INVESTIGATING SPACEBORNE L-BAND POLARIMETRIC SAR FOR OPERATIONAL WILDFIRE MAPPING IN BC

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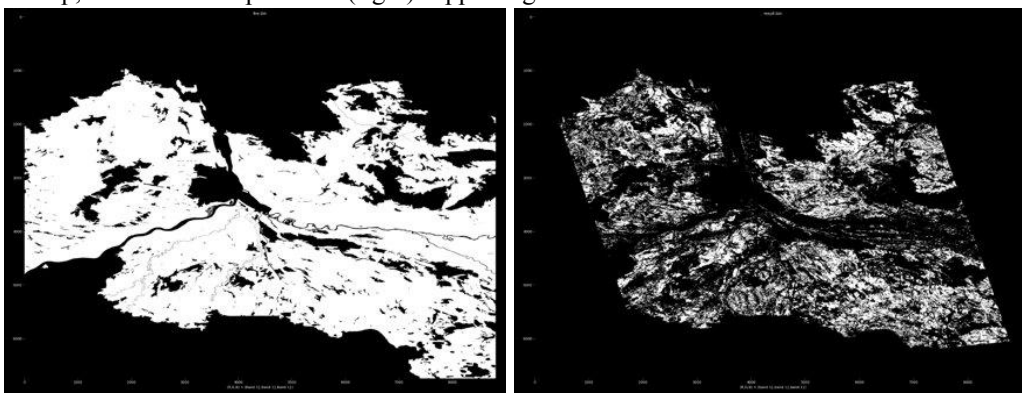
ABSTRACT

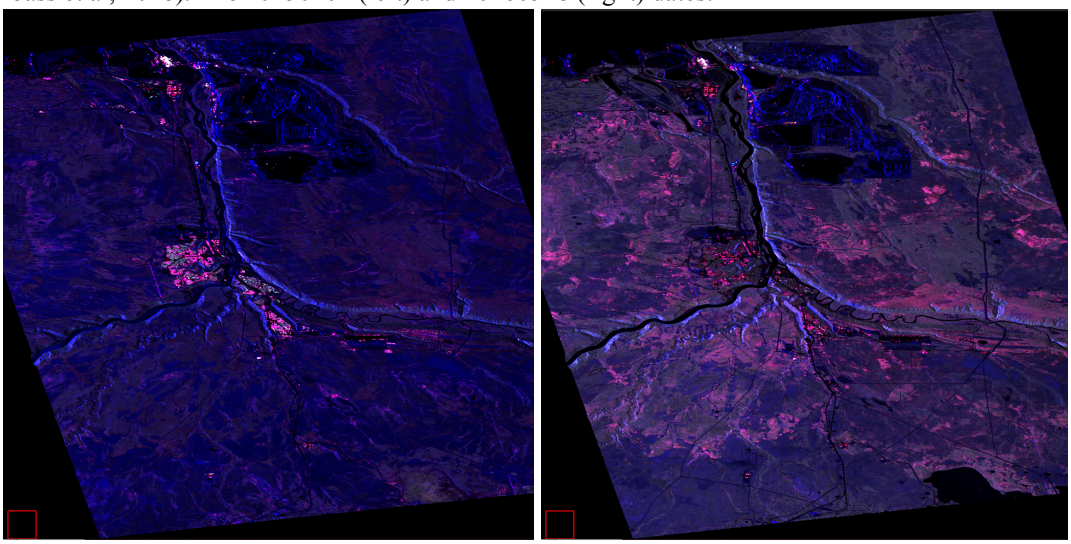
This paper continues investigating L-band Polarimetric Synthetic Aperture Radar (PolSAR) applications, to support optical fire progression and burn severity mapping (Tanase et al, 2015) when clouds are in the way (Goodenough et al, 2011). Due to scarcity of ALOS-2/PALSAR-2 data over British Columbia in the Quad-Pol (QP) mode, we chose the 2016 Horse River fire affecting Fort McMurray, Alberta Canada for assessing operational potential of L-band QP SAR using several methods. Moreover ALOS-2 QP data are available over Fort McMurray in two time series, with overlapping but distinct footprints. Whereas (JAXA, 2016) and (Plank et al 2019) analyse dates from a series where Fort McMurray appears slightly East of the footprint centre, we analyse dates from the other series in which Fort McMurray appears closer to the footprint centre (and classify burned area) to help prepare for using L-band NISAR, ALOS-4/PALSAR3, ROSE-L missions in operational fire mapping scenarios in BC. Finally, as L-band SAR missions aren't guaranteed to provide large coverage in QP mode, we hedge our bets and apply Dual-Pol (DP) methods of (Mascolo et al, 2021) providing physical polarimetric interpretation accessible from both DP and QP acquisition modes.

