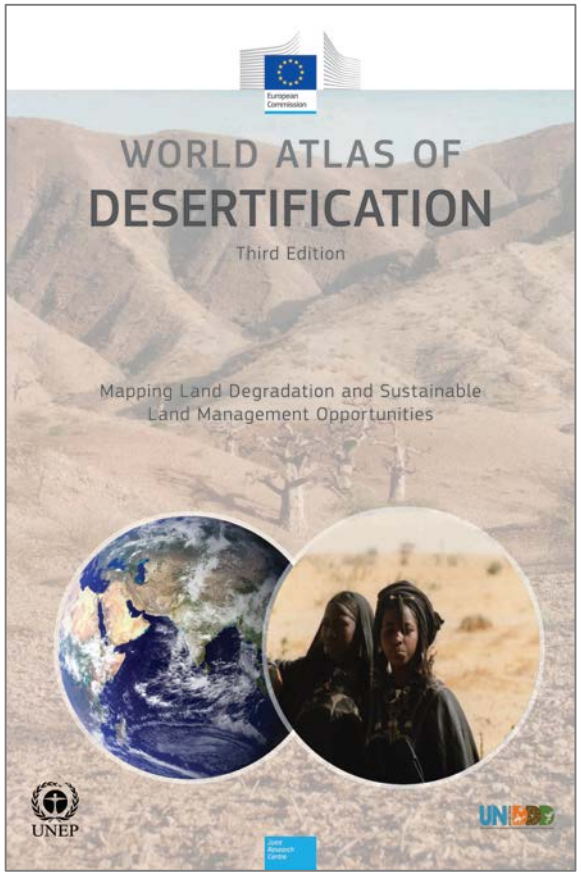
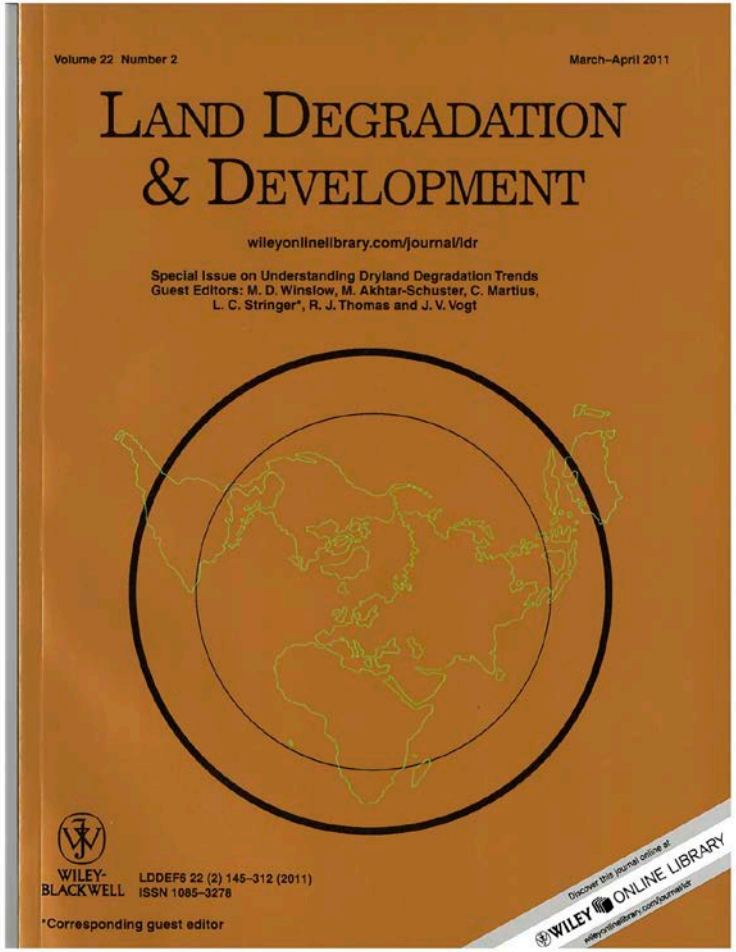


Remote Sensing products and global datasets

Joint Research Centre, European Commission

- Setting the stage ….

Needs and requirements for integrated approach(es) for land degradation assessment …. in



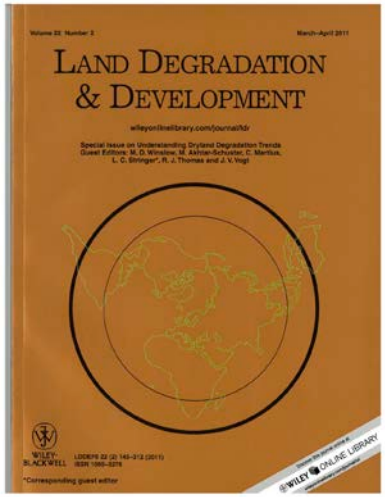
Special Issue in LD&D : April 2011
1st UNCCD CST Special Scientific Conference
Buenos Aires, Sep. 2009

Joint Research Centre

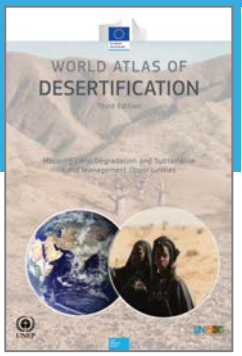
Decision maker needs:

to design policies & where and how to allocate resources, based on priorities

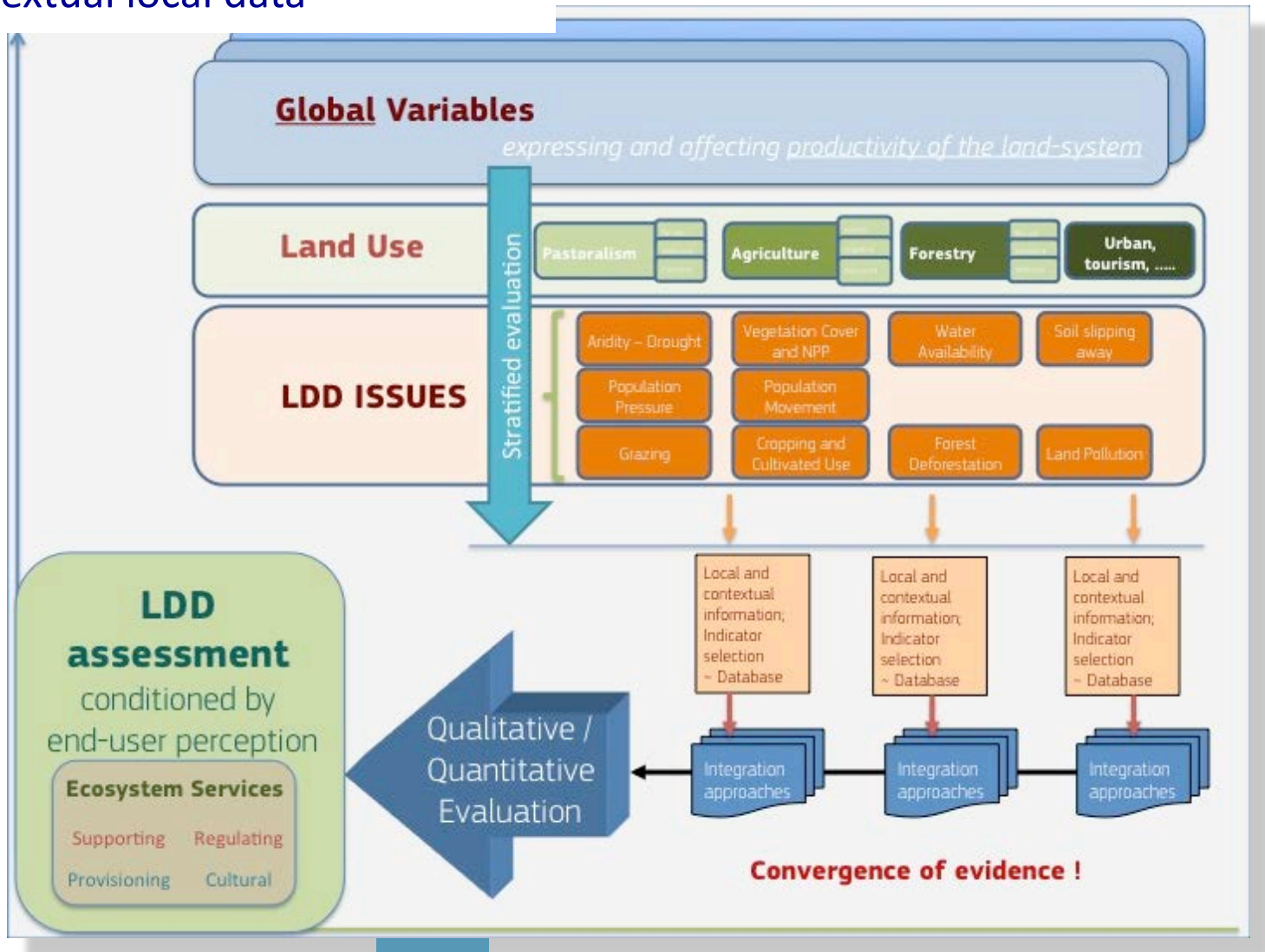
- Clear **definition** of what (impact) to monitor ….
  - ✓ *E.g. persistent reduction or loss of biological/biomass productivity*
- Clear, 'simple' and timely information, economically justified
  - ✓ *Requires **integration** of environmental and socio-economic aspects*

