POTENTIAL OF CHAR FRACTION MAPS FOR EVALUATING BURNED AREA AND POST-FIRE EFFECTS: BRIDGING THE IMMEDIATE TO LONG-TERM DIVIDE

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INTRODUCTION

To appropriately use remote sensing methods to elucidate ecological processes, one is required to mechanistically relate actual surface processes; such as changes in reflectance, surface temperature, or fractional cover; to real indicators of ecosystem condition (Lentile *et al.* 2006). In the remote sensing of wildfires, we have seen a plethora of remote sensing methods applied to map burned areas and more recently to evaluate immediate and longer-term ecological impacts (a.k.a. fire and burn severity). The accurate production of such maps is necessary to reduce uncertainty in carbonaceous emission estimates relevant to global change research; and knowledge of the long term vegetation recovery and/or impact is important for management considerations such as salvage, carbon sequestration, monitoring invasives, and hydrological processes. In this study, we analyze the immediate post-fire remote measure of the fractional char (charcoal, black ash) cover, which should be mechanistically related to longer-term ecological effects, through correlation analysis with typical field-based measures.

METHODS

We generated 30m maps of char, green vegetation, and senesced vegetation fraction using the technique of linear spectral unmixing (Smith et al. in press) applied to Landsat Enhanced Thematic Mapper imagery (courtesy of Smith (2004) and Lentile (2004)). This method highlights the relative contribution and it is possible to have class fractions >1.0, although the sum of all fraction will equal 1. Generic spectral examples of each fraction class were applied to imagery of fires in both Southern Africa (to evaluate burned area) and in North America (to evaluate post-fire effects).

In April 2001, as part of Lentile (2004) 66 pine and 14 aspen 0.28 ha study sites were established across the range of apparent post-fire conditions. Twenty meters from each study site center at 0°, 135°, and 225° bearings, we established three 0.03 ha plots. On these plots, data on the fire effects on the canopy, boles, and around the bases of individual trees were collected. The minimum and maximum heights of crown scorch and crown consumption on individual trees were recorded. The portion of the crown scorched or consumed within this area was visually estimated to the nearest 5%, allowing the percent of crown scorched or consumed relative to the entire live crown length to be inferred. The maximum height of bole scorch and the percent of the bole affected by scorch relative to total tree height were also measured.

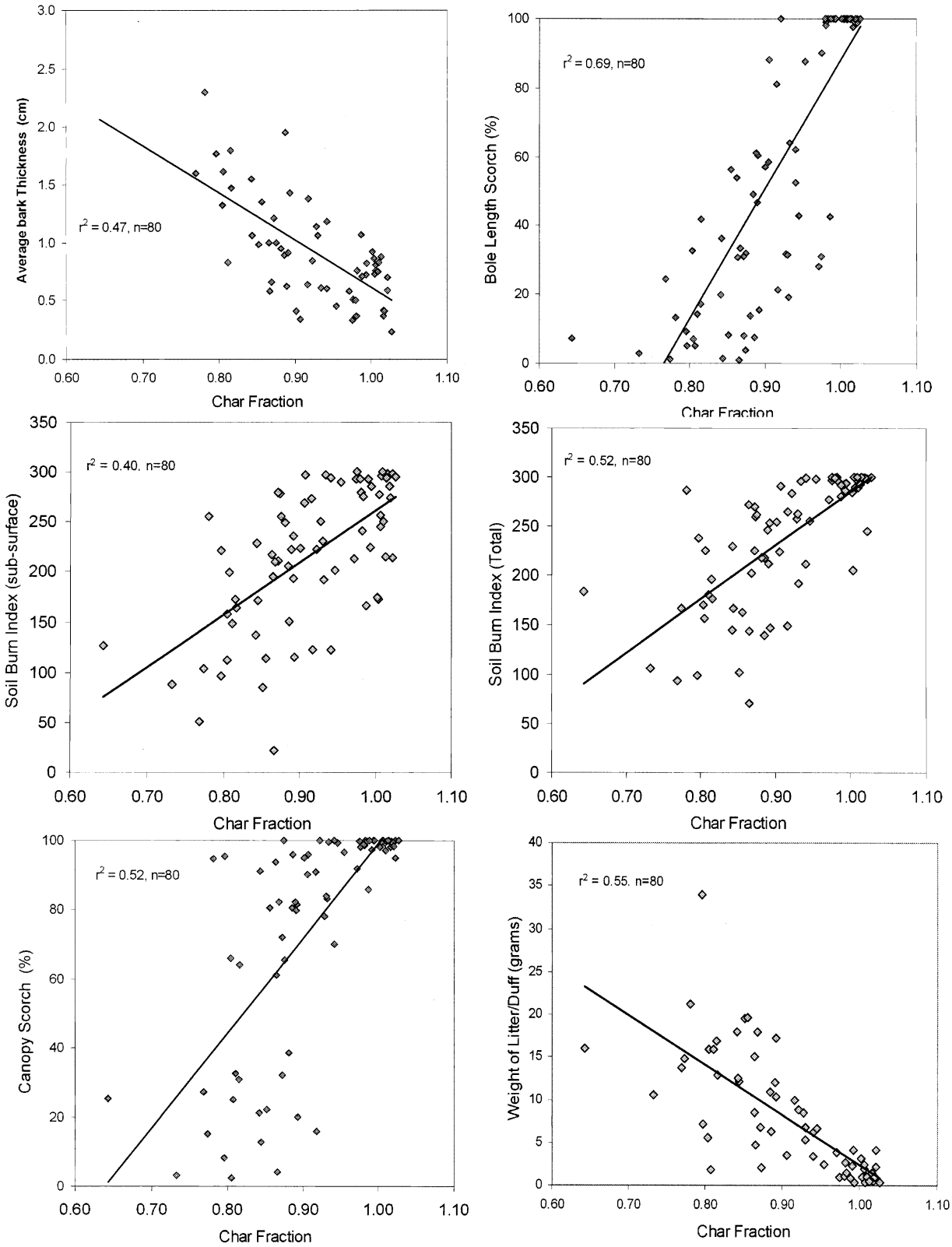

Figure 1. Relationships between fraction char fraction as remotely measured immediately post-fire and surface 1-yr post fire measures. All are significant at the 0.95 level.

Following Ryan and Noste (1985), the percent low, moderate, and/or high ground char in a one meter radius area around the base of each tree was measured, as where bark depths at two points on each tree. 30 m line transects at 90° and 270° bearings with the site center as midpoint were constructed and the depths of forest floor litter/duff and estimated ground char measured. Further samples were oven-dried and weighed to provide an estimate of forest floor biomass. We visually assessed the percent low, moderate, and/or high ground char (Ryan and Noste 1985) for a 0.025 m^2 surface area at 30 points located at 2 m intervals along transects at each study site. We indexed burn severity as the product of the proportion of the ground area charred and the degree of char scaled from low (1) to high (3).

RESULTS AND DISCUSSION

In a case example within southern African savanna, a highly accurate Landsat ETM+ map of burned area was achieved (k=1.00, a=99.5%), where pixels were defined as burnt if the charcoal fraction per pixel exceeded 50%. Application of the char fraction method to the Jasper field data demonstrates (Figure 1) that the fraction of char was a reasonable predictor of bole char, litter weight, canopy scorch and bark thickness.

SUMMARY AND CONCLUSIONS

Preliminary results indicate that the immediate post-fire measure of the fraction of char is a reasonable predictor of several ground based 1-yr post-fire measures, including the degree of bole char and the thickness of bark, which itself is in an indicator of tree mortality.

LITERATURE CITED

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