



geoland2

# Operational applications for Land Monitoring



**R. Lacaze (HYGEOS) on behalf the geoland2 consortium**

geoland2 is a Collaborative Project (2008-2012) funded by the European Union under the 7th Framework Programme (project number 218795)

# Global environment under pressure…

## e.g. man-made and climate induced changes in Europe

**Water – 20% of all surface water sources seriously threatened by pollution**

**Soil Erosion – 17% of total European land area affected, economic loss around 85 € per ha**

**Biodiversity – 335 species highly endangered in Europe**

**Agriculture – intensification leads to water stress, soil erosion and biodiversity decline**

**Urban Settlements and transport networks growing - leads to soil sealing and fragmentation of landscape**

**Man-made impact & climate variability – require adaptation**
**Directives & Regulations – requesting geo-spatial information – supporting reporting & management tasks**

# GMES Land Monitoring Service

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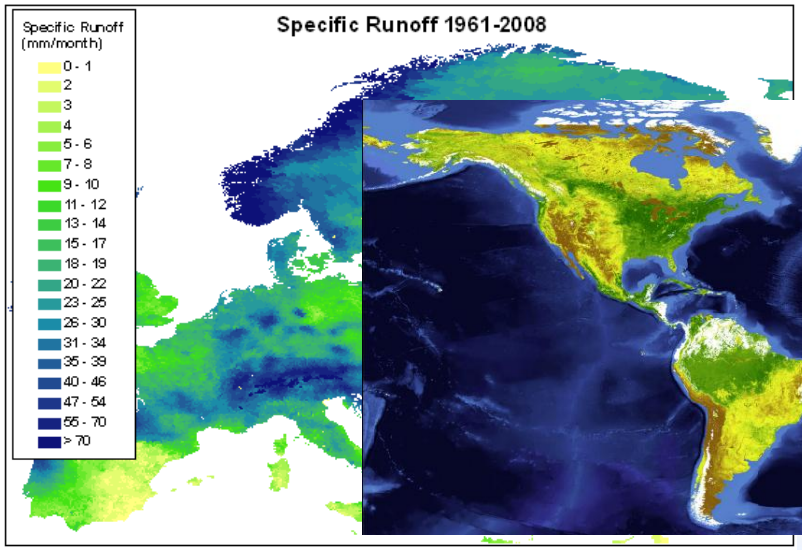
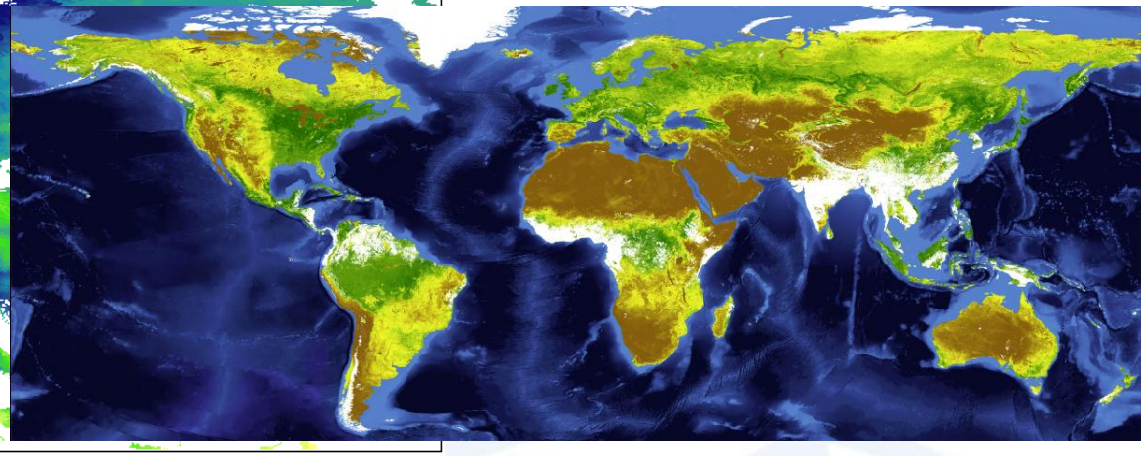
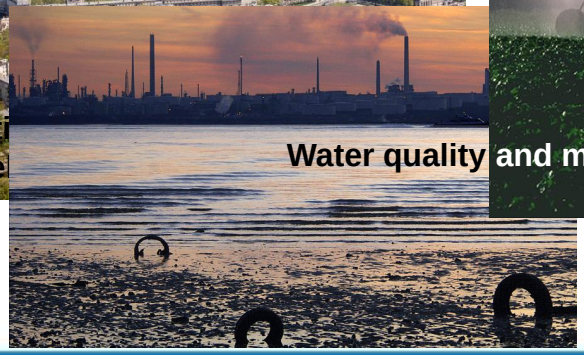


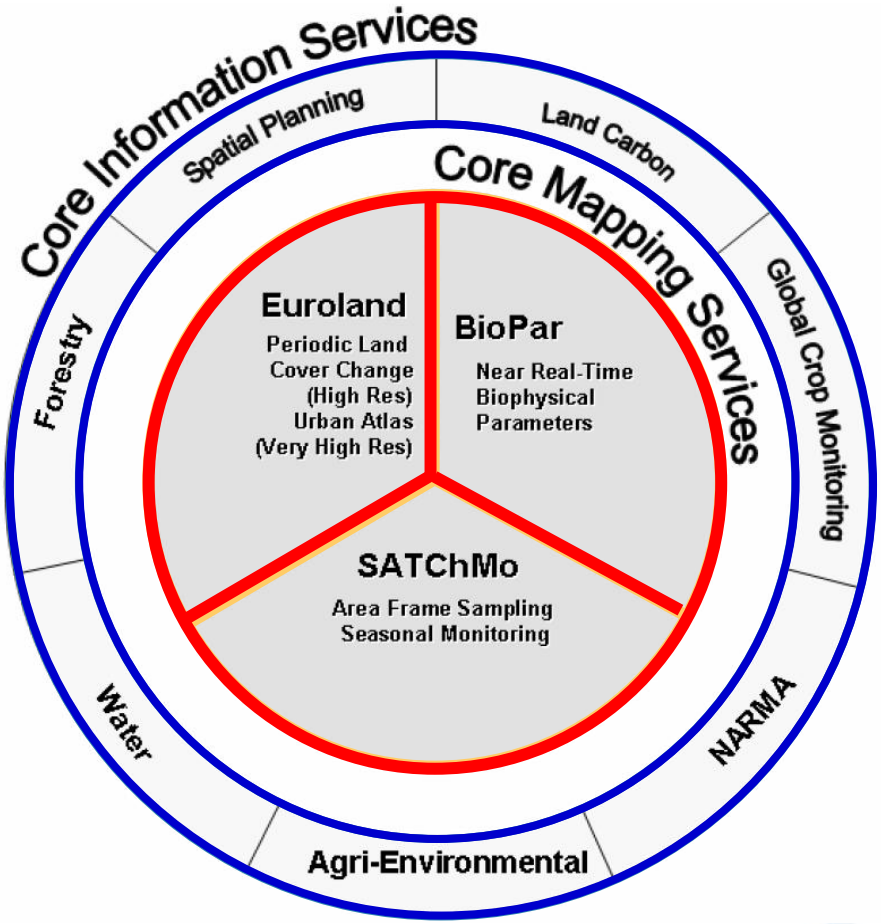


# geoland2 in a nutshell

- **51 Partners**
- **18 European countries**
  (AT, BE, CZ, DE, ES, FI, FR, GR, HU, IT, LT, NL,PL, PT, RO, BU, SE, UK)
- **10 thematic tasks**
- **4 years** (till December 2012)


- **The overall geoland2 objectives are:**
  - the building of operational processing lines
  - the demonstration of services and products
  - the set-up of a production network

# geoland2: functional view




## 3 Core Mapping Services:

set-up production capacity to "capture" and "produce" key basic information (land use / land cover, biophysical parameters)

## 7 Core Information Services:

use CMS inputs and other data sources to generate elaborated information products addressing specific policies.

estimate the added value of CMS in comparison with existing approaches

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# How to use land cover and land use information for integrated local and continental monitoring

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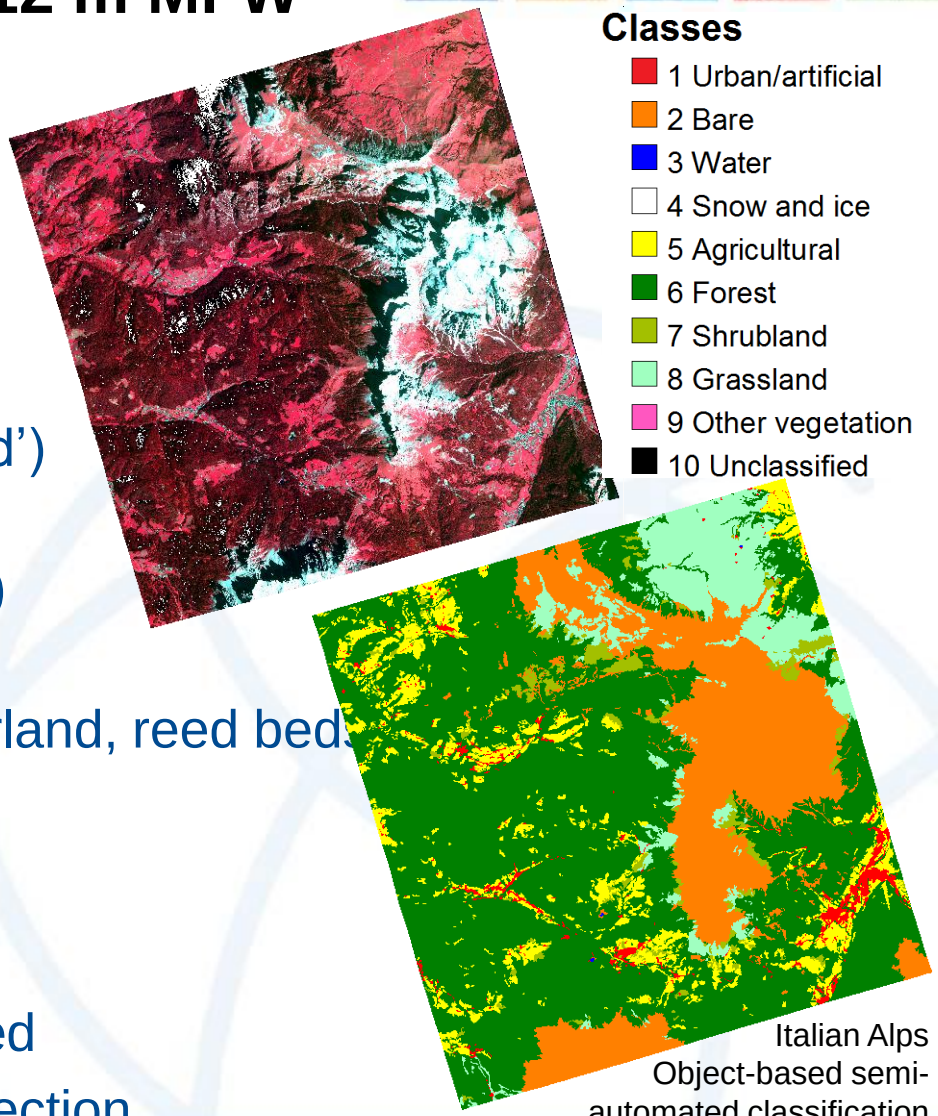
# Local Component
# Area Frame Sampling: “Hot Spot” monitoring

- **Aim: provide detailed mapping of selected and statistically representative sites (“hot spot”)**

- **Key component:**
  - Area frame sampling (AFS) scheme:
    - 15 km by 15 km samples with stratified sampling scheme
    - 114 samples, 8 biogeographic regions, 19 member states
  - VHR data: multi-date Kompsat and Formosat data
  - Products:
    - Generic land cover maps.
    - Change indicator maps.

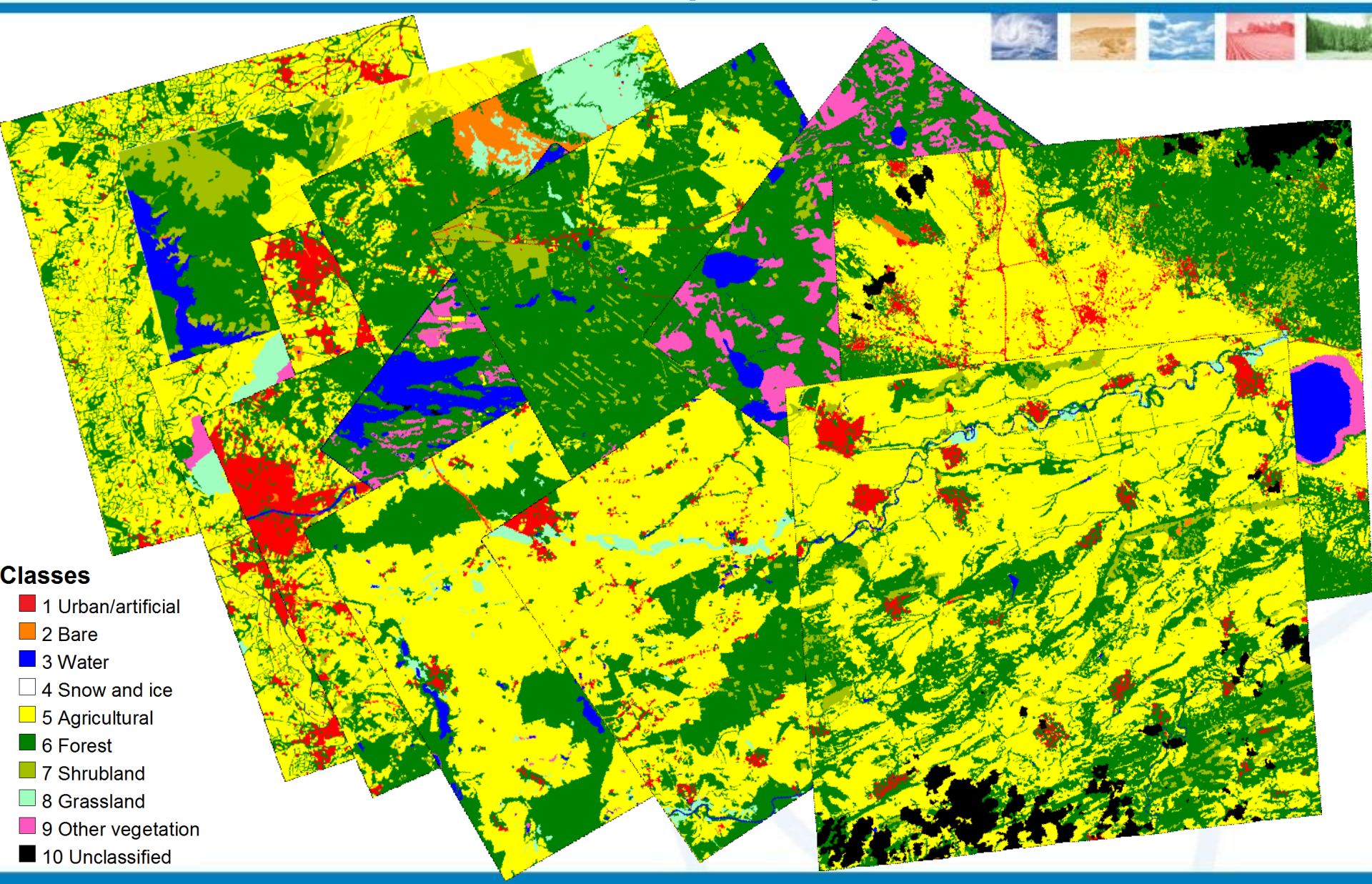
# Local Component
# AFS – Generic Land Cover maps

