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Use of Remotely-Sensed Data in the Development and Improvement of Emission Inventories

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Remotely-Sensed Data

- Satellite Imagery
- Satellite Data Products
- Aerial Photography

Recent EPA Report

An Examination of the Application of Remote Sensing Data in Detecting and Characterizing Air Pollution Transport and Emissions, Science Applications International Corporation, prepared for the U.S. EPA, April 2002.

Available at:

www.epa.gov/ttnchie1/eiip/pm25inventory/remsens.pdf

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Remote Sensing Data: General Uses

- Development of refined land use data
- Bottom-Up EI Development
- Development of activity data for open burning source categories *(see EPA Report)*
- Development of information for refining biogenic emission estimates
- Miscellaneous uses *(e.g. quality assurance)*

Development of Refined Land Use Data

Important wherever area estimates are used to quantify or spatially-allocate emissions:

Example – Wind-Blown Dust:

$$PM_{10}\ (tons/yr) = EF_i \times Area_i \times T$$

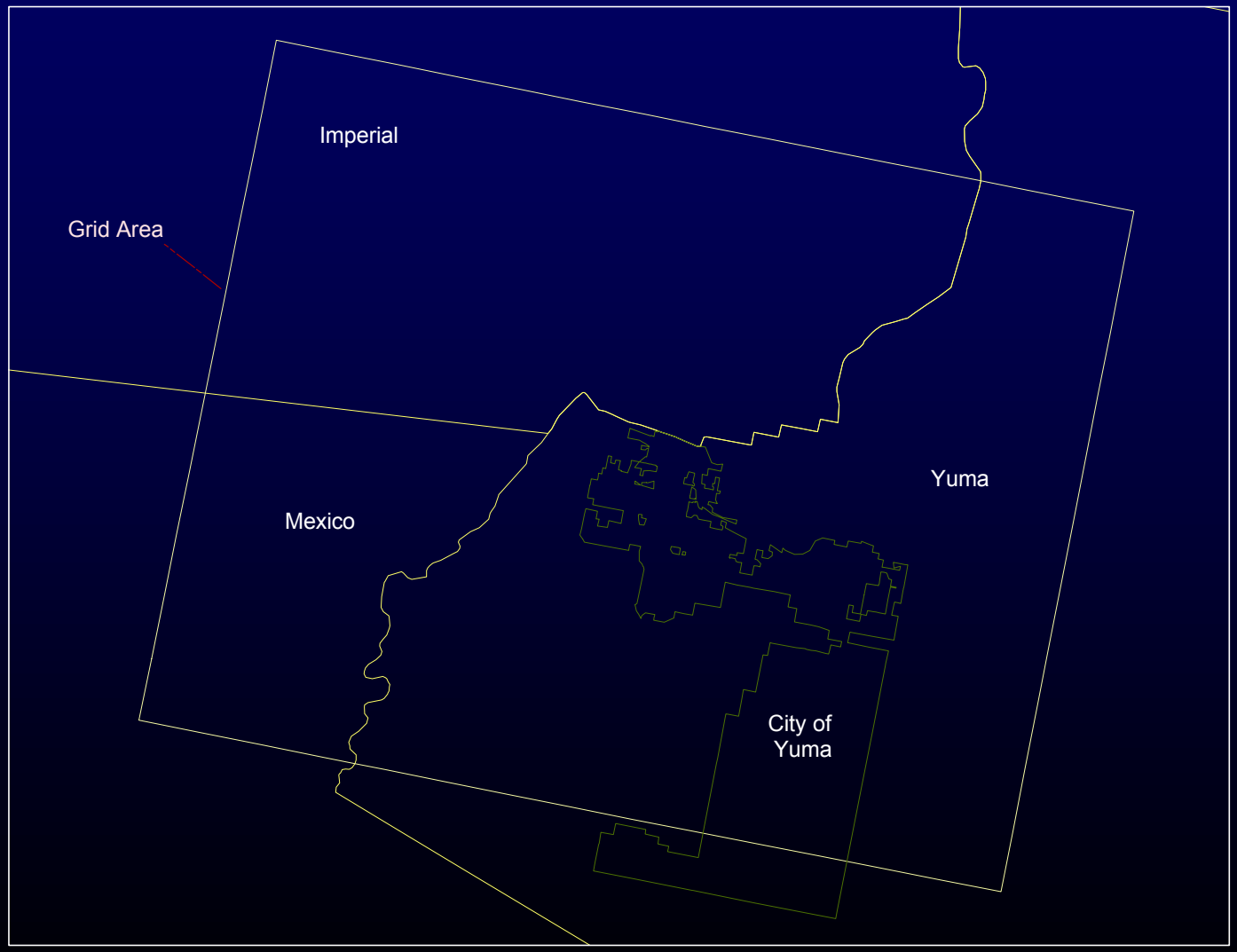
where:

