PROJECT A4: DISASTER LANDSCAPE ATTRIBUTION ASSESSMENT OF THE ADVANCED HIMAWARI IMAGER TO DETECT ACTIVE FIRE

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CURRENT METHODS OF FIRE DETECTION USING REMOTE SENSING RELY ON CONTEXTUAL ALGORITHMS TO CHARACTERISE FIRE. NEW SATELLITE SENSORS SUCH AS THE ADVANCED HIMAWARI IMAGER ALLOW FOR NEW TEMPORAL-BASED TECHNIQUES TO BE EXPLORED THAT TAKE ADVANTAGE OF RICH TIME-SERIES DATASETS.

INTRODUCTION

Fire algorithms rely on an accurate determination of the background surface temperature of the target pixel in order to provide information about fire, as for initial detection fire makes up only a small portion of the total emitted signal in the medium wave infra-red. This background temperature cannot easily be inferred from one static image, as the fire signal influences the measurement.

This research develops a method for the correction of background surface temperature using high temporal resolution satellite sensor information.

The Japanese Meteorological Agency have recently commissioned a new sensor. The Advanced Himawari Imager (AHI) onboard Himawari 8 boasts an improved spatial and temporal resolution for the Asia-Pacific compared to previous geostationary sensors. Of particular importance to fire detection is the ten minute temporal resolution, providing near real-time capability for detection and monitoring.

NEW ALGORITHMS FOR FIRE DETECTION

Existing methods for determining the Diurnal Temperature Cycle (DTC) of a pixel use selected brightness temperature data from a number of days before the fire. This provides data for model fitting the DTC to raw temperature information from the pixel. Finding data for this fitting process can be hampered by long periods of cloud cover in the pixel's immediate history. The fitting itself can be affected by cycles of precession and day length change. This research describes a novel method for producing DTC information for a target pixel, which is more robust when dealing with time series containing consistent or periodic cloud cover, whilst also reducing the amount of processing power required for larger fires.

Wide Area DTC Derivation

By utilising a swath of pixels at a similar latitude to the target pixel, the wide area methods constructs a DTC model by aggregating brightness temperatures according to local solar time. Application of a crude cloud mask eliminates low temperature outliers, and a smoothing filter minimises the influence of factors such as coastal dampening of DTC variation. The resulting cleaned signal can then be applied in a fitting process with raw brightness temperature information to calculate an ideal DTC curve for the target pixel during the fire.

CASE STUDY: ESPERANCE NOV 2015

The method has been applied to a number of areas affected by the Salmon Gums fire in Esperance, Western Australia, in order to gauge initial ignition times, and the effect of clouds and smoke.

Figure 1a shows the state of the active fire at 16:00 local time. A significant amount of smoke can be seen windward of the fire, which affects the fitting process for each of the fire pixels. Figure 1b depicts a pixel with significant smoke prior to ignition, with brightness temperatures reduced by up to 15K by smoke. The curve shown in black shows the process has over-fitted on the smoke affected pixels. Figure 1c is less affected by cloud, and the fitted curve is very close to comparable background temperatures at ignition. Care needs to be taken to ensure fires are not falsely detected – the pixel mapped in Figure 1d is an example of a false positive caused by a sudden absence of smoke.

FURTHER WORK

Current efforts are focused upon the elimination of over-fitting. The DTC modelling process can be undertaken a number of ways with varying success which require further evaluation. The modelling process can be improved via incorporating a measure of land surface emissivity to correct biases in the model caused by standing cloud and coastal effects. Incorporation of a dynamic model for near real-time detection is also possible with this process.

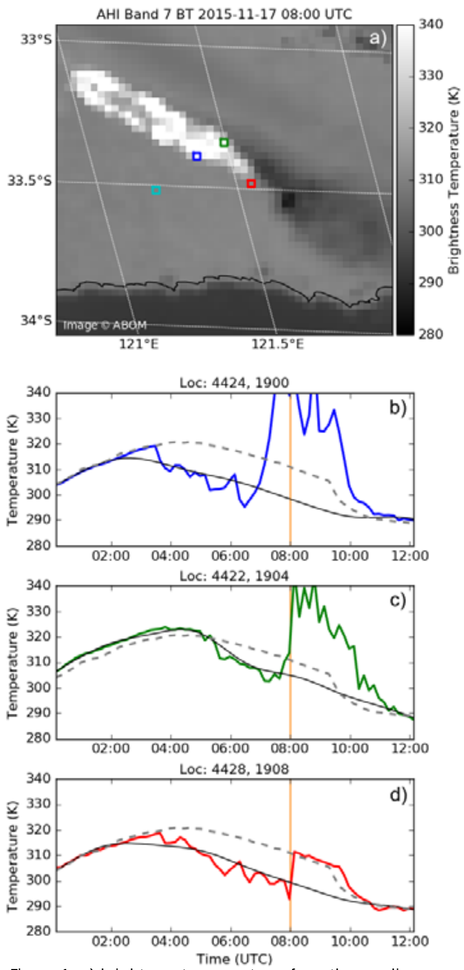

Figure 1. a) brightness temperatures from the medium wave infrared band 7 of AHI, 1600 AWST. b,c,d) coloured line = raw brightness temperatures of selected pixels, black line = SVD fitting of DTC, dotted line = sample brightness temperature of pixel at [4429,1894] shown in cyan on Figure 1a, orange line = time of AHI image in Figure 1a.

"Existing fire detection techniques must evolve alongside new sensor systems. Geoscience Australia supports this project that is developing innovative ways of handling real-time fire data sources. Efficient use of these sources can improve the timeliness and accuracy of active fire detection, and are complementary to other validation efforts on existing fire algorithms." David Hudson – Geoscience Australia