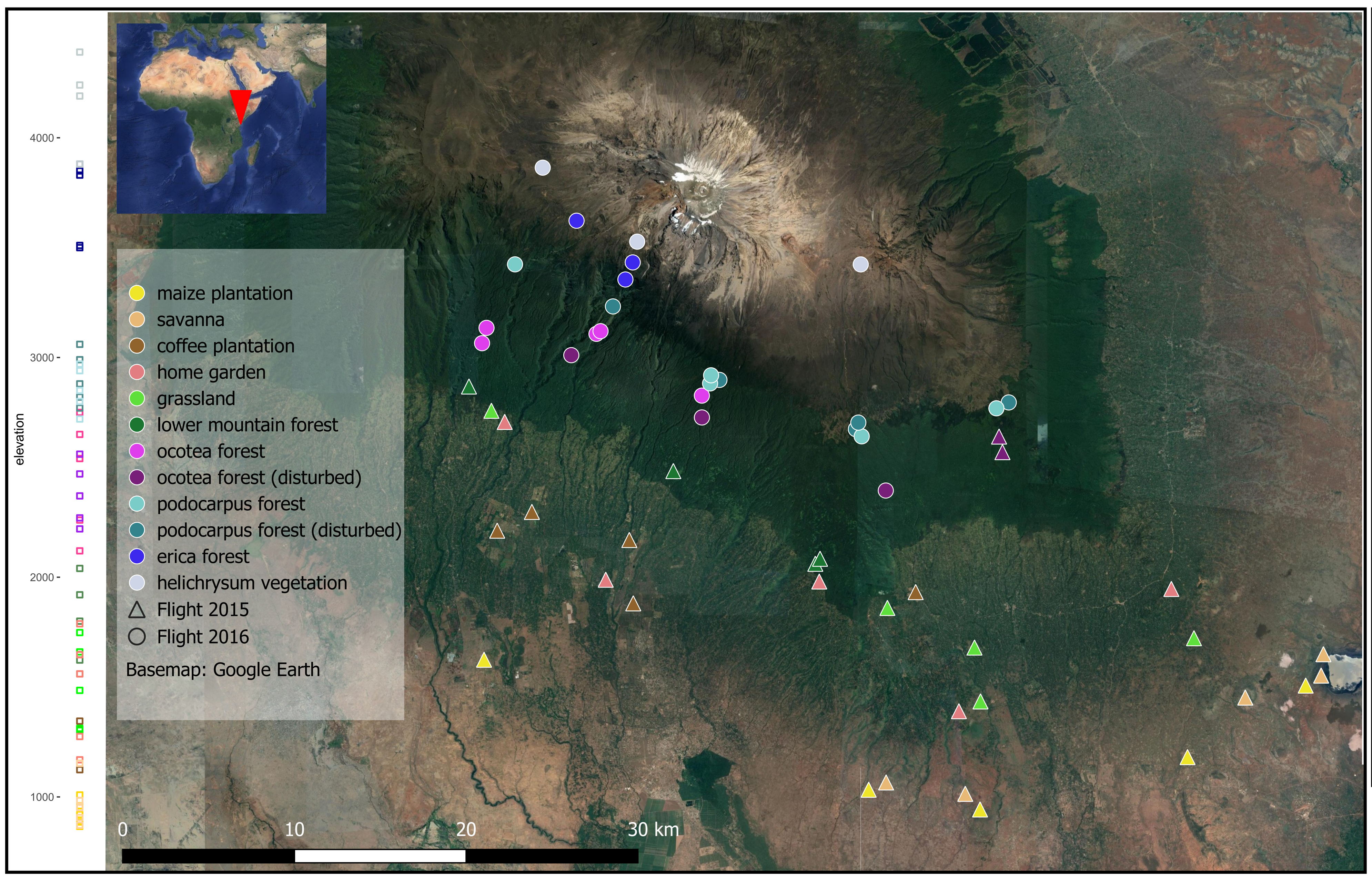
The prediction is accomplished in three consecutive steps:

(1) Species richness of each taxon and trophic level is estimated using Partial Least Square Regression (PLSR) with only elevation and its square as independent variables.

