GOFC-GOLD LCLUC activities
in the European Union

Brice Mora

International LCLUC Regional Science Meeting in Central Europe
Sopron, October 17, 2014
GOFC-GOLD LC-IT activities in Europe

Outline

• Reconstructions of historic land cover/use change for the last century in Europe

• Satellite data time-series analysis for land cover change detection

• REDD+ activities
GOFC-GOLD LC-IT activities in Europe

- Reconstructions of historic land cover/use change for the last century in Europe
NEW CONCEPTS FOR RECONSTRUCTIONS OF HISTORIC LAND COVER/USE CHANGE

A STUDY CASE FOR THE LAST CENTURY OF EUROPE

Richard Fuchs, Martin Herold, Jan Clevers
Laboratory of Geoinformation Science and Remote Sensing, Wageningen University, Netherlands

Peter Verburg
Institute for Environmental Studies, VU University Amsterdam, Netherlands

Jonas Eberle, Hannes Tuenschel
Institute for Geography, Friedrich Schiller University Jena, Germany
Features:

- 1km by 1km spatial resolution,
- 1900-2010 period (decadal)
- EU27 plus Switzerland
- Incl. gross changes
- IPCC land categories (w/o wetlands):
  - Settlement
  - Cropland
  - Forest
  - Grassland
  - Other Land

- Fuchs et al. (2013), Biogeosciences
- Fuchs et al. (2014), Global Change Biology
- Fuchs et al. (2015), in prep.

Reconstruction of European land cover for the 1900-2010 period
Data driven approach

1. Data driven approach

Fuchs et al. (2014), in prep.

Detail of Greater Vienna. Classified (right) and digitized (left) forest areas in purple.
Historic Land Dynamics Assessment (HILDA) model
Automated spatial allocation of land cover/use and land change information

Gross/net ratios per land cover/use class
Transition Matrix for all land cover/use classes for period 1900-2010

Concept of the model approach
Fuchs et al. (2015), in prep.
Land change processes during the last 110 years (1900-2010)

Fuchs et al. (2014) Global Change Biology
Major land change processes during the last 110 years (1900-2010)

Fuchs et al. (2014) Global Change Biology

Fig. S2: Land change processes of the last 110 years. Note: Only the last process of multiple processes per pixel is visualized.
Land change processes during the last 110 years (1900-2010)

Fuchs et al. (2014)
Global Change Biology
Consideration of gross land changes

Illustration of the difference between net and gross changes

Fuchs et al. (2014)
Global Change Biology
Difference of net and gross change after 110 years (1900-2010)

Overall net change: **30.6%**

Overall gross change: **56.0%**

Legend:
- 0
- 1
- 2-4
- 5-7
- 8-10

Difference of net and gross changes after 110 years (1900-2010)

Fuchs et al. (2014) Global Change Biology
Comparison with global models

- All classes for overlapping decades (1900-2000):
  - LUH 28.12% (Hurtt et al., AR5-IPCC)
  - HILDA net 27.64%
  - HILDA gross 49.81%.

Comparison of land changes detected by global and continental approaches for European area

Fuchs et al. (2014) Global Change Biology
For further information & data download

Web map:
www.wageningenur.nl/hilda

Contact
Richard.Fuchs@wur.nl
GOFC-GOLD LC-IT activities in Europe

• Satellite data time-series analysis for land cover change detection
BFAST: Breaks For Additive Season and Trend

Background

• Developed by Jan Verbesselt, Achim Zeileis, Rob Hyndman

• Integrates the decomposition of time series into trend, season, and remainder components with methods for detecting and characterizing change within time series, at pixel level.

• Two modes: BFAST and BFASTmonitor

  - BFAST iteratively estimates the time and number of abrupt changes within time series, and characterizes change by its magnitude and direction.
BFAST: Breaks For Additive Season and Trend
BFAST: Breaks For Additive Season and Trend

Background

- Developed by Jan Verbesselt, Achim Zeileis, Rob Hyndman
- Integrates the decomposition of time series into trend, season, and remainder components with methods for detecting and characterizing change within time series.
- Two modes: BFAST and BFASTmonitor
  - BFAST iteratively estimates the time and number of abrupt changes within time series, and characterizes change by its magnitude and direction.
  - BFASTmonitor provides functionalities for monitoring disturbances in time series models at the end of time series (i.e., in near real-time).
BFAST: Breaks For Additive Season and Trend

BFASTmonitor

![Graph showing time series data with trend and seasonality](image)
BFAST: Breaks For Additive Season and Trend

Background

• Developed by Jan Verbesselt, Achim Zeileis, Rob Hyndman

• Integrates the decomposition of time series into trend, season, and remainder components with methods for detecting and characterizing change within time series.

• Two modes: BFAST and BFASTmonitor
  
  ▪ BFAST iteratively estimates the time and number of abrupt changes within time series, and characterizes change by its magnitude and direction.
  
  ▪ BFASTmonitor provides functionality for monitoring disturbances in time series models at the end of time series (i.e., in near real-time).

• Package available on CRAN repositories: http://cran.r-project.org/web/packages/bfast/index.html
References

BFAST Spatial

Background

• Developed by Loic Dutrieux, Ben Devries, Jan Verbesselt, at Wageningen U.

• Includes a set of utilities and wrappers to perform change detection on satellite image time-series (Landsat and MODIS).

• Includes pre-processing steps and functions for spatial implementation of BFASTmonitor change detection (pre-processing raw surface reflectance Landsat data, inventorying and preparing data for analysis, production and formatting of results).

• Package available on GitHub repository: https://github.com/dutri001/bfastSpatial
BFAST Spatial

Utilities

- Number of valid observations (cloud cover)

- Summary statistics of the dataset (NDVI, other spectral index)
BFAST Spatial

Utilities

- Magnitude of change

- Area of change
BFAST Spatial: study case (Kafa, Ethiopia)

Above: all breakpoints detected in 2011 using:
(A) a 3-year monitoring period window
(B) a 2-year monitoring period window
(C) a 1-year monitoring period window

An iterative 1-year monitoring window was used to allow for interpretation of breakpoints using a consistently defined magnitude metric.
BFAST Spatial: in-Migration (Kafa, Ethiopia)

Image background: SPOT5 (Feb 2011, 2.5m)
BFAST Spatial: Clear-Cutting (Madre de Dios, Peru)

RapidEye: May 5 / 2011

RapidEye: May 2 / 2012

BFM: 2012-2013

Monitoring period: 2000 - 2001

m = 0.037
References

- Ethiopia case:


- Peru case:
Discussion

• BFAST(Spatial) is a significant step toward operational semi-automated land cover-change detection methods
• However still at the R&D stage
• Spatial version will be made available on the CRAN repositories in the coming months
• Depending on area of interest, proper time-series not easy to obtain (archive size, cloud cover)
• Advent of Sentinel data will be beneficial to time-series change detection algorithms (S-1A launched, S-2A scheduled for April 2015)
• Computer intensive when applied over large areas
GOFC-GOLD LC-IT activities in Europe

• REDD+ activities
GOFC-GOLD REDD+ activities

- presents RS methods to produce estimates of changes in forest area and carbon stocks, compliant with IPCC GPG
- updated every year

- in partnership with the World Bank
- REDD+ curriculum
- 14 modules (lectures, exercises, country cases)
- to be released during fall 2014
THANK YOU

brice.mora@wur.nl

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