EF_i = emission factor for land use i (tons/acre-hour);

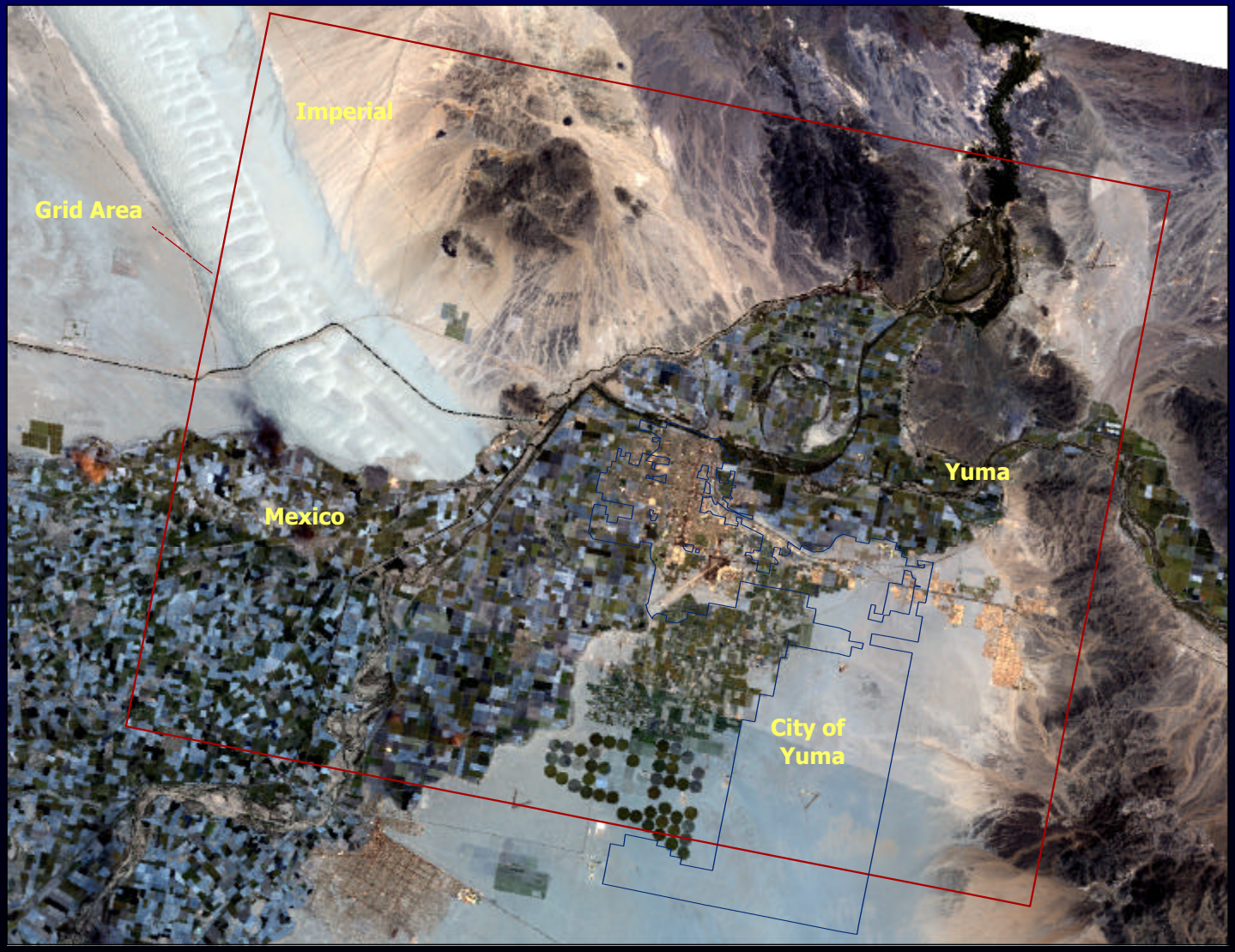
Area = area of land use i (acres);

T = time (number of hours above the wind speed threshold for land use i).