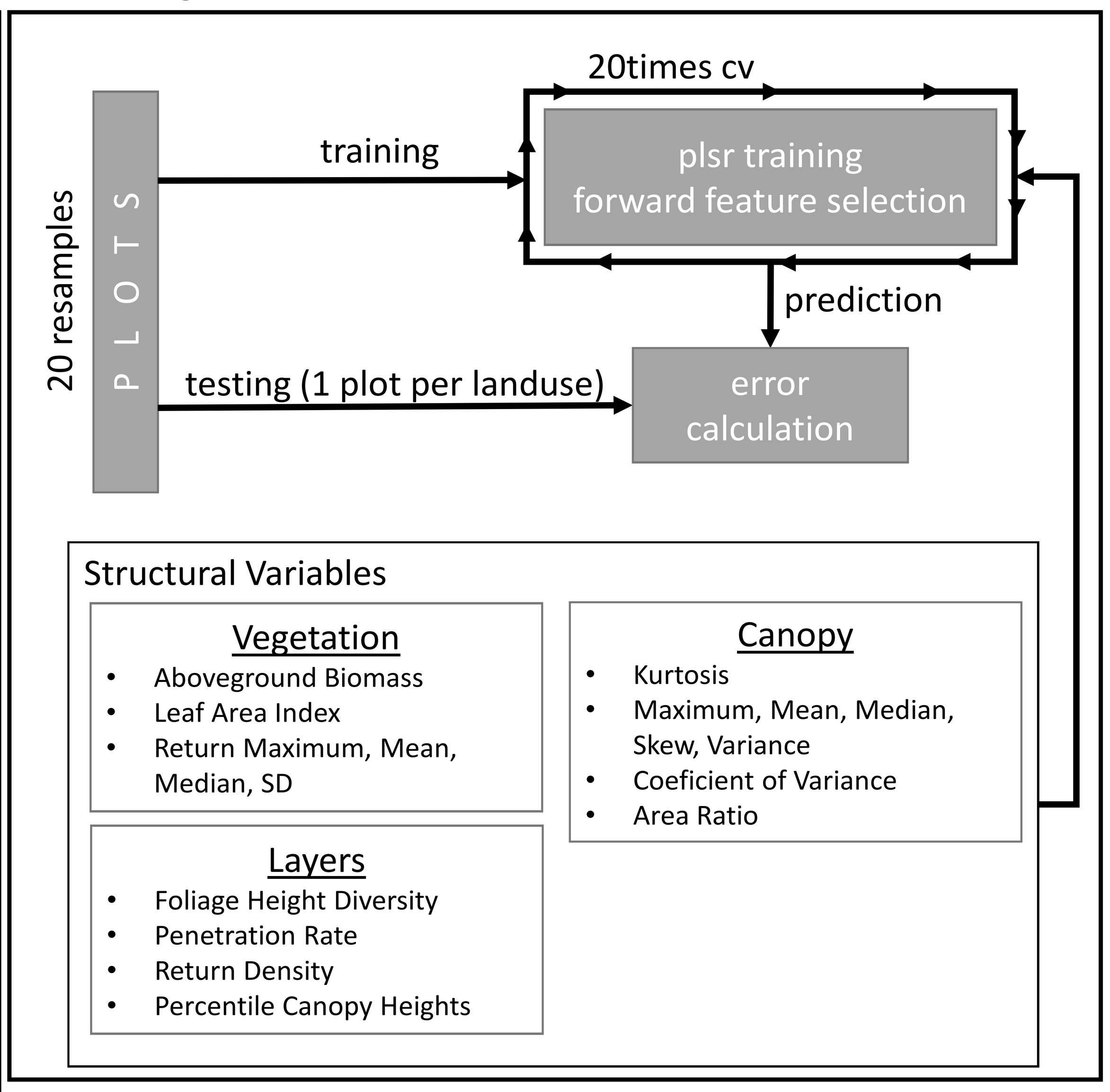
(2) The residuals of this model are then predicted using the LiDAR-derived variables and PLSR.