- **Geometry: 0.25 ha MMU, 12 m MFW**
- **Classes**
  - 1 Urban/artificial
  - 2 Bare non-cultivated ground
  - 3 Water
  - 4 Snow and ice
  - 5 Agricultural areas (‘cropland’)
  - 6 Forest/woodland/trees
  - 7 Shrubland (shrubs, bushes)
  - 8 Grassland
  - 9 Other vegetation (e.g. moorland, reed bed saltmarsh)
  - 10 Unclassified
- **Production**
  - Object-based, semi-automated
  - Rule-based plus manual correction

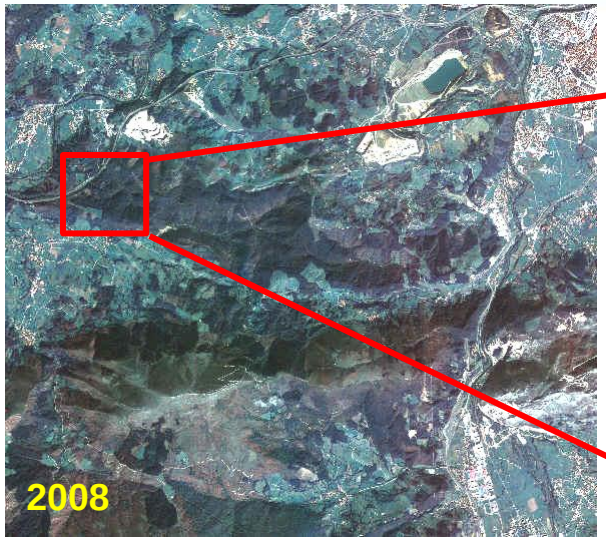



Italian Alps
Object-based semi-automated classification

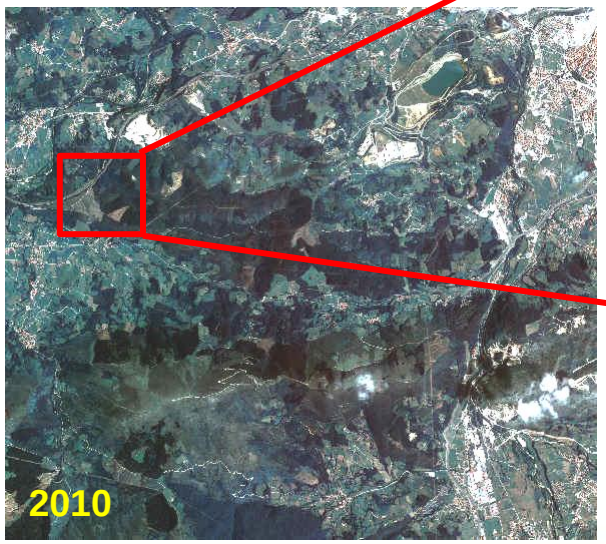
# Local Component
# AFS – Generic Land cover maps: examples



# Local Component
# AFS – Generic land cover change maps




(Test site in Spain)







## Benefit of AFS:

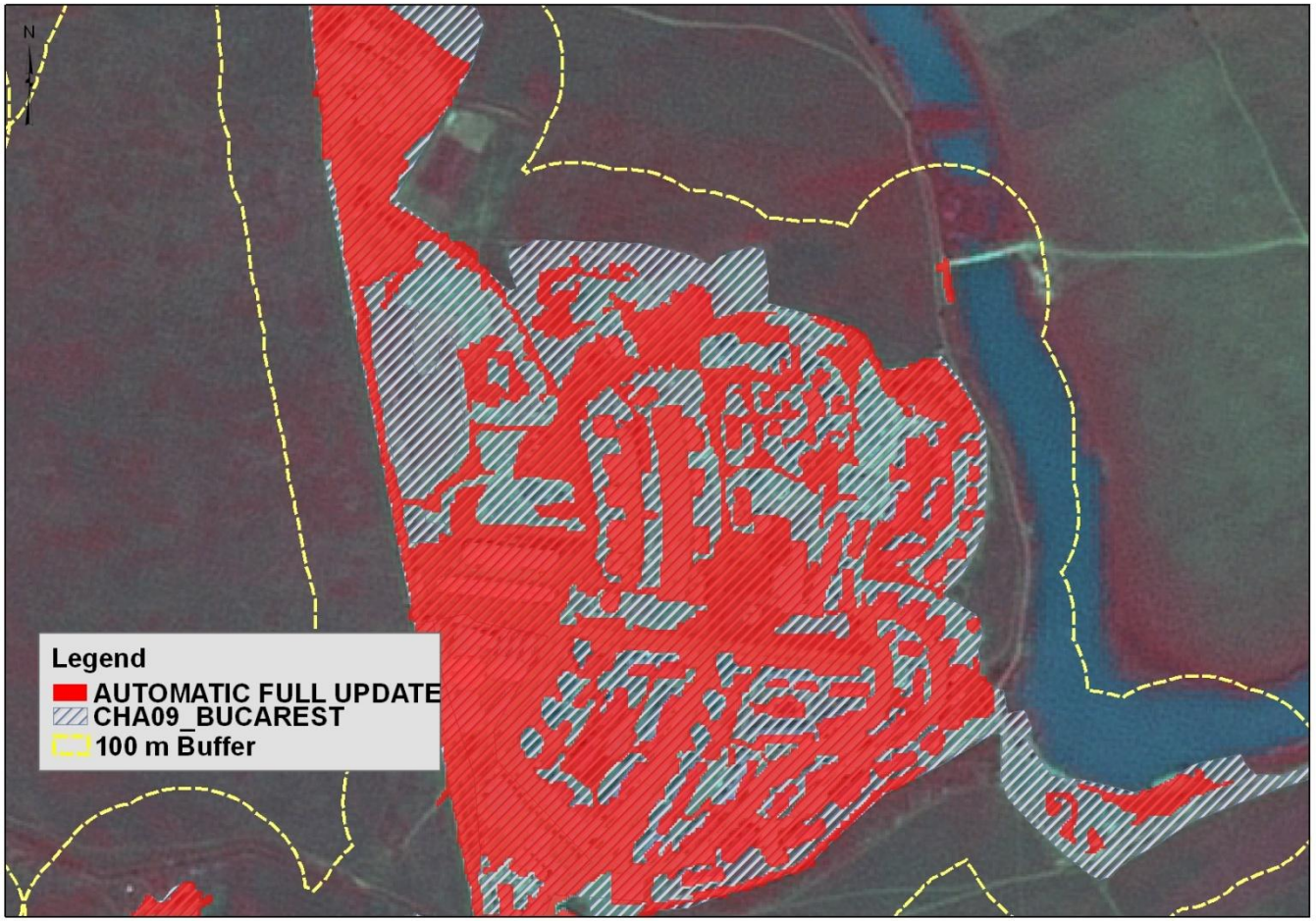
- Indicator of rapidly changing hot-spots (Change Detection)
- Source for validation of HR layer
- Source for validation of Urban Atlas

# Local Component
# Urban Atlas full update

- **Aim: Detailed land use mapping related to Urban Audit**
- **Key components**
  - Sample of cities across Europe
  - Based on VHR  2.5 m multi-date SPOT data
  - 0.25 ha and 1 ha MMUs
- **Production**
  - Object based analysis, automatically created change layer
  - Generic methodology: Transferability of method between images and sensors (with same spatial resolution)
  - Automation inherent advantages: time and cost reduction and homogeneous classification throughout Europe
- **Benefits**
  - Basis for statistical calculations and revision of urban planning
  - Monitoring urban expansion and sprawl in the most dynamic areas

