Rum wild fire – extent and severity

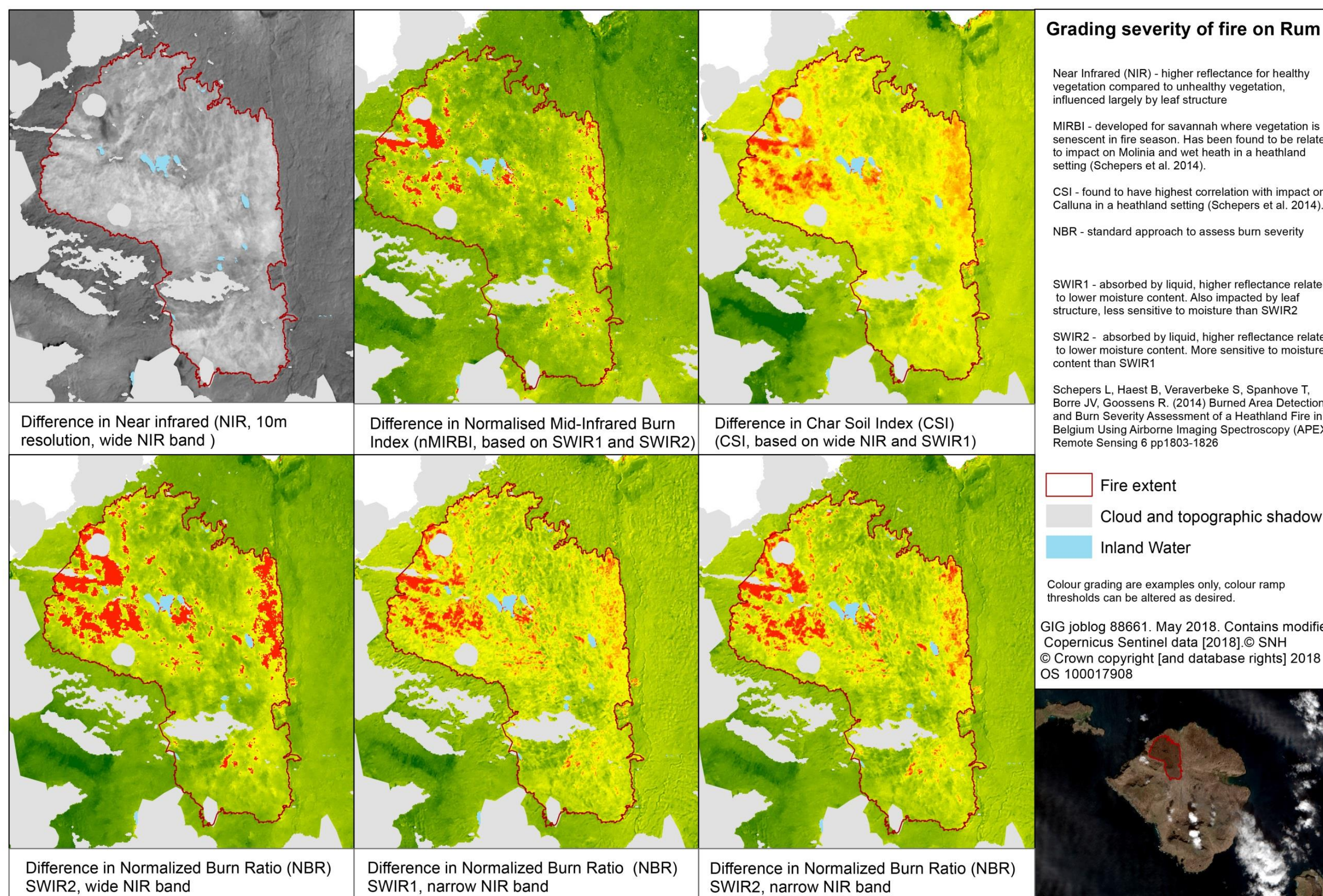Karen Frake – Scottish Natural Heritage – Karen.Frake@nature.scot

Abstract

At the start of April 2018 a hill fire affected approximately 200ha of land on the Isle of Rum on the west coast of Scotland. In order to understand the impact on the habitat within the Special Area of Conservation, the fire boundary and severity was assessed using Sentinel imagery. A number of indices derived from Sentinel 2 imagery were applied in order to determine which best reflected the impact on vegetation. Field data was collected in order to calibrate thresholds and determine which indices are most applicable in this situation. Application of sentinel 1 imagery will also be considered.

