



IIM Newsletter January 2020

FIRE INFORMATION



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Fire is a complex bio-physical process with a range of direct and indirect consequences on Earth's atmosphere, biosphere and hydrosphere (<http://modis-fire.umd.edu/>). The Australian continent is a fire-prone environment; fire is a natural phenomenon essential to maintaining a state of equilibrium in the ecosystem. Indigenous Australians have utilised fire as a land management tool for centuries. Today, prescribed fires are used to clear land for agricultural purposes and to protect properties from uncontrolled fires.



Bushfires in Australia

The massive bushfires sweeping across Australia have shocked the world with their size and ferociousness. In this current fire season, 10 million hectares of Australian land has been burnt. Fire weather in Australia is becoming more extreme and the fire seasons are longer. As climate change is projected to exacerbate the warming and drying of southern and eastern Australia, there will be an increase in fuels that are drier and more ready-to-burn. There will also be an increase in the number of days where the fire danger is characterised as “severe”. Fuel load and human activities are important factors that increase the risk of fire. However, weather conditions including drought, strong winds and extreme temperatures are also critical as they influence the number, intensity, manageability, speed and size of bushfires.

Understanding these factors and managing information related to the weather conditions, eco-system vulnerabilities and situational awareness are essential for proper planning, preparedness, response and action when a fire-driven disaster strikes.

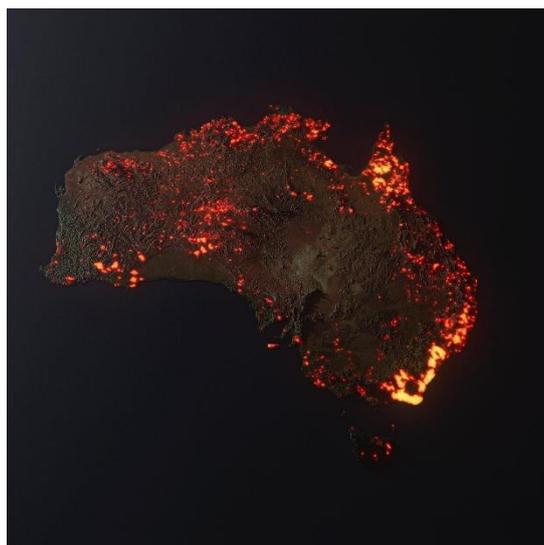
Fire Management Information Systems provide access to information concerning fire management activities. These systems integrate data from remote sensors and Geographic Information System (GIS) technologies to deliver information about fire locations and burned areas, which is used by natural resource managers, firefighters and the general public to understand the associated risks, derive informed decisions and to accurately plan, monitor and assess fire management activities.

The National Aeronautics and Space Administration (NASA) in the United States Federal Government is known for observing the cosmos, but this agency is also heavily involved in monitoring the Earth.



NASA's Earth Observing System program (<https://eosps.nasa.gov/>)

NASA's Fire Information for Resource Management System (FIRMS) distributes near real-time active fire data within 3 hours of satellite observation from both the Moderate Resolution Imaging Spectroradiometer and the Visible Infrared Imaging Radiometer Suite. FIRMS is part of NASA's Land, Atmosphere Near Real-time Capability for Earth Observing System (EOS). The NASA's EOS program started back in the 1980s, supported by a series of coordinated polar-orbiting satellites, designed to monitor and understand key components of the climate system and their interactions through long-term global observations. More information about the NASA's EOS program can be found at: <https://eosps.gsfc.nasa.gov/mission-category/3>.



