

Towards a better understanding of land and soil degradation in Europe

Michael Cherlet, Eva Ivits, Stefan Sommer, Gergely Tóth,
Arwyn Jones, Luca Montanarella, Alan Belward

Land Resource Management Unit
Institute for Environment and Sustainability

www.jrc.ec.europa.eu

The future we want

We recognize the economic and social significance of good land management, including soil,

We stress that desertification, land degradation and drought are challenges of a global dimension and continue to pose serious challenges to the sustainable development of all countries,

We recognize the need for urgent action to reverse land degradation. In view of this, we will strive to achieve a land-degradation neutral world in the context of sustainable development.



UN Convention to Combat Desertification (UNCCD) definition of ‘land’

“the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system”

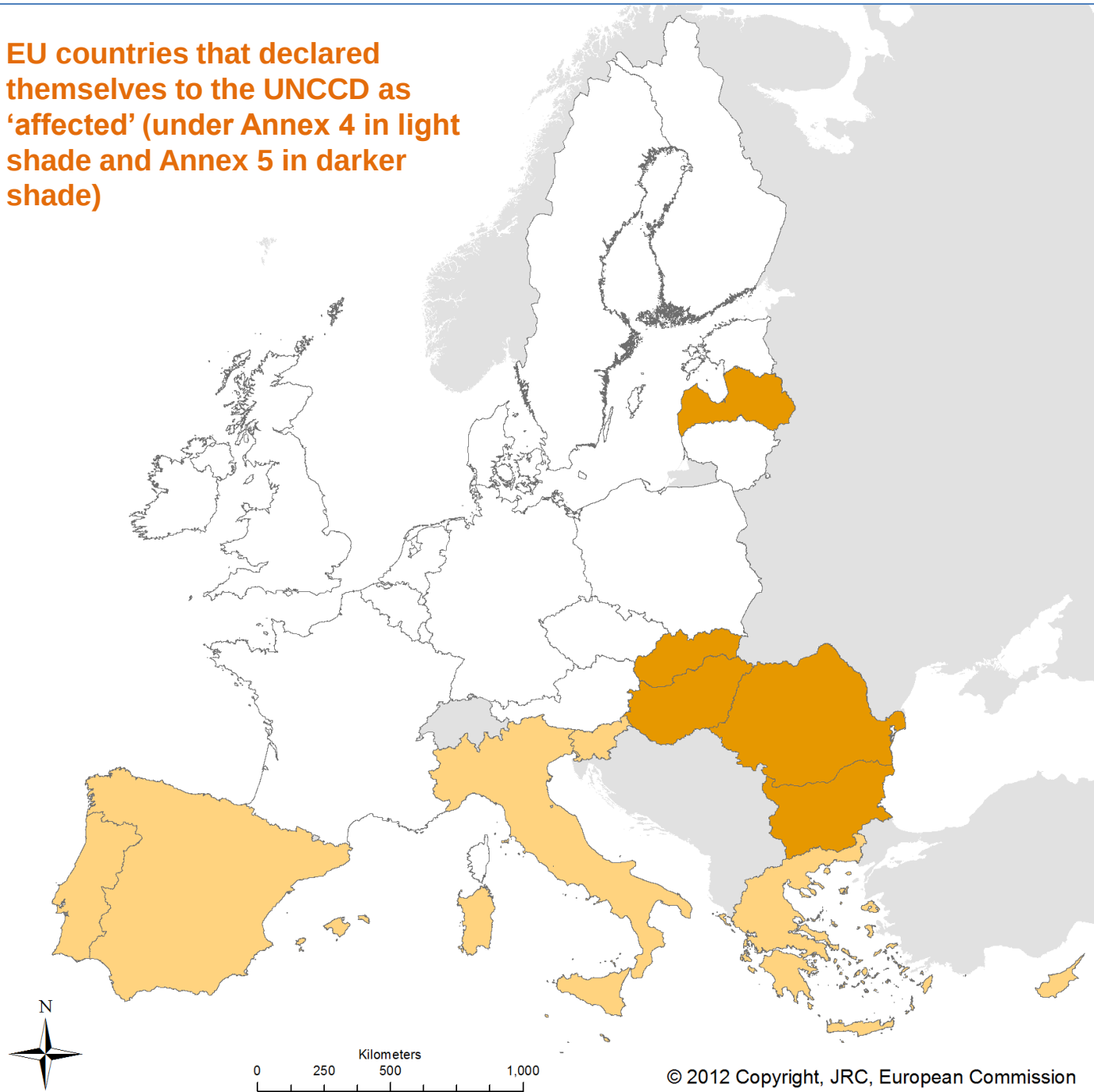


UNCCD definition of land degradation in drylands*

Reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:

- (i) soil erosion caused by wind and/or water*
- (ii) deterioration of the physical, chemical and biological or economic properties of soil*
- (iii) long-term loss of natural vegetation*

EU countries that declared themselves to the UNCCD as 'affected' (under Annex 4 in light shade and Annex 5 in darker shade)



UNCCD 2010 revision (proposal)

(a) Desertification is best to be treated as an extreme case of land degradation, which is expressed in a persistent reduction or loss of biological and economic productivity of lands that are under uses by people whose livelihoods depend on this productivity, yet the reduction or loss of this productivity is driven by that use.

(b) Combating desertification means addressing all stages of land degradation that precede the level of productivity loss specific to desertification, the one that reclamation, rather than rehabilitation measures are required for restoring the persistently lost productivity of the land.

(c) Land degradation and desertification, as described in (a) and (b), require attention in all lands, with special concern directed to all drylands, namely those of climate yielding an aridity index ≤ 0.65 , whether based on 1950-1980 prevailing climate, and/or on more recent climate data.



**Food, fuel
and fibre
value**



**Climate
system**



**Biological
diversity**



**Social
dimensions**

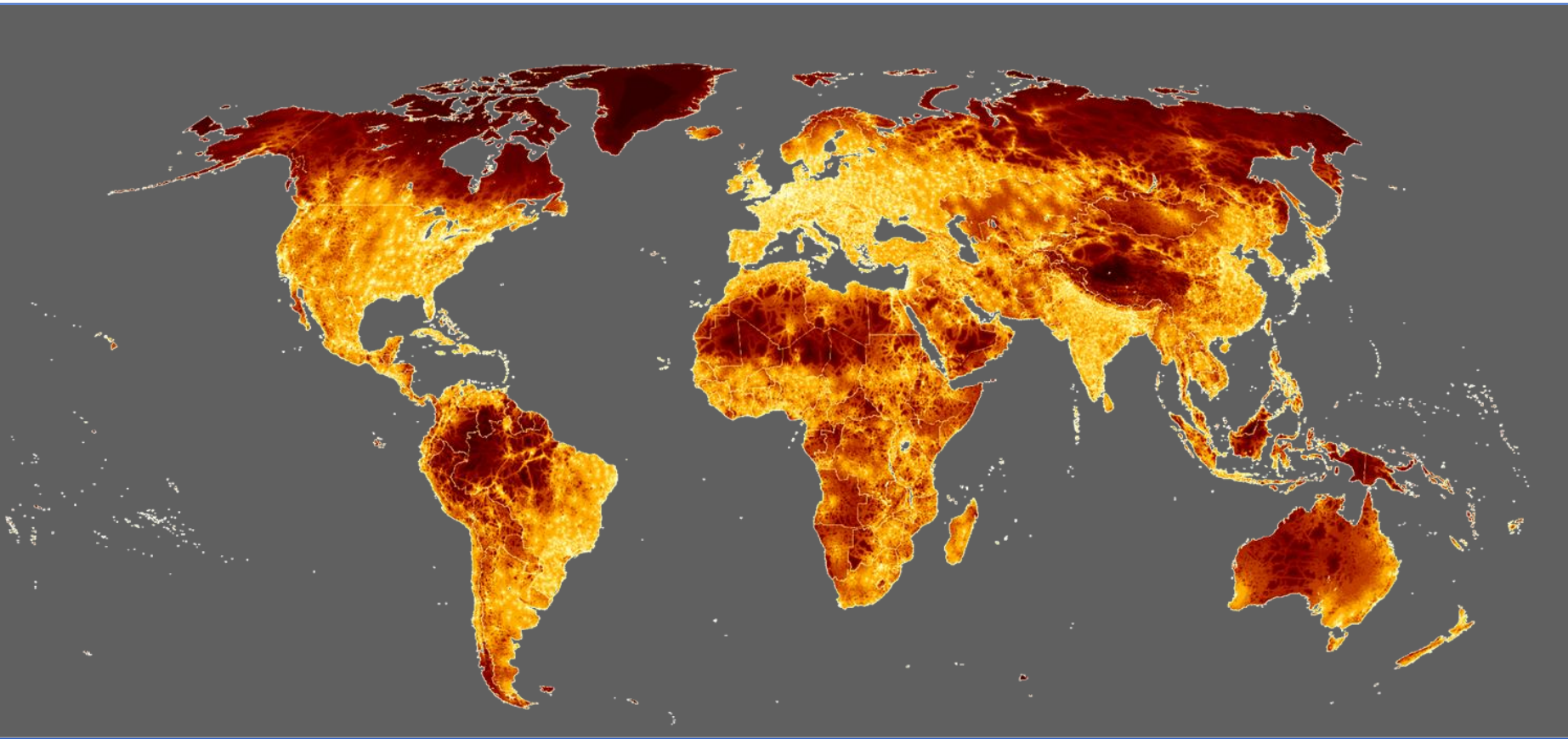


**Hydrology
system**



**Land degradation is a persistent reduction or loss
of biological and economic productivity**

**7% of the land, 7% of the people, 7% of the croplands...
17% of the urban areas**



Travel time (hours, days) needed to reach a city of 50,000 people or more A. Nelson (JRC)

Land Improvement



Climate

wetter – drier
hotter – cooler
windier - calmer

Land Use

change of purpose
intensify - abandon

Land Management

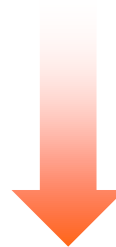
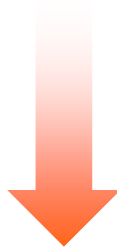
NPK
irrigate – drain
protect

