Visual Exploration of Satellite Images

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Contents

- Graphics, Remote Sensing & Software
- Data & Definitions
- Geography
- Visual Exploration

Stat Graphics & Remote Sensing

- Buja, McDonald, Michalak, Stuetzle (1991) & McDonald, Willis (1987): Confluence of 2 Rivers
- Klein, Moreira (1994): Agricultural Region in Brazil
- Scott (1986): Agricultural Scene on 5 Days
- Salch, Scott (1997): 3 Groups of Farm Crops
- Carr (1991): Nevada Test Site

ArcView/XGobi/XploRe & Remote Sensing

- Symanzik, Majure, Cook (1996) & Symanzik, Majure, Cook (1997)
- Cook, Majure, Symanzik, Cressie (1996)
- Symanzik, Cook, Klinke, Lewin (1998)

XGobi

Swayne, Cook and Buja

- Interactive Environment for Exploring Multivariate Data
  - Linked Views allow “Linked Brushing’’
  - Univariate, Bivariate and Multivariate Views of the Data
  - Grand Tour
  - Wide Variety of Methods

ArcView

ESRI™

- Desktop GIS with wide Range of Viewing and Data Manipulation Functions
  - Editing Features
  - Query Operations
  - Map Display
  - Interactive Interface
  - High Level Internal Scripting Language

The Data

- NOAA-14 Satellite (National Oceanic and Atmospheric Administration)
- AVHRR Sensor (Advanced Very High Resolution Radiometer):
  - Band 1: Red
  - Band 2: Near Infrared
  - Band 3: Mid Infrared
  - Band 4: Long Infrared
  - Band 5: (Very) Long Infrared
- Data from “NASA’s Project Atlanta”
- 18 Days from Jan 1997 to Dec 1997
- Resolution: 1 km x 1 km per Pixel
- Main Study Area: 70 km x 46 km

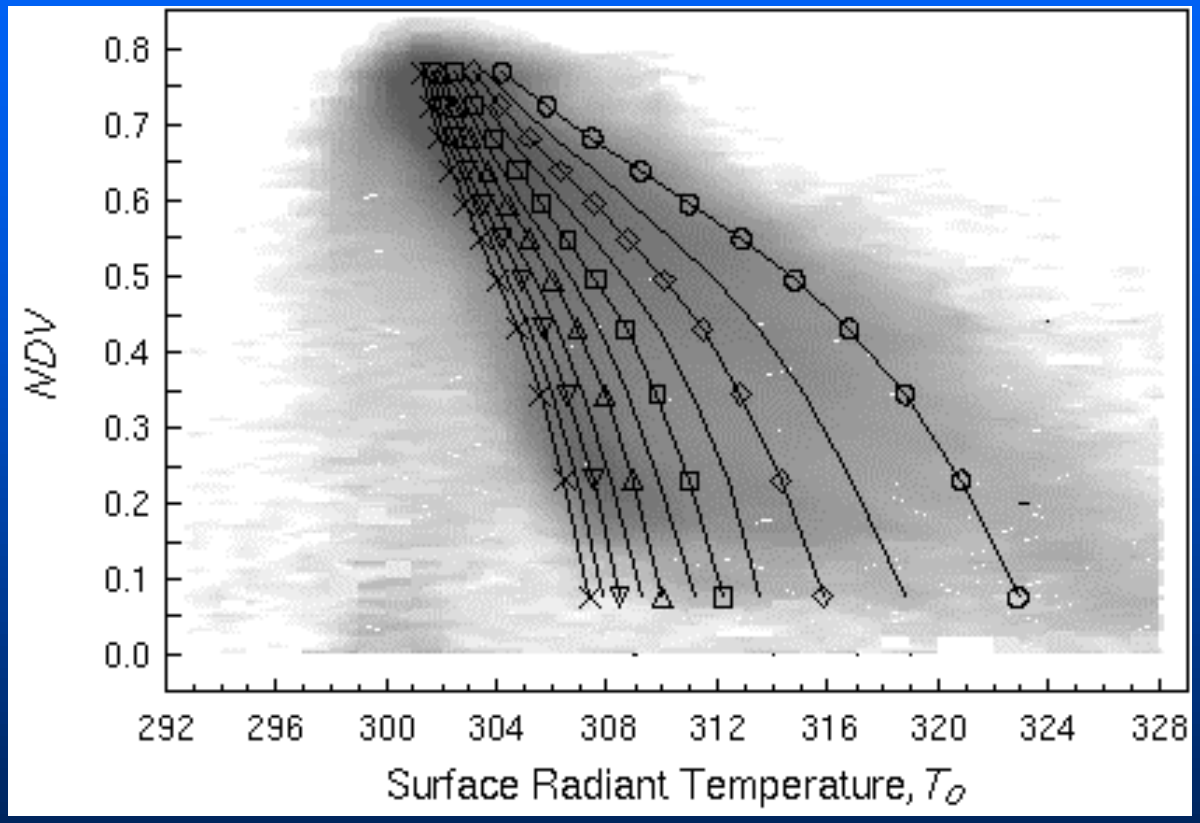
Some Definitions

- Normalized Difference Vegetation Index:

$$NDVI = \frac{Band2 - Band1}{Band2 + Band1}$$

- *NDVI* ~ 0.8 for Highly Vegetated Surfaces
- *NDVI* ~ 0.1 for Bare Soil
- Surface Radiant Temperature T_0: Band 4
- Surface Moisture Availability M_0