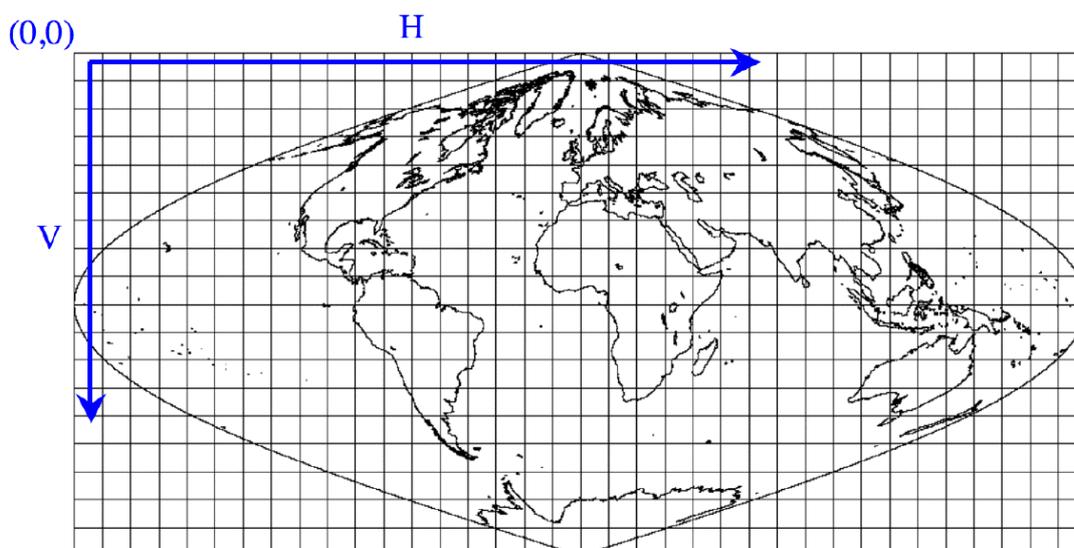
Fires burning in Australia in January 2020 (<https://firms.modaps.eosdis.nasa.gov>)

FIRMS was developed by the University of Maryland, with funds from NASA's Applied Sciences Program and the United Nations Food and Agriculture Organization (UN FAO). Its goal is to provide near real-time active fire locations to natural resource managers that require timely satellite-derived fire information.

A previous version of FIRMS, known as the Global Fire Information Management System (GFIMS) ran at the United Nations Food and Agriculture Organization (UN FAO), where it complemented the FAO's existing suite of projects that deliver near-real time information to ongoing monitoring and emergency projects, used by various UN organisations as well as to the general public.

FIRMS is able to deliver information about active fires as email alerts or downloadable in a range of digital formats (<https://firms.modaps.eosdis.nasa.gov>).

FIRMS uses the Moderate Resolution Imaging Spectroradiometer (MODIS). This system maps the land using a sinusoidal grid. Because these grids are often unmanageably large in their entirety, a common approach is to divide the observed region into fixed tiles. Each tile is assigned a horizontal and vertical coordinate.



MODIS tiling scheme (<http://modis-fire.umd.edu>)

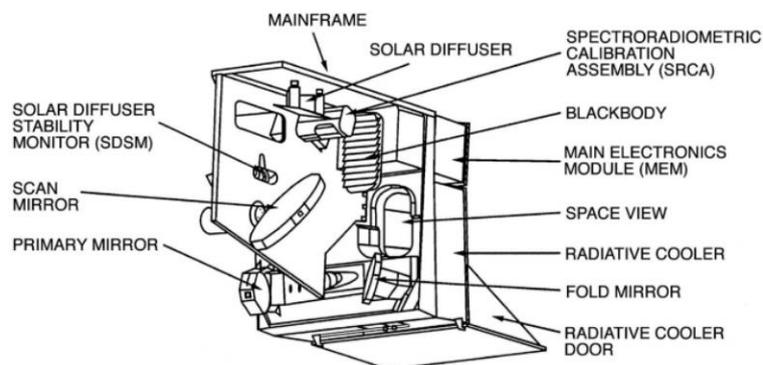
The active fire monitoring systems using MODIS are able to detect fires that are burning at the time of the satellite overpass under relatively cloud-free conditions, using a contextual machine-learning algorithm.

The burned areas are characterised by deposits of charcoal and ash, lack of vegetation and alteration of the vegetation structure (Pereira et al., 1997, Roy et al., 1999). The MODIS burned area mapping algorithm takes advantage of these spectral, temporal and structural changes. It detects the approximate date of burning by locating the occurrence of rapid changes in daily surface reflectance time series data. The algorithm maps the spatial extent of recent fires to distinct them from fires that occurred in previous seasons.



