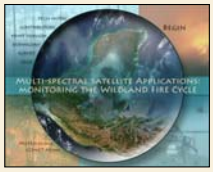
Multi-spectral Satellite Applications: monitoring the Wildland Fire Cycle

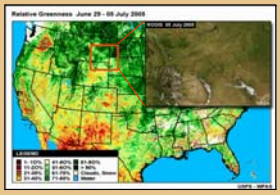
A COMET module developed by Tom Lee and Arunas Kuciauskas (Naval Research Laboratory, Monterey, CA) and Marianne Weingroff and Patrick Dills (COMET, Boulder, CO)



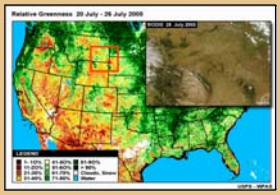
Describes current and future satellite sensors and products used for monitoring the fire cycle, with an emphasis on polar-orbiting satellites

- Product information is presented in the context of the fire cycle (pre-fire: environmental conditions; onset of fire: monitoring fire spread and smoke transport; post-fire: modifications to the landscape)
- Product information is also consolidated in the Fire Product Suite PDF (accessible from the module)
- Module concludes with an interactive case study of 2006 Montana fires
- Intended for those involved with wildfire detection and monitoring–from land use managers and hydrologists to weather forecasters and researchers, etc.

http://meted.ucar.edu/npoess/multispectral_topics/fire_wx/



The contrast in greenness between early and mid summer illustrates higher fire potential for the latter period.

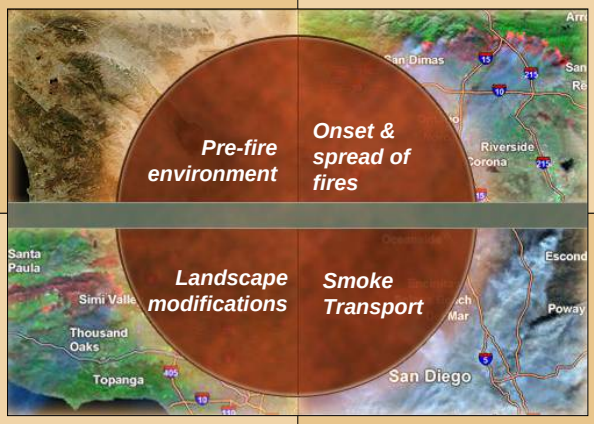


Use of satellite observations in monitoring the pre-fire environment:

Satellite observations: Help monitor broad areas to observe changes in vegetation; particularly useful for areas with few or no surface observations

MODIS true color images: Convey vegetation browning qualitatively

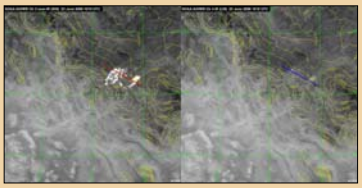
Greenness products: Show vegetation trends more quantitatively than imagery; derived from NOAA AVHRR composite data

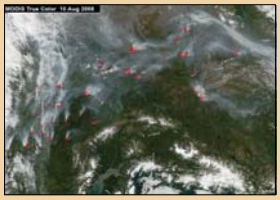


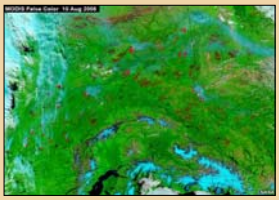
True and false color products:

- Created by combining 3 channels; product has more information than individual channels
- Provide vivid depictions of the landscape
- Red spots or perimeters are often added marking the location of likely fires based on information from IR shortwave 'fire' channels

Shortwave (SW) vs. longwave (LW) channels: SW trace in red has higher sensitivity to fire than LW trace in blue; the temperature difference is a key parameter used to detect fires automatically

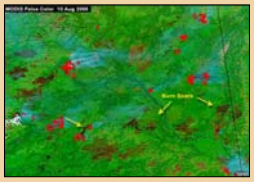






Smoke obscures the surface in true color but not false color imagery.

Much easier to see burn scars from past fires on false color imagery

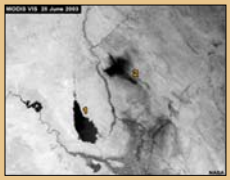


Satellite products & the monitoring of smoke transport:

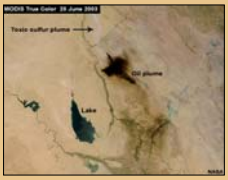
Visible imagery: Much more useful for viewing smoke than IR

Nighttime visible technology: Enables smoke detection at night given sufficient lunar illumination

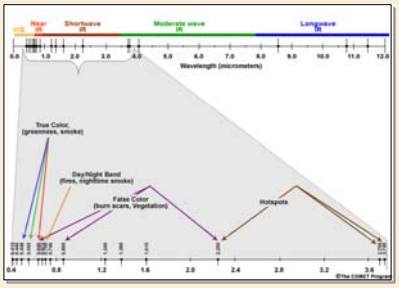
True color imagery: Smoke can be detected more easily in true color than false color imagery



True color image helps unmask a faint but deadly sulfur plume



Satellite channels most responsive toward monitoring the fire cycle:



Upcoming NPOESS VIIRS sensor:

Has all the important fire detection sensors and capabilities; improvements include:

- The NPOESS Safety Net communications design that will drastically decrease data latency (95% of data delivered within 28 minutes)
- New scan geometry that will lead to improved image quality
- A Day/Night Band that will provide nighttime detection capability for fire and smoke

Satellite Application Table

APPLICATION	FIRE: Hot spot	FIRE: Nighttime visible flame	FIRE: Multispectral composites (1)	SMOKE: Smoke & aerosol characterization	SMOKE: Daytime smoke	SMOKE: Nighttime smoke	LAND: True color images (4)	LAND: False color composites (2)	LAND: Vegetation products (3)
Polar-orbiting Satellites									
DMSP OLS		X			X	X			
NOAA AVHRR	X		X	X	X			X	X
MetOp AVHRR	X		X	X	X			X	X
Terra & Aqua MODIS	X		X	X	X		X	X	X
NPOESS VIIRS (future; follow-on to AVHRR, OLS, & MODIS)	X	X	X	X	X	X	X	X	X
Geostationary Satellites									
GOES 10-13 (Vis, 3.9, 10.7, 12 um (GOES-10 & 11 only))	X		X	X	X				

(1) Multispectral composites: imply that 3.7/3.9 µm or other SWIR channel is present
(2) False color: Composites, burned area, vegetation greenness
(3) Vegetation products: Vegetation index, water content
(4) True color images: Smoke detection, realistic land/ocean color
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