



Remote Surveillance Technologies for Assessing Biological Threats

A decorative graphic featuring a vertical orange grid on the left side, transitioning into a horizontal landscape with green and yellow fields and a blue sky with white clouds.

**Stan Morain & Amy Budge
Earth Data Analysis Center
University of New Mexico**

**BTR 2004: Unified Science and Technology for Reducing Biological
Threats & Countering Terrorism "Homeland Security: Toward
Converging Partnerships
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Agenda

- **Overview of paper**
 - Bio-threats defined
 - Elements of an NMGI I
- **Illustration of capabilities**
 - Satellite Assets and ESMF
 - Asthma
 - HPS
- **Recommendations**



BTR Scope and Opportunities

- **DHS & NMDHS Bio-threat Reduction Initiatives**
 - **Bio-Surveillance Program Initiative (BSPI)**
 - **DHS's Information Analysis & Infrastructure Protection Program (IAIP)**
 - **Homeland Security Working Group (HSWG)**
 - **Geospatial Data Acquisition Coordination Committee (GDACC)**
- **Target Applications for NMGII**
 - **Respiratory & Infectious Diseases (Forecasting, Prevention & Mitigation)**
 - **Tracking Microorganisms, Plants and Animals (Food Security and Infrastructure Protection)**
 - **Hazardous, Toxic, & Nuclear Materials Transport (Public Safety, Evacuation Planning, & Risk Avoidance)**



Elements of a New Mexico Geospatial Information Infrastructure (NMGII)

■ National Assets

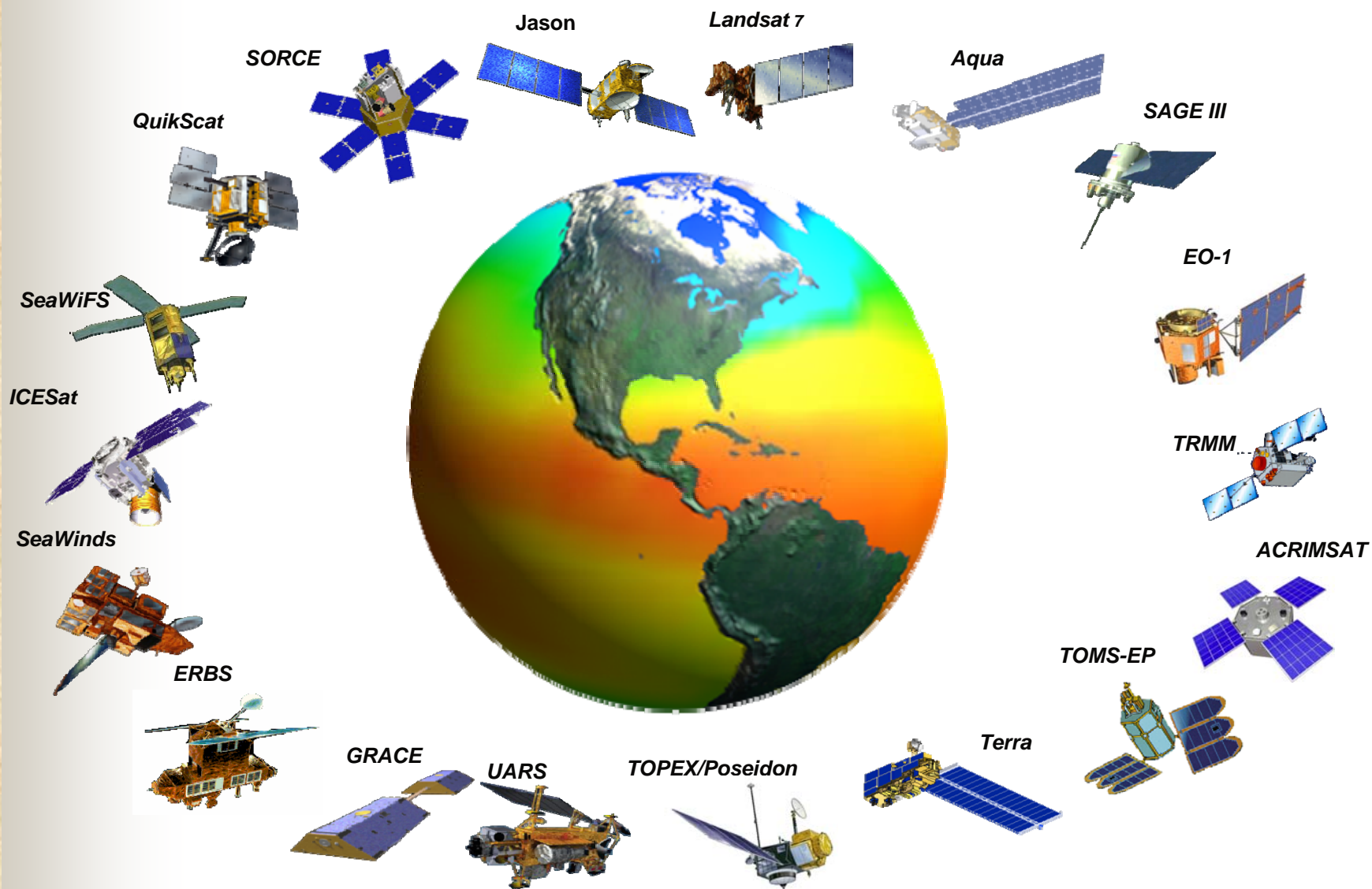
- Satellite Resources
- NSGIC
- NSDI
 - FGDC
 - HSWG
 - National Map
 - Geospatial One-Stop)

■ New Mexico Assets

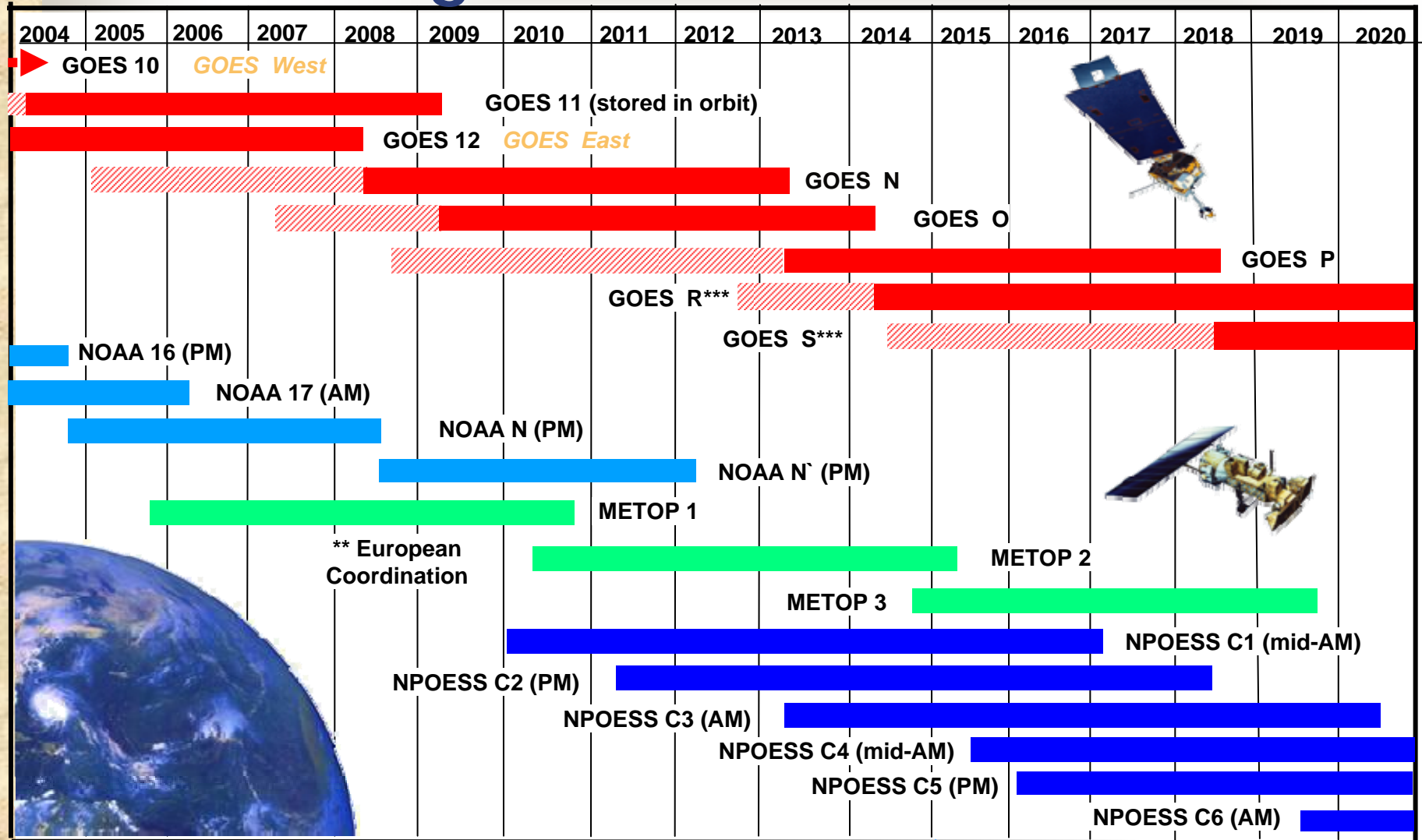
- RGIS
- NMGIC
- GISAC
- GDACC
- EDAC, UNM (Public Health)
- LISA, NMSU (Animal health)



