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The effect of land cover change and forest fires on water quality in natural and anthropic head-water basins of the Cantabrian Mountains (NW Spain): a seasonal approach

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Abstract

In mountainous regions, high rainfall and steep slopes can induce severe surface runoff and soil erosion towards receiving streams. Under these conditions, land cover changes and forest fires may impact water resources (river chemistry and its biotic components) by modifying biogeochemical cycles and nutrient transport. In the Spanish Natural Park of La Sierra de Ancares, the original forest cover has changed during the last decades since traditional practices (e.g., burning, cutting and grazing) have been abandoned or reduced and secondary succession has become a common process. Nevertheless, human-made forest fires affecting mainly heathlands are still ongoing. To test the effects of these recent landscape changes on water resources, 20 head-water basin streams with different management and fire history regimes were sampled during two complete hydrological years across the region. Seventeen physical-chemical and biological parameters were determined in order to investigate the spatio-temporal variability in water quality and the hydrological responses of the basins. We observed that land cover changes play a major role in river systems. pH, electrical conductivity, suspended sediments and concentrations of Ca, Mg, K and NO_3^- were significantly different among forested and non-forested, burned and non-burned basins. Stream flow hydrology and local related biogeochemical cycles are positively altered by land abandonment and vegetation recovery. Alternatively, forest removal through recurrent fire events or land use intensification may lead to increased surface runoff, causing erosion and non-point pollution of the surface water. The macroinvertebrate community also differed meaningfully in abundance, species richness and taxonomic groups. In addition, seasonal variability gave rise to the larger variation in physical-chemical water quality parameters. Significant differences between natural and anthropic basins occurred mainly in summer, while differences within natural basins due to fire events only were found in rainy seasons. Therefore, sampling designs should be conducted during spring or autumn when landscape function is most intimately connected with local waterways. Therefore, the evaluation of the relationships between land cover change, fire occurrence and water resources in mountainous landscapes should be done spatially but also temporally in order to get a comprehensive knowledge of landscape function and connection to local waterways. Only integrated basin management can ensure an efficient use, equitable distribution, management and regulation of mountain water.