

**LCLUC
Science Team Meeting**

***NASA Applications
and Global Landsat
Data Sets***

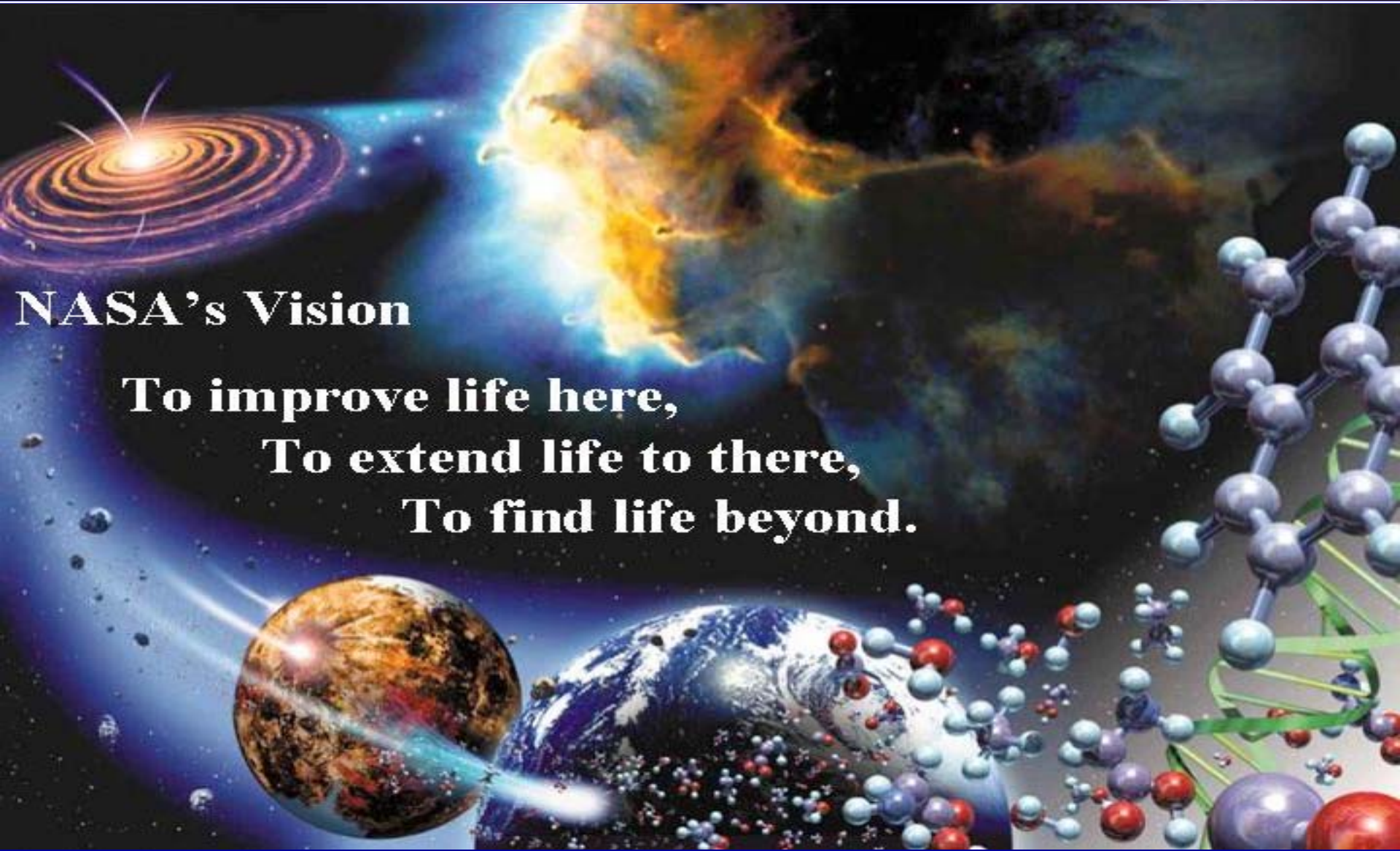
***E. Sheffner
Applications Division
Earth Science Enterprise***

November 21, 2002





The NASA Vision



NASA's Vision

**To improve life here,
To extend life to there,
To find life beyond.**





The NASA Mission

To understand and protect our home planet

To explore the universe and search for life

To inspire the next generation of explorers

...as only NASA can.





Pioneering Scientific Observations of the Earth



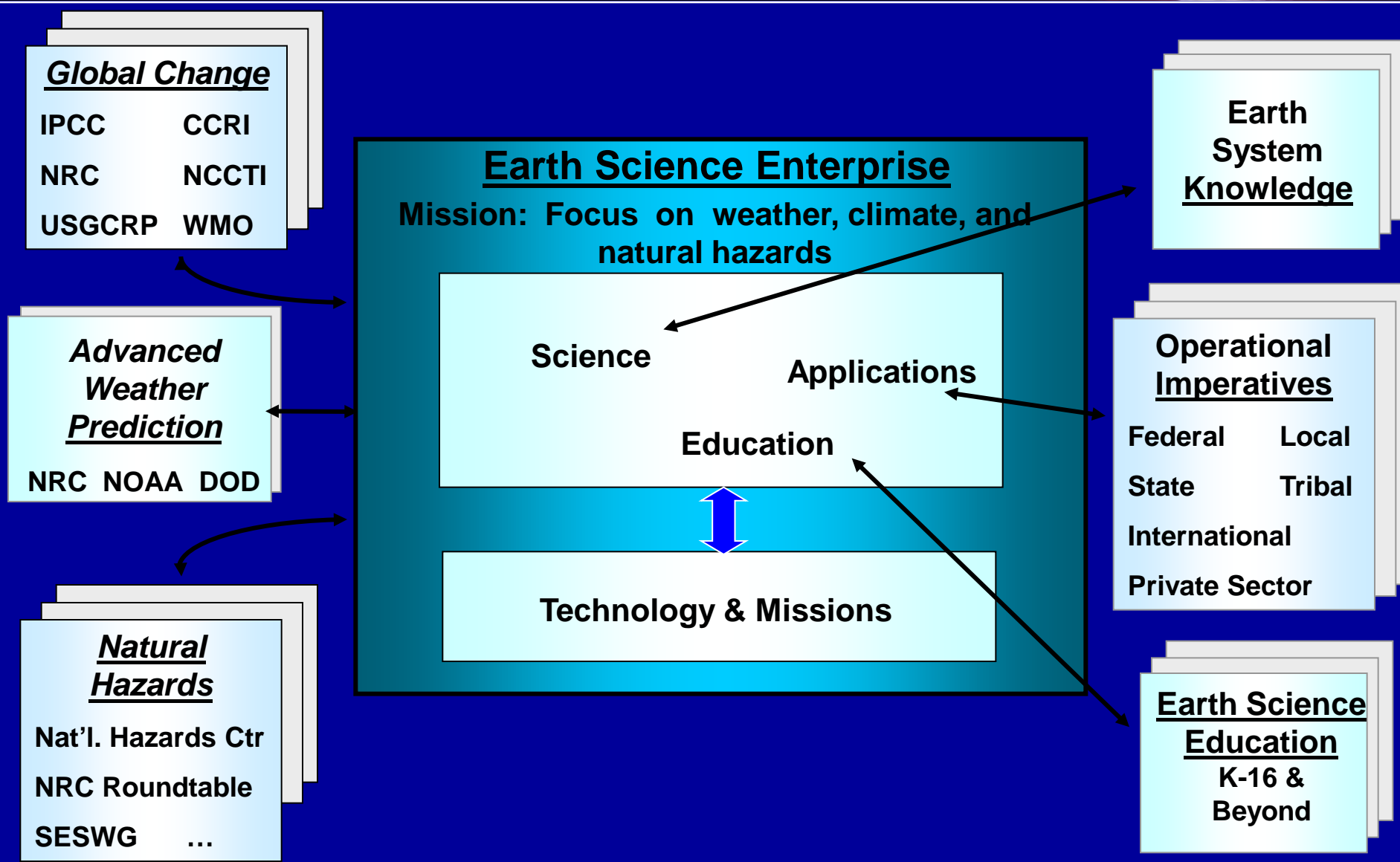
Earth Science Mission:

Develop a scientific understanding of the Earth system and its response to natural and human-induced changes to enable improved prediction of **climate, weather, and natural hazards for present and future generations**