To Protect Our Homeland & Planet



Continuity of Operational Satellite Programs



* Actual launch dates are determined by the failure of on-orbit assets
 ** Assumes METOP will provide the morning orbit and NOAA-N' will provide afternoon orbit instruments
 *** GOES R-Series may be single or suite of satellites (distributed constellation)

Satellite is operational beyond design life
 On-orbit GOES storage

BTR & National Applications



Carbon Management



Public Health



Energy Forecasting



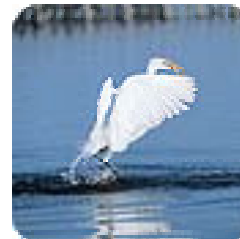
Aviation Safety



Water Management



Homeland Security



Coastal Management



Disaster Management



Agricultural Efficiency



Invasive Species



Ecological Forecasting



Air Quality





Integrated System Solution

EARTH SYSTEM MODELS

1. *Modeling Framework*
MAESTRO* / MAESTRA*
CLSM*
NCEP-ETA* + "DREAM"
2. *Candidate Adjunct Models*
NARAC / ERS
HOTMAC / RAPTAD
Ecological Models (e.g. HPS)
COAMPS*
3. *Statistical models*
(e.g., NARA, NARISA)

Predictions

DECISION SUPPORT TOOLS

- Enhancing RSVP capabilities
- Improving knowledge of vector ecology
- Improving NCEP-ETA model w/ DREAM inputs
- Improving DREAM inputs w/ NASA products
- Improving aerosol and smoke dispersion models w/ NASA products
- Visualizations and animations of key environmental triggers

Data

MONITORING & MEASUREMENTS

1. *TRMM Data Products*
PR 3A-25,26
TMI 2A-12, 3A-11
TRMM 2B-31, 3B-31, #B-42,43
2. *ASTER Data Products*
AST14, AST05,08
3. *MISR Data Products*
MIS05,08,09
4. *MODIS Data Products*
MOD04,08,09,11-17
5. *NPOESS

Observations

VALUE & BENEFITS

1. NASA assets feed DSS
2. Integrated NASA/CDC solution
3. Stimulate Wkfrc Dev w/ space products
4. Benchmark value of solutions
5. Expand user base for RSVP
6. Migrate RSVP-2 to RSVP-3
7. Provide quicker public health response
8. Refine quality of public health response



Reported Predictors/ Triggers Of Asthma

Respiratory Predictors

1. Urbanicity
2. Traffic density
3. Age
4. Gender
5. Temperature
6. Precipitation
7. Humidity

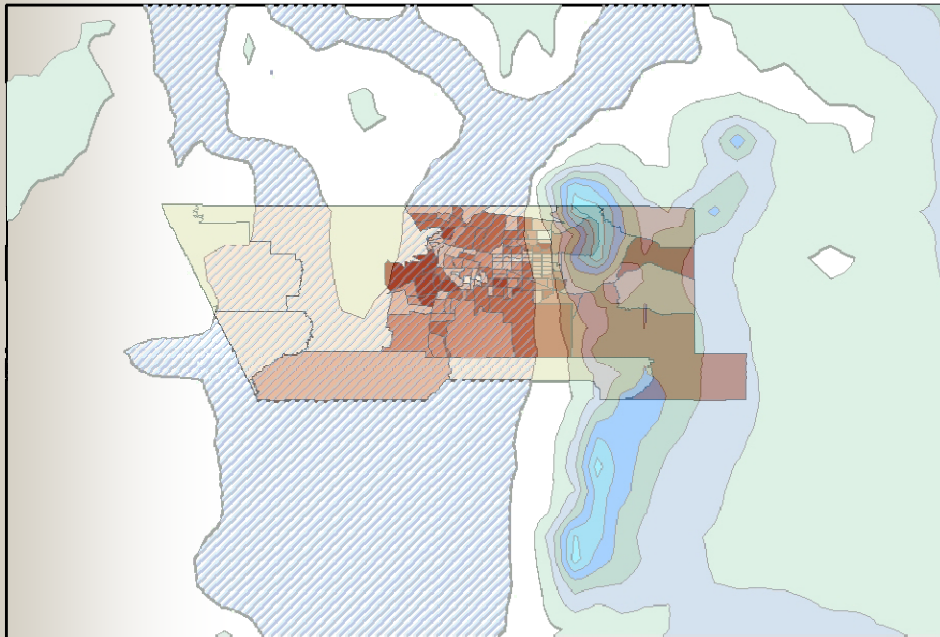
Respiratory Triggers

- A. Outdoor Environment
 1. Dust
 2. Pollen
- ~~B. Indoor Environment
 1. Wall-to-wall carpet
 2. Cockroaches
 3. Stuffed toys~~

