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Identifying areas of drought risk in forest: developing a method for forestry planners

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Drought risk is based on a combination of the frequency, severity, and spatial extent of drought (the physical nature of drought) and the susceptibility of a population or activity to the effects of drought. Droughts are likely to become more frequent and severe in some regions during the expected climate change. It is expected that global climate change will influence the water balance due to modified temperature and precipitation distribution. As a result the change of water balance affects economic and natural sectors. Forestry is jeopardized because on the one hand the biomass productivity of tree stands is closely related to the soil water regime and on the other hand drought stress reduces the tree's defences against pests.
The aim of this study (funded by the INTERREG IVB-project ForeStClim) is to develop a method to identify forestry areas with a high risk of droughts in the mesoscale, where data with high resolution (e.g. soil maps, forestry inventory) are not available.
To reach this goal, in first step areas at the Donnersberg massiv (a climate sensitive forest site between the Rhine-Valley and the Palatinate Forest low mountain range in Rhineland-Palatinate, Germany) that exhibited drought stress during the dry summer season in 2003 were identified. Several leaf water sensitive indices, e.g. the Normalized Difference Water Index (NDWI), were calculated on the basis of Landsat TM data for the drought year of 2003 and a reference year representing "normal" climatic conditions. The results were stratified for different tree species based on a spatial adaptive classification approach considering the eco-regional and phenological characteristics of the heterogeneous low mountain range landscape.
Subsequently, analyses were done to get the information among which circumstances drought risks exist. Therefore it was necessary to assess the most important parameters (e.g. soil, aspect, slope, tree species etc.) for creating a weighting factor for the query. These parameters were weight statistically by doing a linear regression in R. In this step for the regression the dependent variable was TDiff (difference in temperature) and the independent variables consists of WBR (water balance ranges), soil, aspect, slope, and tree species. The resulting indicator variable contains all information of nominal scaled features in codes to derive main issues, indices and parameters for the new tool.
Afterwards, the method to delineate drought risk in mesoscale areas was developed based on the previous results using wide spread available data like DHM, geology, land-use and topology. As a matter of course, the results of the developed method were verified twice: once by comparing the new maps with the data from the analyses of the Landsat images, once during a field campaign and different mapping exercises.
The outcome of this study (maps in different scales) can be the basis for forestry planners and stakeholders to manage their forest provident to reduce damages of trees and losses of biomass caused by droughts.