# Local Component
# Urban Atlas full update : example

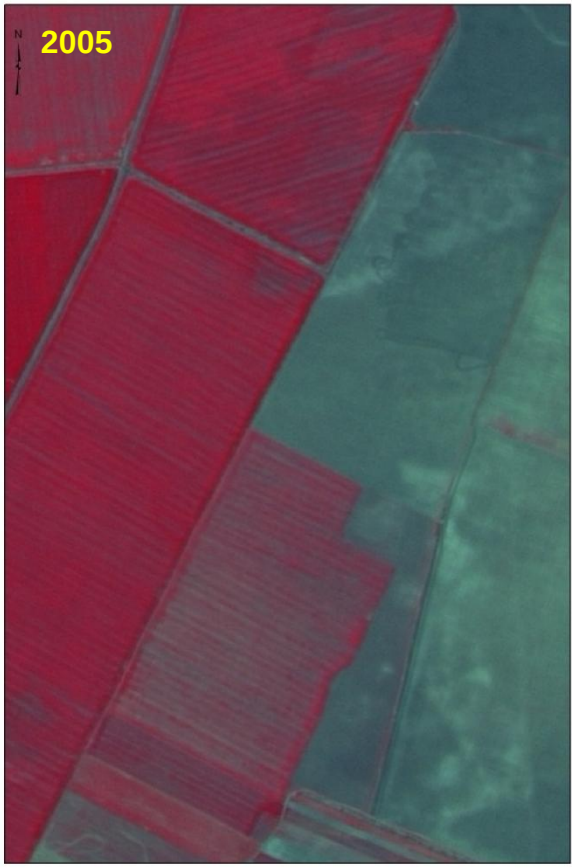
## Buccarest: new constructions

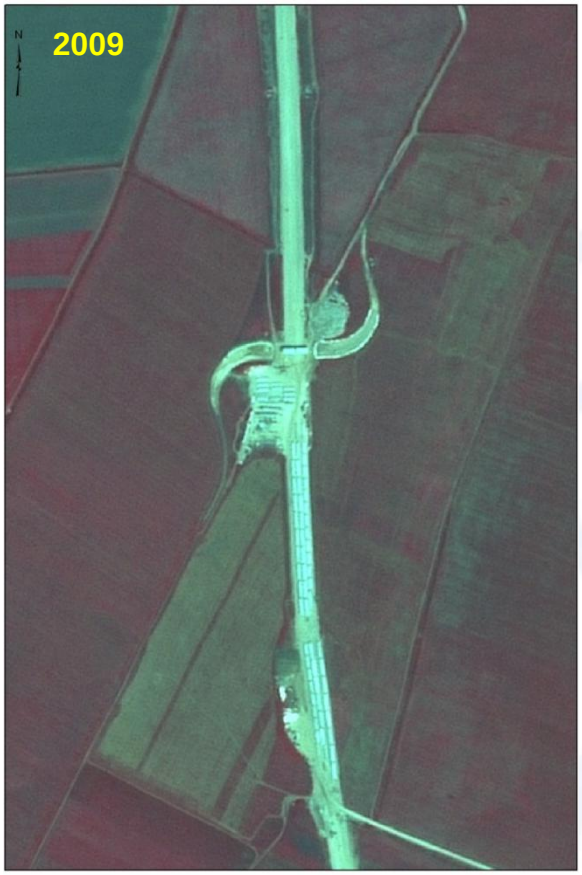


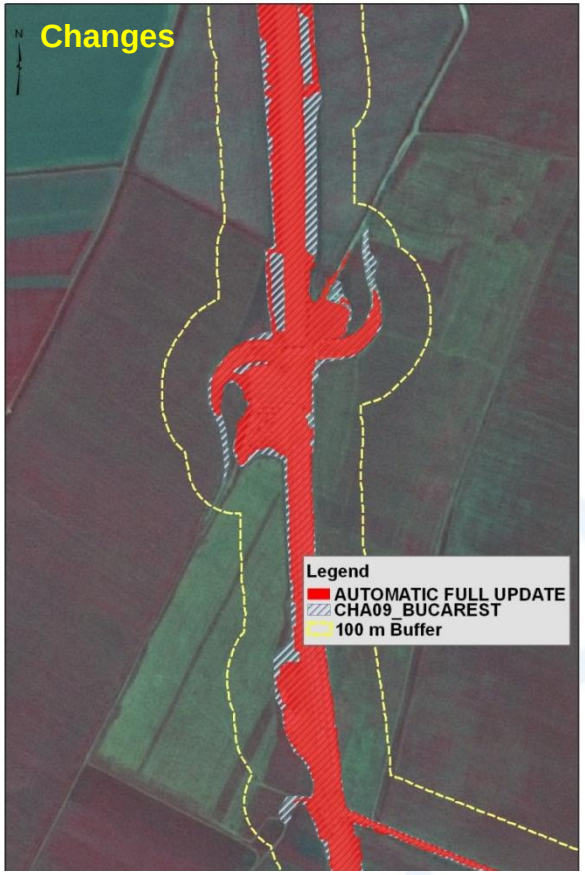

**Changes**

# Local Component
# Urban Atlas full update : example

## Buccarest: new constructions

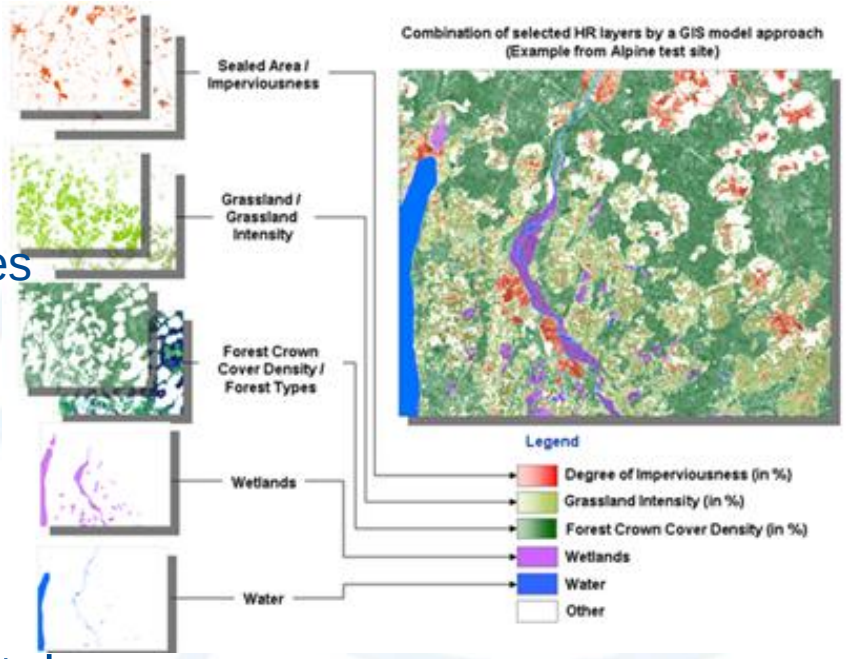


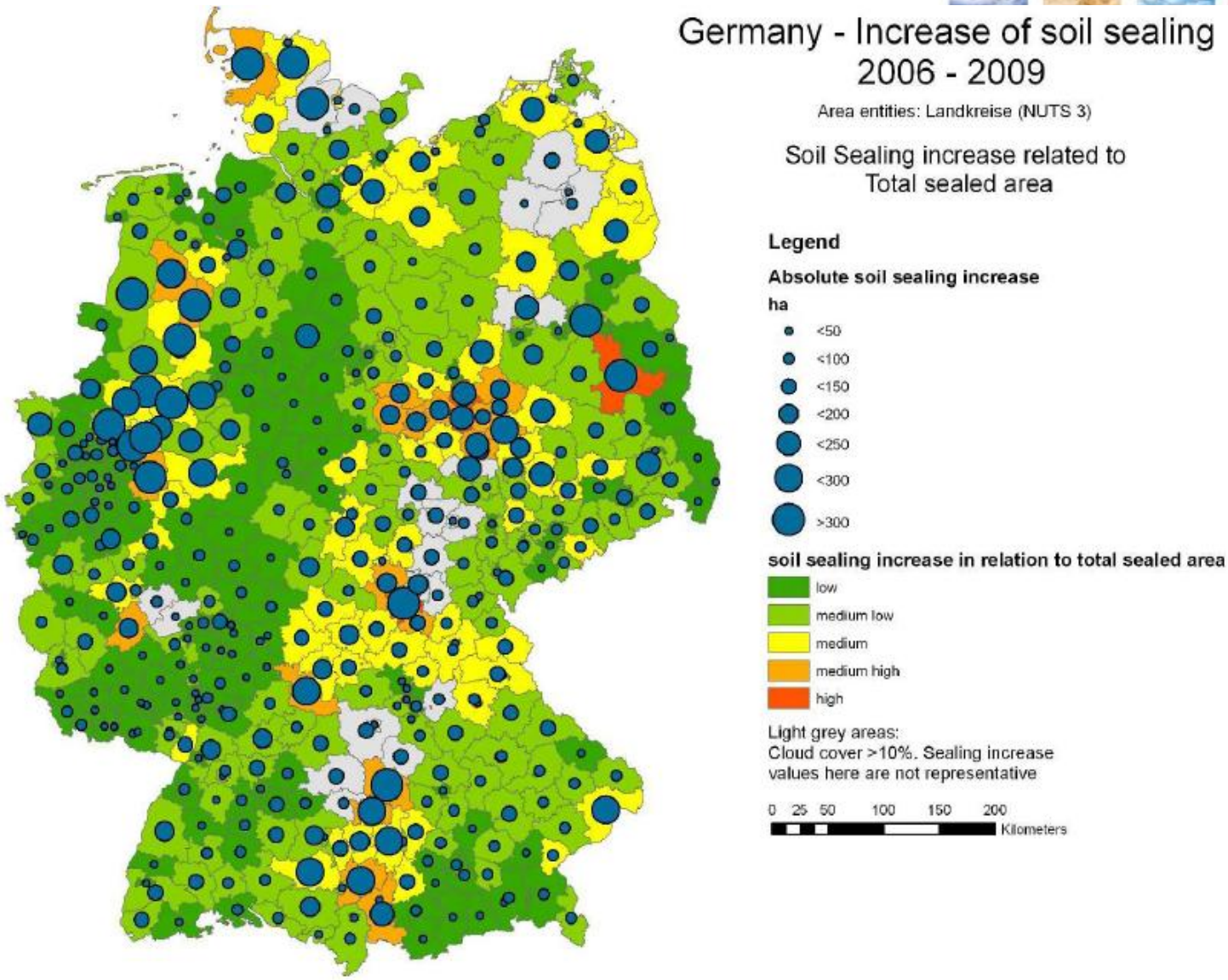



# Pan-European Component
# HR layers

- **Key components**
  - Focused thematically on key physical attributes
  - 20m multi-date SPOT and IRS LISS-III + High temporal frequency MR data (AWIFS)
  - 20 m spatial resolution
- **5 layers**
  - **Imperviousness:** soil sealing degree
  - **Forest:** Crown cover density, forest types
  - **Grassland:** density, cutting indicator
  - **Wetland:** Monitoring RAMSAR sites
  - **Water:** Small water bodies
- **Benefit**
  - Improved CLC update and attribution
  - Support for MS to update national databases
  - Input for European environmental indicators
  - Monitoring changes to mitigate impacts of global warming and environmental degradation



# Pan-European Component
# HR layers : Imperviousness



# Pan-European Component
# HR layers : Forest

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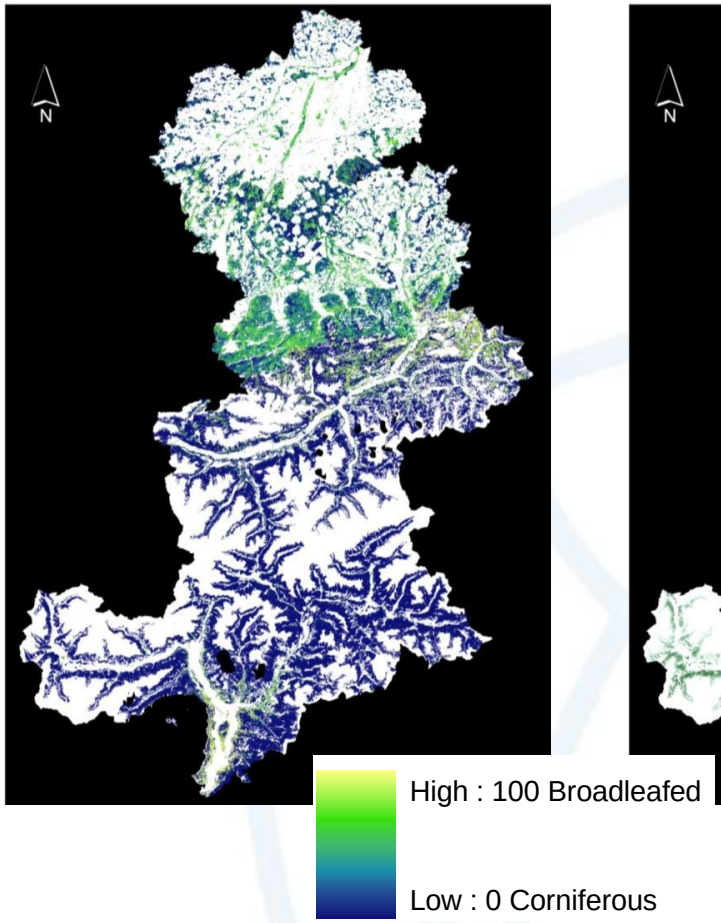
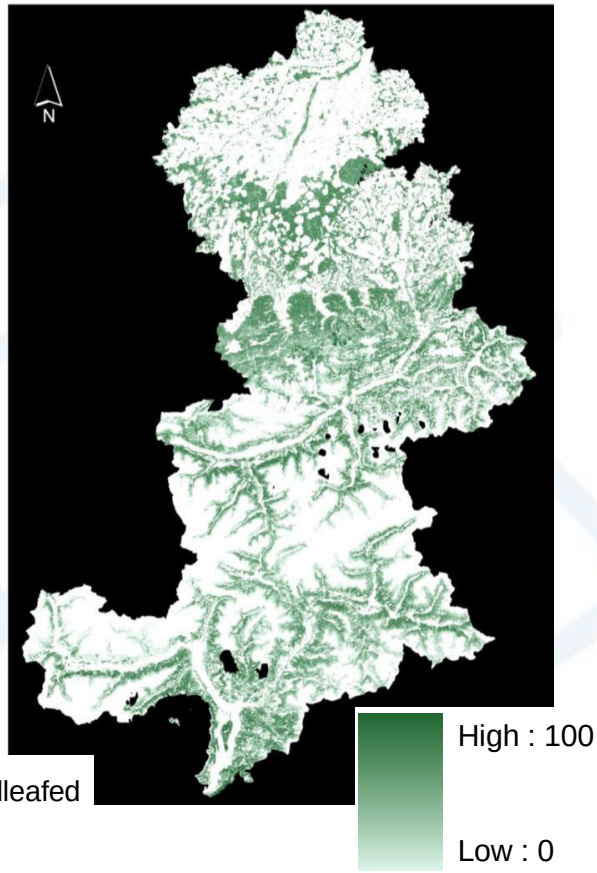
## Forest Area


## Forest type

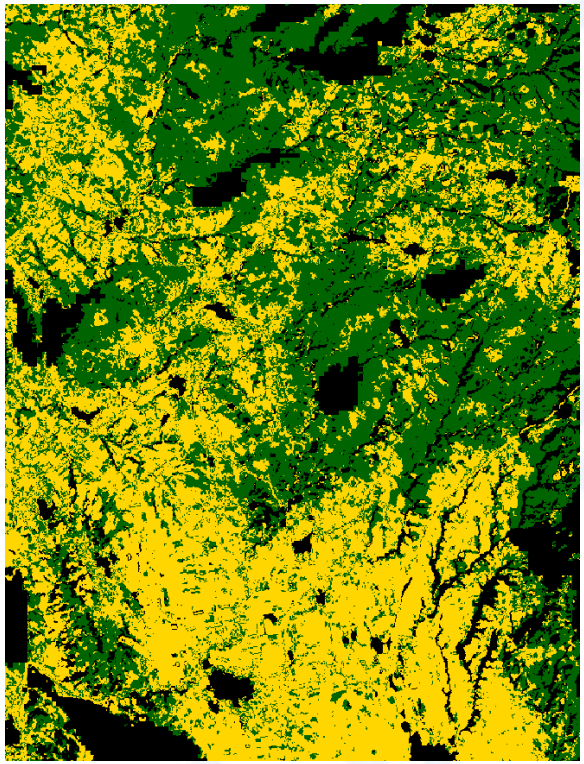



## Crown Cover Density



# Pan-European Component
# HR layers : Grassland

- **Discrimination of permanent grassland from other agricultural land areas such as arable land, bare soil, etc**



**Arable land**

**Grassland**

**Non-agricultural areas**

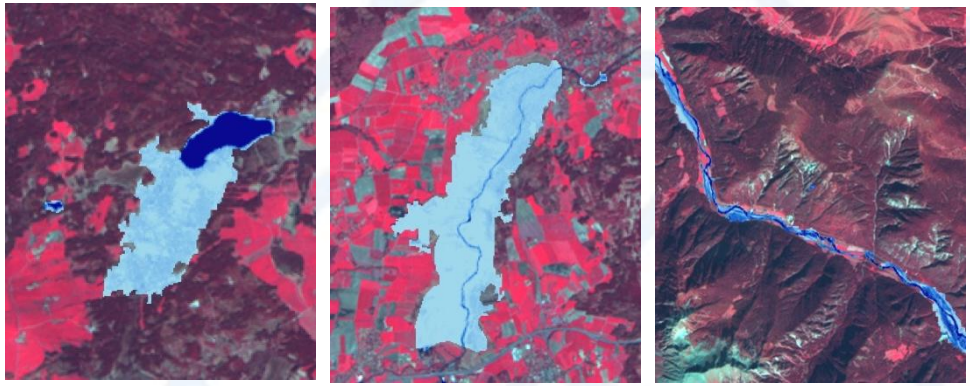
**Test site near Thessaloniki (Greece)**

# Pan-European Component
# HR layers: Wetlands and Water Bodies

- **Wetlands**

**Wetland area**

**Wetland wetness**



- **Small water bodies**
  - Separate permanent and temporary water bodies

# Pan European Component
# HR layers : support Corine Land Cover update

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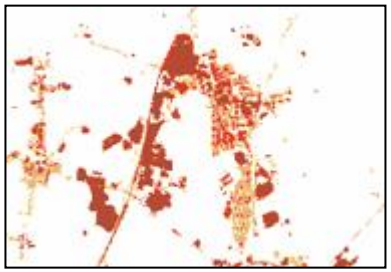
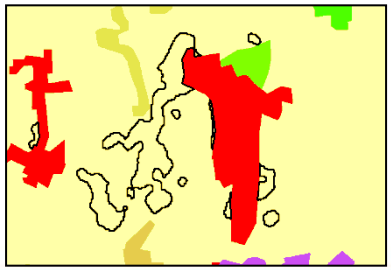
Imperviousness layer

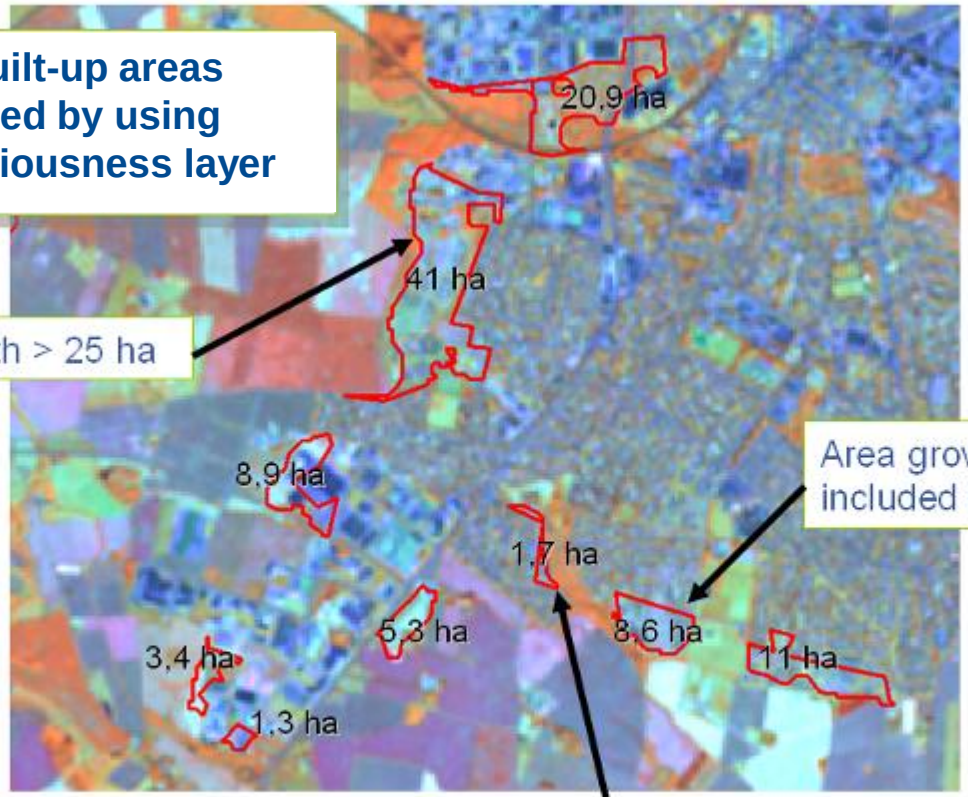


Imperviousness layer – binary mask

CLC2000 with built-up area changes from imperviousness layer



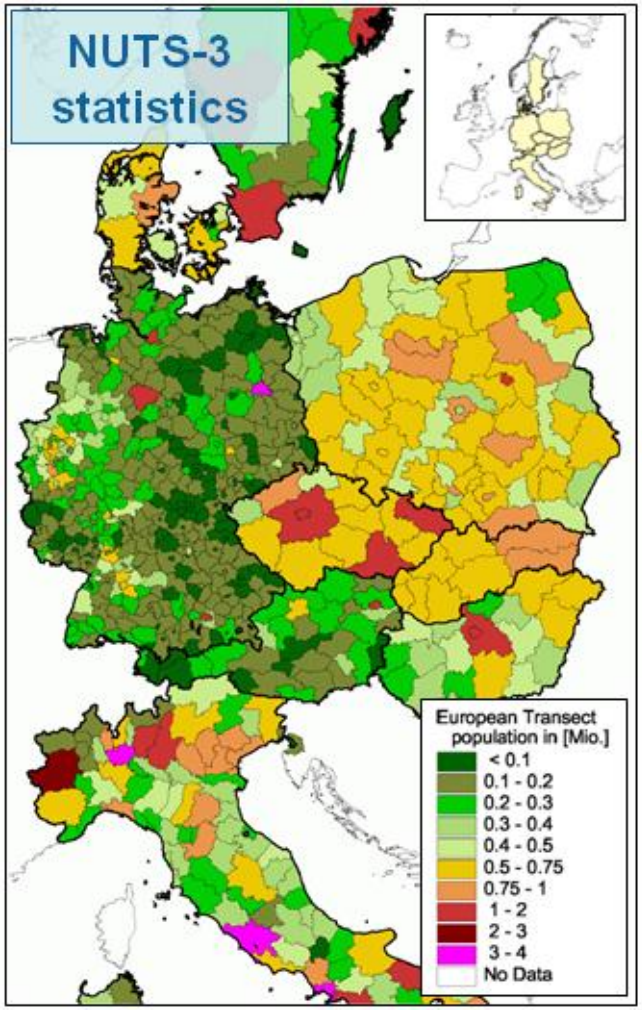
**New built-up areas identified by using Imperviousness layer**

