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Creating a spatially-explicit index: a method for assessing the global wildfire-water risk

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The wildfire-water risk (WWR) has been defined as the potential for wildfires to adversely affect water resources that are important for downstream ecosystems and human water needs for adequate water quantity and quality, therefore compromising the security of their water supply. While tools and methods are numerous for watershed-scale risk analysis, the development of a toolbox for the large-scale evaluation of the wildfire risk to water security has only started recently. In order to provide managers and policy-makers with an adequate tool, we implemented a method for the spatial analysis of the global WWR based on the Driving forces-Pressures-States-Impacts-Responses (DPSIR) framework. This framework relies on the cause-and-effect relationships existing between the five categories of the DPSIR chain. As this approach heavily relies on data, we gathered an extensive set of spatial indicators relevant to fire-induced hydrological hazards and water consumption patterns by human and natural communities. When appropriate, we applied a hydrological routing function to our indicators in order to simulate downstream accumulation of potentially harmful material. Each indicator was then assigned a DPSIR category. We collapsed the information in each category using a principal component analysis in order to extract the most relevant pixel-based information provided by each spatial indicator. Finally, we compiled our five categories using an additive indexation process to produce a spatially-explicit index of the WWR. A thorough sensitivity analysis has been performed in order to understand the relationship between the final risk values and the spatial pattern of each category used during the indexation. For comparison purposes, we aggregated index scores by global hydrological regions, or hydrobelts, to get a sense of regional DPSIR specificities. This rather simple method does not necessitate the use of complex physical models and provides a scalable and efficient tool for the analysis of global water security issues.