(3) This model is subsequently compared to a model that uses the same LiDAR derived variables and PLSR to predict species richness directly rather than its residuals.

Due to this procedure, it is possible to analyze the impact of elevation versus structure for each taxon. A stratified cross validation approach is used to ensure robust modeling results.



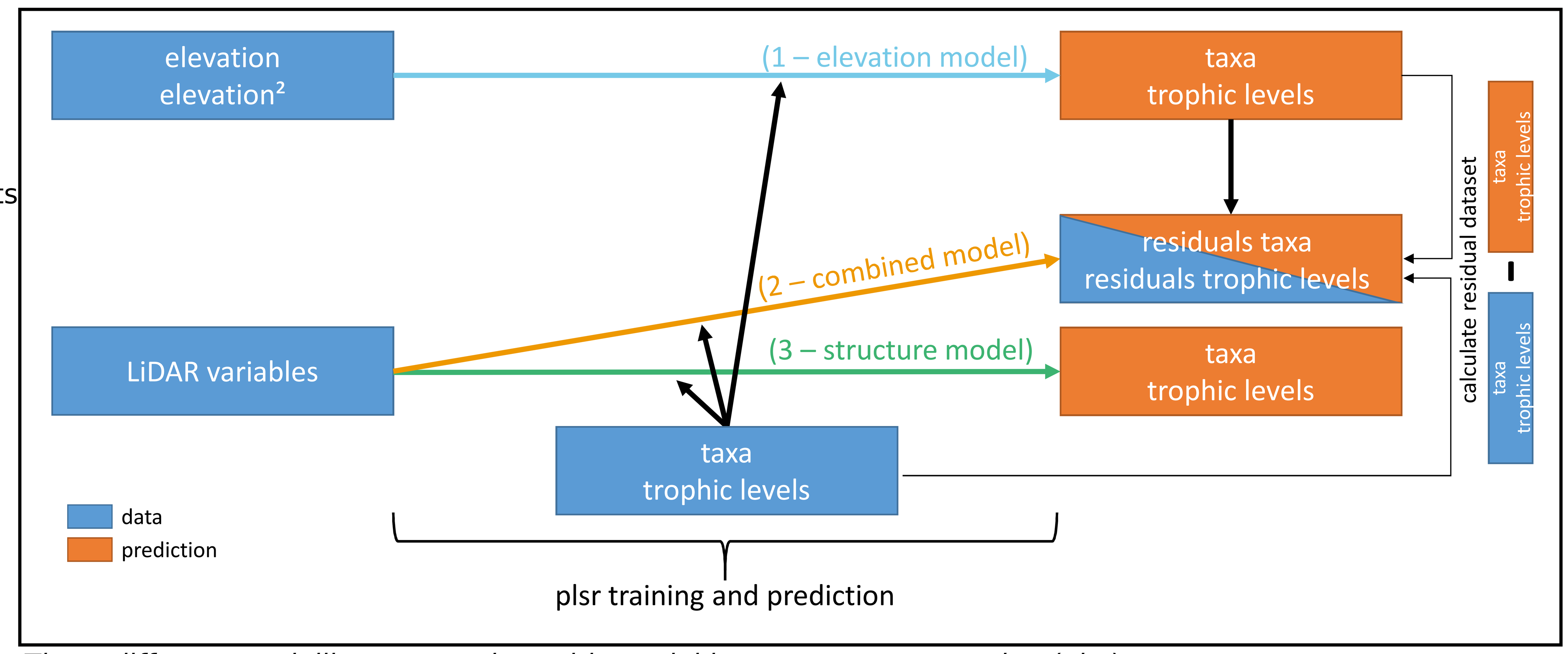
Study area: southern slopes Mt. Kilimanjaro (Tanzania)



