Tools for Protected Area Managers: Ecological Forecasting Within NASA

Edgemont
National Park
New Zealand

OAS Second
Coordination Meeting on
Protected Areas
Information Systems

31 January 2006

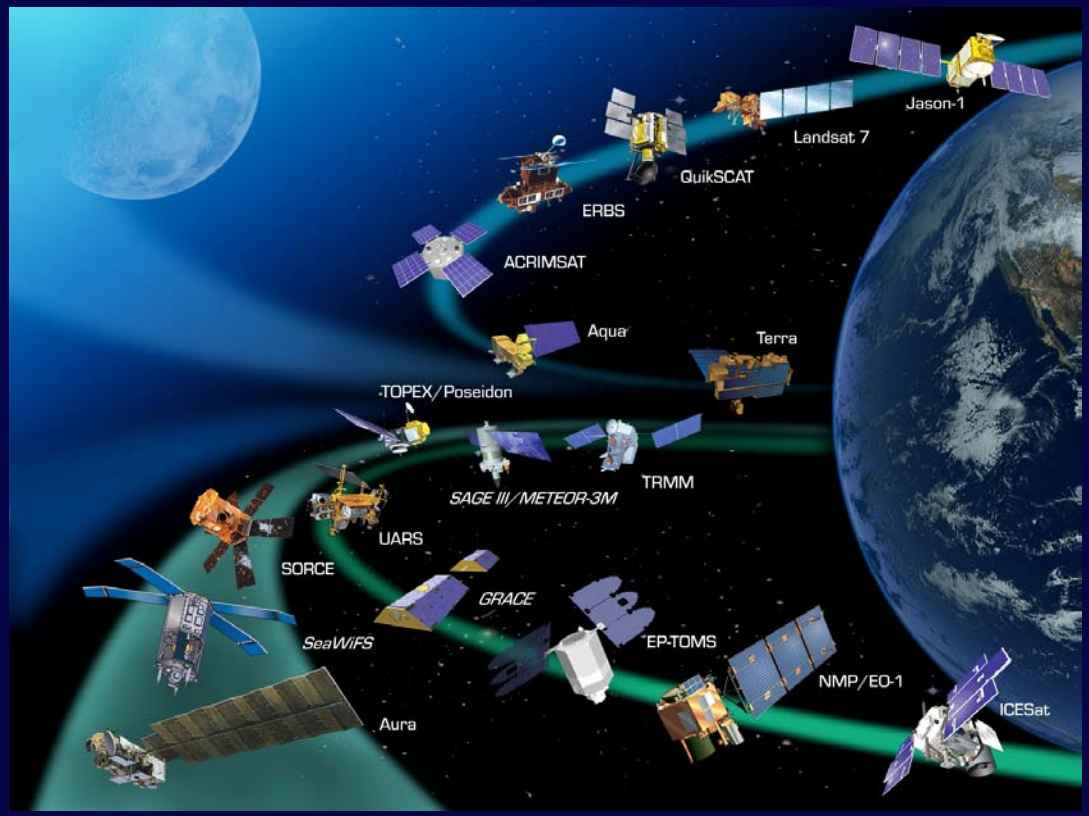
Gary Geller
Jet Propulsion Laboratory
California Institute of Technology
gary.n.geller@jpl.nasa.gov

Overview

- Background
- Tools of interest to PA managers
  - TOPS (Terrestrial Observation and Prediction System)
  - Protected Area Archive
  - CBD Sourcebook
  - SERVIR (Regional Visualization and Monitoring System for Mesoamerica)
  - FIRMS (Fire Information for Resource Management System)
  - NatureServe Vista

Why is NASA Interested in Biodiversity?

1. Many uses of RS for PA and ecosystem management
2. Lots of data…



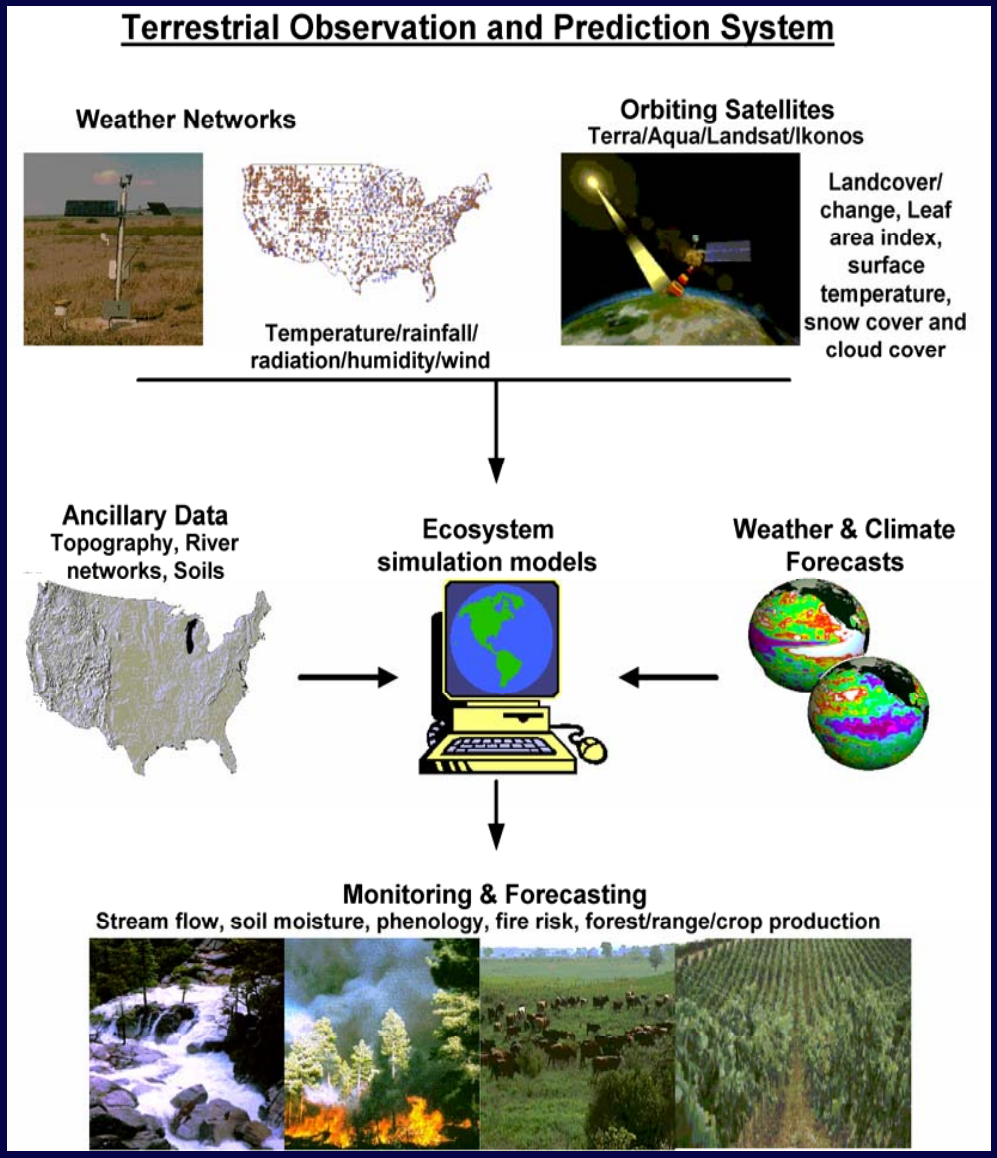
Why is NASA Interested in Biodiversity?

