Towards Operational Land Cover and Fire Observations

Michael Brady Executive Director GOFC-GOLD
Joint Meeting on Land Cover/Land Use Change Processes in Monsoon Asia Region, 12-17 January 2009, Khon Kaen
The need for reliable land cover information has never been stronger

- Scientific requirements (a driver of global change as well as responding to climate change)
  - Carbon cycle
  - Other biogeochemical cycles
  - Hydrological cycle
  - Understanding of vulnerability of human societies
  - Drivers of land cover change
- Sustainable development (World Summit on Sustainable Development)
- To support international agreements (Convention on Biodiversity, FCCC etc.).
- Natural resources management
Uncertainties concerning land monitoring

- Varying national capabilities to monitor forests and land cover
- Remote sensing data are often unavailable
  - Observations not operational in a weather forecasting sense
  - Costs
  - Satellite acquisition strategies
- Different definitions and protocols
  - FAO 2005: tree canopy cover > 10%
  - Many forest agencies IGBP: tree canopy cover > 60%
  - Forestry agencies: 35-40% but harvestable lands, actual or potential
Heterogeneity of forest estimates in global land cover maps

Forest definitions:
IGBP legend: percent tree cover >60% / tree height >2m
GLC2000 legend: percent tree cover >15% / tree height >3m

Credit: M. Herold / GOFC-GOLD
What is GOFC-GOLD?

- GOFC-GOLD is a coordinated international effort to ensure a continuous program of space-based and on-the-ground forest and land cover observations for global monitoring of terrestrial resources and the study of global change.

- A network of participants implementing coordinated research, demonstration and operational projects

- A vision to share data, information and knowledge, leading to informed action and decision support

- A long term process of building an improved match between Observations, Data Products and User Needs
Structure

- GTOS
- Science and Technical Board
- GOFC-GOLD Executive Committee
  - Global Strategies & Frameworks e.g. IGOL; GEOSS, GCOS IP
  - Project Office
  - User Outreach
  - Implementation Teams
  - Regional Networks
  - Working Groups (as required)
  - Partnerships e.g. UNISDR WFAG; CEOS WGCV

Partnerships e.g. UNISDR WFAG; CEOS WGCV
Principal Sponsors

- Canadian Forest Service
- Canadian Space Agency
- European Commission
- European Space Agency
- Global Terrestrial Observing System (FAO, WMO, UNEP, UNESCO, ICSU)
- US NASA
Global Observation of Forest and Land Cover Dynamics

Land Cover Characteristics and Change

- Use and refinement of land cover data and information products
- Coarse resolution earth observations for land cover mapping
- Fine-scale land cover change
- Integration with in-situ observations

http://www.gofc-gold.uni-jena.de
Global Observation of Forest and Land Cover Dynamics

Fire Mapping and Monitoring

- Refining international requirements for fire-related observations
- Best possible use of fire products from existing and future satellite observing systems
- Support fire management, policy decision-making, and global change research

http://gofc-fire.umd.edu
Recent drivers for GOFC-GOLD

• International environmental conventions:
  – UNFCC, UNCCD, CBD, Ramsar, etc.

• GCOS implementation plan:
  – Establish international standards for land-cover characterization
  – Reliable methods for land-cover map accuracy assessment
  – Develop an in situ reference network and apply validation protocols
  – Generate annual products documenting global land-cover characteristics

• FAO Global Forest Resource Assessment 2010

• IGOS-P Land Theme (IGOL)

• GEO & GEOSS work plan tasks:
  – 8 tasks related to land cover, fire and regional networks
Operationalizing Products

- Specification of requirement
- Observations available (as data sets)
- Algorithms/assimilation established
- Research/prototype product created
- Validation procedures established and applied
- Product adopted and distributed by operational agency
- Routine quality assurance & validation
- Further improvements needed to meet requirements?
# Progress in meeting our goals

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<tbody>
<tr>
<td>Active fire detection - daily (polar)</td>
<td>CNES WS App 4, p.35</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>MODIS, AVHRR, DMSP, AATSR, VIRS</td>
<td>P</td>
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<td>Active fire detection - diurnal cycle (geostationery+polar)</td>
<td>FIRE IT web site</td>
<td>Y</td>
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<td>GOES, VIRS</td>
<td>P</td>
<td>Y</td>
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<td>Burnt area</td>
<td>CNES WS App 4, p.36</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Globscar, GBA-2000, MODIS Regional</td>
<td>P</td>
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<tr>
<td>Emission product suite</td>
<td>FIRE IT web site</td>
<td>Y</td>
<td>P</td>
<td>?</td>
<td>N (available regionally)</td>
<td>N</td>
<td>N</td>
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<tr>
<td>Fire danger rating</td>
<td>FIRE IT web site</td>
<td>Y</td>
<td>?</td>
<td>?</td>
<td>N (available regionally)</td>
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Functions of GOFC-GOLD