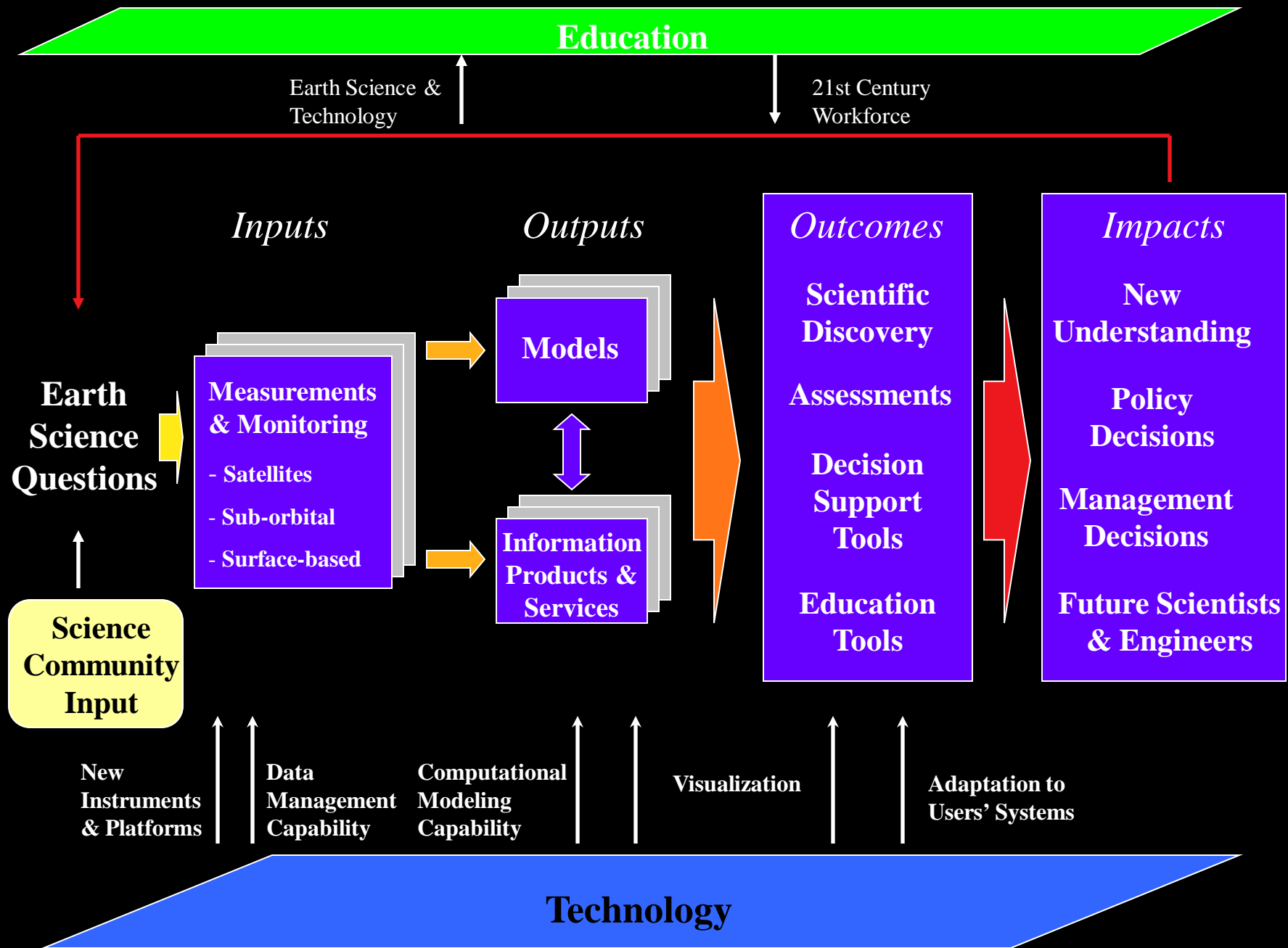
Beyond Scientific Exploration...serving Society



From Science to Societal Impact (and Back Again)

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ESE Applications Strategy Principles

- **Extend the use of NASA/ESE climate, weather and natural hazards research for the social and economic benefit of the nation.**
- **Focus on application areas of demonstrated national significance.**
- **Define specific applications through joint projects with users.**
- **Provide a systems engineering role for the user community - data and measurements, modeling, and decision support.**
- **Operational environment and operational support the responsibility of the user.**





Application: Wildfire Monitoring- Summary

- **Participants: USFS, NIFC, NOAA, UMD, NASA/GSFC**
- **Objective: Provide near time information on wildfire location and intensity to allocate control and recovery resources.**
- **NASA contributions:**
 - MODIS data
 - MODLAND expertise for product development
- **USFS contributions:**
 - Ground stations for direct receipt of MODIS data
 - Operational information systems infrastructure to generate products from MODIS data and distribute products on-line during fire events.
- **Expected outcomes:**
 - Improved response to on-going wildfire events
 - More rapid recovery from fire events.





Application: Wildfire Monitoring



MODIS Science Mission

- **MODIS was designed to monitor large-scale changes in the biosphere and yield new insights into the workings of the global carbon cycle.**
- **MODIS measures the photosynthetic activity of land and marine plants (phytoplankton) to yield better estimates of how much carbon gas is being absorbed and used in plant productivity.**
- **Coupled with the sensor's surface temperature measurements, MODIS' measurements of the biosphere help track the sources and sinks of carbon dioxide in response to climate changes.**





Application: Wildfire Monitoring



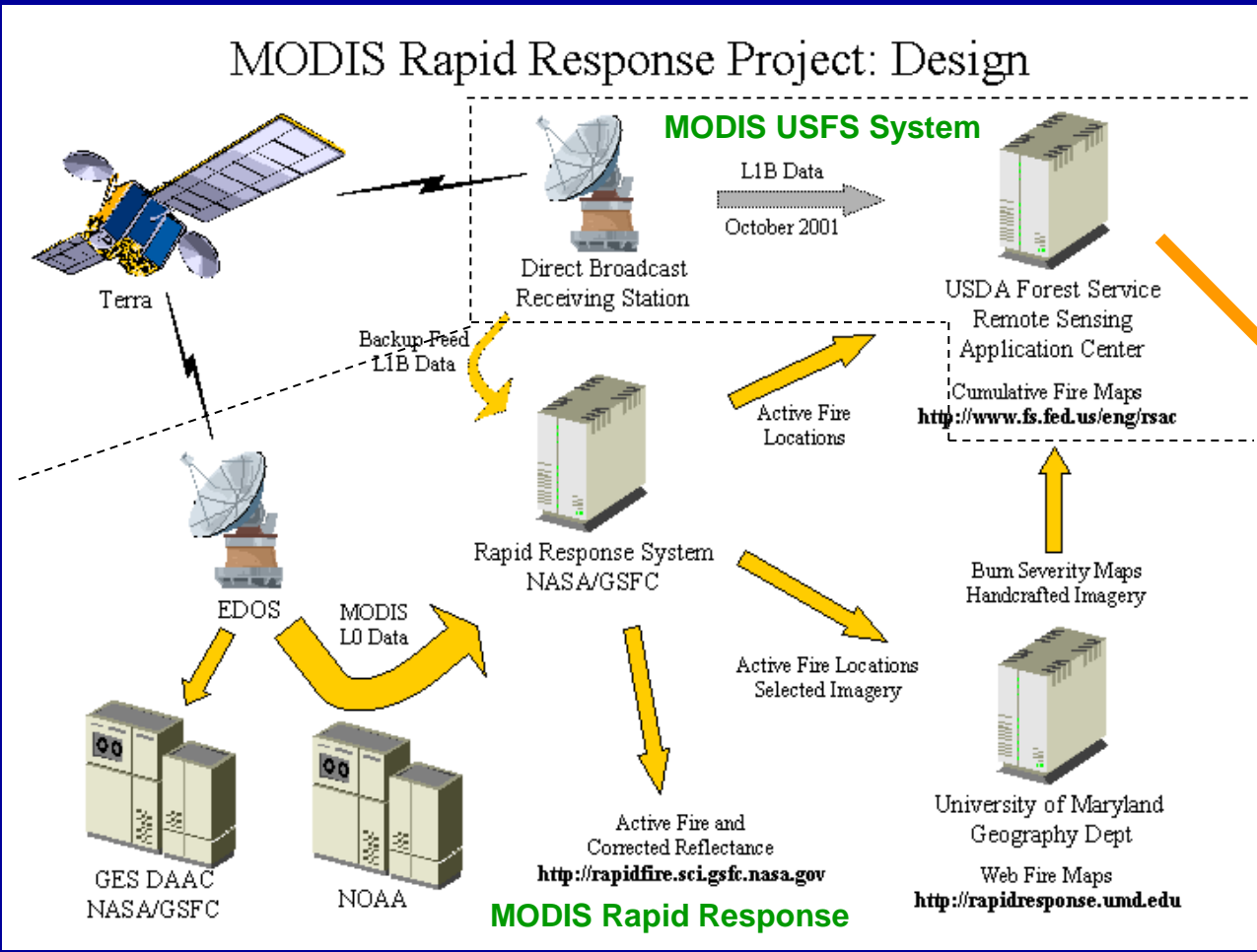
- The MODIS Land Discipline Group (MODLAND) developed a “Rapid response System” to meet science and applications needs when data and data products are required within hours of acquisition.
- Sample products from the Rapid Response System were made available to USFS to address Forest Service needs for better information on active wildfire location and intensity. A prototype end-to-end system for product delivery was engineered and demonstrated.
- USFS is adopting the system operationally and taking responsibility for:
 - acquisition of MODIS data via direct downlink
 - generating and distributing data products
 - Image products are delivered to fire response managers within 4-6 hours of data acquisition.