Soil Quality

carbon – nutrients
biodiversity

Soil Condition

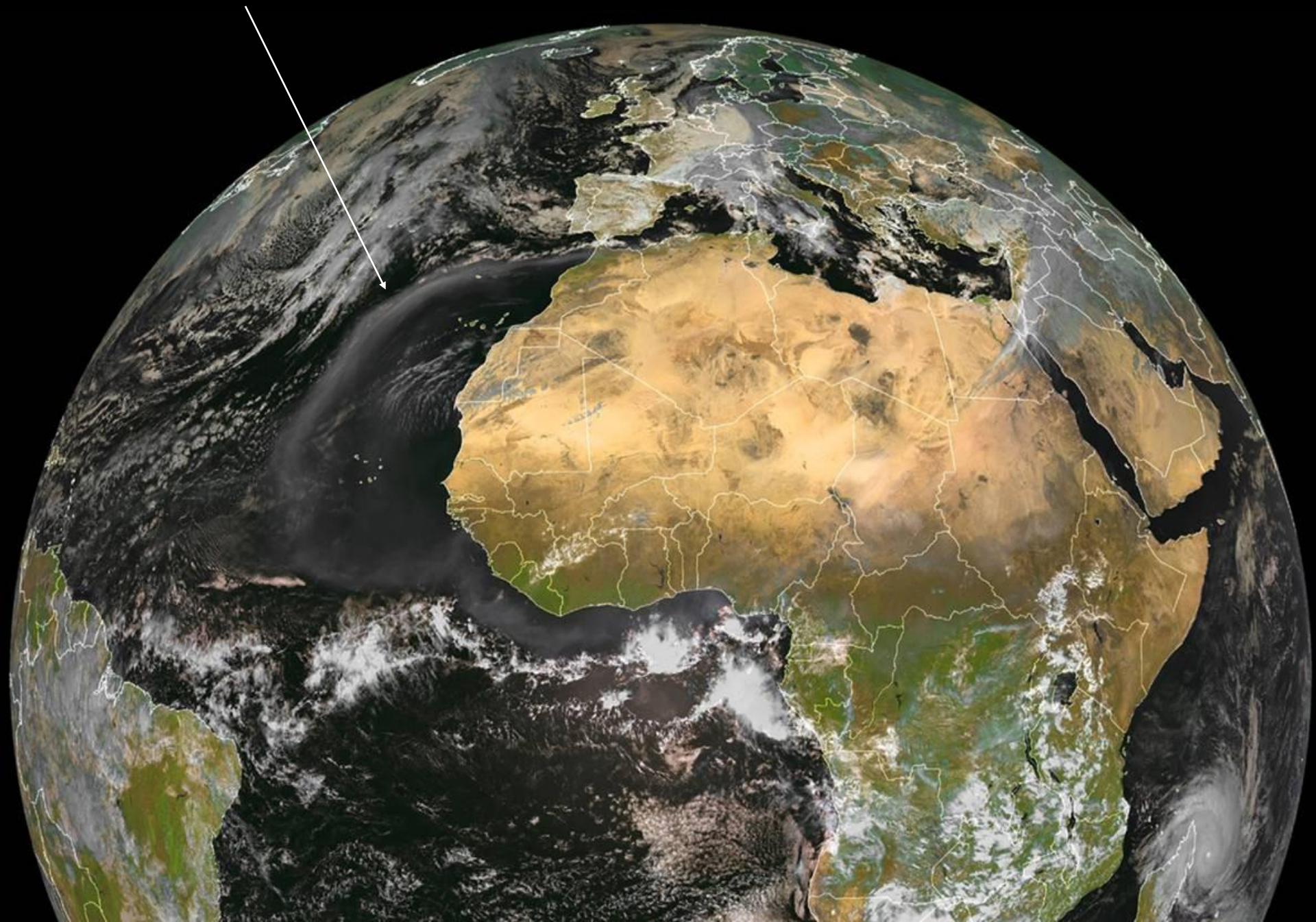
structure
erosion



Land Degradation

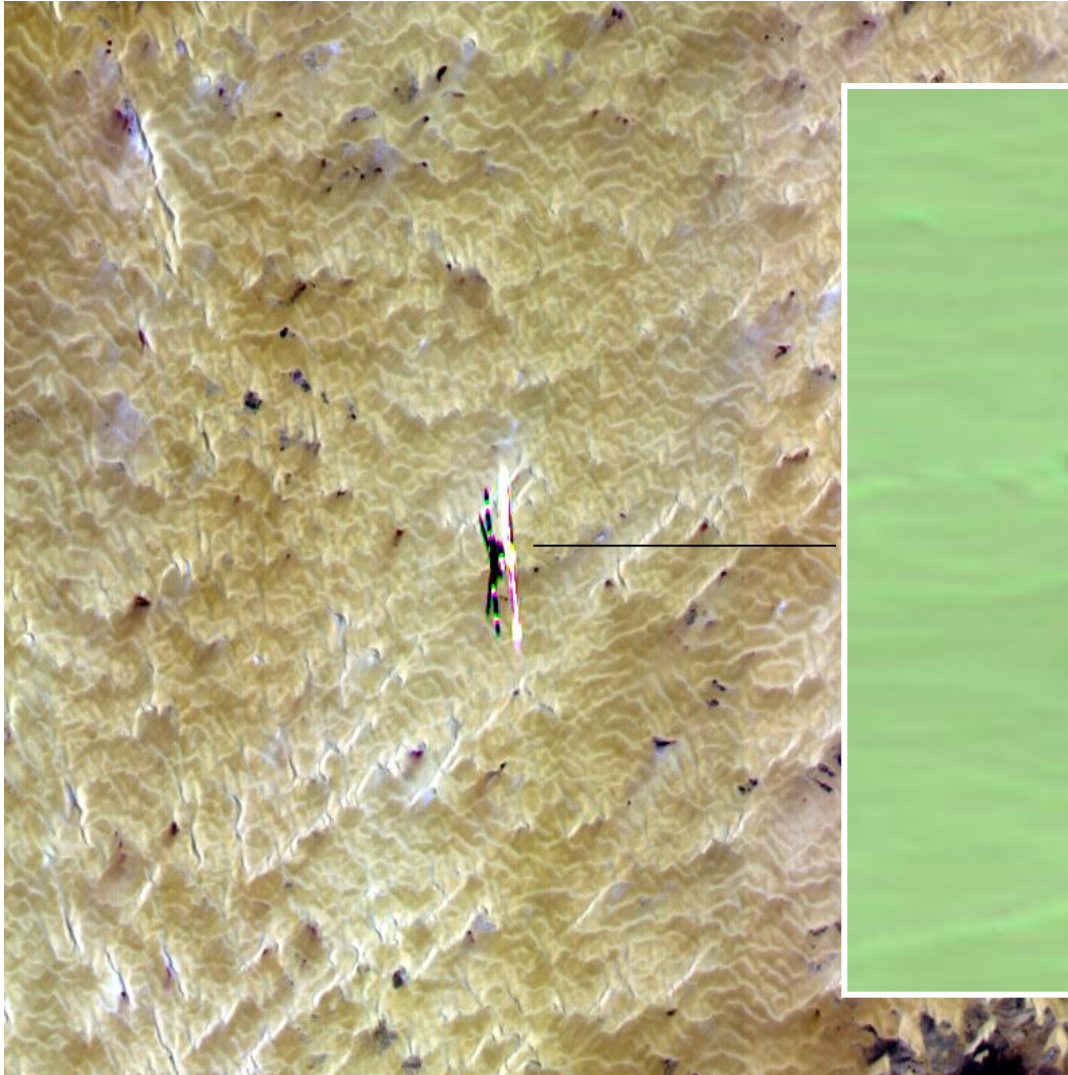
220,000,000 t/yr

MSG 6th March 2004 (Source copyright EUMETSAT)
Sahara dust figures (Prof Andrew Goudie, Oxford)

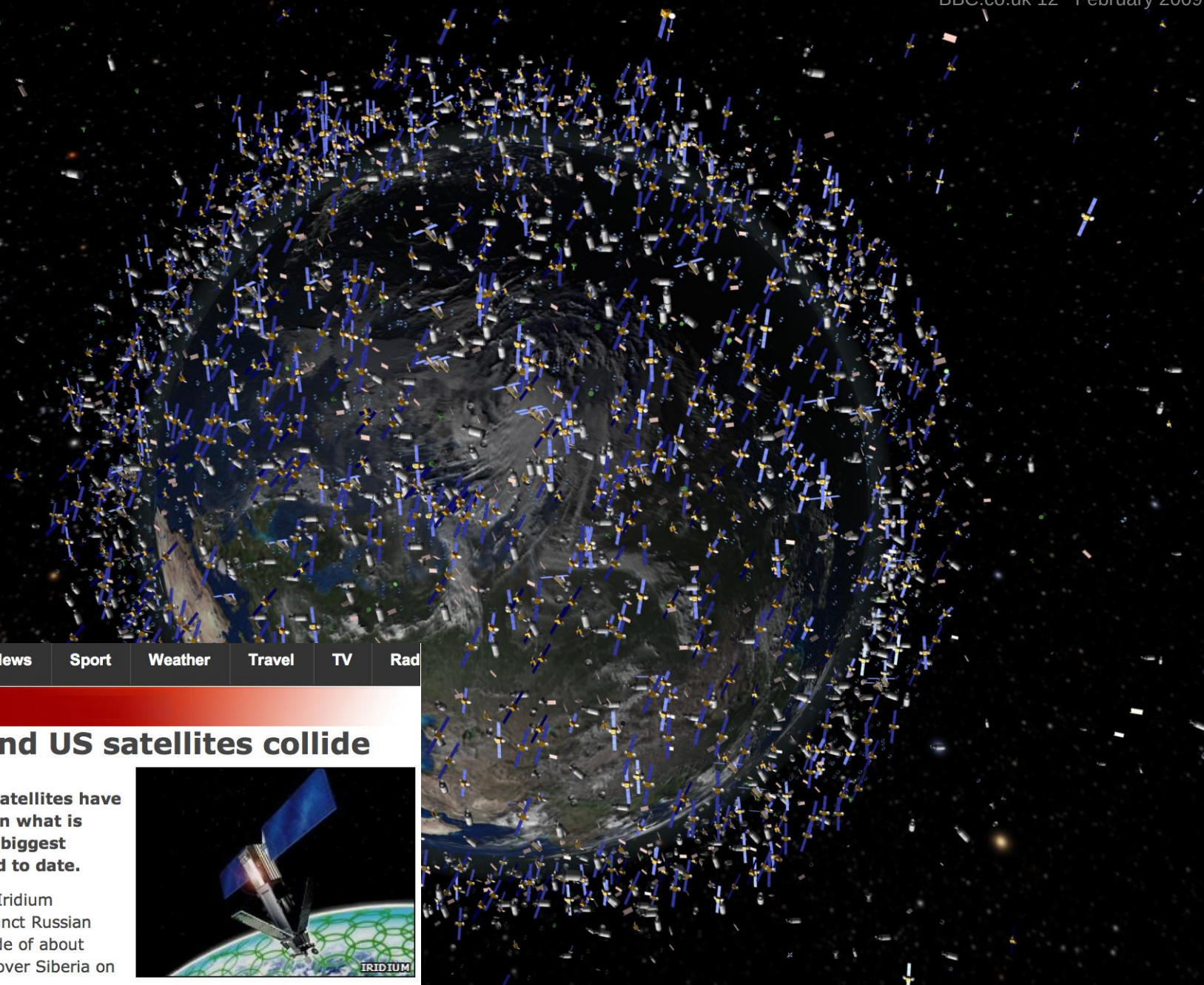




Kutztown University from 684 km altitude , Copyright GeoEye 2008



SPOT 4 images ERS-1 on 6th May 1998



BBC

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Sport

Weather

Travel

TV

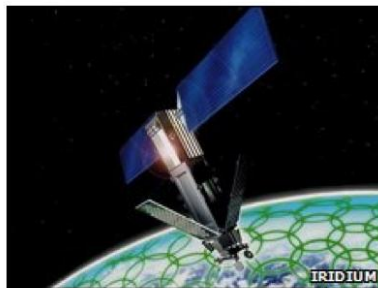
Rad

NEWS

Russian and US satellites collide

US and Russian communications satellites have collided in space in what is thought to be the biggest incident of its kind to date.

The US commercial Iridium spacecraft hit a defunct Russian satellite at an altitude of about 800km (500 miles) over Siberia on Tuesday, Nasa said.