1999 Strategy revisited in 2005 to ensure the global systematic collection of observations of land cover and fire

1. Specifying requirements for products
2. Assessing algorithms and data assimilation procedures
3. Ensuring the availability of observations
4. Harmonization and the development of protocols and standards
5. Ensuring that operational products meet accuracy requirements
6. Capacity building and the role of regional networks
7. Creating GOFC-GOLD products and services
8. Providing information to support international assessments
9. Advocacy role, especially in relation to the continuity of observations and validation
1. Specifying requirements for products

- GOFC-GOLD reports 3&4 (1998)
- Integrated Observations for Land (IGOL)
- GCOS
  - Adequacy Reports (ECVs)
  - Implementation Plan (tasks)
  - Supplementary Report on product requirements
  - CEOS Response Report
- UNFCCC/SBSTA
  - Research and Systematic Obs. CEOS Response Report
  - “Reducing emissions from deforestation in developing countries”
- GEO & GEOSS
  - Tasks on global land cover/forest obs. (AG-06-03 and AG-06-04)
  - UIC CoP Forest Observations
- FAO – FRA 2010
  - Global remote sensing assessment component
<table>
<thead>
<tr>
<th>Variable</th>
<th>Product</th>
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<tbody>
<tr>
<td>Land cover</td>
<td>- Land cover 250 m</td>
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<tr>
<td></td>
<td>- Land cover change 10-30 m</td>
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<tr>
<td></td>
<td>- Land cover change history</td>
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<td></td>
<td>- Vegetation continuous fields</td>
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<tr>
<td>Fire disturbance</td>
<td>- Active fire</td>
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<td></td>
<td>- Burnt area</td>
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<td>- Fire radiative power</td>
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2. Assessing algorithms and data assimilation procedures

Global Geostationary Active Fire Monitoring Capabilities

GOFC-GOLD Fire IT Meeting, 2007
3. Ensuring the availability of observations

Global Forest and Land Cover Datasets and Projects

- AVHRR Global Potential Land Cover Products
- Continuous Fields Tree Cover Project AVHRR
- Continuous Fields Tree Cover Project MODIS
- GISS Global Vegetation Data Set
- Global Land Cover Map for the Year 2000 (GLC 2000)
- Global Land Cover Characterization Program (GLCCP & IGBP DISCover)
- Global Forest Resources Assessment (FRA 2000)
- Global Boreal Forest Mapping Project (GBFM)
- Global Rain Forest Mapping Project (GRFM)
- Global Potential Vegetation Data Base
- International Satellite Land Surface Climatology Project (ISLSCP)
- ISCGM Global Mapping Project
- MODIS Land Cover Products
- MURAI & HONDA World Vegetation Map from UNEP/GRID
- NASA Landsat Pathfinder Humid Tropical Forest Inventory Project (HTFIP)
- USGS Global Land Cover Characterization Program
- WCMC Global Forest Cover Data Set

GOFC-GOLD
LCCS is a world-wide reference system for land cover able to combine high flexibility with an absolute level of standardization of class definitions between different users. The system allows a dynamic creation of classes without the user having to relate to a pre-defined list of names by a dynamic combination of land cover diagnostic attributes called classifiers.
5. Ensuring that operational products meet accuracy requirements

Procedures for global LC validation (Strahler et al, 2006)

Available at: http://landval.gsfc.nasa.gov/pdf/GlobalLandCoverValidation.pdf
6. Capacity building and the role of regional networks

Providing the interface between the panel and national level data users and needs
Background Regional Networks

1. **Miombo network**: founded in 1995 under the auspices of the IGBP, LUCC and START. More than 40 scientists and natural resources managers involved. Focus on land cover activities.

2. **SAFNet**: initiated in 2000 during a GOFC-GOLD regional network meeting. More than 60 members from 12 southern African countries. Activities on fire.

3. **SEARRIN**: initiated during the Manila workshop in 2000. Activities have involved more than 60 scientists and natural resources managers. Has both fire and land cover.

4. **NERIN**: initiated at the GOFC-GOLD Boreal Forest workshop in Novosibirsk, Russia in 2000. Has over 50 scientists and natural resources managers involved. Activities in both fire and land cover.

5. **REDLATIF-Fire**: in Latin America based around interest in a regional burned area project, needs land cover activities (recently initiated).

6. **OSFAC Central Africa**: initiated at the GOFC-GOLD regional workshop in 2000. Linked to the GIS/RS lab at the University of Kinshasa. Focused on land cover with some work on fire.

7. **East Asia**: focus on both land cover and fire. Initial workshop in 2005 with follow up meetings in Mongolia in June 2006 and Beijing in 2008.