Application: Wildfire Monitoring

From Science to Applications



Internet Connectivity

“Near real time” users





ESE Applications Themes

- Weather and climate for **Energy Forecasting**
- Sequestration capacity monitoring for **Carbon Management**
- Weather and climate for **Agricultural Competitiveness**
- Weather and natural hazards for **Aviation Safety**
- Weather, climate and natural hazards - **Community Growth**
- Early warning for **Homeland Security**
- Early warning for **Public Health**
- Community preparedness for **Disaster Management**
- Environmental Indicators for **Coastal Management**
- Management of **Invasive Species**
- **Water Management** and conservation
- Weather and natural hazards for **Air Quality** management





Carbon Management

- Falls within NASA's vision and mission
- Addresses and issue of national importance
- ***Draws upon NASA science data and capabilities***
- Involves partners at the national level - USDA, DOE, NOAA, EPA
- Draws upon, and contributes to, other national applications
 - Weather and climate
 - Disaster management
 - Water and air quality
 - Coastal zone management
 - Invasive species
 - Public health
- Benefits from NASA systems engineering approach





National Importance

- In February 2002 President Bush directed Secretary of Agriculture Veneman to:
 - Provide recommendations on the targeted incentives for forest and agricultural sequestration of greenhouse gases.
 - Develop accounting rules and guidelines for crediting carbon sequestration projects, in consultation with DOE and EPA.





What NASA/ESE Offers

- Data of land, oceans and atmosphere
- Basic research on the carbon cycle, sources and sinks, future trends, etc.
- The capability to evaluate, validate, verify and benchmark technology
- Experience working with the private sector to integrate commercial data and data products into research and applications “solutions.”
- The mandate to transform research results into practical solutions that address issues of national importance through support of the decision making resources in the operational agencies.





NASA/ESE Response

Near Term

- Working with USDA agencies, e.g., CSREES, ARS, Forest Service and ERS to define the decision support for carbon management and how NASA capabilities can be put to use.
 - March 03 workshop
- Working with USDA, DOE and EPA to update the accounting guidelines for the Voluntary Reporting of Greenhouse Gases Program (Sec. 1605(b) of the Energy Policy Act of 1992) for forest and agriculture.

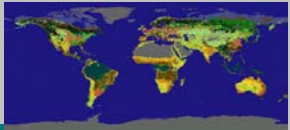
Long Term

Operational decision support system(s) for quantification and verification of carbon sequestration (soil, above ground biomass, oceans, below surface deposition.)



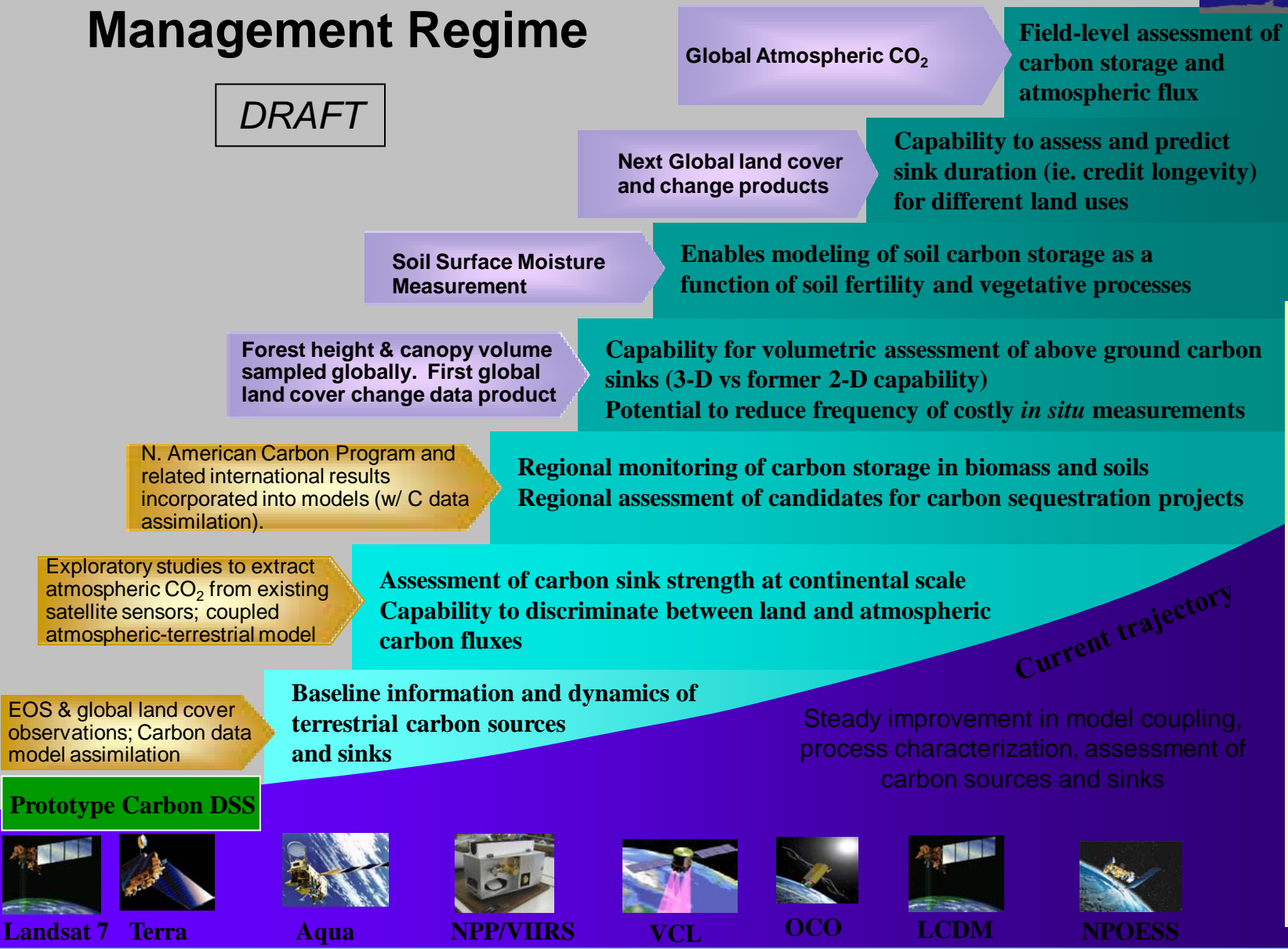


Toward a Carbon Management Regime



DRAFT

Socioeconomic Impact



An operational decision support system for quantification and verification of soil carbon sequestration

Current trajectory

2002 2004 2006 2008 2010 2012



Landsat 7

Terra

Aqua

NPP/VIIRS

VCL

OCO

LCDM

NPOESS



Carbon Mgmt. - Systems Engineering

MODELS

- Carbon assimilation in above and below ground biomass
- Assessment of land and ocean carbon sink strength
- Soil moisture
- Land-atmosphere-ocean carbon exchange

