Characterizing Land Cover Heterogeneity and Land Cover Change from Multisensor Data

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PROJECT ADDRESSES LONG TERM GOAL OF LCLUC PROGRAM:

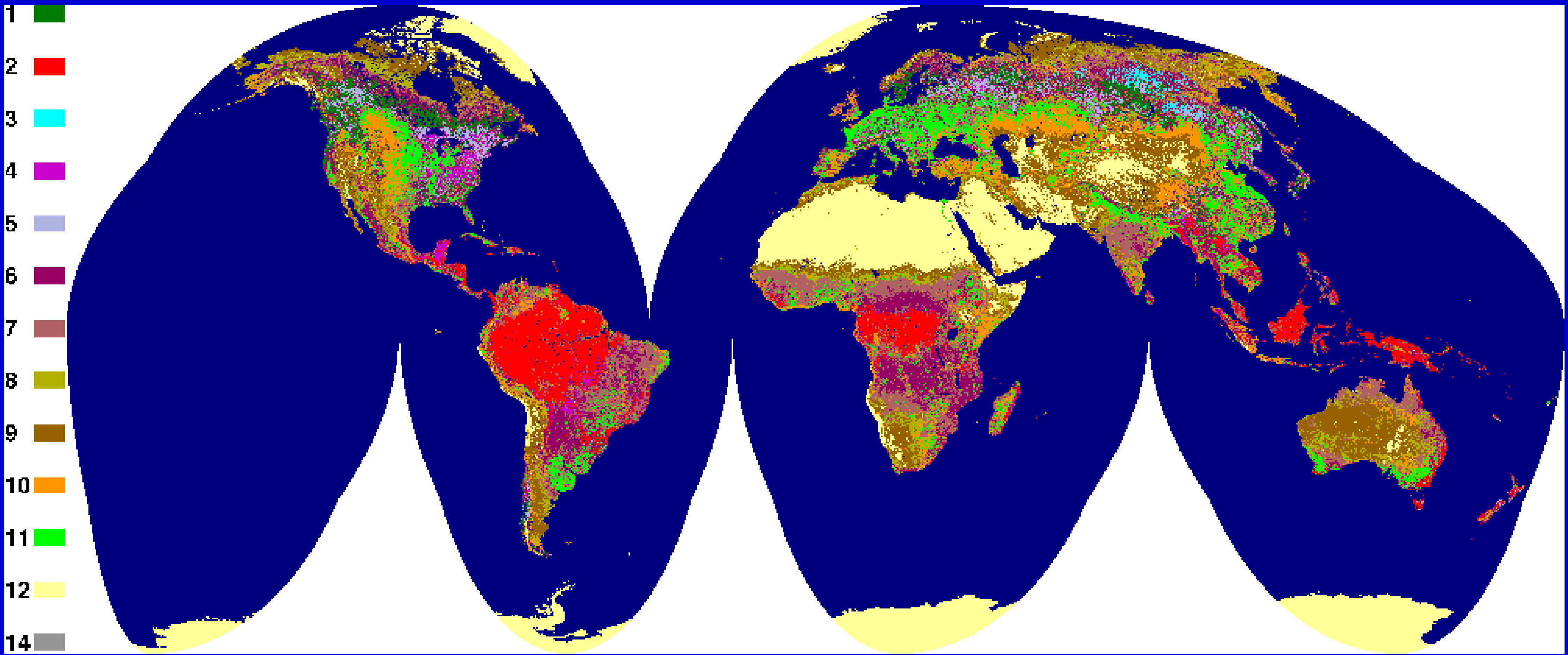
"to develop the capability to perform repeated global inventories of land-use and land-cover from space"

- How to describe spatial heterogeneity in vegetation?
- How to characterize change over large areas?
- How to incorporate land cover heterogeneity in models to assess consequences of land use change?