1. Many uses of RS for PA and ecosystem management
2. Lots of data…

Model predictions

TOPS: Terrestrial Observation and Prediction System

- Provides forecasts, nowcasts, and hindcasts
  - 30 biological and environmental parameters
- Help managers
  - Understand current state
  - Detect disturbance
  - Predict consequences of events and activities



The TOPS-30

MODIS (8 day and annual products)

1 LAI (Leaf Area Index)
2 FPAR (absorbed PAR)
3 GPP / NPP (Gross / Net Primary Production)
4 LST (Land Surface Temperature)
5 NDVI (Normalized Difference Vegetation Index)
6 EVI (Enhanced Vegetation Index)
7 Landcover (Annual)
8 Albedo
9 Snow
10 Fire

Meteorology (Daily)

11 Maximum Temperature
12 Minimum Temperature
13 Rainfall
14 Solar Radiation
15 Dew Point / VPD (Vapor Pressure Deficit)
16 Degree Days

TOPS Ecosystem

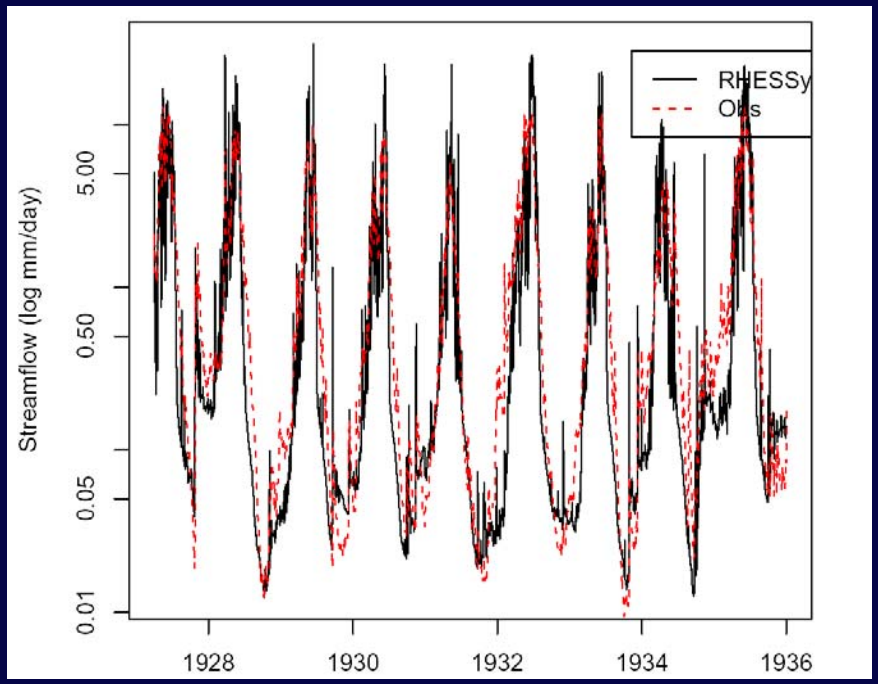
17 Snow
18 Soil Moisture
19 Evapotranspiration
20 Stream outflow
21 GPP / NPP
22 LAI / Phenology
23 Vegetation Stress

TOPS Forecasts (5 to 180 day)

24 LAI/Phenology
25 Soil Moisture
26 Outflow
27 ET
28 Vegetation Stress
29 Snow
30 GPP / NPP

Example: Watershed

- What will be the outflow response to
  - A predicted storm event
  - A wildfire or controlled burn
  - Logging



Stream outflow
Merced watershed, Yosemite
Predicted vs measured

Example: Monitoring

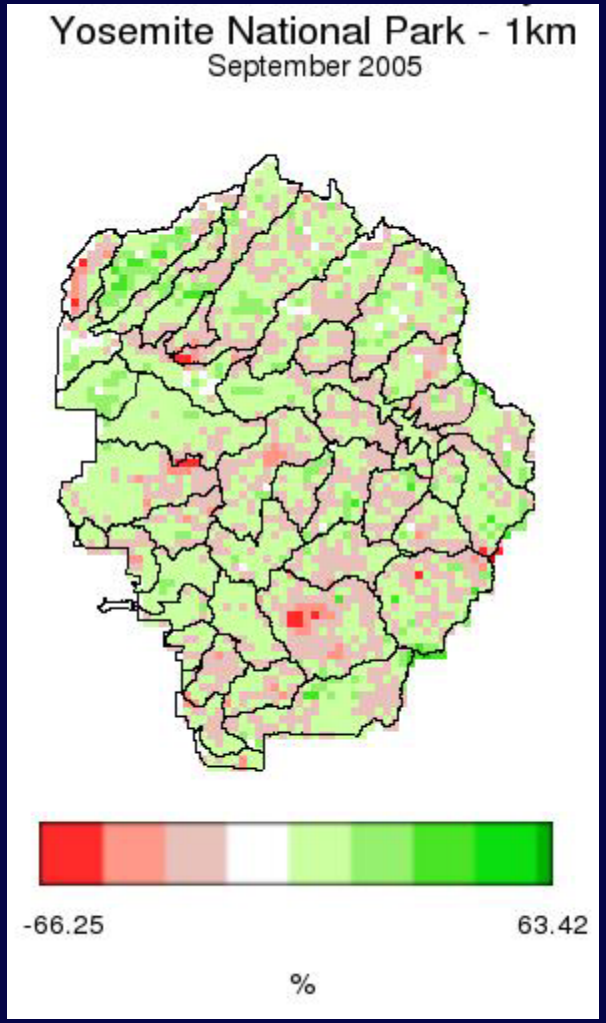
- Look for anomalies
  - Compare current conditions to historical average

