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Evaluating spectral indices and spectral mixture analysis for assessing fire severity and adjusting burning efficiency using Landsat data

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Fire severity data are of paramount importance to (i) organize post-fire rehabilitation plans and (ii) reduce uncertainties in wildfire emission estimates by allowing spatio-temporal variability in burning efficiency values. We have used a Landsat Thematic Mapper (TM) image to assess fire severity of the large 2011 Wallow fire in Arizona, USA. The Normalized Burn Ratio (NBR), differenced NBR (dNBR), Relative dNBR (RdNBR) and the char fraction estimated by Spectral Mixture Analysis (SMA) were evaluated. Geo Composite Burn Index (GeoCBI) and vegetation mortality data were used as ground truth. Of all remotely sensed measures tested the dNBR had the highest performance (GeoCBI-dNBR R2 = 0.84 and % black trees-dNBR R2 = 0.91), which supports the operational use of the dNBR for post-fire management. Without initial calibration with field data, however, dNBR values lack biophysical meaning. The SMA-derived char fraction also had moderate-high correlations with the field data (GeoCBI-char fraction R2 = 0.66 and % black trees-char fraction R2 = 0.82). The char fractions provide a direct mechanistic link with the fire processes that occurred on the ground. Such data have big potential to adjust burning efficiency values. This is of great importance to reduce uncertainties in wildfire emission estimates.