An improved global 1km land cover data set

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Aim & Motivation

• validation efforts and inter-map comparisons of global high-resolution land cover data sets from NOAA-AVHRR (GLCC), SPOT-VGT (GLC2000) and TERRA-MODIS reveal significant discrepancies between the maps that cannot be explained by varying acquisition times or classification schemes (see Figure 1).
• disagreements between the maps are mainly related to different land cover mapping approaches and classification algorithms
• cross-walking the classification schemes of the products to a legend suitable for model parameterization frequently introduces uncertainties due to ambiguous class definitions of the original map legends

→ developing a method to produce a synthetic land cover data set with ***reduced uncertainties***
→ the ***landcoverization*** method blends different data sets and allows the definition of a classification scheme designed for an intended application, here land surface parameterization of C-cycle models

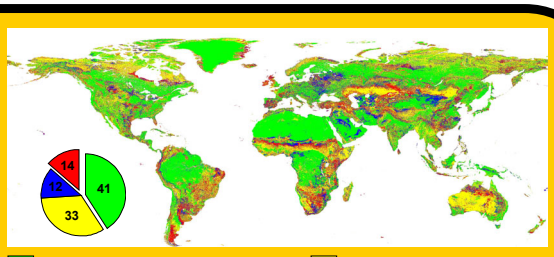

Figure 1: Maps of agreement and disagreement between land cover products: GLCC, GLC2000 and MODIS. The pie charts and numbers therein give percentages of the individual cases. The homogenization of the legends results in generally better agreement since many adjacent classes with frequent confusion (e.g. open & closed shrublands) are combined. However, there are still large disagreements between maps, especially in heterogeneous regions such as transitional ecozones (e.g. Mediterranean, Sahel).

Landcoverization

The principle is based on ***fuzzy logic*** and involves three steps:

(1) Definition of target legend,

(2) Assigning affinity scores,

(3) Calculation

Input data sets

Product	Version	Satellite & Sensor	Acquisition Period	Download
GLCC	2.0	NOAA-AVHRR	April 1992 – March 1993	http://edcdaac.usgs.gov/glcc/glcc.asp
GLC2000	1.0	SPOT-VGT	Nov 1999 – Dec 2000	http://www-gvm.jrc.it/glc2000/
MODIS	V003	TERRA-MODIS	Nov 2000 – Dec 2001	http://duckwater.bu.edu/lc/mod12q1.html
CFTC	1.0	NOAA-AVHRR	April 1992 – March 1993	http://glcf.umiacs.umd.edu/data/treecover/

Note: Two different classification schemes of GLCC (IGBP & USGS) and MODIS (IGBP & PFT) are used respectively.

(1) Defining target legend

- Classes defined by a single or a combination of maximal two dominant life forms (16 categories)
- For each land cover class that has a tree component leaf type (needle, broad, mixed) and longevity (deciduous, evergreen, mixed) is specified
- → 48 classes (36 are associated with trees).

Life form classes
Trees
Trees & Shrubs
Trees & Grasses
Trees & Grasses
Trees & Crops
Shrubs & Crops
Grasses & Crops
Crops
Shrubs
Shrubs & Grasses
Shrubs & Barren
Grasses
Grasses & Barren
Barren
Urban & Built-Up
Snow & Ice

(2) Assigning affinity scores

Affinity scores between the classes of the original maps and the target classes are assigned according to semantic rules.

Land cover class example	Semantic rule	Affinity score	Target class example
Woody savanna	'is not'	0	'Barren'
	'has minor parts of'	1	'Grasses'
	'has parts of'	2	'Trees'
	'has major parts of'	3	'Trees & Grasses'
	'is'	4	'Trees & Shrubs'

(3) Calculating scores for target classes

• Calculation integrates over 6 land cover data sets and a 3x3 pixel window while the centre pixel is weighted by 8 to increase the number of addends and to account for potential misregistration of the individual maps and the 'mixed pixels problem' .

• Target class with highest accumulated score wins

Data Set	Original land cover class	Trees & Shrubs	Trees & Grasses	Shrubs	Grasses	Shrubs & Grasses
GLCC-IGBP	'Open Shrubland'	1	0	2	2	4
GLCC-USGS	'Mixed Shrubland/Grassland'	1	1	2	2	4
MODIS-IGBP	'Woody Savanna'	4	3	1	1	1
MODIS-PFT	'Shrub'	2	0	4	0	2
GLC2000	'Herbaceous Cover'	0	2	0	4	2
GLC2000	'Herbaceous Cover'	0	2	0	4	2
Total Score		8	8	9	13	**15**

Note: GLCC & MODIS are used with two different classification schemes to enhance the capability of 'cross-mapping'. GLC2000 is available with only one legend and goes in twice to be consistent that each land cover data base contributes the same amount of information.

SYNMAP

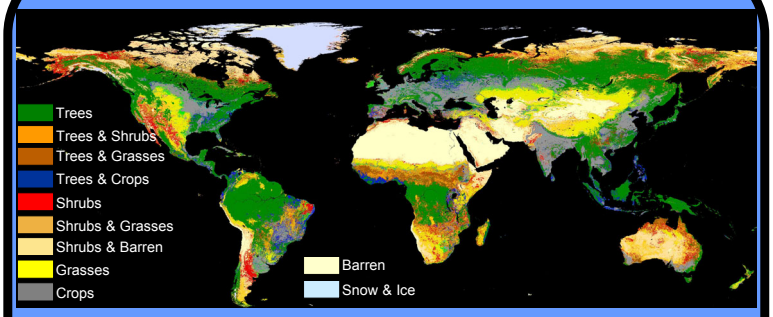

Figure 2: The SYNMAP data set (life form assemblages). 'Shrubs & Crops', 'Grasses & Barren' and 'Urban' have too little extent and are invisible on that scale. Leaf attributes of trees (evergreen, deciduous, needle, broad) are not shown for reasons of visibility but are defined for each class that has a tree component. The data set in full spatial resolution (30") is ***available*** on request.

SYNMAP evaluation

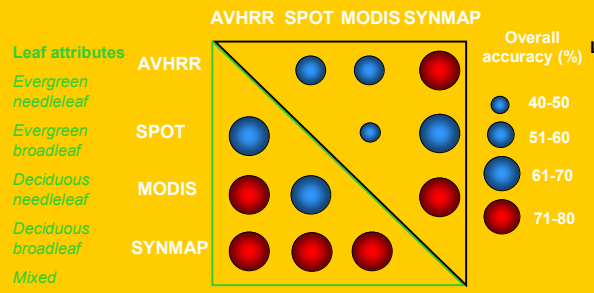

Figure 3: Overall agreement between GLCC, GLC2000, MODIS and SYNMAP based on an aggregated class level (considered classes are given next to the graphics). Above diagonal: for land cover types; below diagonal: for tree leaf attributes.

• Pixel-based map corroboration (Figures 3) suggests that the landcoverization method has successfully explored ***synergies*** between the original land cover products

• SYNMAP is believed to be an improvement over existing global land cover maps in terms of accuracy and classification scheme.

Reference

Jung, M., Henkel, K., Herold, M., Churkina, G. (in preparation): SYNMAP - An improved global land cover data set for terrestrial carbon cycling modelling.