Productivity

Spatial anomaly

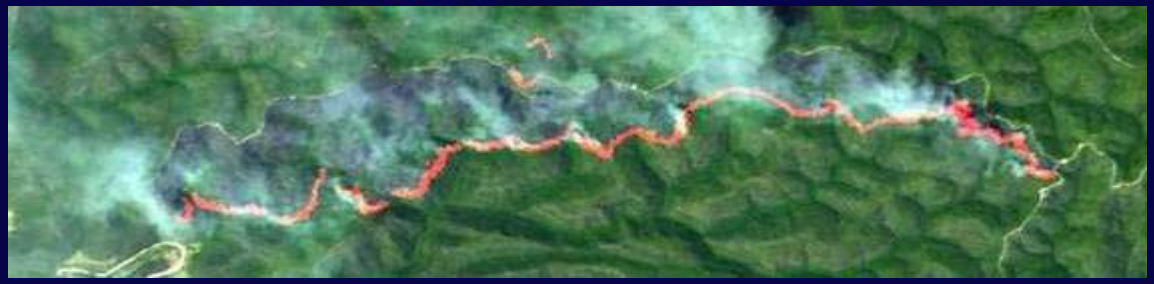
Can indicate disturbance

- Logging
- Fire



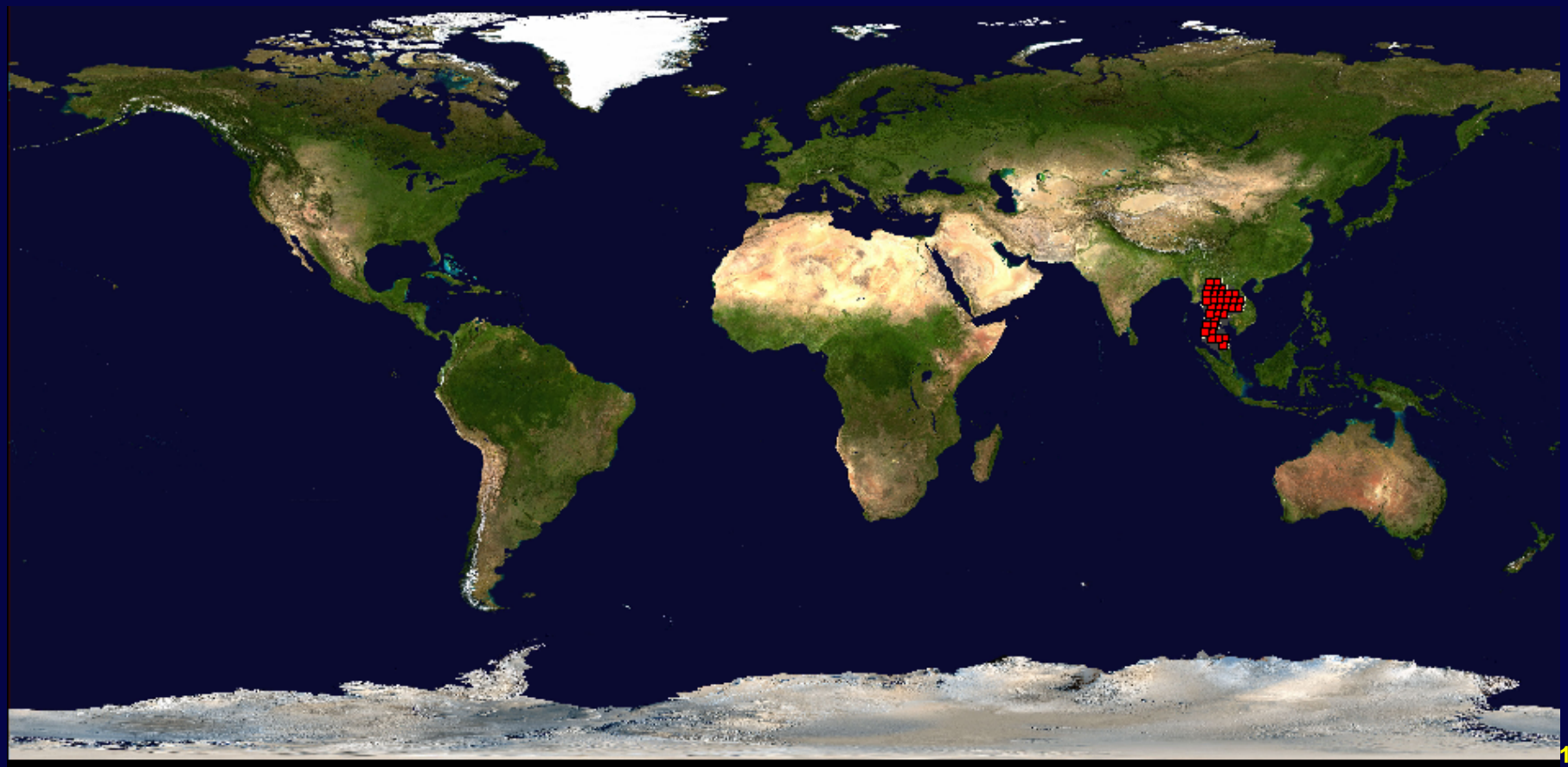
Protected Area Archive

- Problem
  - Tools to provide access to satellite images are for remote sensing experts
- Result
  - Data not accessible to many conservation managers → underutilization
- Solution
  - Devise a system that is easy to use



