



The loss of ecosystem services due to land degradation. Integration of mechanistic and probabilistic models in an Ethiopian case study

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Land and soil degradation are widespread especially in dry and developing countries such as Ethiopia. Land degradation leads to ecosystems services (ESS) degradation, because it causes the depletion and loss of several soil functions. Ethiopia's farmland faces intense degradation due to deforestation, agricultural land expansion, land overexploitation and overgrazing. In this study we modelled the impact of physical factors on ESS degradation, in particular soil erodibility, carbon storage and nutrient retention, in the Ethiopian Great Rift Valley, northwestern of Hawassa. We used models of the Sediment retention/loss, the Nutrient Retention/loss (from the software suite InVEST) and Carbon Storage. To run the models we coupled soil local data (such as soil organic carbon, soil texture) with remote sensing data as input in the parametrization phase, e.g. to derive a land use map, to calculate the aboveground and belowground carbon, the evapotranspiration coefficient and the capacity of vegetation to retain nutrient. We then used spatialised Bayesian Belief Networks (sBBNs) predicting ecosystem services degradation on the basis of the results of the three mechanistic models. The results show i) the importance of mapping of ESS degradation taking into consideration the spatial heterogeneity and the cross-correlations between impacts ii) the fundamental role of remote sensing data in monitoring and modelling in remote, data-poor areas and iii) the important role of spatial BBNs in providing spatially explicit measures of risk and uncertainty. This approach could help decision makers to identify priority areas for intervention in order to reduce land and ecosystem services degradation.