INTER-COMPARISON OF HIMAWARI-8 AHI FIRE SURVEILLANCE DATA WITH MODIS AND VIIRS FIRE PRODUCTS

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ABSTRACT: Satellite remote sensing is regularly used for wildfire detection, fire severity mapping and burned area mapping. MODIS and VIIRS active fire products area commonly used for wildfire monitoring. However the low temporal resolution of four times daily and twice daily, limits the applications in terms of wildfire monitoring. Traditionally geostationary satellites provide high temporal resolution data. But have a spatial resolution inadequate for fire detection and surveillance. Himawari-8 is a new geo- stationary weather satellite launched in October 2015 by Japan Meteorological Agency (JMA). On board is the AHI (Advance Himawari Imager) 16 channel mutli-spectral sensor with 2km middle infrared(MIR) and thermal infrared (TIR) . AHI provides high temporal data capturing the full disk every 10 minutes, which covers the East Asia region. High temporal resolution makes it ideal for wildfire monitoring applications. Thus it is important to understand the capabilities of AHI in-terms of active fire detection. This paper presents an inter-comparison with other existing fire products, Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) with respectively 1km and 375m spatial resolution active fire products. MODIS active fire algorithm "Version 4" which is a bi-spectral fire detection algorithm is adopted for AHI sensor. Initial results show AHI was able to detect large fires with a high detection rate. The results also show possible applications of AHI for wildfire detection and tracking. Making way for near real-time monitoring of large fires.

1. INTRODUCTION

Himawari-8 is a new geo-stationary weather satellite launched in October 2015 by Japan Meteorological Agency (JMA). On board is the Advance Himawari Imager (AHI) 16 channel mutli-spectral sensor with a 500 meter RED channel, 1km GREEN, BLUE and NIR (Near Infrared) channels. The remaining 12 channels are in the MIR (Middle Infrared) and TIR (Thermal infrared) region ranging from 1.6-13.3 micrometers with a 2 km spatial resolution. In terms of coverage, AHI currently captures an entire hemisphere every 10 minutes covering the East Asia region (Da2015). This paper investigates the use of the AHI sensor for near real-time wildfire surveillance. A new algorithm, AHI Fire Surveillance Algorithm (AHI-FSA), is proposed to map fire lines at 500 resolutions every 10 minutes. The algorithm is based on utilizing three different spatial resolutions provided by the MIR, NIR and RED channels. Initial case studies of three fires shows the algorithm can effectively and accurately track the fire line at \unit{500}\meter~resolution, demonstrating the viable applications of AHI-FSA algorithm for near-real time wildfire surveillance. The algorithm also shows potential for detecting small, low intensity fire compared to existing MODIS thermal anomalies data products.

The AHI-FSA algorithm takes advantage of the multi-spatial resolution data available via the AHI to map a burning fire line i.e fire front at a 500 meter resolution every 10 minutes. A condition of the algorithm is that wind is present throughout the duration of the fire. This implies that the fire line is also moving in the direction of the wind, thus, there is minimal or no smoke over the burnt area and the highest density of smoke will be at the leading edge of the fire. The algorithm also requires cloud free imagery.

The algorithm is implemented using a four-step process. The first step is for the algorithm to reference the MIR channel to detect thermal anomalies at a sub-pixel level. This will bound the fire to within2x2km) area. The second step utilises the NIR channel to distinguish between the burnt/partially-burnt and unburnt vegetation within the detected MIR pixel, improving the resolution to 1 km square. Once burning and partially burning areas have been identified, the RED channel is used to detect the edge between high smoke density and non-smoking pixels. These edge pixels are then flagged as the potential active fire line.

2. RESULTS & DISCUSSION

Figure 1 below shows the variation in fire false positive data compared with MODIS active fire proudts.

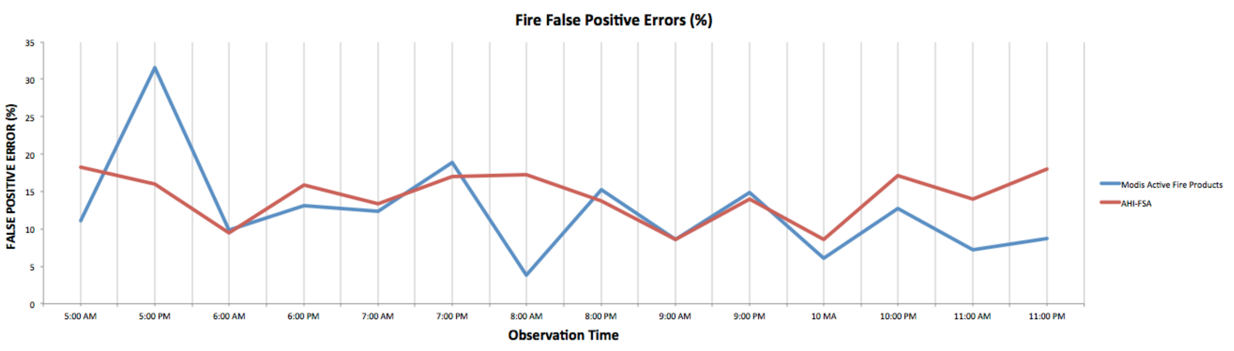

Figure 1 Shows compares false positive detection over single fire period

3. CONCLUSTION

Over all the algorithm performed well with comparsion to the MODIS active fire products. Within the case studies, the algorithm showed the ability to detect low intensity smoldering fires. Further tests must be carried out to identify the minimum area and temperature of the fire that could be detected by the algorithm. The algorithm can easily be adopted to pick up continuously smoldering pixels by tracking non-moving pixels. Fire duration data can also be used in fire severity mapping where fire intensity as well as duration is of importance. Compared with MODIS thermal anomalies products in the algorithm proved great improvement in terms of temporal and spatial resolution. MODIS products area limited to only four observations per day. Where as the AHI-FSA can provide data every 10 minutes during the day at 500meters compared to 1 km in the case of MODIS. AHI-FSA is limited to day-time surveillance due to dependence on RED and NIR channels. Further evaluation of the algorithm must be carried to quantify the performance of the algorithm, tests must also be done over additional land covers types. AHI-FSA can be further developed by adding temporal contextual awareness to the algorithm such as the state of the pixel in the previous time stamp. This would enable the algorithm to track status of the pixel such as non-fire, fire,burnt, and could reduce the false detection in already burnt are as due to smoke.

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