RESULTS

- Global land cover classifications at scales almost fine enough to represent human activities
- Continuous fields of vegetation properties for spatially consistent characterization of heterogeneity
- Techniques moving toward LCLUC goal of repeated inventories

RESULT
Global land cover classifications at scales almost fine enough to represent human activities

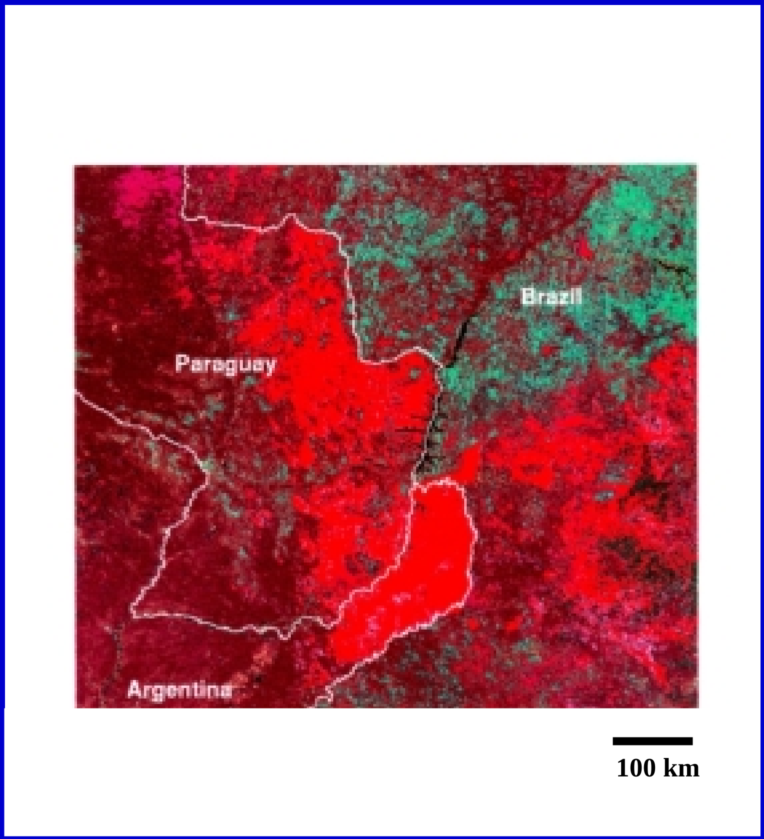


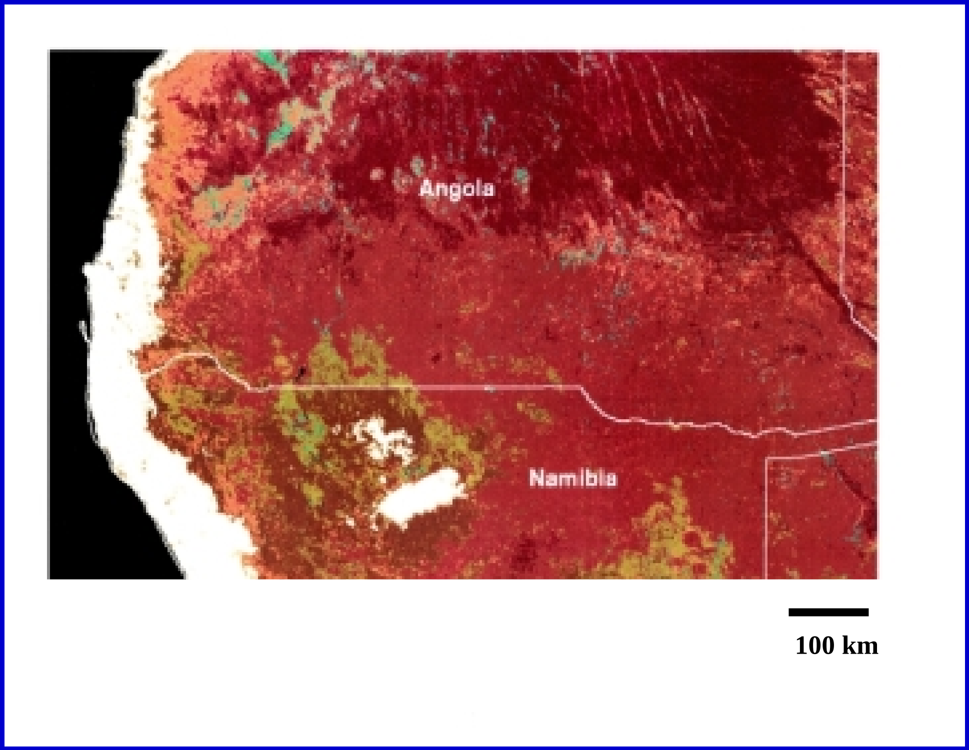
(Hansen et al., 2000)

