A Dynamic Threshold Method for Fire Detection based on Spatial-temporal Features using MODIS Data

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At present, the problem of forest disaster especially on forest fires has attracted increasingly attention of researchers. With the development of technology, this disaster can be prevented and reduced easier. Satellites and sensors have been widely used to monitor the forest fires due to remote sensing with high-frequency, large-scale, multi-spectral characteristics.

Most of the present satellite-based fire detection methods are based on fixed thresholds. The thresholds adopted in these methods are generally limited to a specific area or certain seasonal weather conditions and always failed to be applied for different time or regions, therefore the actual effects are sometimes unsatisfactory especially confronted with smolder points or relative lower temperature pixels.

Given the disadvantages of traditional methods, a dynamic threshold method is proposed in this paper for fire detection based on spatial-temporal features. By selecting a large number of different time and regions of cloud-free image pixels as experimental data sets, We analysis relationships between Typical Brightness Temperature (TBT) and other environmental features, such as time, locations, altitude, DEM, and make fire detection with the rule of dynamic range of the TBT as following:

$$T = f(lon, lat, h, day) \pm \Delta\text{T}$$

T: TBT of an image pixel;

Lon: longitude of an image pixel;

Lat: latitude of an image pixel;

H: DEM of an image pixel;

ΔT : TBT of dynamic change range of an (decision by the image pixel corresponding features typical emissivity)

When the detection of the pixel brightness temperature in the image is higher than its typical brightness temperature derived from the above-mentioned formula, the pixel is considered to be abnormal high temperature point. And then combine with NDVI and other auxiliary data to detect forest fire.

The experiment is carried out by using MODIS images as the experimental data in the region of a Mountain in Great Xing (Heilongjiang Province, China). The MODIS (Moderate Resolution Imaging Spectroradiometer) sensor, on board the Terra and Aqua satellites in Earth Observing System(EOS) of National Aeronautics and Space Administration(NASA)have been widely used for fire detection and offered an improved combination of spectraltemporal and spatial resolution for global fire detection compared with previous sensors,. The results will be presented along with accuracies achieved in the paper. By the dynamic threshold method, the results for fire detection are satisfying. Compared with conventional algorithms and NASA fire product, the scheme presented in this paper is an improvement both in efficiency and reliability.