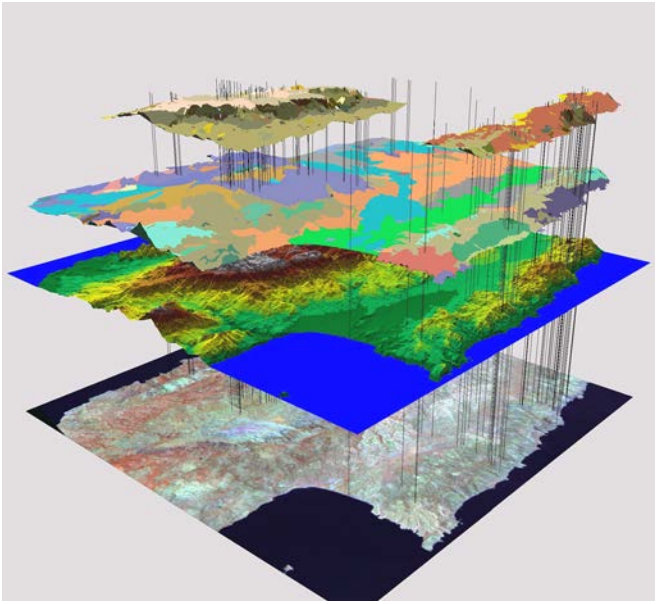


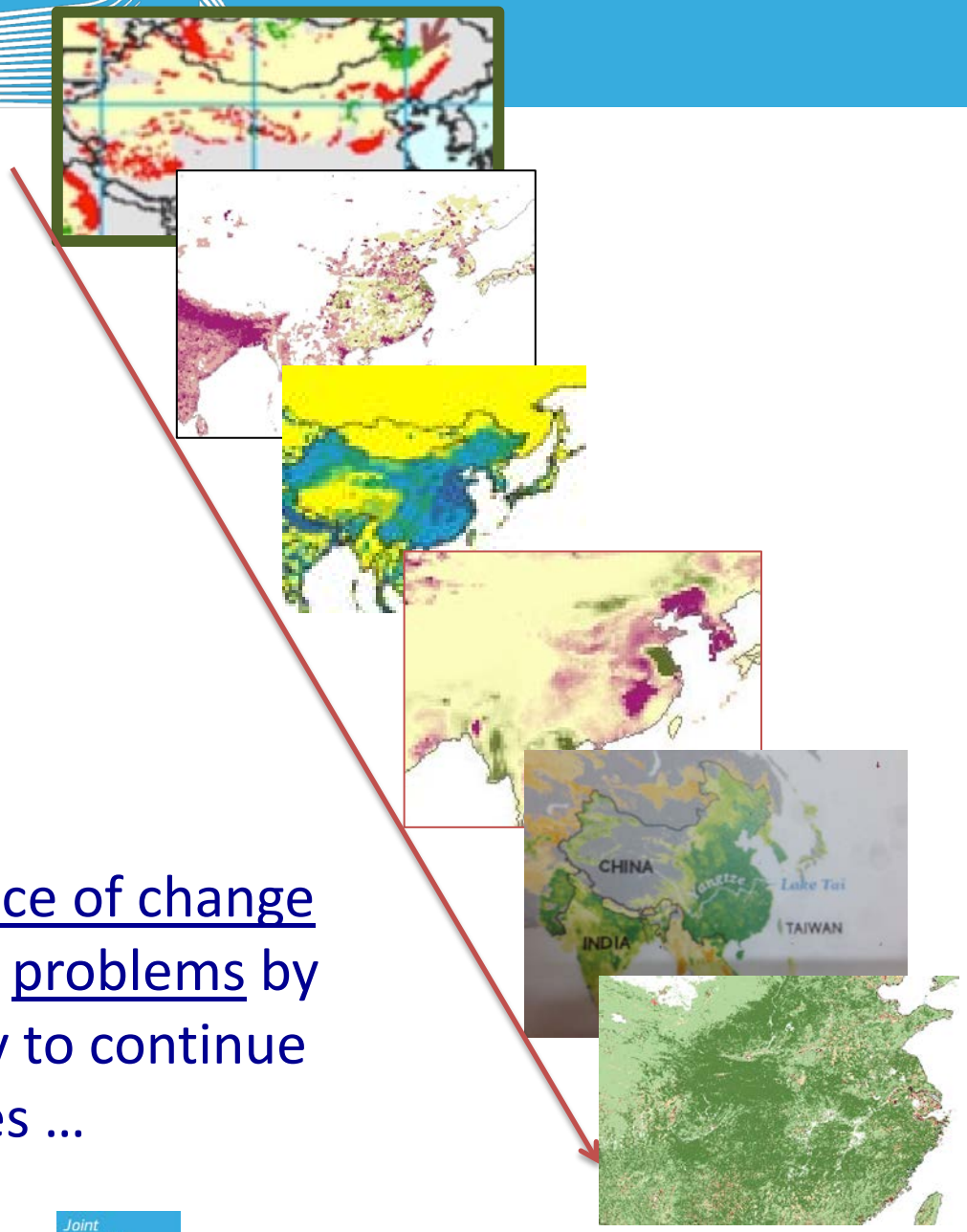
- Stratified Integration of data ….



Stratified Integration of global remote sensing datasets with land degradation causal factor and contextual local data







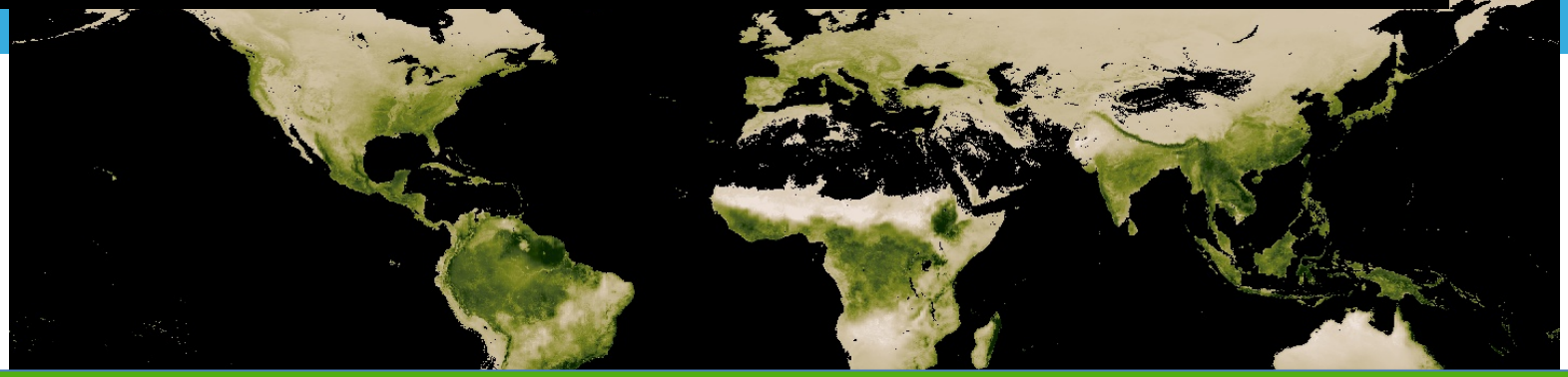
Analysis of converging evidence of change to indicate areas which are in problems by showing a decreased capacity to continue to produce ecosystem services …

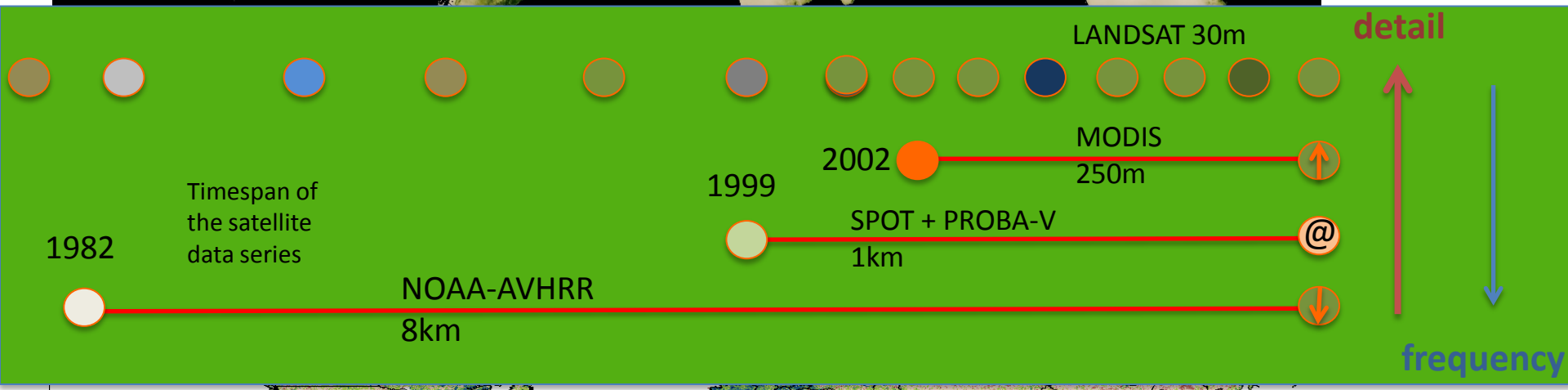
Joint Research Centre

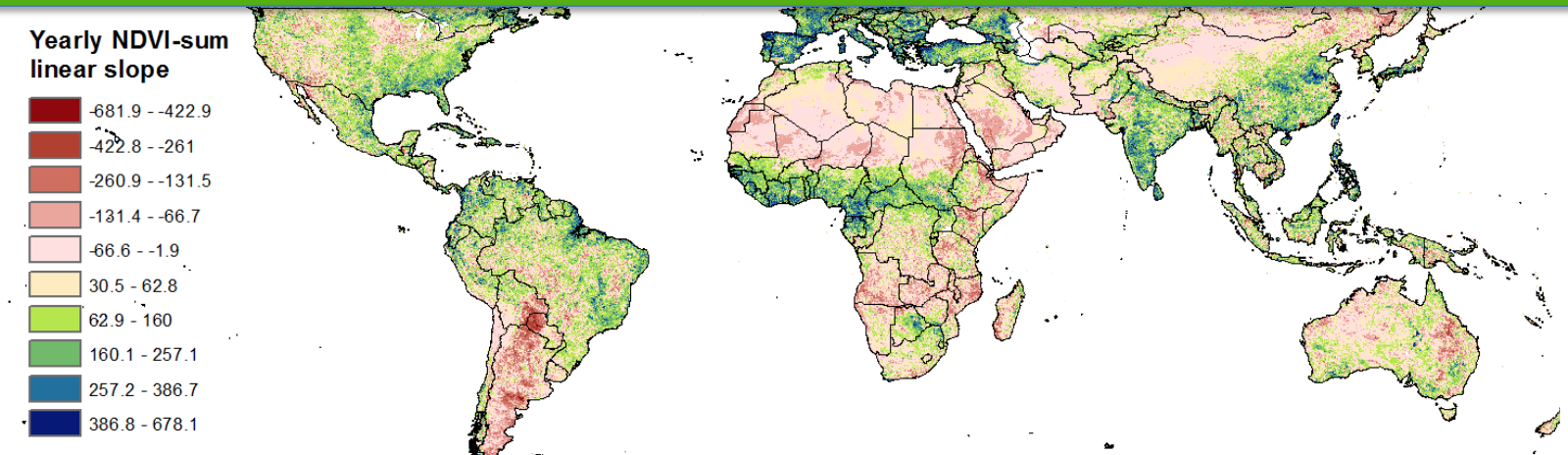
- Remote Sensing data ….

Global variables / Indicators – satellite earth observation

MODIS
(ex. Oct13)



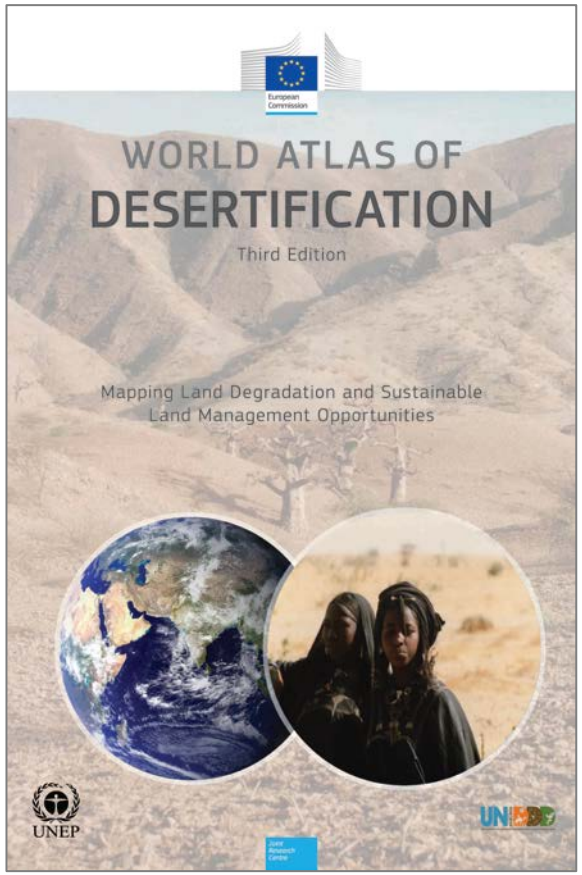




NPP proxy
Sum NDVI
Gimms3G

Slope over
1982-2010

- Using remote sensing time-series ….