Yuma Arizona PM_{10} Study Area



15-Meter LANDSAT Image



Quantifying Erodible Areas

Alluvial Channels - Yuma Study

Alluvial Information estimated using a Landsat Satellite Image

15 meter Landsat Satellite Image fall 2001

AREA	CLASS_ID
6072.71094	3
31271.85156	3
15608.71875	3
396888.7031	3
3488.16.375	3
2002.6.101563	3
6224.8.84375	3
116207.0625	3
129122.710938	3
317398.9844	3
2005.8125	3
50778.15625	3
4092.84375	3
3616.546875	3
67057.32813	3
24703.21875	3
15071.48438	3
8824.242188	3
9177.8125	3
6482.8125	3

Legend

CLASS_ID

Sand, Silt Alluvial Material *51% of area*

Desert Pavement *49% of area*

1000 meter grid square

Imagery Resolution Issues

Land Use Classification Using Satellite Images - Disturbed Areas

Scale 1: 2,500

1 - Meter IKONOS Pansharpen image

4 - Meter IKONOS Multispectral image

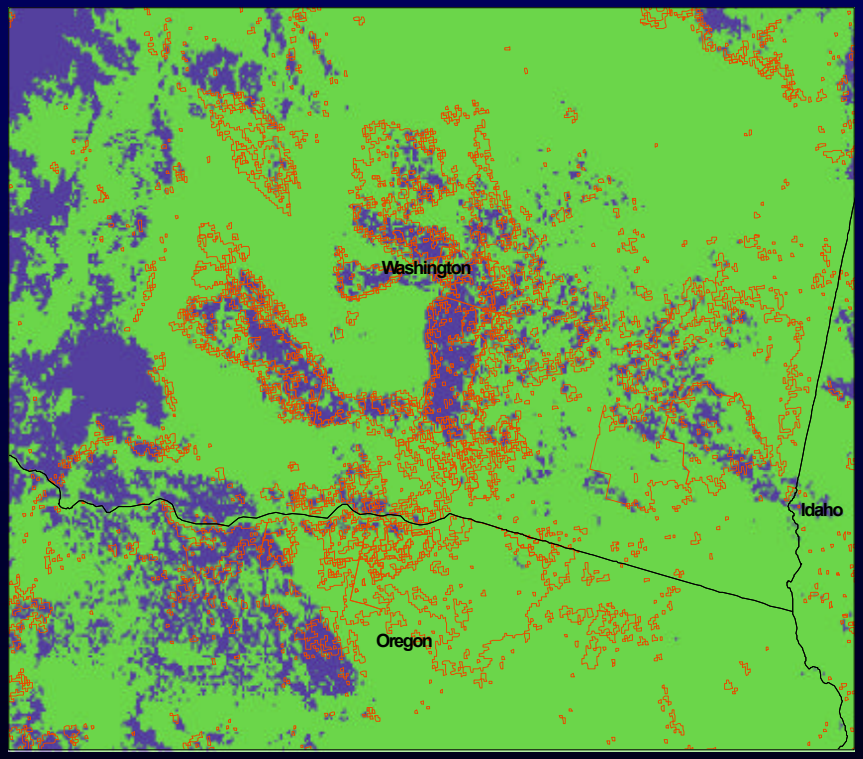
15 - Meter Landsat +7 Pansharpen image

Normalized-Difference Vegetation Index (NDVI)