An Example

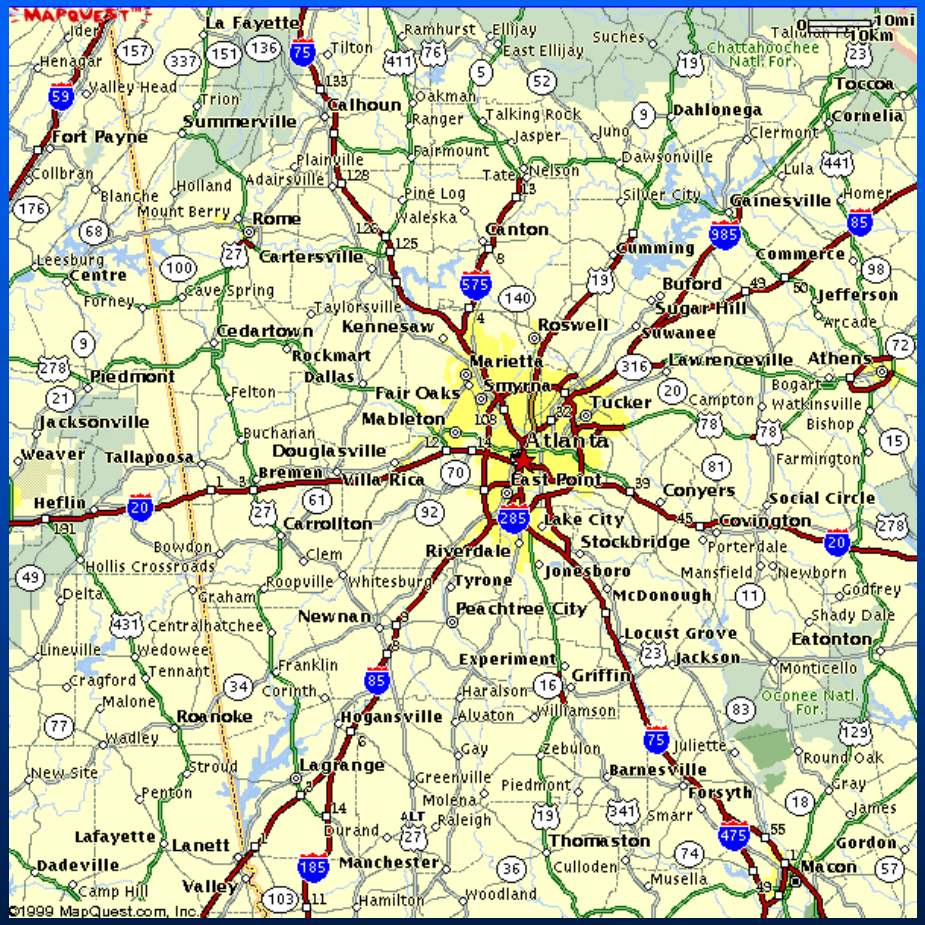


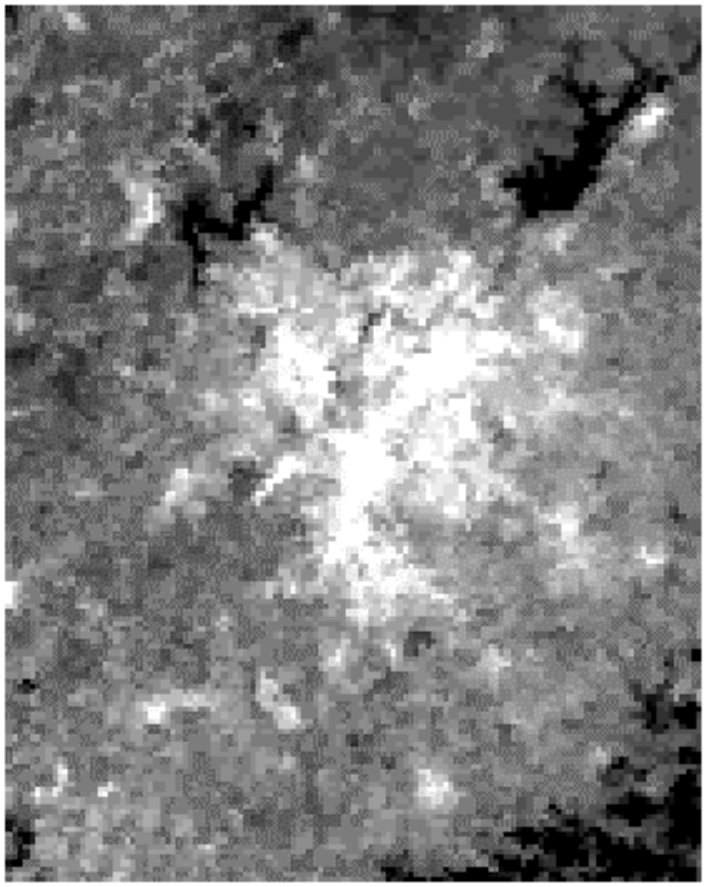
NS001-TMS derived T_o-*NDVI* scatterplot (gray spectral scaling) at a 5 meter spatial resolution for a 7 x 3 km area of the Mahantango Watershed, Pennsylvania. 18 July 1990, 1145 LST. Isopleths representing moisture availability index, M_o are overlaid with the legend, o = 0.0 ('warm' edge), ◊ = 0.2, □ = 0.4, Δ = 0.6, ∇ = 0.8, and × = 1.0 (cold edge).

Goal of the Study

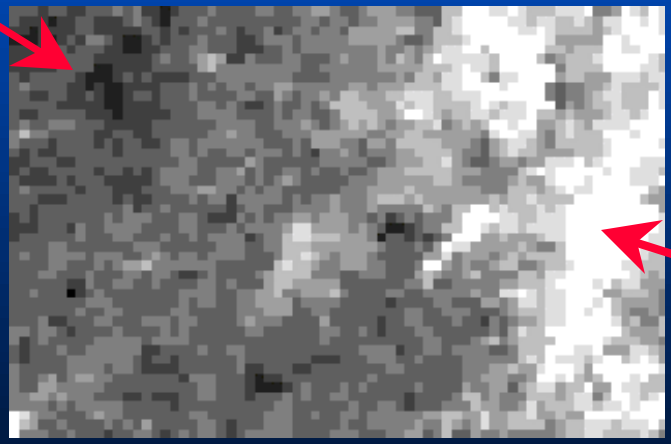
- Explore (and Model) Relationships between *NDVI*, T_0 and M_0 for different Seasons
  - Specify Wide-Range Behavior (e.g., for City, Forest, Water)
  - Find Unusual Places