Application of Sentinel 2 indices - methodology

A range of indices were applied in order to map the extent and severity of the fire. Indices considered were :

- NDVI
- Char Soil Index (CSI)
- dNBR
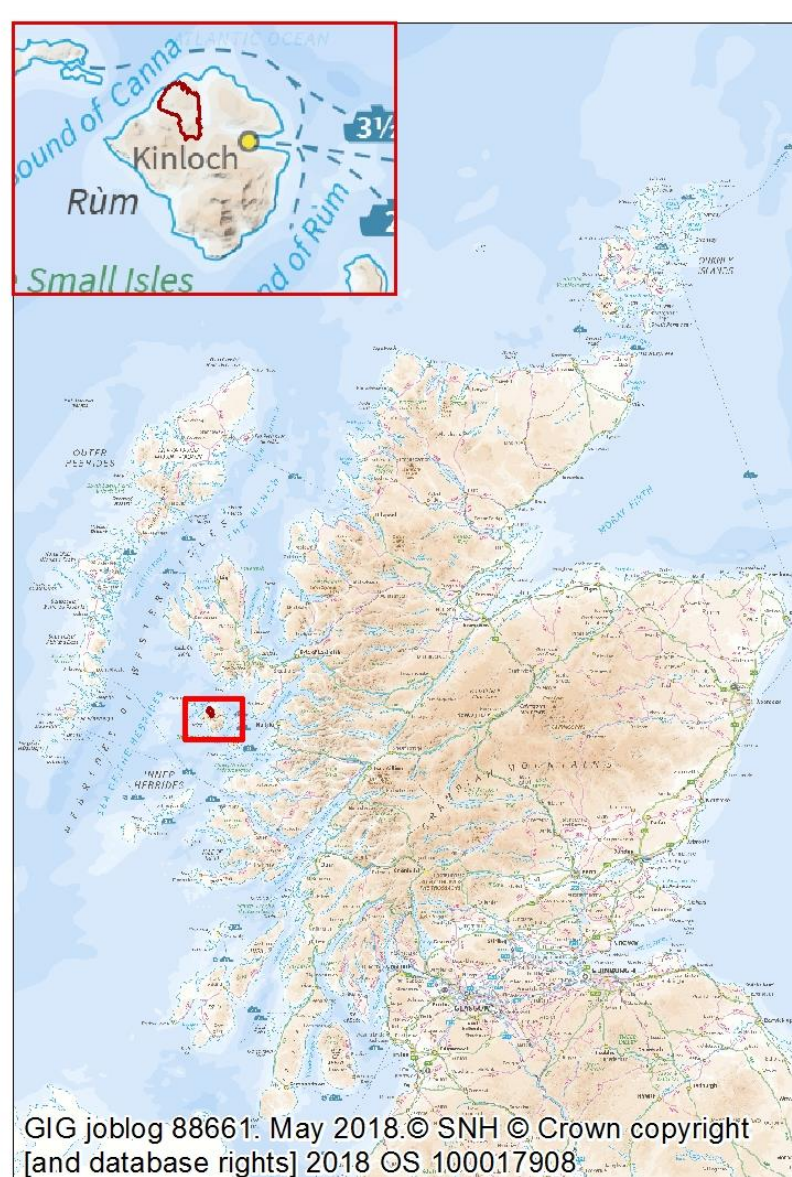- Relativised dNBR
- Range of red edge indicies

Cloud, topographic shadow and water masks were applied. Given the high latitude, topography and season of capture shadows were relatively prominent in the initial image.