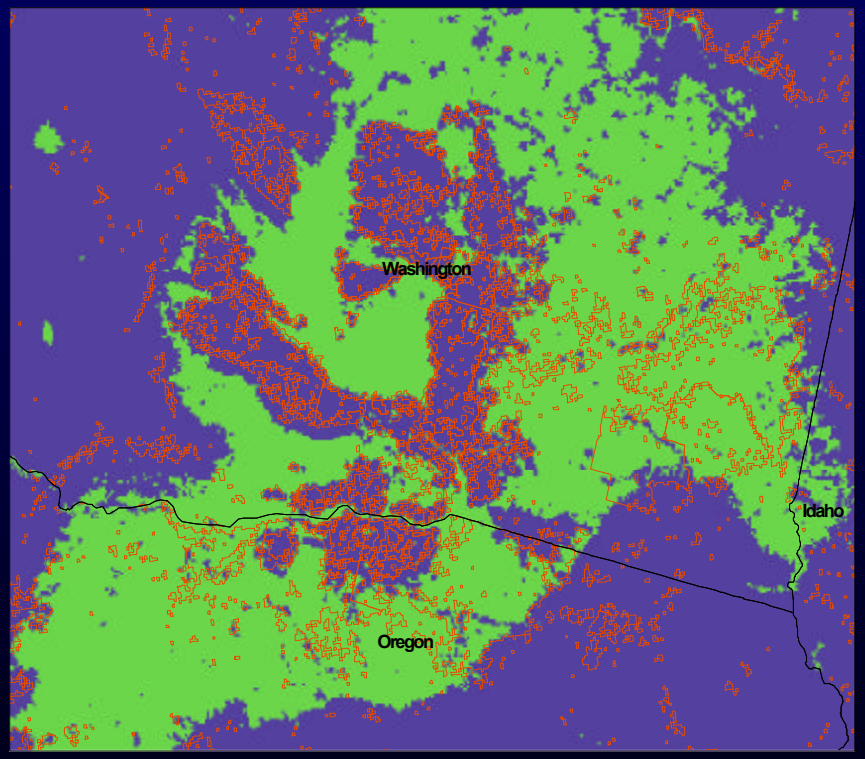
- Data from both the visible and infrared bands of satellite-based advanced very high resolution radiometers (AVHRR) are used to calculate the NDVI

- NDVI data can be used to identify areas where vegetation is healthy and growing versus being either dormant or barren

