On November 8th 2018 the Camp Fire began burning on the west side of the Sierra Nevada mountains in Butte County, Northern California. This catastrophic fire took the lives of over 85 people and destroyed over 14,000 structures. https://en.wikipedia.org/wiki/Camp_Fire_(2018). The Camp Fire was 100% contained on November 25th 2018.

Mapping the burn severity of wildfires often involves multi-spectral remotely sensed data. Commonly used multi-spectral data comes from the LandSat satellite https://www.usgs.gov/land-resources/nli/landsat or the Sentinel-2 satellite https://sentinel.esa.int/web/sentinel/home. Furthermore, the organization that is tasked with mapping burn severity in the United States is the Monitoring Trends in Burn Severity http://www.mtbs.org.

Since the Camp Fire started late in the fire season, rapidly mapping the burn severity using multi-spectral remotely sensed data presents common obstacles. These obstacles are: low sun angles and shadows, extensive cloud cover obscuring the burned area, and snow. The aforementioned obstacles can produce inaccurate burn severity results when using multi-spectral remotely sensed data.

Synthetic Aperture Radar (SAR) data is rapidly playing a role in mapping burn severity. SAR satellites use microwaves to collect data. Microwaves are not influenced by low sun angles and shadows, extensive cloud cover obscuring the burned area, or snow. However, SAR data does require more effort in data processing to produce useful products for mapping burn severity.

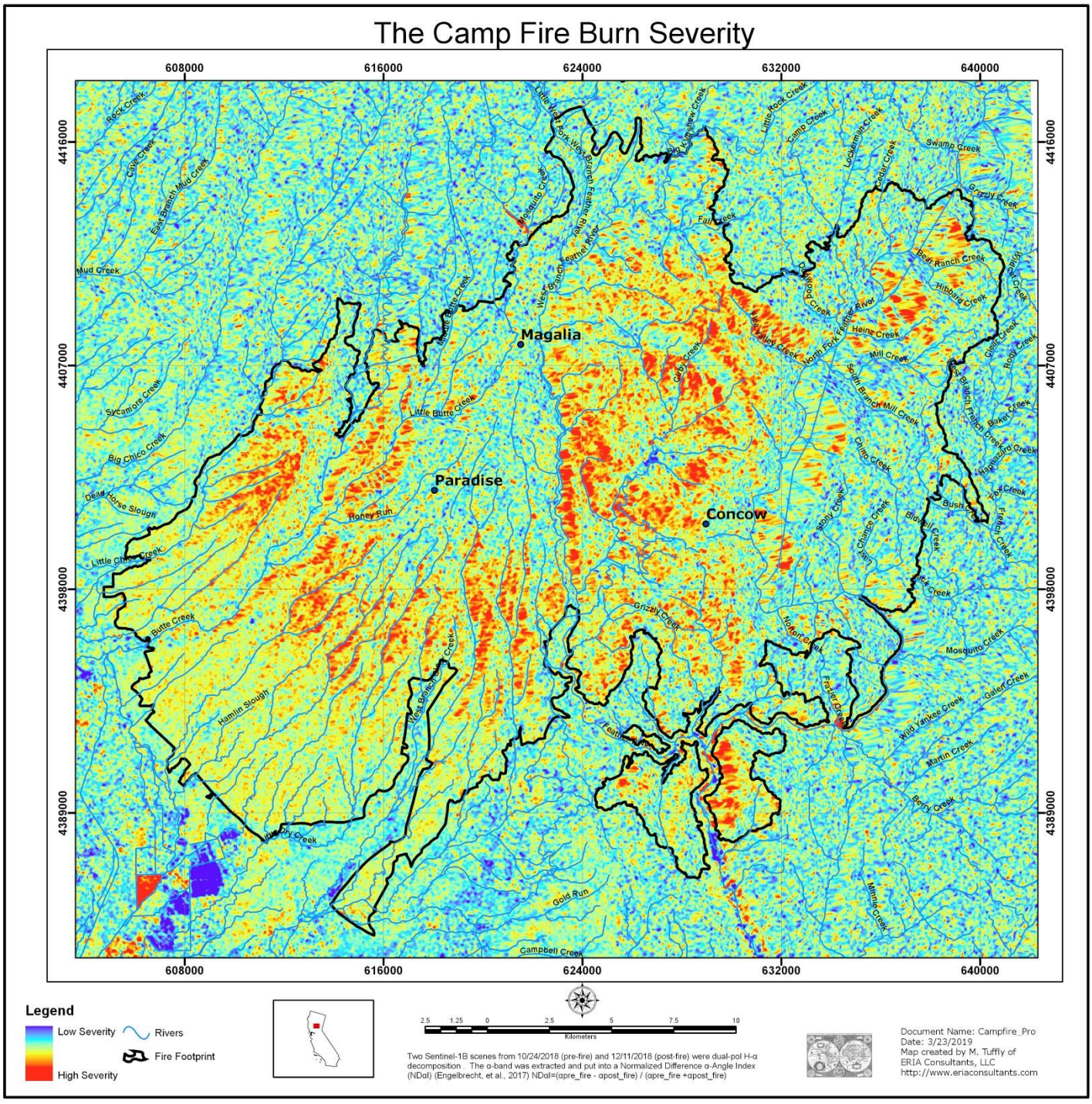
Depicted in the burn severity map are data from the Sentinel-1B satellite https://sentinel.esa.int/web/sentinel/home. Two Sentinel-1B scenes were collected from the University of Alaska in Fairbanks https://vertex.daac.asf.alaska.edu/. One of the scenes was collected before the Camp Fire started (10/24/2018) (pre-fire). The second scene was collected after the fire was extinguished (12/11/2018) (post-fire).

The two Sentinel-1B scenes were decomposed (i.e. dual-pol H-α decomposition). The decomposition was performed using the European Space Agency (ESA) Sentinel 1 Toolbox (SNAP) http://step.esa.int/main/. SNAP is an easy to use open source software designed to process Sentinel data.

After the SAR decomposition was implemented the Alpha band (α) for the pre-fire and post-fire were isolated. Research by Engelbrecht, et al., 2017 states that wildfire burn severity can be mapped using the Normalized Difference α-Angle Index (NDαI).

$$\mathrm{ND}\alpha\mathrm{I} = \frac{\alpha\ \mathrm{pre\_fire} - \alpha\ \mathrm{post\_fire}}{\alpha\ \mathrm{pre\_fire} + \alpha\ \mathrm{post\_fire}}$$

The NDαI data needed to be further processed so that a useful burn severity surface can be used in a map product. Dr. Tuffly created a custom python script that process the NDαI raster data into a user-friendly surface. The custom python script used the python libraries gdal and numpy. Next, a fire boundary layer was downloaded from the Geospatial Multi-Agency Coordination (GeoMac) http://www.geomac.gov and overlaid upon the SAR burn severity surface. The purpose of the fire boundary layer from GeoMac is to provide spatial context to the NDαI burn severity surface. The red areas illustrated in the NDαI map are regions of high burn severity; whereas, the blue regions are low burn severity; finally, the yellow regions depict moderate burned areas. The final map was produced by Dr. Tuffly in ESRI's ArcMap.



References

Engelbrecht, J., A. Theron, L. Vhengani and J. Kemp (2017). "A Simple Normalized Difference Approch to Burnt Area Mapping Using Multi-Polarisation C-Band SAR." Remote Sensing **9**(8).