Data

ESE MISSIONS

- Aqua
- Terra
- Landsat 7
- LDCM
- NPP/VIIRS
- EO-1
- OCO
- Aquarius
- NPOESS

Information Products, Predictions, and Data from NASA ESE

Missions and Models:

- Land cover condition and change
- Volume of above ground biomass
- Forest condition
- Soil moisture
- Agricultural production and yield - CO₂ concentration in the atmosphere
- Oceanic carbon uptake and storage
- Fire management

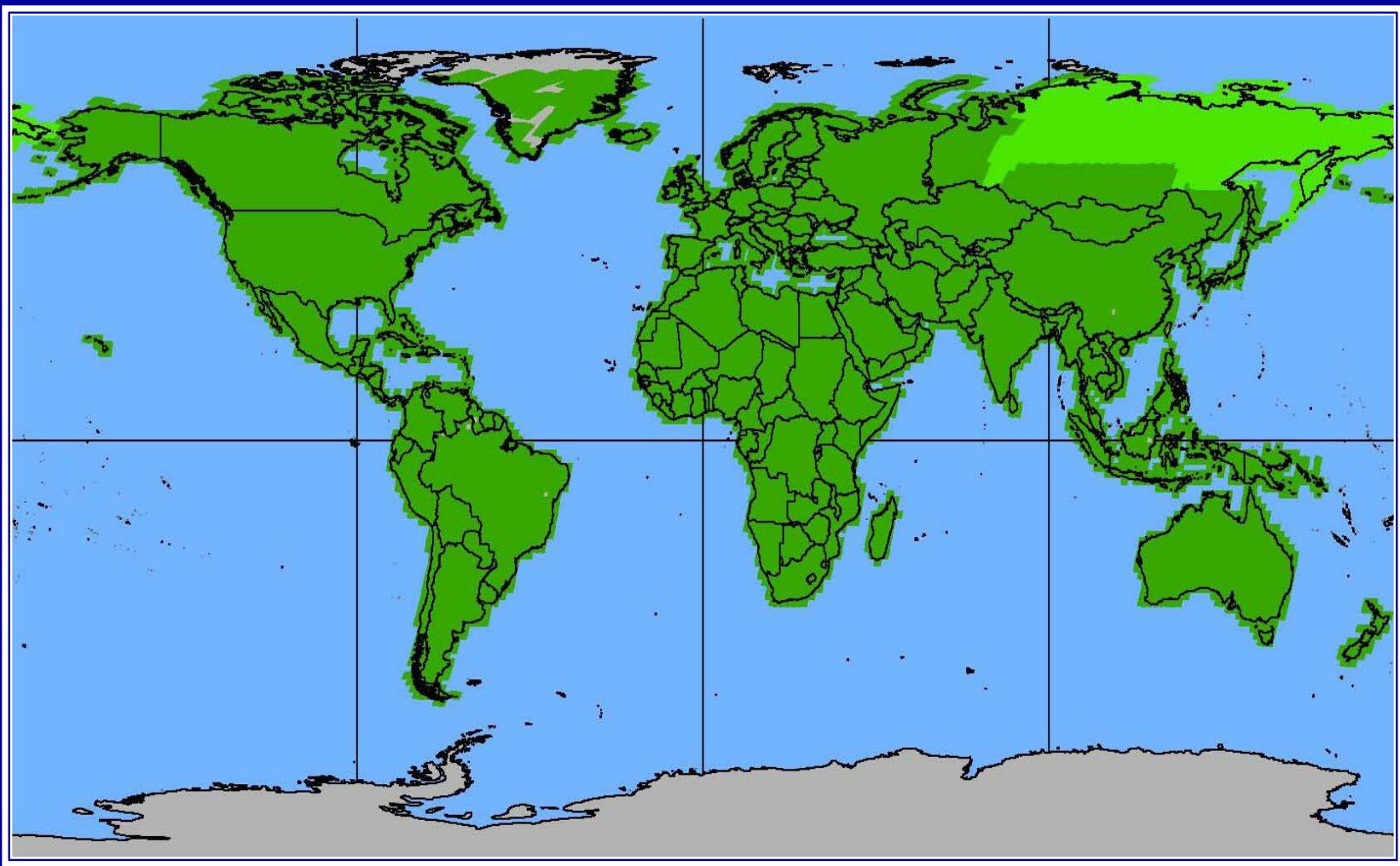
DECISION SUPPORT

- Soil carbon sequestration
- Forest management
- Crop planning and rotation
- Irrigation control
- Atmospheric pollution monitoring & prediction
- Energy production (burning of fossil fuels)
- Climate and weather Prediction
- Oceanic carbon sequestration

VALUE & BENEFITS

- Climate change mitigation
- Improved efficiency in energy production
- Improved efficiency in crop production through enhancements in soil carbon
- Improved economy in marginal rural agricultural areas