Phenology and Productive Variables (yearly)

From vegetation index timeseries (NDVI, FAPAR)

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

SPOT VGT NDVI
1998-2013 (15 years)

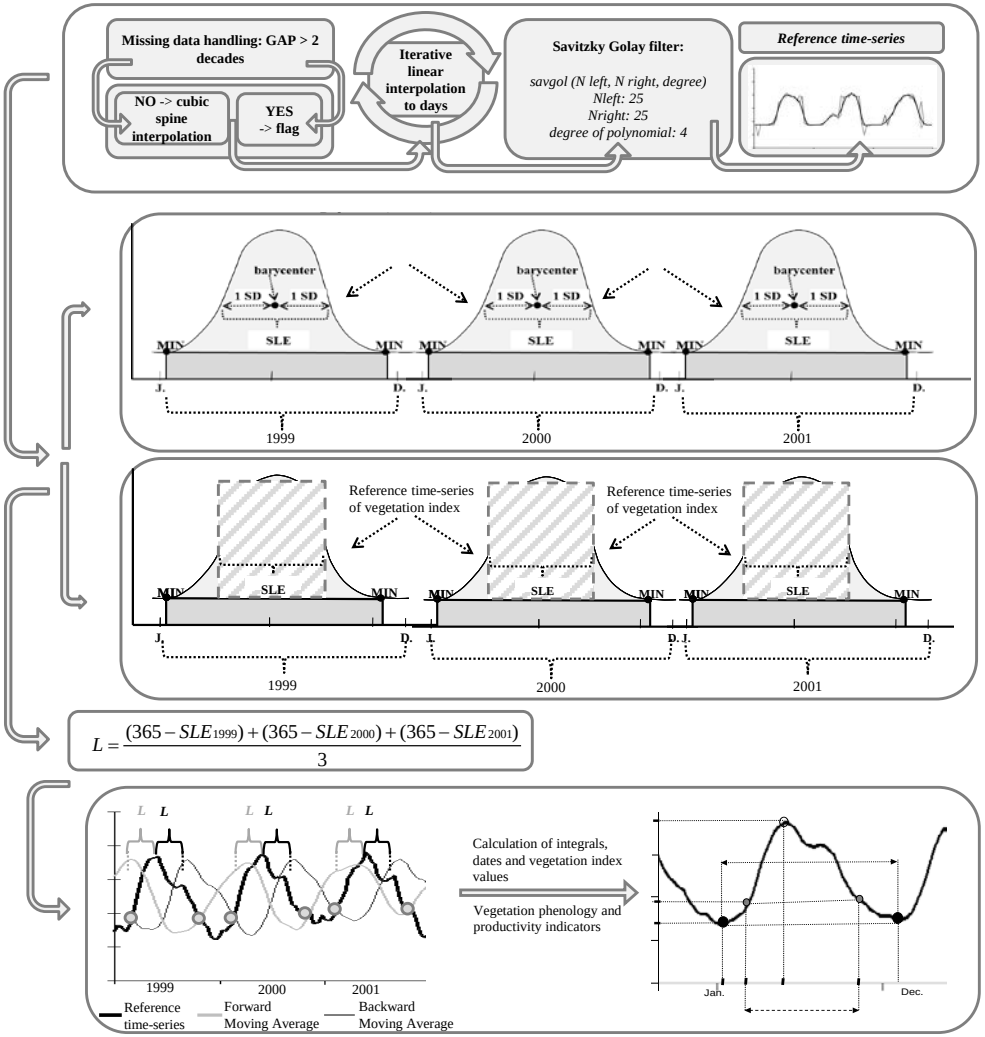
* **Seasonal Sum NDVI**
* **Annual Sum NDVI**

Annual Cyclic Production
Permanent Veg. Fraction
Start of Season
Season length
Max of Season
…….

Phenology and Productive Variables (yearly)
PHENOLO

European Commission

Decomposing the yearly NDVI/FAPAR curve into a number of yearly phenological and productivity variables showing land system dynamics



Method based on

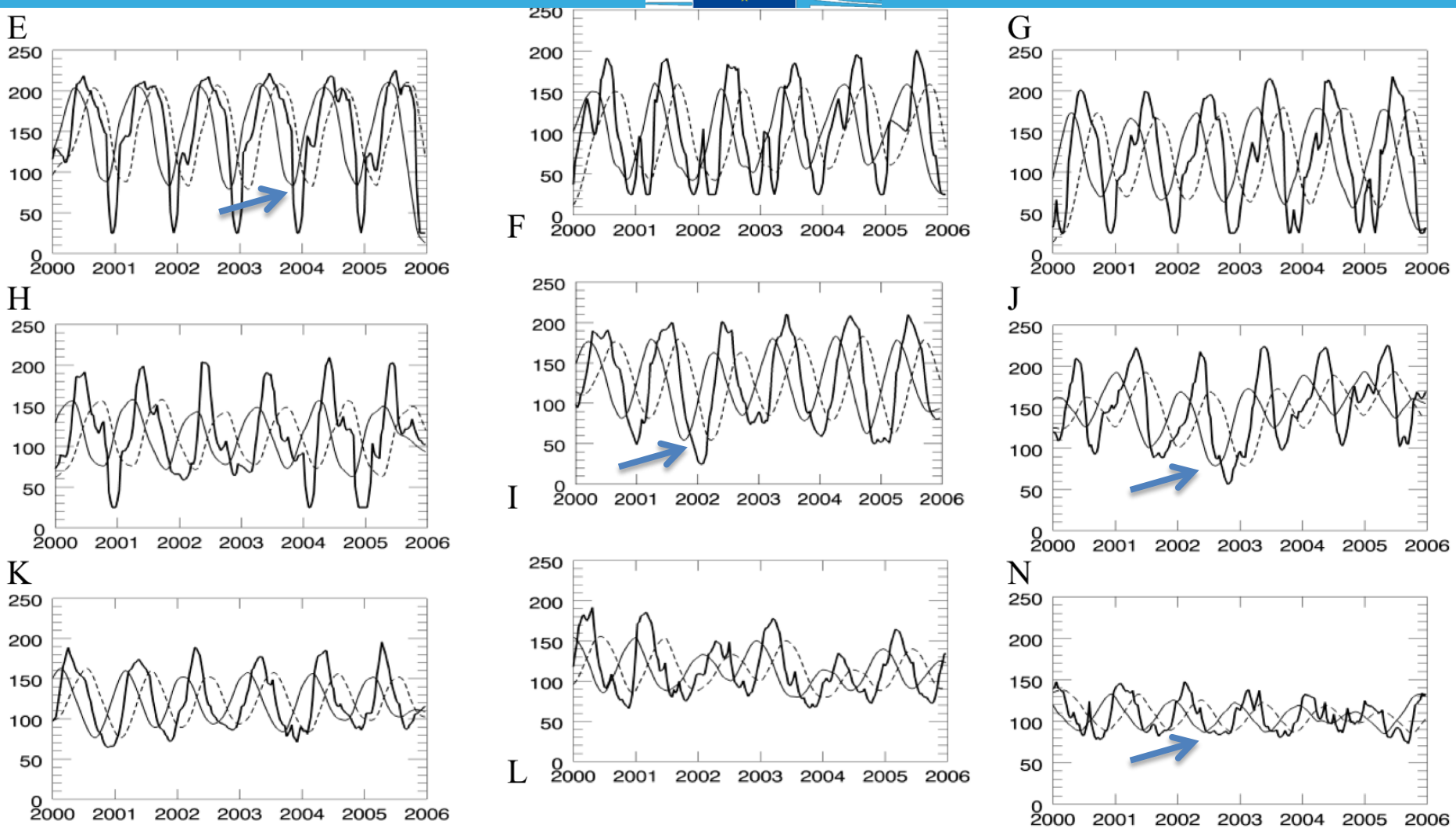
Reed, B., Brown, J.F., Vanderzee, D., Loveland, T.R., Merchant, J.W., Ohlen, D.O., 1994. Measuring phenological variability from satellite imagery. Journal of Vegetation Science 5: 703-714.

and adapted/changed for global automated application *in Ivits et al., 2012*

Joint Research Centre

Phenology and Productive Variables (yearly)

PHENOLO



SPOT VGT NDVI

Climatic zones over Europe

Phenology and Productive Variables (yearly)

From vegetation index timeseries (NDVI, FAPAR)

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

SPOT VGT NDVI
1998-2013 (15 years)

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

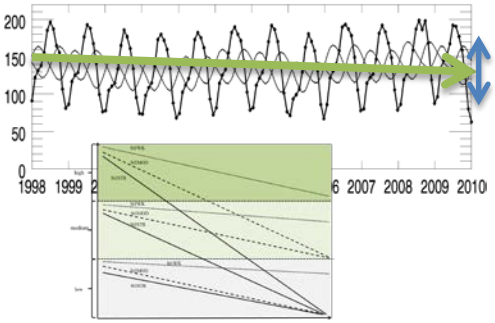
Ecosystem Functional Types Stratification

