Tools for Protected Area Managers: Ecological Forecasting Within NASA

OAS Second Coordination Meeting on Protected Areas Information Systems

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

Edgemont National Park
New Zealand
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…
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
<table>
<thead>
<tr>
<th>MODIS (8 day and annual products)</th>
<th>TOPS Ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 LAI (Leaf Area Index)</td>
<td>17 Snow</td>
</tr>
<tr>
<td>2 FPAR (absorbed PAR)</td>
<td>18 Soil Moisture</td>
</tr>
<tr>
<td>3 GPP / NPP (Gross / Net Primary Production)</td>
<td>19 Evapotranspiration</td>
</tr>
<tr>
<td>4 LST (Land Surface Temperature)</td>
<td>20 Stream outflow</td>
</tr>
<tr>
<td>5 NDVI (Normalized Difference Vegetation Index)</td>
<td>21 GPP / NPP</td>
</tr>
<tr>
<td>6 EVI (Enhanced Vegetation Index)</td>
<td>22 LAI / Phenology</td>
</tr>
<tr>
<td>7 Landcover (Annual)</td>
<td>23 Vegetation Stress</td>
</tr>
<tr>
<td>8 Albedo</td>
<td></td>
</tr>
<tr>
<td>9 Snow</td>
<td></td>
</tr>
<tr>
<td>10 Fire</td>
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<table>
<thead>
<tr>
<th>Meteorology (Daily)</th>
<th>TOPS Forecasts (5 to 180 day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Maximum Temperature</td>
<td>24 LAI/Phenology</td>
</tr>
<tr>
<td>12 Minimum Temperature</td>
<td>25 Soil Moisture</td>
</tr>
<tr>
<td>13 Rainfall</td>
<td>26 Outflow</td>
</tr>
<tr>
<td>14 Solar Radiation</td>
<td>27 ET</td>
</tr>
<tr>
<td>15 Dew Point / VPD (Vapor Pressure Deficit)</td>
<td>28 Vegetation Stress</td>
</tr>
<tr>
<td>16 Degree Days</td>
<td>29 Snow</td>
</tr>
<tr>
<td></td>
<td>30 GPP / NPP</td>
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</tbody>
</table>
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

Yosemite National Park - 1km
September 2005
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
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