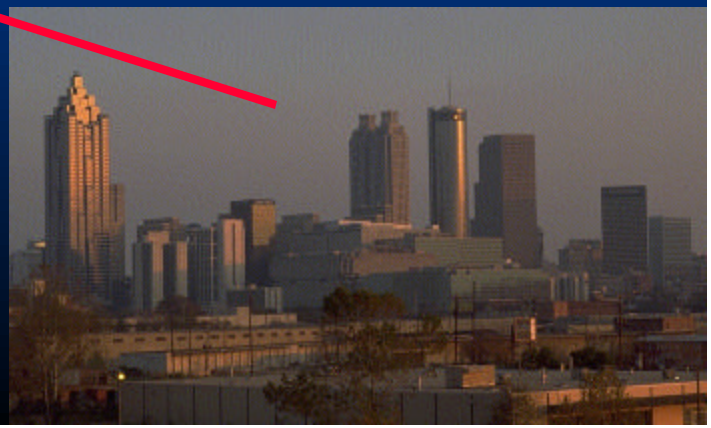
The Geographic Setting



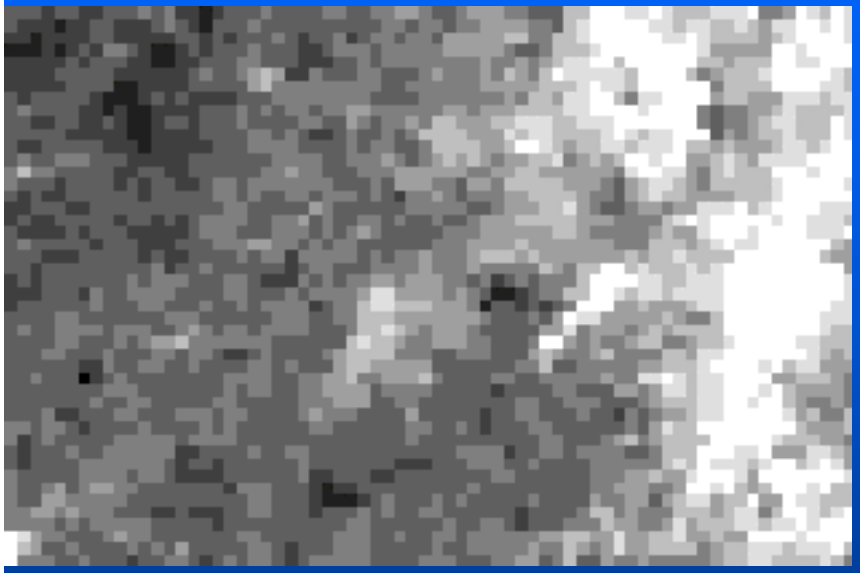


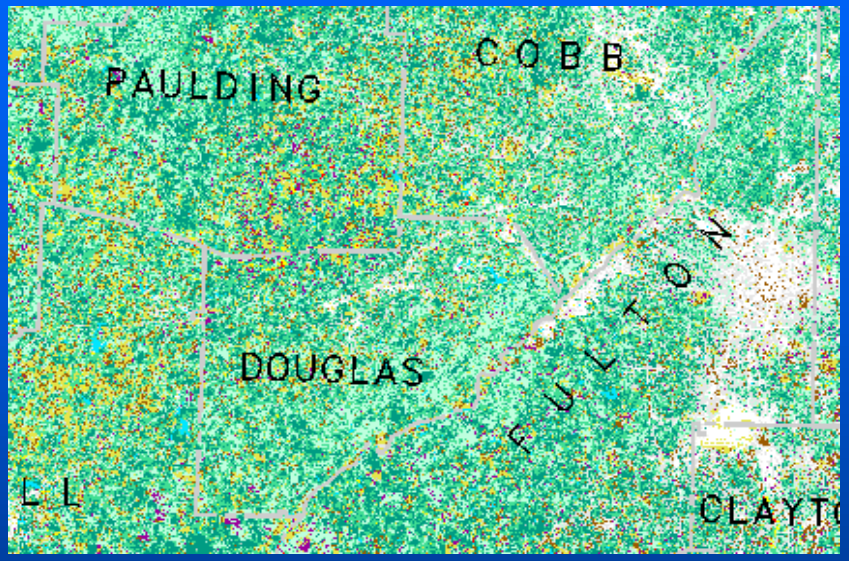
The Main Study Area





The Main Study Area - Landcover



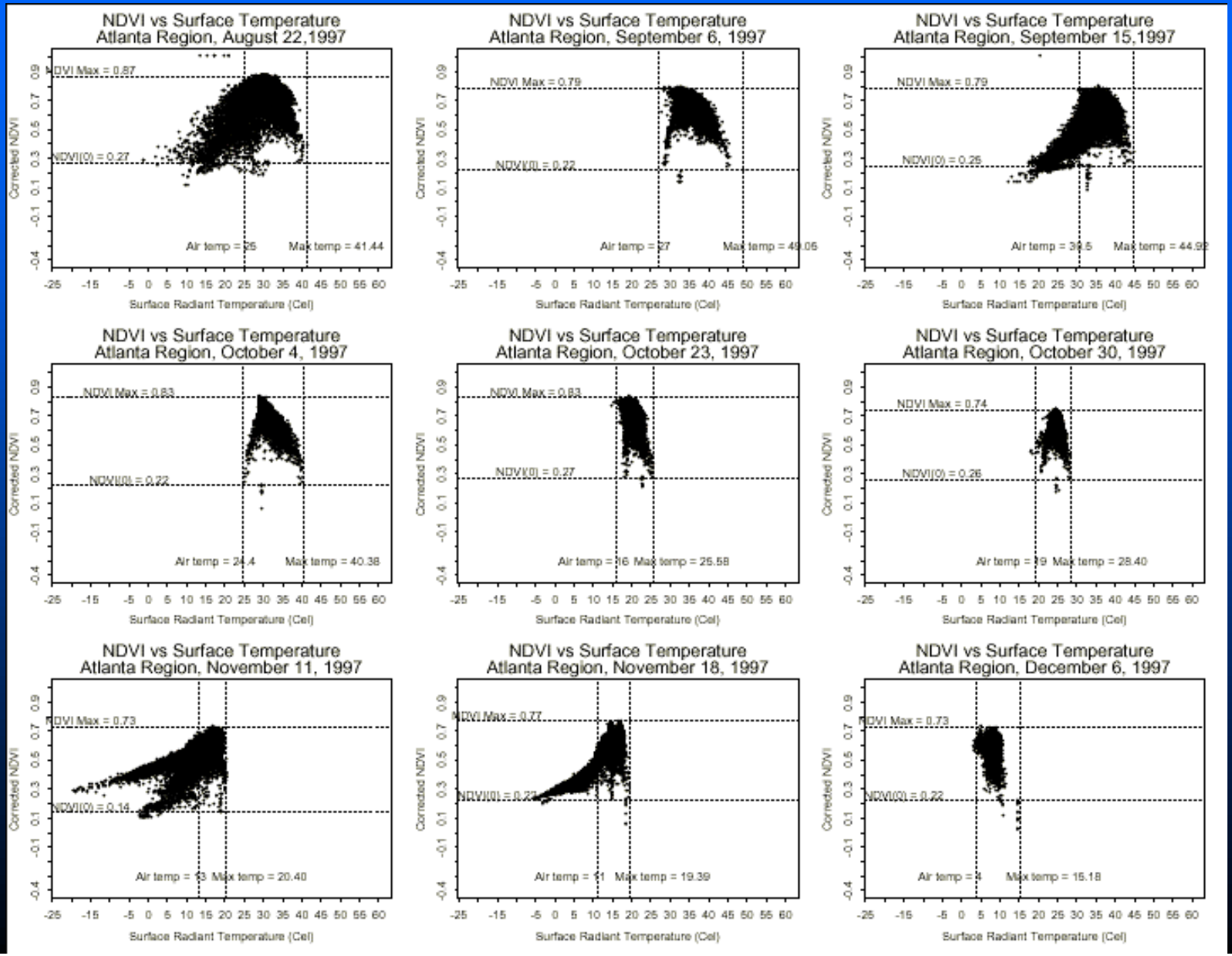


EXPLANATION

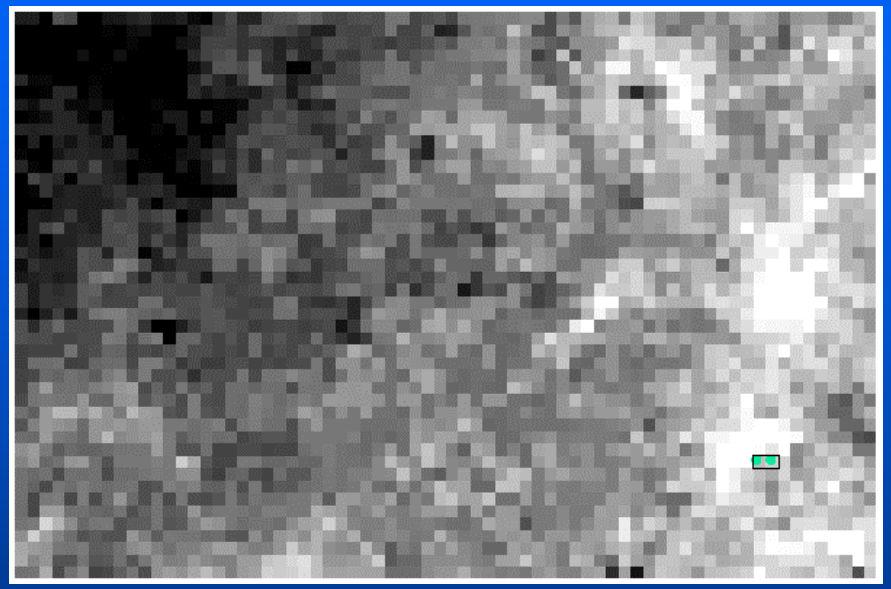
- Open Water
- Clear Cut / Young Pine
- Pasture
- Cultivated / Exposed Earth
- Low Density Urban
- High Density Urban
- Emergent Wetland
- Scrub / Shrub Wetland
- Forested Wetland
- Coniferous Forest
- Mixed Forest
- Hardwood Forest
- Salt Marsh
- Brackish Marsh
- Tidal Flats

Digital Landcover from Georgia Department of Natural Resources, Wildlife Resources Division, Natural Heritage Program, 200ft resolution.
Digital state and county data compiled from US Census TIGER/line files 1:100,000.
Digital shoreline data compiled from NOAA vector shoreline of the US 1:70,000.