8. **West Africa**: initial network discussions focused on land cover, now discussing joint collaboration with fire (initial workshop 2005).
We need strong Regional Networks
7. Creating products and services

- **GLOBCOVER**: international consortium (i.e. ESA, JRC, UN, GOFC-GOLD) to ensure application of existing standards
- Global land cover using ENVISAT/MERIS 2005 (300 m resol.)
- Built upon experiences (GLC2000, LCCS)
- Link to international initiatives (i.e. GEO) and regional mapping programs (i.e. CORINE)

Global MERIS mosaic
First GLOBCOVER global map product available in January 2007
7. Creating products and services

Global Fire Danger Rating System

Drought masked by fuel

ATSR Hotpots, 1995-2000
ATSR Hotspot Density, 1995-2000

Drought x Fuel x Hotspot Density

GOFC-GOLD
8. Providing information to support international assessments

FAO FRA 2010: Information framework
Sampling design

~ 13,500 monitoring sites
9. Advocacy role: continuity of observations and validation

AR-06-09 High Resolution Multispectral Imager Continuity
Advocate establishing continuity for near real-time, 30-m (or better) resolution, multi-spectral remote-sensing coverage everywhere on the Earth’s surface, including support for the launch of a Landsat-equivalent follow-on mission.

AR-07-P3: Virtual Constellations
Advocate virtual constellation space observations following the “CEOS constellation concept” for better temporal, spatial, and spectral resolution and related data management and dissemination.
Opportunities for GOFC-GOLD engagement in Southeast Asia

1. Global network of LC validation test sites
2. Global Fire Assessment
3. GOFC-GOLD Data Initiative
4. GEO and GEOSS
Characterizing Global Fire

Interannual variability: April-May 2000 -2005

GOFC-GOLD
GOFC-GOLD Regional Network Data Initiative

• Goals
  – Disseminate US earth observation data in regions where available distribution methods are not effective
  – Engage regional expertise in global data set development, evaluation and validation

• Opportunity
  – USGS to complete the orthorectified GLS 2005 data set and provide free access to Landsat 4–7 archive at EDC
  – New LC and LCC products using GLS data
  – Use of Landsat data for validating global science results

• Approach -- GOFC-GOLD regional network structure will be used to establish regional nodes within the networks to:
  – disseminate data on media (DVD, Disk)
  – encourage regional products to be developed using the data

• Pilot for Africa
  – Involves 5 regional networks
  – Network representatives to receive data and training over 3 weeks at USGS EDC and South Dakota State University (SDSU) in early 2009

• Future Initiatives
  – to be undertaken for the other GOFC-GOLD networks, including SEARIN?
RASTER: Radar Applications for Sensitive Treed Ecosystem Regions

A New Opportunity of Collaboration

Paul Briand

Earth Observation Applications & Utilisations

Canadian Space Agency

GOF-GOLD Symposium on Forest and Land Cover Observations,
Jena, Germany, 13-17 October 2008
Context

- Need to monitor the state of Global forest and Land cover
- SAR archive acquired over landmass are under used/exploited
- Over 15 years of multi-frequency/polarization data available over global forests
Opportunity

- Make accessible the SAR archives acquired over Global Forest to the international science community
- Opportunity for GOFC-GOLD
  - Lead and coordinate scientific requirements (definition of global products and regional products of global significance)
  - Develop users requirement fact sheets, and science plan to help space agencies in the definition of their contribution
  - Focus on global scale key products and regional scale products of global importance
- Engage International, National and Regional science expertise in the exploitation of this global dataset
  - Creation of new products
  - Support global science
- Requires coordination among the Space Agencies
GEO societal benefits and land cover observations

- **Climate**: Land change & GHG emis. Water+energy exchanges
- **Weather**: Land-surface climate int. Vegetation characteristics
- **Energy**: Bio-energy/biomass Wind/hydro power assess.
- **Disasters**: Fire monitoring Land degradation assess.
- **Agriculture**: Cultivation pattern+forestry Land degradations
- **Biodiversity**: Ecosystem characteristics Habitats + fragmentation
- **Health**: Land change / disease vectors / boundary cond.
- **Water**: Water resources / quality Land+water use pattern
- **Ecosystems**: Change environment cond. Services + accounting
8 Forest Tasks in GEO Work Plan

1. Forest Mapping and Change Monitoring
2. Global Land Cover
3. Virtual Constellations-Land Surface Imaging
4. Implementation of a Fire Warning System at Global Level
5. Key Terrestrial Observations for Climate
6. Regional Networks for Ecosystems
7. Pilot Communities of Practice
8. Forest Carbon Tracking
Thank you,

Questions?

Main web page http://www.fao.org/gtos/gofc-gold/
Land cover IT web page http://www.gofc-gold.uni-jena.de/
Fire IT web page http://gofc-fire.umd.edu