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Spectral Radiant Energy Emission Measurements of Vegetation Fires

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Biomass burning is a globally significant source of trace gases and aerosols and a major mechanism controlling exchanges of carbon between the land and atmosphere. Remote sensing is key to the study of large scale vegetation fire activity, and in the last decade active fire remote sensing has progressed from simple 'hotspot' detection, to include measures based around detailed quantification of a fires thermal radiation release. Such measures are conducted from both aircraft and spaceborne systems, mostly with a focus on improving estimates of gaseous and particulate smoke emissions. These thermal radiant energy observations provide, for example, information related to combustion rates and/or combustion phase (flaming vs. smouldering), and here we demonstrate how fire radiative power (FRP) estimates derived from thermal or SWIR wavelength spectral radiance observations appear independent of fuel type. We validate the ability of the FRP metric to provide remotely-derivable data on fuel consumption at hectare-scale or larger [boreal] forest fire events using airborne platforms, and we indicate how temporal compositing of polar-orbiter FRP data can provide the necessary estimates of fire radiative energy (FRE) used in fuel consumption estimation, without necessarily requiring the highest temporal resolution geostationary observations. Finally we illustrate how spectral radiant energy observations of active fires made in the VIS-NIR region of the electromagnetic spectrum can be used to supplement FRP data via the detection of the narrow spectral emission lines emanating from thermally excited trace elements contained within the burning vegetation. Since these spectral features are only initiated by flaming activity, they provide an indication of the combustion phase of the fire and may therefore hold information with which to better tailor the trace gas emissions factors used to convert between estimates of fuel consumption and the trace gas and particulate releases.