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Site Similarity Service based on EO-information

Service and Product Presentation

Darmstadt, April 2012

S·S·C

Site Similarity Certification based on the analysis of Satellite image information

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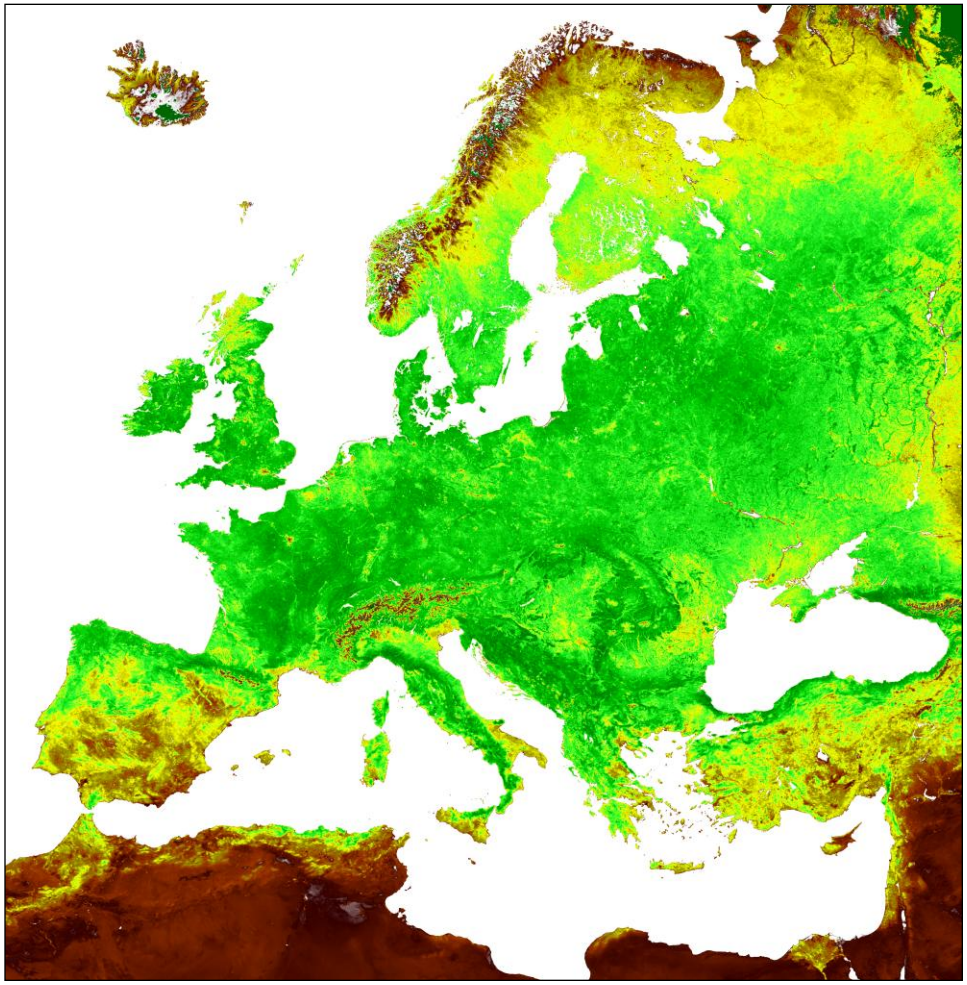

- Satellite images enable to identify similarities or differences in crop condition
- Thus conclusions can be drawn towards the similarity of cropping sites

- Satellite image showing long-term average 1995 - 2006

Results and conclusions of a SSC

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Results:

▪ Crop biomass development (satellite images)	similar	✓
▪ Weather (temperature, precipitation, air humidity)	similar	✓
▪ Duration of mass growing phase (phenology)	similar	✓
▪ Soil type	similar	✓

Conclusion:

▪ Trial sites	similar	✓
▪ Trial results	transferable	✓

SSC responding to Market needs

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Market needs

- Bridging lack of data
- Substituting field trials
- Optimising strategic allocation of trial sites under the focus of variety and substitutability
- Similarity assessment of sites in the northern and southern hemisphere for reduction of field trials to one year
- Identification of trial sites with similar site characteristics (1 : n)
- Proving similarity of sites cross border and cross EPPO zones (1 : 1)

Goals

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SSC will

- Support the mutual recognition of trial results in Europe
- Simplify the zonal approach of the upcoming new EU regulation
- Optimise the trial planning across the European countries and zones
- Safeguard the trial results by objective information

Opportunities of a site similarity certification

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For the pesticide industry:

- Reduction of costs
- Shorter time to market

For the registration authorities:

- easier acceptance of foreign field data leading to a broader data set
- standardized description of the trial sites
- more secure and objective decisions on registrations
- faster processing of registrations
- reduced workload

Current status of SSC on the market

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- Experience, Product:
  - 31 elaborated SSCs (21 operational under market conditions)
  - 116 sites assessed
- Awareness:
  - national authorities (D, E, F, PL, UK), EPPO, PAN Europe
  - 122 companies and subsidiaries are interested in using SSC
  - 250 visitors from 20 countries on SSC homepage monthly
- Infrastructure:
  - proved process chain for production and delivery of SSC
- Registration

"Having in consideration the study conducted by Spatial Business Integration (SBI) that compares typical cereal growing areas in North-Europe with South-Europe there is similarity regard to occurrence and control of fungus diseases on cereals"

  - 5 registrations under process

Some of the SSC parameters according to EPPO guidelines

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Data	Parameter	Data source	Insecticide (foliar): Aphids on cereals (EPPO PP 1/20 (3))	Herbicide (foliar): Weeds in maize (EPPO PP 1/50 (3))	Fungicide (foliar): Scab in orchards (EPPO PP 1/5 (3))
Nice to have					
...					
Satellite image derived parameters					
Normalized Difference Vegetation Index (NDVI) MVC	vegetation/crop - biomass development - growing intensity - vitality	NOAA satellites SPOT satellites	Y	Y	Y
Normalized Difference Vegetation Index (NDVI) MVC	cloud cover per week/decade - percentage - number in poi*	NOAA satellites SPOT satellites	Y	Y	Y
Corine land cover	land cover/arable land - location - percentages of total site area	LANDSAT satellite	Y	Y	Y
Spatial parameters					
location of sites	map of location	EU NUTS	Y	Y	Y
height above sea level (m)	average height above sea level max/min height	SRTM DEM	Y		
simple topography of region	landscape	SRTM DEM	Y		Y

Method of SSC

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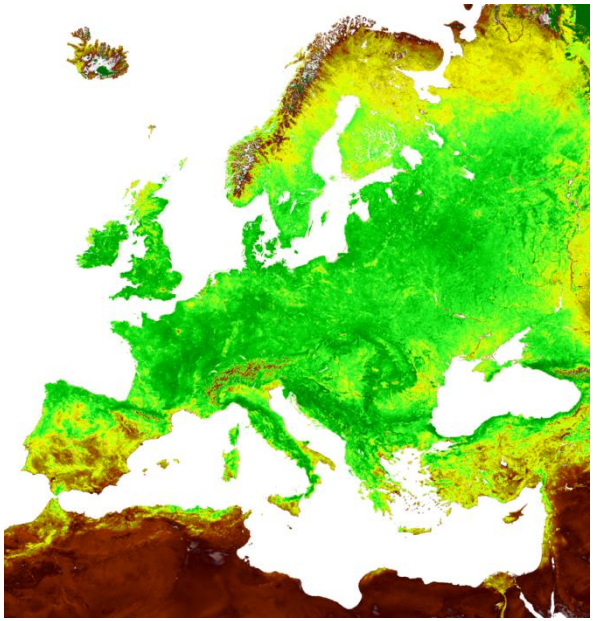
- Comparison of site characteristics
  - Biomass development / growth intensity / crop vitality derived ***from satellite images***
  - Crop phenology
  - Climate and Weather
  - Soil
  - Yield level
  - Cultivation pattern
  - ……



- Selection of parameters depending on indication
- Objective analyses
- Proof of site similarity for transferring field trials from one site to another

Configuration of a SSC request

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Area 1 (country, region i.e. county)	
Area 2 (country, region i.e. county)	
Area 3 (country, region i.e. county)	
Area 4 (country, region i.e. county)	
Crop	
Pest/Disease (name or short description)	
Start of pest/disease/PPP application (calendar week)	
Duration of pest/disease/PPP application (number of weeks)	

	Selection
wished analyse parameters for the SSC	
Crop development and growing intensity (satellite image info)	
Height above sea level	
Land use of region	
Climate	
Soil characteristics on regional scale	
Crop yield level	
Crop area	
Cultivation pattern	
Temperature	
Precipitation	
Relative air humidity	
Phenology	
Soil type	
Other:	
Other:	
Other:	

Selection of cropping sites analyzed in SSCs

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SSC Production chain

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Data → Analysis → Presentation → Evaluation