NDVI Applied to SE Washington Ag Fields



July, 1996

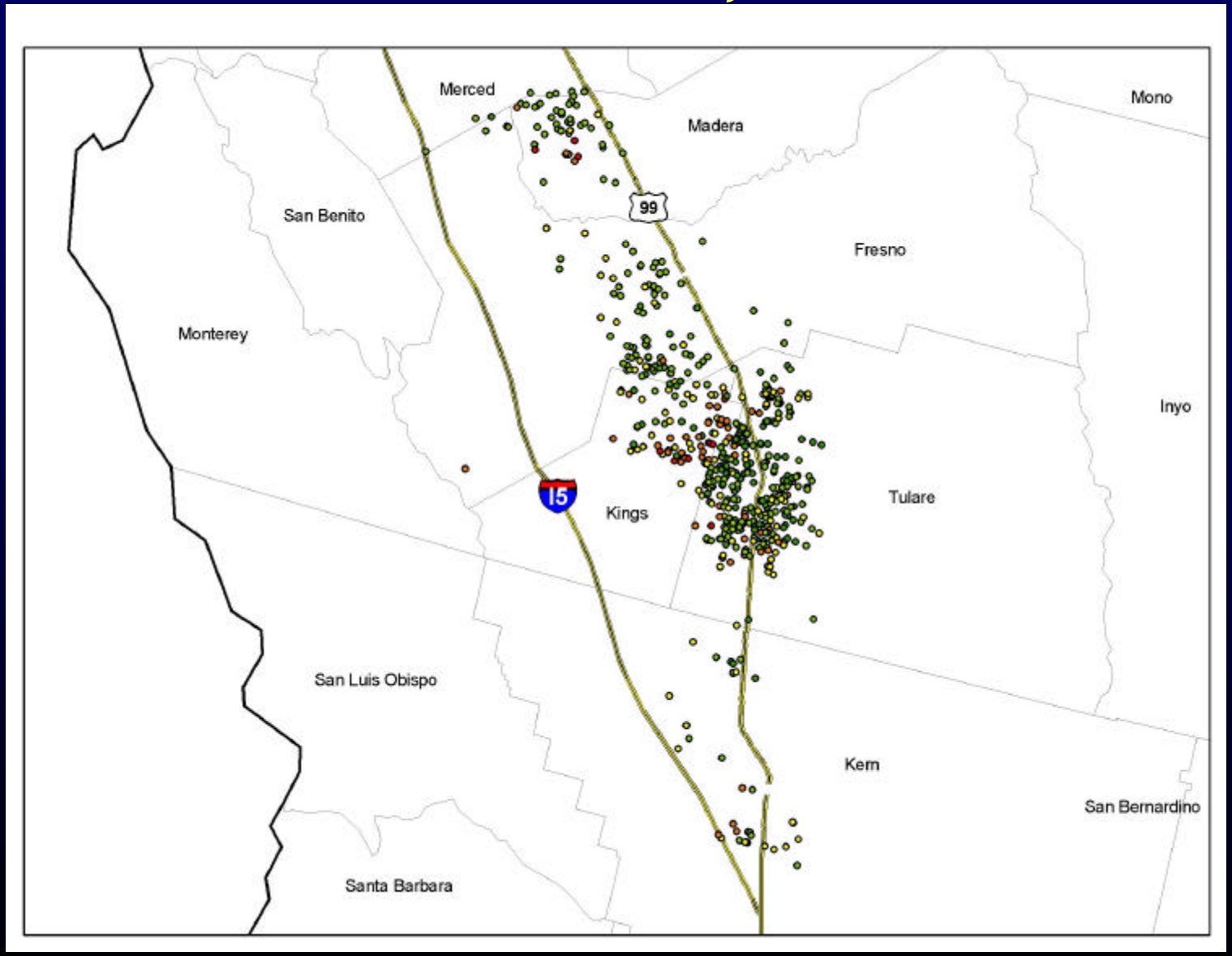


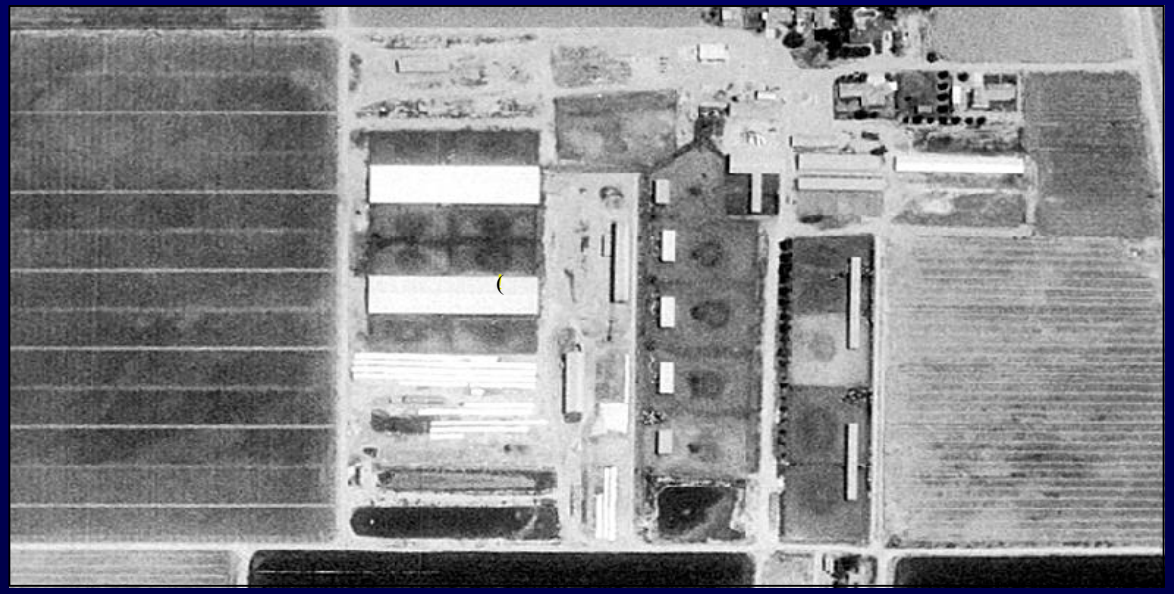
December, 1996

Miscellaneous Uses for Remote Sensing Data

- Spatial Surrogate Refinement
- Micro-Inventories (e.g. around ambient monitors, Class I areas)
- Development or Quality Assurance of Geo-coded point source locations

So. SJV, CA Dairies





Bottom-Up EI Development

1. Field Identification - In the field, identify and locate land use, roads, and industrial sources contributing to emissions and note these on printouts of the satellite imagery of area of interest.