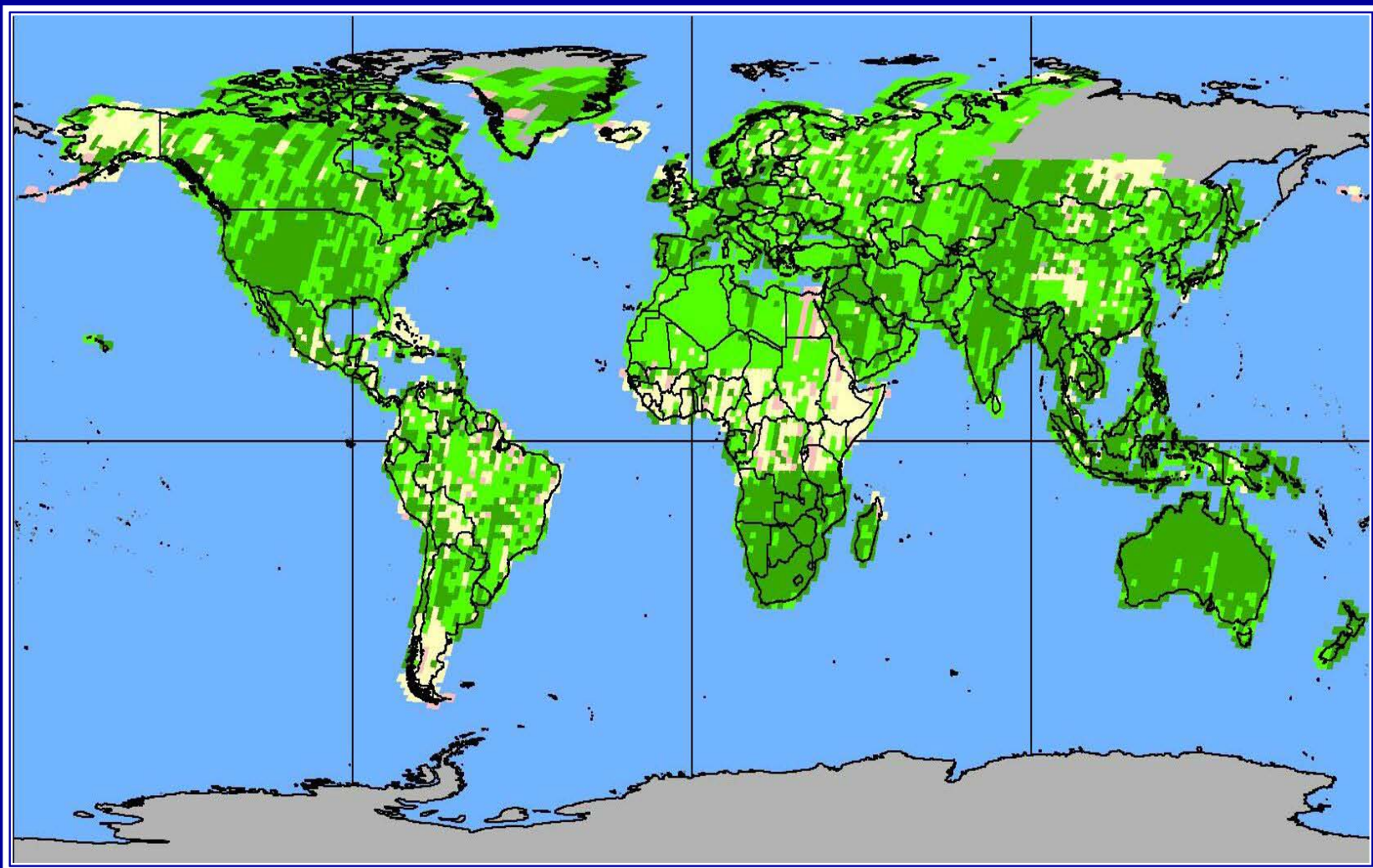


Dark Green: Circa 1990 data; Light Green: Year 2000 Landsat-7





Circa 1990 Landsat TM by Acquisition Year



Dark Green: 1990 +/- 1 year; Light Green: +/- 3 years; Yellow: +/- 4+ years