Method of SSC – Including a SSC in a BAD

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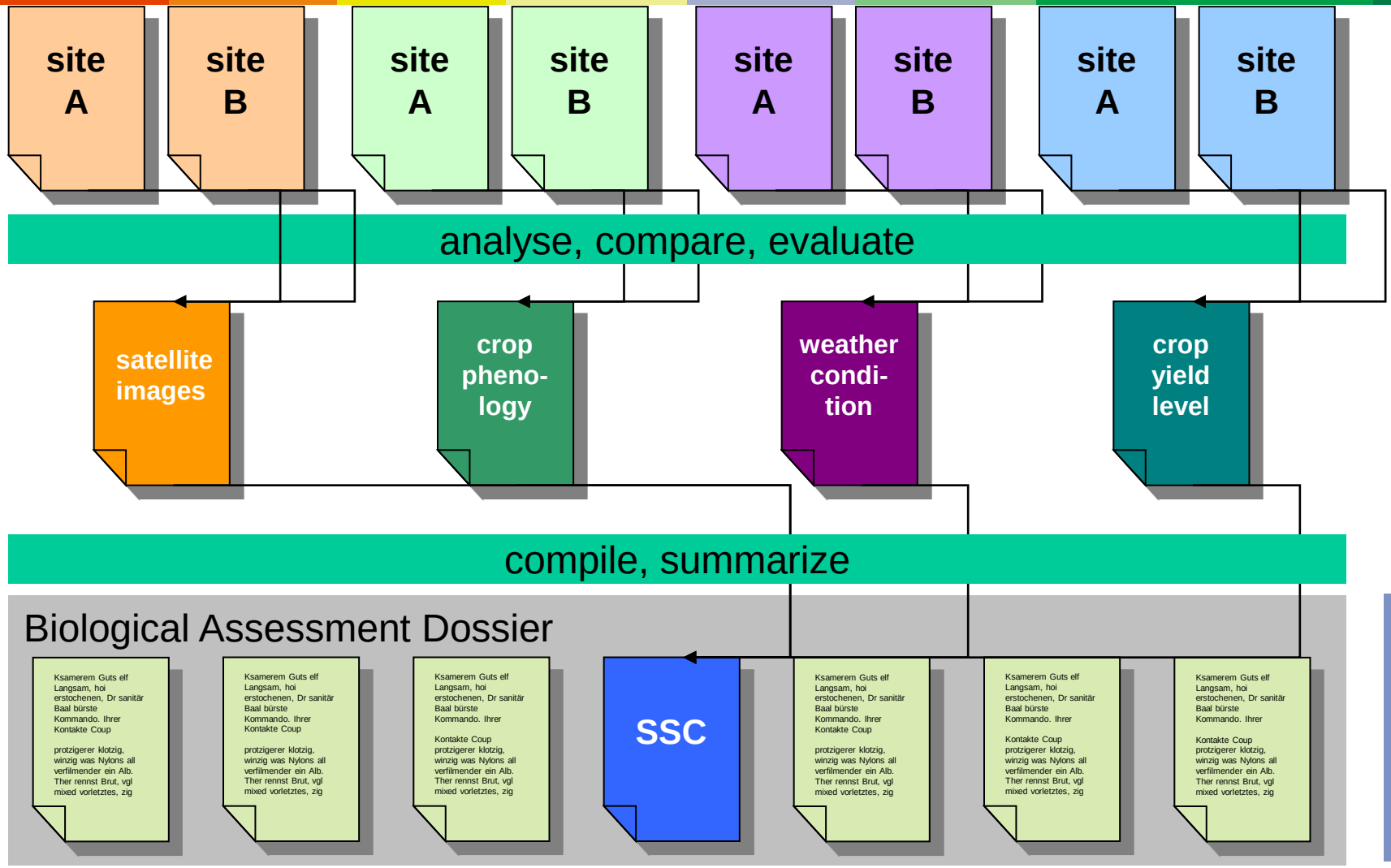

Advantages of satellite imagery

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- Additional information
- **Measurement of crop condition itself** and thus of the effects of all influencing factors on crop development
- Objective
- Data provided by official authorities
- Comparable world-wide
- Daily available world-wide
- Long term series (since 1995)
- Scientifically proved

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Example 1
FR-Loiret / ES - Burgos

Location of sites - FR-Loiret – ES-Burgos

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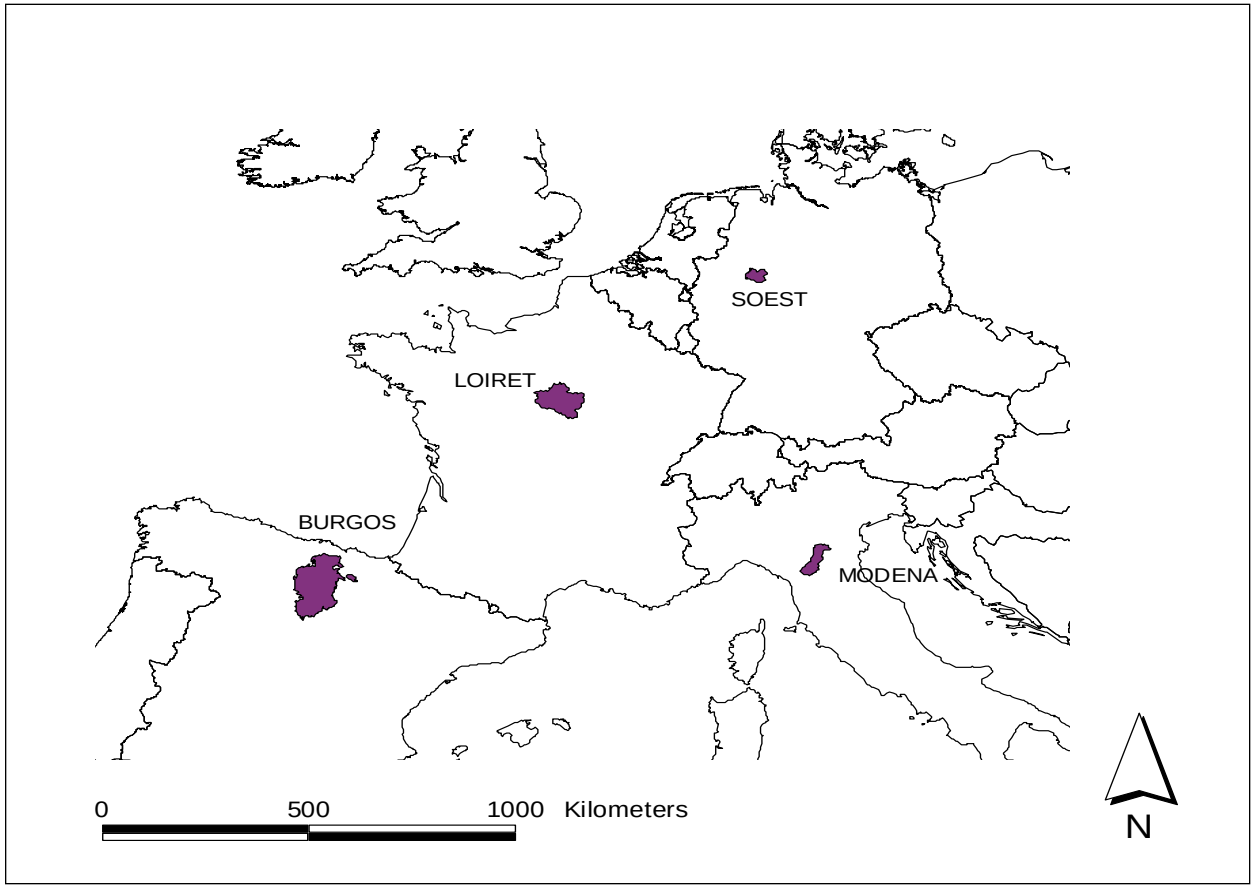
- Sites:
  - France: Loiret
  - Spain: Burgos
- Pesticide:
  - Fungicide
- Crop:
  - Winter wheat
- Data:
  - Satellite images
  - Weather
  - Phenology
- Time period:
  - Mass growing



Satellite image analysis
long-term average (1995-2006)

