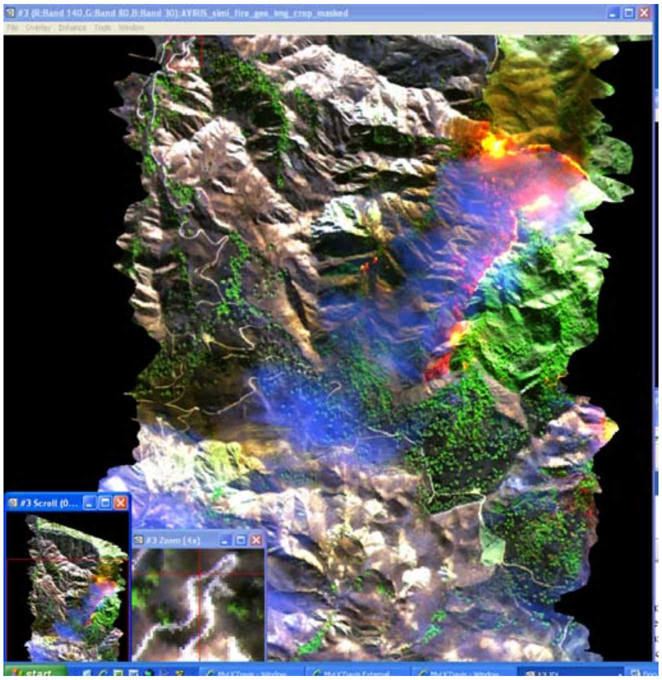
Arielle Simmons



Problem Background:
Fire Mapping using AVIRIS (spatial res: 4.1 meters, spectral res: 224 bands…p.s. this is radiance data NOT ATMOSPHERICALLY CORRECTED FOR REFLECTANCE).

Data Background:
Image data of the Simi Fire in Southern California was acquired on October 27, 2003. Fire ignition took place on October 25, 2003 and containment was on November 3, 2003. Overall, the Simi Fire burned 315 structures and 44,000 ha in the Santa Susana Mountains and cost approximately $10 million to contain (Dennison et al. 2006).

Fig 1: False Color: RGB (R: 140, 1682 nm; G: 180m 1107 nm; B: 30, 655 nm)

Processing: eliminating smoke from image bands…

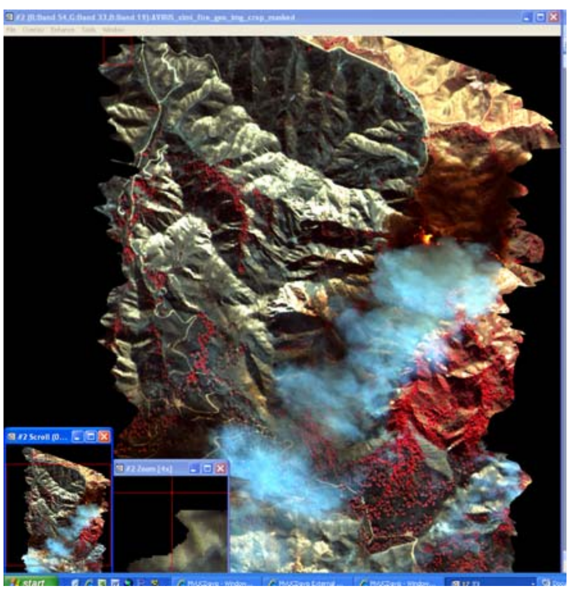


Fig 2: False Color Infrared: (R: 54, 855 nm; G: 33, 654 nm; B: 19, 548 nm)