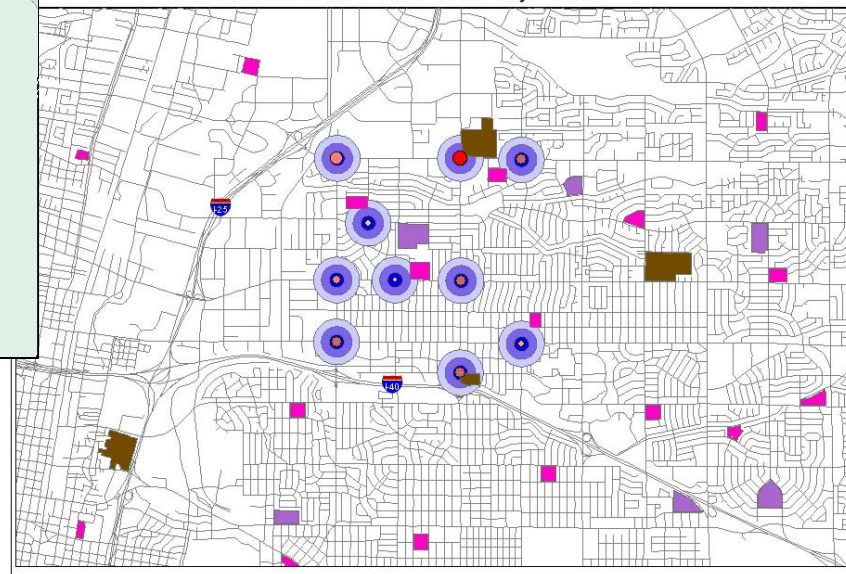


Sample Coverages For Asthma Predictors

Bernalillo County Population Density
and
Annual Precipitation



Albuquerque Public School Locations
and
Intersection Traffic Density Rates



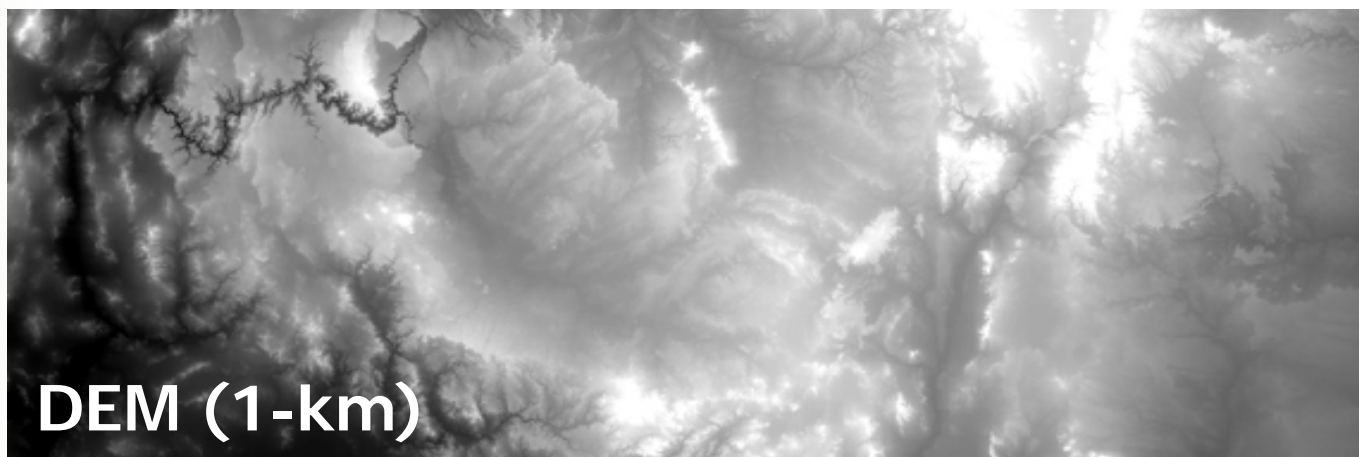


BTR/NASA Data Products

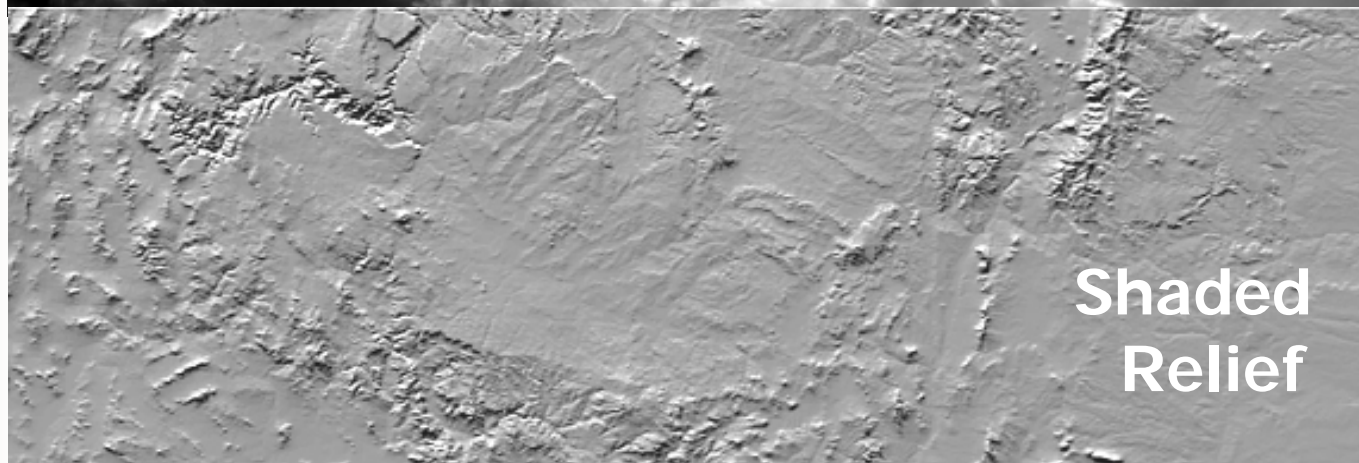
- **Tropical Rainfall Measuring Mission (TRMM)**
 - Precipitation Radar (3A-25) **Monthly accumulated rainfall**
 - PR (3A-26) **Accumulated surface rainfall**
 - TRMM Microwave Imager (2A-12) **Surface rainfall & vertical structure**
 - TRMM (3B-31) **Monthly combined accumulated rainfall & vertical structure**
- **Advanced Spaceborne Thermal Emission & Reflection Radiometer (ASTER)**
 - (AST14) **Digital elevation models**
 - (AST05) **Surface temperatures**
 - (AST07,09) **Surface reflectance and radiance**
- **Multi-angle Imaging Spectroradiometer (MISR)**
 - (MIS05) **Aerosol and surface product**
- **Moderate Resolution Imaging Spectroradiometer (MODIS)**
 - (MOD04) **Aerosol product**
 - (MOD08) **Atmosphere products (Aerosol properties, radiative energy fluxes)**
 - (MOD09) **Surface reflectance, atmospheric correction, algorithms (Vegetation & Land cover, vegetation & land cover dynamics)**
 - (MOD11-17) **Surface temperature, vegetation dynamics, land cover, fire, thermal anomalies**



Digital Elevation Model/ Shaded Relief



DEM (1-km)



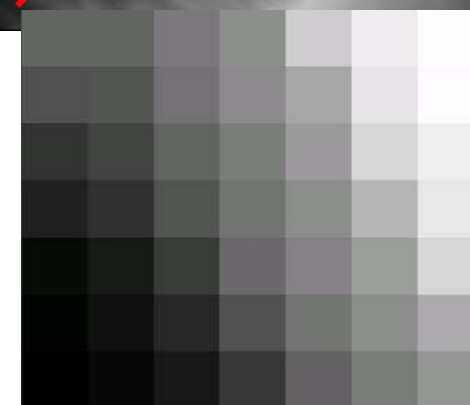
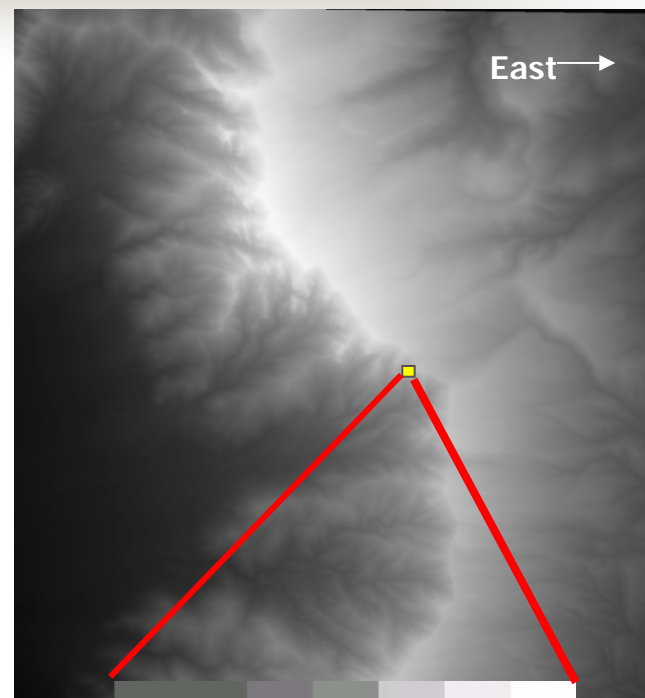
Shaded
Relief



DEM (Sandia Crest)

Digital elevation values (m asl)

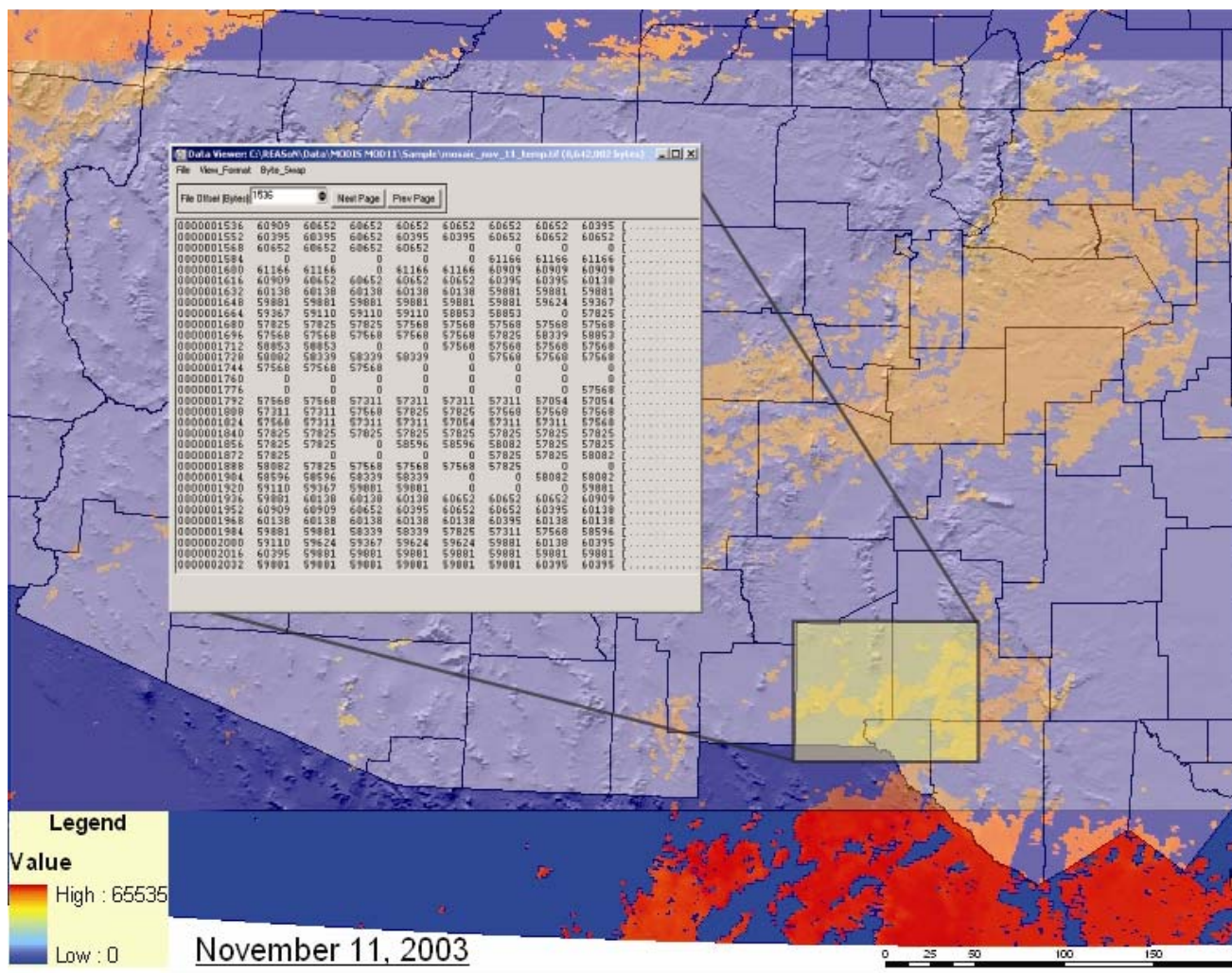
| | | | | | | |
|------|------|------|------|------|------|------|
| 2849 | 2851 | 2862 | 2874 | 2909 | 2928 | 2939 |
| 2837 | 2840 | 2856 | 2870 | 2888 | 2923 | 2935 |
| 2823 | 2831 | 2850 | 2864 | 2880 | 2916 | 2930 |
| 2809 | 2820 | 2842 | 2859 | 2873 | 2898 | 2924 |
| 2799 | 2809 | 2827 | 2853 | 2867 | 2883 | 2914 |
| 2795 | 2801 | 2815 | 2838 | 2860 | 2874 | 2890 |
| 2791 | 2797 | 2805 | 2823 | 2848 | 2864 | 2877 |