Derived from 1km AVHRR 1992-93

RESULT

Global land cover classifications at scales almost fine enough to represent human activities





Thematic agreement between satellite-derived and ground-based land cover data sets

DISCover/UMD	Forest/woodland	Grass/shrubs	Crops	Bare ground
Forest/woodland	88.6%	9.0	2.4	0.0
Grass/shrubs	15.8	68.0	10.0	5.2
Crops	8.6	12.2	79.2	0.0
Bare ground	0.0	9.3	0.0	90.7

Average class agreement = 81.87%
Overall agreement = 80.32%

Satellite-derived

Olson/Matthews	Forest/woodland	Grass/shrubs	Crops	Bare ground
Forest/woodland	70.2%	22.0	7.1	0.7
Grass/shrubs	14.9	60.0	6.7	18.5
Crops	16.1	29.5	51.1	3.2
Bare ground	0.5	14.6	1.0	83.9

Average class agreement = 66.30%
Overall agreement = 68.34

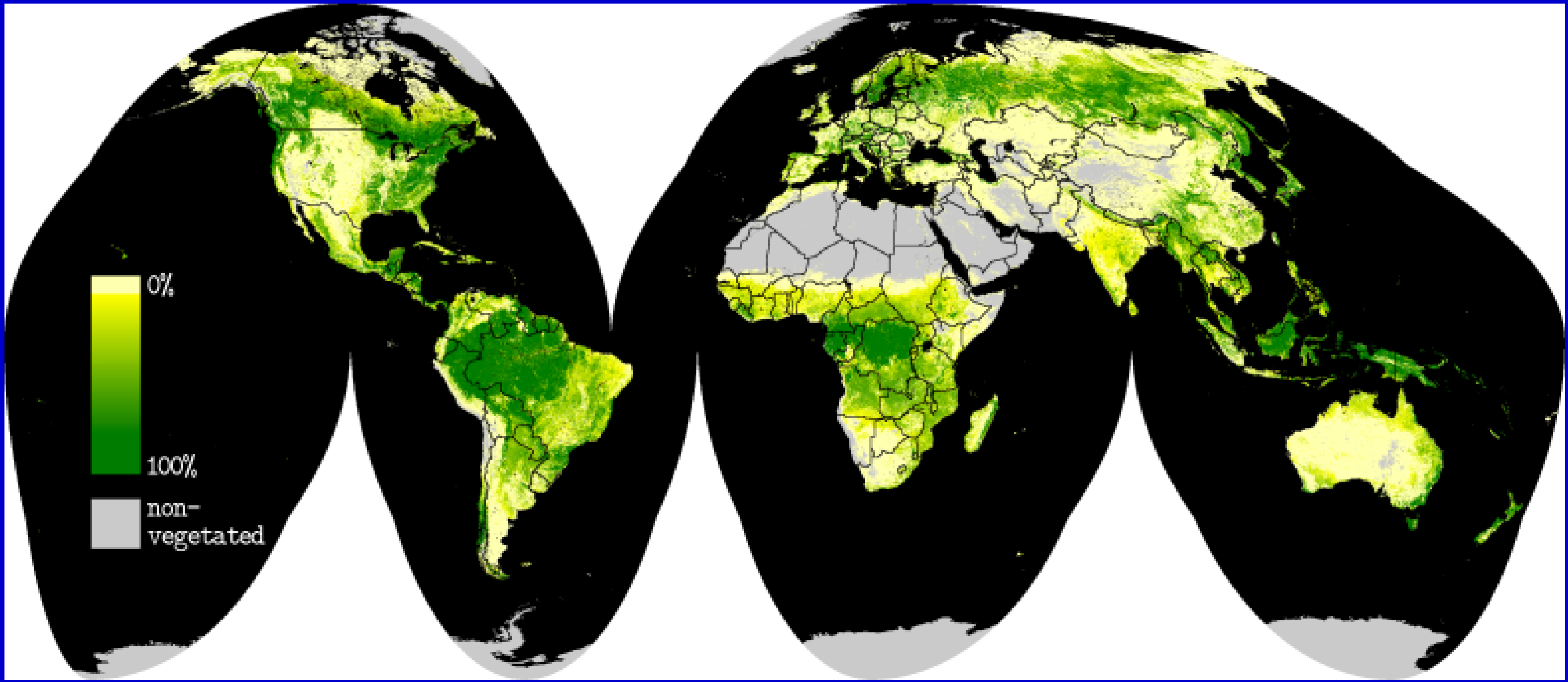
Ground-based

(Hansen and Reed, 2000)

Increased by 50% with satellite-derived products

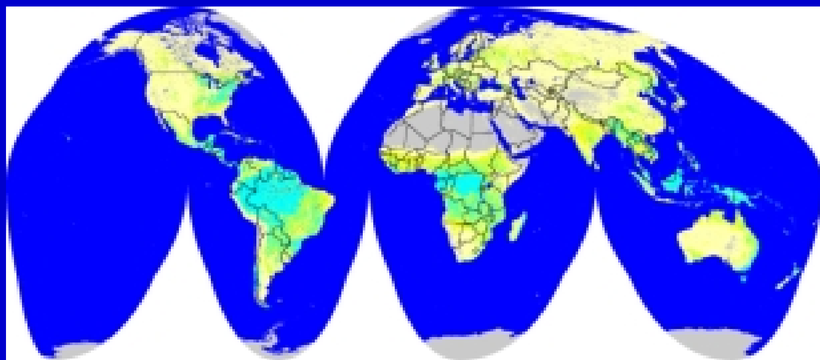
RESULT

Continuous fields of vegetation properties to improve representation of land cover heterogeneity

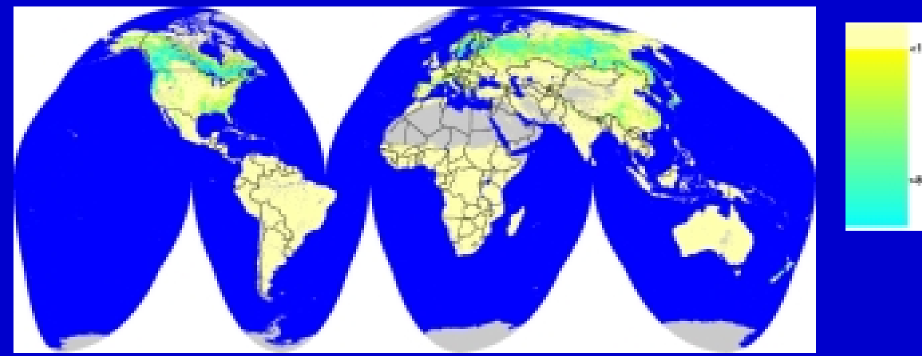


% tree cover derived from 1992-93 1km AVHRR (DeFries et al, 2000)

