OPERATIONAL WILDFIRE MAPPING WITH SENTINEL-2 AND LANDSAT IN BRITISH COLUMBIA

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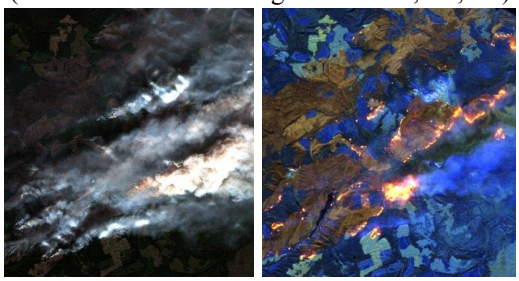
ABSTRACT

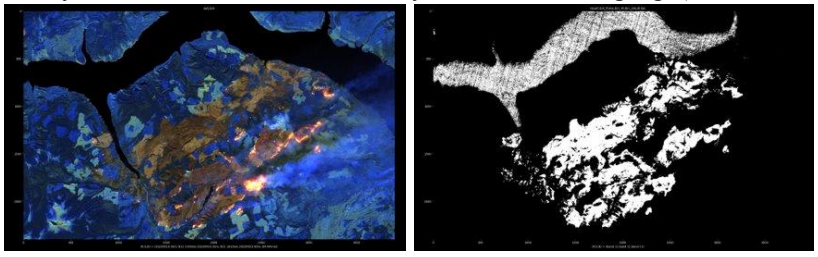
We outline a 2022 operational trial of satellite fire perimeter mapping in British Columbia using ESA Sentinel-2 data, augmented by USGS/NASA Landsat data. In the trial the BCWS (BC Wildfire Service) Predictive Services unit generated over three hundred "low latency" fire polygon updates which were then vetted by BCWS's Geospatial Services Team, showing that Sentinel-2 is effective for timely (delivery in under twelve hours from capture) fire mapping, even of small or unknown fires, as well as mapping fires under smoke cover. Front-line staff on high-profile incidents in 2022 recognized the products' value. Moreover, increasing extreme weather event potential (White et al, 2023) supports furthering the exploitation of Remote Sensing to improve situational awareness.

In 2022, BC Wildfire Service used Sentinel-2 spaceborne multispectral data from ESA with two objectives: monitoring progression of remote fires where active suppression was not occurring, and improving situational awareness. The result was improving the frequency and fidelity of fire mapping updates, including for fires being actively suppressed. A short-wave based (i.e. non-thermal) infrared method (Wooster et al, 2021) was used, illustrated here with September 10, 2022 imagery of the Battleship Mountain wildfire (G72150) and outlined in steps one to five below.

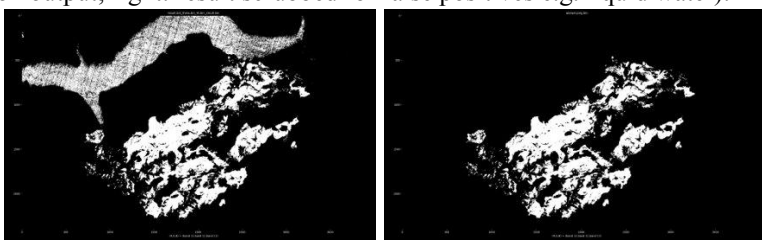
1. Prepare Sentinel-2 (select bands B12, B11 and B9) or Landsat data (spectrally interpolate to simulate Sentinel-2's bands B12, B11 and B9). Cloud-penetration and sensitivity to active fire motivate selecting the three longest wavelengths (Right: false color encoding: RGB = B12, B11, B9). For comparison (Left: true color encoding: RGB = B4, B3, B2) over the same area.



2. Classify fire with a simple rule (e.g. the "band math" expression: B12 > B11 && B12 > B9) whose output is shown to the right below (false color encoding: RGB = B12, B11, B9 on the left). Alternatively if this fails, can use rudimentary statistical learning e.g. (Richardson et al, 2010).

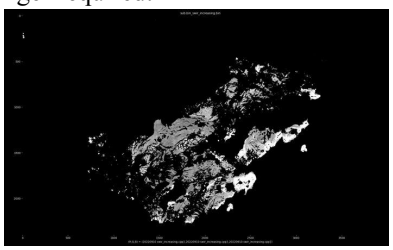


3. False positives are scrubbed manually using a GUI tool such as GIMP (below left: “band math” expression output; right: result scrubbed for false positives e.g. liquid water):



4. Convert the raster result of the “band math” expression to polygon using a Python script, then use QGIS to overlay and compare with existing publicly available BCWS perimeter data.
5. Submit polygon in KMZ format for Subject Matter review by BCWS’s Geospatial Services.

Currently a new fire classification rule, the “band math” expression “B12 / B9 > 1.1” is being investigated to reduce false positives due to water in solid, liquid or gas state. The new rule is shown below, multiplied by B12 so that brighter spots in the map reflect higher fire intensity. In this example, scrubbing of false positives is no longer required:



Acquisition frequency and data latency were the most significant issues. The effect of fire smoke on classification accuracy will be discussed. The authors are grateful for infrastructure support provisioned by NRCan’s Emergency Geomatics Service team, which is anticipated to improve this application’s latency by several hours, for use in the 2023 fire season. Continued development of this initiative will contribute towards Knowledge Exchange (KE) and readiness activities for Canada’s upcoming WildfireSat mission. Please see (McFayden et al 2023) for more details.

Keywords— Fire Mapping, Sentinel-2, Landsat, SWIR, Fire intelligence, Situational awareness

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