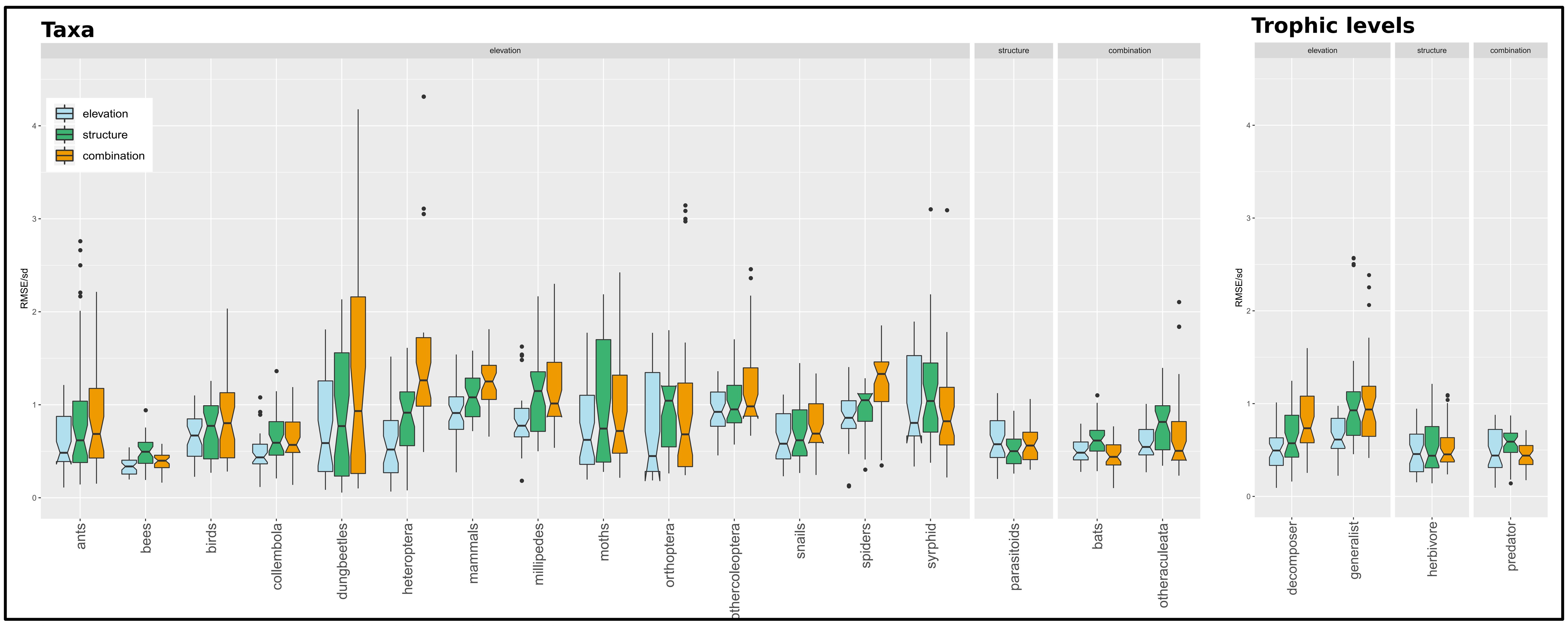
Cross validation and variable selection

Results and Discussion

- taxa: 14 of 17 perform best with elevation model
- trophic levels: 2 of 4 perform best with elevation model
- general: elevation superimposes structural effects
- tendency of higher trophic levels to be less dependant on structure
- models in mountainous areas need special precautions to avoid spurious correlation effects of elevation need to be considered for ecological variables



Three different modelling approaches with partial least squares regression (plsr)



Model performance (notches serve as indicators for significance)