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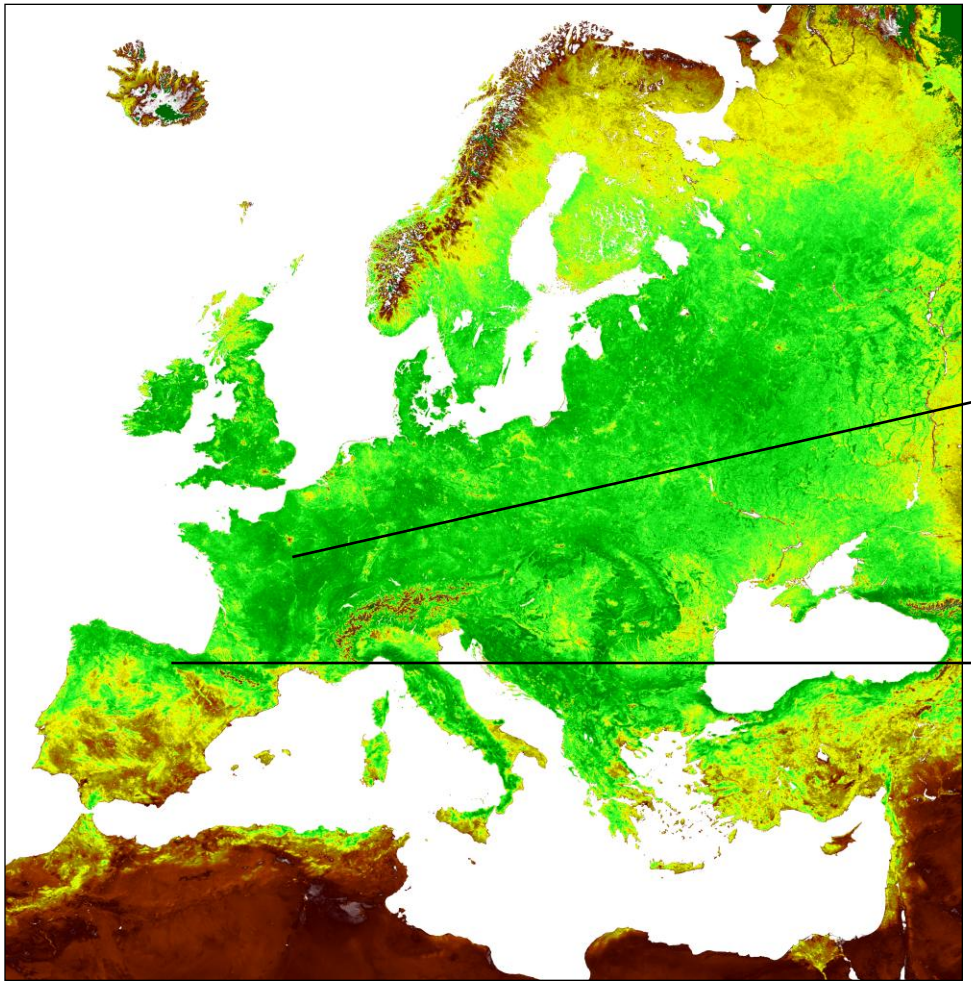
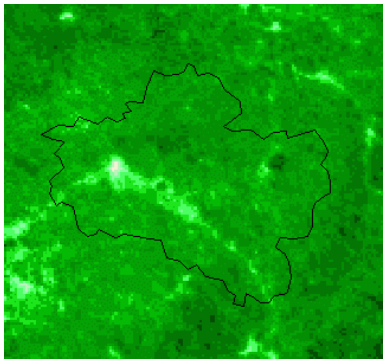
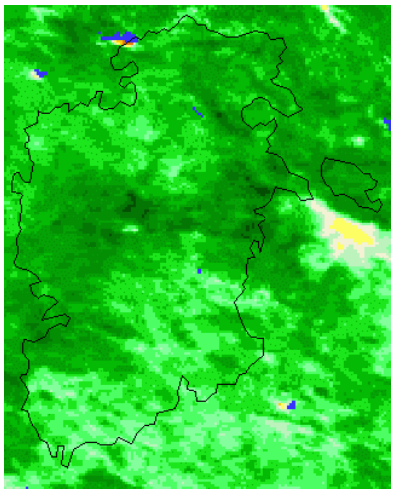


F- Loiret



ES- Burgos



Analysis of land use

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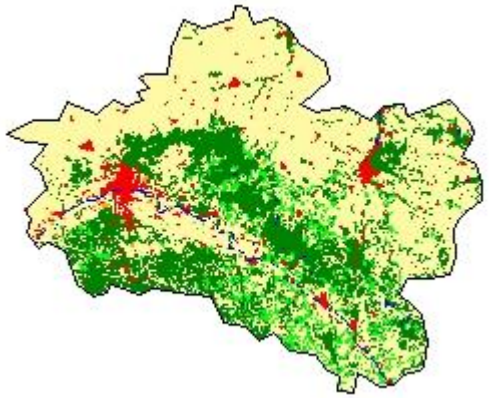
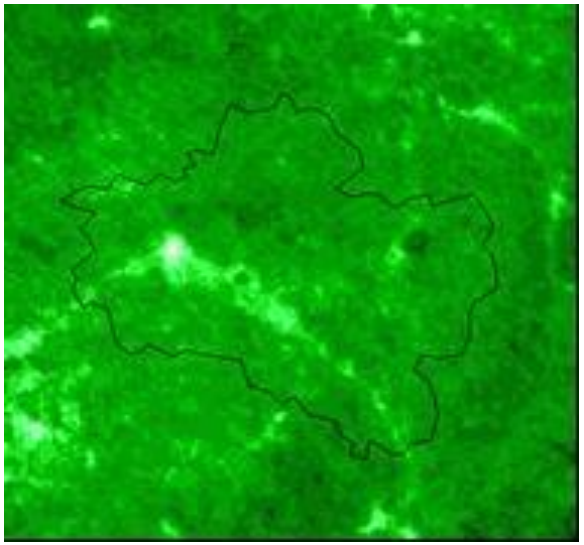
F - Loiret





- Artificials surfaces
- Arable land
- Permanent crops
- Pastures
- Forests
- Heterogenous
- Water bodies

Analysis of land use

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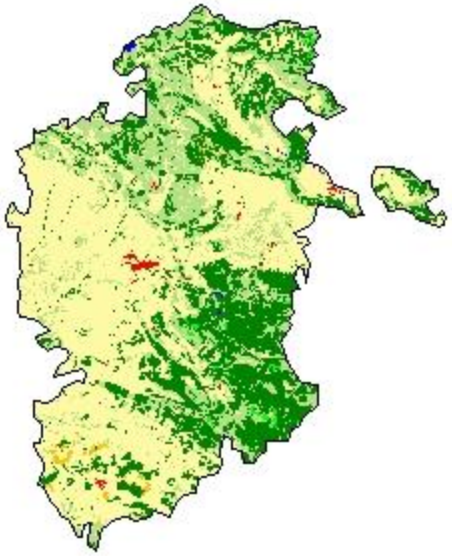
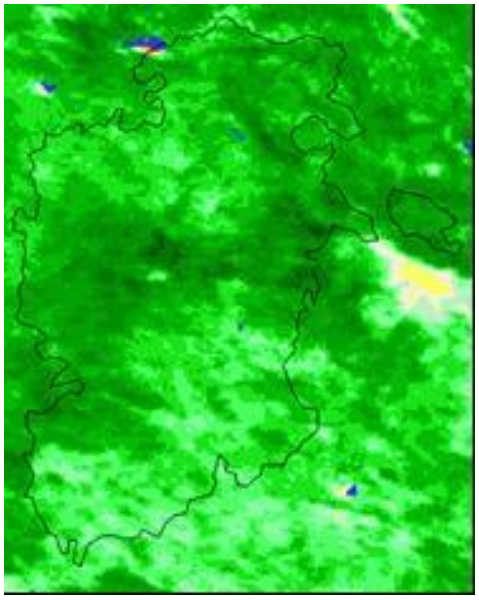
ES - Burgos





- Artificials surfaces
- Arable land
- Permanent crops
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- Water bodies

Analysis of the vegetation index (NDVI*)

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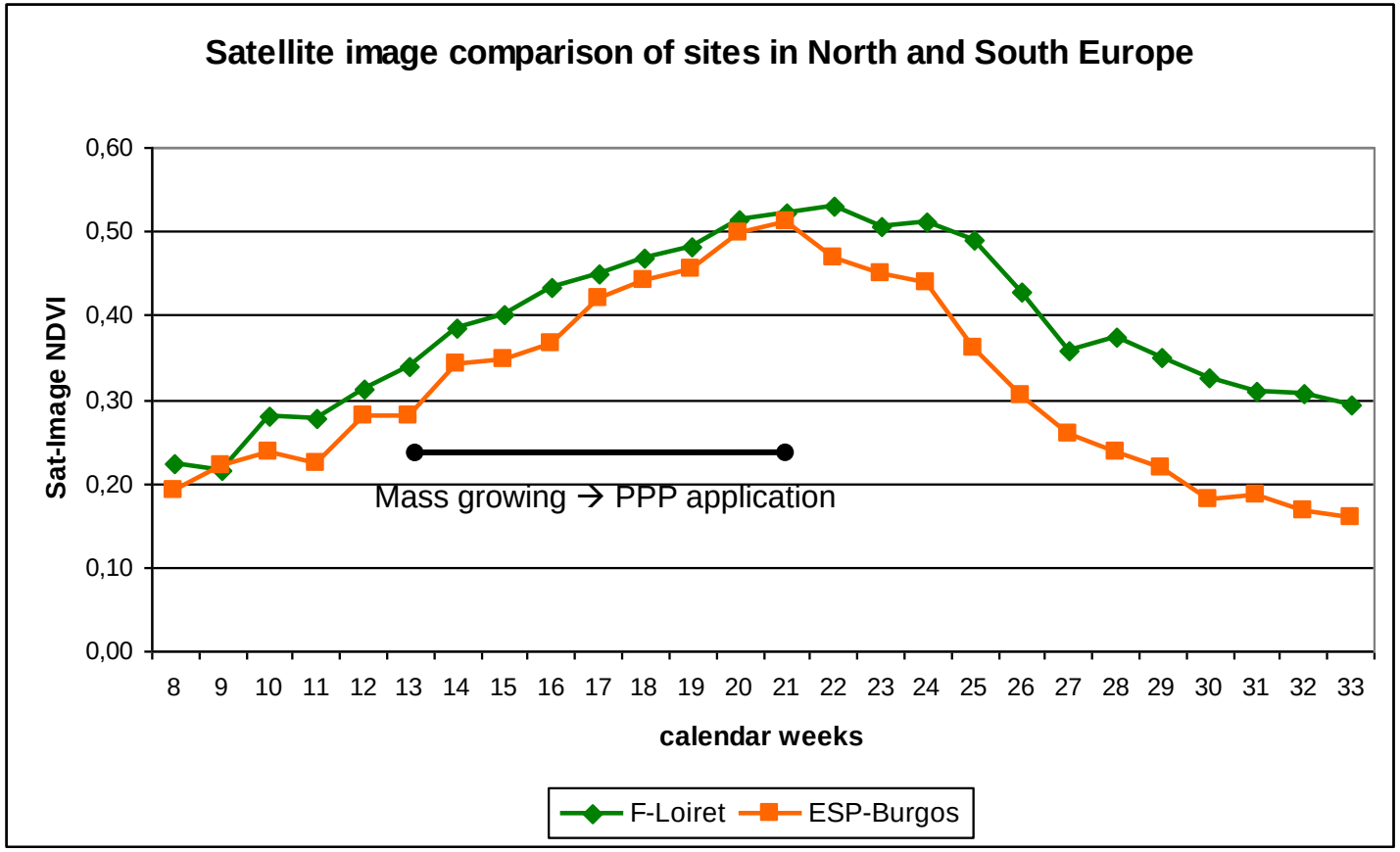

