ERS 186 Study Question Set # 5

KEY

20 points

Due June 5, 2008 (or submitted electronically by noon on Monday June 9th (when answers will be posted on class website).

1) You work for the Office of Emergency Services in California and you are asked what remote sensing capabilities are available to the state to respond to different types of emergencies. Give an example of what instruments would be best for the following emergencies (2 pt each) and say why they would be good for this purpose (e.g., airborne/satellite; spatial, spectral bands/resolution and timing, etc.)?

a) wildfires in the Sierra Nevada mountains

AVIRIS would be an instrument that may be useful for wildfires. It is an airborne instrument that can be deployed at will, it can be flown to have small pixel sizes (20-4 meters), and has very high (224 narrow bands ranging from 400-2500nm) spectral resolution. Certain bands can be used to detect smoke, while others can be used to penetrate smoke and detect burned area, available fuel area, and actual burning area (based on the emission spectra).

AVHRR, flown on NOAA's Polar Orbiting Environmental Satellites (POES) have been used for fire monitoring. Although originally intended as a meteorological satellite system, its visible detectors can detect smoke plumes and burn scars, and it has been used to detect active fires at night. AVHRR can acquire images of the entire earth two times each day, has a pixel size of ~ 1km, a swath width of 2700km, and has two bands in the VIS-NIR, two in the SWIR, and two thermal bands. More recently the MODIS sensor, on NASA's Aqua (p.m. equatorial crossing) and Terra (a.m. equatorial crossing) satellites has been designed to specifically include fire monitoring in its design. MODIS can detect burned area, active fires, smoke and emissions. MODIS has a return interval of every 1-2 days, a swath width of 2,330 km, and pixel sizes of 250 m, 500 m, and 1km. It collects data in 36 spectral bands, 20 from 400-3,000 nm, and 16 from 3-15 µm.

b) severe winter storm and threat of flooding in the delta

Severe winter storms are best monitored by high temporal resolution satellite sensors. The GOES (Geostationary Operational Environmental Satellite) system has two sensors that can be used for severe storm monitoring, the GOES Imager provides multispectral image data, and the GOES sounder provides hourly 19 channel soundings. The GOES spacecraft are placed in geostationary orbit above the equator, and rotate at the same speed and direction as earth. The visible band (0.52-0.72 µm) of the GOES Imager (1km) is used to monitor thunderstorms, frontal systems, and tropical cyclones. The thermal band (10.2-11.2 µm) can be used for assessing the severity of thunderstorms, and tracking clouds and frontal systems at night. The imager can scan the continental United States every 15 minutes. The sounder data is used to augment data from the imager to provide information on atmospheric temperature and moisture profiles.

Although the Tropical Rainfall Measuring Mission (TRMM) carries several sensors that together provide some of the best data for precipitation estimation, its 35 degree latitude limit misses much of Central and Northern California, and may disqualify its use for monitoring precipitation in the Delta.

c) earthquake on the San Andreas fault

Very high resolution satellite remote sensor data, such as the IKONOS satellite sensor (1 m panchromatic band and 4m multispectral bands), or the Quickbird satellite sensors (0.61 m panchromatic band and 2.44 m multispectral bands) have flexible data acquisition and frequent return capabilities, can acquire images at different look angles for stereoscopic purposes, and can be tasked to acquire imagery very close to, or immediately following a natural disaster such as an earthquake. This data can provide information about building and infrastructure damage, as well as outline possible routes of both accesses for Emergency Medical Services and evacuation of citizenry.

At a longer time scale, lower pixel resolution satellite data that has a higher swath width can be used to track movement of continental plates along faults. Displacement along lineaments can be measured over time. The Landsat sensors have visible data that can be used to identify and track lineaments in California. The visible bands pixel size (30 m) and swath width (185km) are moderate enough to collect data over the entire state of California along the fault, and the instrument record (36 years) is long enough to measure displacement over recent time. The return interval is every 14 days, which, over the course if a year, should net at least one and hopefully many cloud-free scenes.

d) chemical explosion at a factory in Richmond, CA

AVIRIS or another hyperspectral airborne sensor would be an instrument that may be useful for monitoring and managing a chemical fire in a factory. It is an airborne instrument that can be deployed at will, it can be flown to have small pixel sizes (20-4 meters), and has very high (224 narrow bands ranging from 400-2500nm) spectral resolution. High spectral resolution data of energy releases during chemical burns can be used to differentiate and quantify different chemical emissions that may result from the explosion.

2) It is a drought and you work for the City of Davis and are asked to estimate how much water is used to irrigate lawns in Davis. What kind of information would you want to know (4 pts)?

Evapotranspiration is often used as a proxy for irrigation, thus knowing the ET rates for lawns would be important for estimating water use in Davis. Additional GIS layers that delineate water works, property boundaries, and zoning districts may help with a land cover classification that allows consideration of lawns, and not parklands, community gardens, or agricultural production.

3) What are the characteristics of the data you want to make this assessment e.g., airborne/satellite; spatial, spectral bands/resolution and timing, etc. (4 pts)?

High spatial multispectral airborne data would be best for this assessment. You need something with a small enough pixel size to avoid many mixed pixels for a single lawn. Additionally, and airborne acquisition would be sufficient, as you would want to collect this data seasonally (~ 4 x/year), over the entire city of Davis (may require several flightlines). Multispectral data that has visible and near-infrared bands would be sufficient to map lawns in an urban setting.

4) What image analysis methods and techniques would you use to do the analysis you propose (4 pts)?

Answers will be feasible given above data requirement descriptions, and should demonstrate understanding of techniques learned during lab portion of the course.