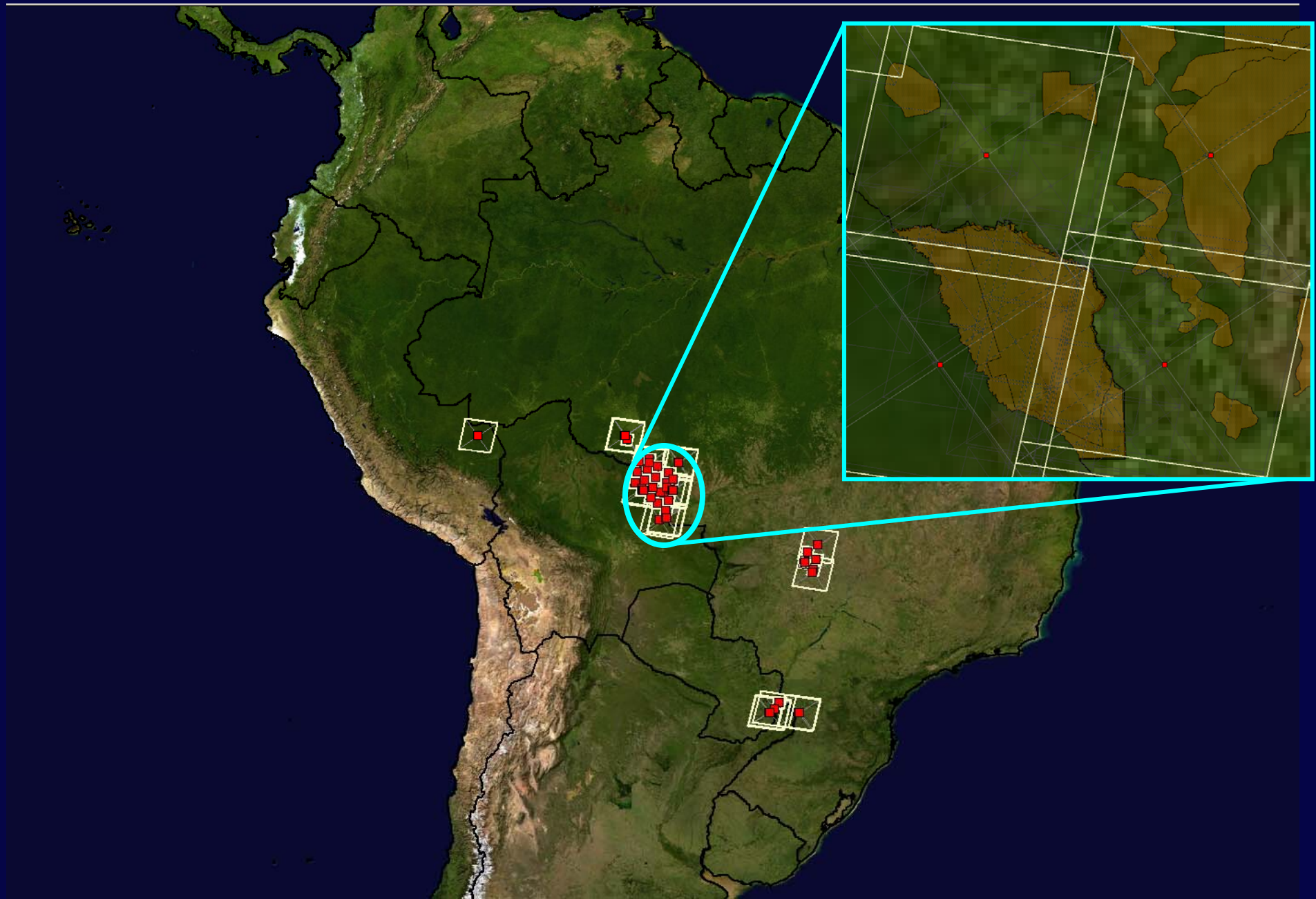
Protected Area Archive

- Combines
  - Collections of images
  - Simple tools to view and use them

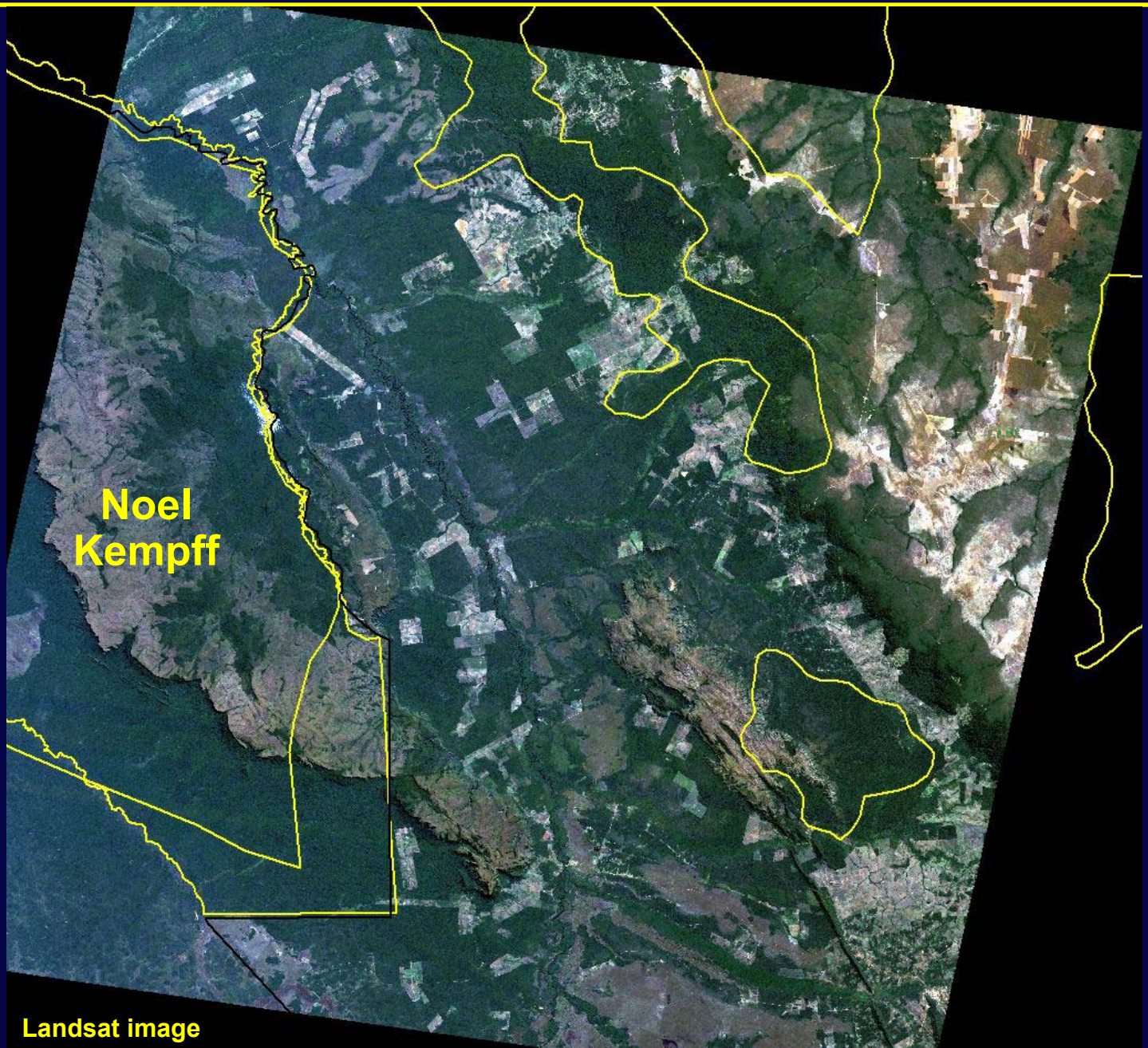


Selected PAs In South America

Selected PAs In South America

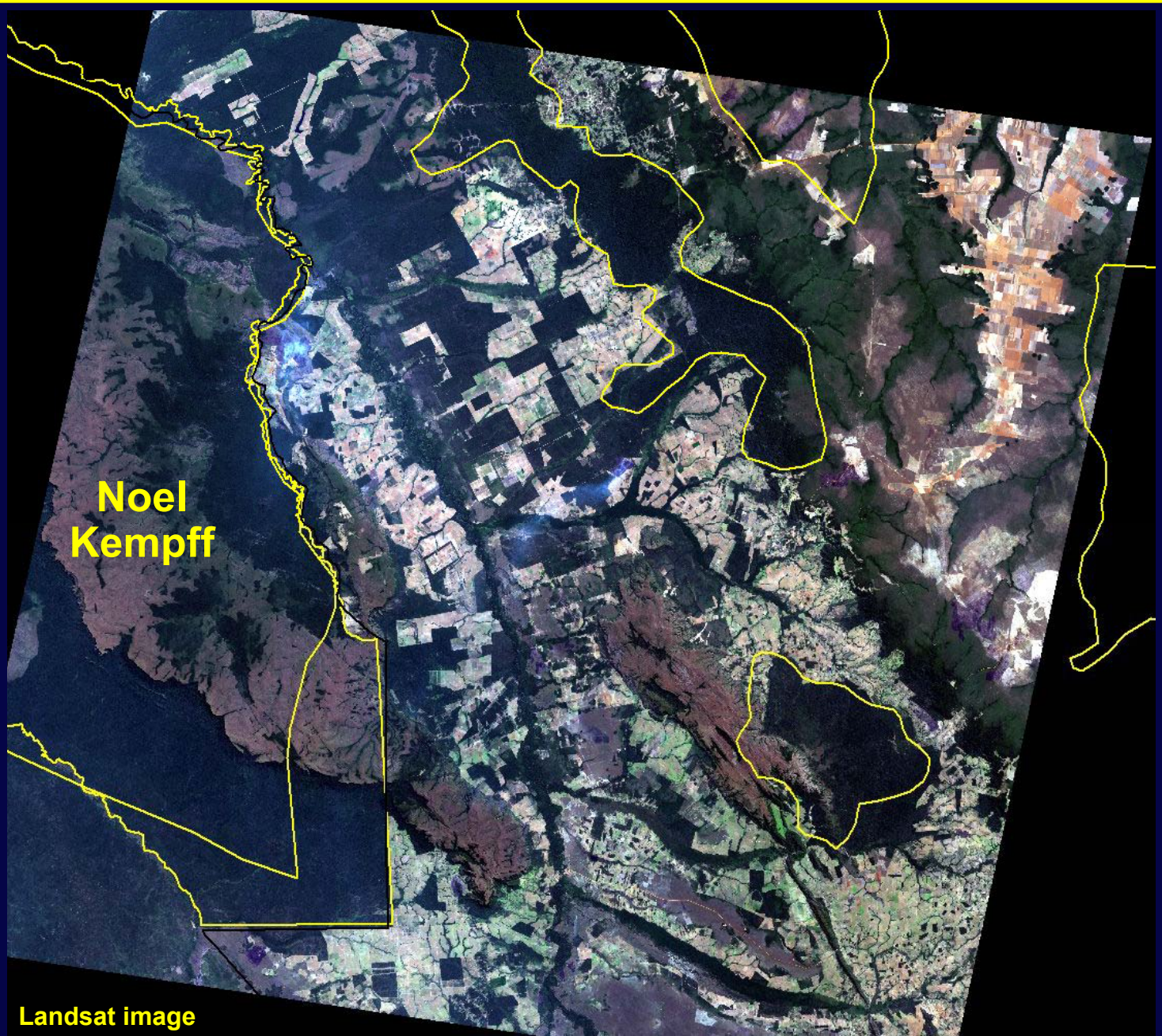


1988



Landsat image

2000



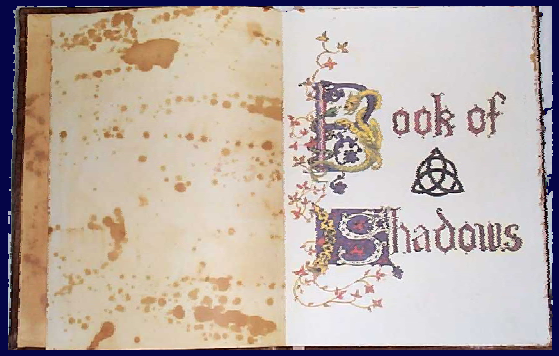
Landsat image

Collections

- All countries in Central America
- Ecuador
- Peru
- Bolivia
- Venezuela (partial)
- Colombia (partial)
- Eventually: all of Amazon Basin

CBD Sourcebook

- "Sourcebook on Remote Sensing and Biodiversity Indicators"
- Developed for CBD--and a non-RS audience
- Purpose: help countries utilize RS to meet their CBD obligations
- Discusses
  - Basic RS concepts
  - RS-based health/status indicators
- Now undergoing final revisions

