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# Measuring Subpixel Fire Sizes and Temperatures to Improve Global Remote Sensing of Fires and Their Effects

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Some of the most widely-used datasets for monitoring fires and their effects come from the Moderate-Resolution Imaging Spectroradiometer (MODIS) sensors aboard NASA's Terra and Aqua satellites, which can cover the entire Earth multiple times each day. For virtually all remote sensing systems, including MODIS, pixels that contain fires all comprise a mix of flaming, smoldering, and non-burning components, each with sizes and temperatures that vary between pixels. Current remote sensing products unfortunately provide little information about these subpixel components, severely limiting measurements and forecasts of the gas and aerosol emissions, ecological impacts, and spreading behavior from the world's fires. This study shows how multiple endmember spectral mixture analysis (MESMA) can measure subpixel fire sizes and temperatures from MODIS and other sensors, and overcome many limitations of existing methods for characterizing fire intensities from remotely sensed data, such as the Dozier and fire radiative power (FRP) approaches. This study also compares MESMA results with other measures of fire properties across multiple sensors, at nominal spatial resolutions ranging from 5 m to 1 km. Prior to this work, few studies, if any, had used MESMA for estimating fire sizes and temperatures from a sensor with global coverage like MODIS, or compared MESMA estimates of fire properties to higher-resolution data or other methods for measuring fires. Because a fire's size and its temperature exert strong influences on its gas and aerosol emissions, ecological effects, and spreading rates, MESMA estimates from MODIS and other sensors could contribute useful new information for monitoring, understanding, and forecasting the behavior and impacts of many fires worldwide.