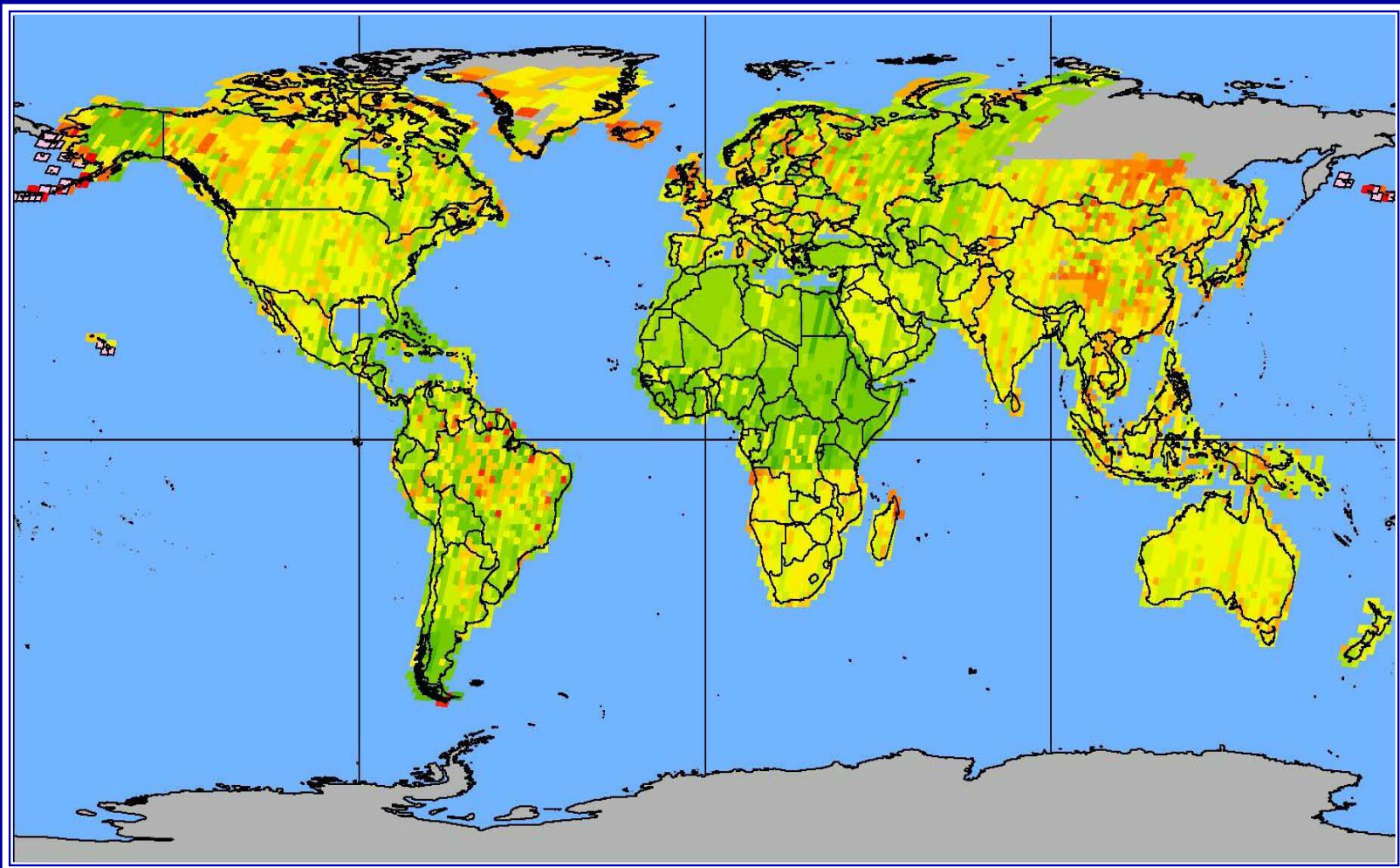




Circa 1990 Landsat TM by Acquisition Year



EarthSat

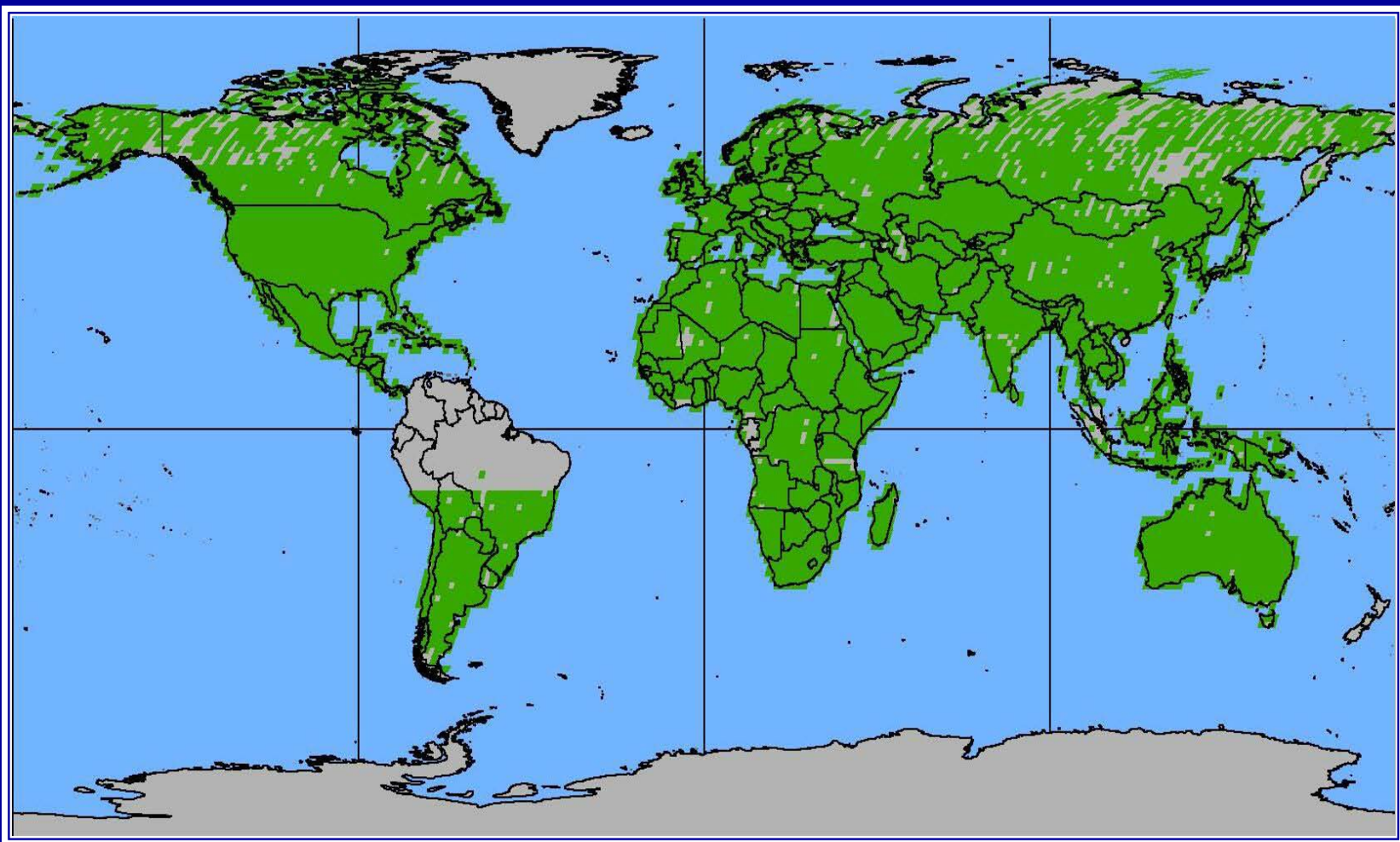


Acquisition year given by legend on right





Science Data Purchase 1970s-80s Landsat MSS

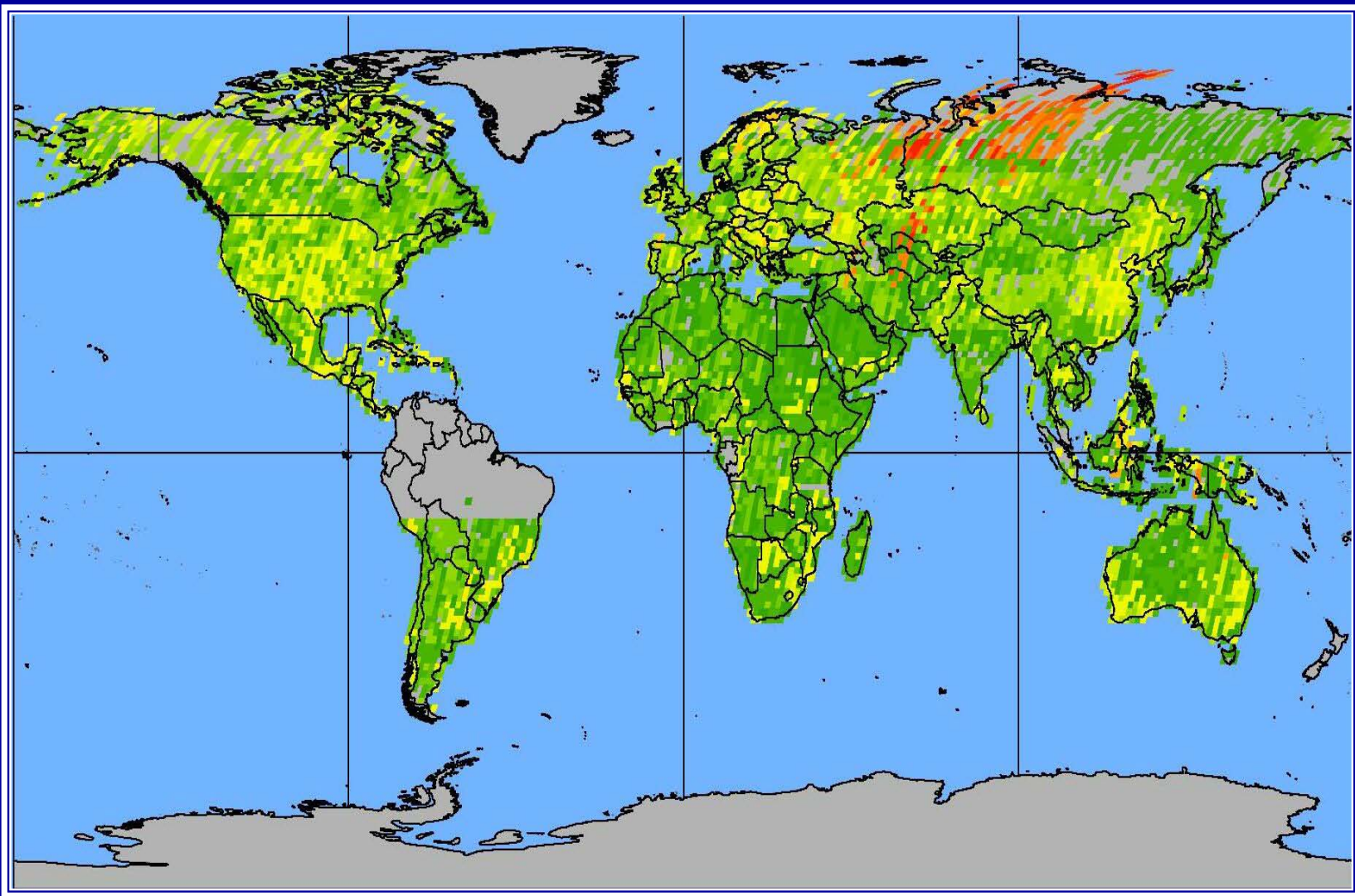


