Spatial heterogeneity of burn severity in Northern Rocky Mountain forests (USA) between 1984 and 2011

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Fire frequency and area burned are increasing in most parts of the world, but whether the spatial configuration of fire severity may also be changing is not known. Large datasets and powerful analytical tools now exist to study spatial variability in burn severity over space and time, but such efforts are often hindered by the limited availability of spatially and temporally extensive field data for calibration. As part of a project assessing regional trends in spatial burn severity patterns, we evaluated the relationship between satellite-derived measures of burn severity (e.g. dNBR, RdNBR) and field measurements (e.g., tree mortality, postfire ground cover, fire-severity class) within 2 years after large fires that occurred in the Northern Rocky Mountains. Field data for fires that burned from 1988 to 2011 in Greater Yellowstone (n > 1,000 plots) were combined with data collected for fires that burned during 2011 throughout the Northern Rockies (n = 182 plots, from Greater Yellowstone to Glacier National Park). Mean RdNBR and dNBR values differed among burn-severity classes ($P < 0.05$), with high- and low-severity classes being more distinct than moderate severity. Thresholds were identified for each burn-severity class and we used RdNBR to map fire-severity categorically; model fit was assessed through cross-validation. Classes at the extreme ends of the burn-severity gradient (severe crown fire and unburned/low severity) were mapped with higher accuracy than moderate severity. We then compared metrics of spatial heterogeneity of burn severity among major forest types and topographic settings. Fires that burned in subalpine forests and in flatter topography had higher a proportion of high-severity burn than montane forests situated in more complex topography. Further, subalpine forests contained more area farther from unburned or low-severity edges. Understanding these differences in burn-severity patterns is critical for evaluating temporal trends in fire severity over large regions.