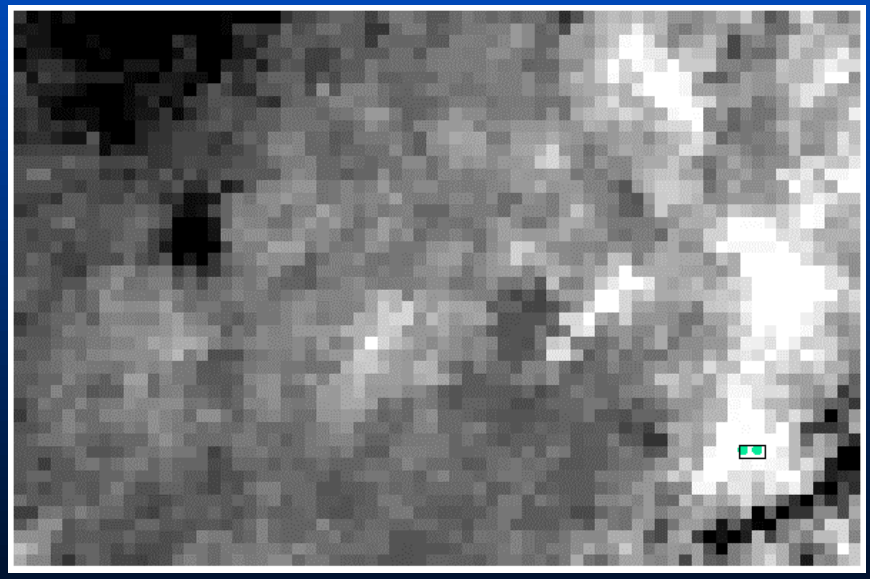
NDVI vs Surface Temperature



Two Months



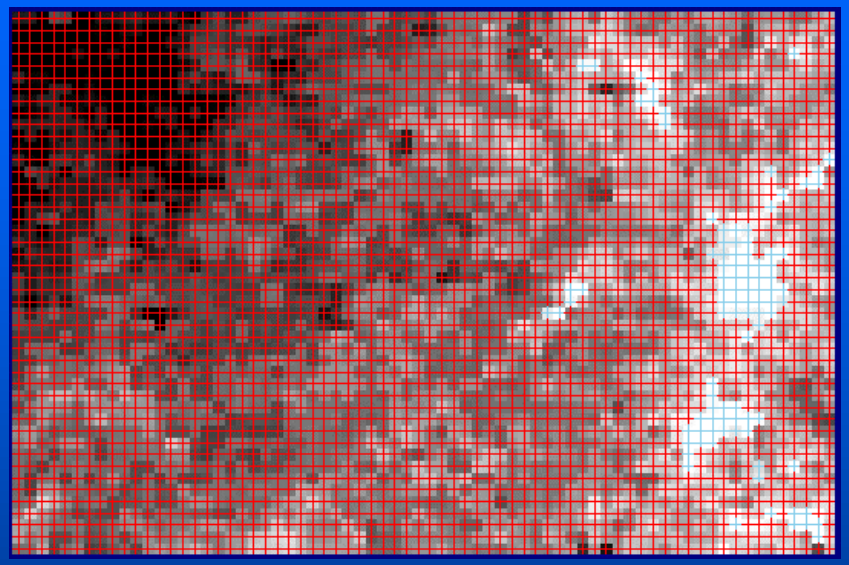
December

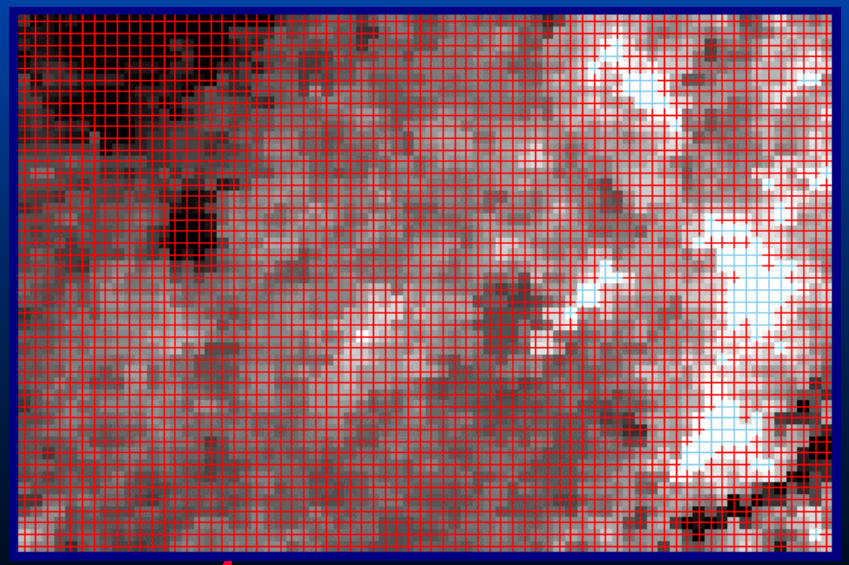


August

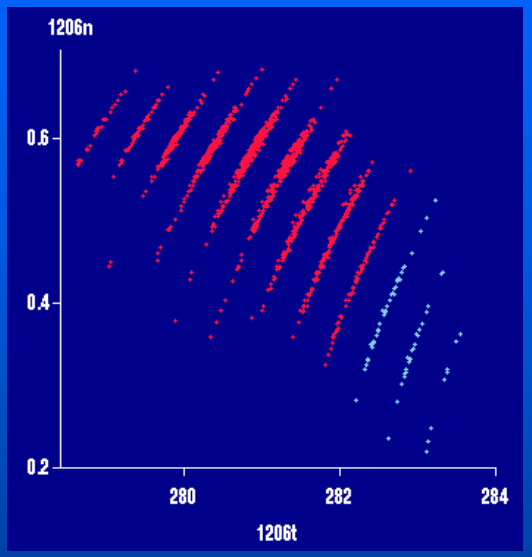
The City

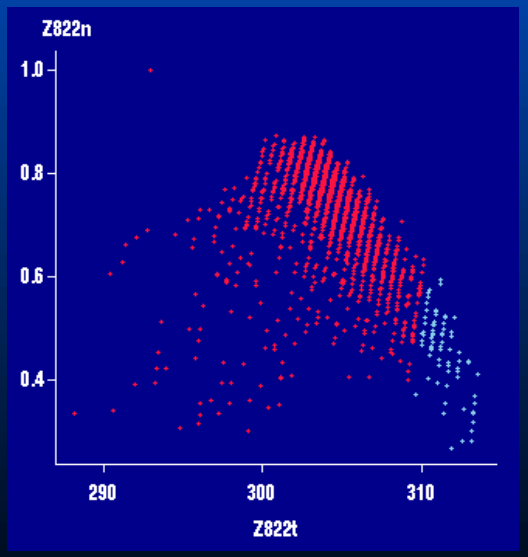
