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Fire spatial heterogeneity, fire seasonality and burned area mapping accuracy in the tropical savannas of Northern Australia

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Accurate burned area mapping from remotely sensed data should be able to identify spatial heterogeneity within a fire perimeter, for an improved representation of fire effects as experienced by plants and animals. In order to derive a very high spatial resolution characterization of fire patterns in the tropical savannas of the Northern Territory, Australia, we walked 38.2km of line transects, sampling the presence/absence of burning evidence at 1m intervals, in 35 different fires that occurred between 2009 and 2011. Transects were sampled in the early and in the late dry season, and in five dominant vegetation classes. We used lacunarity analysis and spatial autocorrelation to assess the dominant scale of burned area patches, which turns out to be approximately 200m. Lacunarity analysis also suggests that burnt areas exhibit a clustered pattern and that fire heterogeneity is more pronounced in the early dry season. This is consistent with our observation that patches in the late dry season tend to be smaller and more randomly distributed. Finally, we used our high resolution data date to simulate remote sensing detection of burnt areas for a range of spatial resolutions. We quantify the omission error for each sensor and conclude that if resolution is lower than the dominant scale, then the error tends to be small. Our results also suggest that sensors with spatial resolution higher than the dominant scale have similar omission errors over a broad range of resolution values. The forthcoming Sentinel-2 satellites, which combine 5-day revisit, and systematic acquisition of all land surfaces at 10-20 m spatial resolution, with a large number of spectral bands, ought to allow for very accurate and timely mapping of fire heterogeneity, for improved assessment of fire impacts on biodiversity and pyrogenic emissions.