Ice, Cloud, and Land Elevation Satellite-2 (ICESat-2) APPLICATIONS

Fuels and Wildfires

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Application Question: How can ICESat-2 contribute to mapping of potential fuel in forests that may lead to hazardous wildfires?

Monitoring Wildfire Hazard Potential

Wildfires are uncontrolled fires that can rapidly burn acres of land and everything else in their path including homes and businesses. On average, wildfires affect 4 to 5 million acres of land in the United States every year, and the number and intensity of these fires have been increasing. A wildfire can move at speeds of up to 14 miles per hour, making them a serious hazard to the communities near where they occur.

Much of today's wildfire problem is rooted in the expansion of communities into wildlands, modified vegetation conditions, and climate change. There are three factors needed to sustain combustion – oxygen, a heat source, and fuel. Heat can come from human activities (e.g., improperly extinguished campfires and cigarettes, sparks from hot car exhaust, downed power lines) or from natural sources (e.g., lightening, hot winds). Fuel is defined as any flammable material surrounding a fire, including trees, grasses, brush, and buildings. The extent, spread rate, severity, and intensity of the fire, and therefore its risk to lives and property, will depend on the amount of fuel present, the topography, and weather. ICESat-2 data can provide valuable information on the structure and distribution of the vegetation present (i.e., the amount of burnable material), which can be used to better model the intensity and spread of a wildfire, as well as information on topography, which influences wildfire behavior.

Who Cares and Why?

Local, state and national agencies, homeowners and families are all concerned about wildfires. In 2015, wildfires burned more than 10 million acres in the United States, destroying 4,500 homes and structures and killing 13 firefighters. Fire suppression costs the United States, on average, $2.9 billion per year. In addition to cost, wildfires contribute to poor air quality, increase risk of landslides and cause other ecological changes, which may hinder recreational use. Reducing fire risk, as a result of being aware of high fuel loads, includes activities such as forest thinning, prescribed burns, establishing fire-breaks, and an increased focus on reducing the probability of home ignition in the wildland-urban interface.

Needed Measurements

Lidar data can provide critical information on canopy structure and vegetation characteristics to estimate fuel load and wind. Lidar is ideal for estimating canopy height, canopy cover and whether or not enough vegetated material exists to propagate fire vertically into the canopy. These parameters are critical inputs to models used by the US Forest Service and other agencies in estimating the behavior of wildfires. Coupling highly accurate, space-based Lidar observations with satellite thermal detections of fire (e.g., VIIRS and Landsat) and thermal infrared information on fuel condition through water-use history (e.g., ECOSTRESS) can improve understanding of how fuel amount and condition affect the occurrence and behavior of wildfires.

The NASA Response

Launching no later than 2018, the Ice, Cloud and Land Elevation Satellite-2 (ICESat-2) mission will use one of the most spatially dense and high precision active remote sensing instruments for global measurement of surface elevation. The micro-pulse, multi-beam Advanced Topographic Laser Altimeter System (ATLAS) instrument will provide global terrain elevation, global canopy heights, and global canopy cover at resolutions varying from 30 m to 100 m. Coupled with other data sources (e.g., Landsat), ICESat-2 could allow for the consistent representation of canopy structure across the entire United States.

A number of ICESat-2 Early Adopters are conducting research to quantify the composition and structural variability of vegetation needed for understanding fuel loads and fire behavior. For example, NASA, US Forest Service, the Nature Conservancy, and the USGS EROS Center are exploring the potential for incorporating ICESat-2 observations into the Landscape Fire and Resource Planning Tools (LANDFIRE) program (landfire.gov) that provides consistently developed, spatially continuous vegetation and fuel data for the entire US at a 30 m pixel resolution. LANDFIRE data products are used for strategic planning and coordination across all United States government wildfire management efforts. Another Early Adopter is working to use ICESat-2 data to better characterize the fuel load present in shrubs and brushlands, which are prevalent in many Western states and are experiencing changes in local fire regimes as a result of increased invasive fire-prone annual plants, thus making these ecosystems vulnerable to high-severity fire and potentially long recovery times. ICESat-2 data can be used either independently or in conjunction with hyperspectral and multispectral data to quantify aboveground biomass of semi-arid and arid ecosystem vegetation.

Comments? Thoughts?

For additional information about ICESat-2 mission applications or this particular application please contact Molly Brown at mbrown52@umd.edu.