December



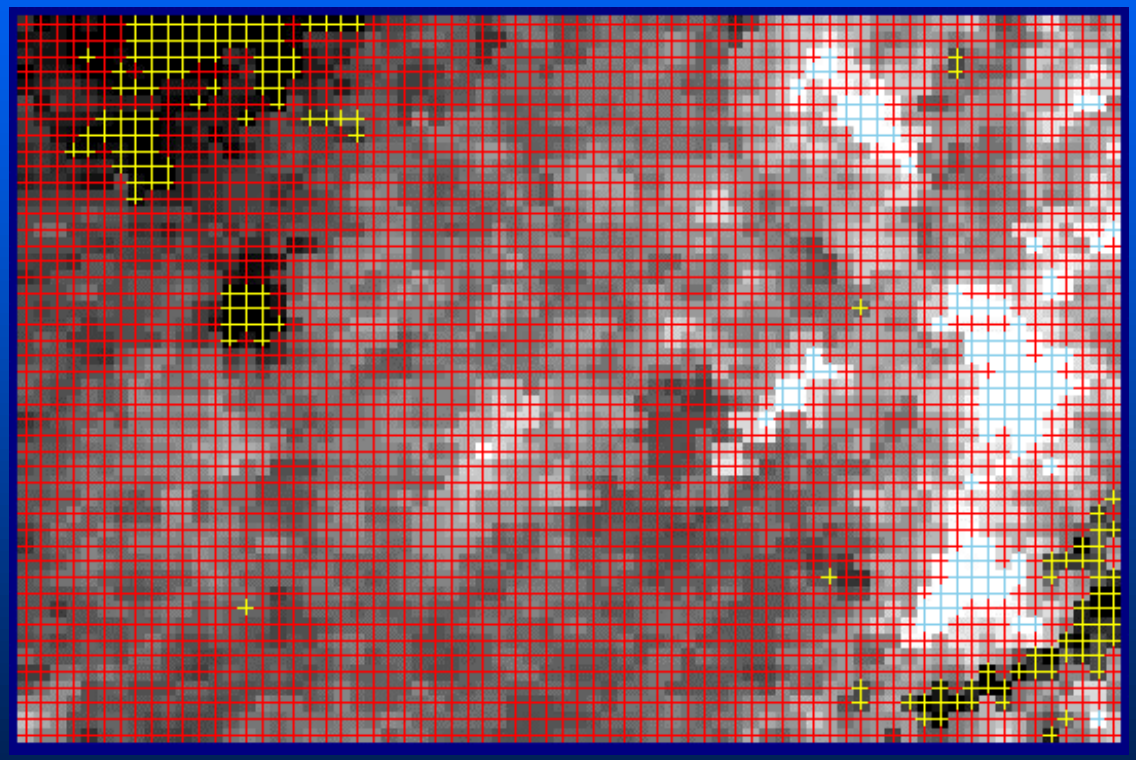


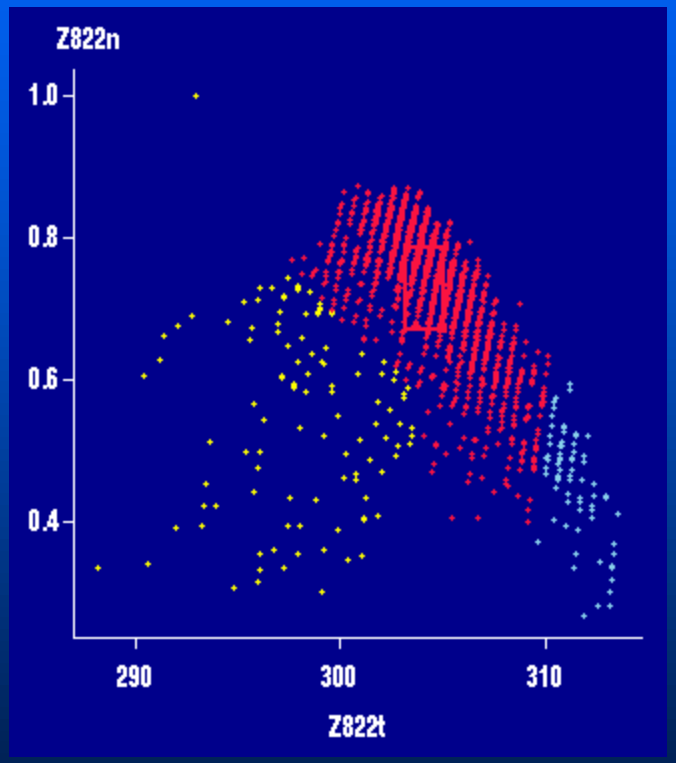
August





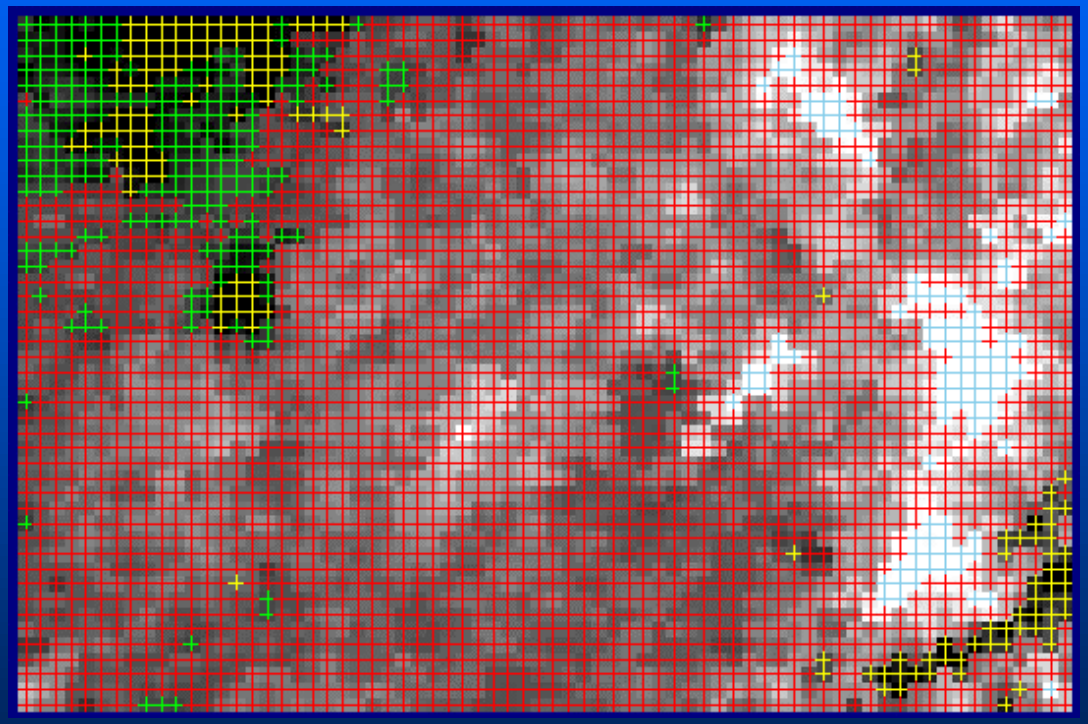
Clouds in August

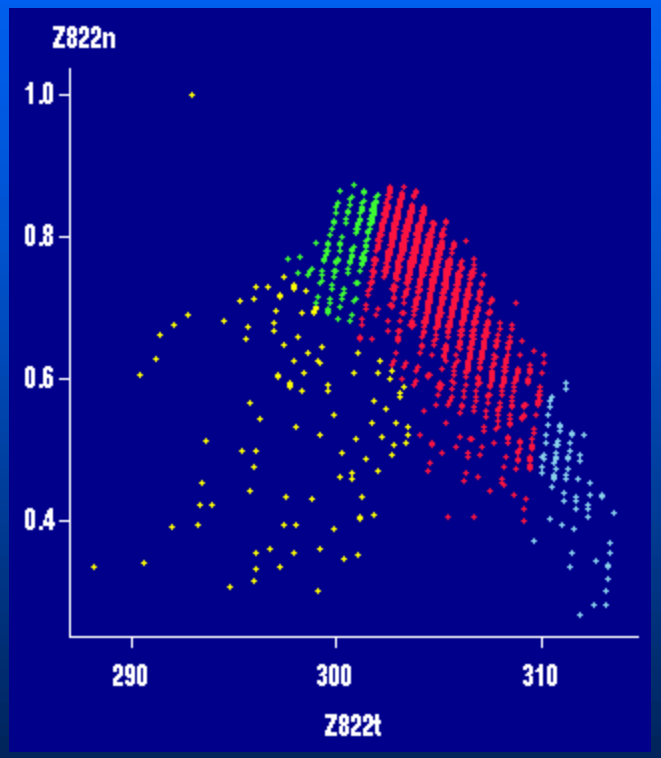




August

Clouds and Forest in August

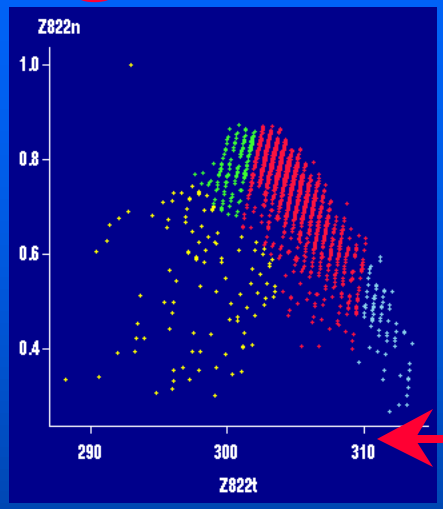




