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Estimation of Fire Radiative Energy in Siberia Using MODIS Data

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The intensity of heat release during biomass combustion is an important characteristic of wildfires. Space-borne systems, such as MODIS radiometer, provide observations of fire locations, as well as an estimate of the amount of radiant energy emitted by the fire. Such measures of fire radiative power (FRP) provide information on the fireline heat release intensity and on the rate of biomass combustion in large scale and are important for the analysis of fire impact on vegetation.
In this study we analyzed the spatial distribution and temporal dynamics of detected wildfires in Siberia considering their radiative power. For the analysis we used database of fire detections made by MODIS instrument located on TERRA and AQUA satellites for 2002– 2013. For the detected fire pixels the frequency of their occurrence was calculated depending on the radiative power. More than 80% of all detected pixels had radiative power less than 100 MW. The distribution of fires according to their radiative power values was obtained for different regions of Siberia characterized by various vegetation and climatic conditions. Geospatial analysis performed using vegetation maps for the territory of Siberia and GIS layers of active fire detections showed that fires in deciduous and pine forests generally had lower intensities than fires in larch and spruce/fir forests.
The rate of biomass combustion and the amount of heat emitted are strongly related to fuel moisture and therefore to weather conditions. In this study weather conditions were characterized using Russian and Canadian weather fire danger indices. Using images obtained during day and night satellite passes daily and long-term dynamics of fire radiative power was calculated. The long-term dynamics of fire radiative power measured by MODIS sensor was compared to weather fire danger indices calculated using on-ground weather stations data located in several Siberian regions mostly liable to fires. For most of the weather stations considered the Canadian fire weather index has better correlation with fire radiative power dynamics. However, the relationships between fire danger indices and fire radiative power have region specific parameters which can vary significantly.