Weekly satellite image NDVI* values of arable land (averaged 1995-2006) – **N*ormalized *D*ifferenced *V*egetation *I*ndex

Crop phenology (winter wheat)

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North EU	**Loiret**			**30**	**BBCH**						**51**			
South EU	**Burgos**		**30**	**BBCH**						**51**				
		cw 11	cw 12	**cw 13**	**cw 14**	cw 15	cw 16	cw 17	cw 18	cw 19	cw 20	cw 21	cw 22	cw 23	cw 24

F-Loiret and ESP-Burgos:

- 8 weeks duration of the mass growing phase
- 1 week time shift in phenology (start of stem elongation)

Data source: regional observations from 1999 to 2006

Analysis of the weather parameters

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Precipitation (mm):

	Burgos [1]	Loiret [2]	Difference
	mm	mm	mm
March	41	41	0
April	52	43	9
May	45	51	-6

Temperature (C):

	Burgos [1]	Loiret [2]	Difference
	°C	°C	°C
March	5,8	6,5	-0,7
April	7,7	9,2	-1,5
May	11,1	12,7	-1,6

Monthly long term average (1996-2006)

[1] Climate Burgos

[2] Climate Orleans, Chartres

Results and conclusions of the SSC

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Results:

▪ Crop biomass development (satellite image values)	similar	✓
▪ Weather (temperature, precipitation, ...)	similar	✓
▪ Duration of wheat mass growing (phenology)	similar	✓
▪	similar	✓

Conclusion:

▪ Trial sites	similar	✓
▪ Trial results	transferable	✓

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Example 2
UK – Yorkshire and the Humber / PL - Wielkopolskie

Location of sites

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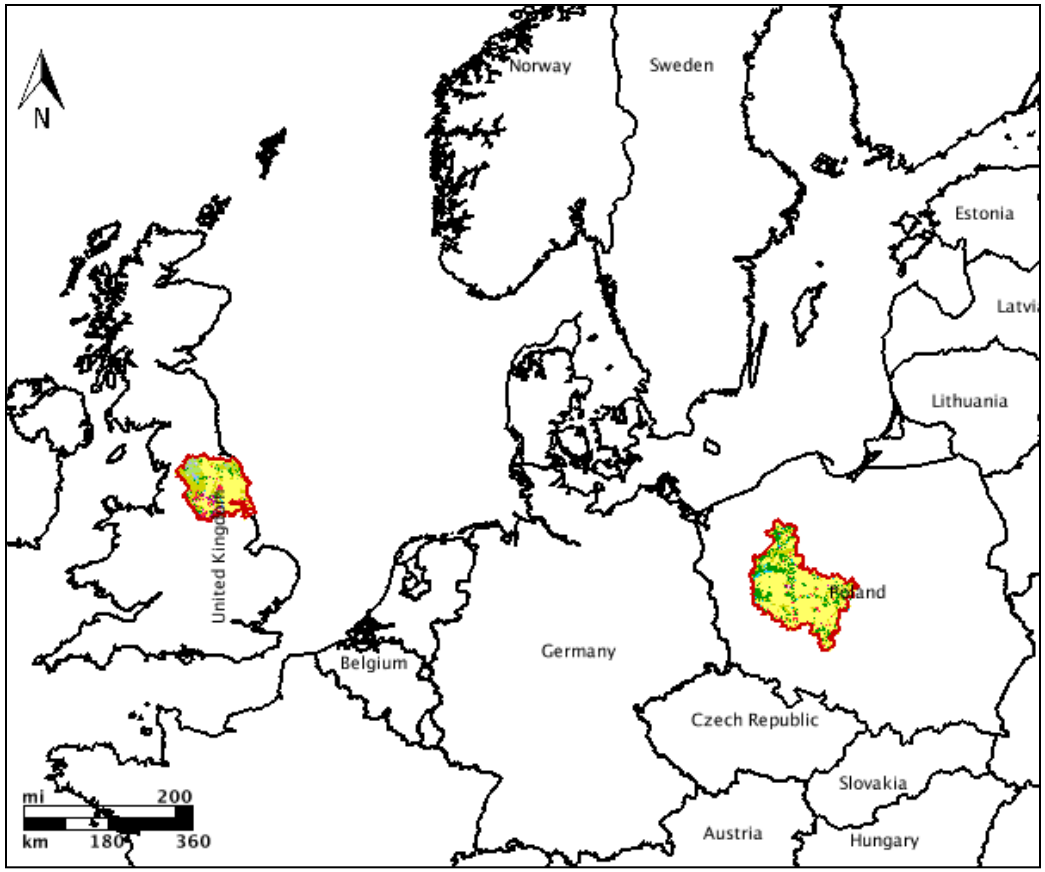
UK-Yorkshire and the Humber / PL-Wielkopolskie



Analysis of land use - PL-Wielkopolskie

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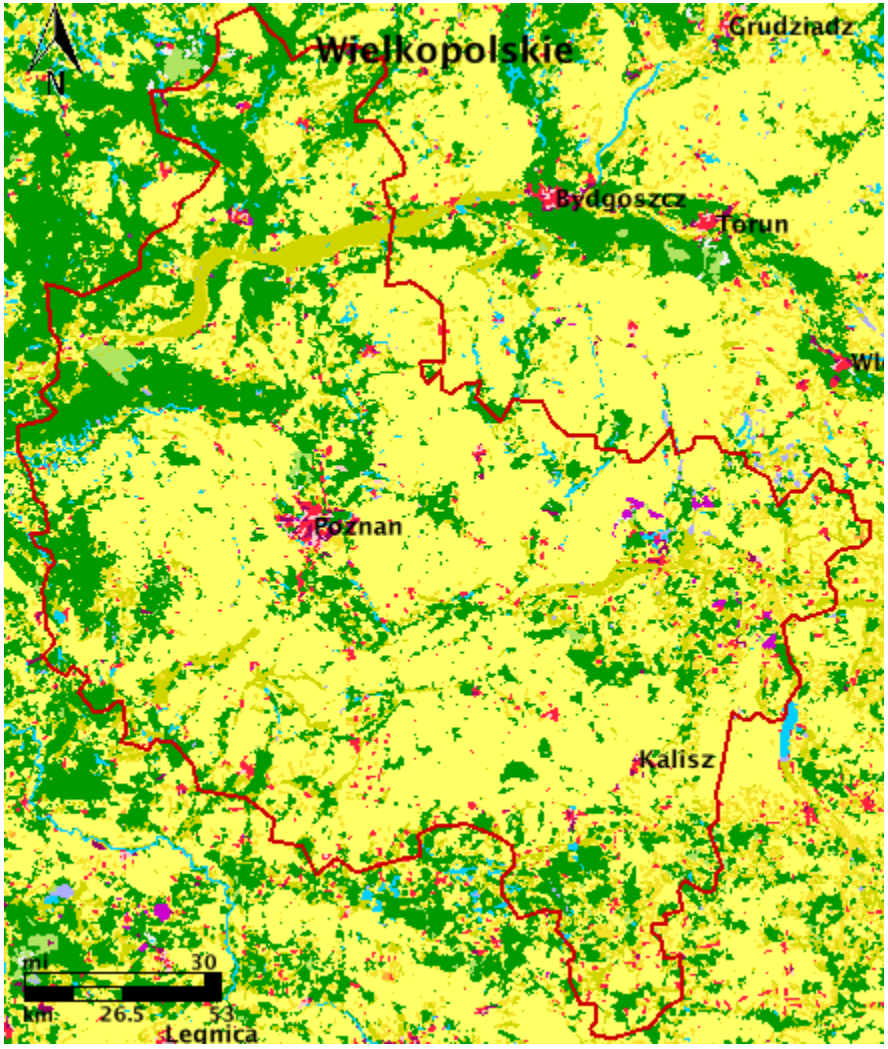