Area enlargement
30-m pixel

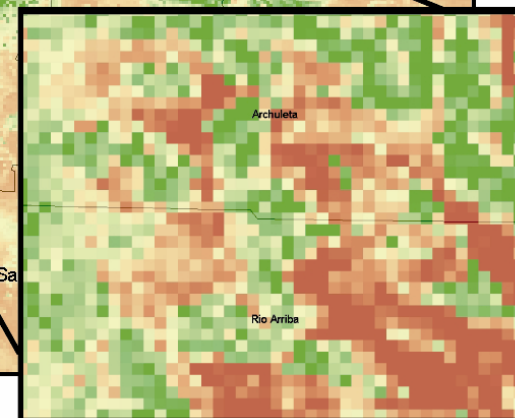
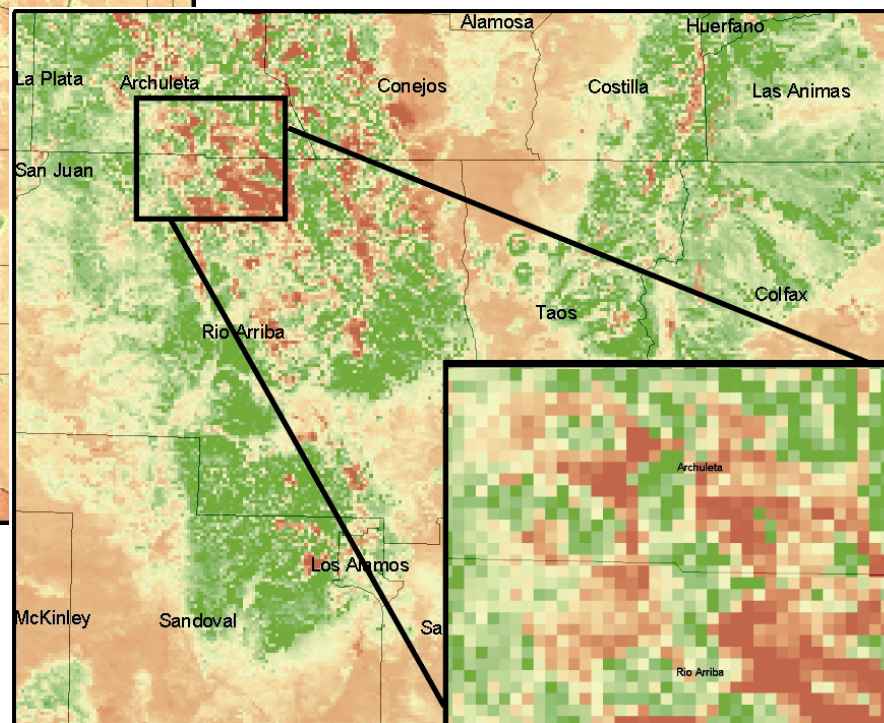
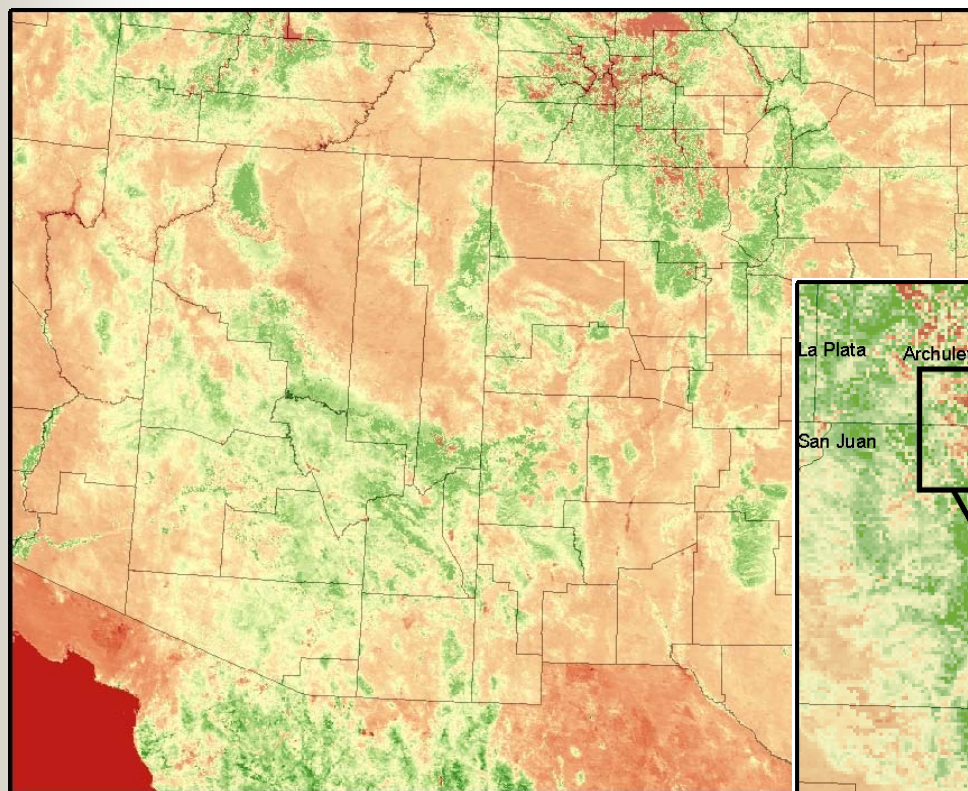