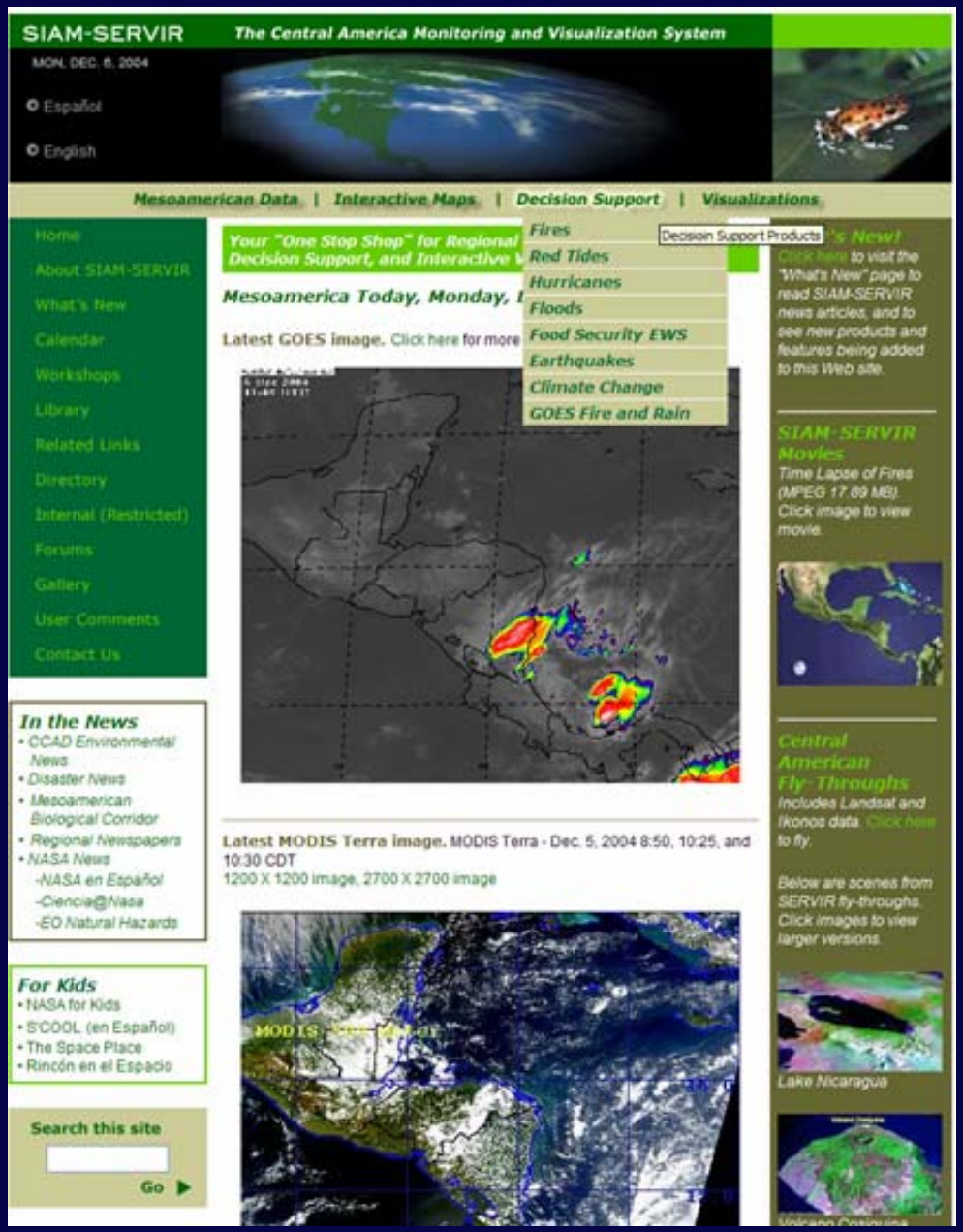


SERVIR

- Regional Visualization and Monitoring System for Mesoamerica
- Purpose
  - Provide geospatial information for natural resource and disaster management
- Supported by USAID, NASA, the seven participating countries (and others)
- Operating, and expanding

Iguazu Falls National Parks
Brazil, Argentina

Four Main Components



http://servir.nsstc.nasa.gov

1. Mesoamerican data
2. Online maps
3. Decision support
4. 3-D visualizations

1. MesoStor Regional Data Store

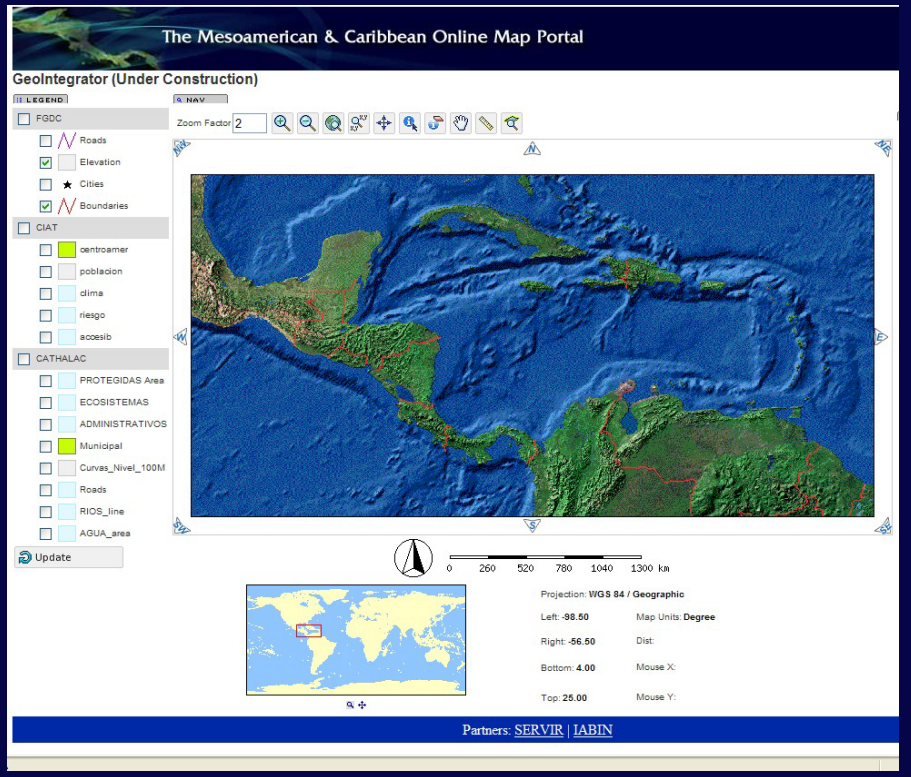
Purpose: Provide geospatial data for download

- One-stop data store
- Provides vector ("shapefiles") and raster (image) data covering all of Mesoamerica
- Web-based system for data selection and delivery

2. Online Maps

Purpose: Provide tools and data to generate maps in an interactive browser window