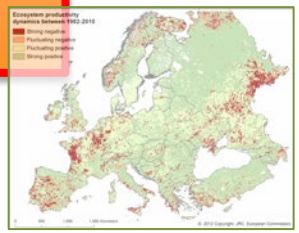
15 years SPOT 1km based

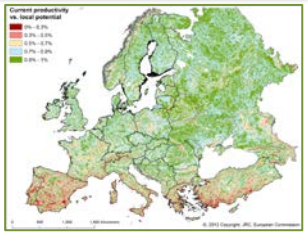
5 years SPOT 1km 2008-2013

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

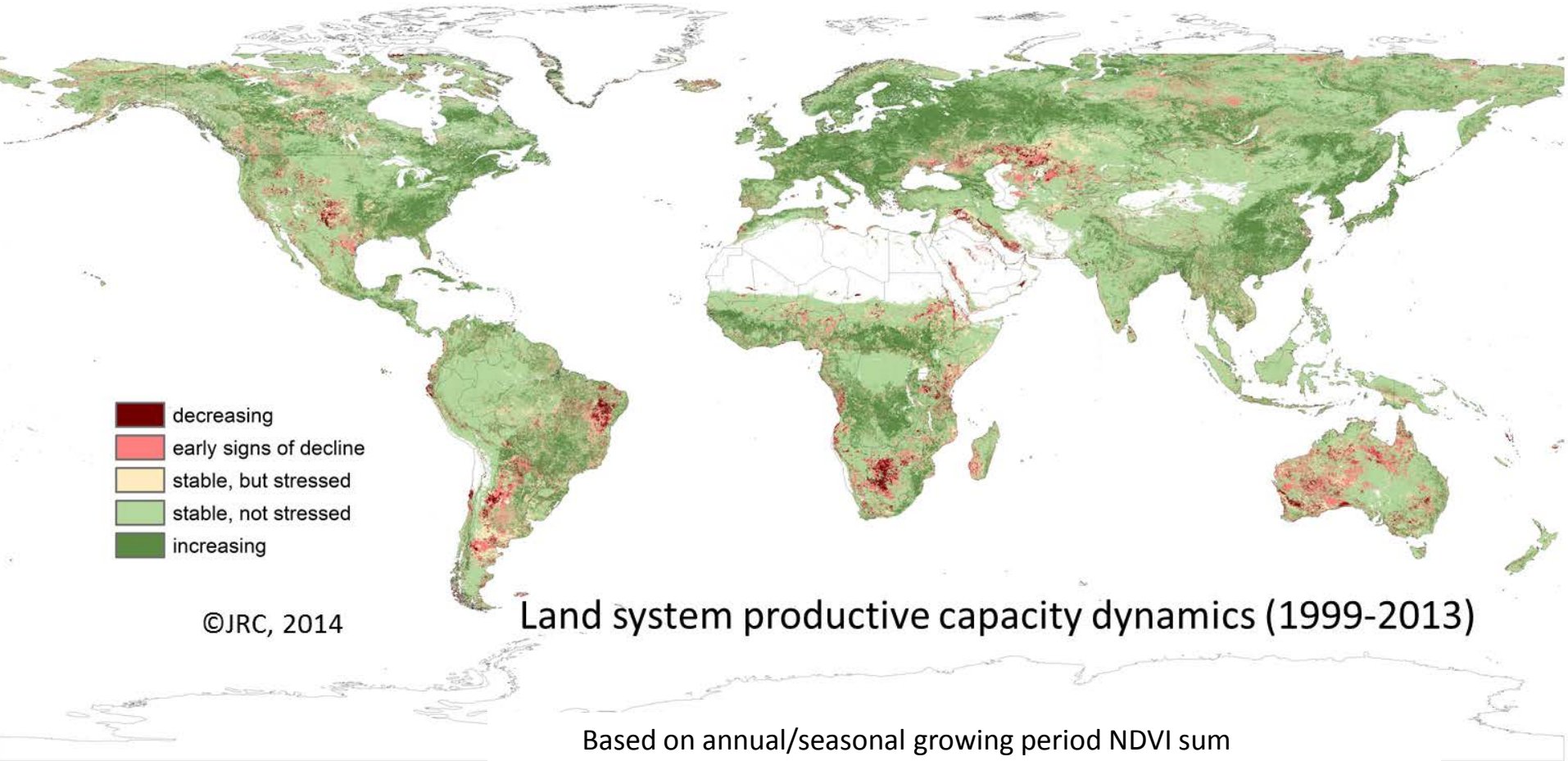
Current STATUS Map:
Local Scaling







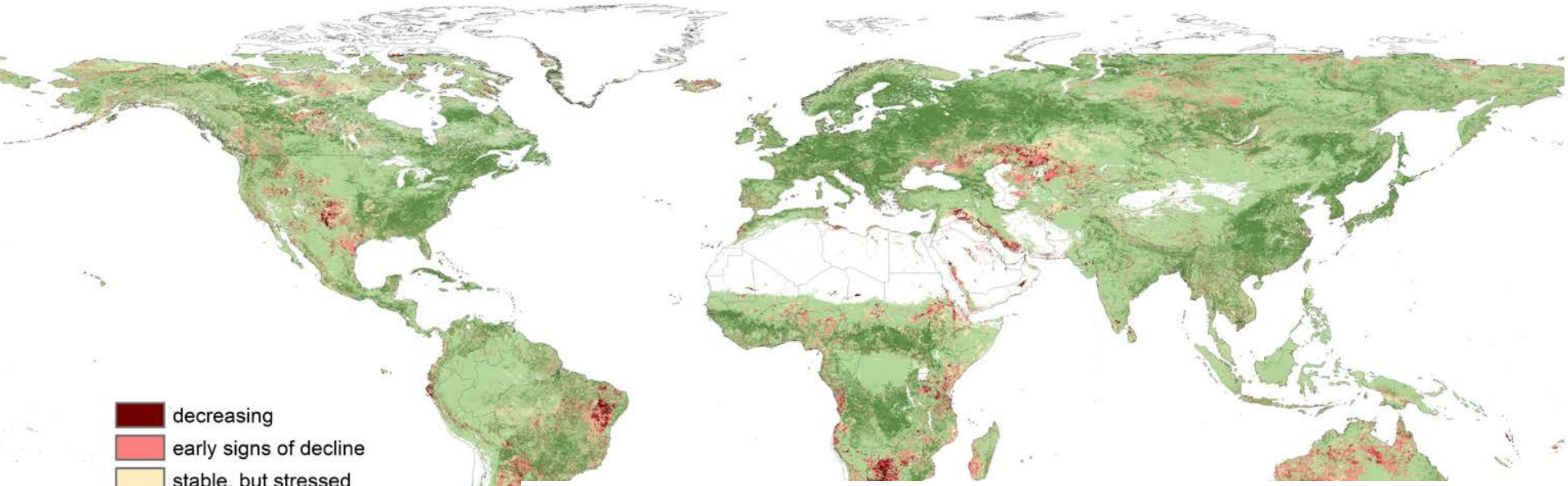
Land System Productive Capacity Dynamics Map



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)



References

Cherlet M., Ivits E., Sommer S., Tóth G., Jones A., Montanarella L., Belward A., **2013.** Land-Productivity Dynamics in Europe. Towards Valuation of Land Degradation in the EU. http://wad.jrc.ec.europa.eu/data/EPreports/LPDinEU_final_no-numbers.pdf (accessed 17.12.2014)

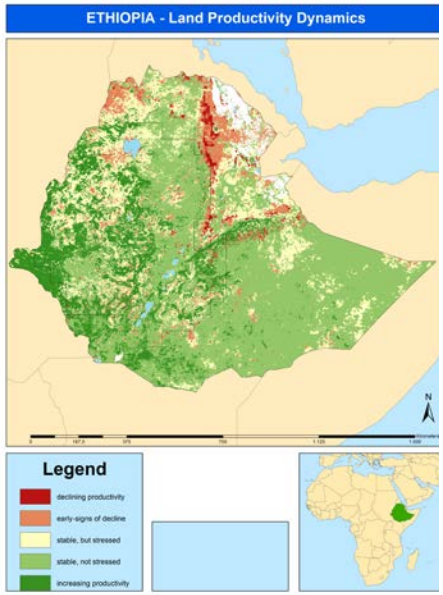
Ivits, E., Cherlet, M., Sommer, S., Mehl, W. **2012**a. Ecosystem Functional Units characterized by satellite observed phenology and productivity gradients: a case study for Europe**. Ecological Indicators** 27, 17–28.

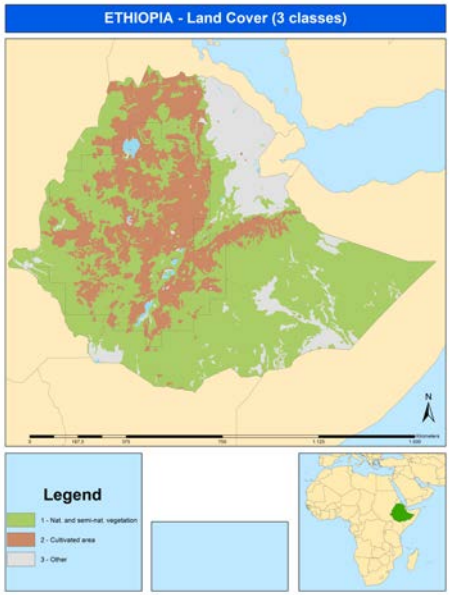
Ivits, E., Cherlet, M., Toth, G., Sommer, S., Mehl, W., Vogt, J., Micale, F., **2012**b. Combining satellite derived phenology with climate data for climate change impact assessment**. Global and Planetary Change** 88–89, 85–97.

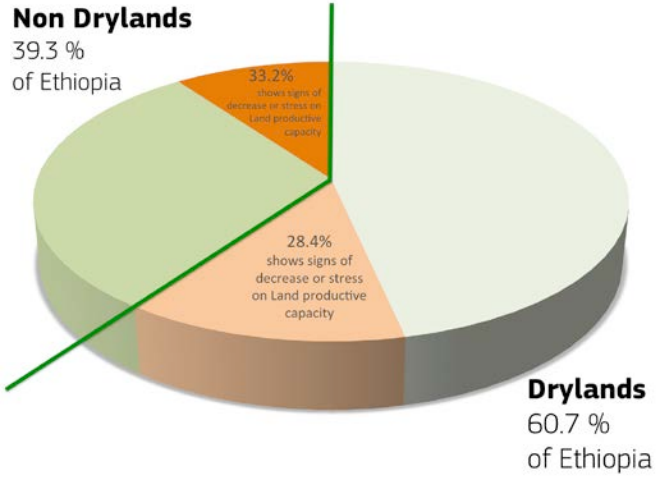
Prince, S.D., Becker-Reshef, I., Rishmawi, K., **2009**. Detection and mapping of long-term land degradation using local net production scaling: Application to Zimbabwe**. Remote Sensing of Environment** 113 (2009) 1046–1057.

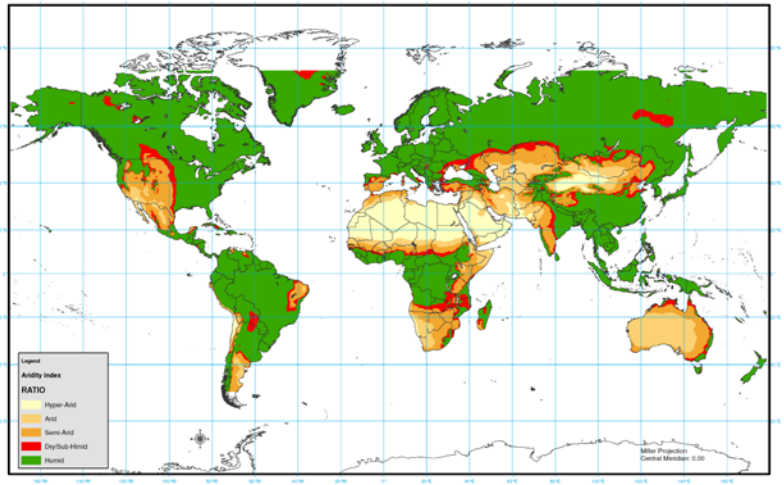
Sommer, S., C. Zucca, A. Grainger, M. Cherlet, R. Zougmore, Y. Sokona, J. Hill, R. Della Peruta, J. Roehrig, G. Wang**, 2011**: Application of indicator systems for monitoring and assessment of desertification from national to global scales**. Land Degrad. Develop**. 22: 184–197 (2011)**.**

