Estimation of potential vegetation-distribution in a snowy basin in Ou Mountains with logistic regression models and a 10-m DEM

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Topography is one of the important factors which control vegetation-distribution in mountainous regions. Logistic regression (LR) models and a 10-m digital elevation model (DEM) were used for estimating the potential vegetation-distribution in a snowy basin (approx. 27 km^2) in the Ou Mountains in Iwate prefecture, northern Japan. The spatial distributions of seven vegetation classes, i.e., old-growth beech forest, mature beech forest, dwarf beech shrub, dwarf bamboo meadow, five-needle pine forest, snow avalanche shrub or meadow, and riparian forest, that were sampled from a 1:25,000 scale physiognomic vegetation map were analyzed. The distribution of each vegetation class had strong correlations with morphometric parameters derived from the 10-m DEM, e.g., elevation, gradient, aspect, plan and profile curvatures, relative slope position and the topographic wetness index (TWI). These results indicate the effectiveness of the morphometric parameters for estimating vegetation-distributions in mountainous regions, which can be explained mainly in relation to the topoclimatic conditions such as the snow depth distribution, wind exposure and the occurrence of snow glides and avalanches. The potential distribution of each vegetation class that was inferred in the study basin and subsequently verified with the area under the receiver operating characteristic curve (AUC) indicated good performance of the LR models for most of the vegetation classes except for the old-growth and mature beech forests. A potential vegetation-distribution map was further generated by overlaying the estimated presence/absence of each vegetation class that was dichotomized from the probability of occurrence map at the threshold value where the kappa value of each vegetation class was maximized. Since the models with higher AUC values generally tend to be more accurate, the vegetation classes with lower AUC values were overwritten by the classes with higher AUC values. Although overall accuracy and kappa values were generally low, the generated potential vegetation-distribution map approximately corresponds to the actual vegetation-distribution map based on the visual comparison. Since vegetation mapping is difficult in the dense forested mountainous regions, the obtained results are very useful for estimating vegetation-distribution without intensive fieldworks. The result shows the capability of estimating potential vegetation-distribution with the use of fine resolution DEM as well as the LR models. Such maps are useful not only for mapping of potential vegetation-distribution but also for managing and rehabilitating forest biodiversity.