Leaf type

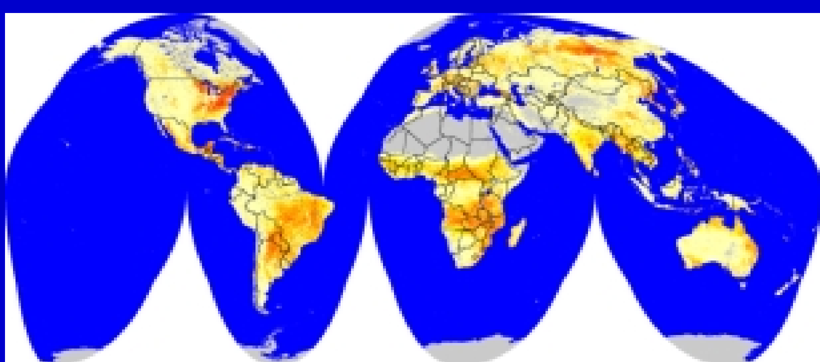


% broadleaf

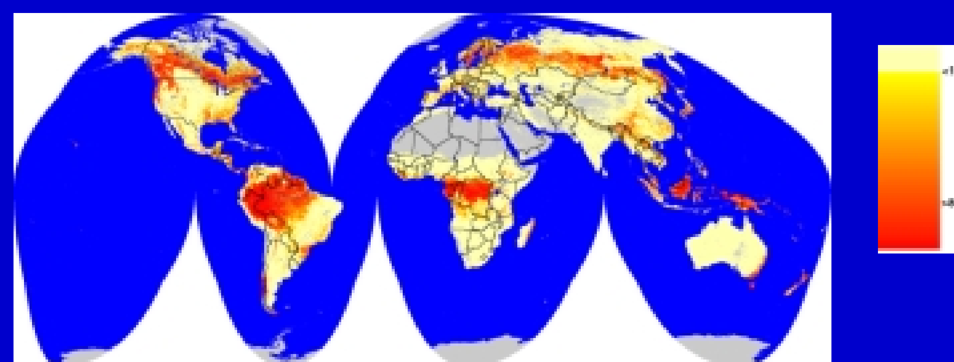


% needleleaf

Leaf longevity



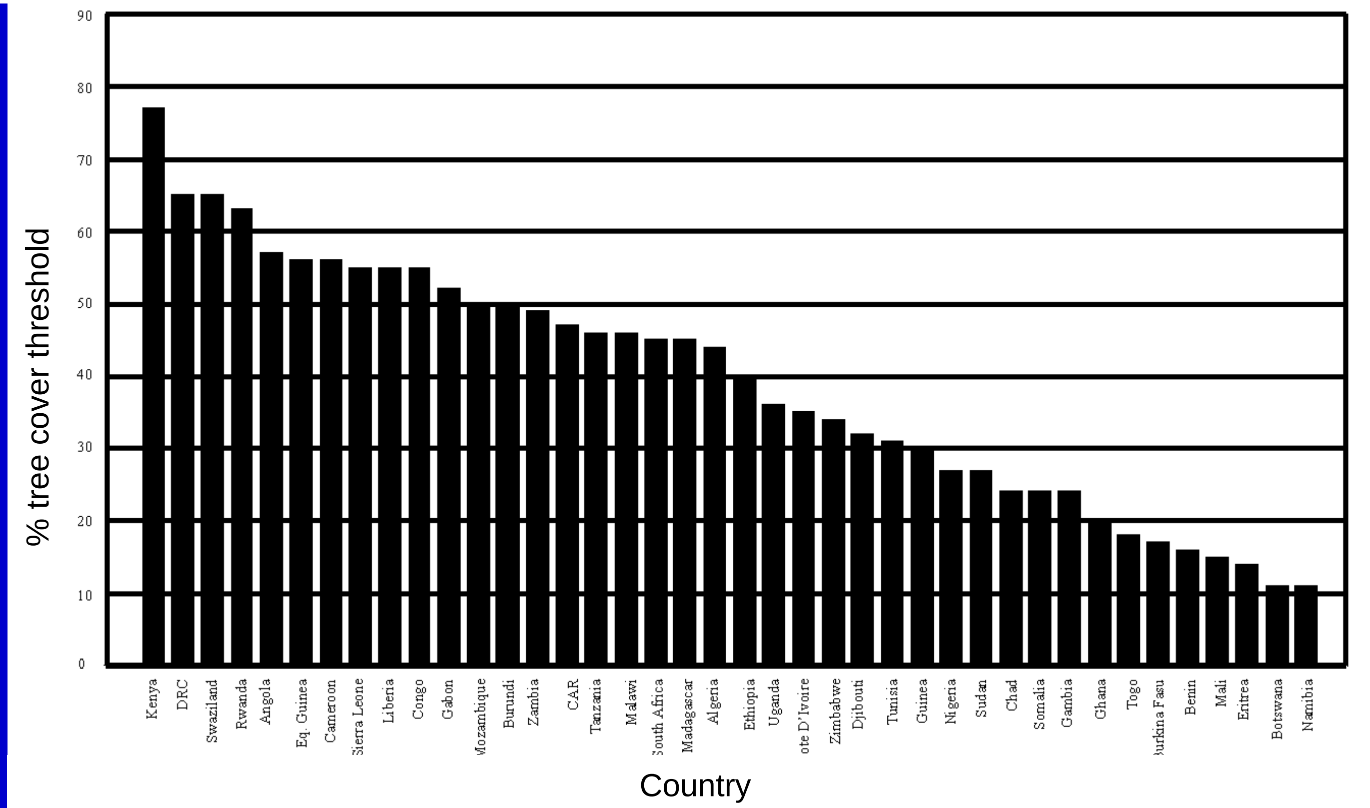
% deciduous



% evergreen

Spatially consistent estimates of % tree cover is <u>one</u> requirement for quantifying carbon stocks

