Remote Sensing products and global datasets

Joint Research Centre, European Commission
• Setting the stage ....
Needs and requirements for integrated approach(es) for land degradation assessment .... in

*Special Issue in LD&D : April 2011*
1st UNCCD CST Special Scientific Conference
Buenos Aires, Sep. 2009
Decision maker needs:
to design policies & where and how to allocate resources, based on priorities

- Clear **definition** of what (impact) to monitor ….
  
  ✓ *E.g. persistent reduction or loss of biological/biomass productivity*

- Clear, ‘simple’ and timely information, economically justified
  
  ✓ *Requires integration of environmental and socio-economic aspects*
• Stratified Integration of data ....
Stratified Integration of global remote sensing datasets with land degradation causal factor and contextual local data
Analysis of **converging evidence of change** to indicate areas which are in **problems** by showing a decreased capacity to continue to produce ecosystem services ...
• Remote Sensing data ....
Global variables / Indicators – satellite earth observation

- NOAA-AVHRR: 8km
- SPOT + PROBA-V: 1km
- MODIS: 250m
- LANDSAT: 30m

Timespan of the satellite data series:
- 1982
- 1999
- 2002

Yearly NDVI-sum linear slope:
- -81.9 - 422.9
- -422.8 - 261
- -260.9 - 131.5
- -131.4 - 66.7
- -66.6 - 1.9
- 10.5 - 62.8
- 62.9 - 160
- 160 - 257.1
- 257.2 - 386.7
- 386.8 - 678.1

NPP proxy
Sum NDVI
Gimms3G
Slope over 1982-2010
• Using remote sensing time-series ....
Phenology and Productive Variables (yearly)

From vegetation index timeseries (NDVI, FAPAR)

- **Seasonal Sum NDVI**
- **Annual Sum NDVI**
  - Annual Cyclic Production
  - Permanent Veg. Fraction
  - Start of Season
  - Season length
  - Max of Season
  - ........

- NOAA GIMMS 3G NDVI
  1982-2010 (29 years)

- SPOT VGT NDVI
  1998-2013 (15 years)
Decomposing the yearly NDVI/FAPAR curve into a number of yearly phenological and productivity variables showing land system dynamics

Method based on


and adapted/changed for global automated application in Ivits et al., 2012.
Phenology and Productive Variables (yearly)

SPOT VGT NDVI
Climatic zones over Europe
Phenology and Productive Variables (yearly)

From vegetation index timeseries (NDVI, FAPAR)

- Seasonal Sum NDVI
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NOAA GIMMS 3G NDVI
1982-2010 (29 years)

SPOT VGT NDVI
1998-2013 (15 years)

15 years SPOT 1km based

Long term CHANGE Map
Steadiness Index
+ initial levels
+ class change

Ecosystem Functional Types Stratification

5 years SPOT 1km 2008-2013

Current STATUS Map: Local Scaling

Land System Productive Capacity Dynamics Map
Based on annual/seasonal growing period NDVI sum
- **long term tendency** (1999-2013)
- **current performance** (2008-2013)
540 observations on +/- 150 Million points on land (1km SPOT data)
Based on annual/seasonal growing period NDVI sum - long term tendency (1999-2013) - current performance (2008-2013)

540 observations on +- 150 Million points on land (1km SPOT data)

References


Stratified use and interpretation
Areas with land cover change between 2000 and 2010. Area extents are exaggerated in order to be visible at presented scale.

**Based on ESA Land Cover CCI (ESA-3epochs)**
Climate effect on biomass productivity changes:

Correlation between FaPAR and SPEI (1982-2010)

AVHRR GIMMS3g time-series (1982-2011)
Ivits et al. / Remote Sensing (2014)
• COPERNICUS EO User Products ....
**Sentinel 1 – SAR imaging**
All weather, day/night applications, interferometry  

**Sentinel 2 – Multispectral imaging**
Land applications: urban, forest, agriculture,..  
Continuity of LANDSAT, SPOT, ...  

**Sentinel 3 – Ocean and global land monitoring:**
ocean color, vegetation, sea/land surface temperature, altimetry  

**Sentinel 4 – Geostationary atmospheric**
Atmospheric composition monitoring, trans-boundary pollution  

**Sentinel 5 – Low-orbit atmospheric**
Atmospheric composition monitoring  
(S5 Precursor launch in 2014)
COPERNICUS Core Services

Services monitoring Earth systems

Land

Marine

Atmosphere

Emergency

Security

Climate Change
Value added of an Operational Core Services

- Long term and reliable provision of products and services for downstream applications
- Delivery of fully validated products and services

COPERNICUS: a public good.
- free and open access
  (Security restrictions may apply)
Biophysical Variables

Products

> Vegetation
Leaf Area Index
Fraction of PAR
Fraction of COVER
Vegetation Index
Vegetation Productivity
Vegetation Condition
Dry Matter Productivity
Burned Area

> Water
Water Bodies
Soil Water Index

> Energy
Surface Reflectance
Surface Albedo
Surface Temperature
<table>
<thead>
<tr>
<th>Variable</th>
<th>Temporal Coverage</th>
<th>Temporal resolution</th>
<th>Spatial coverage</th>
<th>Spatial resolution</th>
<th>Sensor</th>
<th>Timeliness</th>
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<td>1999 – present</td>
<td>10 days</td>
<td>Global</td>
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Global Surface Water layer: 30 years change

Nanchang Lake 1984-1994
Landsat archive, processing: Google Earth Engine

JRC-Google, 2015
Nanchang Lake 1995-2004
Landsat archive, processing: Google Earth Engine

JRC-Google, 2015
Global Surface Water layer: 30 years change

Nanchang Lake 2015-2014
Landsat archive, processing: Google Earth Engine

JRC-Google, 2015
Cost effectiveness and capacity ...
MESA PROJECT
To conclude ....
Use of remote sensing EO data:

**Advantages:**
- Global, continuous and frequent coverage
- Adapted resolutions
- Many bio-physical variables, proven quality available
- CHANGE DETECTION
- sets of bio-physical indicators

**Limitations:**
- one data ‘group’ doesn’t tell full story – integrate societal data

**Need:**
- Ensemble approaches
- Solid integration schemes
Thank you!

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