Iridium spacecraft provide satellite phone services

Courtesy ESA

← 20 km →



13th March 1973

Image Courtesy USGS and NASA

← 20 km →



13th June 1988

Image Courtesy USGS and NASA

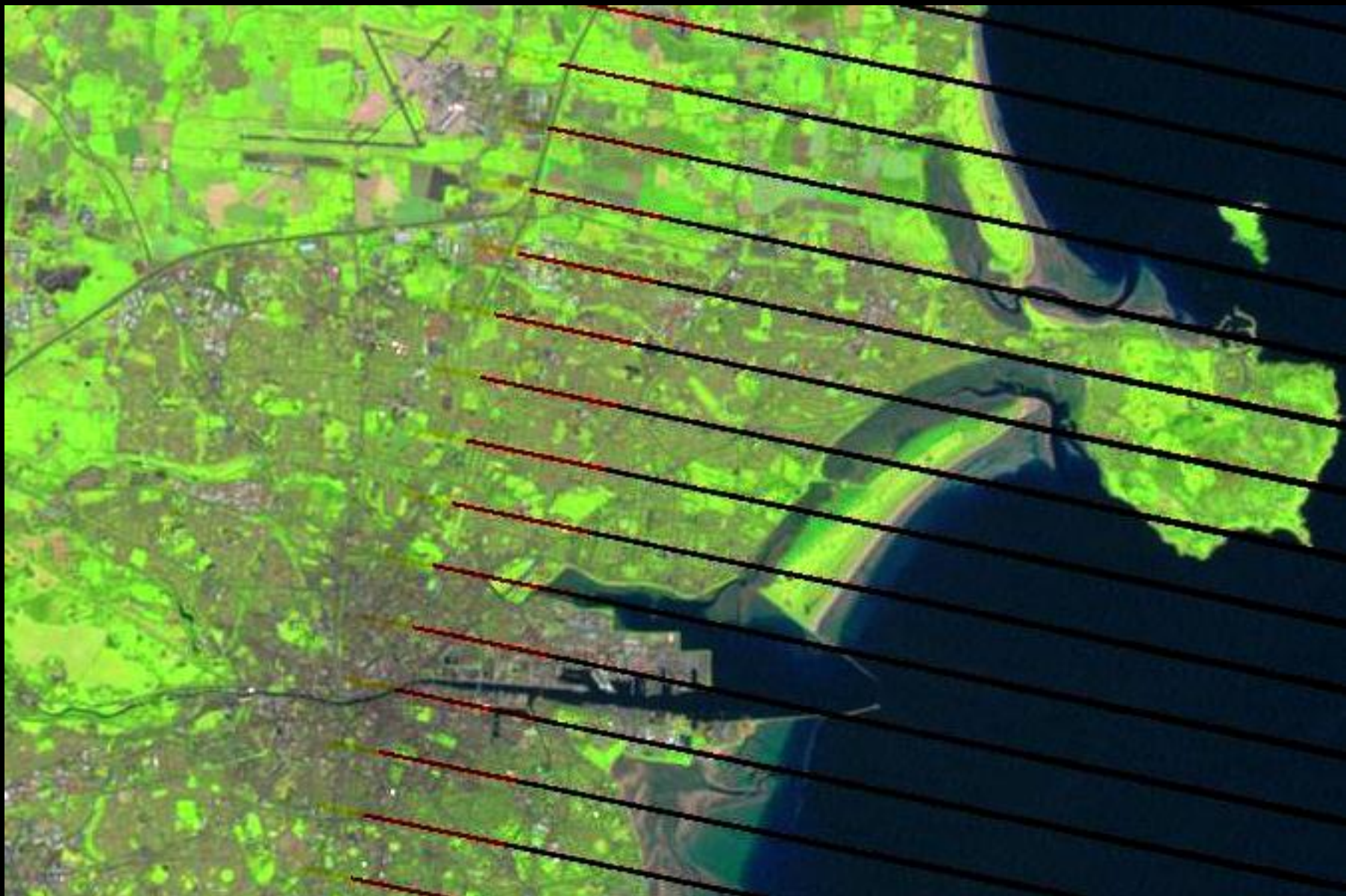
← 20 km →



17th July 2006

Image Courtesy USGS and NASA

← 20 km →



10th August 2012

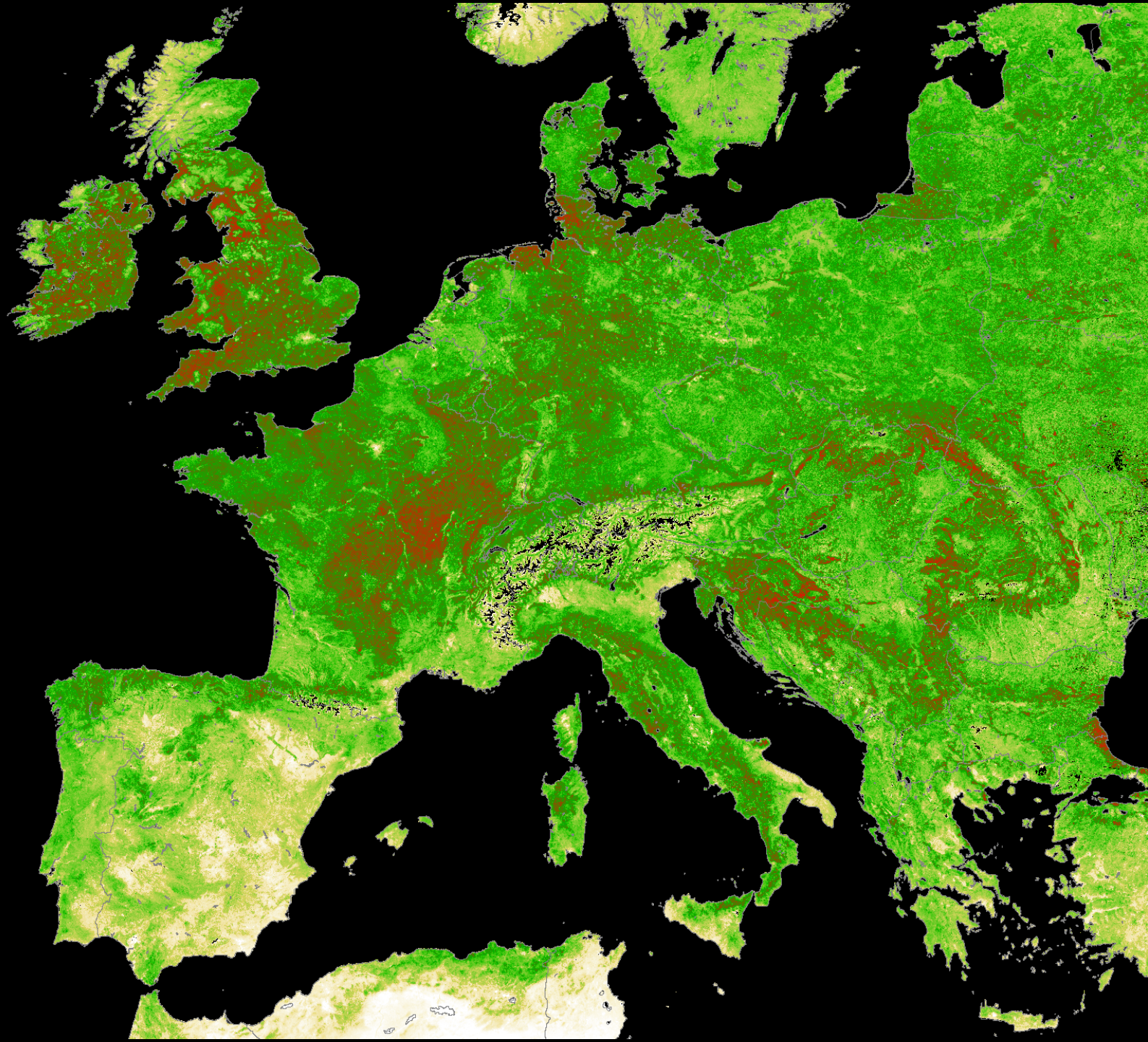
Image Courtesy USGS and NASA

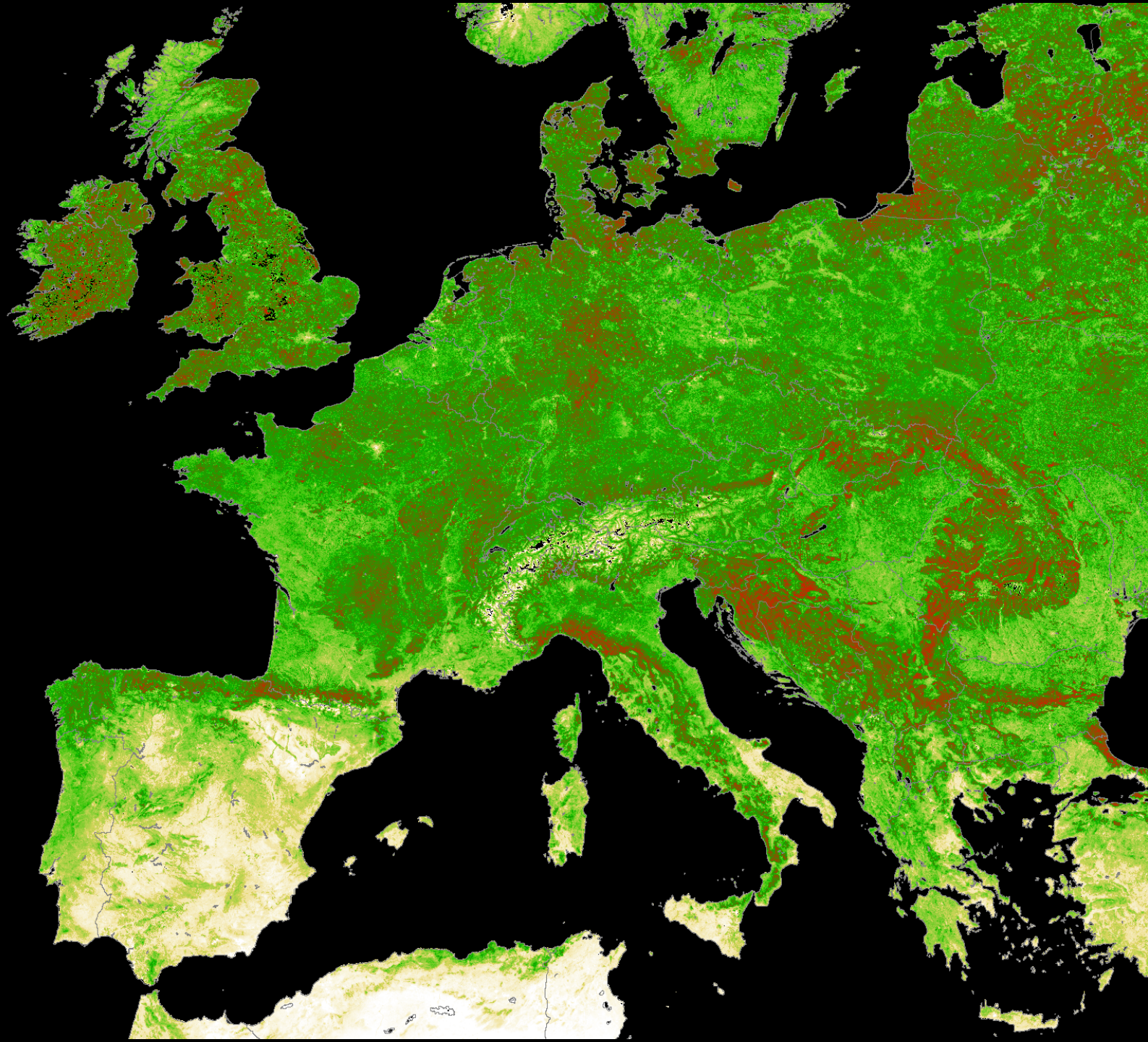














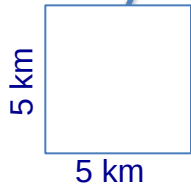










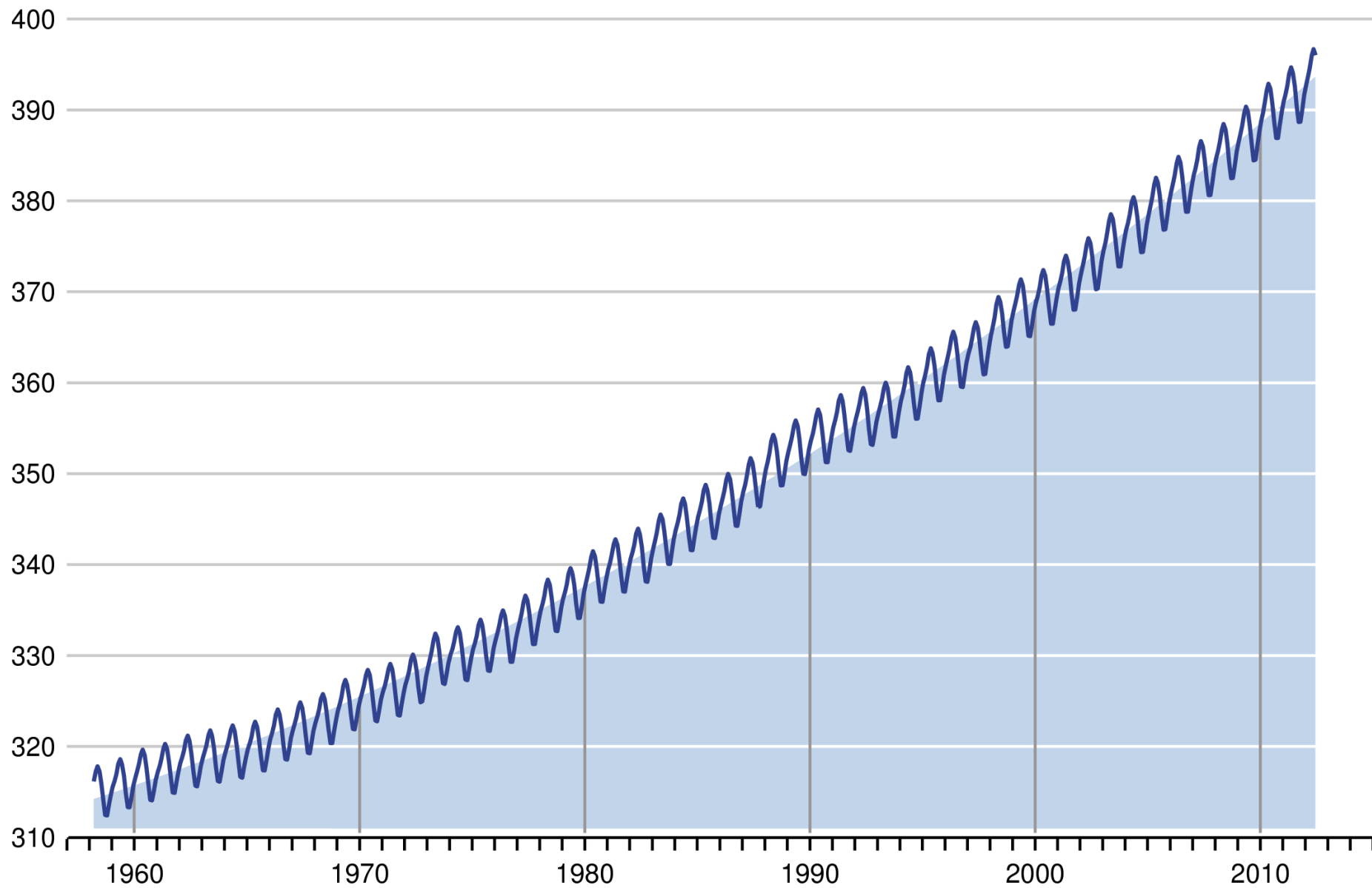


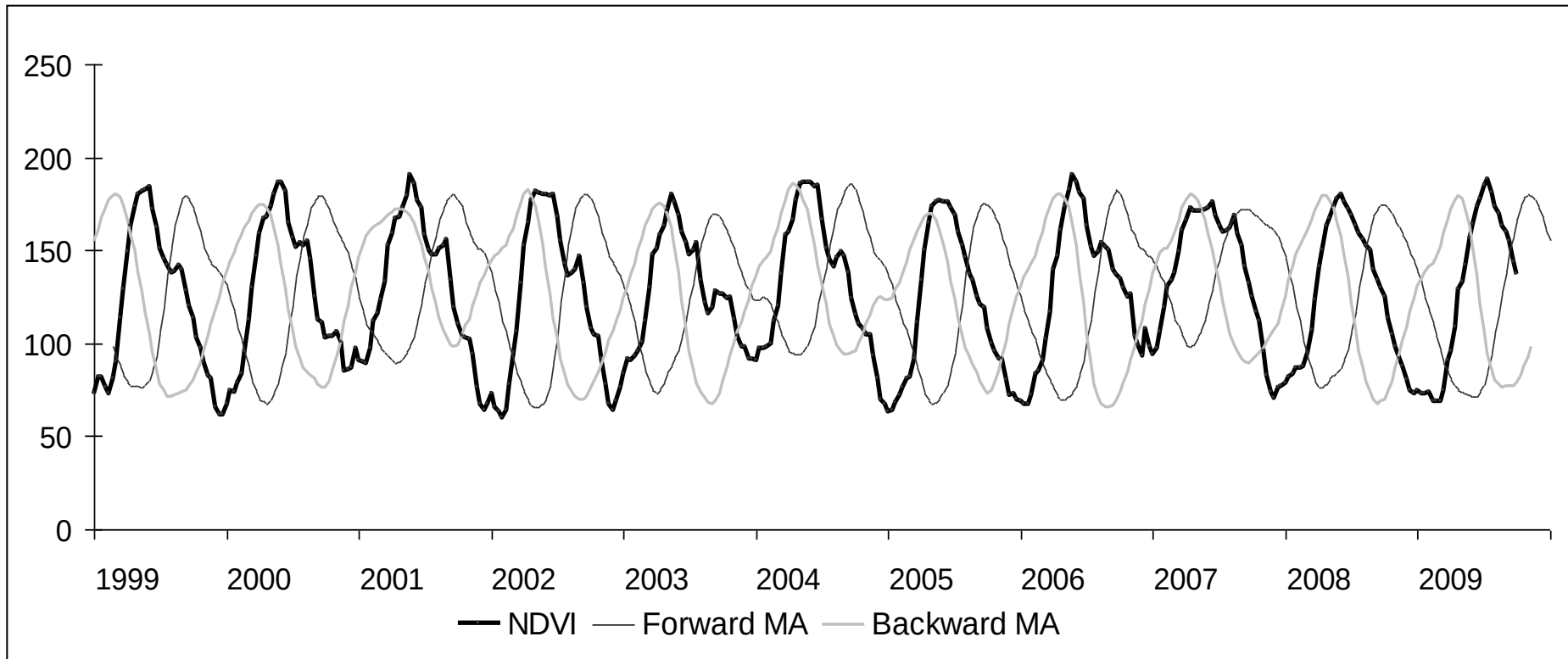
Each 'pixel' integrates the surface reflectance from a square of 2,500 ha



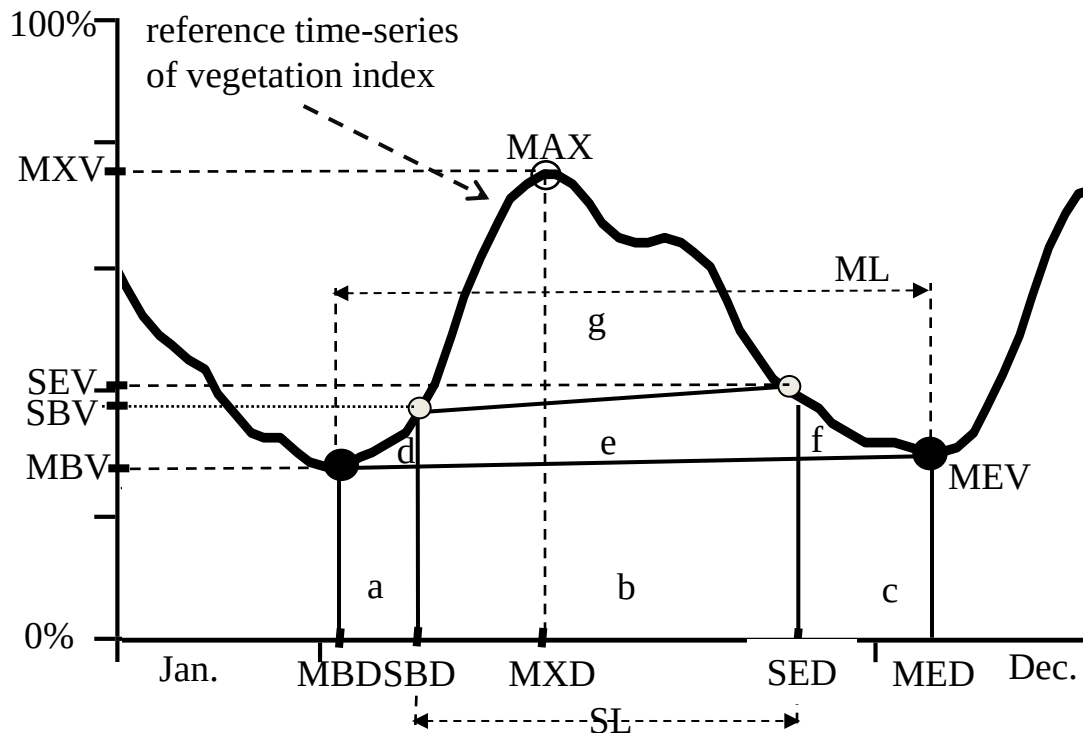
Monthly Carbon Dioxide Concentration

parts per million





MA = Moving Average curve that defines the SBD (Season Begin Day) and SED (Season End Day) points on the NDVI curve.



Productivity parameters:

$MI = a + b + c + d + e + f + g$ (Minimum-Minimum Integral)

Approximation of the Gross Primary Productivity.

$MPI = a + b + c$ (Minimum Permanent Integral)

Area characterising the perennial vegetation component and depending on the vegetation index used may also contain components of soil substrate.

$SER = d + f$ (Season Exceeding Residual Integral)

The amount of senescent vegetation outside of the growing season. May be more indicative to before/after harvest of agricultural areas.

$CF = g$ (Cyclic fraction)

This parameter may be directly related to purely seasonal growth.

$PF = d + e + f$ (Permanent Fraction)

The amount of vegetation that does not have a characteristic seasonal cycle within the growing season.

Phenological parameters:

SBD = Season Begin Day.

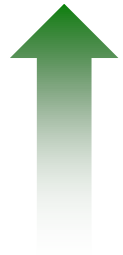
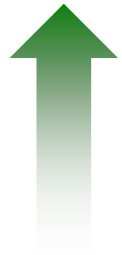
SL = Season Length.

MXV = Maximum Value of the vegetation index.

MXD = Maximum Day.

SBV = Season Begin Value of the vegetation index.