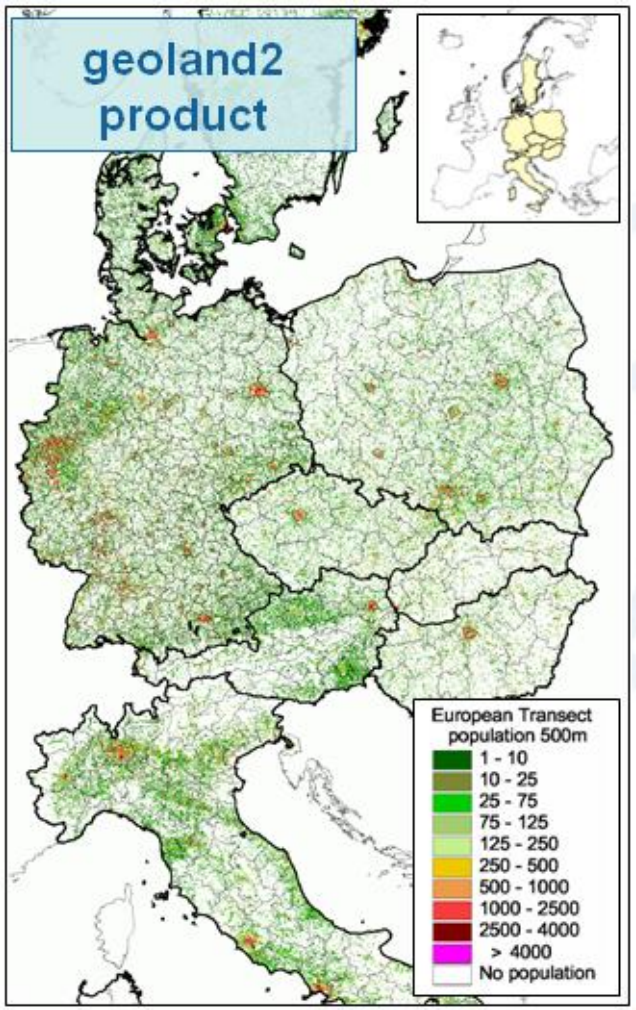


# Pan-European Component
# HR layers: support Spatial Planning - 1

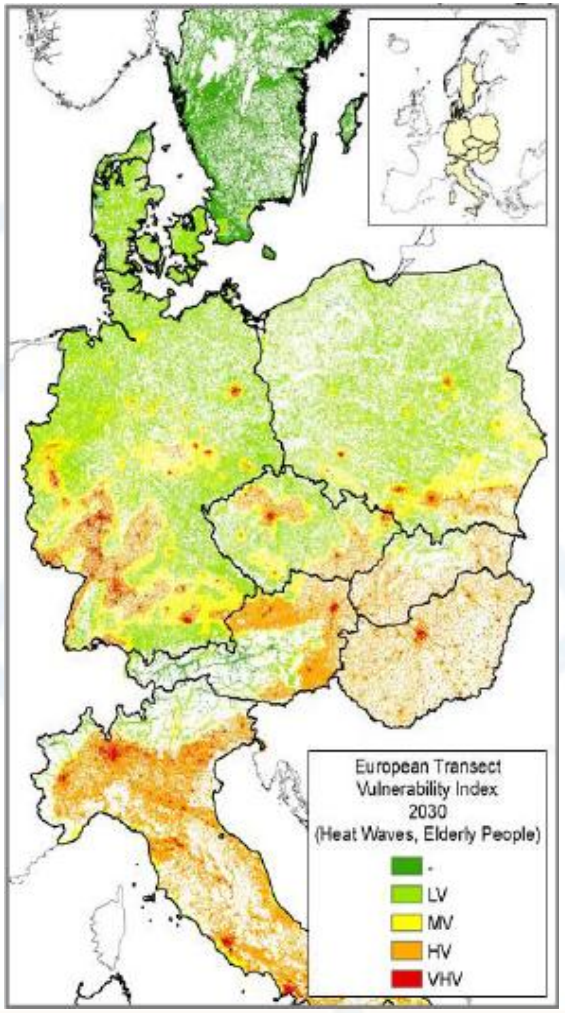
- **European Land Take trend Indicator**

Population



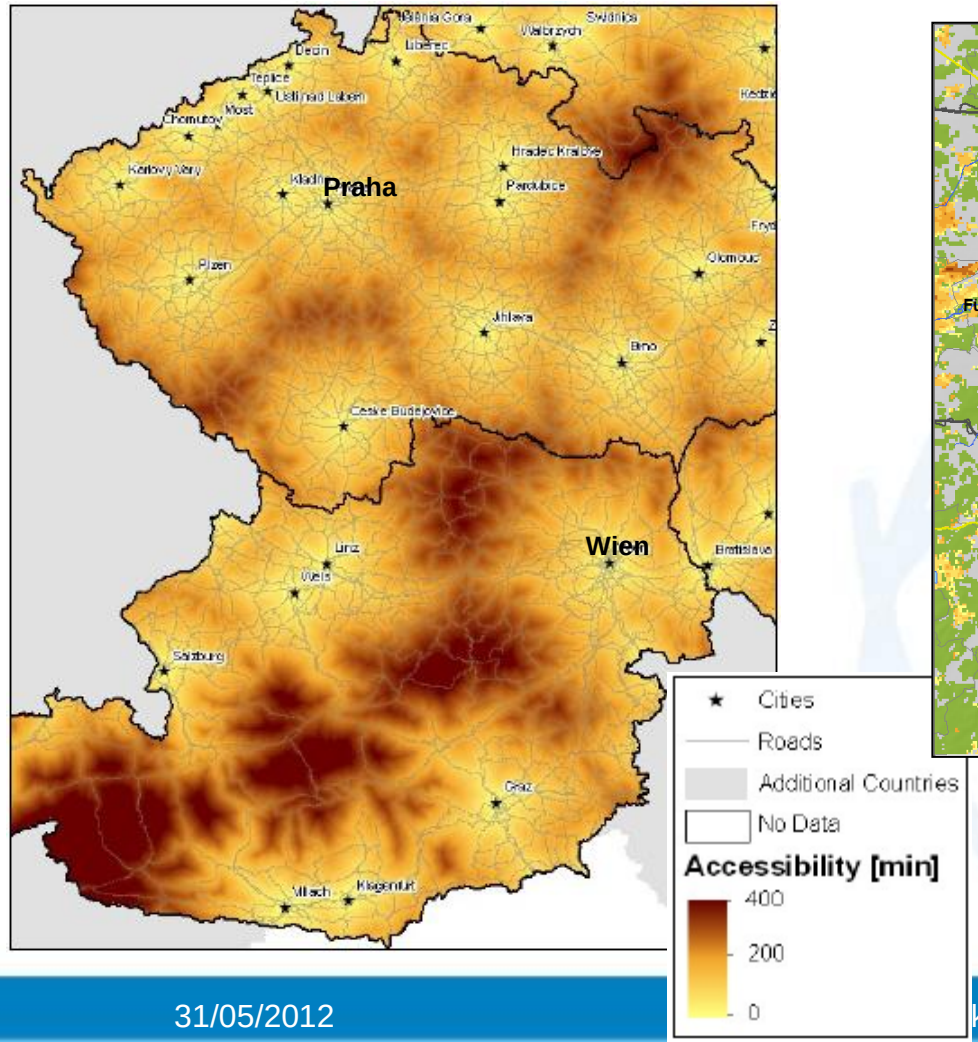




Vulnerability Index
(Heat waves, Elderly people)