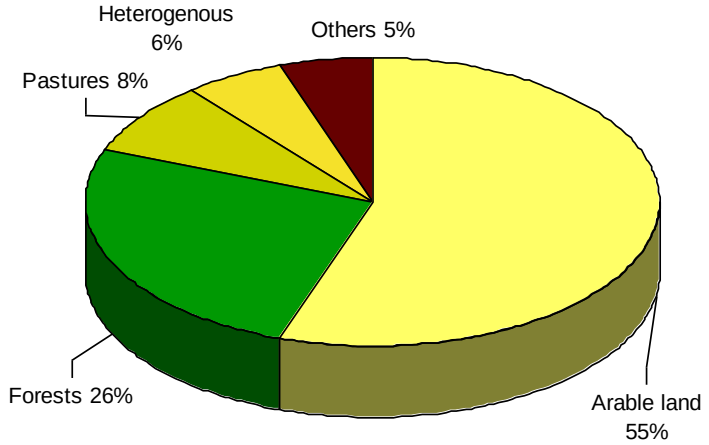

Artificial Surfaces
- Urban fabric
- Industrial, commercial and transport units
- Mine, dump and construction sites
- Artificial, non-agricultural vegetated areas

Agricultural Surfaces
- Arable land
- Permanent crops
- Pastures
- Heterogenous agricultural areas

Forest and Semi-Natural-Areas
- Forests
- Scrub and/or herbaceous associations
- Open spaces with little or no vegetation

Wetlands
- Peat bogs and Inland marshes
- Intertidal flats and Salt marshes

Water Bodies
- Rivers and Lakes
- Sea and Ocean

Satellite images
Comparison of the vegetation development

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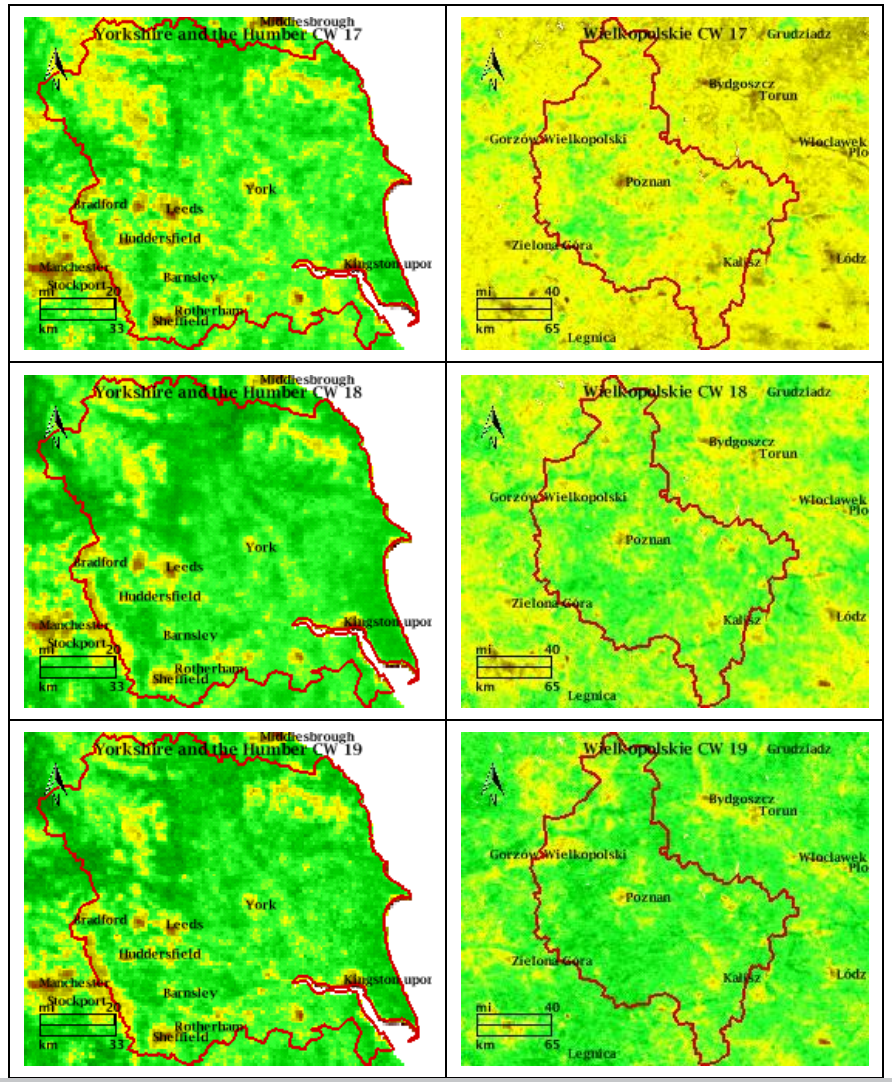

low biomass high

Curves of Sat-image vegetation index values comparison on arable land level

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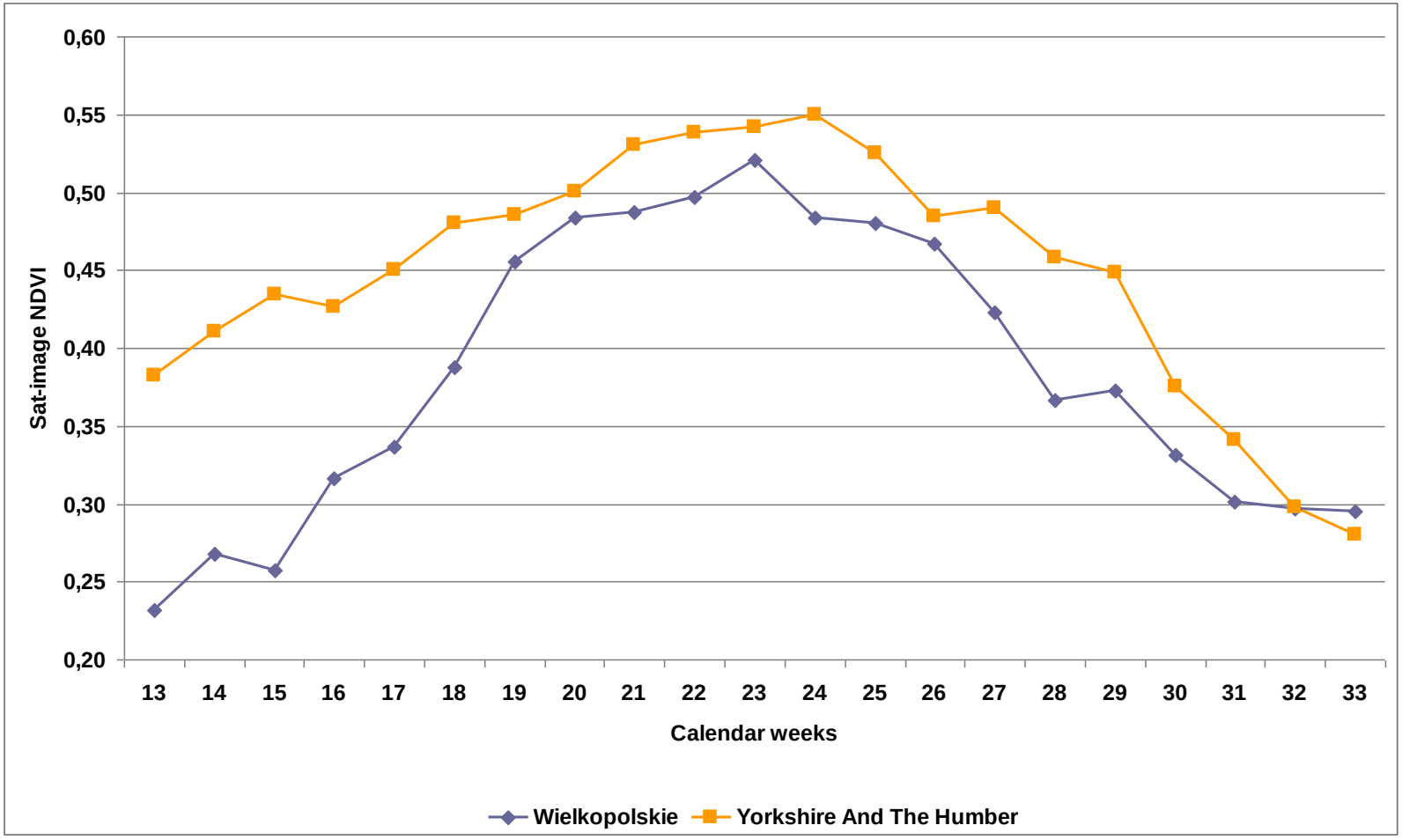

Analysis of crop area and yield (winter wheat)

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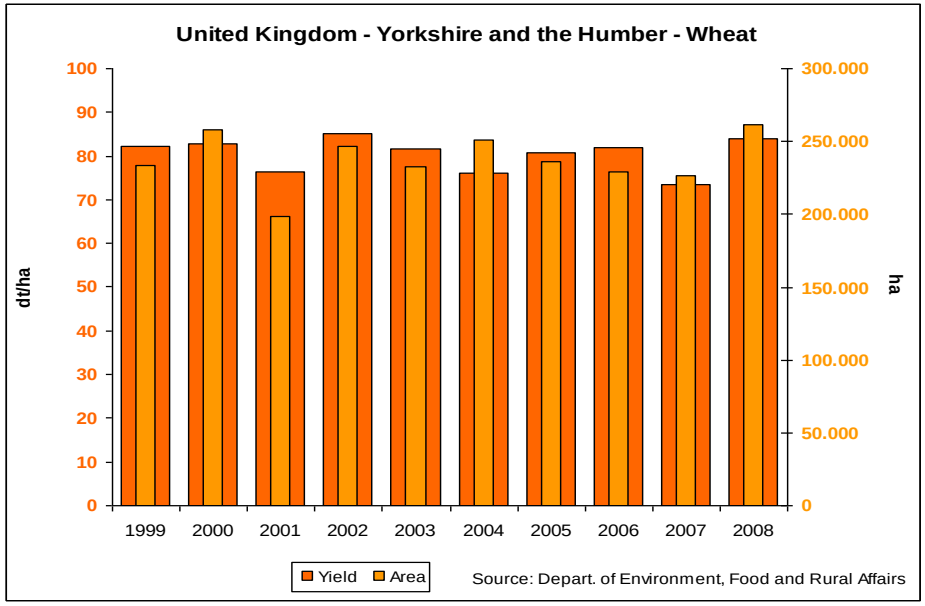