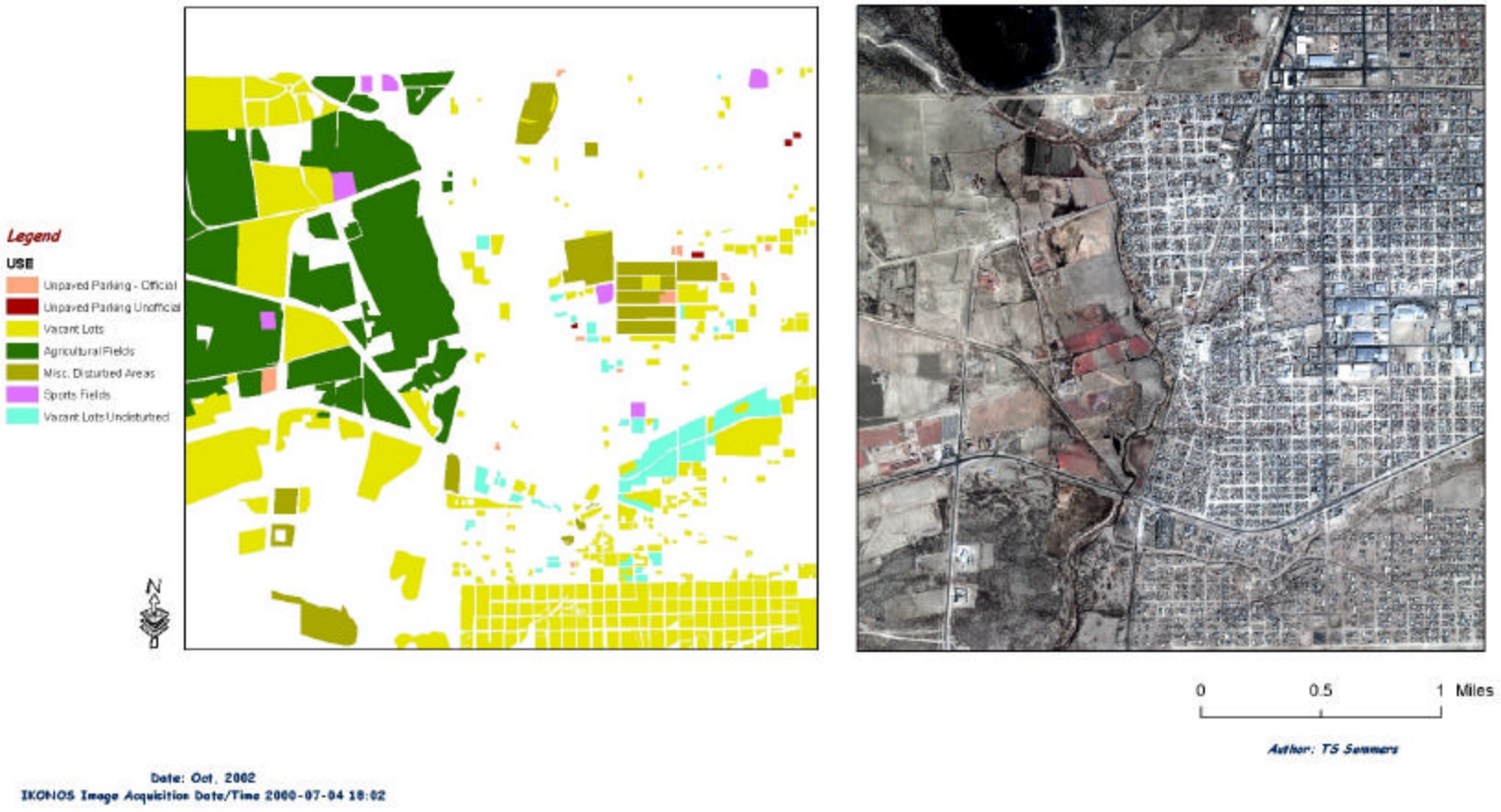
2. Digitize - In the office, digitize the annotated satellite printouts using GIS and satellite imaging processing software