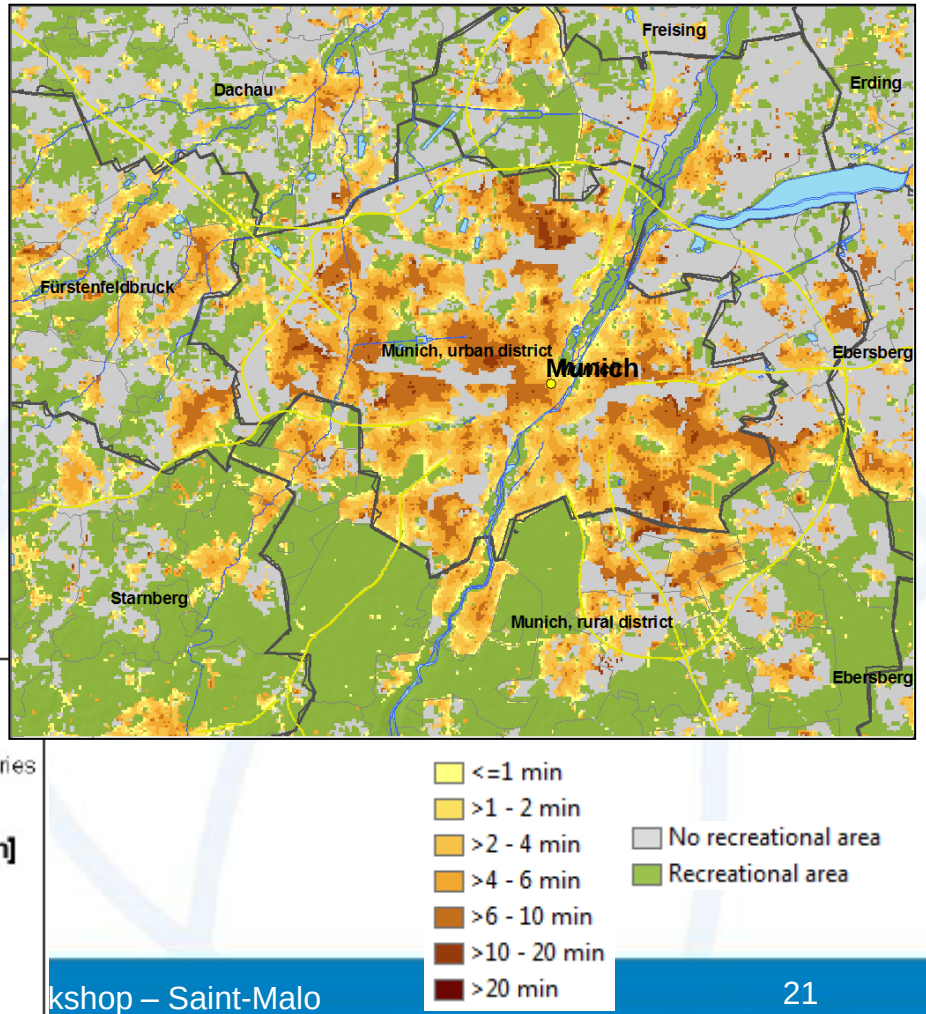


- **European Land Take trend Indicators**

**Travel time to closest urban centers (> 50 000h)**

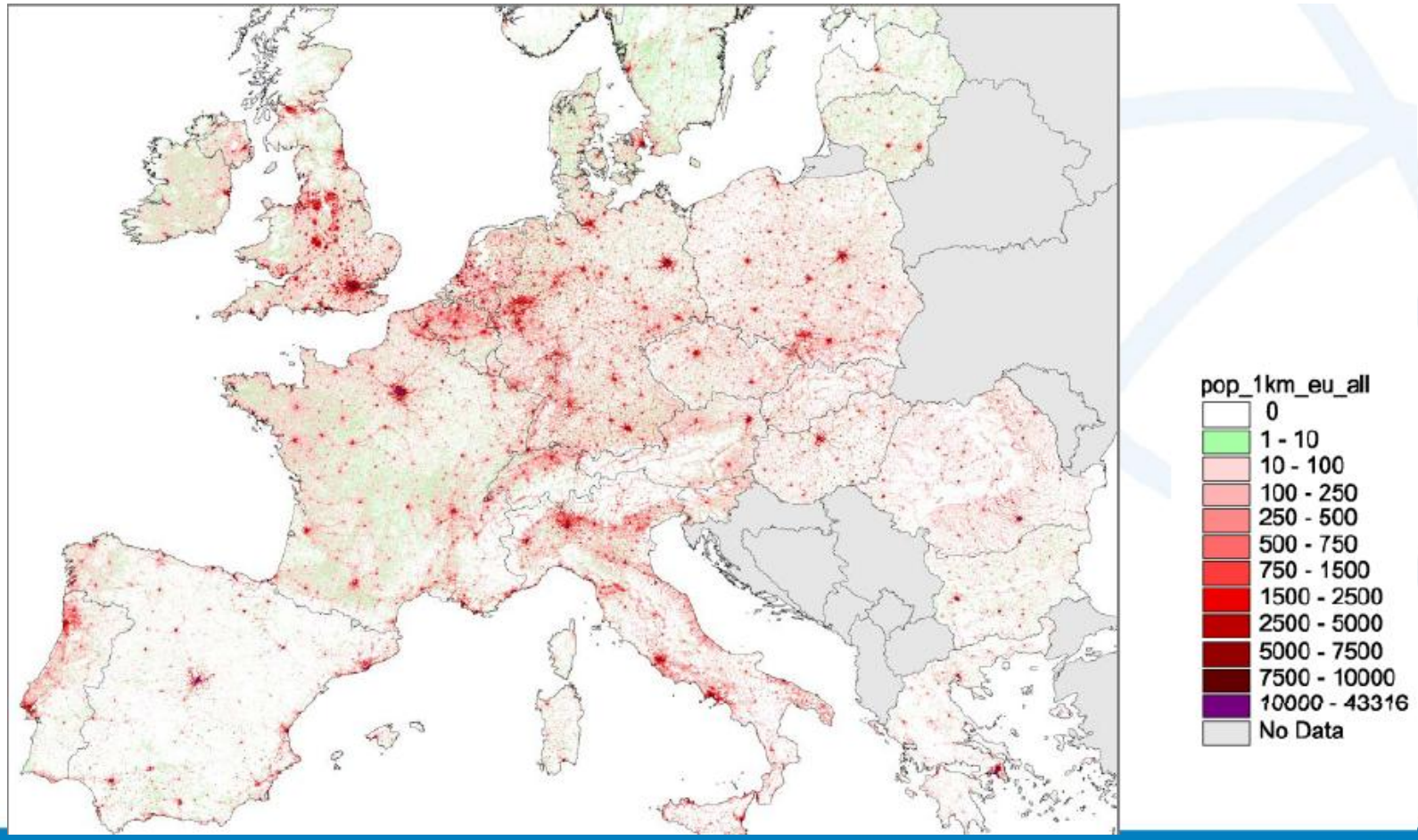



**Travel time from residential areas to closest recreational zones**



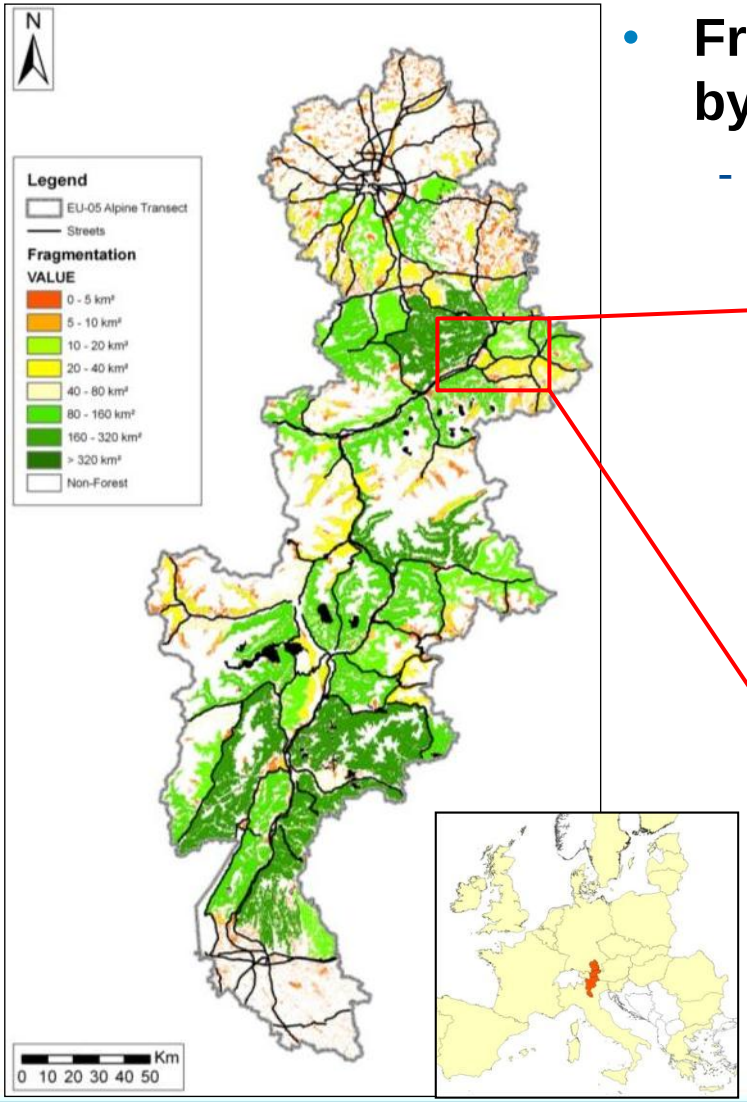
# Pan –European Component
# HR layers: support to Spatial Planning - 2

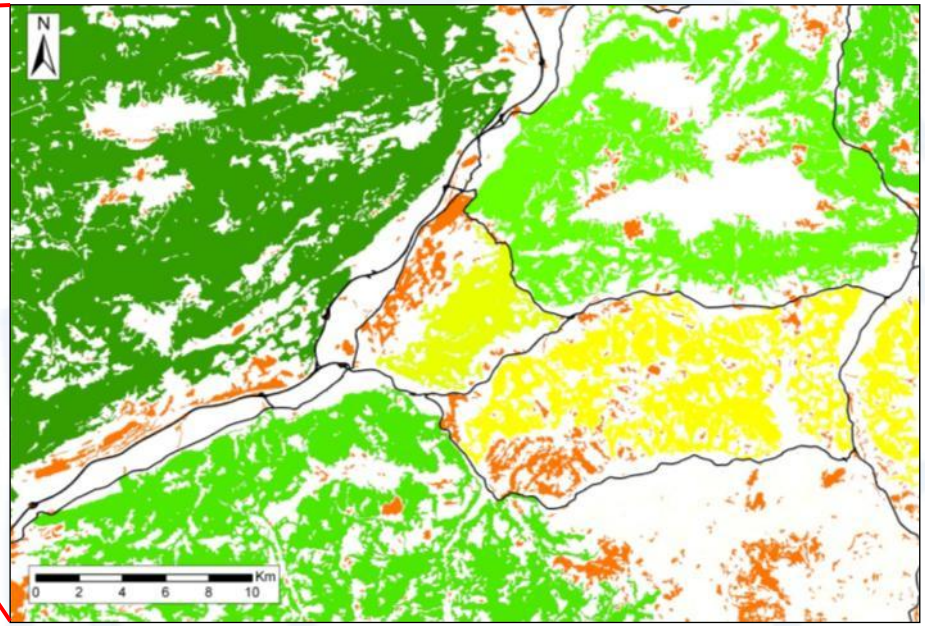
- **Population grid for Europe**
  - 500m population layer derived from LAU-2 statistics (2006) and HR Imperviousness layer



# Pan-European Component
# HR layers: forest management

- **Fragmentation of large Forest complexes by major roads**
  - UNCBD indicator



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# How to use biophysical variables for integrated continental and global monitoring

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# Global Component
# Benefit of monitoring vegetation and water

- **Water and Food scarcity are among the most serious natural threats to society and generate conflicts:**
  - See recent Nature paper : Hsiang, S.M. , K. C. Meng, M. A. Cane "Civil conflicts are associated with the global climate" doi:10.1038/nature10311, published: 25 August 2011

- **A designated high priority for United Nations**
  - Ban Ki-moon speech on 2011 World Water Day urged governments to recognize water crisis and its link with irrigation and farming activities.

- **Water and Food are assets of the global economy that can face speculation**
  - Willem Buiter (Citi-group top's economist) identified that the water-related market will probably eclipse the oil market

# Global Component
# The Biophysical Variables

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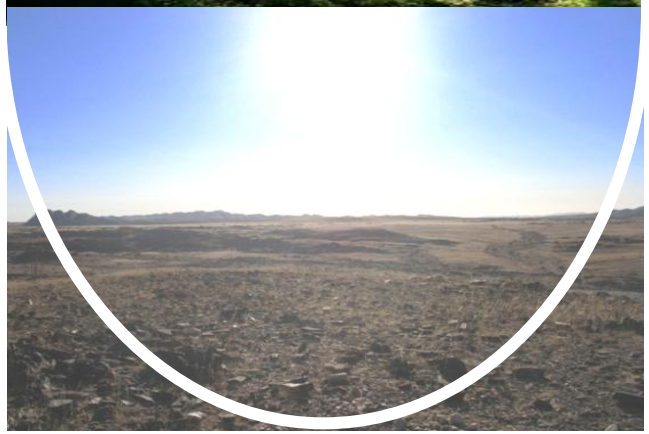
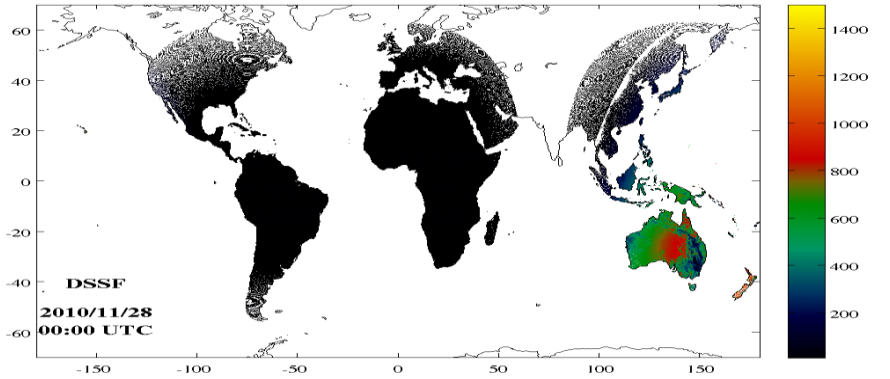
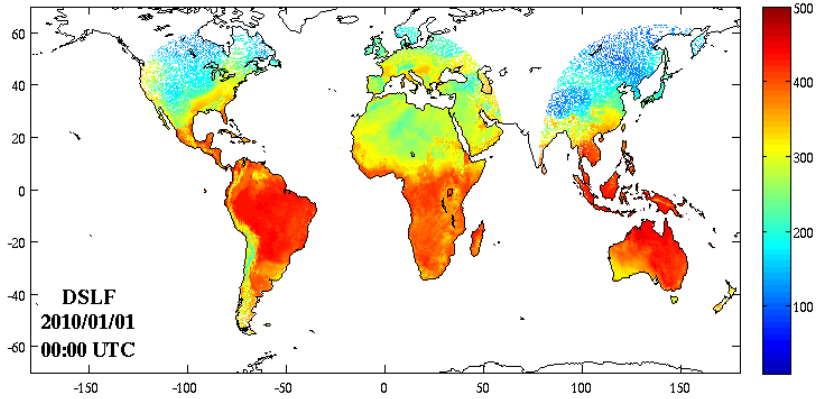


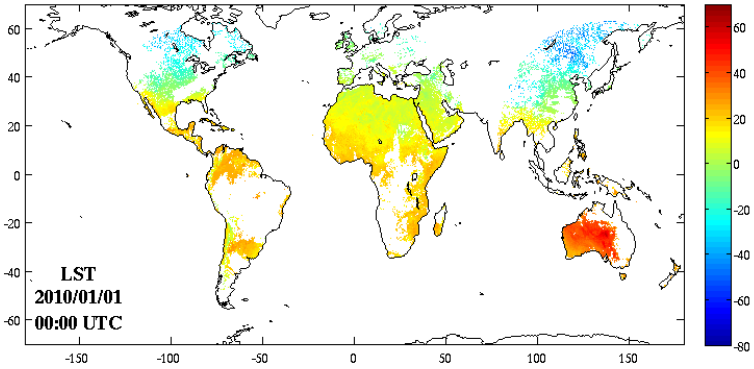

# Global component
# Radiation variables

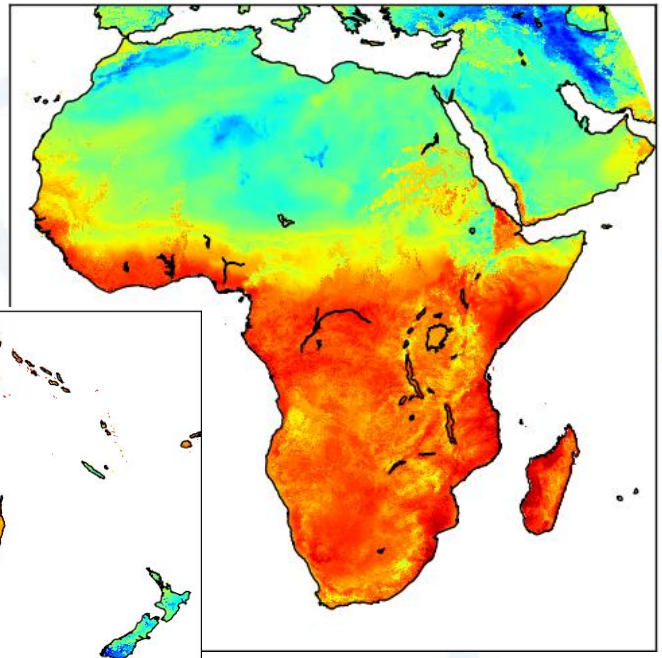
- **They are needed:**
  - Components of surface radiation budget (ECV)
  - main source of energy for surface processes
- **Global hourly products from ΣGEO data**
  - Daily cycle
  - Estimates of integrated values are more reliable since they use higher frequency data
- **Complementary with Eumetsat LSA SAF products**
- **Applications:**
  - Atmospheric forcing of surface models
  - Essential to monitor vegetation state, forecast yields and productivity, carbon modeling and carbon surface budget

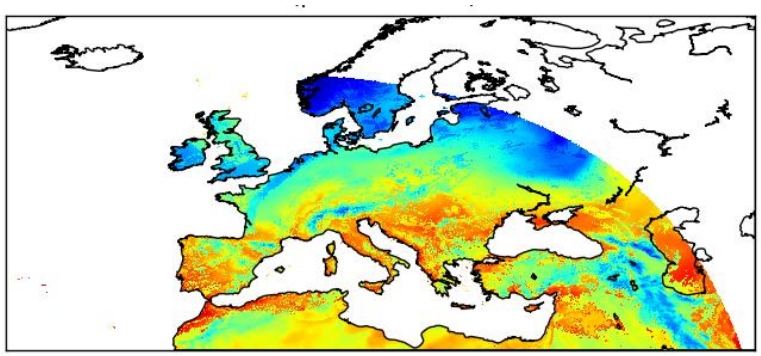
# Radiation variables (Downwelling surface fluxes, Land Surface Temperature)

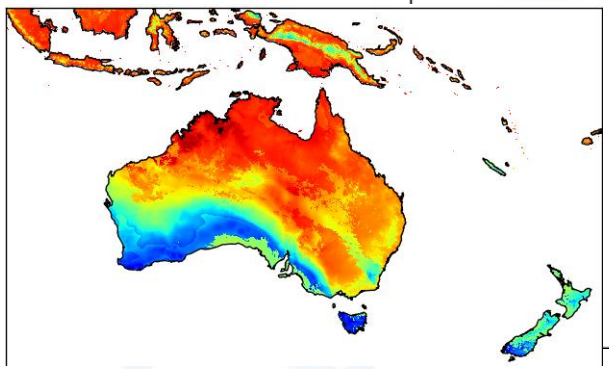


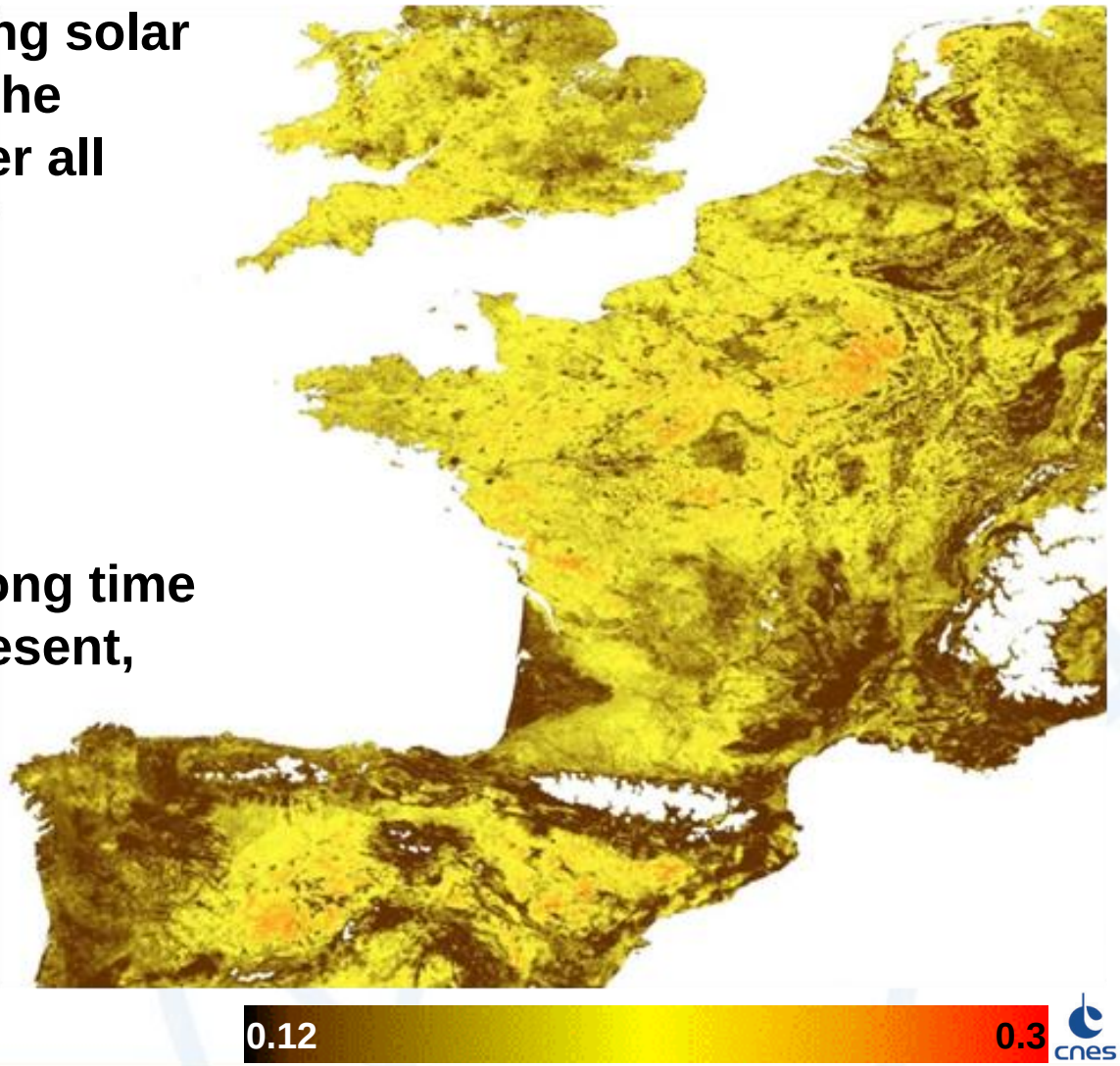







# Global Component
# Radiation variable - Albedo

- **Fraction of the incoming solar radiation reflected by the surface, integrated over all viewing directions**
- **Terrestrial ECV**
- **Global products from SPOT/VGT, NRT and long time series from 1999 to present, updated every 10 days**
- **Control the energy budget in land surface models**