Increasing land-productivity



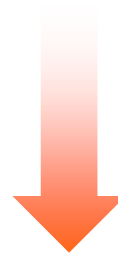
**Declining
productivity**

**Early-signs
of decline**

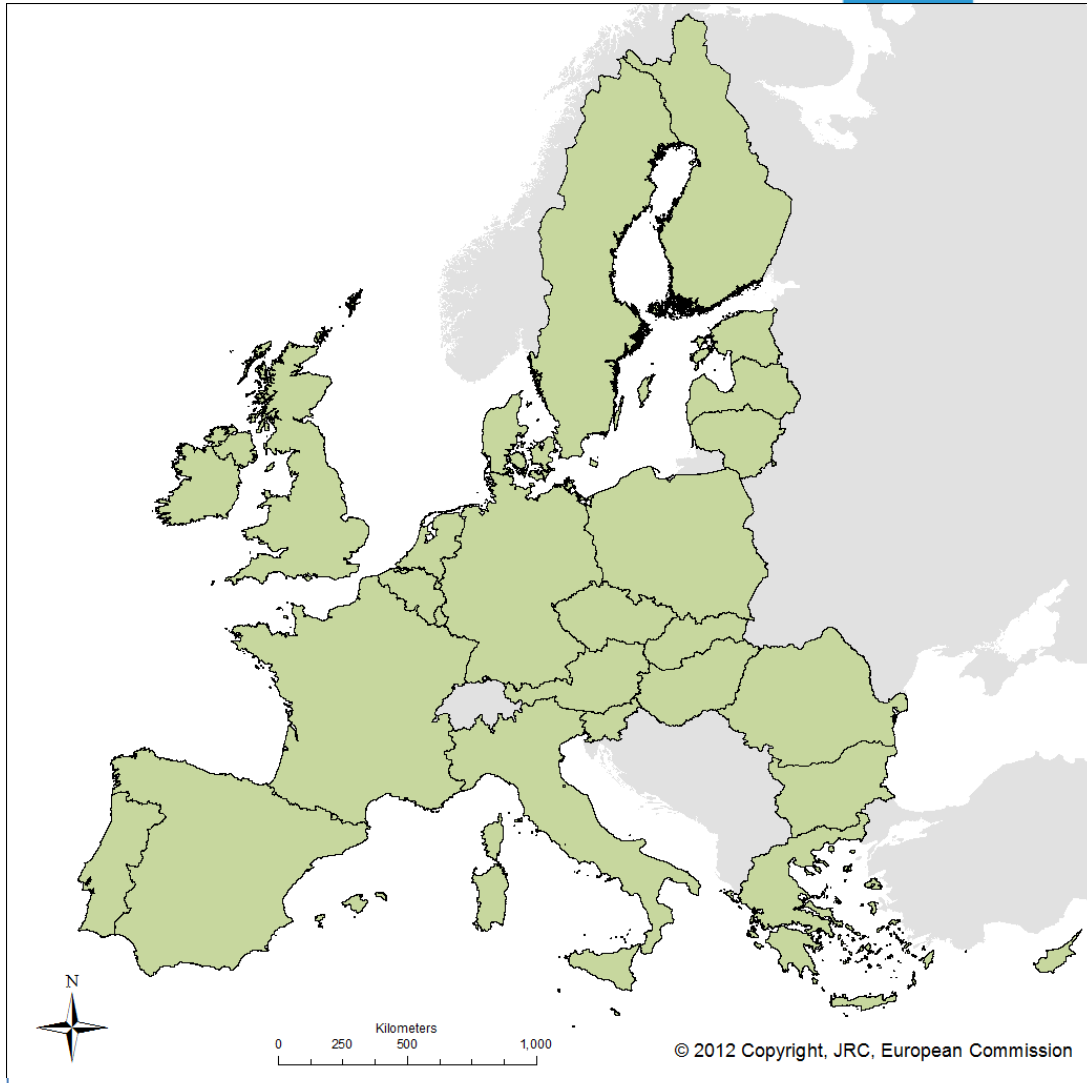
**Stable
but stressed**

**Stable
not stressed**

**Increasing
productivity**



Declining land-productivity



**Declining
Productivity**



**Early-signs
of decline**



**Stable,
but stressed**



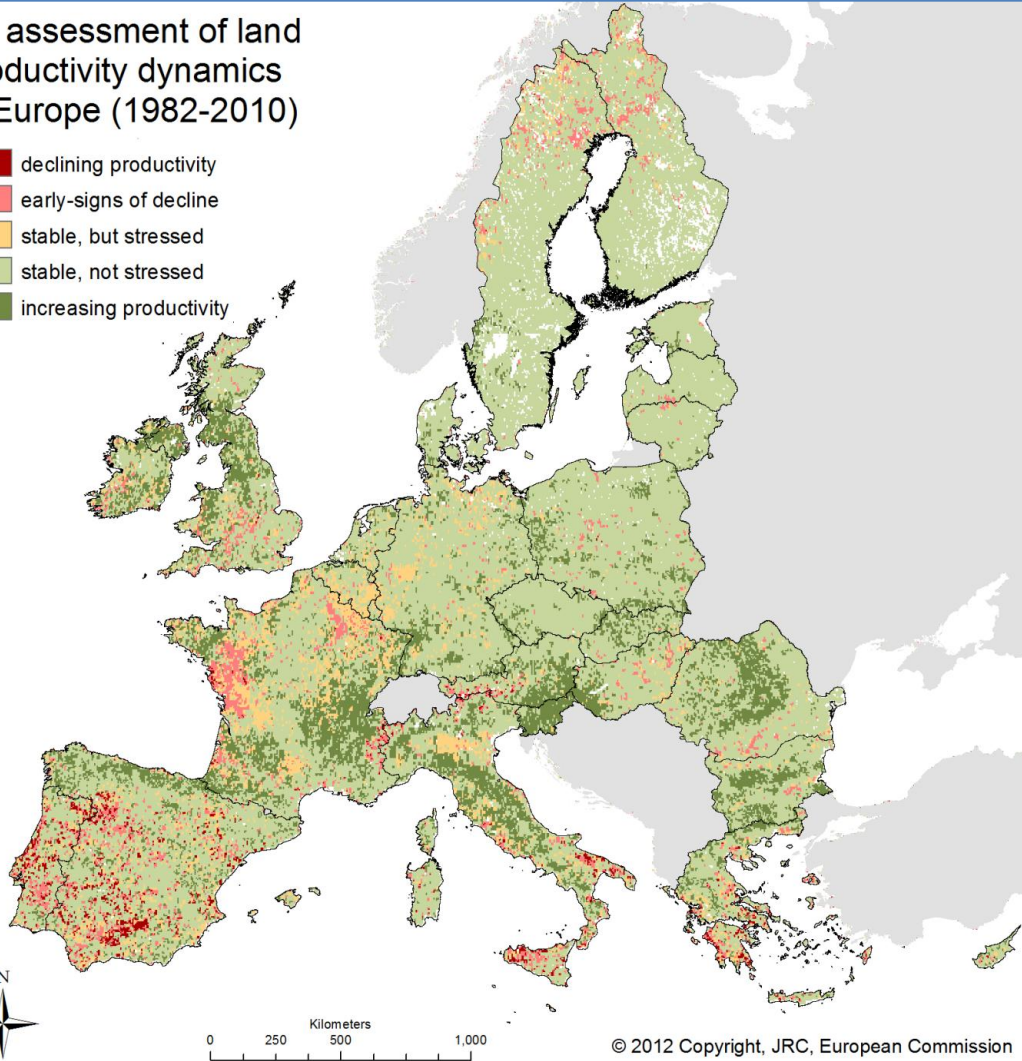
**Stable,
not stressed**



**Increasing
Productivity**

An assessment of land productivity dynamics in Europe (1982-2010)

- declining productivity
- early-signs of decline
- stable, but stressed
- stable, not stressed
- increasing productivity