Stratified use and interpretation

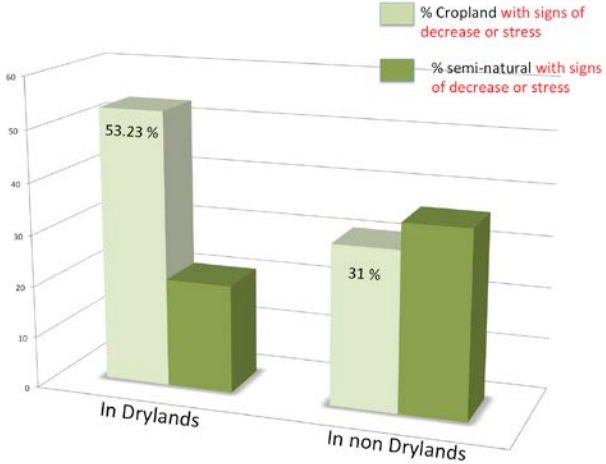




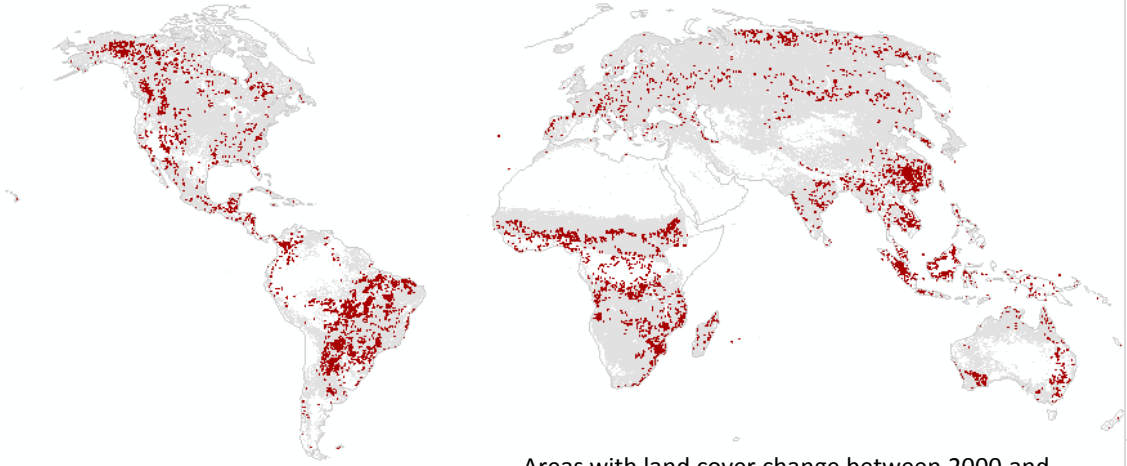




Rain/Eto ratio between 1989 to 2010

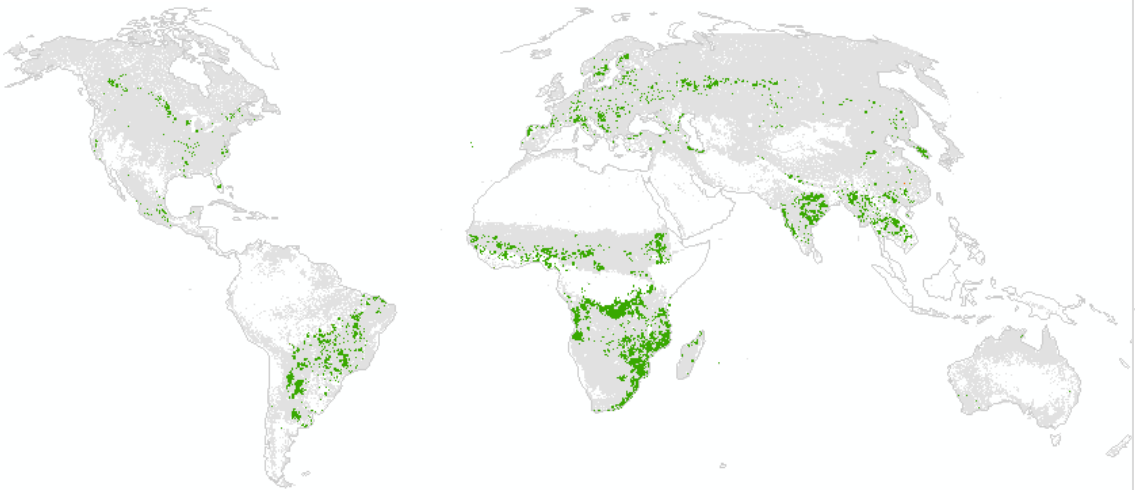


Joint Research Centre



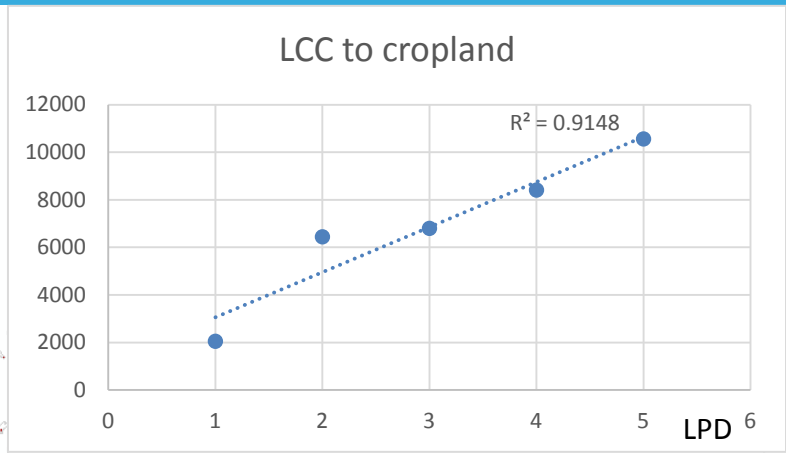
Land Cover Change

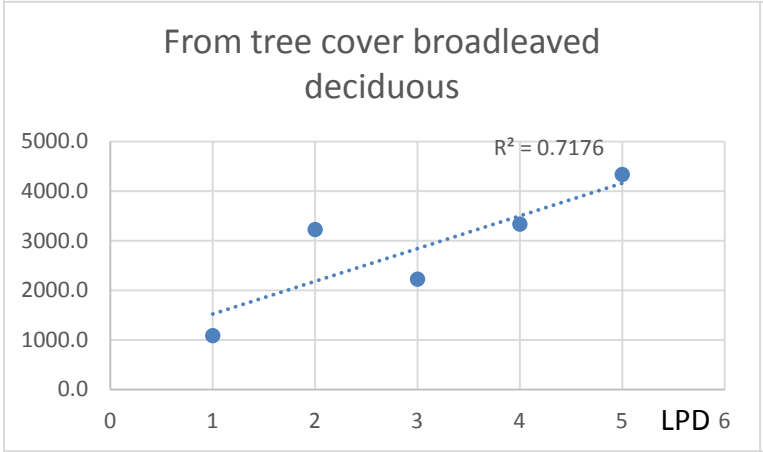
Areas with land cover change between 2000 and 2010. Area extents are exaggerated in order to be visible at presented scale.

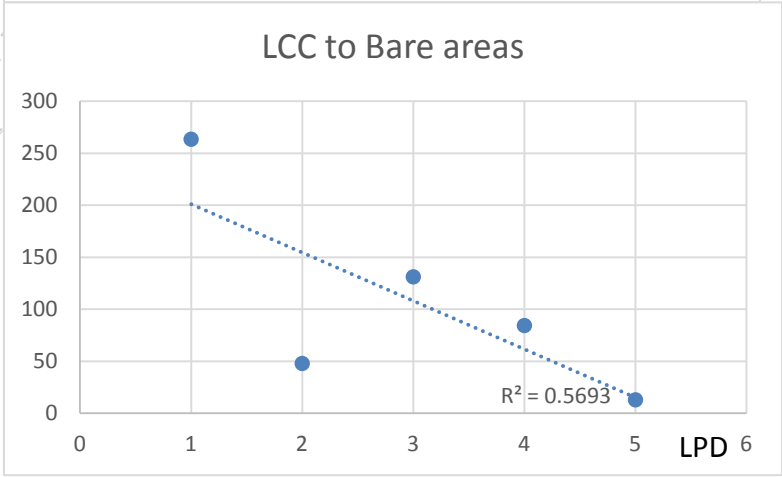


Land Cover Change to agriculture

Based on ESA Land Cover CCI (ESA-3epochas)

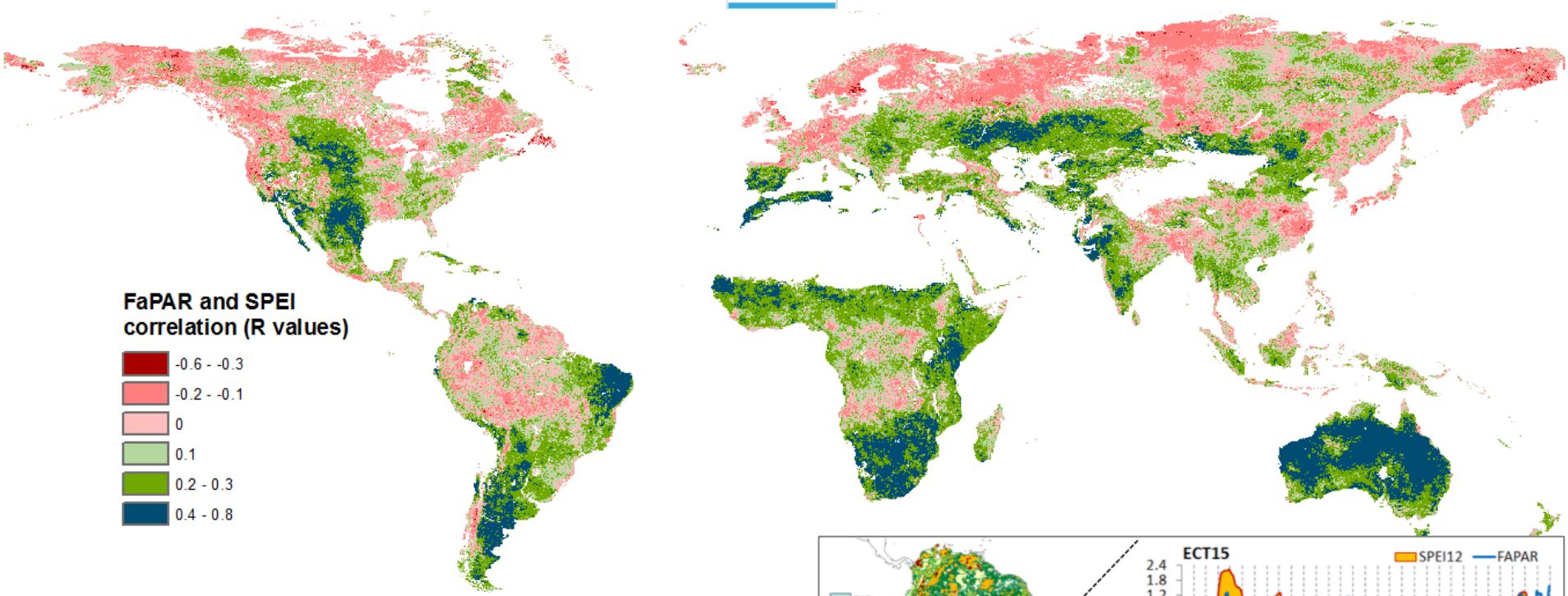






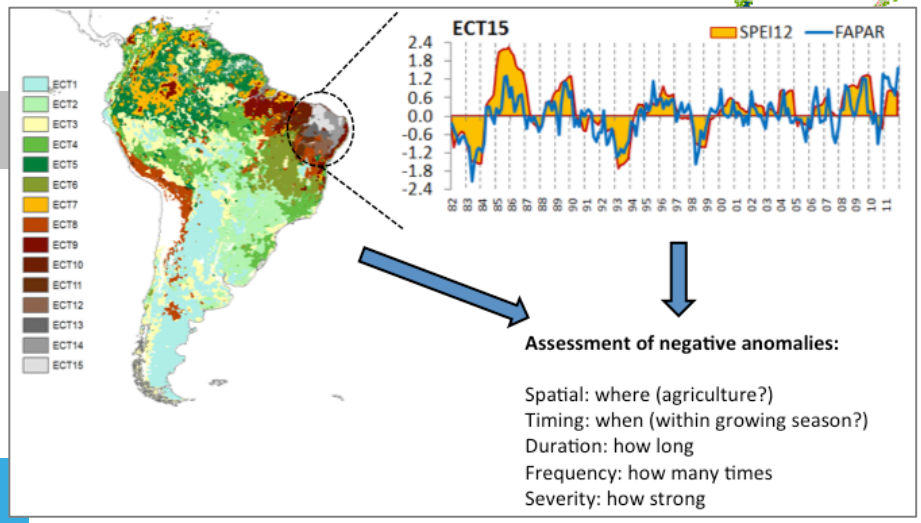
Joint Research Centre

European Commission



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)

Joint Research Centre

- COPERNICUS EO User Products ….

Sentinel 1 – SAR imaging
All weather, day/night applications, interferometry

2014

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

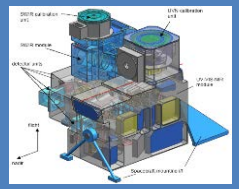
2015

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

2015

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

2017



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

2014, 2019+

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

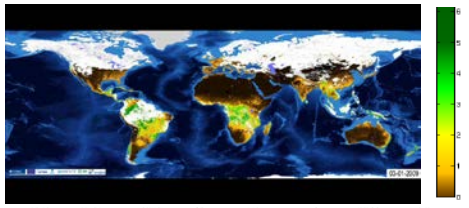
COPERNICUS: a public good.