August

Reclassifying Clouds

August



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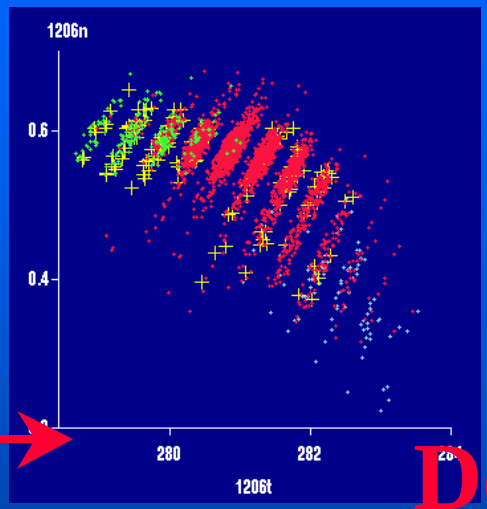

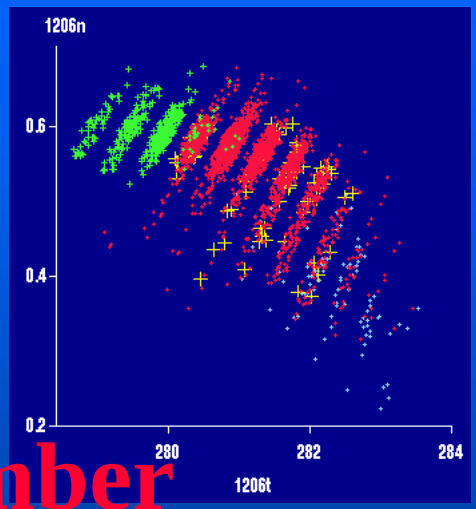

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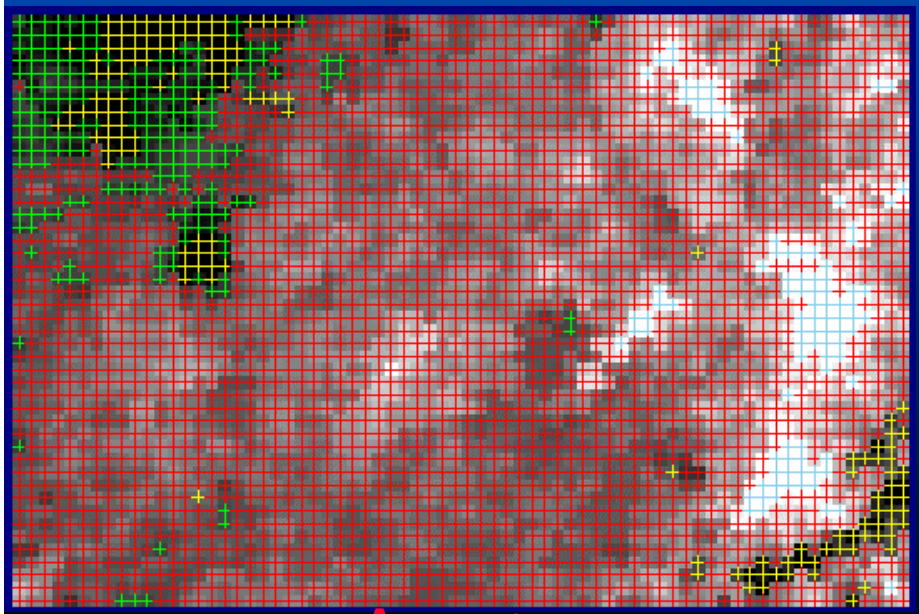