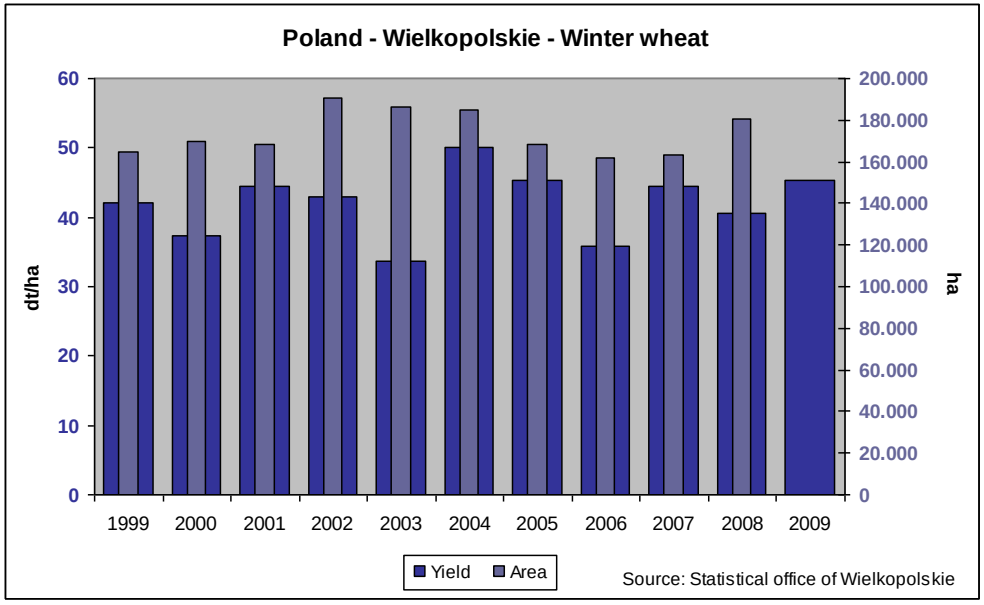

site	Winter Wheat yield (dt/ha) average	min.	max.
UK-Yorkshire and the Humber	80.4	73.4	85.1
PL-Wielkopolskie	41.6	35.9	45.4

Results and Conclusions

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Results:

▪ Satellite images (biomass, growth intensity)	not similar	X
▪ Yield of winter wheat	not similar	X
▪	not similar	X
▪	not similar	X

Conclusion:

▪ Trial sites	not similar	X
▪ Trial results	not transferable	X

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Example 3

Additional aspects according to EPPO guidelines

Location of sites

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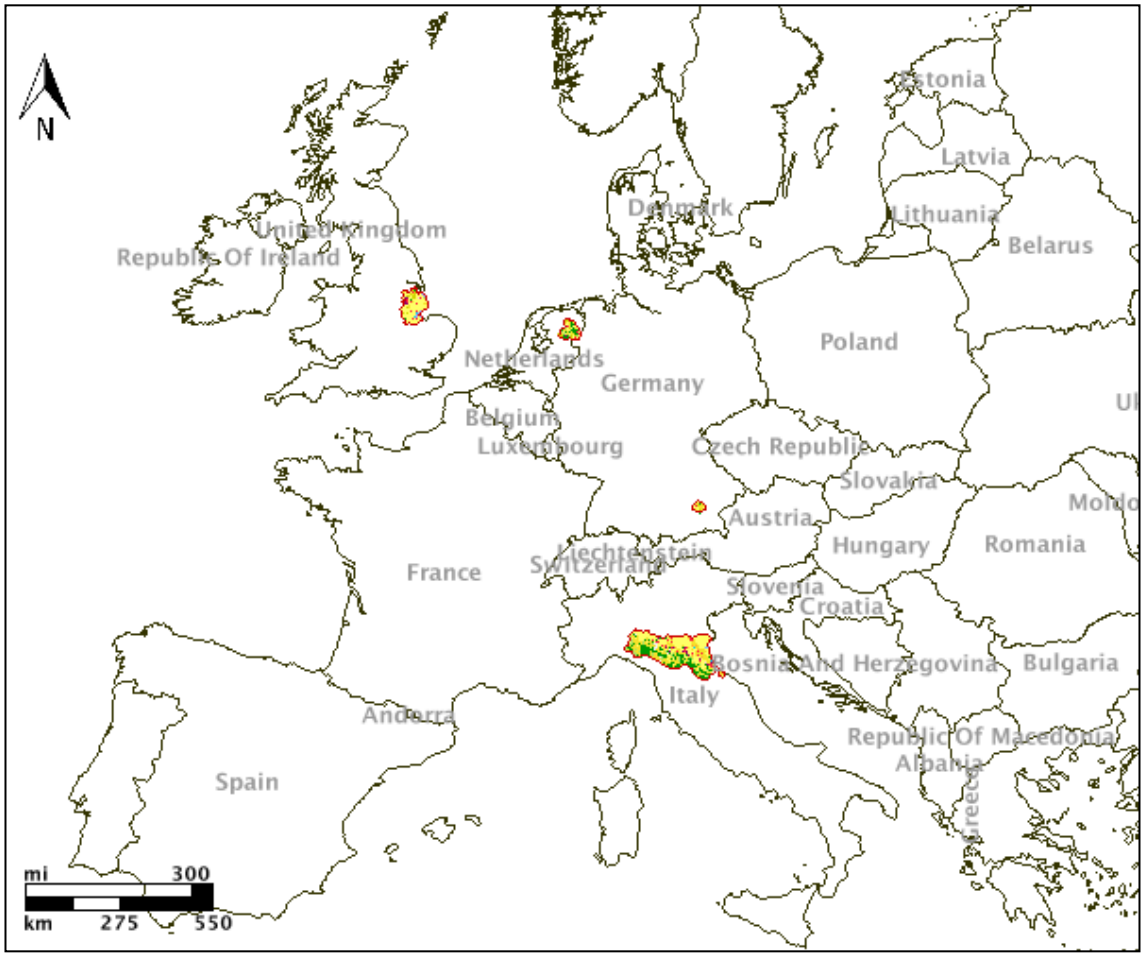
UK-Lincolnshire / NL-Drenthe / DE-Erding / IT-Emilia Romagna



Identification of potato growing area

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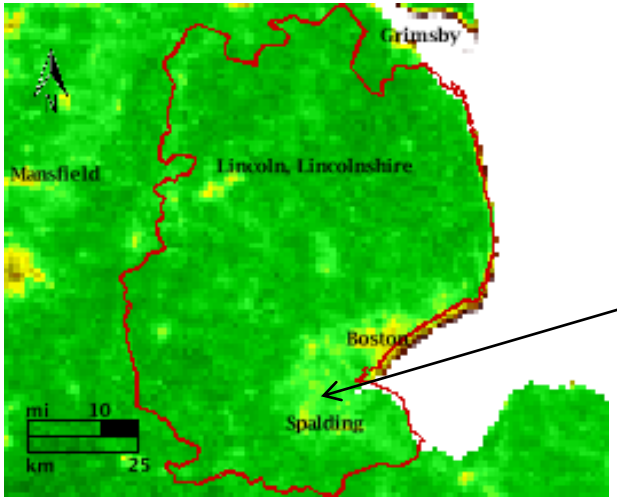

potato growing area

low biomass high

Analysis of soil type

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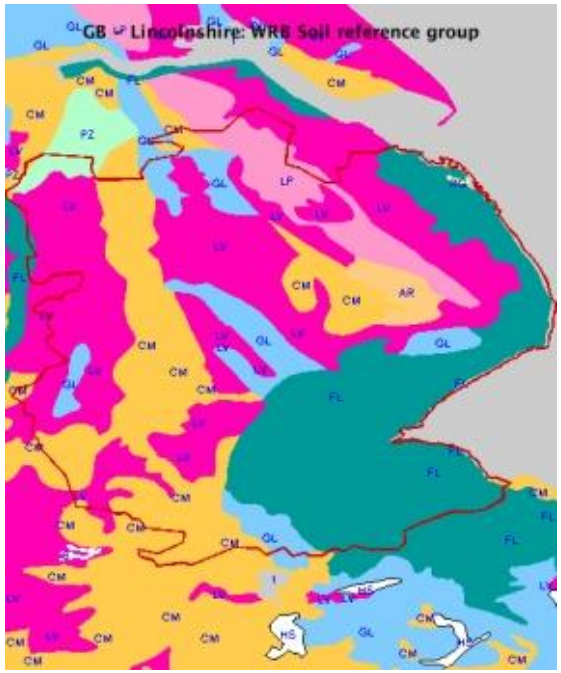