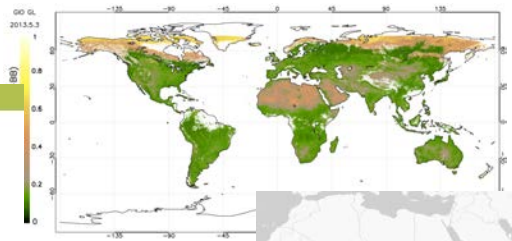
- **free and open access**

(Security restrictions may apply)

Land Service - Global

Biophysical Variables





European Commission

Land Service - Global

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

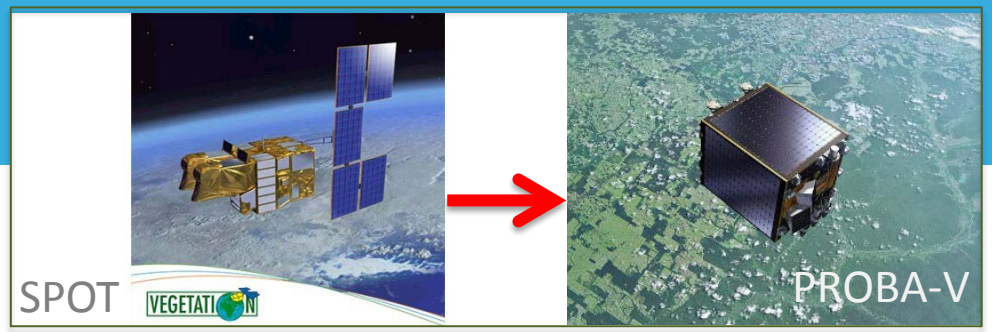
- Water Bodies
- Soil Water Index

> Energy

- Surface Reflectance
- Surface Albedo
- Surface Temperature

Joint Research Centre

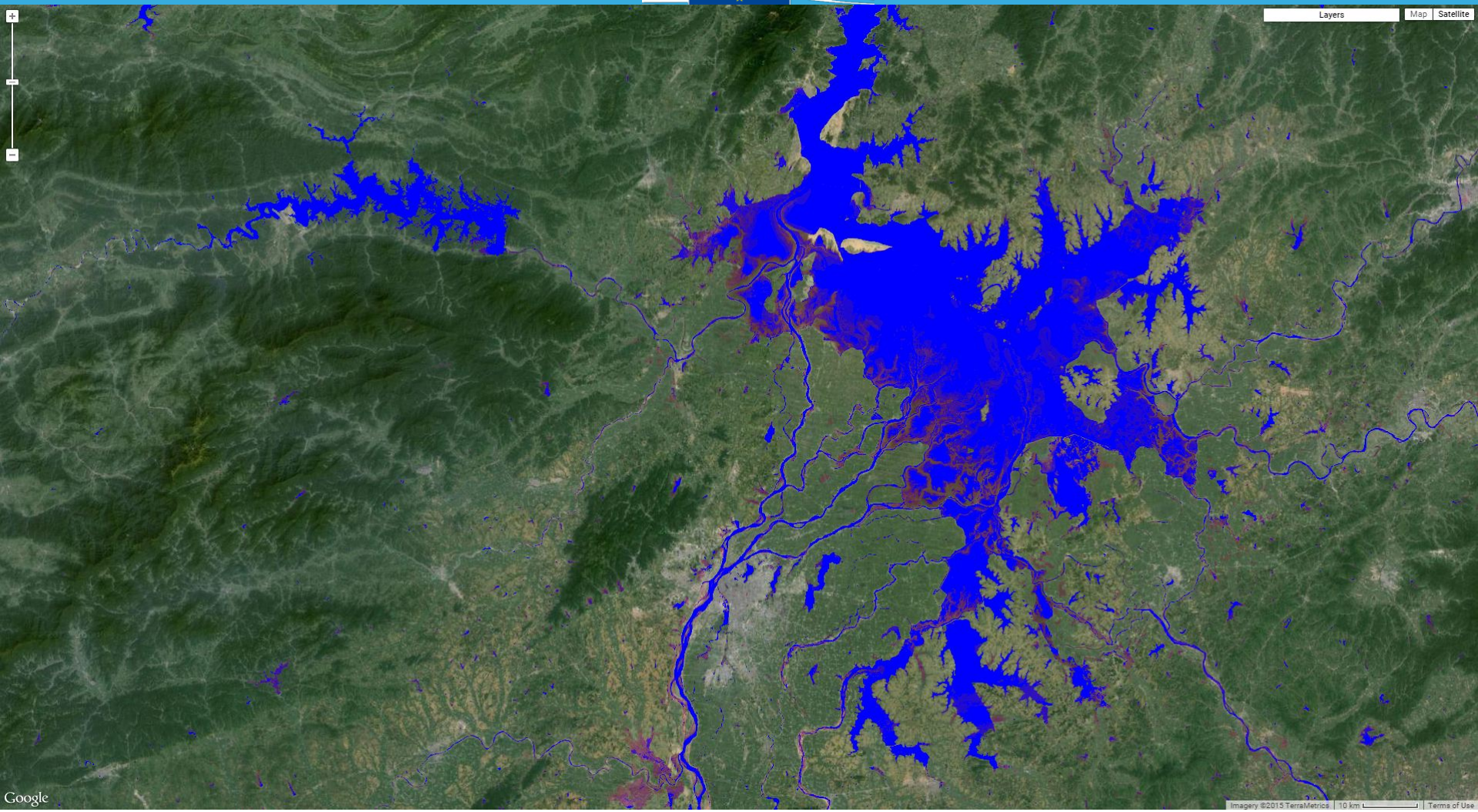
Global Land Service Portfolio



	Variable	Temporal Coverage	Temporal resolution	Spatial coverage	Spatial resolution	Sensor	Timeliness
*	LAI/FAPAR/FCover	1999 – present	10 days	Global	1km	SPOT/VGT	3 days
*	NDVI/VCI/VPI	1999 – present	10 days	Global	1km	SPOT/VGT	3 days
	Dry Matter Productivity	2009 – present	10 days	Global	1km	SPOT/VGT	3 days
*	Burnt Area	1998 – present	1 day	Global	1km	SPOT/VGT	3 days
	TOC Reflectance	2013 – present	10 days	Global	1km	SPOT/VGT	3 days
*	Surface Albedo	1999 – present	10 days	Global	1km	SPOT/VGT	3 days
	Land Surface Temperature	2009 – present	1 hour	Global	0.05°	ΣGeo	1 day
*	Soil Water Index	2007 – present	1 day	Global	0.1°	Metop / ASCAT	1 day
*	Water bodies	1999 – present	10 days	Global*	1km	SPOT/VGT	3 days

Product Family	Variable	Algorithm Version (2)	Near real time		Archive (3)	
			Sensor	Status (1)	Sensor	Temporal coverage
Vegetation	Fraction of photosynthetically active radiation absorbed by the vegetation	3	PROBA-V	In development		
		2	PROBA-V	In development		
		1	PROBA-V	Pre-operational	SPOT/VGT	1999 - 2014
	Fraction of green vegetation cover	3	PROBA-V	In development		
		2	PROBA-V	In development		
		1	PROBA-V	Pre-operational	SPOT/VGT	1999 - 2014
		0			SPOT/VGT	2009 - 2014
	Leaf Area index	3	PROBA-V	In development		
		2	PROBA-V	In development		
		1	PROBA-V	Pre-operational	SPOT/VGT	1999 - 2014
		0			SPOT/VGT	2009 - 2014
	Normalized Difference Vegetation Index	2	PROBA-V	Pre-operational	SPOT/VGT	2013 - 2014
		1			SPOT/VGT	1999 - 2014
		0			SPOT/VGT	1998 – 2014
	Vegetation Condition Index	1	PROBA-V	Demonstration	SPOT/VGT	2013 – 2014
	Vegetation Productivity Index	1	PROBA-V	Demonstration	SPOT/VGT	2013 – 2014
		0			SPOT/VGT	1998 – 2014
	Dry Matter Productivity	1	PROBA-V	Demonstration	SPOT/VGT	2009 - 2014
		0			SPOT/VGT	1998 - 2014
	Burnt Area	1	PROBA-V	In development	SPOT/VGT	1998 - 2014
		0			SPOT/VGT	2009 - 2014
Energy budget	Land Surface Temperature	1	Geostationary	Operational	Geostationary	2009 - 2014
	Top Of Canopy Reflectance	1	PROBA-V	In development	SPOT/VGT	2013 - 2014
	Surface Albedo	1	PROBA-V	In development	SPOT/VGT	1999 - 2014
		0			SPOT/VGT	2009 - 2014
Water	Soil Water Index	3	ASCAT A+B	In development		
		2	ASCAT	Operational	ASCAT	2007 - 2014
	Water Bodies	2	PROBA-V	In development		
		1	PROBA-V	In development	SPOT/VGT	1999 - 2014
		0			SPOT/VGT	1999 - 2014