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1.5%



5.6%



7.9%



70.2%

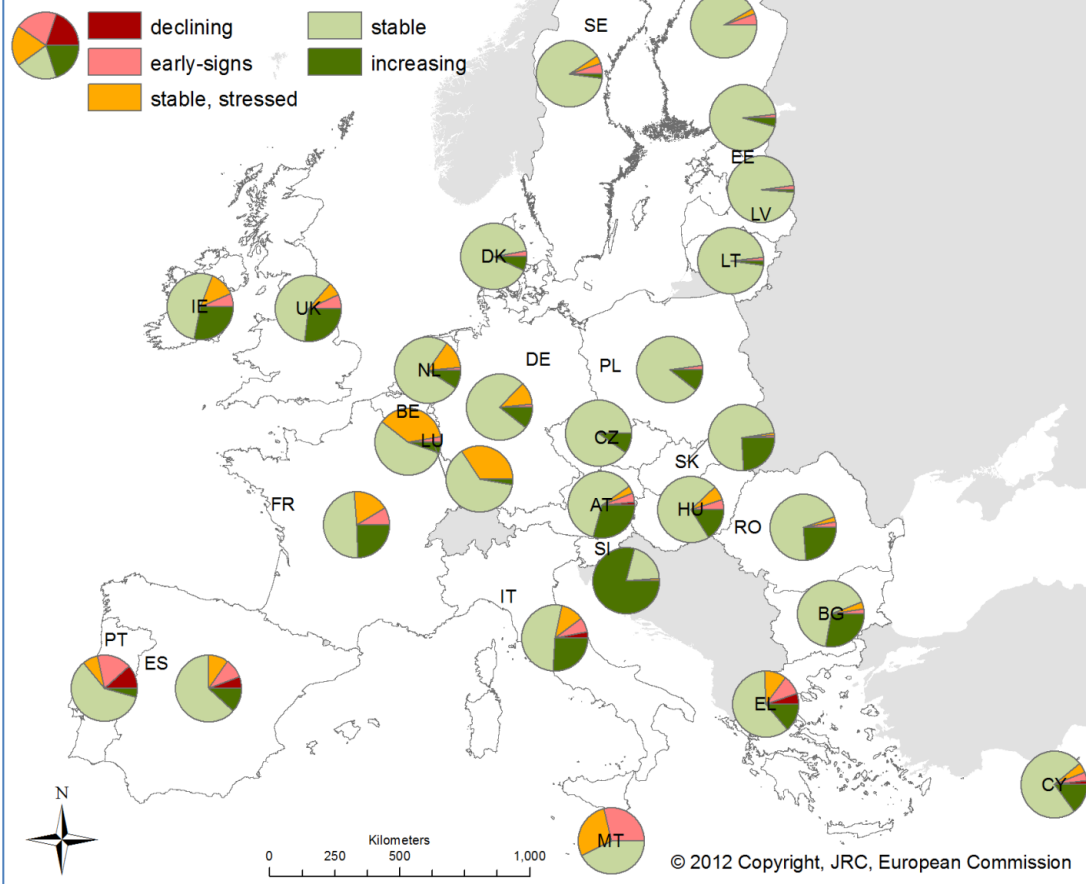


14.9%

Measuring Land degradation is a challenge

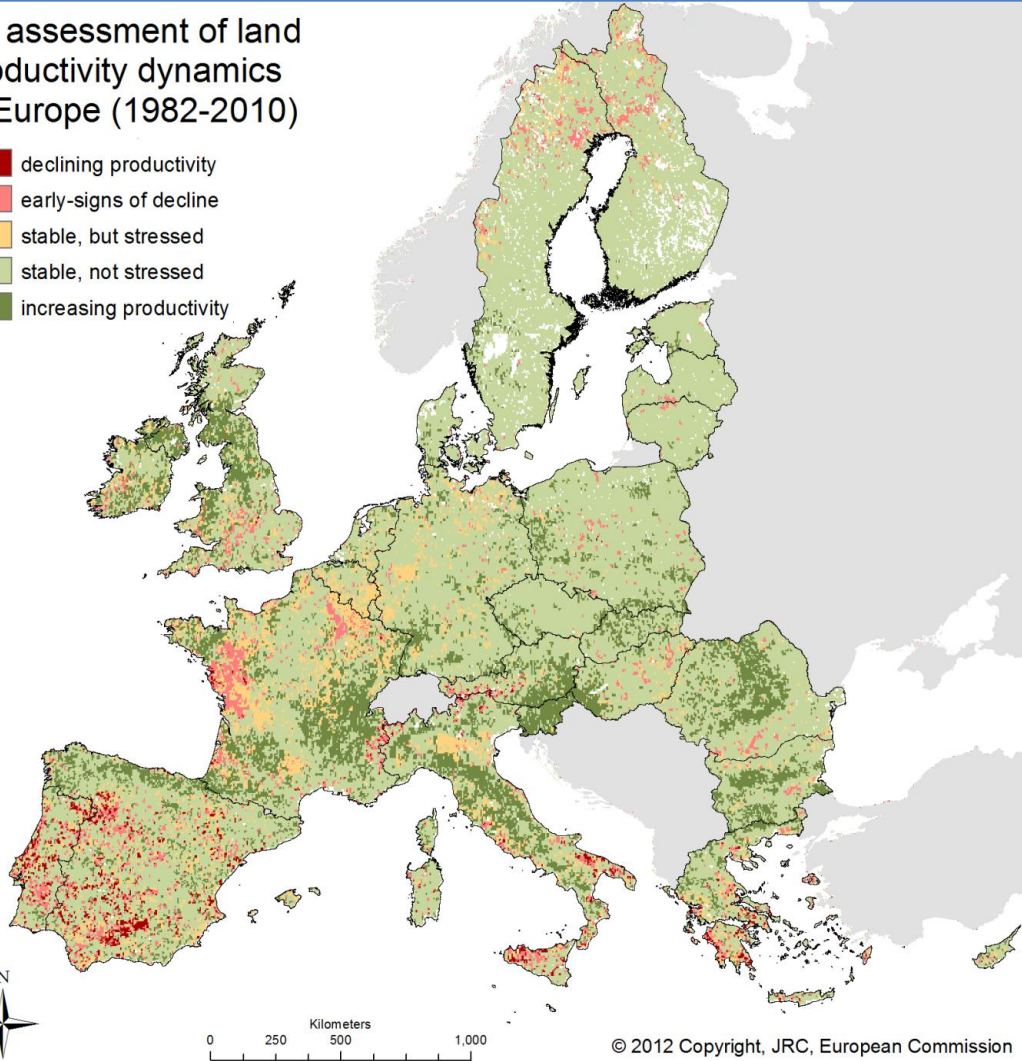
- ① **Declining land-productivity $\neq$ Land degradation**
e.g. less intensive agriculture may decrease yields in the short-term, but improve environmental quality in the long-term
- ② **Increasing land-productivity $\neq$ Land improvement**
e.g. intensive agriculture may increase yields in the short-term, but reduce environmental quality in the long-term
- ③ **Land degradation = Declining land-productivity**
degraded land will always perform worse than its unaffected counterpart

An assessment of land productivity dynamics in the member states of the European Union (1982-2010)



An assessment of land productivity dynamics in Europe (1982-2010)

- declining productivity
- early-signs of decline
- stable, but stressed
- stable, not stressed
- increasing productivity



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1.5%



5.6%



7.9%



70.2%



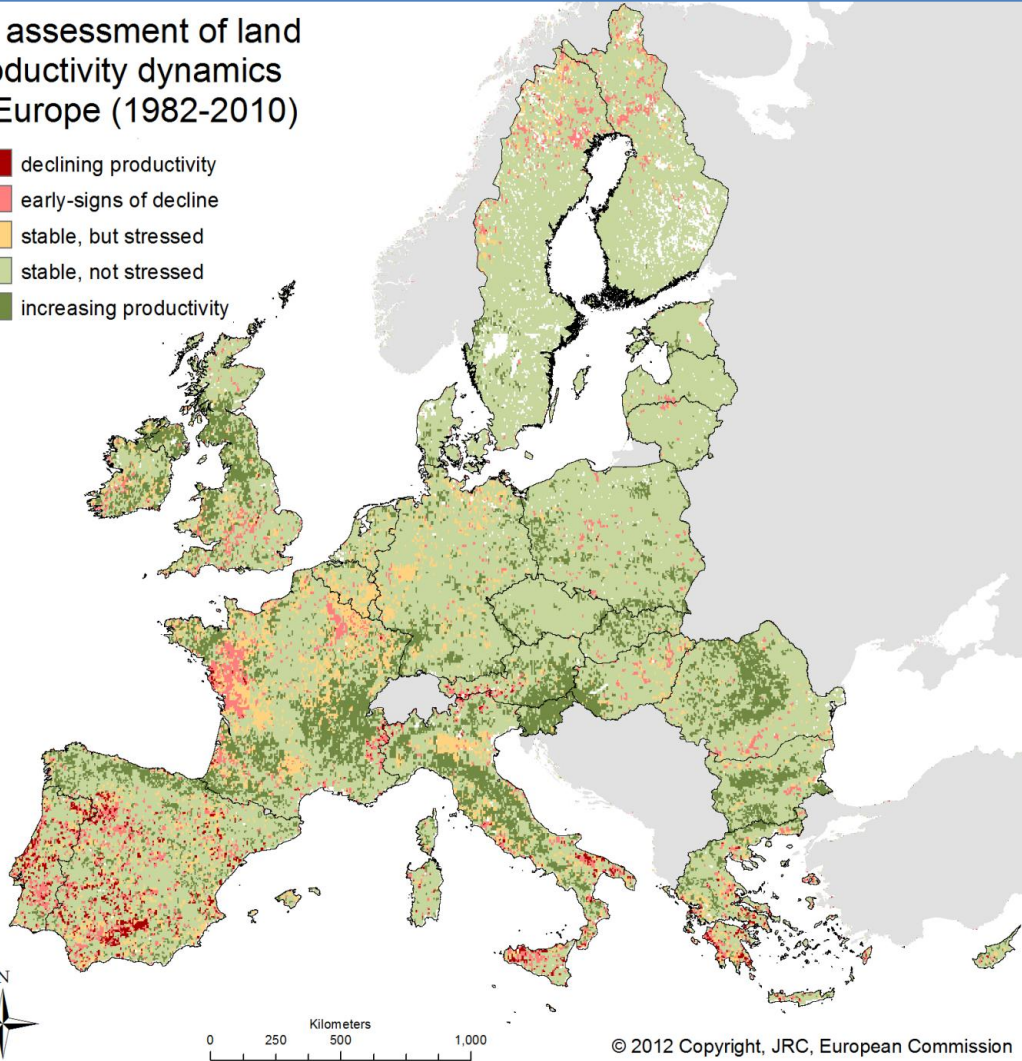
14.9%

	Land cover class				
Land-productivity dynamics	Arable land	Permanent crops	Pastures	Forests and semi natural areas	other
declining	0.7	11.8	0.2	1.4	2.5
early-signs of decline	7.3	9.2	4.1	4.1	7.1
stable but stressed	9.2	9.6	12.1	5.8	8.3
stable, not stressed	73.3	58.7	58.4	72.1	66.2
increasing productivity	9.6	10.7	25.2	16.6	15.9

Table 2a: Land-productivity Dynamics within different Land Cover types EU27 (as % of the EU27 land surface; based on Corine2000)

An assessment of land productivity dynamics in Europe (1982-2010)

- declining productivity
- early-signs of decline
- stable, but stressed
- stable, not stressed
- increasing productivity