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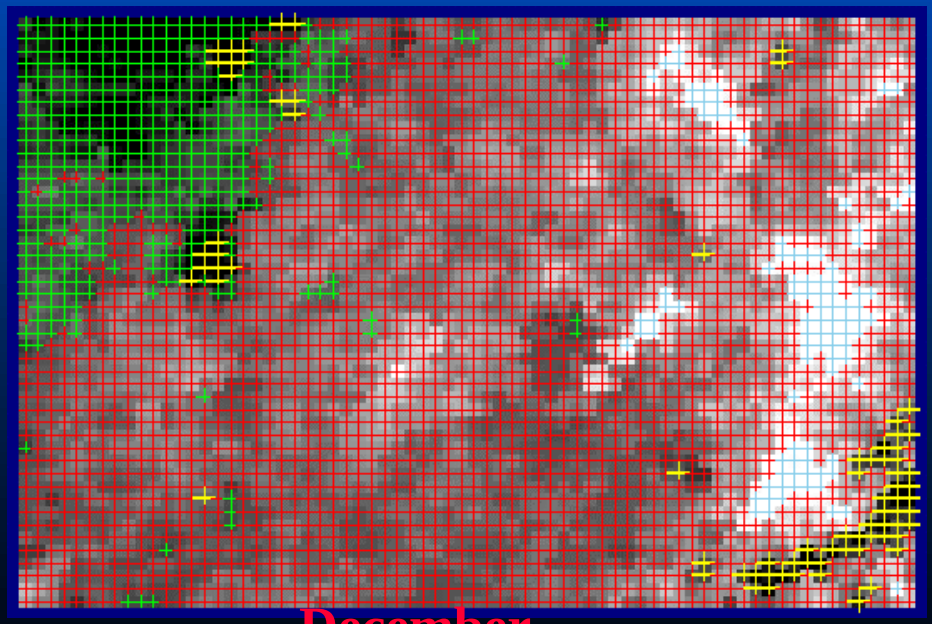
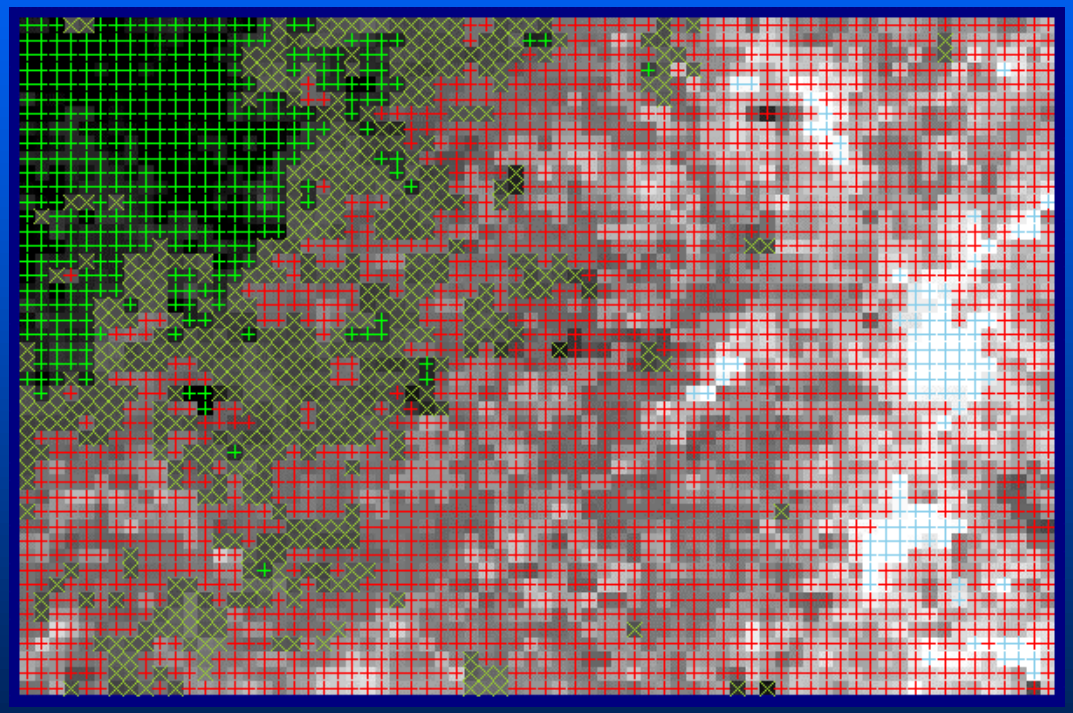


December

Final Classification



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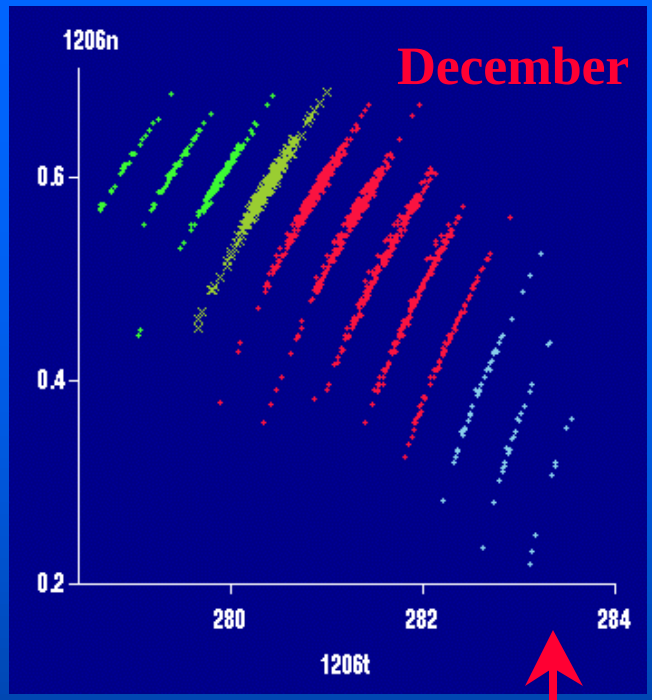

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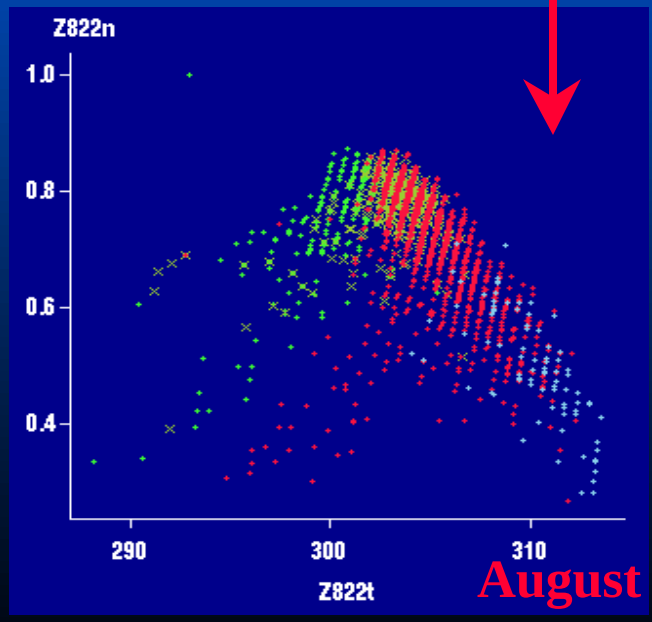
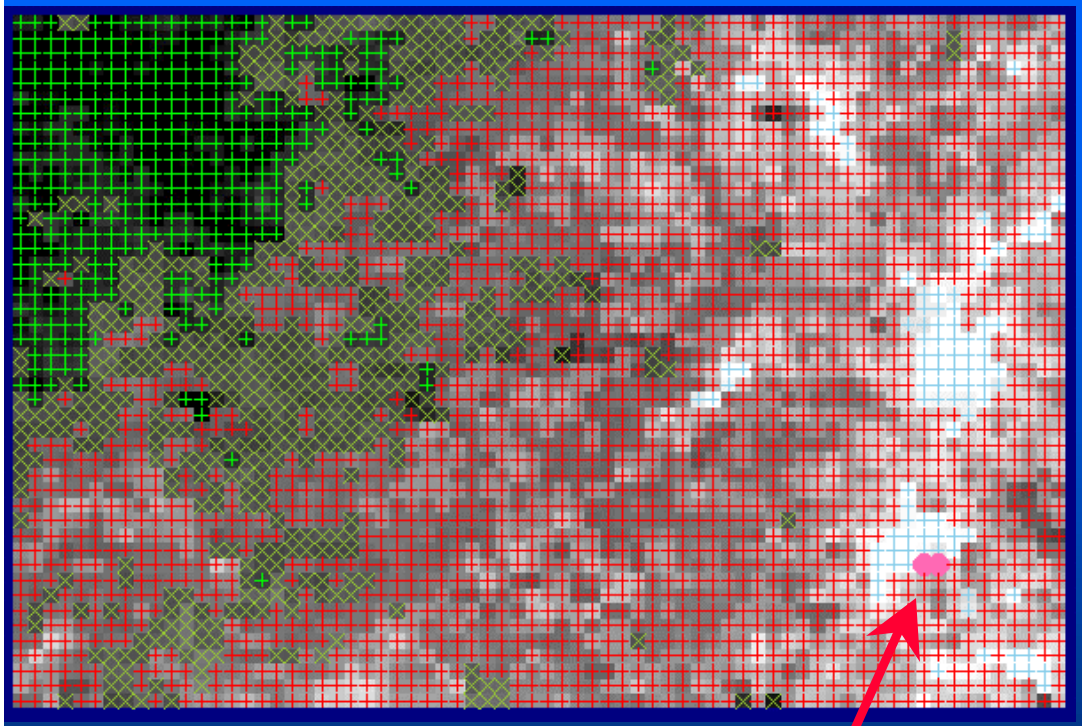


