Remote Sensing and Ecosystem Restoration of South San Francisco Bay

Figure 1

Figure 2

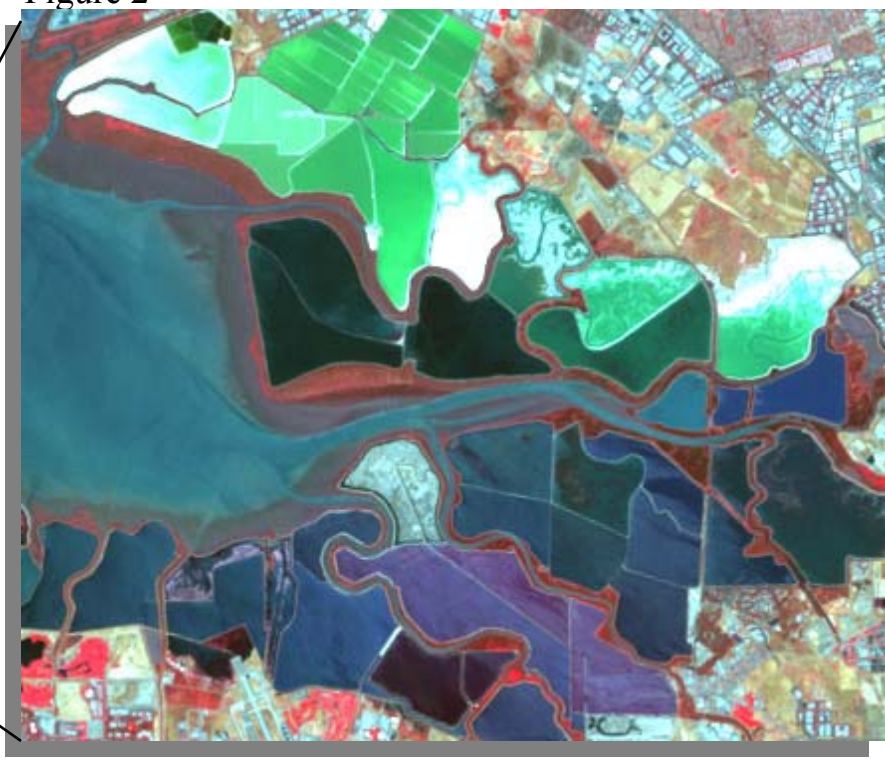
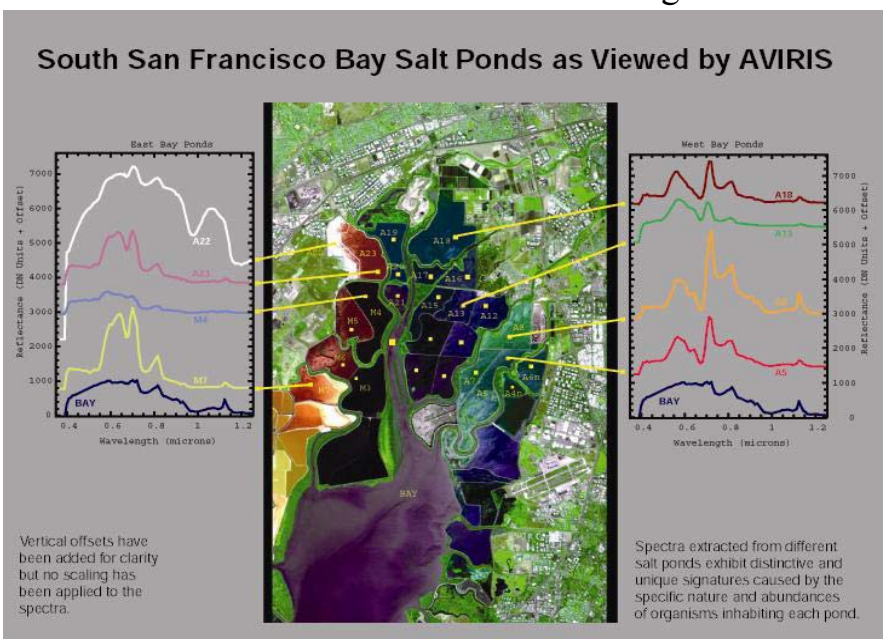


Figure 3



AVIRIS Hyperspectral Analysis of South Bay Salt Evaporation Ponds

Initial analysis from July 31, 2002 by Dr. James Bradley Dalton, NASA Ames Planetary Systems Branch, Space Science Division

Remote Sensing and Ecosystem Restoration of South San Francisco Bay

Key Investigator: L. Jean Palmer-Moloney, Ph.D.

The wetlands of San Francisco Bay have been altered as a result of land use decisions made since the 1850s. Over the past 150 years, the area's population has grown and the area's economy has diversified. Urbanization and industrial development have been supported at the expense of the Bay's wetlands, and the wetlands ecosystem has floundered. Solar evaporation salt production is one of the industrial developments that has affected the wetland ecosystem directly. At the turn of the 21st century, more than 29,000 acres of artificial salt evaporation ponds were actively maintained in San Francisco Bay.

In July 2002, a team of scientists from NASA Ames's Earth System Science Division began providing information to a multi-agency team from the US Fish and Wildlife Service (USFWS), the US Geological Survey (USGS), the California State Department of Fish and Game, and the California Coastal Conservancy to assist them as they devise a plan for returning 16,500 acres of the South Bay salt ponds to tidal marsh wetlands. Data collected with NASA technology--both multispectral (Figure 2) and hyperspectral (Figure 3) remotely sensed images--are proving valuable to the process. Spectral reflectance data of the ponds along with *in situ* data from the ponds themselves are being compared to generate information on current pond conditions. Scientists are exploring ways to monitor pond-to-wetland habitat transition in the future using these techniques.

The southern portion of the San Francisco Bay (Figure 1) was imaged on July 7, 1999 by Enhanced Thematic Mapper (ETM+), the multi-spectral scanning sensor on board the Landsat 7 satellite. Figure 3 shows the "true colors" of the ponds as they would appear when viewed with the human eye. In the false color (near Infrared) image (Figure 2), colors varying according to land use and physical conditions. Water absorbs most light in all bands, so clear pond water looks black. Ponds and bay water that reflect shades of light blue contain relatively high levels of sediment. Turbid ponds and ponds where gypsum settles out appear purplish. Deep red indicates healthy vegetation containing chlorophyll that is highlighted by the sensor's infrared band. High-salinity evaporation ponds appear green in Figure 2. The gray color in the image indicates urban areas. Tan colors are indicators of the area's Mediterranean climate and its associated summer drought; tan areas are dead grasses lacking chlorophyll. Currently remote sensing research of the South Bay and its associated ponds has expanded to include the use of data from the AVIRIS hyperspectral sensor (Figure 3). The data analysis possible with AVIRIS makes it possible to discern subtle differences in salinity levels among the ponds, making it possible to monitor water changes and water quality from a distance.

NASA Ames Research Center

Earth Science Division

Ecosystem Science & Technology Branch

http://geo.arc.nasa.gov

COLLABORATORS: State University of New York at Oneonta, Department of Geography; NASA Ames Research Center Planetary Systems Science Branch