Threshold of tree cover from 1km global data which best matches FAO forest area for African countries



FAO estimates of forested area inconsistent between countries

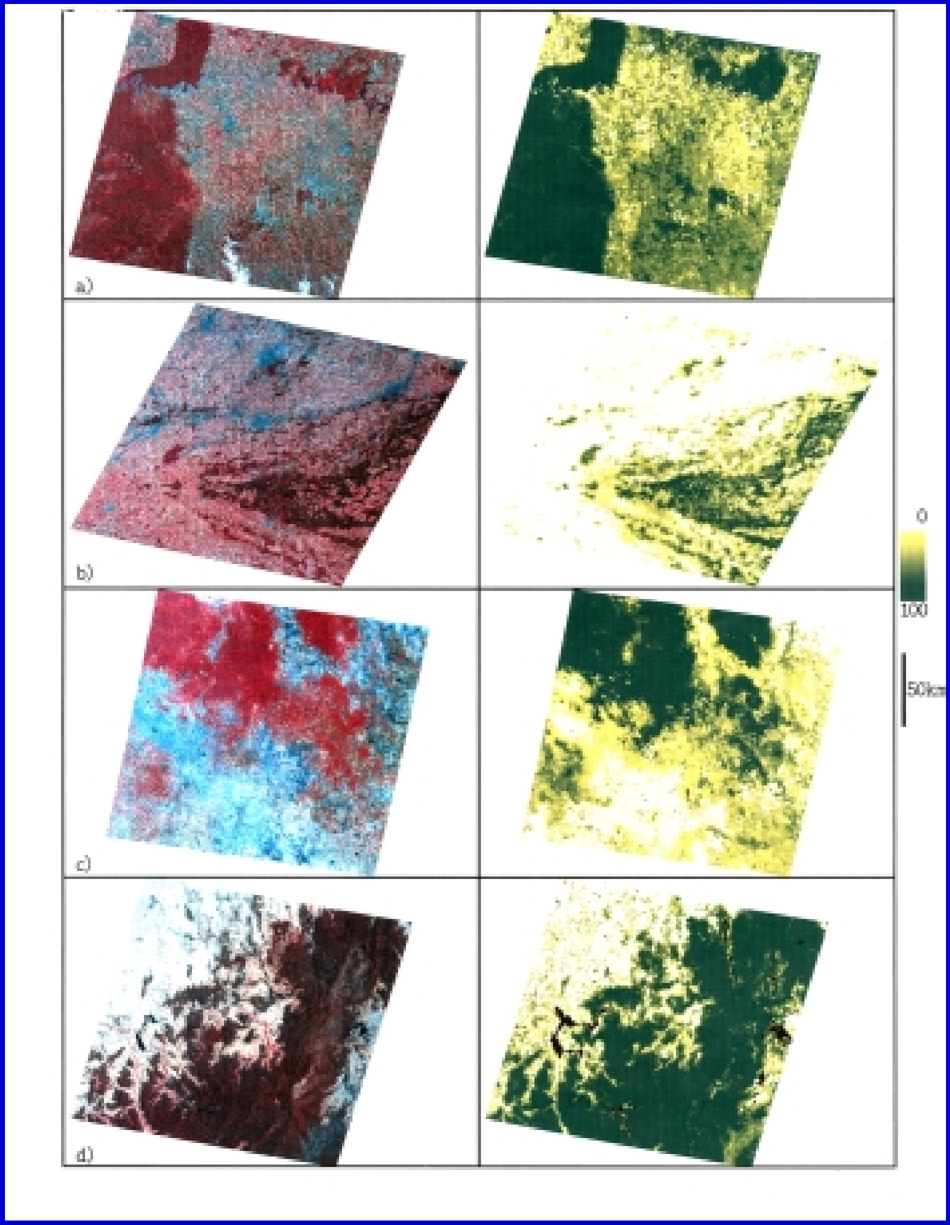
Continuous fields potentially improve representation of land cover heterogeneity in models