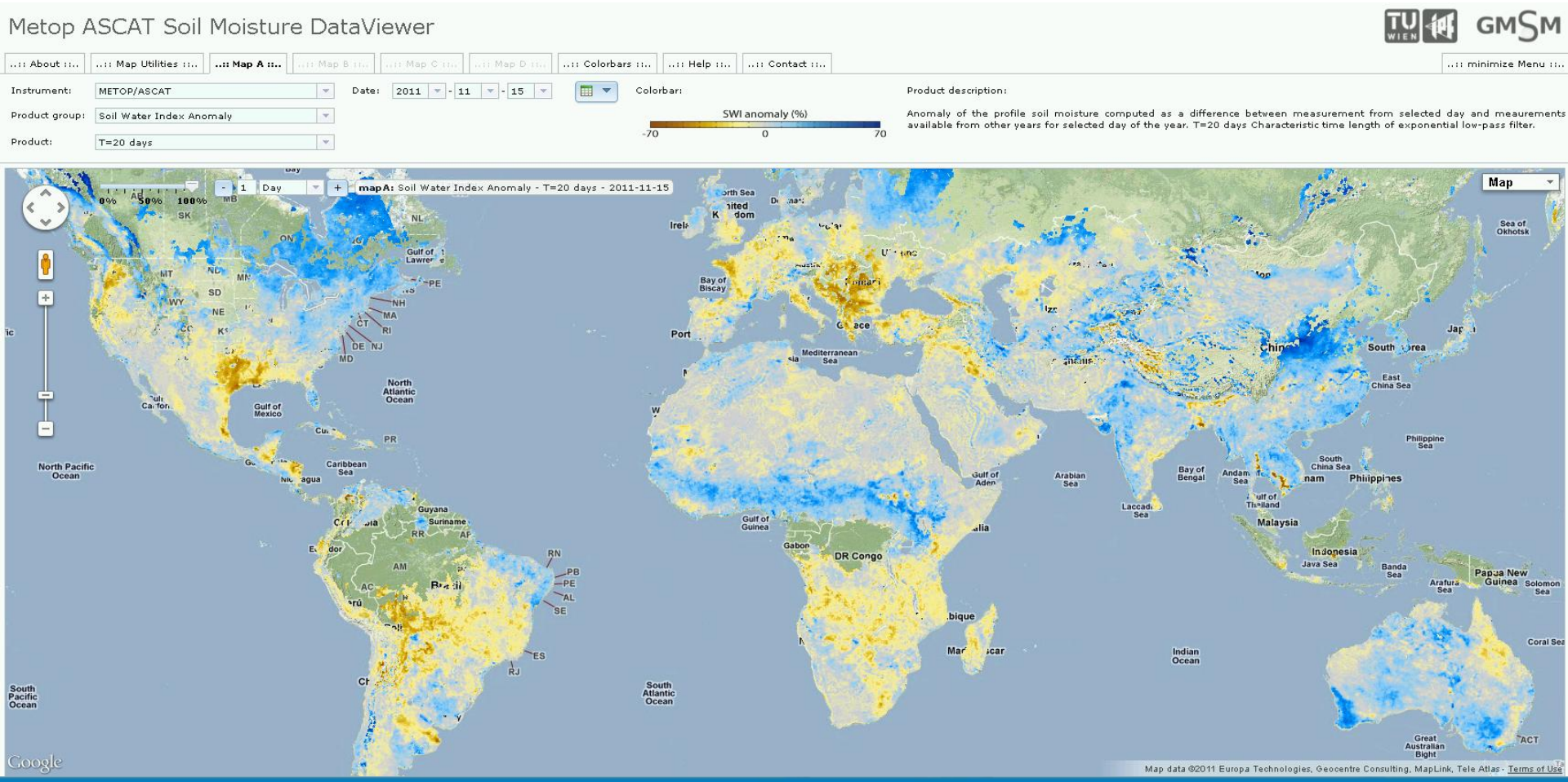


# Global Component
# Water variable - Soil moisture

- **Soil moisture is needed**
  - by all GEO Social Benefit Areas and was ranked the second top priority parameter (behind precipitation) in a year 2010 GEO report on „Critical Earth Observation Priorities“
- **Geoland 2 ASCAT Soil Water Index**
  - Level 3 product based on EUMETSAT’s Level 2 product, the only global NRT soil moisture service worldwide
  - Estimate of the profile soil moisture content: easier to use & more relevant in terms of the applications
- **Long heritage since 1999**
  - Widely validated by independent research teams
  - SWI algorithm now also used with other soil moisture products (AMSR-E, SMOS, etc.)

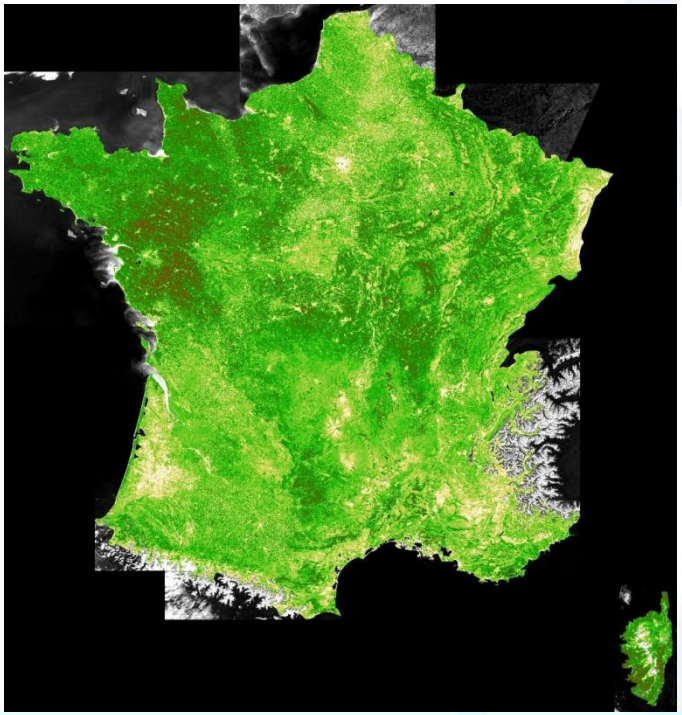
# Global Component
# Water variable - Soil moisture

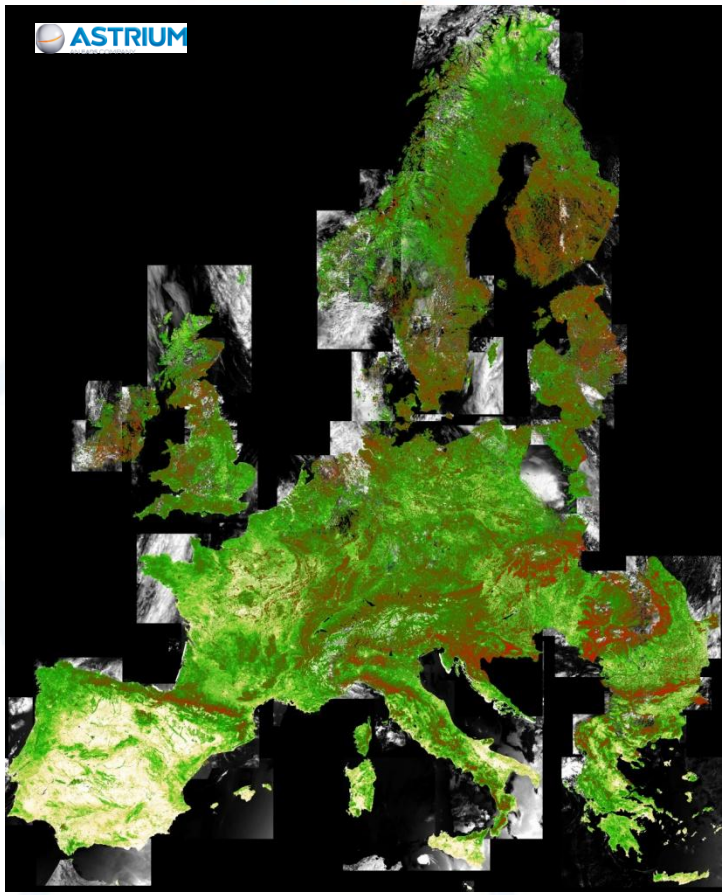
- **Applications**
  - Prediction of next month‘s vegetation status, improved runoff prediction, drought monitoring etc.



# Global component
# Vegetation variables over Europe

- **MERIS full resolution products over Europe**
  - ‘basic’ parameters: LAI, FAPAR, fCover
  - 'advanced' parameters: Chlorophyll, fBrown, Canopy Shade Factor
  - 1 year from March 2011 to April 2012
  - Provided by country






FAPAR
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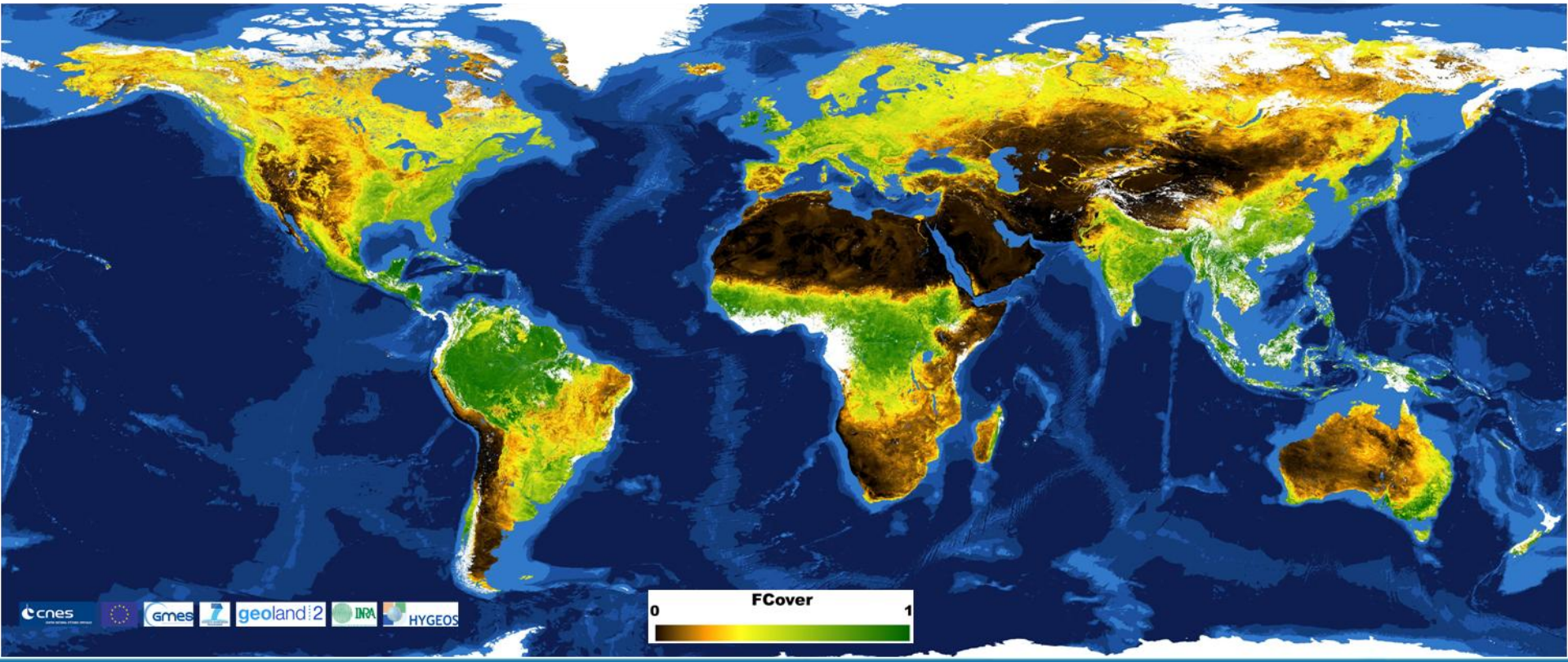
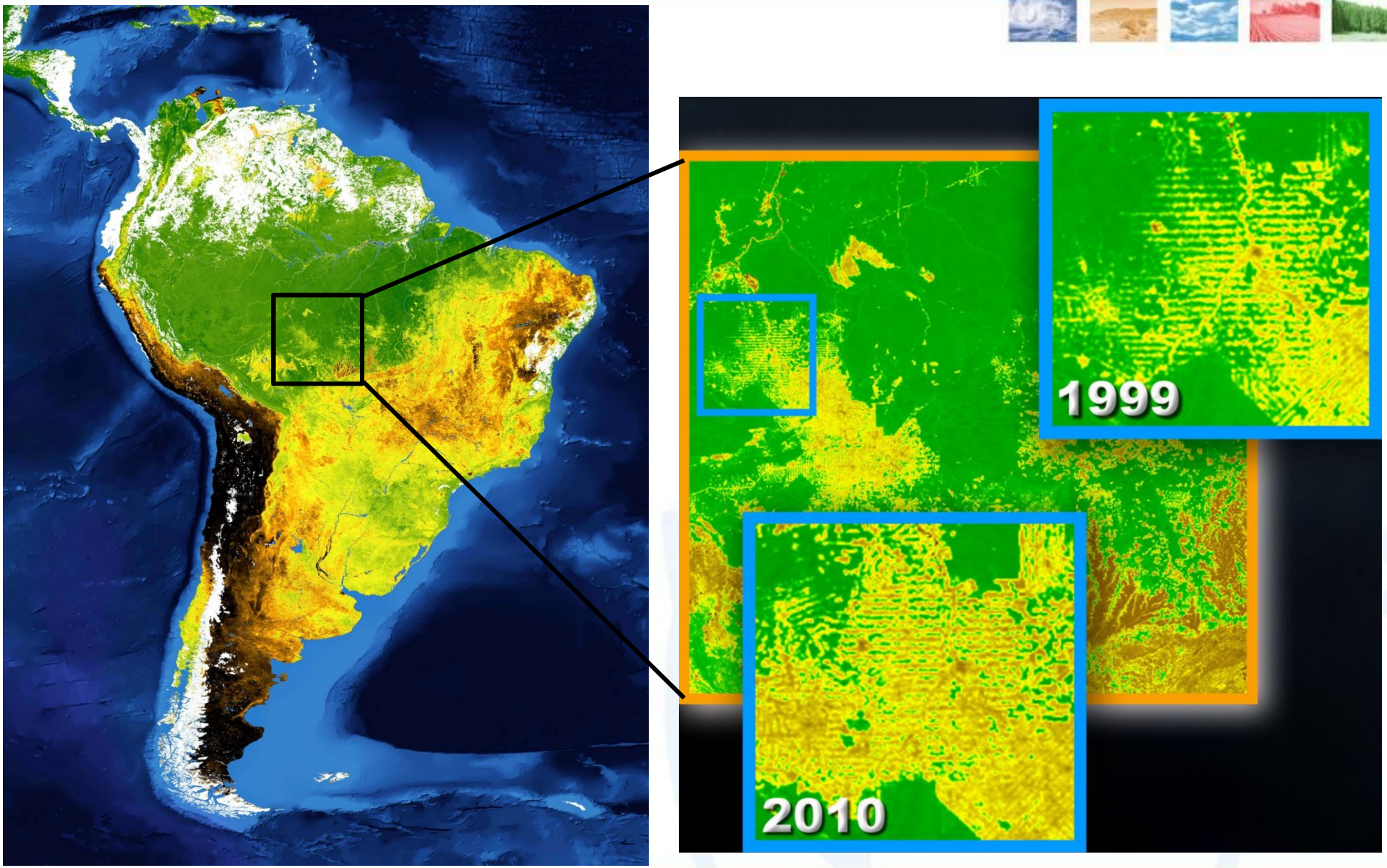
# Global component
# Vegetation variables