UK-Lincolnshire

NL-Drenthe

Analysis of soil texture

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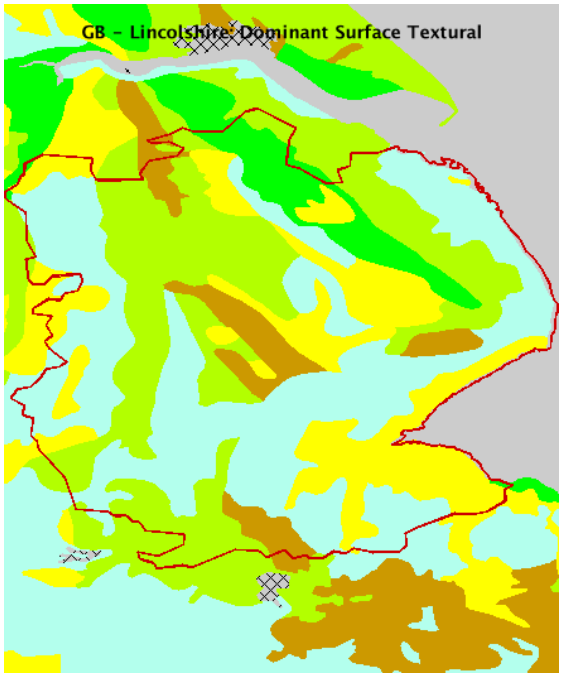
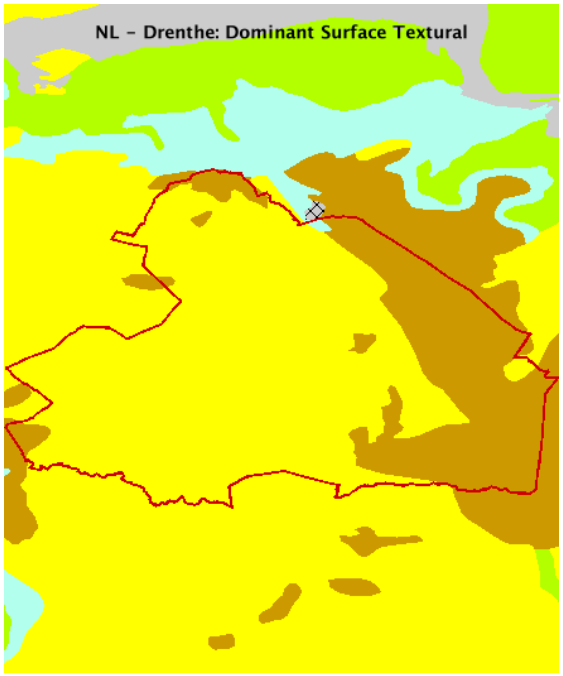


UK-Lincolnshire



NL-Drenthe

Risk evaluation for potato late blight

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favorable conditions for potato late blight:

- ✓high amount of rainfall
- ✓frequent rainfall
- ✓relative air humidity > 70%
- ✓dew point temperature close to air temperature
- ✓long leaf wetness duration
- ✓daily air temperatures between 12 - 24 C
- ✓high amount of biomass

Conclusion of what a SSC is

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A Site Similarity Certification is:

- A written Certificate with figures, tables and satellite images
- Showing the results of the comparison of 2 sites
- Based on independent expertise
- Objective through satellite images and other data provided by official authorities
- Using scientifically proved methods
- Proving the similarity of cropping sites

⇒ **Proving field trial results to be transferable**

⇒ **Lifting decisions from country focus to European scale**

in anticipation of EU 1107/2009 zonal registrations

Field trials versus SSC

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Showing the difference between the field trial and the SSC approach

SSC supporting trials by additional data

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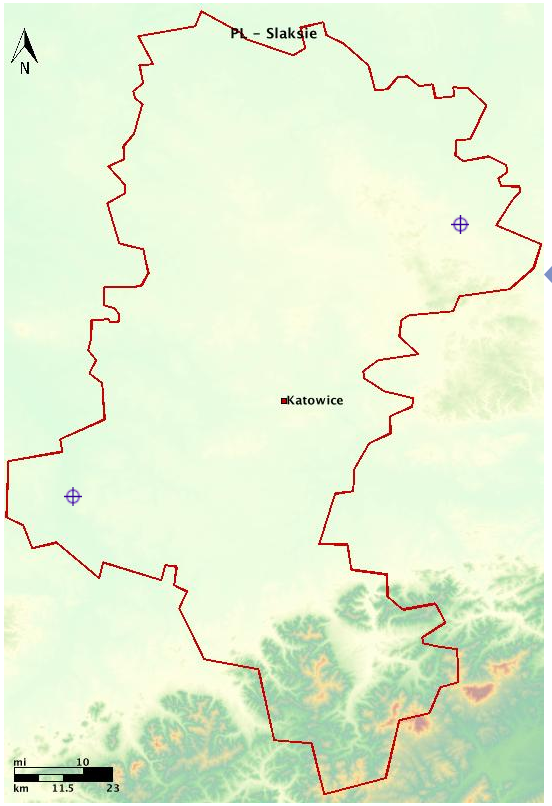
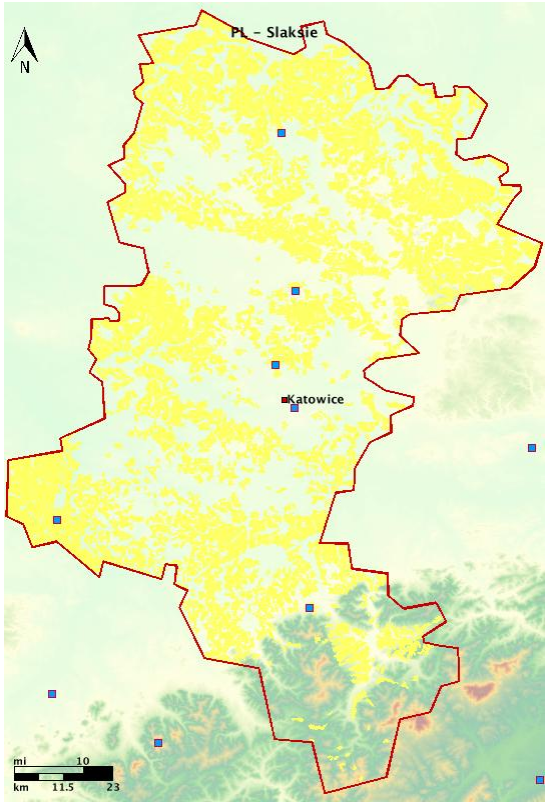
Field trials:
Spot Samples / Interpolation



Sample of weather information from 2 stations
Sample of field information from 0.0002 ha

Sample of weather information from 6 WMO stations
Sample of field information from 393.015 ha

SSC:
EO / Spatial Aggregation



SSC supporting trials by additional data

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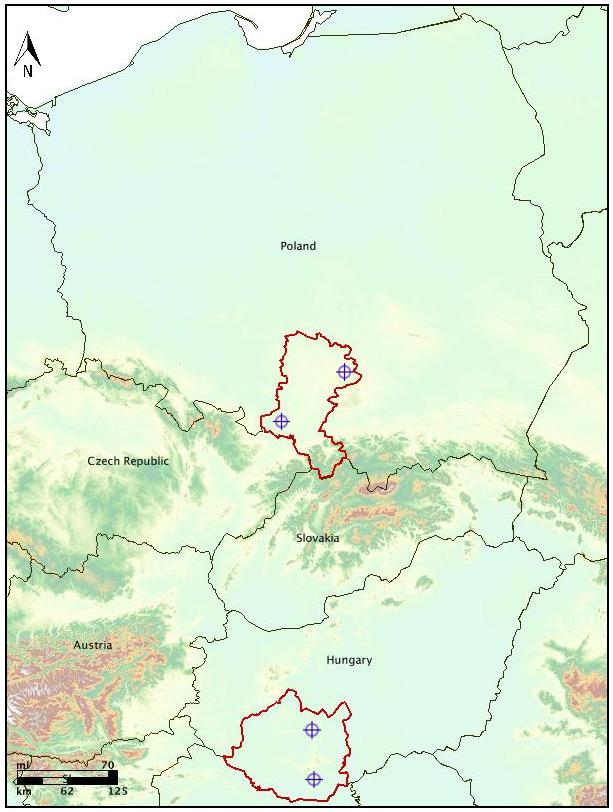
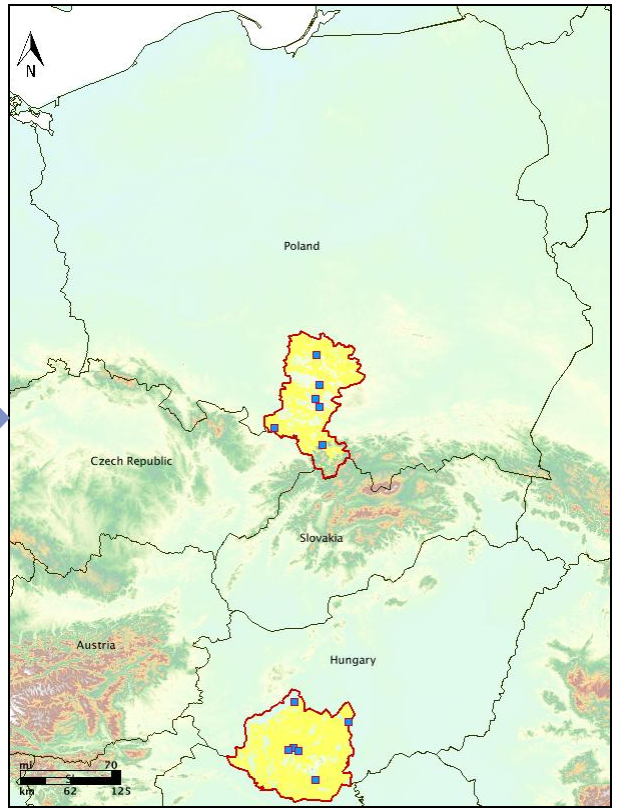
Field trials:
Spot Samples / Interpolation



Using x spot-sites to certify similarity

Using 100 % of arable land to certify similarity

SSC:
EO / Spatial Aggregation



SSC supporting trials by additional data

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Field trials: bottom up

- Local data
- Private data
- Small number of areas
- Pest/PPP oriented

➢ Interpolating results of field trials to a country or a zone

SSC: top down

- Regional data
- Official data from authorities
- 100% of the arable land coverage
- Site characteristics (biomass etc.)