Transect	Nigeria		S Africa		Siberia		USA	
	gLAI	Z_0	***gLAI***	z_0	***gLAI***	z_0	***gLAI***	z_0
Dominant cover type	.153	.032	.621	.462	.603	.225	.555	.100
Continuous fields	.049	.014	.413	.037	.159	.034	.324	.018

Root Mean Square Difference of Aggregated green Leaf Area Index *(gLAI)* and surface roughness (z_0) at 1ºx1º Grids from 1km Reference using SiB2

Landsat TM

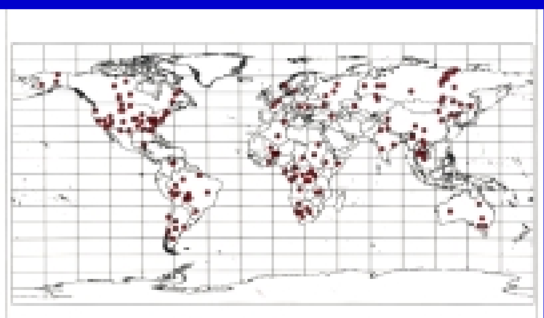
% Tree cover estimate



Spatial patterns compare with high resolution data

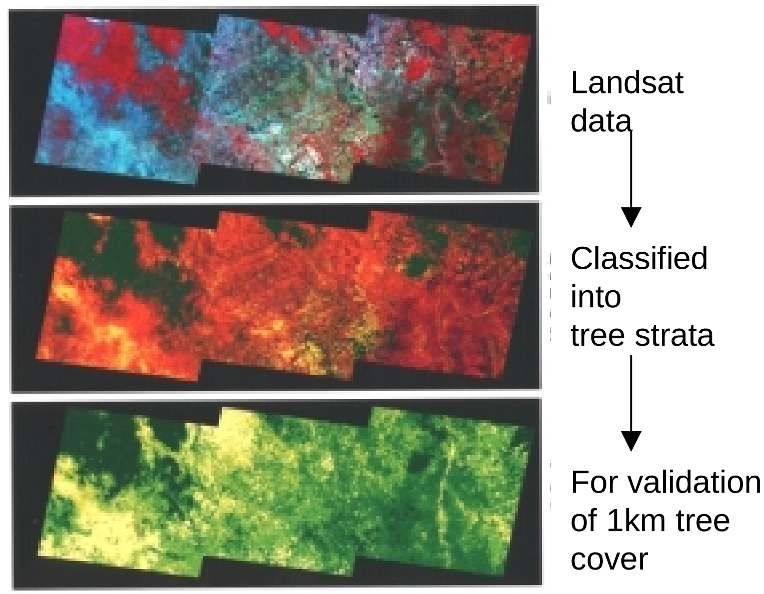
Next step comparison with in situ data

RESULT
Techniques Toward Operational Land Cover Monitoring from Satellites



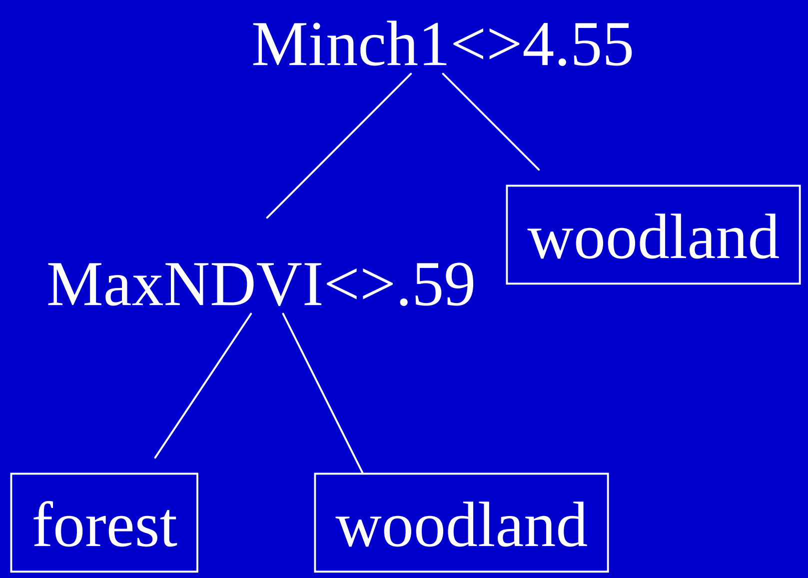
Landsat Training Areas for Global Land Cover Classification

Example from Democratic Republic of Congo



High resolution data to train and validate coarse resolution data

RESULT
Techniques toward operational land cover monitoring from satellites



Decision tree algorithm to classify land cover with training derived from Landsat data

$$R_i = \sum_{j=1}^{Q} r_{ij} x_j + e_i$$

Mixture modeling with coarse resolution data

WHAT'S LEFT?

- Integrating heterogeneity into models to address consequences of change
- Characterizing land cover dynamics and integrating into models
- Linking with ground based observations for calibration and validation
- Integrate 250-1000m MODIS data
- "Operationalize" capabilities for repeatable land cover monitoring

Selected Publications

DeFries, R. Hansen, M., Townshend, J.R.G., Janetos, A.C., and Loveland, T.R. 2000. A new global 1km data set of percent tree cover derived from remote sensing. *Global Change Biology*. 6: 247-254.

DeFries, R., Hansen, M., and Townshend, J., 2000, Global continuous fields of vegetation characteristics: A linear mixture model applied to multiyear 8km AVHRR data, *International Journal of Remote Sensing.* 21: 1389-1414.