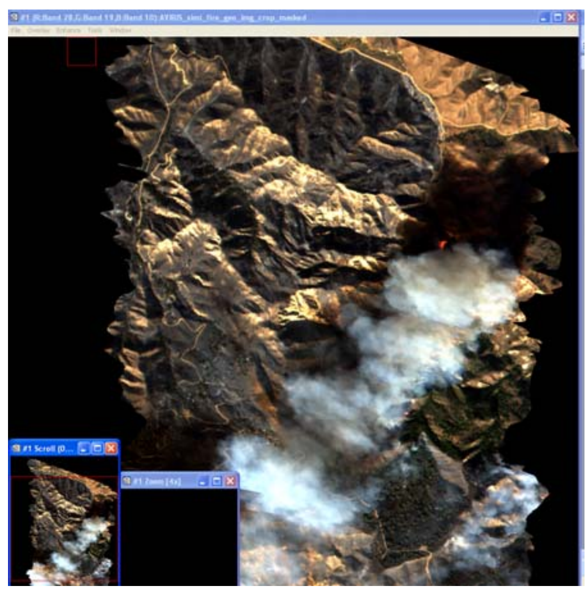


Fig 3: True Color: (R: 28; G: 19; B: 10)

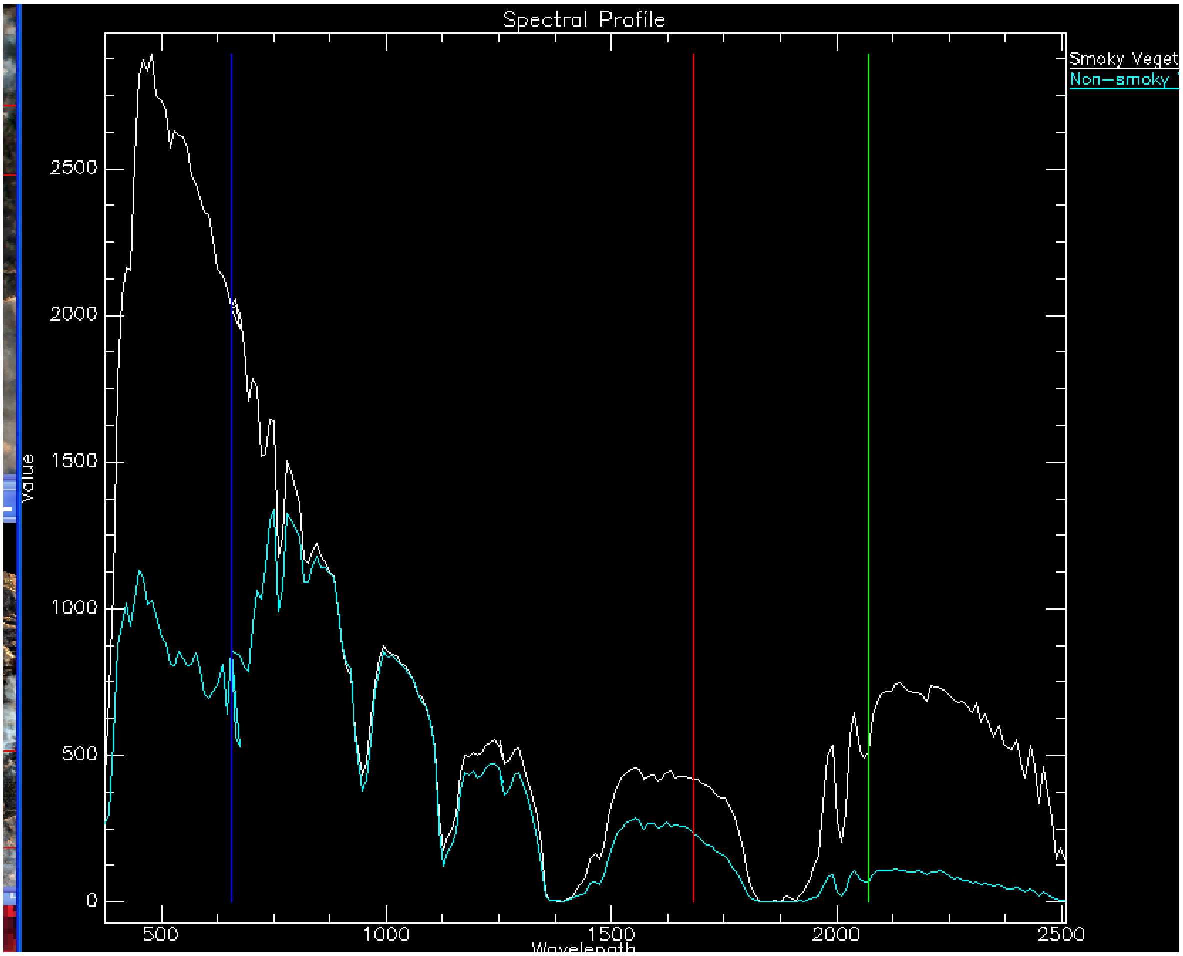


Fig 4: Influence of Smoke on Vegetation Spectrum. Note: Radiance NOT Reflectance.