Terra/MODIS Land Surface Temp/Emissivity-Daily, 1-km





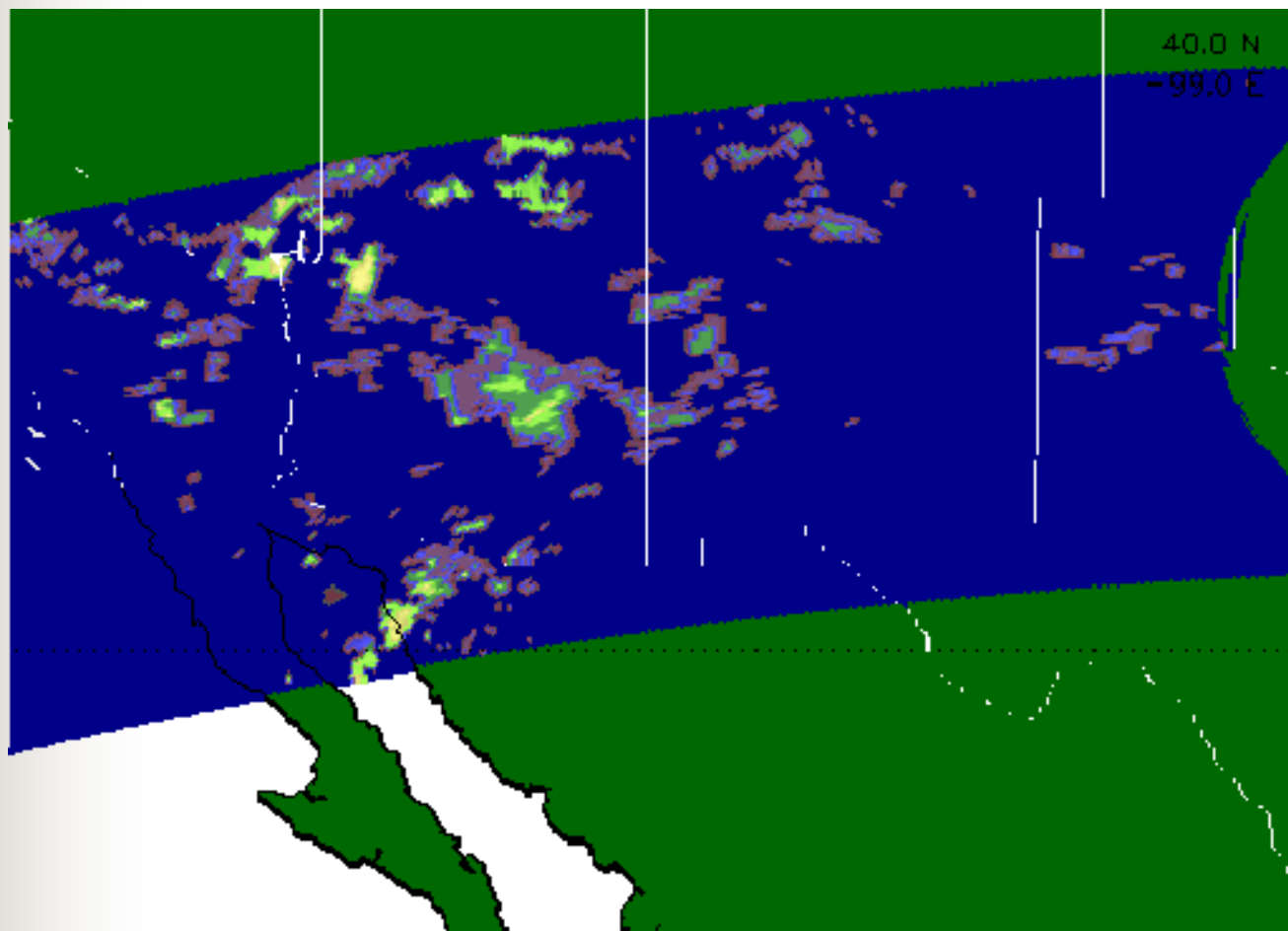
AZ/NM (MOD13A4) 16-Day Vegetation Index 1-km