2 Pixels of Interest



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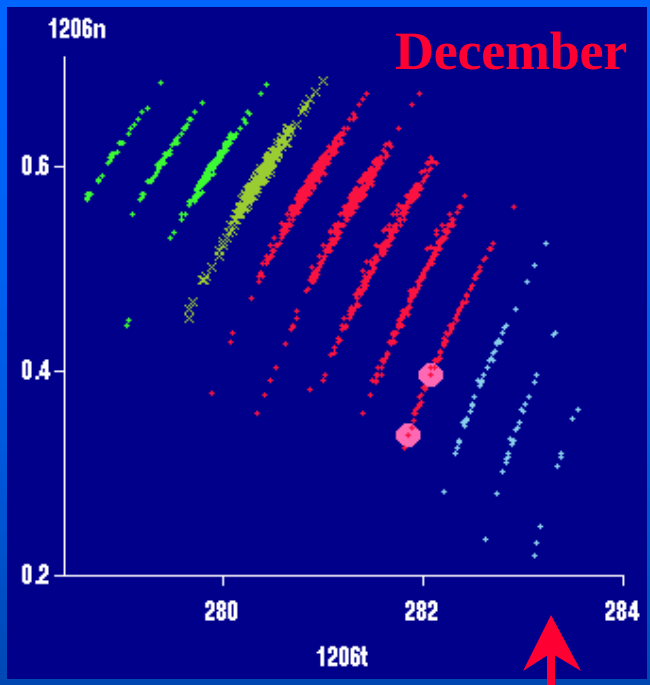

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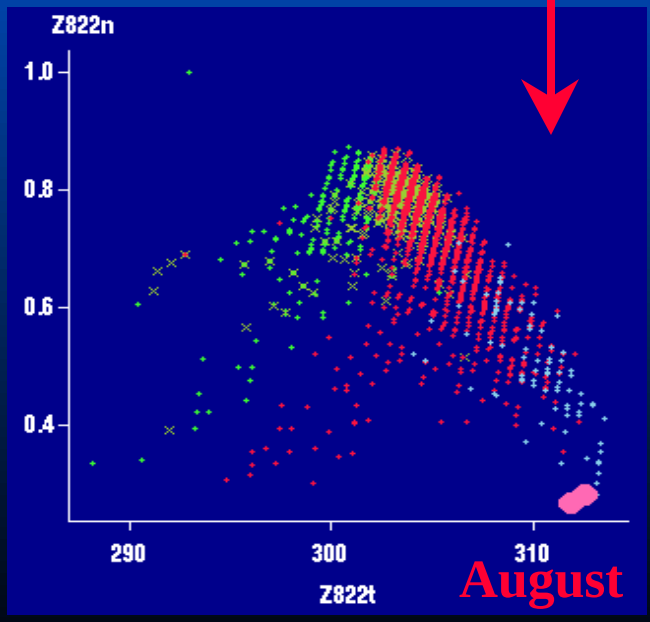
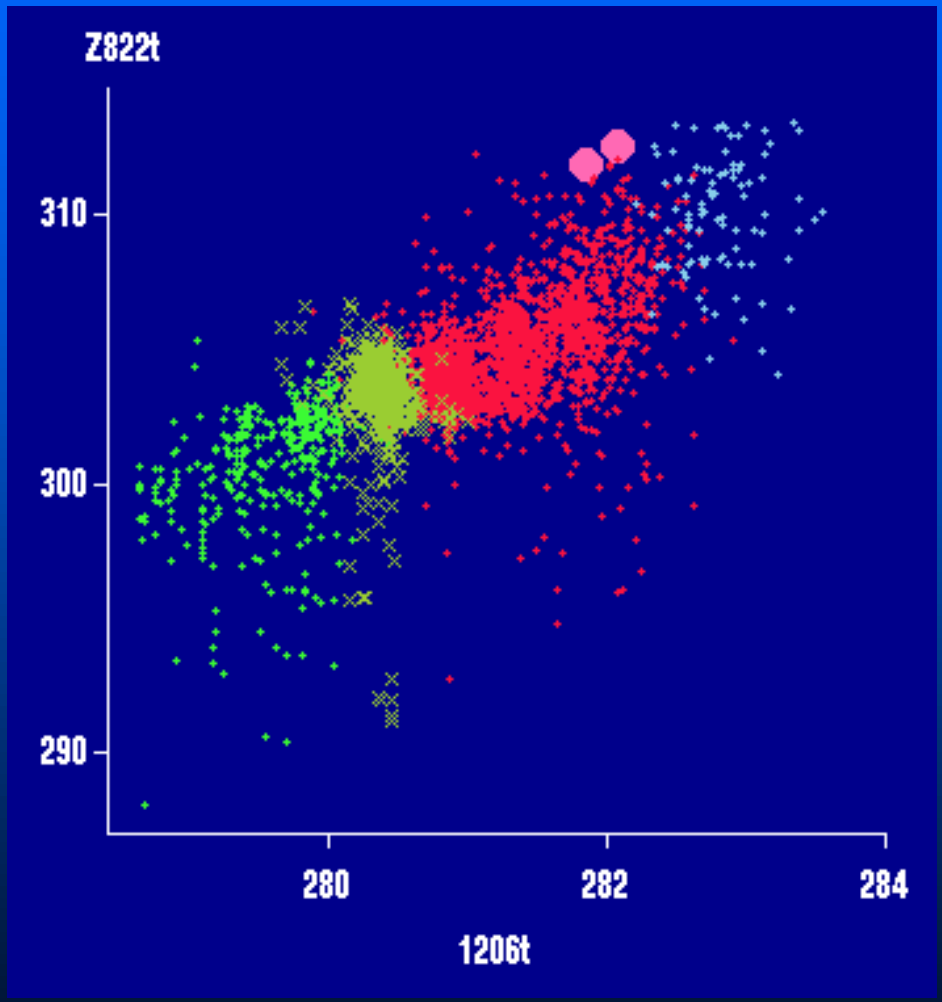


Correlation of Temperatures



Additional Information

- Articles on ArcView/XGobi/XploRe
  - http://www.math.usu.edu/~symanzik
- Main Web page
  - http://www.public.iastate.edu/~arcview-xgobi/homepage.html