- **Data can come from any participating organization**
  - **E.g., country environment agencies**
- **Thematic areas--biological, protected areas, etc.**
- **GeoIntegrator—tool that helps combine the data onto a single map**



3. Decision Support

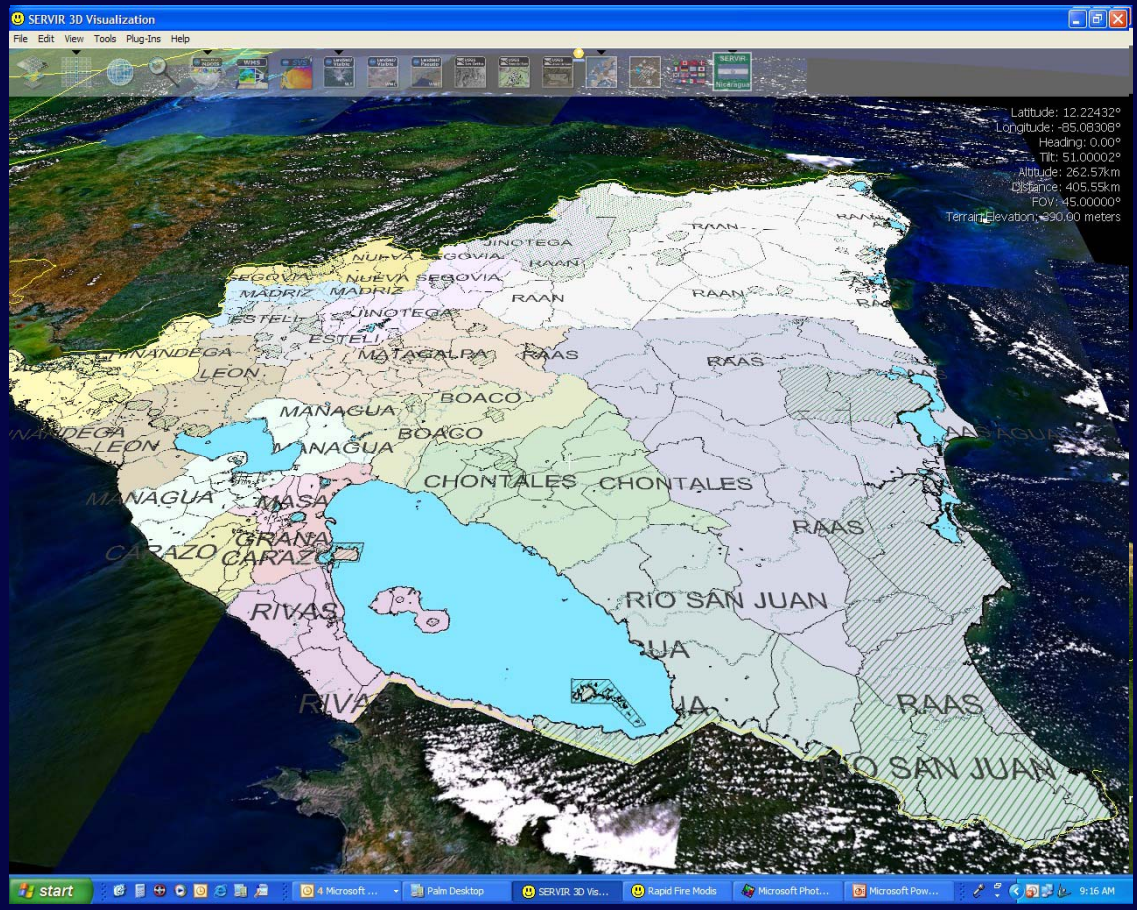
Purpose: Provide/link to various Decision Support Tools

- Fires
- Red tides
- Climate change scenarios
- Short term weather prediction
- Land cover and land use change for carbon inventories
- Floods
- Other

4. Visualization Tools for Decision Support

Purpose: Provide easy access to data and 3-D visualization tools

- **Tools**
  - **World Wind - NASA**
  - **Skyline**
  - **Space Time Toolkit**
- **Users**
  - **Decision Makers**
  - **Media**
  - **Educators**
  - **Students**



Websites

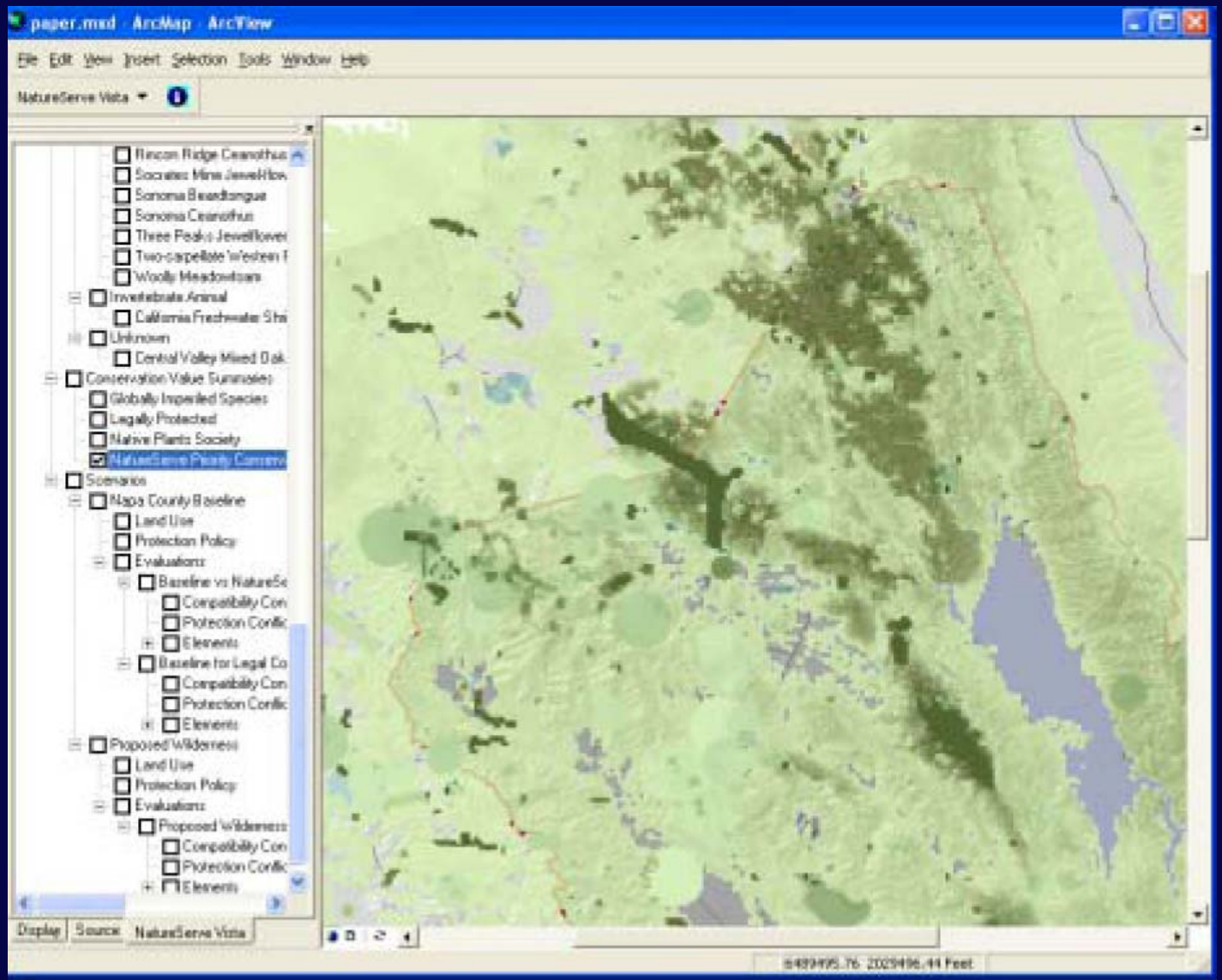
- TOPS http://ecocast.arc.nasa.gov/
- Protected Area Archive http://asterweb.jpl.nasa.gov/paa
- SERVIR http://servir.nsstc.nasa.gov/home.html
- Vista http://www.natureserve.org/prodServices/vista.jsp