Dark Green: Landsat MSS Coverage





1970s-80s Landsat MSS by Acquisition Year

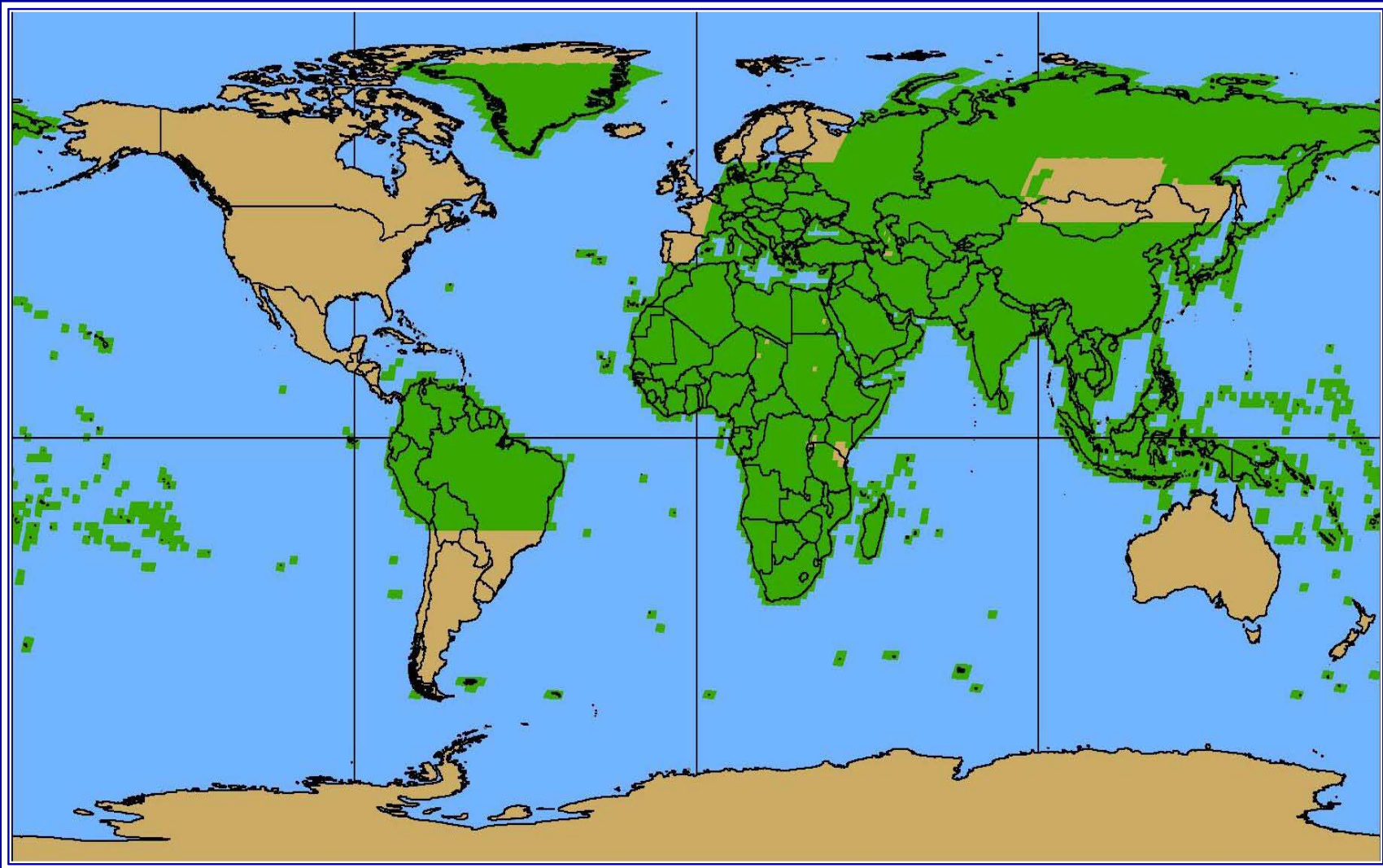


1972
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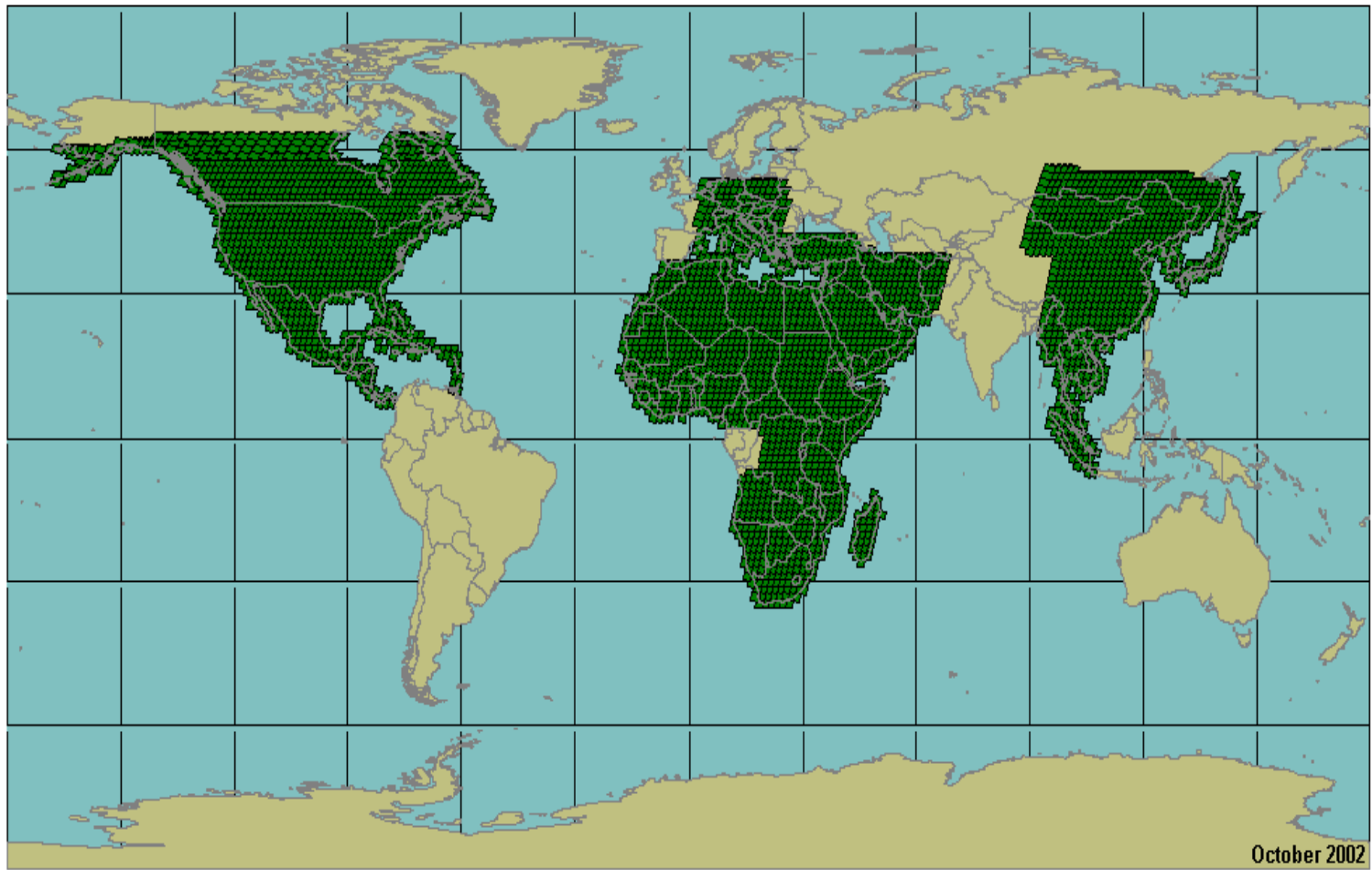


