Detection and simulation of long-term land-air changes induced by wildfires in the United States

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Wildfire is a severe natural hazard in the United States. One of the damages from wildfires is removal of vegetation. This can further lead to anomalies in local and regional climate. This study investigates the changes in the land-air system caused by some large wildfires in the United States using data analysis and modeling technique. Satellite remote sensing was used to quantitatively evaluate the land-surface changes. It was found that the changes in land-surface properties induced by mega-fires are very complex, depending on vegetation type and coverage, climate type, season and year after fires. The changes in LAI (and NDVI to a less degree) are remarkable only if the actual values meet a threshold. Large albedo changes occur in winter for fires in cool climate regions. The signs are opposite between the first post-fire year and the following years. Large increases in day-time temperature are found, mainly in summer, while nigh-time temperature changes have various patterns. The changes are larger in magnitude in forested lands than shrub / grassland lands. A parameterization scheme was developed based on the detected post-fire changes. The changes were decomposed into trend and fluctuation. The trend was described using a natural exponential function. The fluctuation included periodic variations determined by the Fourier analysis with their amplitudes determined by natural exponential functions. The final algorithm was a combination of the trend, period, and amplitude functions. This scheme was further used with climate and earth system modeling to simulate the local and regional climate effects of wildfires.

Keywords: wildfire, land-surface , climate, remte sensing, modeling

