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Radiative and Geometric Aspects of Fire Radiative Power Measurement from Space

C. Ichoku (1) and L. Ellison (1,2)

(1) NASA Goddard Space Flight Center, Climate & Radiation Laboratory, Code 613, Greenbelt, United States (charles.ichoku@nasa.gov), (2) Science Systems & Applications, Inc. (SSAI), Lanham, Maryland, USA

Large fires and similar sources of heat energy such as volcanoes, gas flares, and open biomass burning that are prevalent annually in many vegetated regions of the world, are detectable from space. These fires are quantitatively characterized from space in terms of fire radiative energy (FRE) release rate or power (FRP), based on radiance signal acquired in a suitable narrow-band mid-infrared (MIR) channel (typically in the 3.7-μm to 4-μm wavelength range). FRP data acquired over vegetation fires have been shown to have a direct relationship with the rates of biomass consumption and emissions of major smoke constituents. Over the last decade or so, FRP has been measured by a variety of satellite sensors from different orbits. The Moderate-resolution Imaging Spectro-radiometer (MODIS) was the first sensor to measure FRP from space aboard Terra (starting 2000) and subsequently aboard Aqua (starting 2002), both from polar orbits at 705 km above the Earth's surface. Geostationary satellite sensors, such as the Spinning Enhanced Visible and Infrared Imager (SEVIRI) aboard the Meteosat Second Generation (MSG) also measure FRP from a geosynchronous orbit located at 36,000 km above the Earth's surface. During the last few years, FRP has steadily gained increasing recognition as an important parameter for facilitating the development of various scientific studies and applications relating to the quantitative characterization of biomass burning and their emissions. To establish the scientific integrity of the FRP as a stable quantity that can be measured consistently across a variety of sensors and platforms, with the potential of being utilized to develop a unified long-term climate data record of fire activity and impacts, it needs to be thoroughly evaluated, calibrated, and validated. In an effort to start to pursue this goal, we are conducting a detailed analysis of the FRP products from MODIS, and performing some comparisons with similar SEVIRI and airborne measurements. In particular, we are examining the effects of the satellite altitude and variable observation geometry, sensor radiometric limitations relative to fire-scene characteristics, as well as other relevant factors, in order to establish their error budget for use in diverse scientific research and applications. In this presentation, we will show recent results of the FRP uncertainty analysis and propose potential error mitigation solutions.