Year 2000 Landsat ETM+ Production Status - 11/18/02





GeoCover LC 1990: Production Status



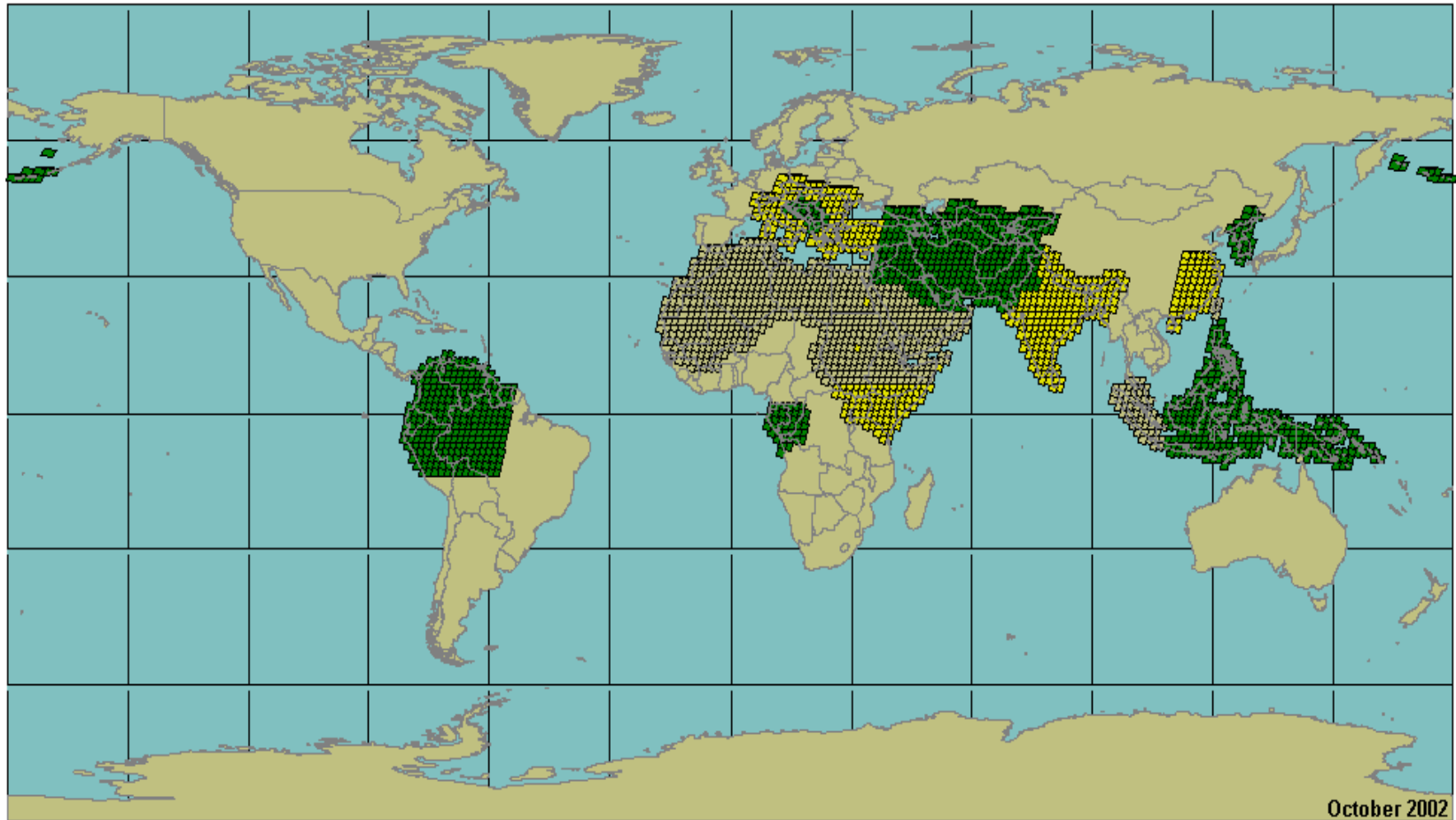
Earthsat GeoCover LC Status

1990 GCLC Coverage
■ LC Complete - 3669 Scenes





GeoCover LC 2000: Production Status



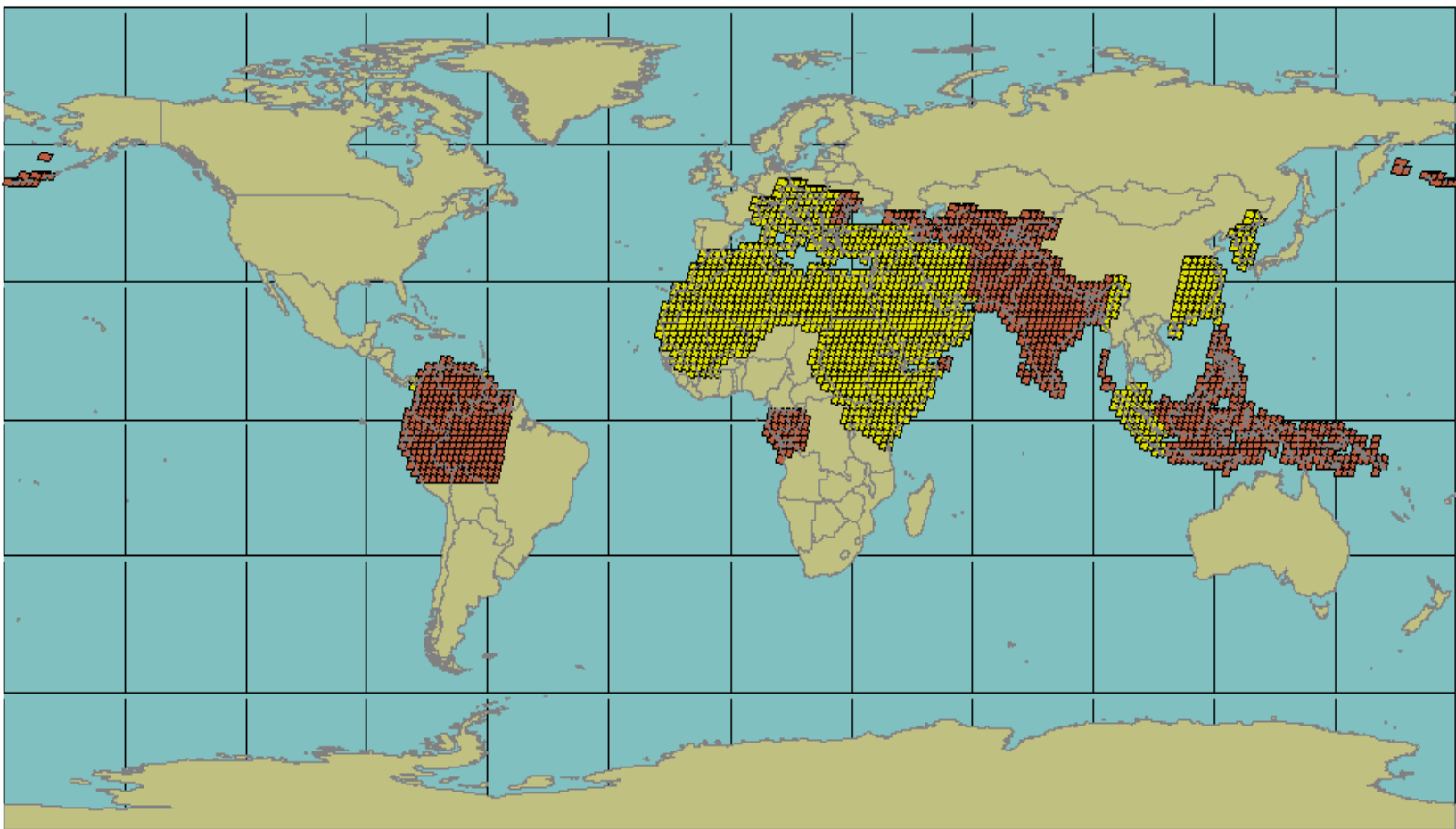
EarthSat GeoCover LC Status

- 2000 GCLC Coverage
- LC Complete - 1051 Scenes
 - LC Contracted - 479 Scenes
 - LC In Progress - 721 Scenes







GeoCover LC Update: Production Status



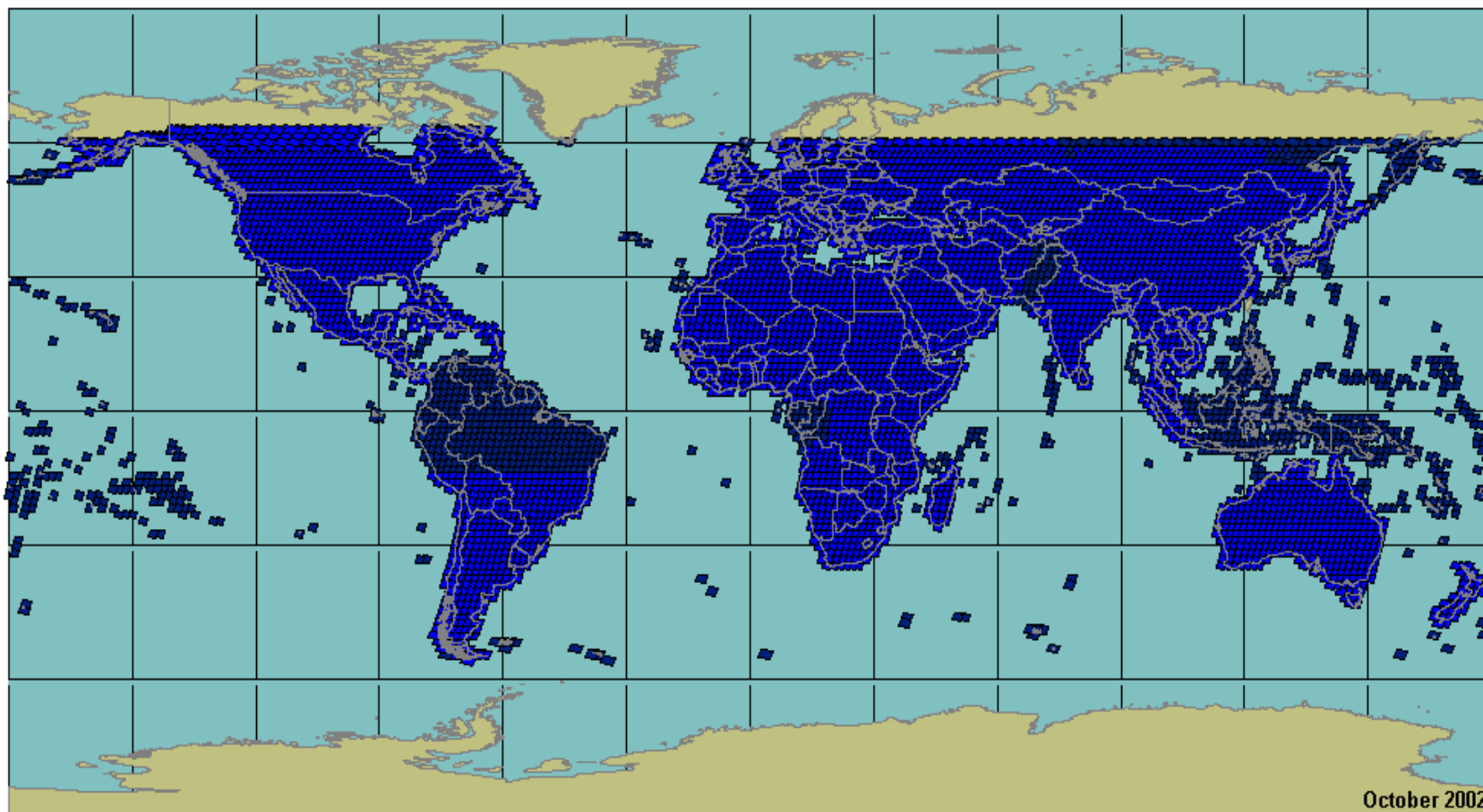
Earthsat GeoCover LC Status

- GCLC 2000 Versions**
-  Full 13 Class - 1056 Scenes
 -  Update / CCA - 1224 Scenes





GeoCover LC Water: Production Status



EarthSat GeoCover LC Status

GCLC SRTM Water Masks

-  1990 Complete - 5500 Scenes
-  2000 Complete - 1339 Scenes





Recommendations on Land Cover from the Landsat Global Data Working Group



1. NASA is strongly encouraged to pursue Landsat-scale analyses of global land cover
2. Focused regional products will be needed to augment global products
3. Validation is the key to product success
4. Access to underlying observations is vital
5. Difficulties with access to products and observations are currently hampering progress
6. The NIMA-sponsored land-cover product is inadequate for NASA's scientific goals
7. Priorities are needed for NASA's global Landsat data production
8. The role of the private sector is important





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