TRMM/TMI-Rain Rate

11/12/03



mm/hr



100.0000

10.0000

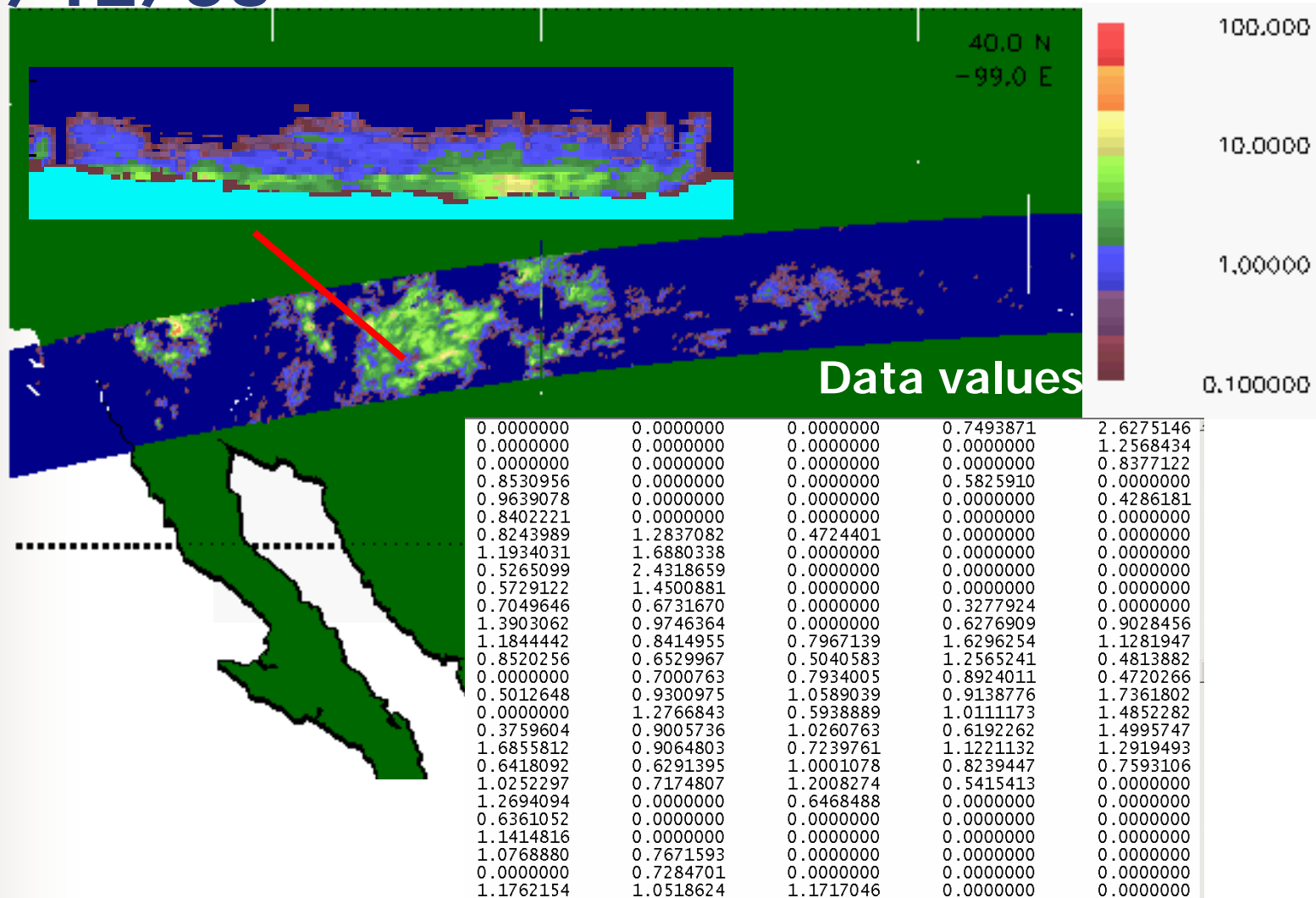
1.00000

0.100000



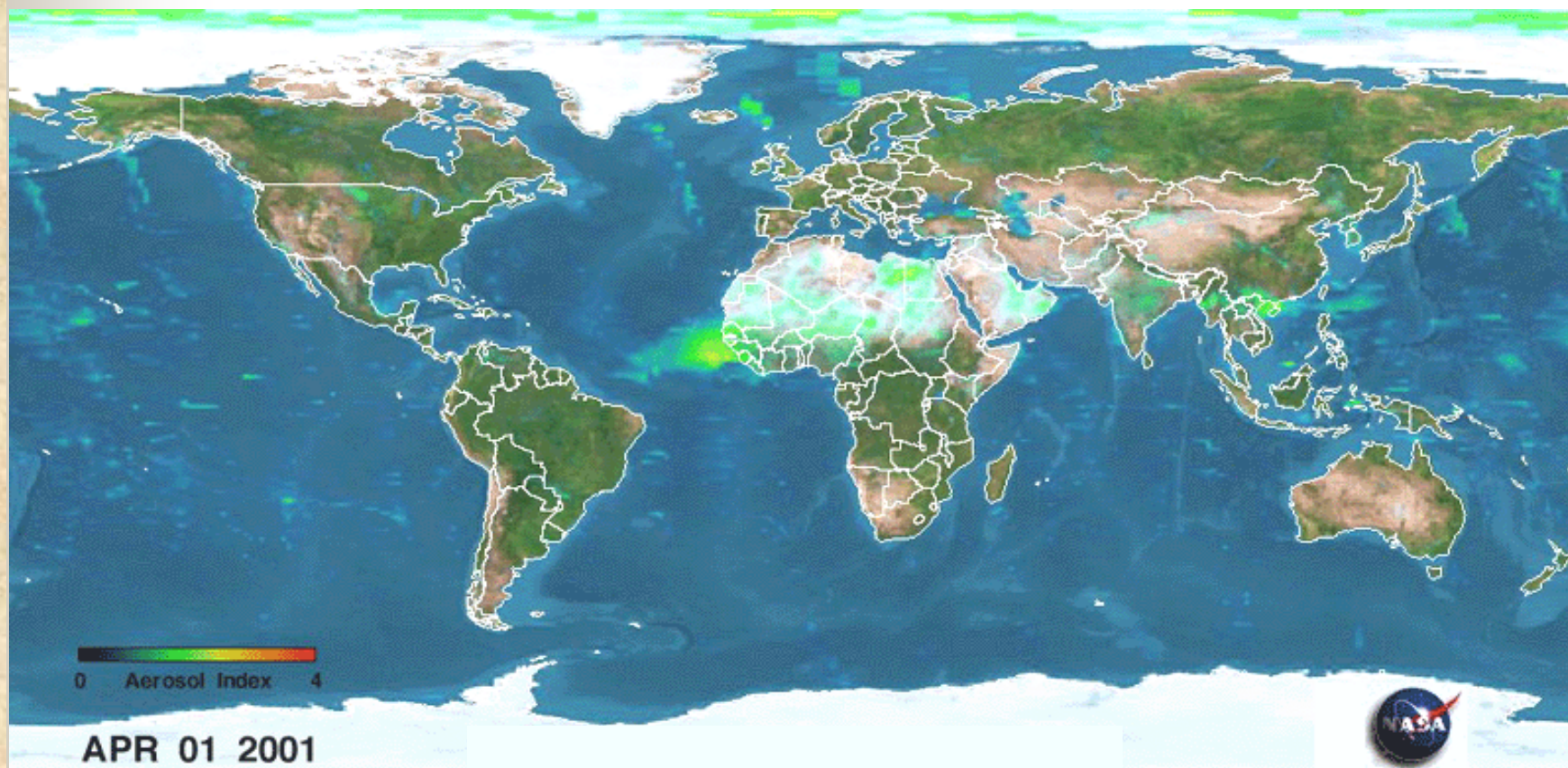
TRMM/PR Surface Rain Rate

11/12/03



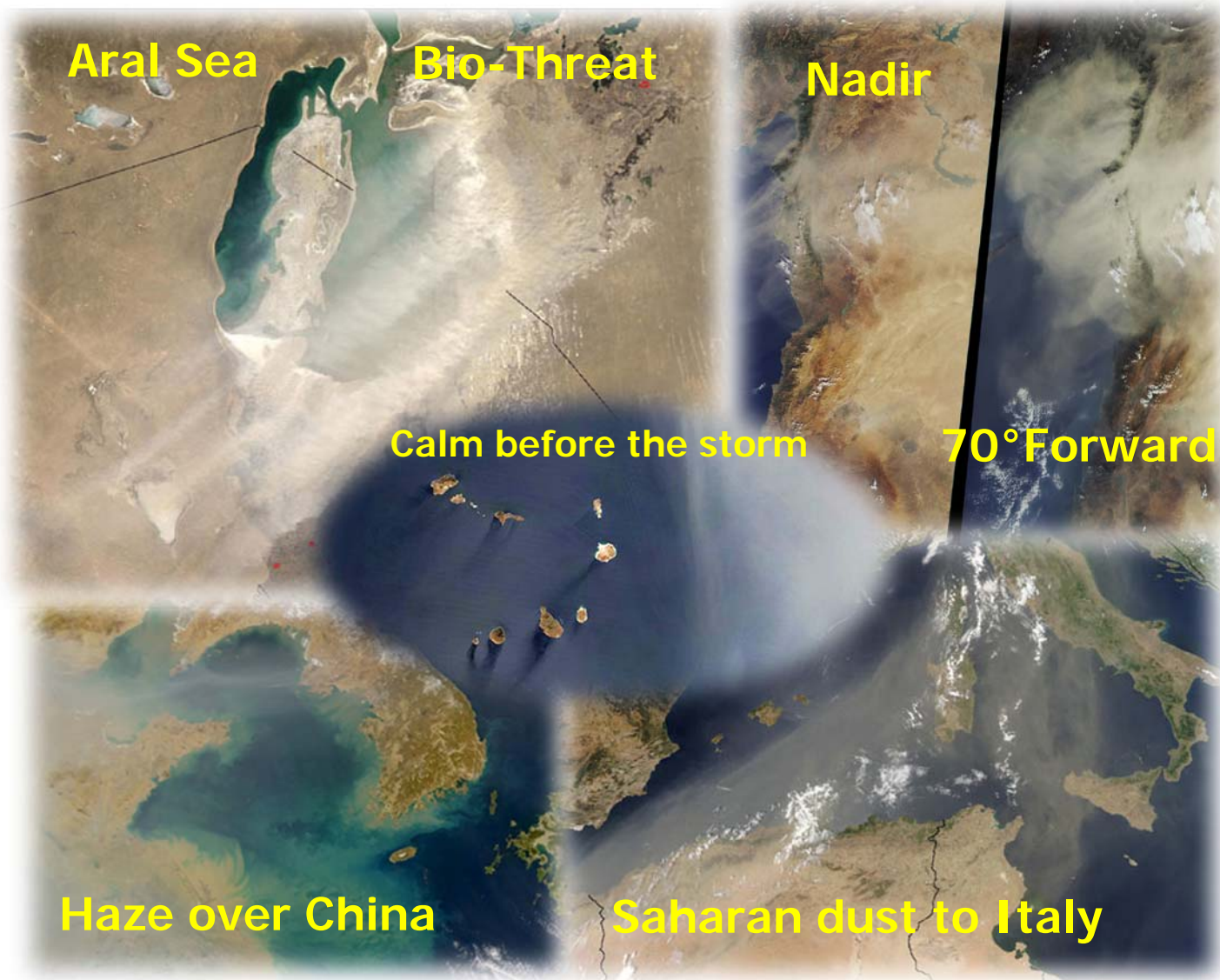


Temporal Visualization of Global Aerosol Migration





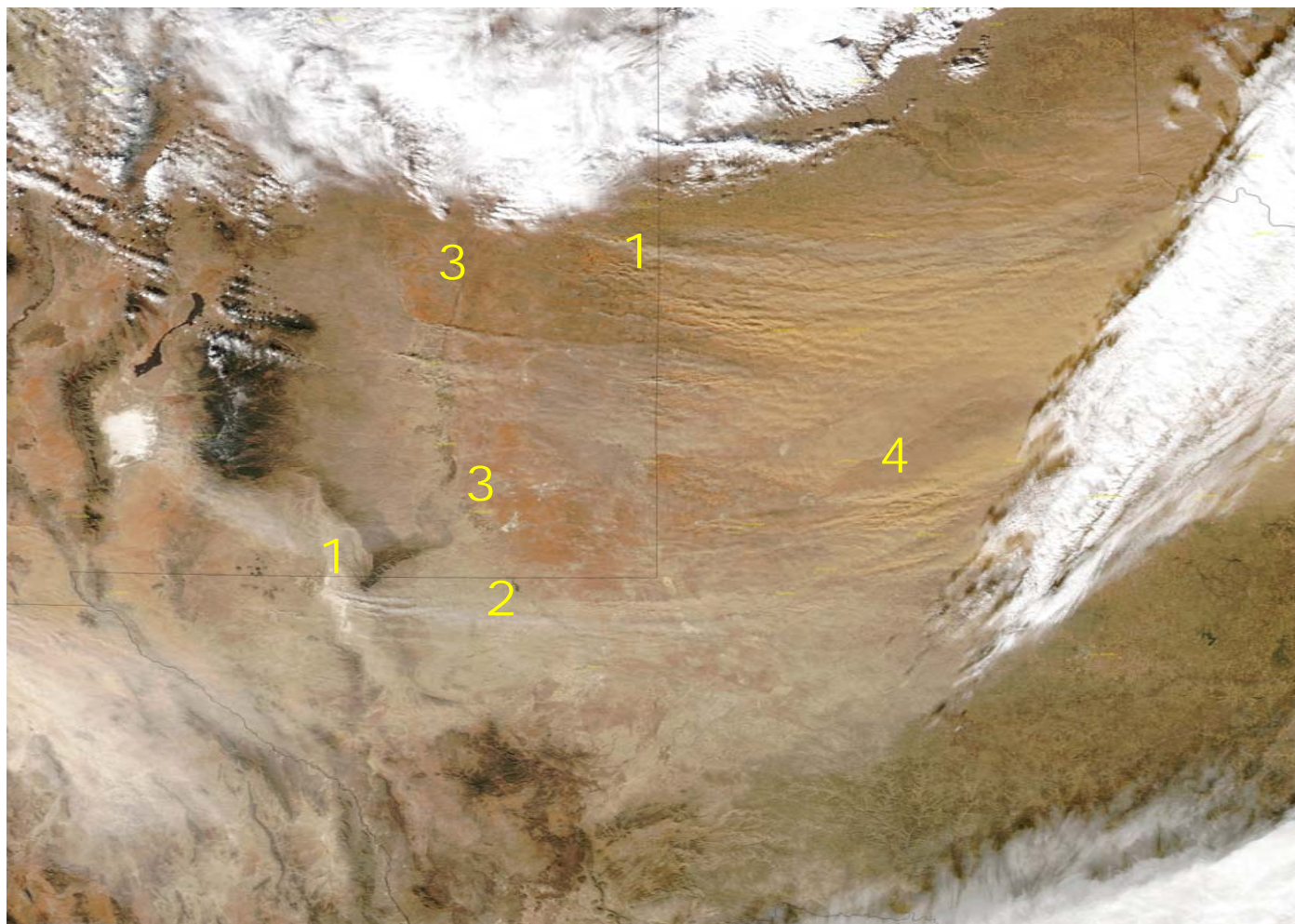
A World of Dust





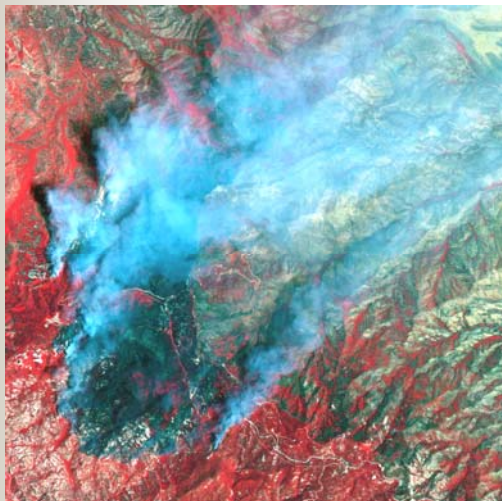
Dust Storm over New Mexico & Texas

Aqua/MODIS 12/15/03