The latest map of fires in the Australian region based on VIMODIS data
(<https://firms.modaps.eosdis.nasa.gov>)

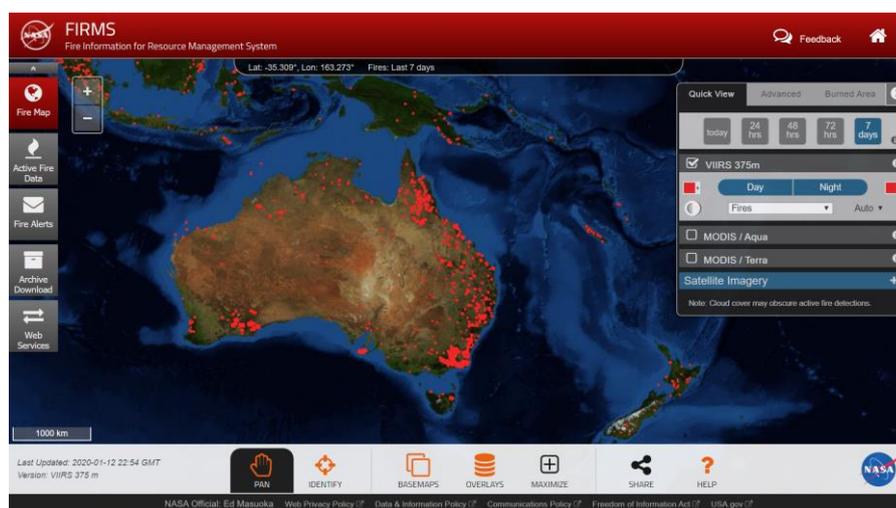
The MODIS instrument has been designed and developed since the Engineering Model was completed in 1995. Since then, two space-flight units, the Protoflight Model (aboard the *Terra* Satellite) and the Flight Model 1 (aboard the *Aqua* Satellite) have been orbiting our planet. Terra was launched in December 1999 and Aqua was launched in May 2002. The MODIS instruments, representing the finest in engineering of spaceflight hardware for remote sensing, were built to NASA specifications by Santa Barbara Remote Sensing.



MODIS Components (<https://modis.qsfc.nasa.gov/about/components.php>)

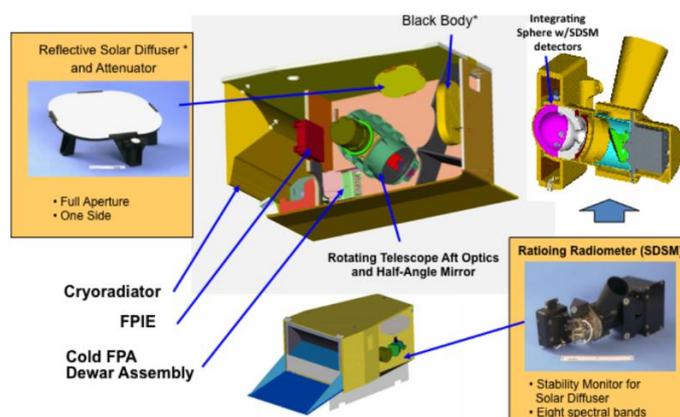
For more details about MODIS, visit: <https://modis.qsfc.nasa.gov/>.

The Visible Infrared Imaging Radiometer Suite (VIIRS) active fire monitoring is the latest technology that was added to FIRMS. It provides data from the VIIRS sensor aboard the joint NASA/NOAA Suomi National Polar-orbiting Partnership satellite launched in October 2011. The VIIRS data complements MODIS fire detection capability, as both of these systems provide fire hotspot detection. With the improved spatial resolution of the 375m, VIIRS data provides a greater response over fires of relatively small areas and provides improved mapping of large fire perimeters. The first fire detections using VIIRS sensor occurred in January 2012, when this instrument was fully commissioned.



The latest map of fires in the Australian region based on VIIRS data

(<https://firms.modaps.eosdis.nasa.gov>)



VIIRS optical Components

(https://www.researchgate.net/figure/VIIRS-optical-system-components_fig1_266417122)

For more details about VIIRS, please refer to: <https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data/viirs-nrt>

The strength of the systems utilised by FIRMS lies in their time-series of daily multi-spectral observations, which are used to characterise and monitor the land surface, from regional to global scales. MODIS provided a new standard in calibrated, science-quality, coarse-resolution satellite observations. VIIRS data is used to expand upon the MODIS applications to fire and air quality monitoring, agriculture monitoring and production modelling, carbon modelling and flood and sea ice mapping (<https://firms.modaps.eosdis.nasa.gov>).



The cost of the bushfires to the Australian community will be in the billions. We will need to rebuild lives and properties, support the recovery of wildlife and forests, cover the health and social costs, and manage huge losses to businesses and our environment. We as a nation must become smarter in the way we use the available data for better situational awareness, the prevention of fire disasters and the proactive management of risks. However, it is most critical that we consider our own actions and lifestyle choices to reduce the overwhelming impact of humanity on the natural environment, as climate change will continue to devastate communities across the globe if we do not take action now.