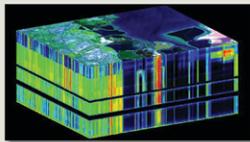




# HYPERSPECTRAL APPLICATIONS OF GEOSTATIONARY SATELLITE REMOTELY SENSED DATA

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## HYPERSPECTRAL REMOTE SENSING



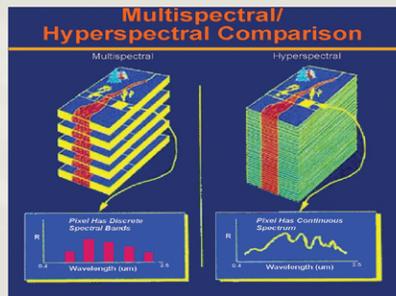
### Background

Combines imaging and spectroscopy in a single system

Data sets composed of hundred or thousands of spectral bands or narrow bandwidth, assuring high resolution.

After collection, hyperspectral data is used to form a spectral signature or curve that is stored in a "spectral library" for future use.

Before hyperspectral data was collected, multispectral data was used. A comparison between the two processes is shown below.



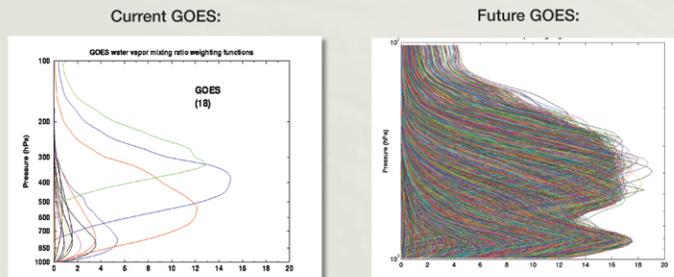
http://cstars.ucdavis.edu/projects/chevronwhitepaper/

Notice the difference in the number of spectral bands and derived signature.

### Importance

Hyperspectral data allows humans to detect objects over a continuous portion of the electromagnetic spectrum.

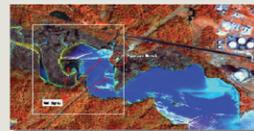
### Water Vapor Mixing Ratio weighting functions



from Menzel et al., 2004

Provides greater spectral resolution, temporal resolution, horizontal and vertical resolution, and radiometric accuracy for monitoring the evolution of temperature and moisture structures in the atmosphere

## HYPERSPECTRAL APPLICATIONS



http://www.crisp.nus.edu.sg/~acrs2001/pdf/108SALEM.PDF

### Toxic Emissions

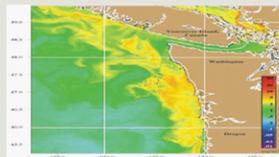
With hyperspectral data, scientists can identify and track toxic emissions that could be hazardous to a wide variety of ecosystems.

It is possible to track the location and progression of a variety of potentially harmful materials such as pollutants from pipeline breaks (shown above).

### Harmful Algae Bloom (HAB)

Spawn in various parts of gulfs and oceans causing severe contamination of the water in those areas in addition to causing fish kills.

Hyperspectral remote sensing allows algal blooms to be detected by measuring environmental indicators such as high chlorophyll concentrations and high salinity levels.



http://www.crisp.nus.edu.sg/~acrs2001/pdf/108SALEM.PDF

### Weather



Courtesy of the NSSL

The HES sensor suite aboard the GOES-R satellites will lead to an improved capability to measure three and four dimensional atmospheric moisture on smaller horizontal, vertical and temporal scales.

Will lead to more accurate precipitation forecasts and rainfall potential assessments over the entire coverage area.

### Agriculture/Wild Fires

Hyperspectral data will allow scientists to observe and assess the complex moisture and temperature characteristics of the atmosphere which will aid in forecasting agricultural events such as frost/freeze events, planting, harvesting, and distribution of pesticides for crop protection.



USDA



Courtesy of the NASA Earth Observatory

### Health/Aerosols

Aerosols can cause increased chronic bronchitis, asthma, and other respiratory illnesses in humans.

With hyperspectral remote sensing, these harmful particulates can be located, monitored, and characterized. Better characterization of harmful particulates may lead to mitigation of negative effects or elimination of their formation all together.

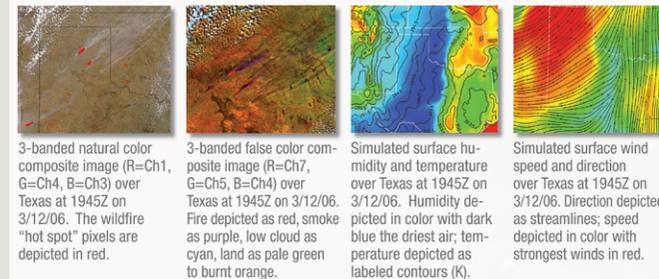
## TYPICAL END USER EXAMPLE

### Hazardous Weather Situation

Several major wild fires swept across the Texas Panhandle on March 12, 2006 killing 11 people (including 4 in a highway accident on Interstate-40), injuring 10 firefighters, and consuming over 700,000 acres of dry grassland before being brought under control.

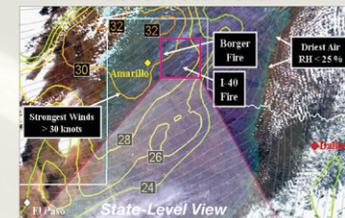
### Example Datasets

NASA MODIS data and NOAA NWP data are used as representative datasets to depict typical products that can be derived from the HES and ABI sensors. The two on the left are from MODIS and the two on the right are simulated from the Rapid Update Cycle (RUC) model.



### Local Fire Emergency Manager

Requests & receives products from GOES-R User Portal



Fuses products with GIS data to create an operational view for continuous monitoring



Analyzes situation...recognizes local highway threat... issues emergency warnings!

## SUPPORTS NOAA MISSIONS

### Ecosystem



http://classic.mountainzone.com/photo/berg/graphics/photo06.html

**Relates to Ecosystem:** Many ecosystems in the area were negatively affected by these wildfires. The fires destroyed over 700,000 acres of grassland which is important to animal habitat and agriculture in the area.

### Weather and Water



Courtesy of the NSSL

**Relates to Weather and Water:** Using temperature and moisture soundings from hyperspectral data it is possible to forecast areas ideal for wildfire development. Areas with high temperatures, low humidity and moderate to high wind conditions are prime for wildfire development. Additionally, powerful updrafts in the area could carry wildfire debris to stratospheric heights where it can affect cloud formation and climate change.

### Climate



http://classic.mountainzone.com/photo/berg/graphics/photo06.html  
A Wally Berg Photo

**Relates to Climate:** The dust and aerosol that are emitted in the form of smoke from large wild fires can directly impact the climate of the region. Heavy smoke can block solar radiation by preventing light and heat from reaching the surface. The impact of wildfires has been compared to the impact of volcanic eruptions on climate. The debris from large wildfires can reach stratospheric levels where it can effect climate by changing the atmospheric chemistry.

### Commerce and Transportation



**Relates to Commerce and Transportation:** The wildfires in Northern Texas caused numerous transportation problems including a large accident on a major highway which ended in fatalities. The smoke from these wildfires resulted in poor visibility inducing numerous problems for evacuees, emergency management emergency first responders. The wildfires also caused problems for major airports across the state.