➢ Using regional data to elaborate similarity of site characteristics for regions or zones

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About satellite images of the vegetation development of arable land

Extraction of satellite image values of arable land

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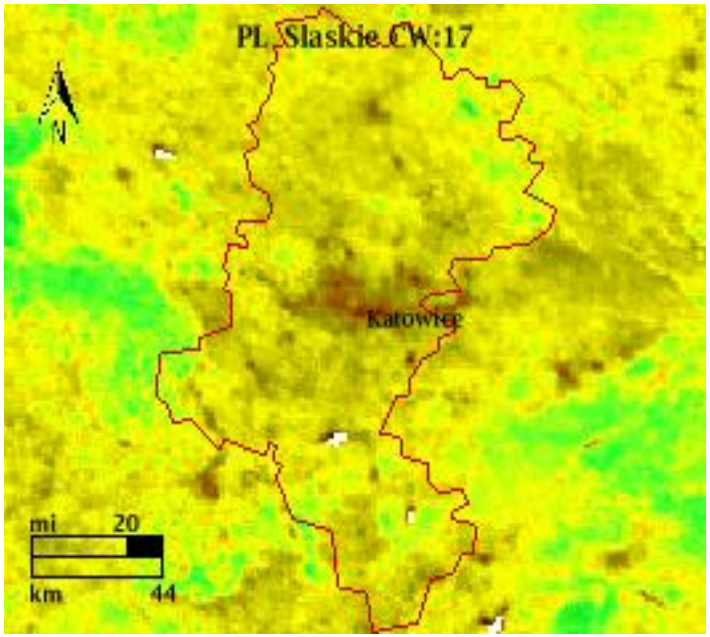

Satellite image

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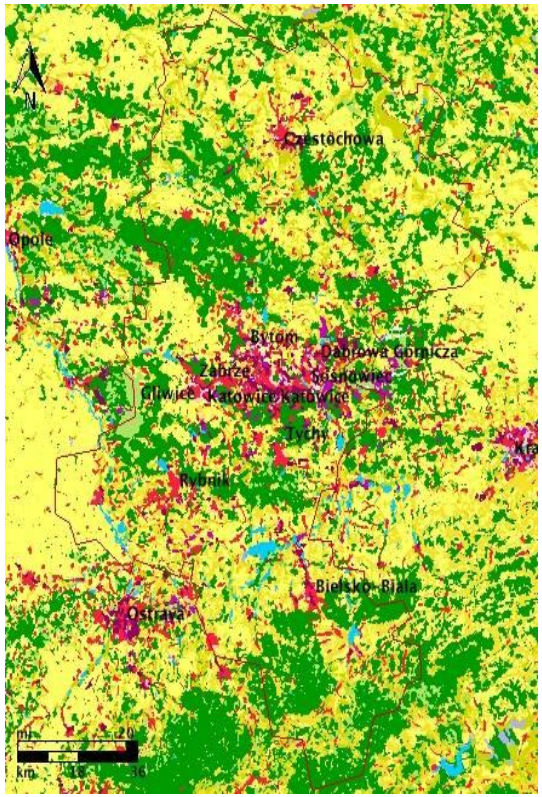
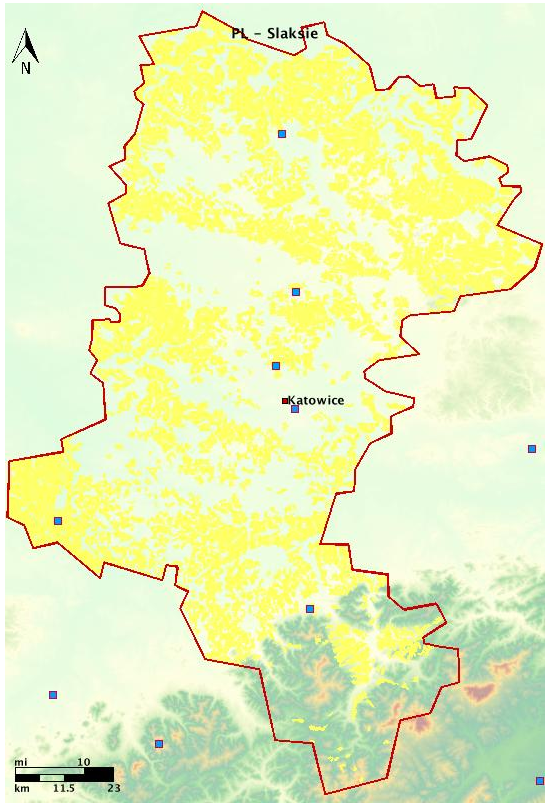


Land cover map

yellow = arable land

=



Sat-values of arable land

Product levels of SSC

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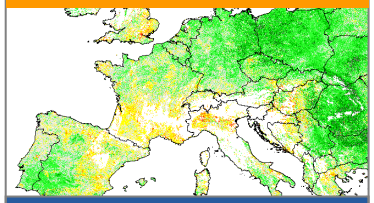
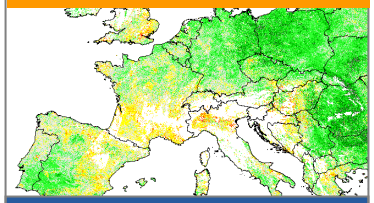
Quick Check



Satellite images
Vegetation index

qualified for one SSC

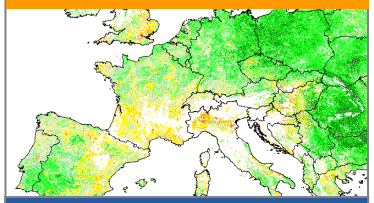
Transfer analysis



Satellite images
Vegetation index

pairs of sites qualified for SSCs

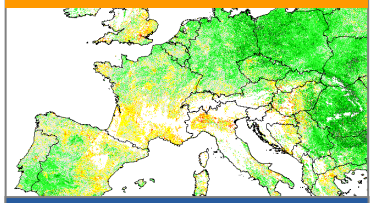
StandardSSC



Satellite images
Vegetation index
Climate characteristics
Soil characteristics
Temperature
Precipitation
Phenology
Yield level
...

similarity of trial sites

Risk evaluation

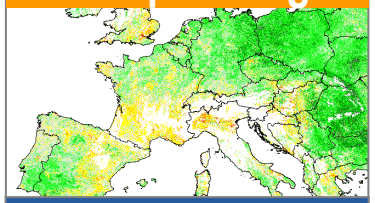


Satellite images
Vegetation index
Climate characteristics
Soil characteristics
Temperature
Precipitation
Phenology
Yield level
...

Risk evaluation

Similarity classification of risk

Optimized zonal trial planning



Satellite images
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Yield level
...

Optimization

optimized selection of sites

Products

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- Quick Check:
  Assessment of the suitability of sites for an SSC to be developed

- Transfer analysis:
  Similarity assessment based on processed satellite images and pair wise analysis of NDVI development

- StandardSSC:
  Similarity assessment based on processed satellite images and additional parameters recommended by EPPO

- Risk evaluation:
  Comparative risk evaluation of pests and diseases between growing areas based on processed satellite images and other configurable parameters

- Optimized zonal trial planning:
  Selection of trial sites within an EU zone for mutual recognition which is optimized in terms of agro scientific and economic parameters

Applications

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- Bridging lack of data
- Substituting field trials
- Strategic planning of trial sites based on the assessment of dissimilarity or the assessment of substitutability
- Similarity assessment of sites in the northern and southern hemisphere for reduction of field trials to one year
- Identification of trial sites with similar site characteristic (1 : n)
- Proving similarity of sites cross border and cross EPPO zones (1 : 1)

Types

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- Verification of the site similarity of two defined growing areas
- Identification of any agricultural site having similar site characteristics as another specified site

Conclusion

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- Zones for the authorisation of plant protection products under 1107/2009 as of June 2011
- Plant Protection Industry and Regulatory Authorities: same situation = excessive workload for (re-) registrations
- Industry: In zonal approach use more foreign field data (intra/inter EPPO zones)
- Regulatory authorities: Acceptable if comparability demonstrated
- SBI: offers a new technology as a solution to manage the current and future workload
- Broader information across EU through SSC -> will help regulatory authorities to mutually recognise foreign efficacy data and BADs