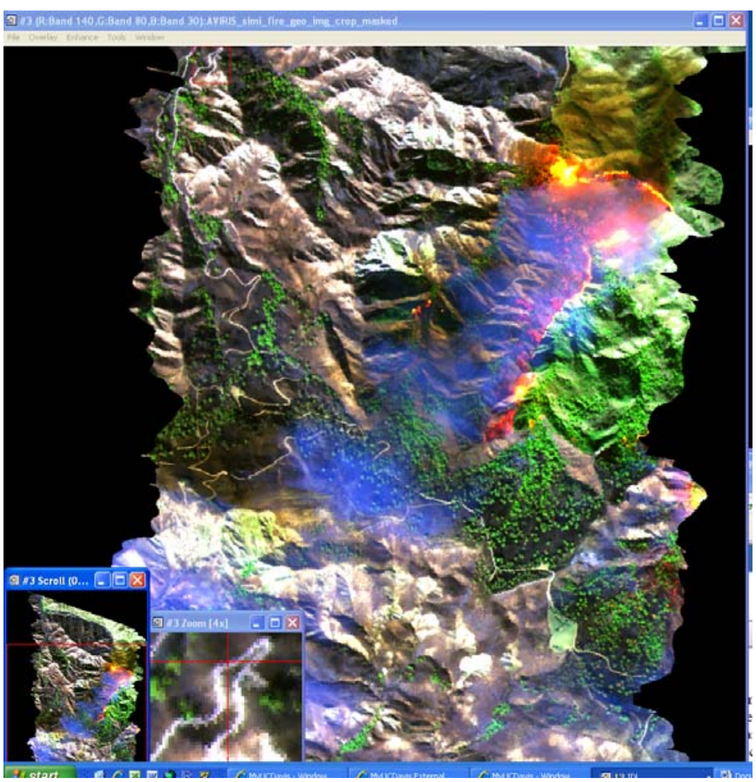
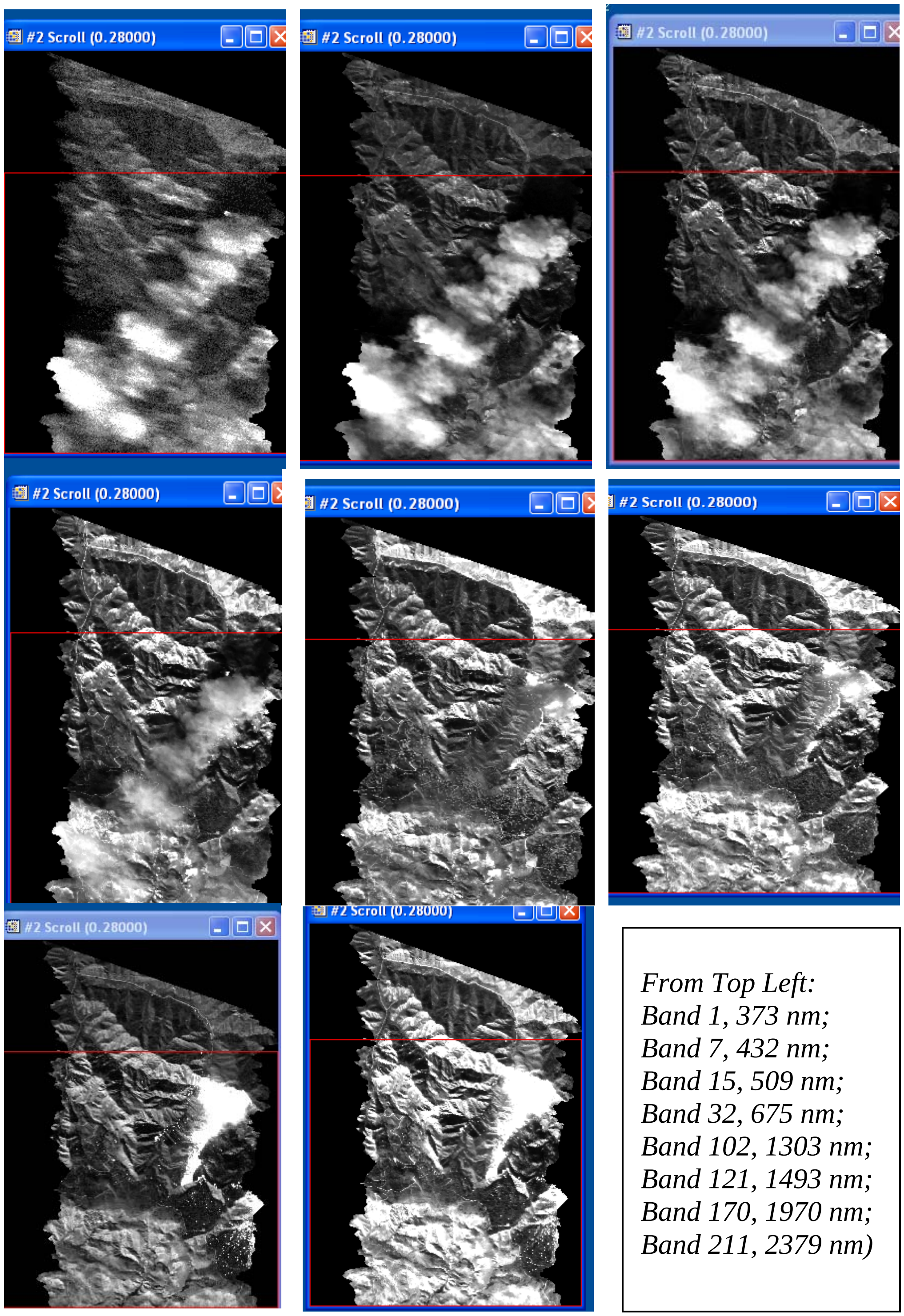


