Reconstructing wildfires using satellite imagery

Simon Ramsey[1], Karin Reinke[1], Simon Jones[1]

Introduction

The high imaging frequency of geostationary satellites provides information which is invaluable for monitoring fire behaviour, with the limitation of a coarser sampling than low earth orbiting satellite sensors. Modern data fusion techniques present a means to reconstruct savannah fire activity with a high spatial and temporal detail by combining satellite inputs.

The low intensity and high frequency of savannah fires presents a challenge for emissions estimates based solely on burned area [1], leading to interest in using fire radiative power (FRP), a satellite-derived estimate of a fire's energy output [2]. This requires continuous unobscured satellite observations so that the fire radiative power diurnal cycle can be modelled [3].

Aims

- Evaluate the approaches used to assess the accuracy of satellite fire detections in savannahs.

- Determine how false negatives (undetected fire presence) can be differentiated from true negatives (fire absence) in a time series of geostationary satellite observations.

- Combine multiple satellite sensor inputs to reconstruct the spatial and temporal distribution of wildfire in a savannah environment and model FRP.

Methods

- Upsample geostationary satellite data using a semantic segmentation algorithm trained on low earth orbit satellite active fire detections.

- Reconstruct fire activity by producing fire mask isochrones from the upsampled geostationary satellite data.

- Estimate the integrated FRP, or fire radiative energy, by modelling the energy radiated by each pixel within the fire masks.

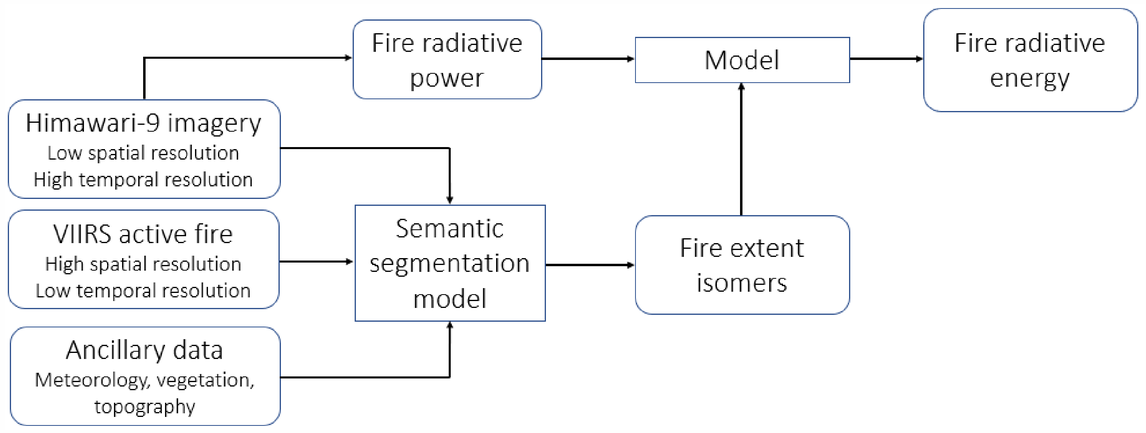

Figure 1 (above): Processing flow chart for wildfire reconstructions

Table 1 (below): Satellite system and instrument specifications

Satellite	Instrument	Spatial Resolution	Temporal Resolution
Suomi NPP / NOAA 20	VIIRS	375 – 750 m	Twice daily
Himawari-8/9	AHI	500 – 2000 m	Every 10 minutes

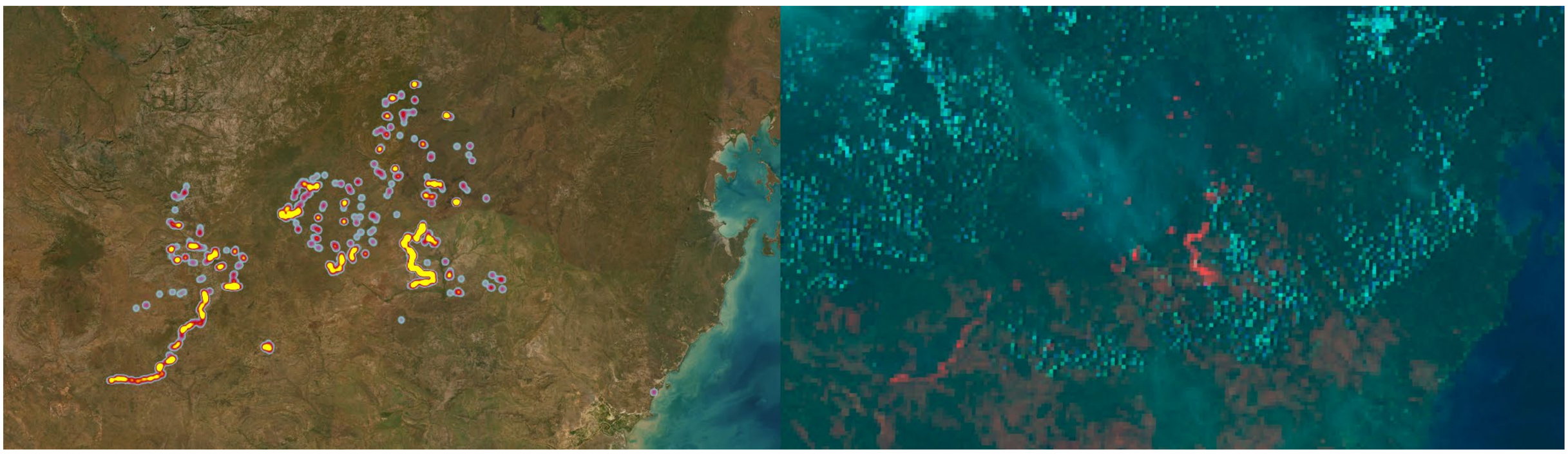

Figure 2: Satellite observations of a fire complex in the Northern Territory savannas: Left - VIIRS Active Fire 375m, Right - Himawari-8 false-colour image

References

1. Randerson, J.T. et al. (2012). "Global burned area and biomass burning emissions from small fires." J. Geophys. Res., 117, G04012.

2. Van Der Werf, G.R. et al. (2017). Global fire emissions estimates during 1997–2016. Earth Syst. Sci. Data, 9, 697–720.

3. Giglio, L. (2007). Characterization of the tropical diurnal fire cycle using VIRS and MODIS observations. Remote Sensing of Environment, 108, 407–421.

[1]School of Mathematical and Geospatial Sciences, The University of Royal Melbourne Institute of Technology (RMIT)

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