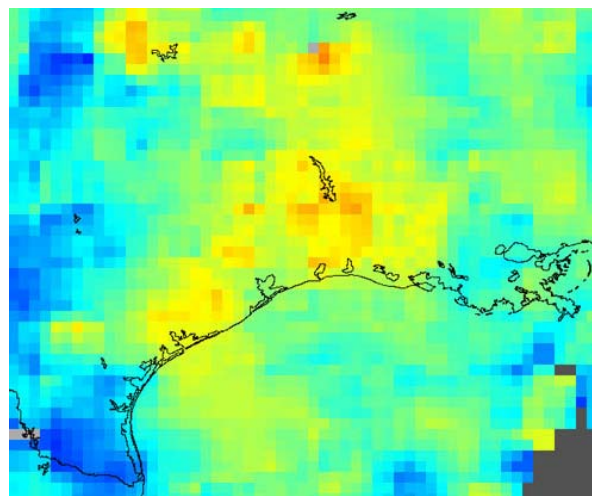




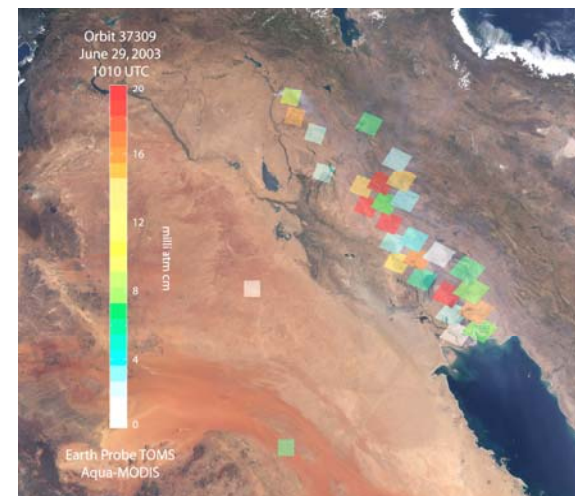
More BTR/NASA Products



Smoke

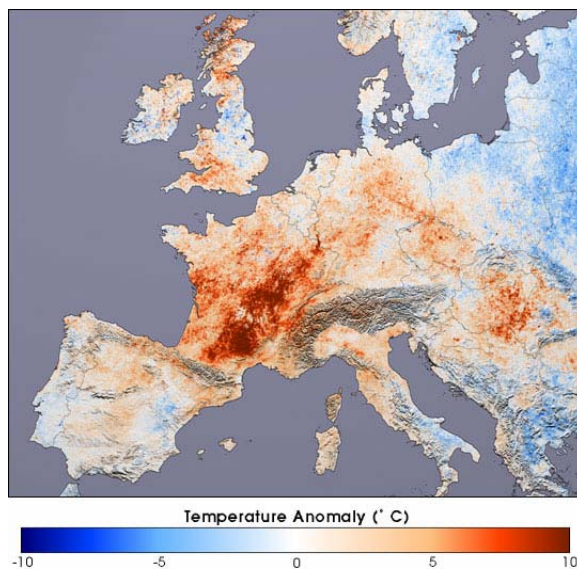


Carbon Monoxide

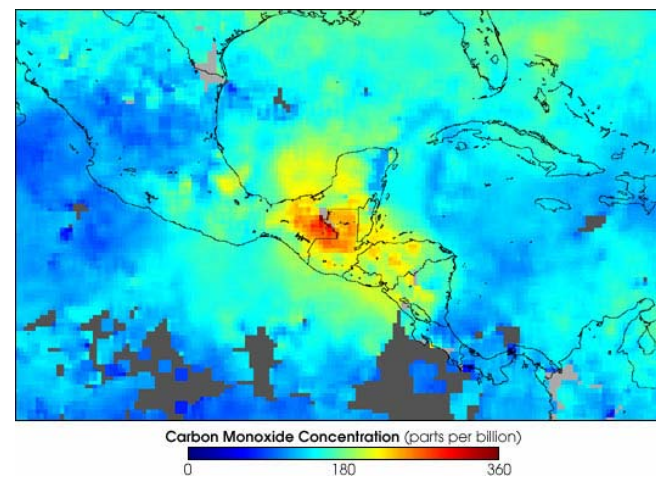


Sulfur Dioxide

Temperature
Anomalies



Temperature Anomaly (°C)

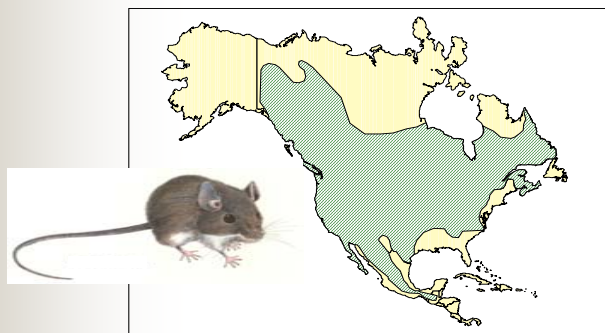


Carbon Monoxide Concentration (parts per billion)

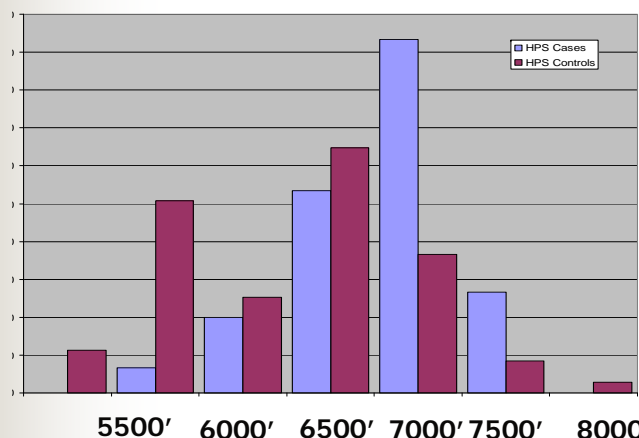
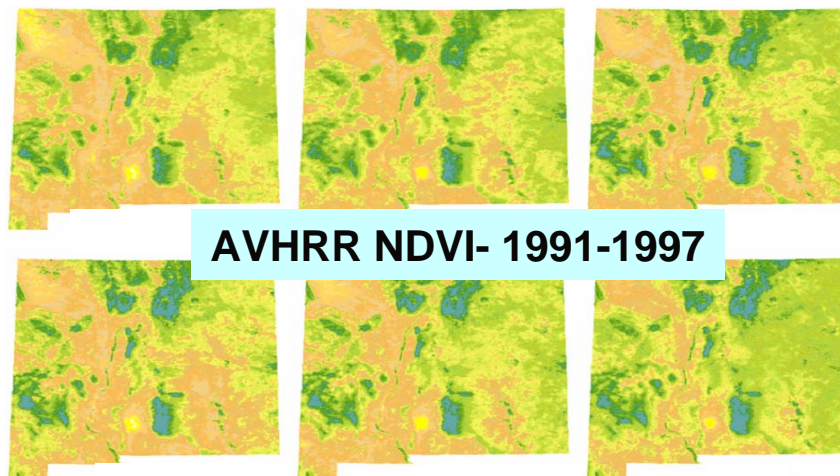