Fig 5: False Color RGB. In this display, vegetated areas appear green and burned areas appear dark gray. Smoke appears bright blue due to high reflectance in the 655 nm channel. Fire varies from red (cooler fires) to yellow (hotter fires). In this projection, smoke is not completely obscuring the display. Much greater burn area is visible. Can see both flaming and smoldering fires.



From Top Left:
Band 1, 373 nm;
Band 7, 432 nm;
Band 15, 509 nm;
Band 32, 675 nm;
Band 102, 1303 nm;
Band 121, 1493 nm;
Band 170, 1970 nm;
Band 211, 2379 nm)

As fire temperature increases, radiance in the SWIR increases (SWIR~ 1100 – 2500 nm). As pixels become even hotter and more dominated by fire, the AVIRIS sensor is saturated (see Band 170 and 211). However, even saturated pixels provide some indication of fire temperature.

Hyperspectral Indexes to Detect Fire: Potassium Emission

First, I projected the image to the left. I then explored the flaming/smoldering pixels to look for the K-emission feature (see spectral curve below). Then I created a image ratio of Band 45 (769 nm) and Band 46 (779 nm) using the Band Math feature. See results on next page).

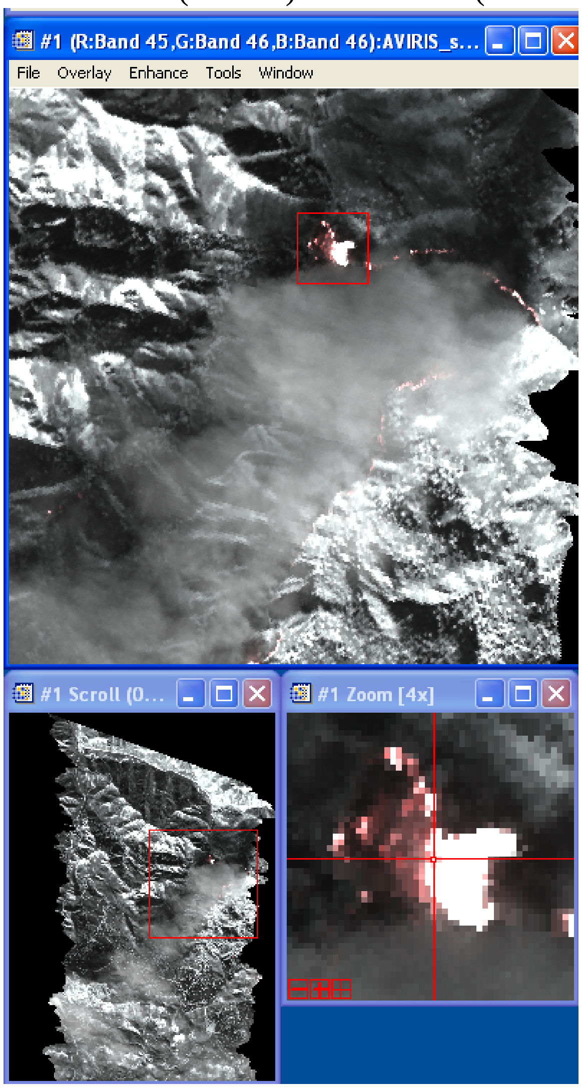


Fig 6: False Color RGB: R: 45, 769 nm; G: Band 46, 779 nm; B: Band 46, 779 nm)