Hansen, M., DeFries, R., Townshend, J. R. G. and Sohlberg, R., 2000, Global land cover classification at 1km resolution using a decision tree classifier, *International Journal of Remote Sensing.* 21: 1331-1365.

Hansen, M. and Reed, B. 2000. Comparison of IGBP DISCover and University of Maryland 1km global land cover classifications, *International Journal of Remote Sensing*. 21: 1365-1374.

DeFries, R., Townshend, J. R. G. and Hansen, M., 1999, Continuous fields of vegetation characteristics at the global scale at 1km resolution, *Journal of Geophysical Research - Atmospheres.* 104, 16,911-16,925.

DeFries, R. and Los, S., 1999. Implications of land cover misclassifications for parameter estimates in global land surface models: An example from the Simple Biosphere Model (SiB2). *Photogrammetric Engineering and Remote Sensing*. 65(9): 1083-1088.

DeFries, R. and Townshend, J., 1999, Global land cover characterization from satellite data: From research to operational implementation?, *Global Ecology and Biogeography Letters.* 8 (5): 367-379.

DeFries, R., Hansen, M., Townshend, J. R. G. and Sohlberg, R., 1998, Global land cover classifications at 8 km spatial resolution: The use of training data derived from Landsat imagery in decision tree classifiers, *International Journal of Remote Sensing;* 19 (16): 3141-3168.

Zhan, X., DeFries, R., Los, S.O, and Yang, Z.-O.. in press. Using vegetation continuous fields data set to aggregate land surface. Proceedings of the American Geophysical Union spring meeting, May 30 – June 3, 2000, Washington, D.C.

Zhan, X., DeFries, R., and Los, S.O. in press. Application of vegetation continuous fields data set in global atmosphere-biosphere models. *Proceedings of the International Geosciences and Remote Sensing Symposium*, Honolulu, Hawaii, July 2000.