Rum - 16 April 2018 - Copernicus Sentinel data 2018

Rum - 20 March 2018 - Copernicus Sentinel data 2018

Ground truth data – methodology

An additional field visit took place in August 2018 in order to obtain data to calibrate thresholds used for severity and determine which index was most applicable to situation.

The peatland CBI (composite burn index) was applied, which was developed for moorland and peatland in the UK (Davies et al. 2016). This includes information on impact on sphagnum, in addition to more commonly used factors such as amount of litter consumed, moss scorching and plant survival.

Circular plots of 30m diameter were scored for burn severity. Plots were located in areas of low, moderate, and high severity as predicted by the indices. Additional plots were surveyed outwith the burn extent, in two areas where severity was thought to be less severe than indicated by the indices, and in areas where different indices indicated differing levels of severity.

Ground truth data – results

Preliminary results suggest that severity predicted by the indices generally matches that measured using the peatland CBI. A detailed analysis is yet to be completed.

Difference in Near infrared (NIR, 10m resolution, wide NIR band)

Difference in Normalised Mid-Infrared Burn Index (nMIRBI, based on SWIR1 and SWIR2)

Difference in Char Soil Index (CSI) (CSI, based on wide NIR and SWIR1)

Difference in Normalized Burn Ratio (NBR) SWIR2, wide NIR band

Difference in Normalized Burn Ratio (NBR) SWIR1, narrow NIR band

Difference in Normalized Burn Ratio (NBR) SWIR2, narrow NIR band

Grading severity of fire on Rum

Near Infrared (NIR) - higher reflectance for healthy vegetation compared to unhealthy vegetation, influenced largely by leaf structure

MIRBI - developed for savannah where vegetation is senescent in fire season. Has been found to be related to impact on Molinia and wet heath in a heathland setting (Schepers et al. 2014).

CSI - found to have highest correlation with impact on Calluna in a heathland setting (Schepers et al. 2014).

NBR - standard approach to assess burn severity

SWIR1 - absorbed by liquid, higher reflectance related to lower moisture content. Also impacted by leaf structure, less sensitive to moisture than SWIR2

SWIR2 - absorbed by liquid, higher reflectance related to lower moisture content. More sensitive to moisture content than SWIR1

Schepers L, Haest B, Veraverbeke S, Spanhove T, Borre JV, Goossens R. (2014) Burned Area Detection and Burn Severity Assessment of a Heathland Fire in Belgium Using Airborne Imaging Spectroscopy (APEX). Remote Sensing 6 pp1803-1826

🟥 Fire extent
⬜ Cloud and topographic shadow
🟦 Inland Water

Colour grading are examples only, colour ramp thresholds can be altered as desired.

GIG joblog 88661. May 2018. Contains modified Copernicus Sentinel data [2018].© SNH © Crown copyright [and database rights] 2018 OS 100017908

Application of Sentinel 2 indices - results

The most useful indices were dNBR (using various combinations of wide NIR, SWIR1 and SWIR2), CSI and MIRBI. dNDVI was not found to provide discrimination between burnt/ unburnt areas, perhaps related to the low productivity of vegetation at this time of year under prolonged dry conditions.

dNIR (narrow band, 20m resolution) provided the most distinct delineation of the burn area and was used to map the extent of the fire.

Discussion

Sentinel 2 imagery has been applied in delineating the extent and mapping severity of burn of a wildfire that took place in April 2018 on the Isle of Rum. Indices derived from Sentinel 2 provided information about severity and field data will enable calibration of thresholds and determine applicability of individual indices, to determine impact across the site.

Header image – ©Nic Goddard

Davies GM, Domènech R, Gray A, Johnson PCD. 2016. Vegetation structure and fire weather influence variation in burn severity and fuel consumption during peatland wildfires. Biogeosciences 13, 389–398.

Schepers, L.; Haest, B.; Veraverbeke, S.; Spanhove, T.; Vanden Borre, J.; Goossens, R. Burned Area Detection and Burn Severity Assessment of a Heathland Fire in Belgium Using Airborne Imaging Spectroscopy (APEX). Remote Sens. 2014, 6, 1803-1826.

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