- **LAI, FAPAR  (terrestrial ECV) + FCover and NDVI**
- **NRT Global products from SPOT/VGT, from 1999 to present**
- **Complemented (from 1982) by AVHRR/NOAA products**
- **More than 30 years of fully consistent time series**



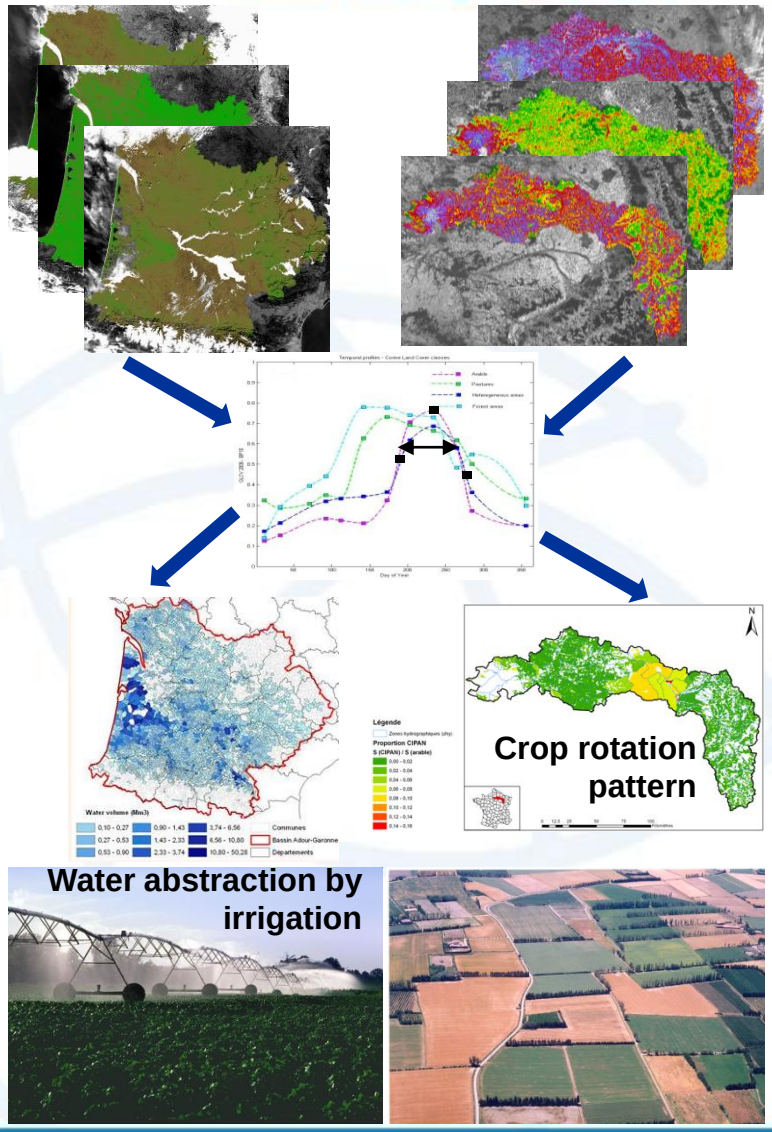
# Global Component
# Deforestation extension



# Global Component
# Biophysical variables : Agri-environment - 1

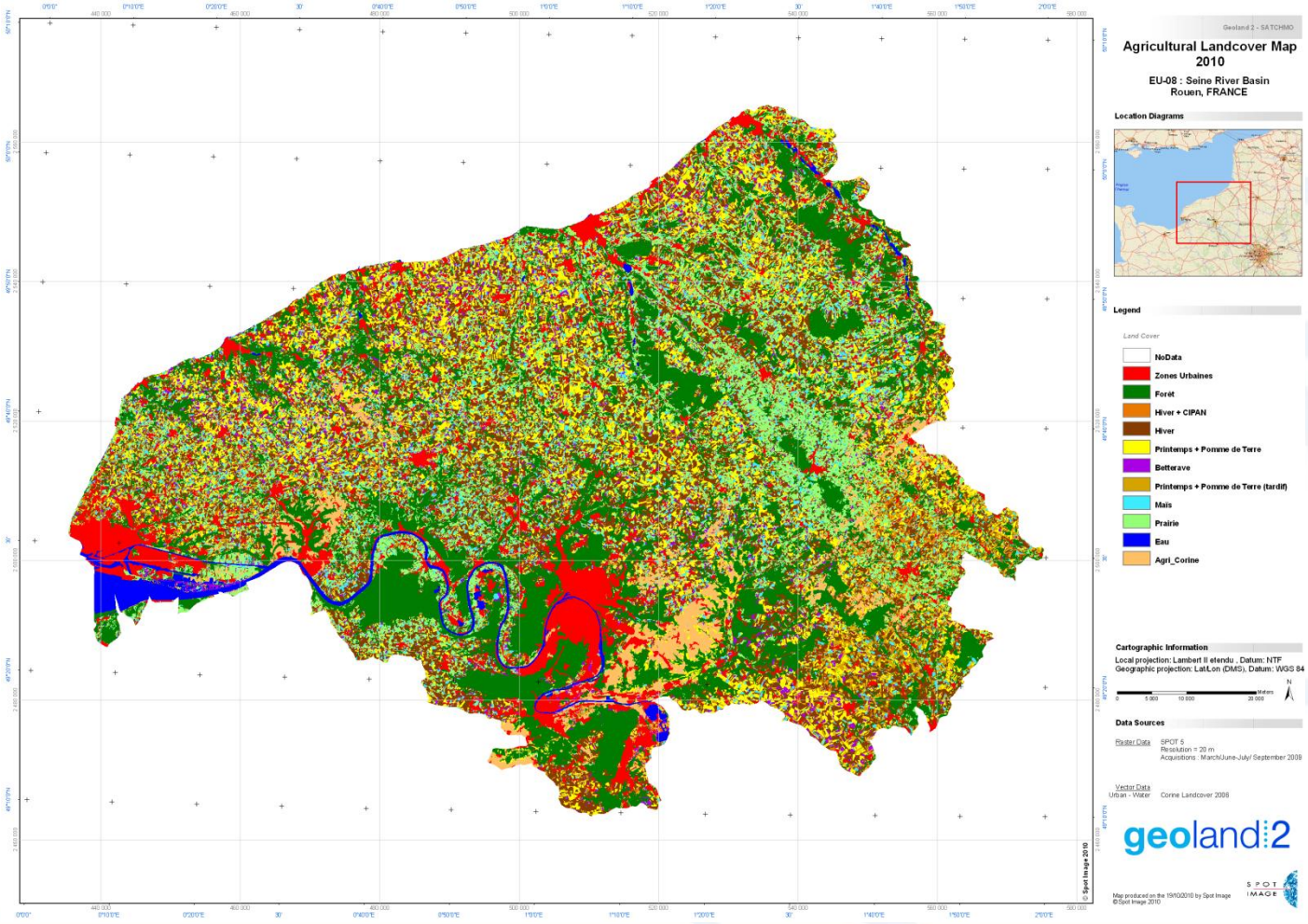
- **Agri-environment:**
  - Exploiting the HR & MR time series of biophysical variables
  - Deriving phenological trends and set-up agri-environmental indicators

- **Benefit:**
  - Better timely monitor the agricultural land use state and its changes
  - Analyses their impacts on biodiversity and landscape at the European, national and regional levels.
  - Fulfill needs of users
    - involved in the definition of European directives (Soil Thematic Strategy, Water Framework Directive, Nitrate Directive), and of the CAP
    - Responsible of the implementation of European directives in MS



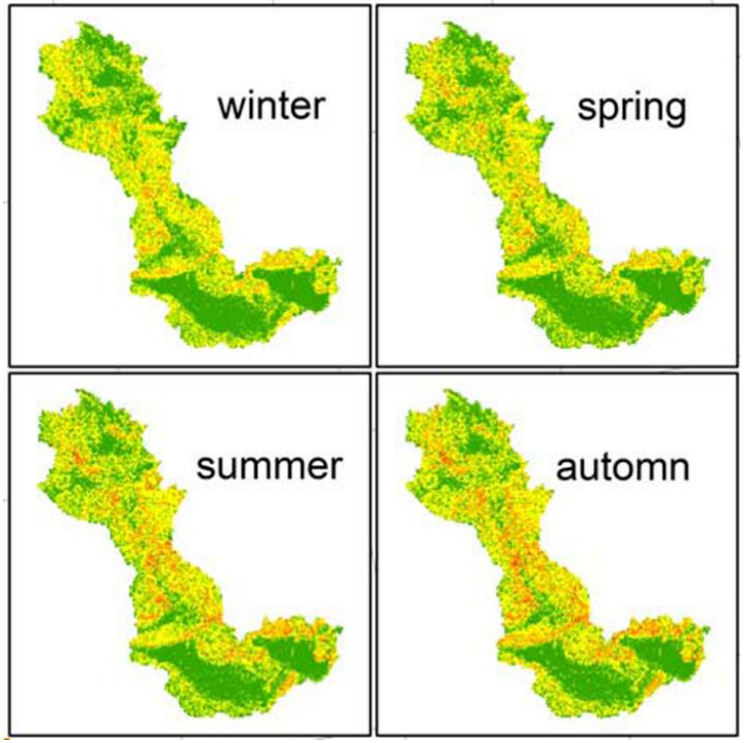
# Global Component
# Biophysical variables : Agri-environment - 2

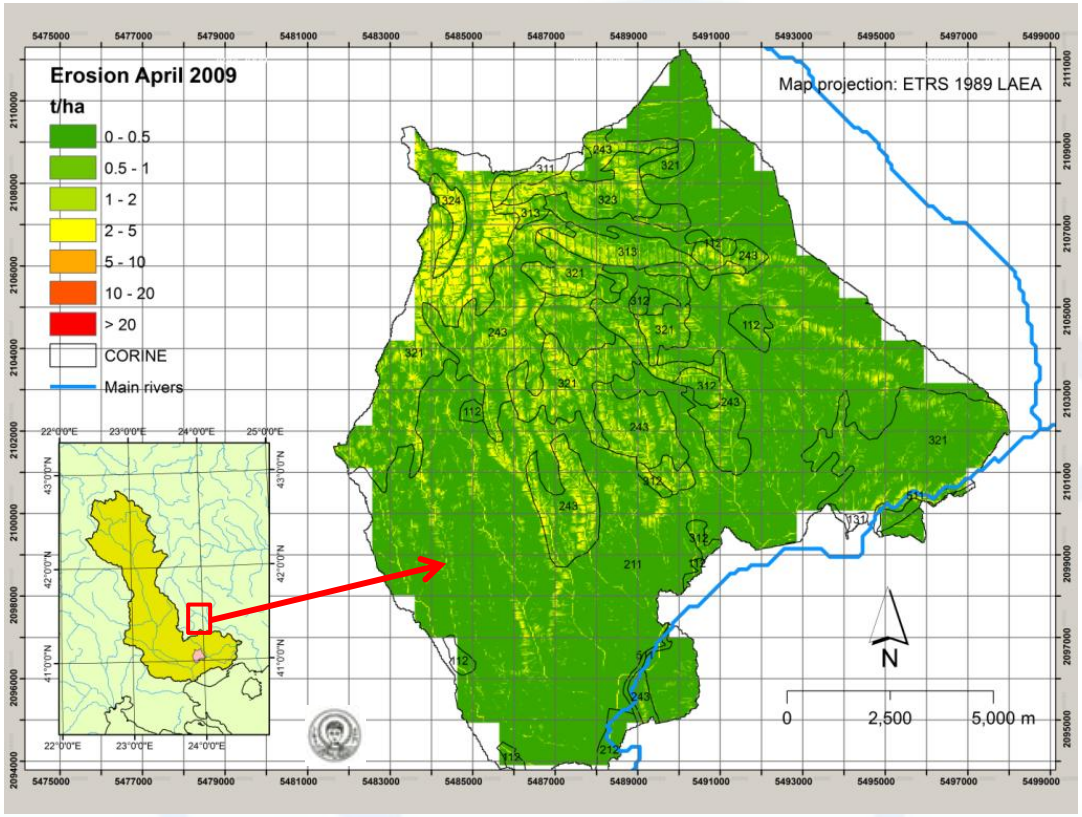
- **Agricultural land cover map (10m) – 2010**
  - For Agence de l'Eau Seine-Normandie



- **Regional and local erosion risk maps**
  - From LAI and Fraction of soil + erodibility model

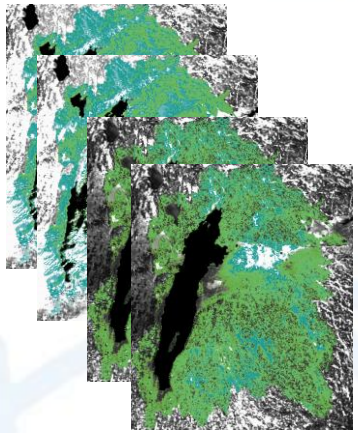
Strymonas-Struma catchment (Bulgaria + Greece)

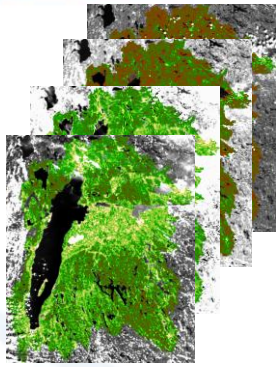


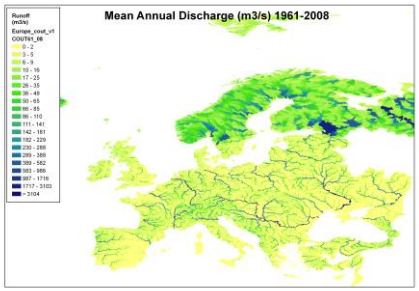



# Global Component
# Biophysical variables – Water management

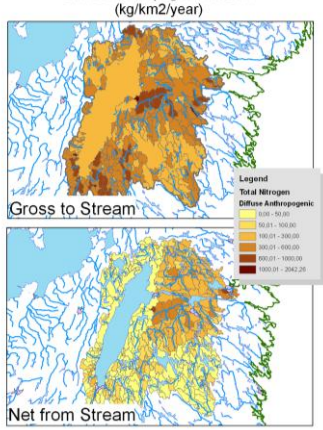
- **Water:**
  - Exploiting time series of vegetation and water variables to improve and/or validate model output.
    - Crops phenology related to nutrient load
    - Snow melting related to runoff
    - Water bodies maps related to location, surface area, and time-varying surface/volume of lakes.
- **Benefit:**
  - Flexible, Sustainable and cost-efficient water management in Europe
  - Water Framework Directive (WFD) and the Flooding Directive.
  - Fulfill the needs of European, national, regional & local users involved in the implementation of these directives.