Hantavirus Pulmonary Syndrome

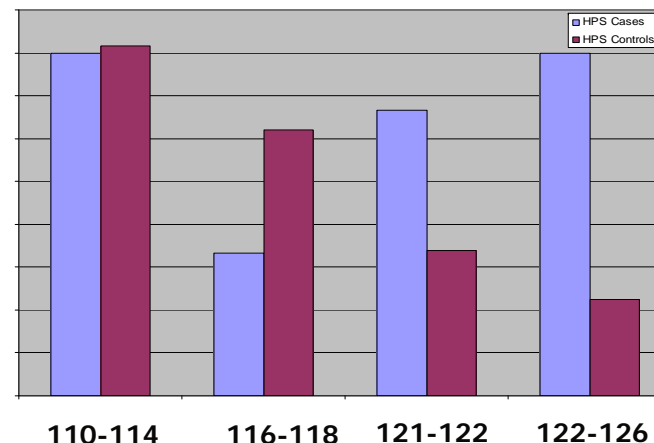
Peromyscus Maniculatus



Reservoir for
Sin Nombre Virus



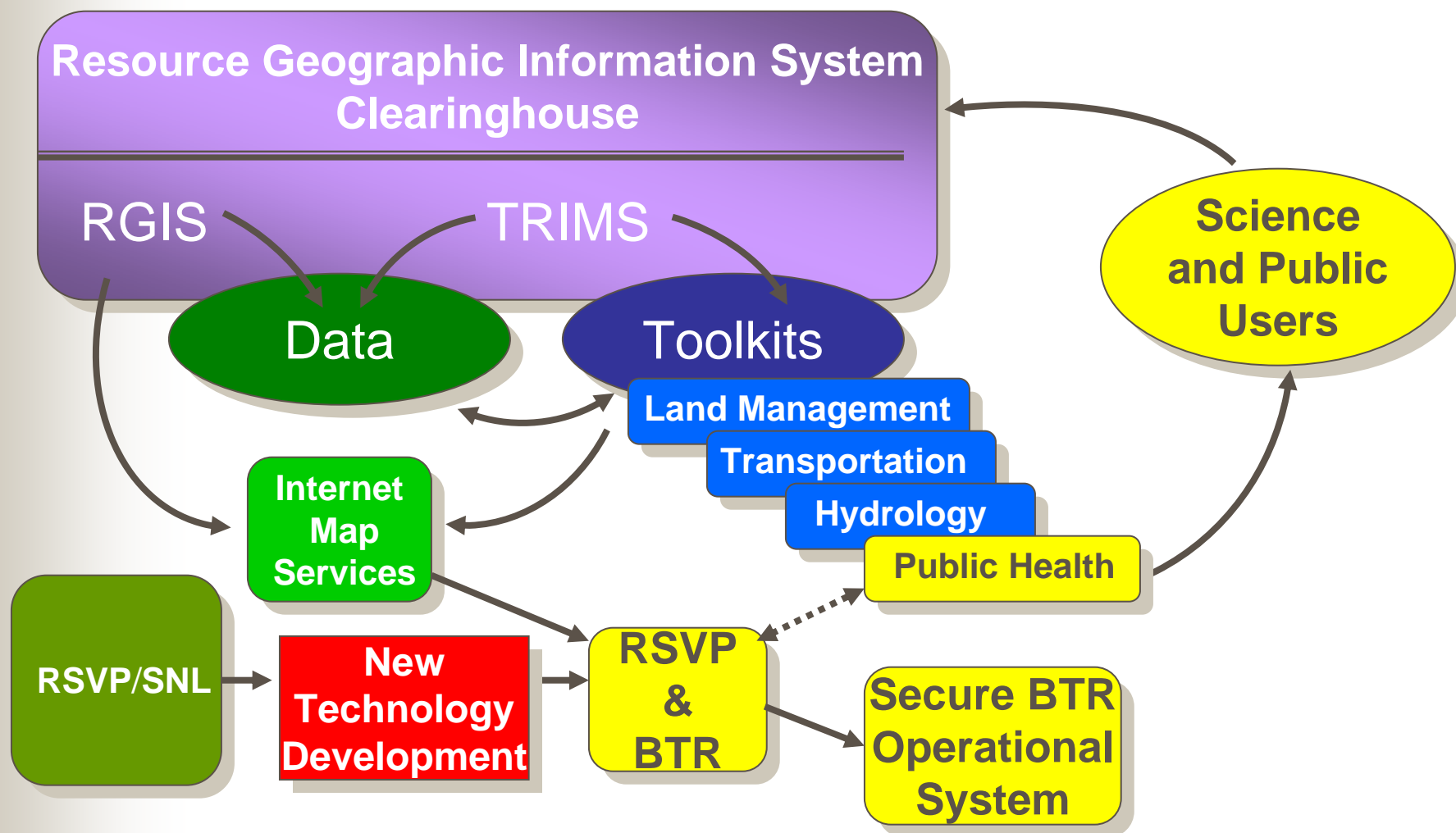
HPS Cases & Controls as a Function of Elevation



% Frequency of HPS and Control Sites w/i NDVI Intervals

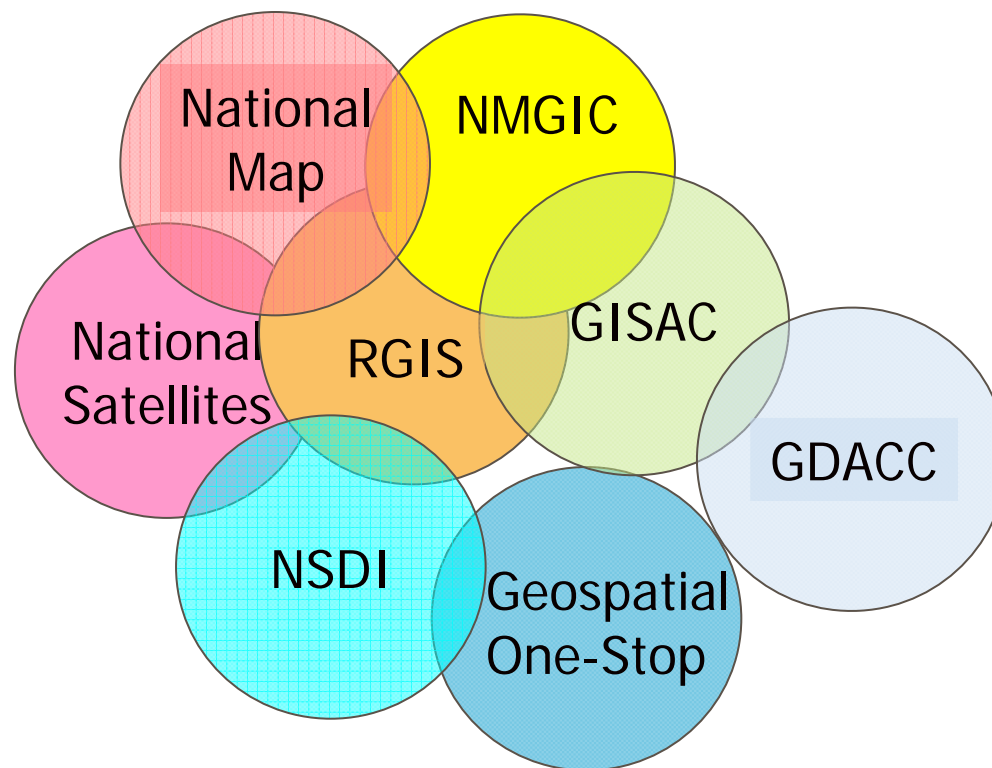


Data Flow and Delivery System





Federal and State Partnerships



Elements collaborate at minimal level with untested compatibility and interoperability; Gaps prevail; Architecture is incomplete



Closing Thought

“Human actions have become a dominant force [for] environmental change. Globalization has led to the introduction and spread of invasive species and infectious diseases with little understanding of the consequences...

“Achieving a mechanistic and predictive understanding [of changes] will require [spanning] large spatial and temporal scales, and transcending [many] levels of biological complexity (*National Science Foundation, NEON Announcement, March '04. Page 4*).”