Because fire perimeter data are operationally oriented, classification of October 3, 2016 Landsat data was used in conjunction with the existing CNFDB fire perimeter data (left) to create a reference burned-area map, with less false positives (right) supporting our assessment of the JAXA data:



Next we performed a preliminary classification on 20150404 (pre) and 20160528 (post) dates, with the Nearest Neighbour classifier (i.e., the simplest version of *k*NN with *k*=1) and an unreasonably small number of identified positive and negative samples (only N=20 pixels for training to classify a raster with millions of pixels). Using the T22 channel only as in (JAXA, 2016) 77% overall accuracy was obtained. For T11, T22, and T33 channels 80% accuracy was obtained. Moreover, 75% accuracy was reported using the T22 channel only using only the post date. Finally, 75% accuracy was also produced by classifying the

DP parameters (Mascolo et al, 2021) for the post date only. Accordingly, we expect to report classification accuracy close to 90% in the full paper after using a contemporary Machine Learning (ML) classification algorithm, as well as a more substantial number of training samples. Finally, additional info will be gained from the other five images available over the same footprint, such as coherent change detection as in (Lehrbass et al, 2018). The 20150404 (left) and 20160528 (right) dates:



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Keywords— Radar, Polarimetric SAR, Fire mapping, ALOS-2, Wildfire, Fort McMurray

REFERENCES

Tanase, M.A., Kennedy, R., and Aponte, C. 2015. "Radar Burn Ratio for fire severity estimation at canopy level: An example for temperate forests." Remote Sensing of Environment, Vol. 170: pp: 14-31. doi: http://dx.doi.org/10.1016/j.rse.2015.08.025

Goodenough, D. G., Chen, H., Richardson, A., Cloude, S., Hong, W., and Yang., Li. 2011. "Mapping fire scars using Radarsat-2 Polarimetric SAR Data." *Canadian Journal of Remote Sensing,* Vol. 37 (No. 5): pp. 500-509. doi: https://doi.org/10.5589/m11-060

"ALOS-2/PALSAR-2 Observation Results on Wildfire in Canada", JAXA Space Technology Directorate, JAXA, Last updated January 21, 2016. https://www.eorc.jaxa.jp/ALOS-2/en/img_up/dis_pal2_can-forest_fire_20160509.htm

Plank, S., Karg., S. and Matinis, S. 2019. "Full-polarimetric burn scar mapping - the differences of active fire and post-fire situations." International Journal of Remote Sensing, Vol 40 (No. 1): pp 253-268. doi: https://doi.org/10.1080/01431161.2018.1512768

Mascolo, L., Cloude, S.R., Lopez-Sanchez, J.M. 2021. "Model-based decomposition of dual-pol SAR data: application to Sentinel-1." *IEEE Transactions on Geoscience and Remote Sensing,* Vol 60. doi: https://doi.org/10.1109/TGRS.2021.3137588

Lehrbass, B., and Decker, V. 2017. "Natural Resources Canada's Response to the Fort McMurray Wildfire." Presentation at EO Summit 2017, Montréal, Québéc, June 20-22, 2017.