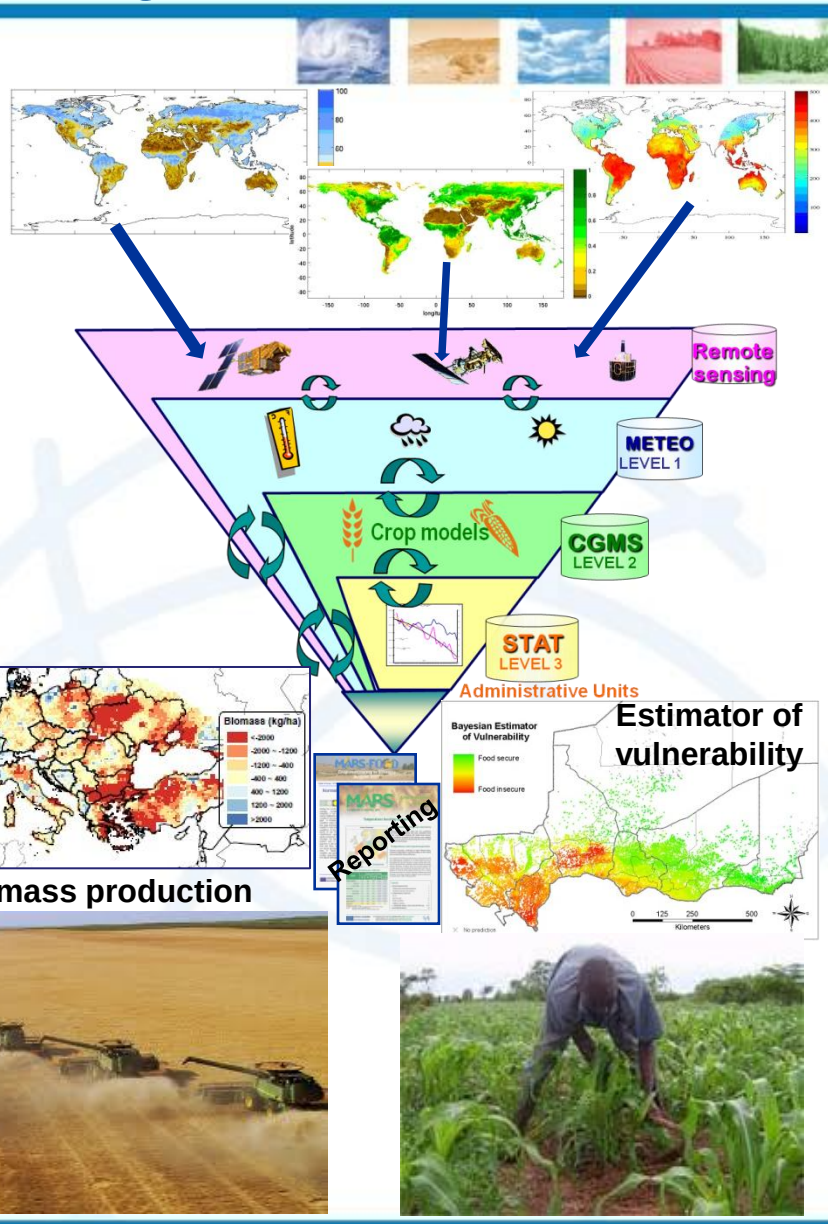

Discharge of European rivers




Nutrient load

# Global Component
# Biophysical variables – Crop monitoring

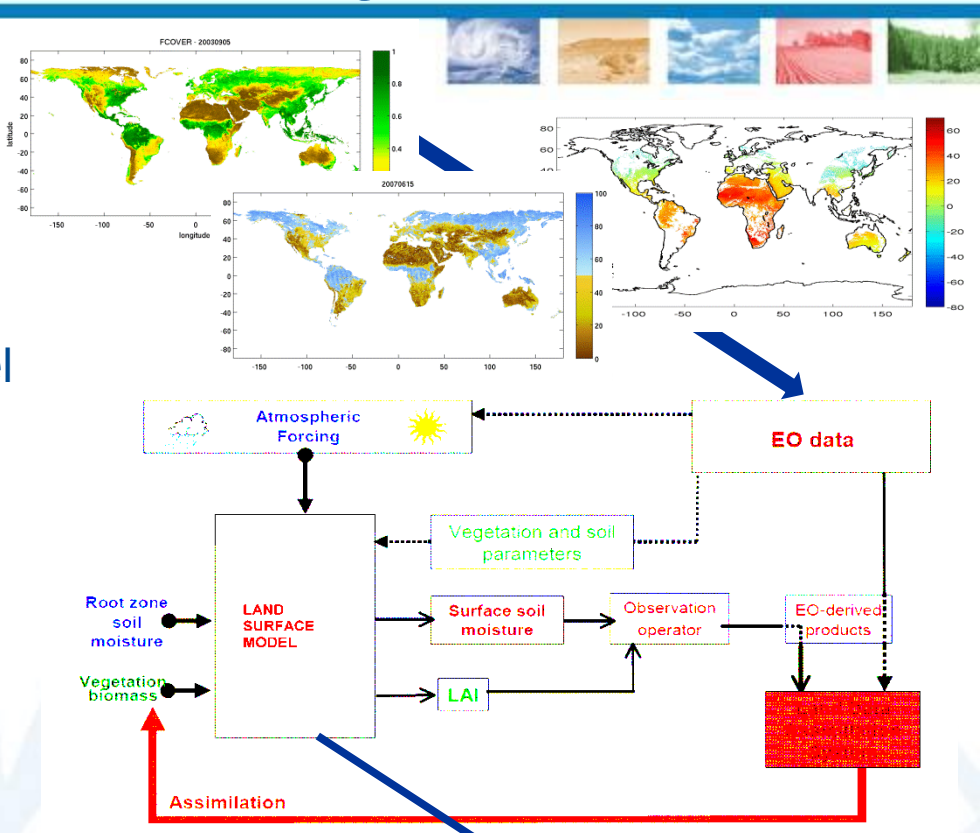
- **Crop Monitoring and Food Security**
  - Integrated analysis: remote sensing data, agro-meteorology models and field observations
  - Indicators based upon inter-annual and long time series analysis to detect trends and anomalies
- **Benefit:**
  - Provides objective, near-real time crop assessment and yield forecast
  - Fulfill the needs of:
    - DG AGRI and EUROSTATS for trading related information (crop conditions, yields, and area estimates) covering Europe and emerging countries.
    - DG RELEX (e.g. Aidco) for early warning in potentially food insecure area
    - UN Organizations (FAO, WFP,…)



# Global Component
# Biophysical variables – Carbon monitoring

- **Terrestrial Carbon Monitoring**
  - Reprocessed and NRT LAI, soil moisture variables, and radiation variables
  - Assimilation in land surface model
  - Global & regional analyzed LAI, soil moisture, carbon & water fluxes, biomass, C storage

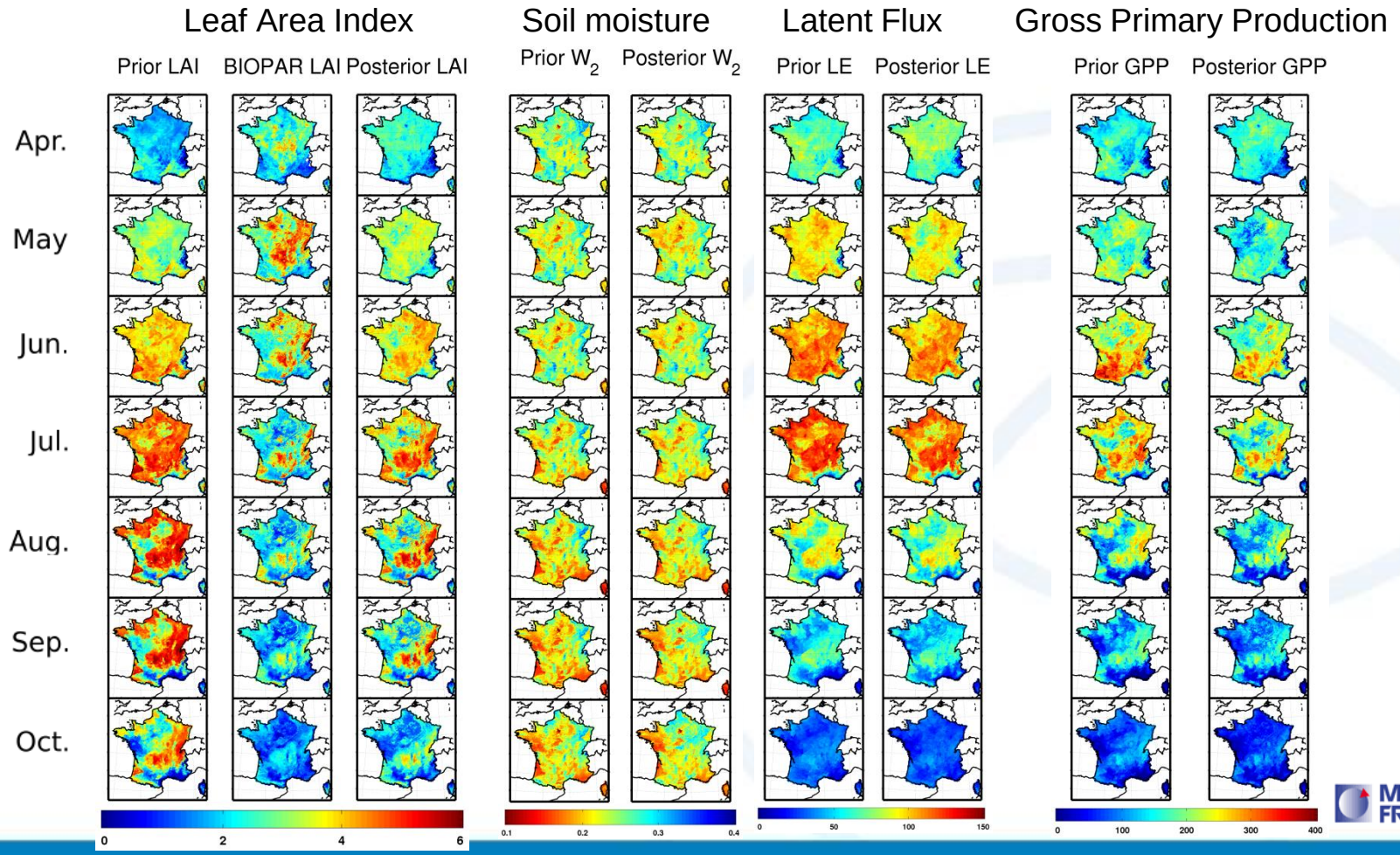
- **Benefit**
  - Understand and assess the impact of weather and climate variability on terrestrial biospheric carbon fluxes, in the context of international conventions (UNFCCC)




**Net Ecosystem exchange of CO2**

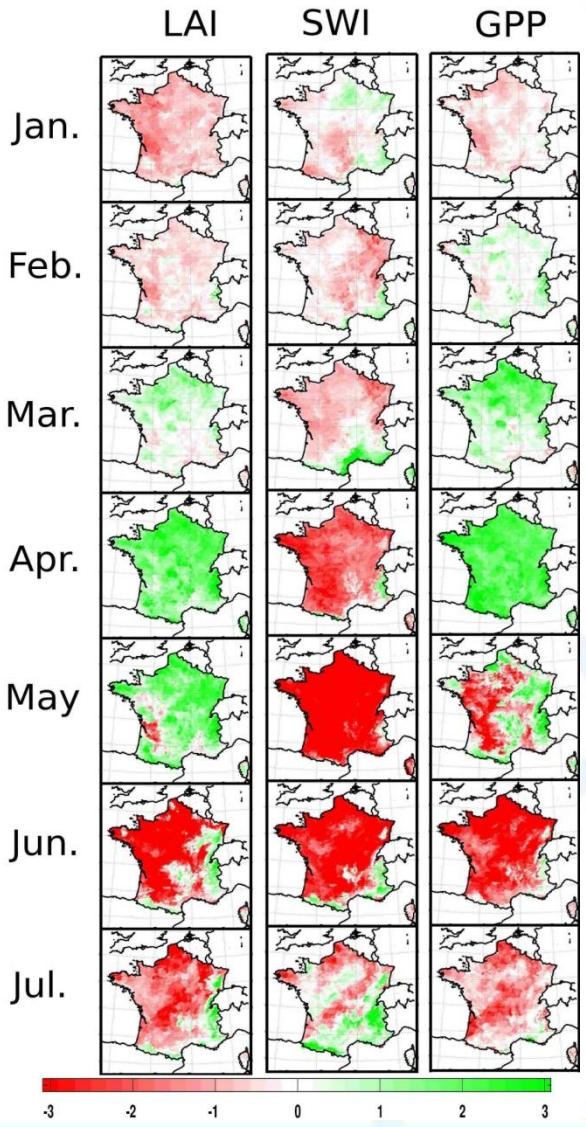
# Global Component
# Biophysical variables – Assimilation - 1

- **Joint assimilation of Leaf Area Index and soil moisture over France (2007)**



# Global Component
# Biophysical variables – Assimilation - 2

- **Drought Monitoring – 2011**
  - Anomalies of LAI, soil moisture (SWI) and GPP
- **Operational over France**
  - Extension to Europe



# Dissemination and Product Access


**Web site: http://gmes-geoland.info**

- Description and portfolio of geoland2 services
- News and events
- Direct links to the web portal


**Portal : http://www.geoland2.eu**

- Discover, view, and order after registration
- Subscription possible for NRT products
- Documents and tools

**Contact: rl@hygeos.com**

Roselyne Lacaze
HYGEOS

# Geoland2 follow-on

- **Operations continue in GIO**
  - Local component: technical coordination by EEA
    - 1st: focus on biodiversity and ecosystem policy, defined in detail in 2013.
    - 2nd: update of Urban Atlas in preparation to be based on 2012 imagery
  - Pan-European Component: technical coordination by EEA
    - Publication of the call for tender made in August 2011
    - First specific agreements began in January 2012
  - Global Component: technical coordination by JRC
    - Publication of the call for tender should be made in June 2012

- **R&D continue through FP7 projects**
  - Adaptation and evolution of methodologies to new sensors capacities (Sentinels missions)

# Announcement

## geoland Forum 8

## Copenhagen, Denmark, 18th -19th October 2012

**Organised by FP7 Fast Track service Land "geoland2" in coordination with parallel GMES and research activities**

Further details and registration will be announced shortly

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