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1.5%



5.6%



7.9%



70.2%

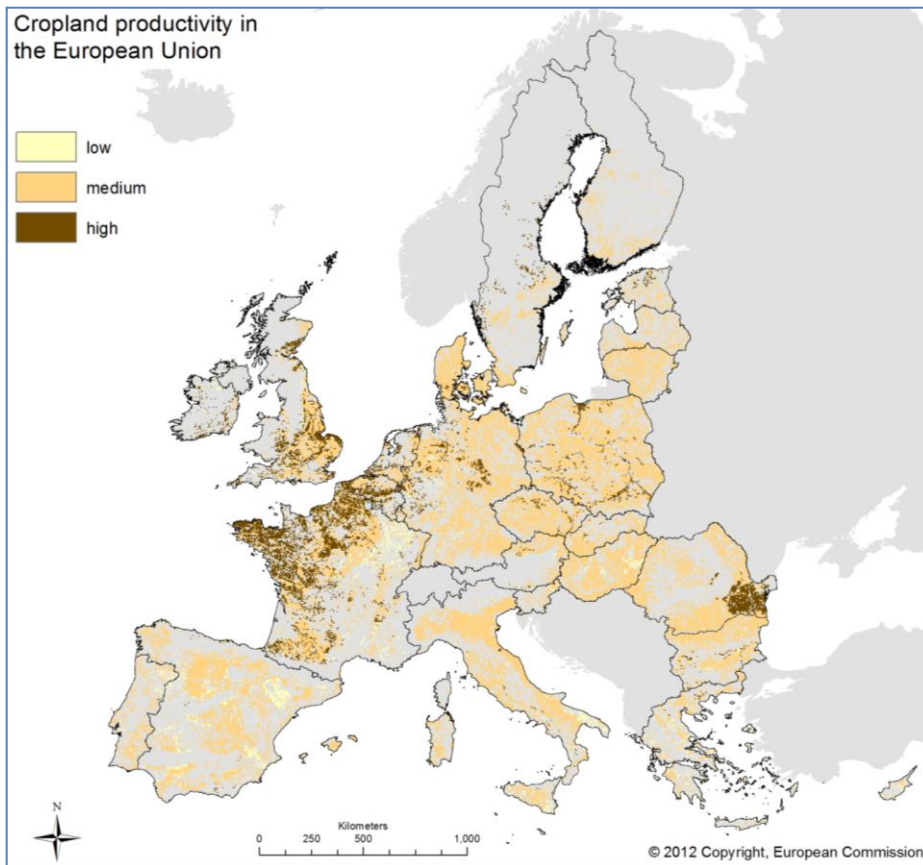


14.9%

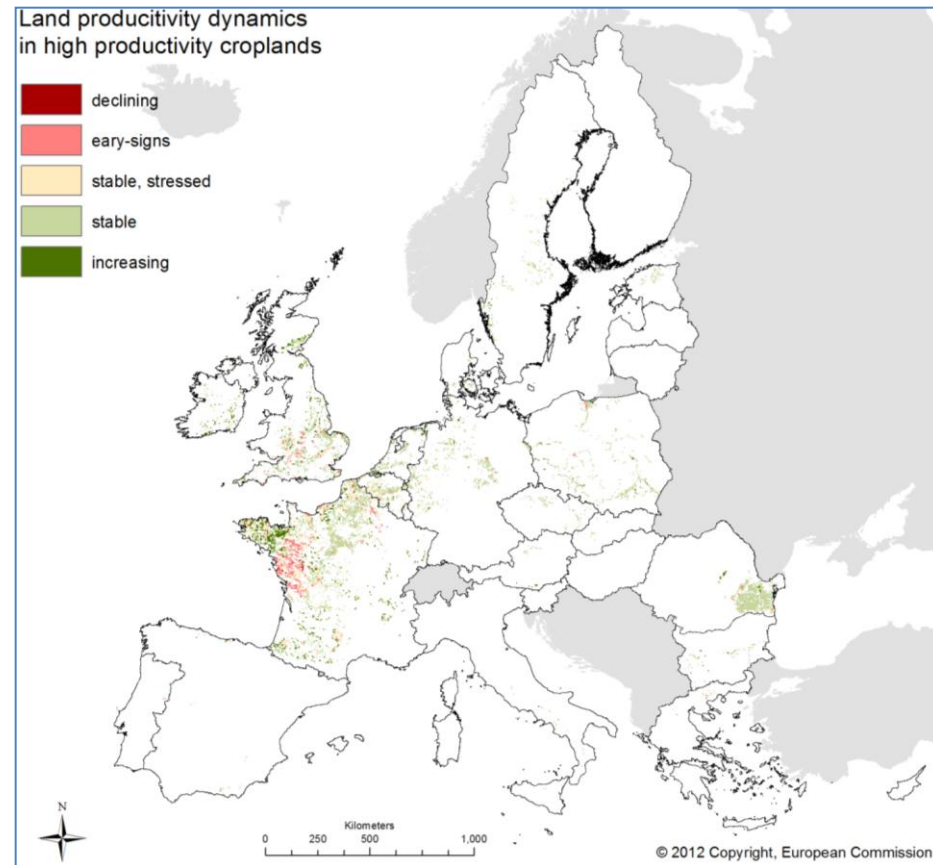
	Land productivity class				
Land covers	declining	early-signs of decline	stable but stressed	stable, not stressed	increasing productivity
Arable land	13.9	38.4	34.2	30.6	18.8
Permanent crops	19.7	4.0	3.0	2.0	1.7
Pastures	1.4	6.3	13.1	7.1	14.4
Forests and semi-natural areas	40.7	31.2	31.8	44.1	47.6
Other	24.3	16.920.1	148.0	126.1.5	14.17.4

Table 2b: Land Cover types of the EU within the land-productivity dynamics classes (as % of the EU land surface; based on Corine2000)

Cropland productivity in
the European Union



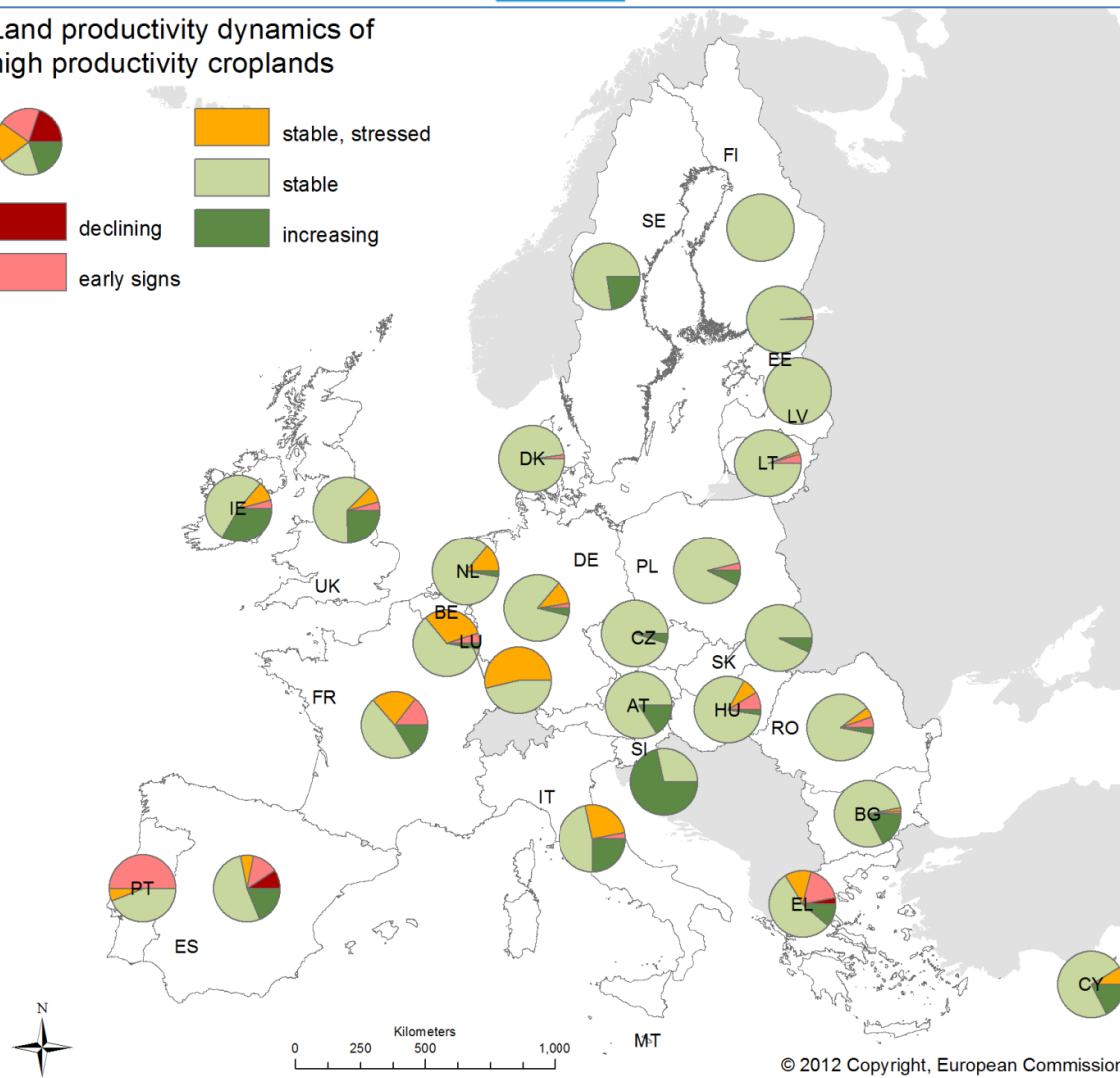
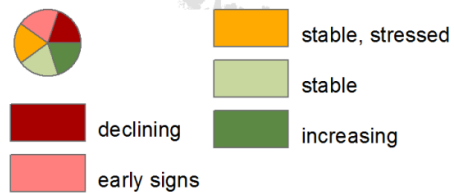
Land productivity dynamics
in high productivity croplands



Land-productivity dynamics	Cropland soil productivity classes		
	low	medium	high
declining	4.7	0.9	0.5
early-signs of decline	10.3	6.0	9.7
stable but stressed	14.4	7.8	14.2
stable, not stressed	59.1	73.4	63.4
increasing productivity	11.6	11.8	12.3

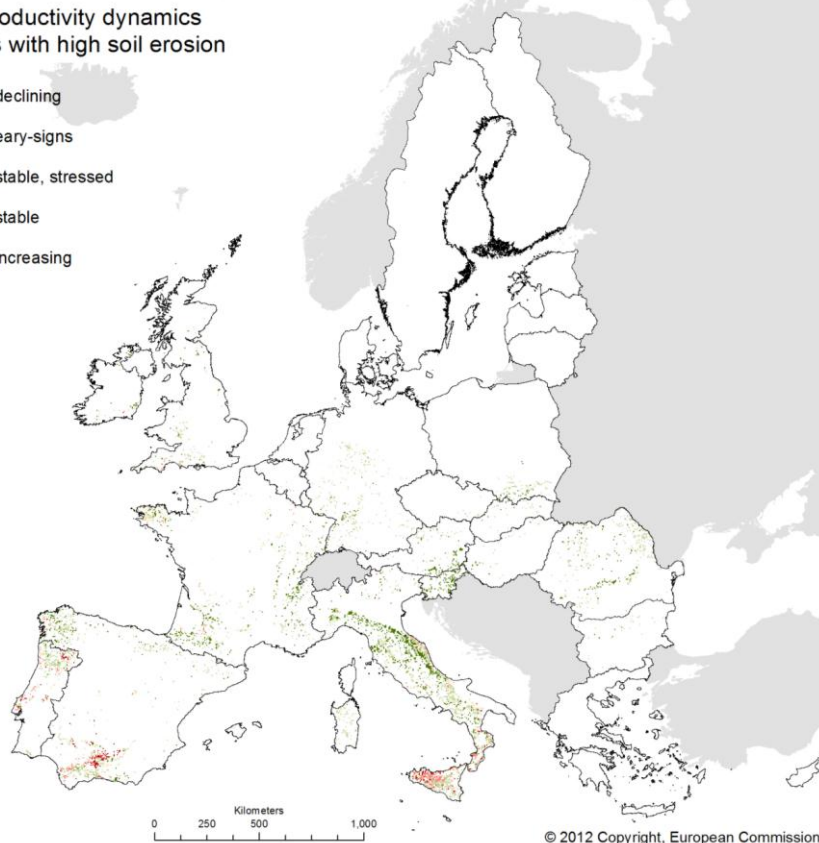
Table 3: Land-productivity dynamics for European classes of soil productivity for croplands (in % of cropland-productivity classes).

Land productivity dynamics of high productivity croplands



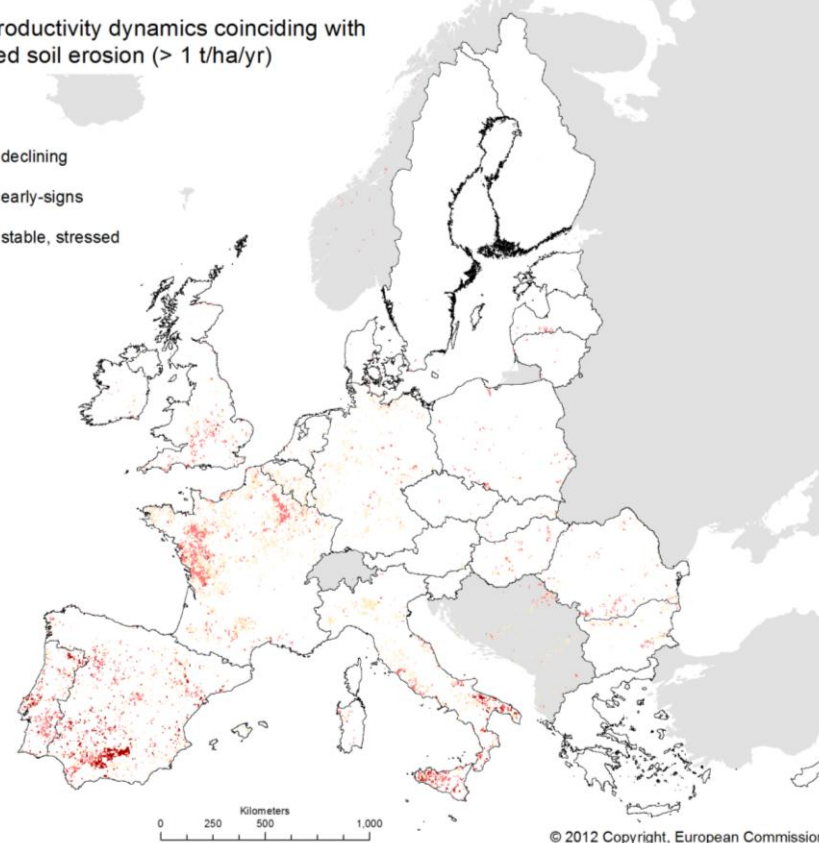
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Land productivity dynamics
in areas with high soil erosion