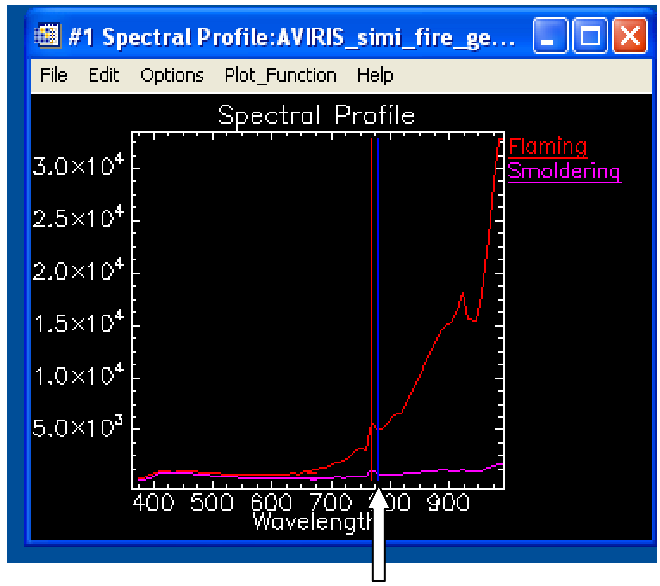
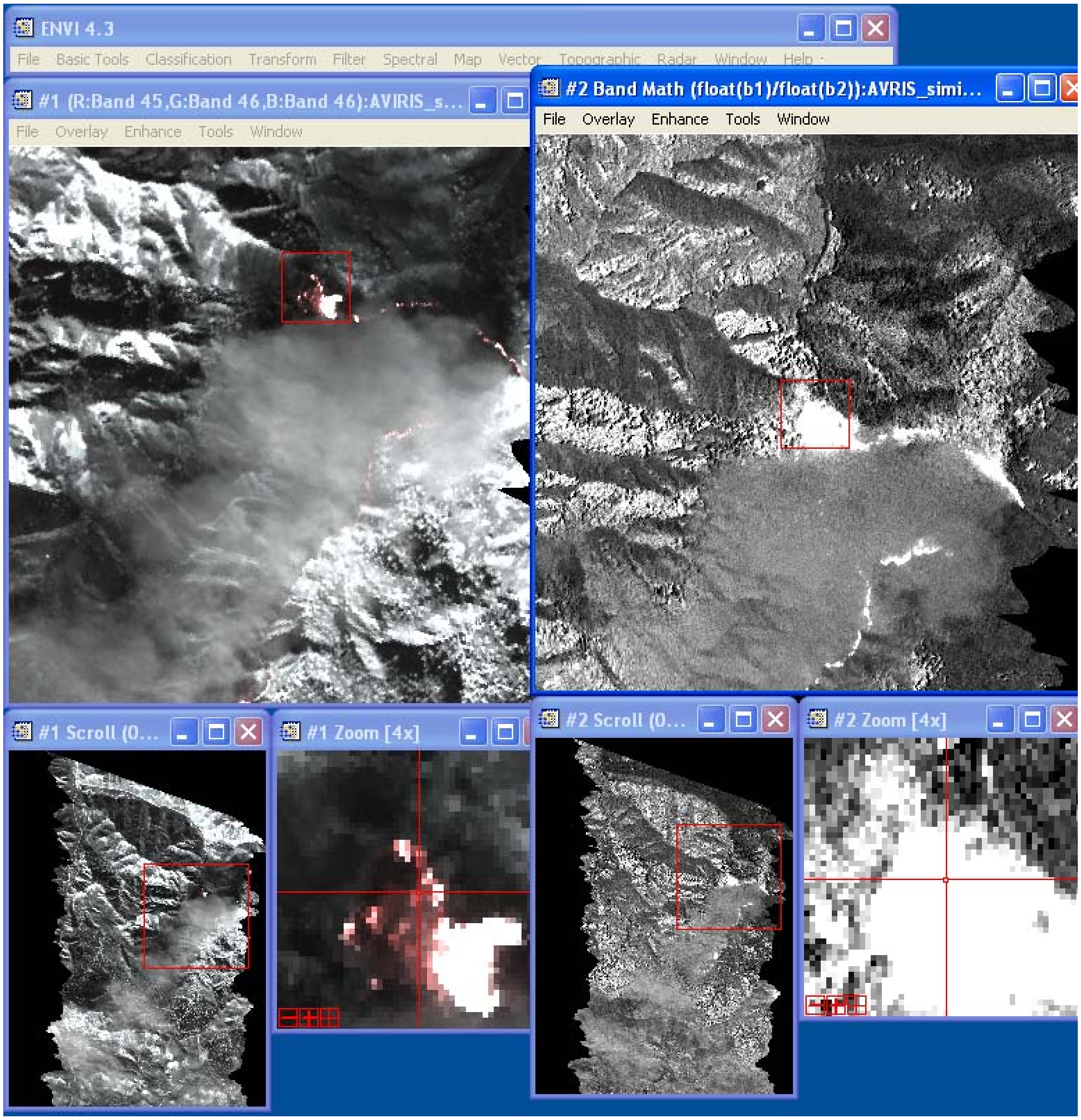


Fig 7: K emission feature (i.e. the peak at 766-769) in the spectral profiles of Flaming and Smoldering pixels: (i.e. combustion thermally excites potassium (K) at relatively low excitation energies; the excited potassium then emits at the NIR wavelengths 766.5 and 769.9 nm.)