NatureServe Vista

- Toolset to assist in "Smart Growth"
- Helps integrate biodiversity information into planning efforts
- Provides ability to optimize a land use strategy for multiple goals
- Can answer questions such as
  - Where can we place new development to best protect our environment?
  - Where can we best invest funds for conservation land?
- Pilot is for Greater Yellowstone Area

NatureServe Vista

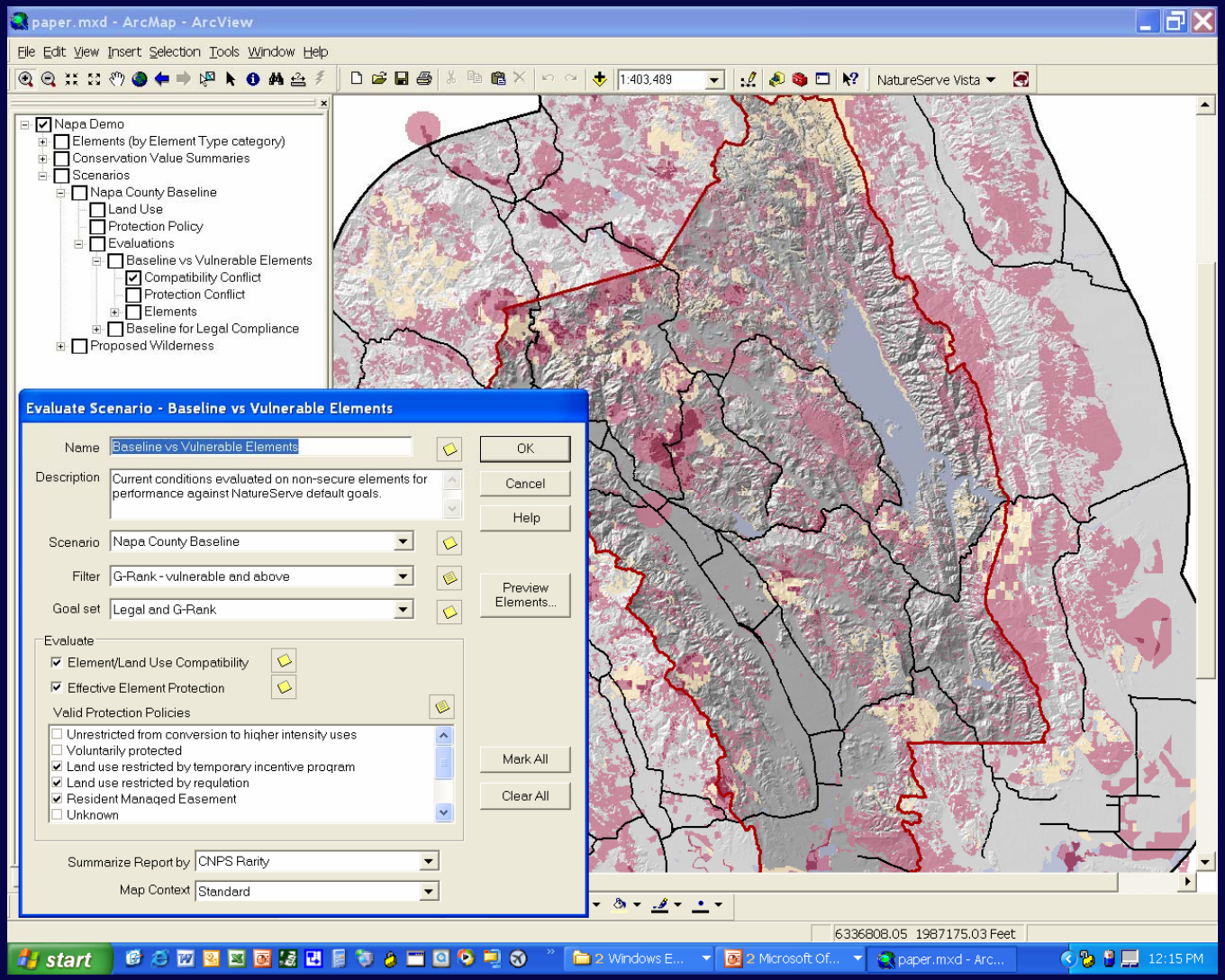
Example: Conservation value assessment



Intensity of green indicates overall conservation value (hotspots of biodiversity)

NatureServe Vista

Example: Land use conflict analysis



Intensity of red indicates level of conflict between different potential uses (“hotspots of incompatibility”)

Conceptual Organization

NASA Earth Science

Research

Ecology, Biodiversity, Land Cover…

Applications

Ecological Forecasting