Bottom-Up EI Development

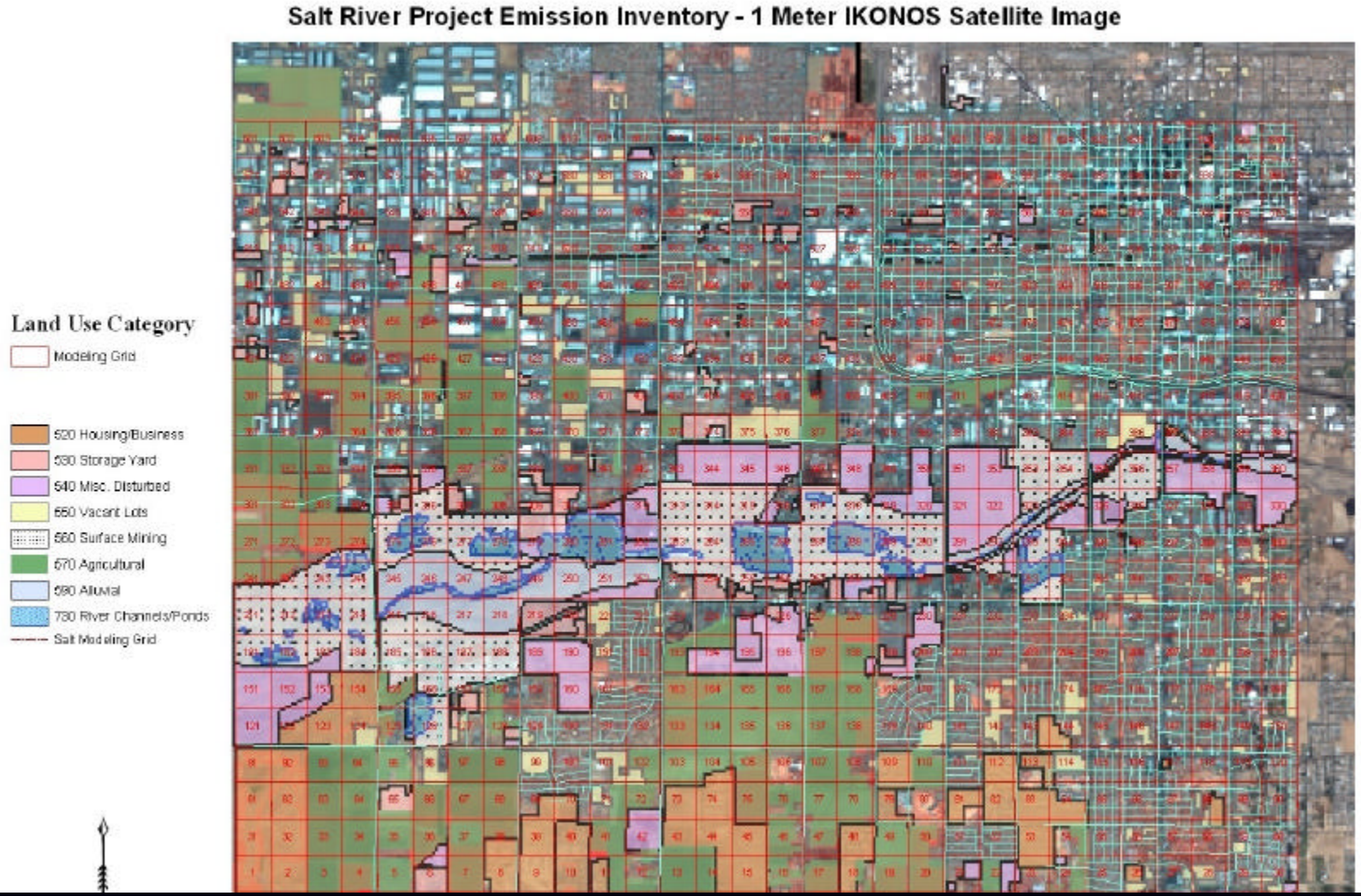
3. Grid - Lay modeling grid over satellite image and calculate spatial area, length, or point location of the emission sources for each grid cell using GIS.

4. Emissions – Convert area and length data for each emission source in a grid cell using in-house emissions software based on USEPA emission factors.

Comparison of Digitized Land Use with Satellite Image



Digital Overlay of Land Use On Satellite Image



Considerations of Using Remotely-Sensed Data

Match Image Resolution & Cost To EI

- Low Resolution Image (15-meter)
  - ID of general land use (e.g, agriculture)
  - Cost Range: Free to hundreds of dollars
- Medium Resolution Image (4-meter)
  - ID of smaller features (e.g., parking lots)
  - Cost Range: Thousands of dollars
- High Resolution Image (1-meter)
  - ID of very small features (e.g., buildings)
  - Cost Range: Thousands to 10's of thousands of dollars

Considerations of Using Remotely-Sensed Data

Lead Time For Ordering Satellite Imagery

- High resolution images have longer lead time than low resolution images;
- High resolution image collected after customer order;
- Low resolution image, such as LANDSAT, are collected continuously.

Regional Inventory Development

- Start with low level resolution imagery and then identify areas where higher level imagery is needed.