Global Surface Water layer: 30 years change



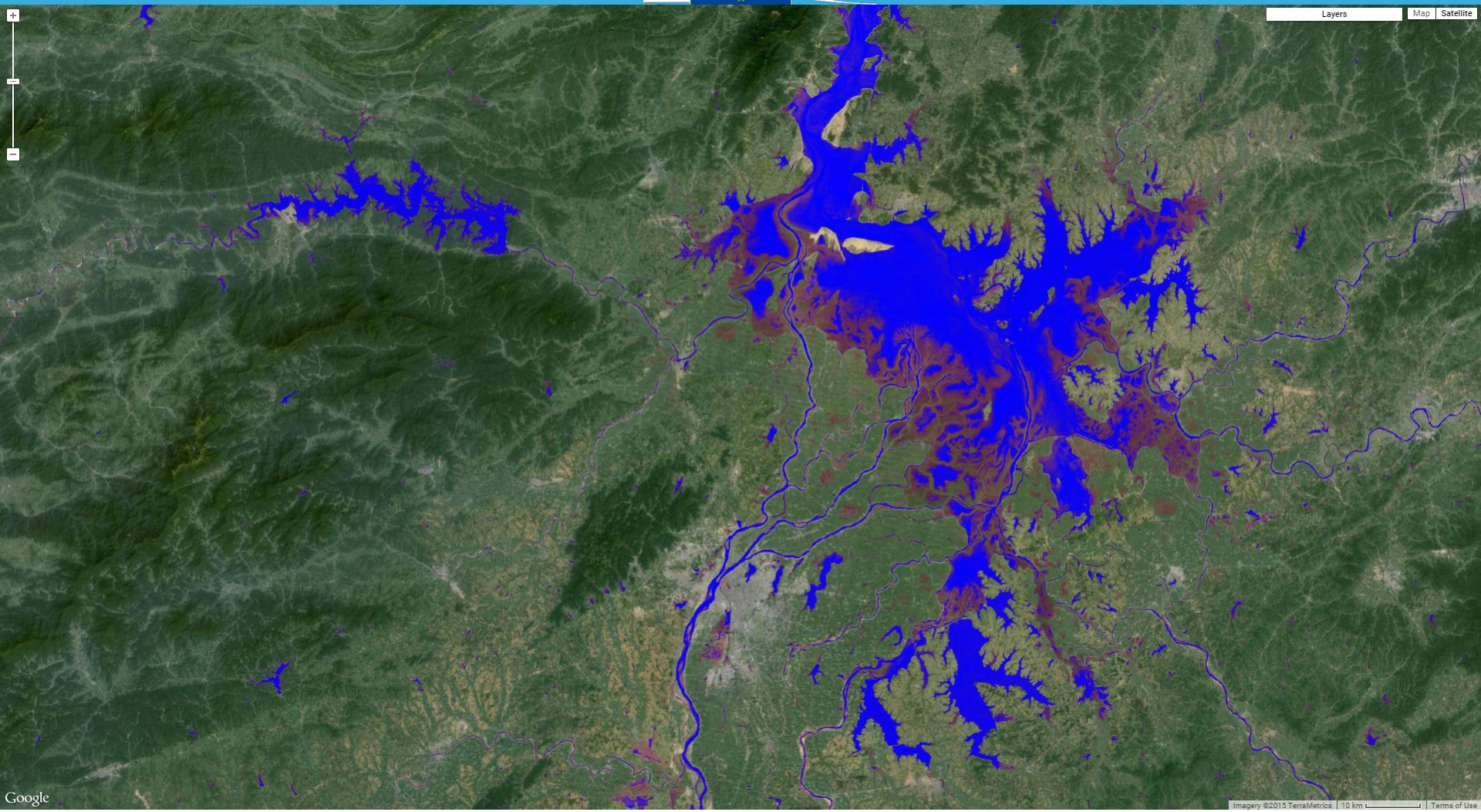
Nanchang Lake 1984-1994

Landsat archive, processing: **Google Earth Engine**

JRC-Google, 2015

Joint Research Centre

Global Surface Water layer: 30 years change



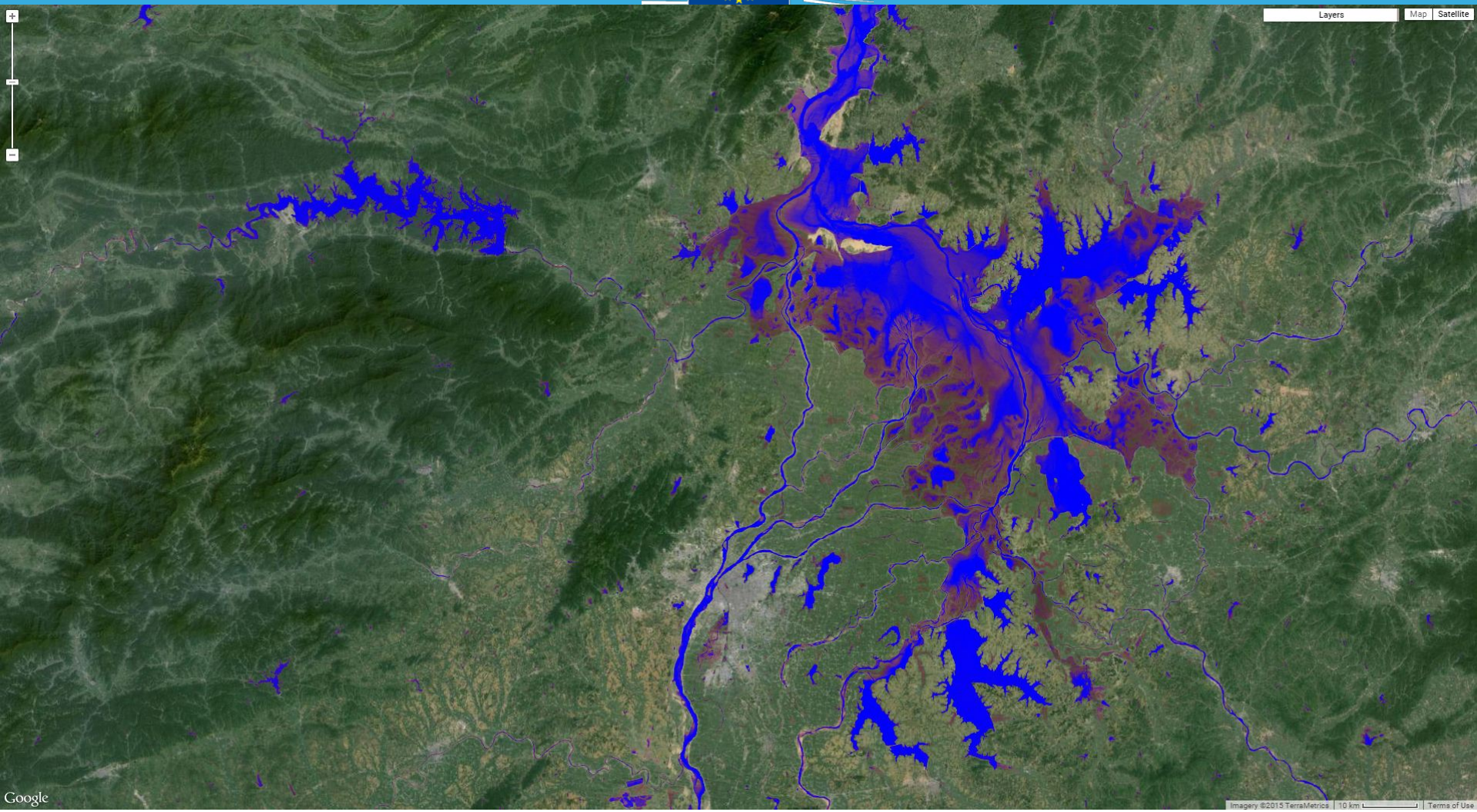
Nanchang Lake 1995-2004

Landsat archive, processing: Google Earth Engine

JRC-Google, 2015

Joint Research Centre

Global Surface Water layer: 30 years change



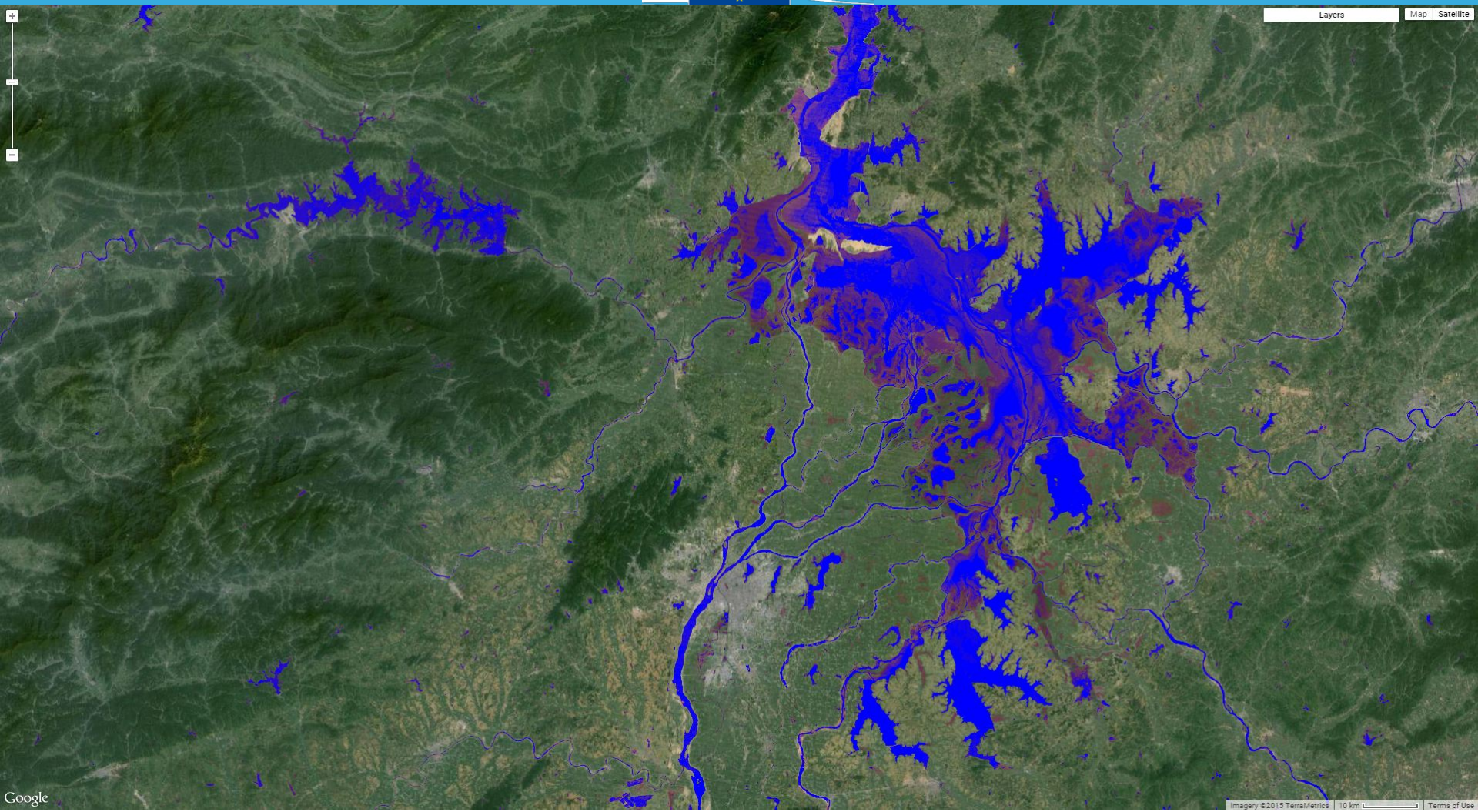
Nanchang Lake 2015-2014

Landsat archive, processing: Google Earth Engine

JRC-Google, 2015

Joint Research Centre

Global Surface Water layer: 30 years change



Nanchang Lake 2014

Landsat archive, processing: Google Earth Engine

JRC-Google, 2015

Joint Research Centre

European Commission

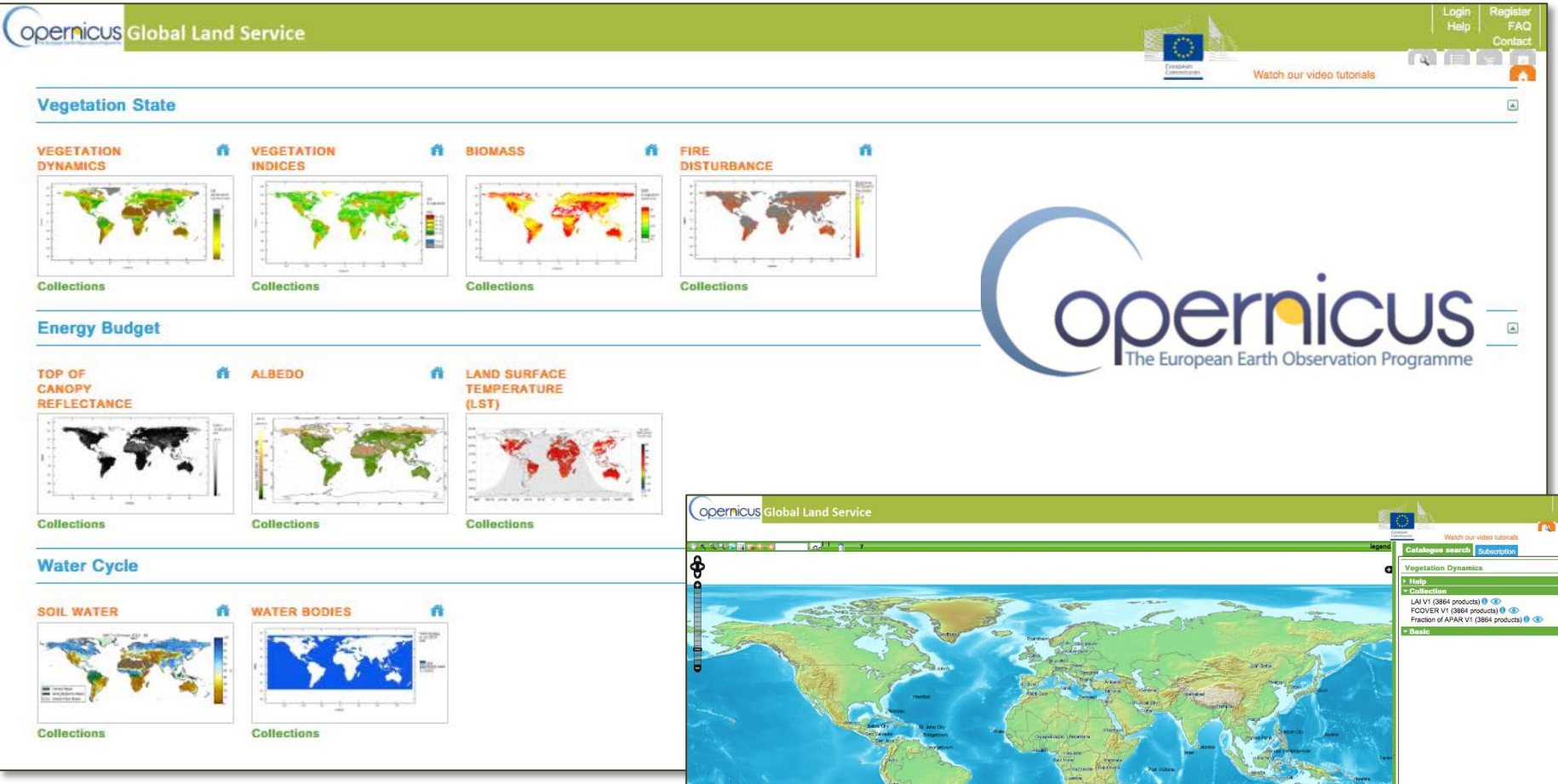
- Cost effectiveness and capacity ….