Left image: Original ***Right Image: Ratio of Bands 45:46***

Comparison of (Radiance) Pixel Values

	Original Image	Ratio of Band 45:46
Smoldering Pixel	R: 487, B/G: 369	1.13 -1.6
Fire (saturated pixel)	R/B/G: 32766	1
Smoky pixels	R: 861, B/G: 1069	.8-.9
Not Burning pixels	R: 1210. B/G: 1529	.75-.8

Hyperspectral Indexes to Detect Fire: Atmospheric CO2 Absorption

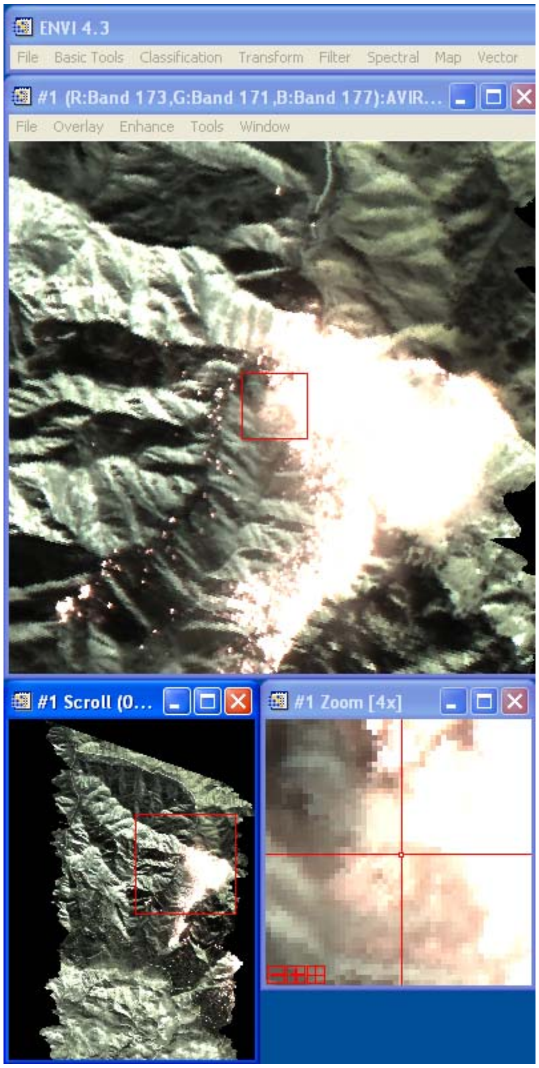


Fig 10: False Color RGB: R: 173 (2000 nm); B: 171 (1980 nm), G:177

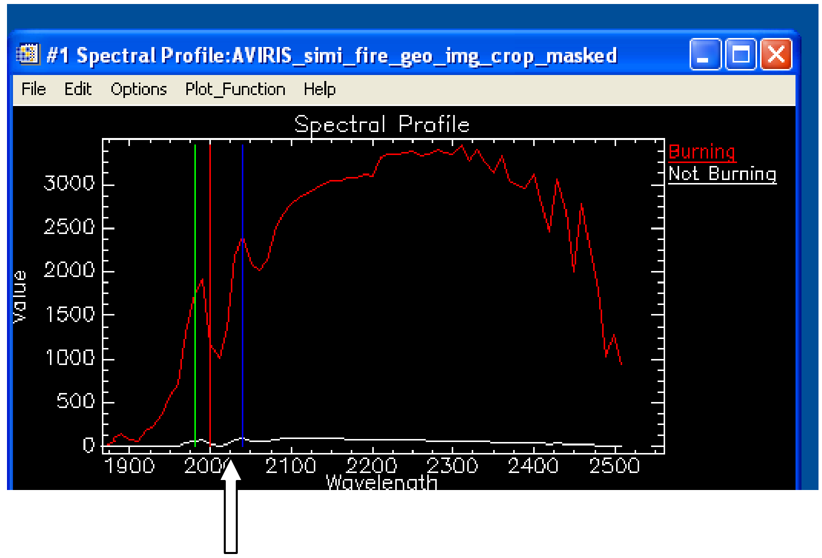
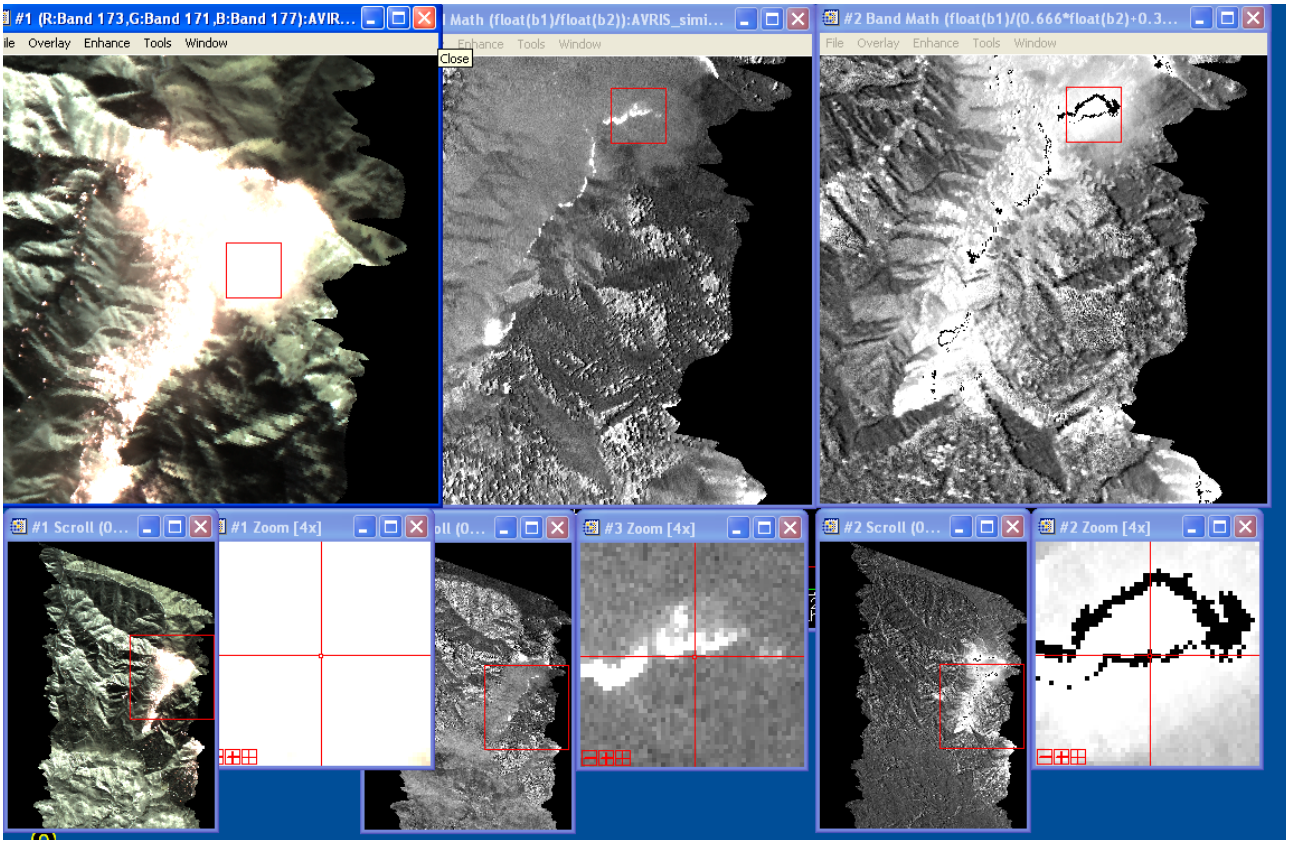


Fig 11: CO2 absorption feature (i.e. the dip in 2000-2010) in the spectral profiles of Burning and Not Burning pixels: (i.e. Burning pixels should therefore have shallower atmospheric absorption features, including the CO_2 absorption at 2000 nm, than pixels that are not burning and are dominated by reflected radiance (Dennison 2006).



False Color RGB **Potassium Index (*Bands 45:46*)** **CO_2 Absorption (Band 173/ (0.666*Band 171+0.334*Band 177)**

	CO_2 Absorption
Smoldering Pixel	.11-.50
Fire (saturated pixel)	1
Smoky pixels	.5-.6
Not Burning pixels	.3-.5