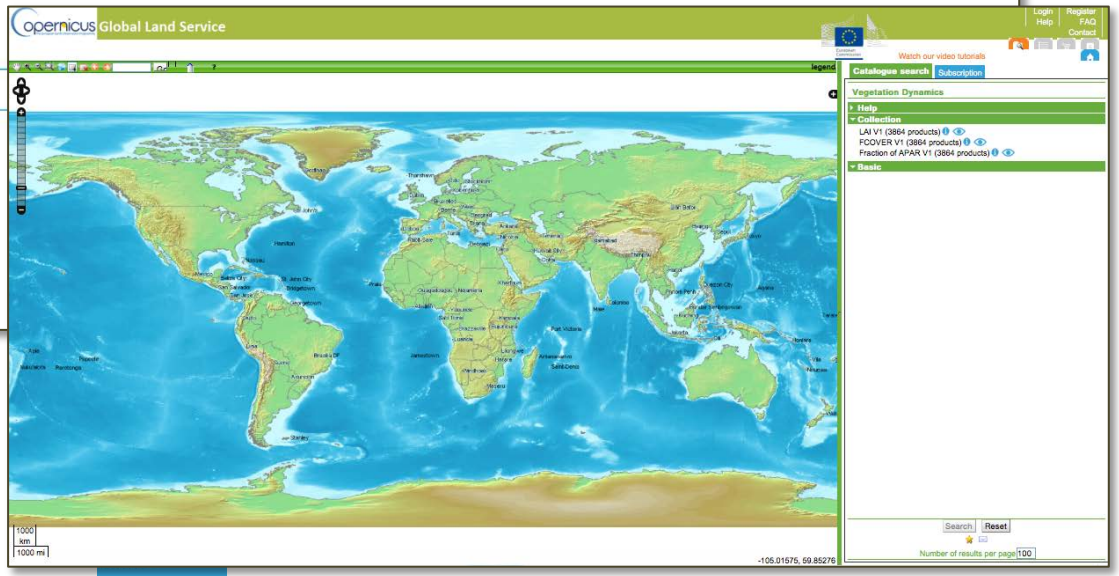
Copernicus
The European Earth Observation Programme

MESA PROJECT

Joint Research Centre

European Commission





Copernicus
The European Earth Observation Programme

European Commission
emma
Environment Mapping & Monitoring of Africa

Search on EUROPA | Contacts | Legal notice

European Commission > JRC > IES > GEM > EMMA Home

RELEASE 1.3.1

Welcome adminuser (Logout)

EMMA

English

Save to Portfolio | Save local | Portfolio

Reset

Map size

Current map width : 720 px
Current map height : 720 px

Cursor Position

Latitude: 4.47784 °
Longitude: 24.02770 °

Predefined Regions

Display regions

- Africa admin 0
- Africa admin 1
- Africa admin 2
- Regions
  - CILSS
  - ECOWAS
  - IGAD
  - CEMAC+RDC
  - SADC
  - IOC
- Outmask

Zoom

2
zoom factor

Mouse click actions

Panning

W. lon. : -26.00
S. lat. : -41.50
E. lon. : 60.00
N. lat. : 44.50

N

Joint Research Centre, 2012

0 620 1240 1860 km

SOC_TOP_CLASSIFIED [t/ha]

very low (<15) | low (15-40) | medium (40-120) | high (120-250) | very high (250>)

Images | Time series | Layers | Map options

Selected: Miscellaneous
Global Soil Organic Carbon Content -GLOBAL SOC
SOC in top soils

- Vegetation
- Rainfall
- Fire
- Inland water
- Oceanography
- Temperature
- Miscellaneous
  - Global Soil Organic Carbon Content -GLOBAL SOC
    (Data source: HSWD - FAO/IIASA/ISRIC/ISS-CAS/JRC)
    - SOC in sub soils (soc_sub_30sec)
    - SOC in top soils (soc_top_30sec)
      The Harmonized World Soil Database (HSWD) is a 30 arc-second raster database with over 15000 different soil mapping units that combines existing regional and national updates of soil information worldwide (SOTER, ESD, Soil Map of China, ISRIC-WISE) with the information contained within the 1:5 000 000 scale FAO-UNESCO Soil Map of the

File date and color scheme

Year: 2012 | Month: February | Day: 2

Legends of image:
SOC in top soils

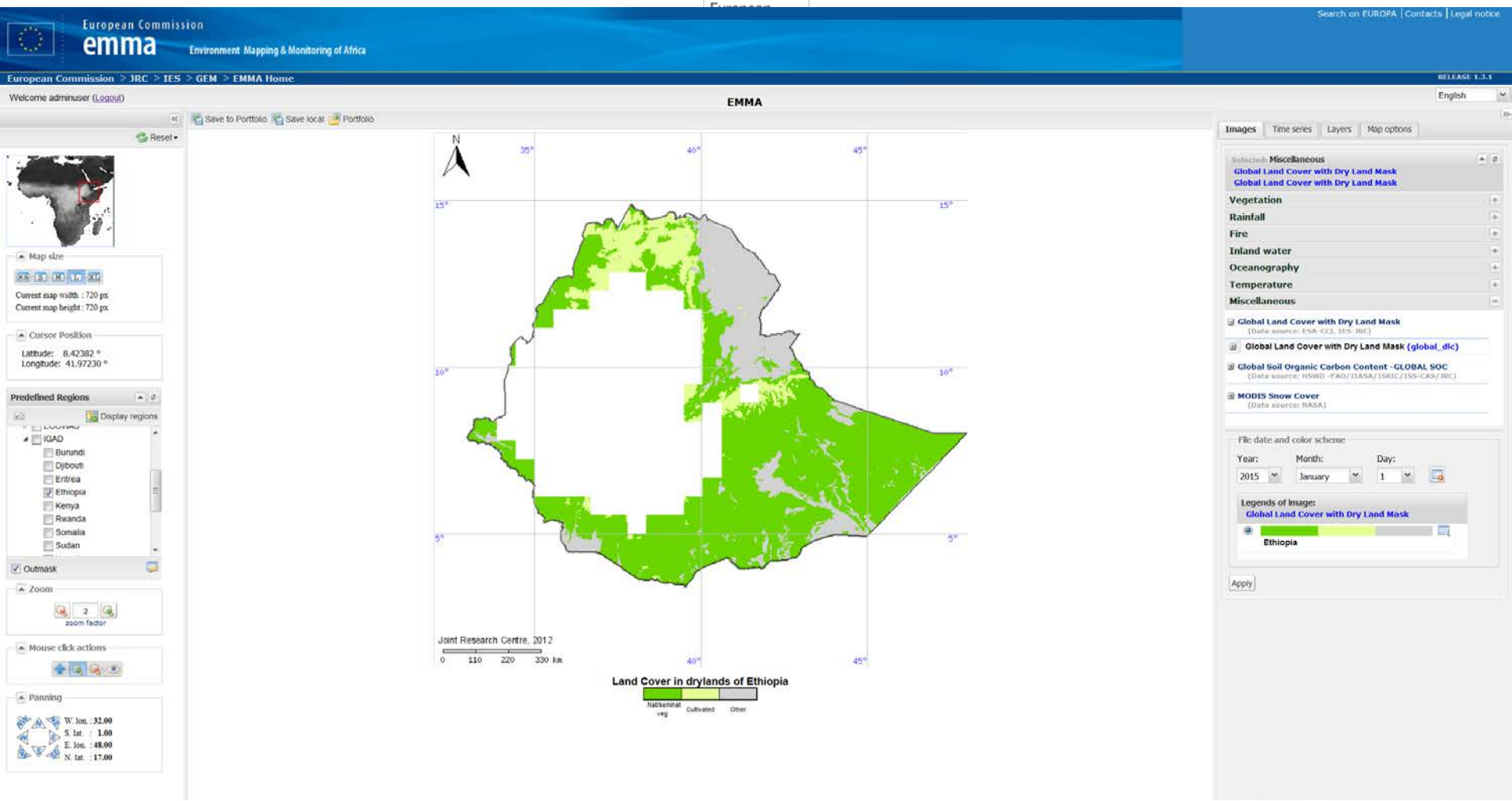
SOC [t/ha]

SOC_TOP_CLASSIFIED [t/ha]

Apply

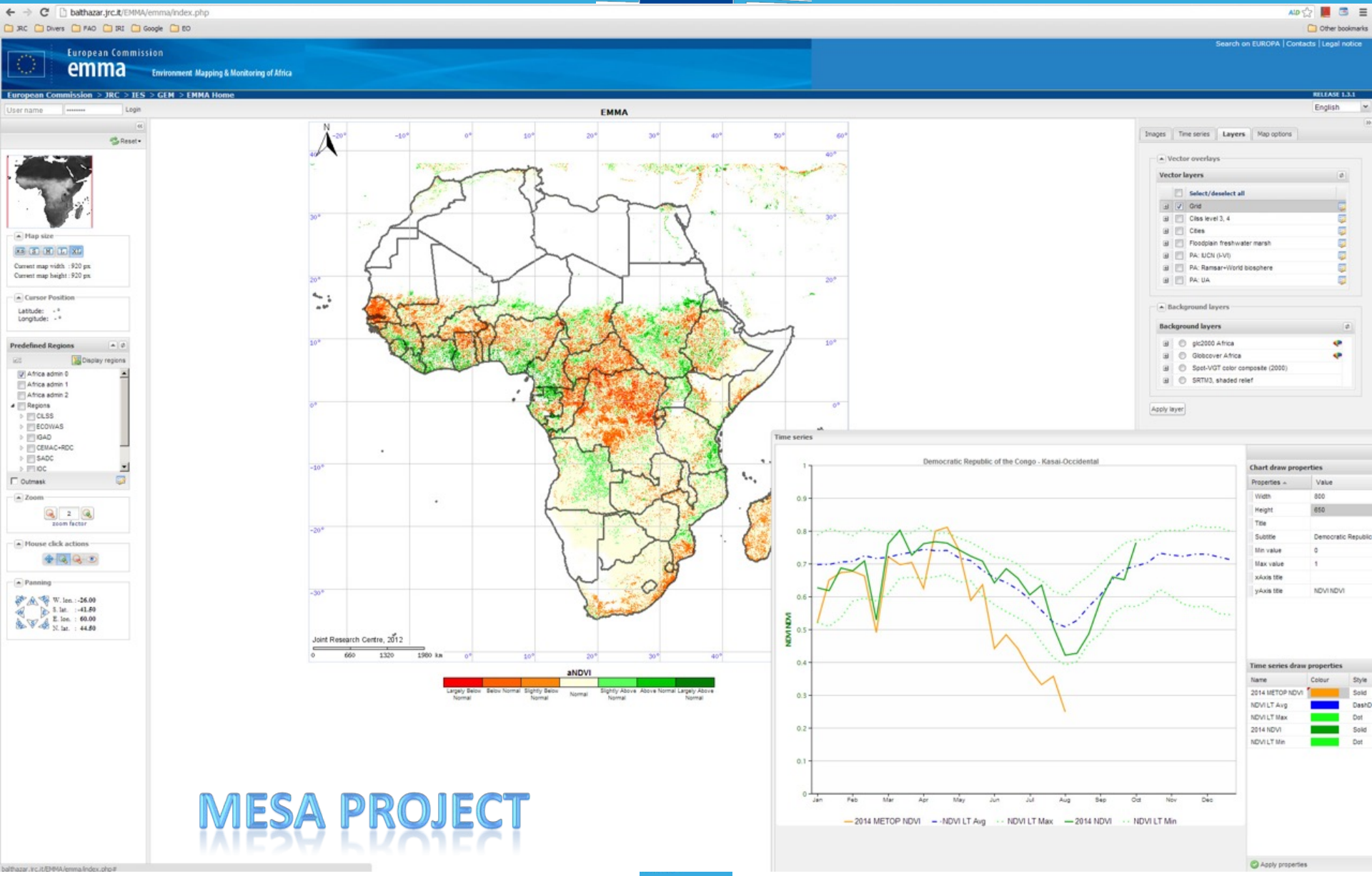
MESA PROJECT

Joint Research Centre



MESA PROJECT

Joint Research Centre



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

European Commission

Thank you !

Michael.cherlet@jrc.ec.europa.eu

Joint Research Centre