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Land productivity dynamics coinciding with
modelled soil erosion (> 1 t/ha/yr)

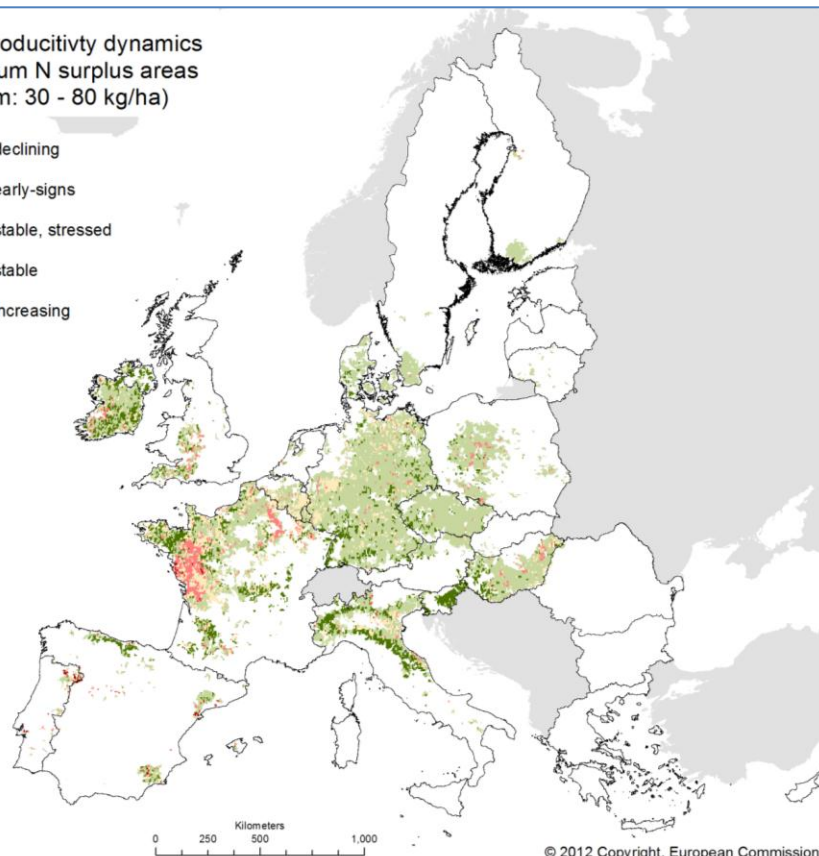


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	Land-productivity		
	declining	early-signs	stable, stressed
EU27	38.3	60.5	54.5

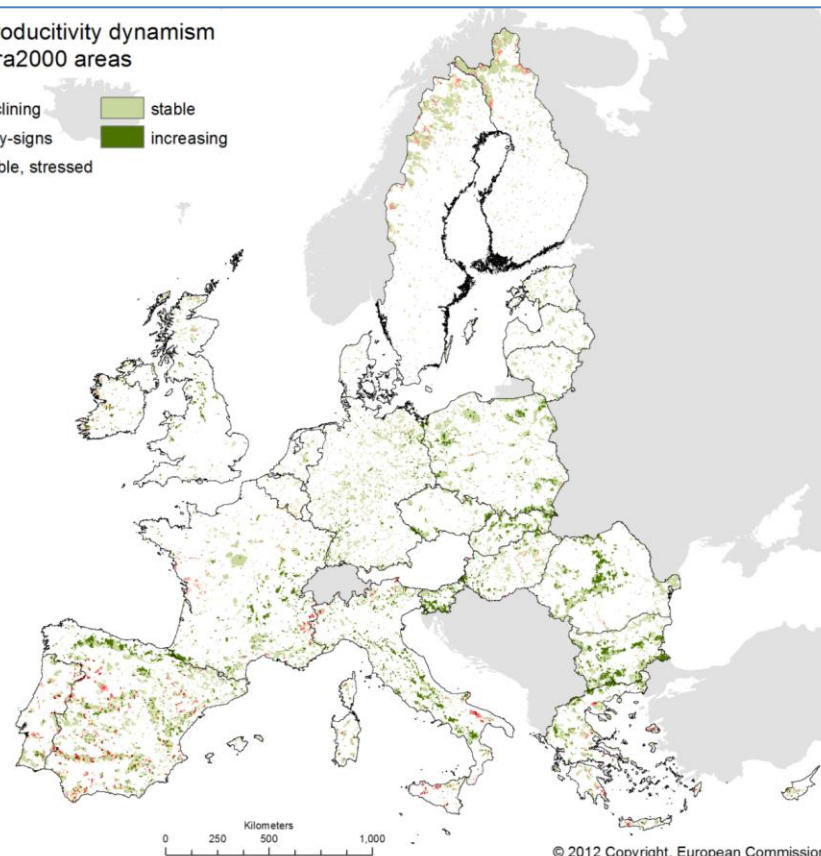
Table 5: Share of the Land-productivity Dynamics classes coinciding with erosion of more that 1 t/ha/yr. (in % of the Land-productivity Dynamics class)

Land productivity dynamics
in medium N surplus areas
(medium: 30 - 80 kg/ha)

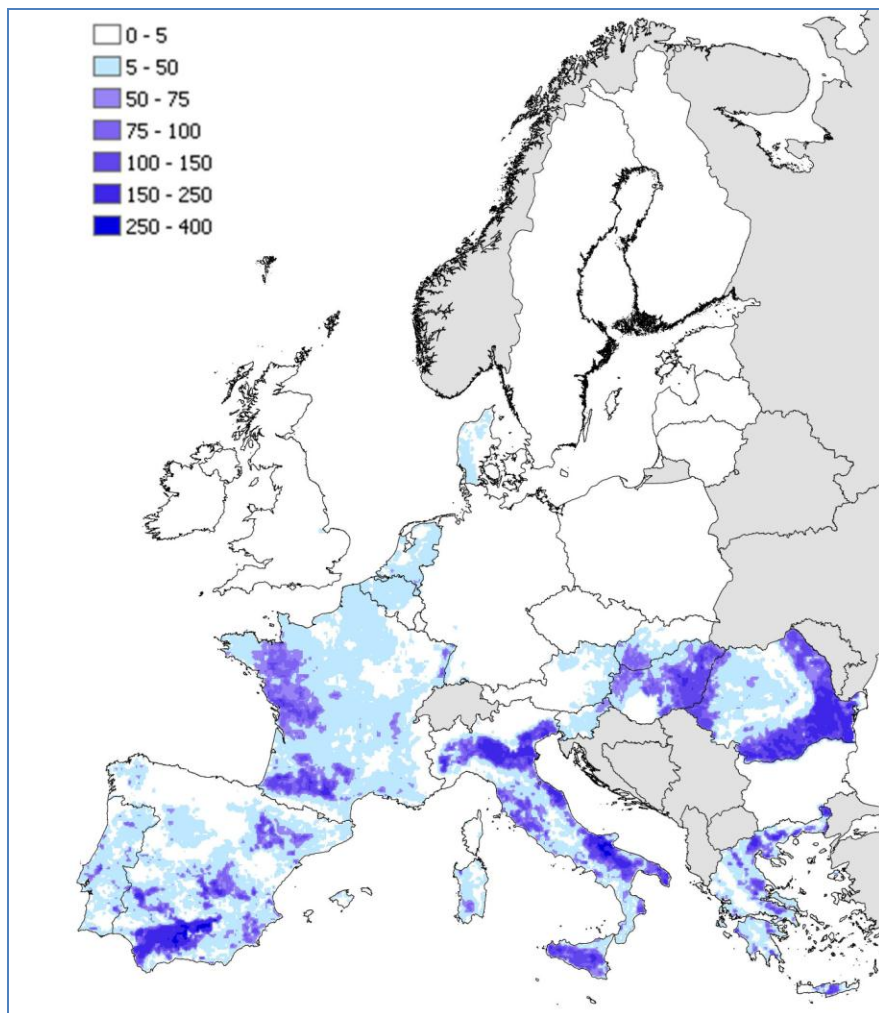


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Land productivity dynamism
in Natura2000 areas

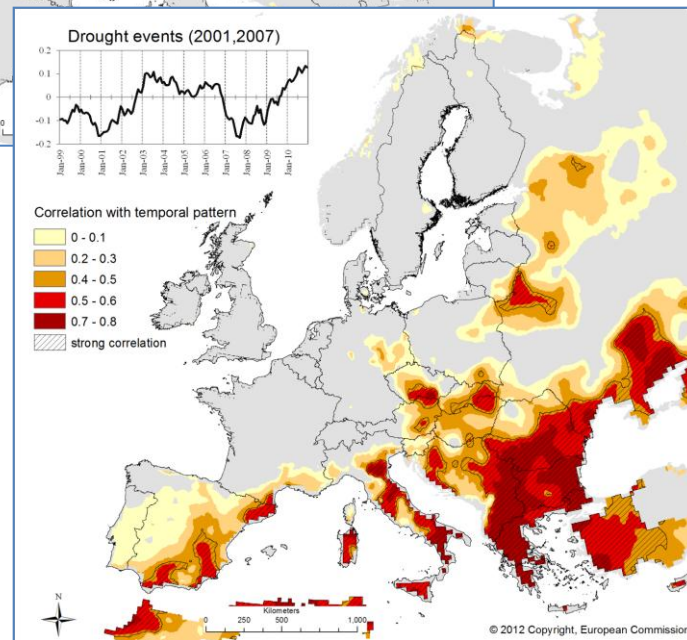
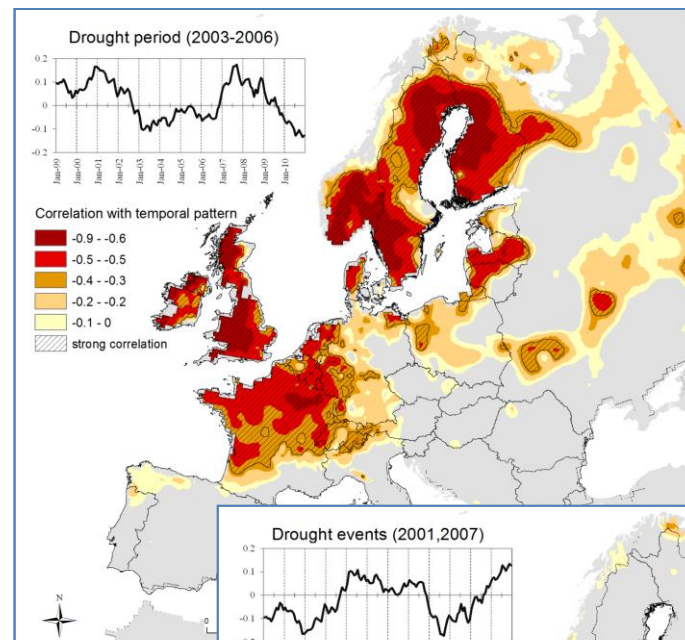


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**Average annual irrigation water requirements
for Europe (mm per 25 km² grid).**

Source: JRC/Bourauoi, Wriedt (2008).



Discussion points

- ① Land and soil degradation are complex and we don't have agreed measurement protocols / indicators today
- ② Land-productivity dynamics are a proxy for land degradation, not a measure of land degradation
- ③ Long-term satellite-based observations offer considerable potential as a source of information on land-productivity dynamics – but remember that satellites observe above-ground biomass
- ④ Complex social, economic and biophysical processes drive both positive and negative changes in land-productivity dynamics
- ⑤ Systematic validation is needed, including further analysis of the causes, statistics and economics behind the observed changes

Conclusions

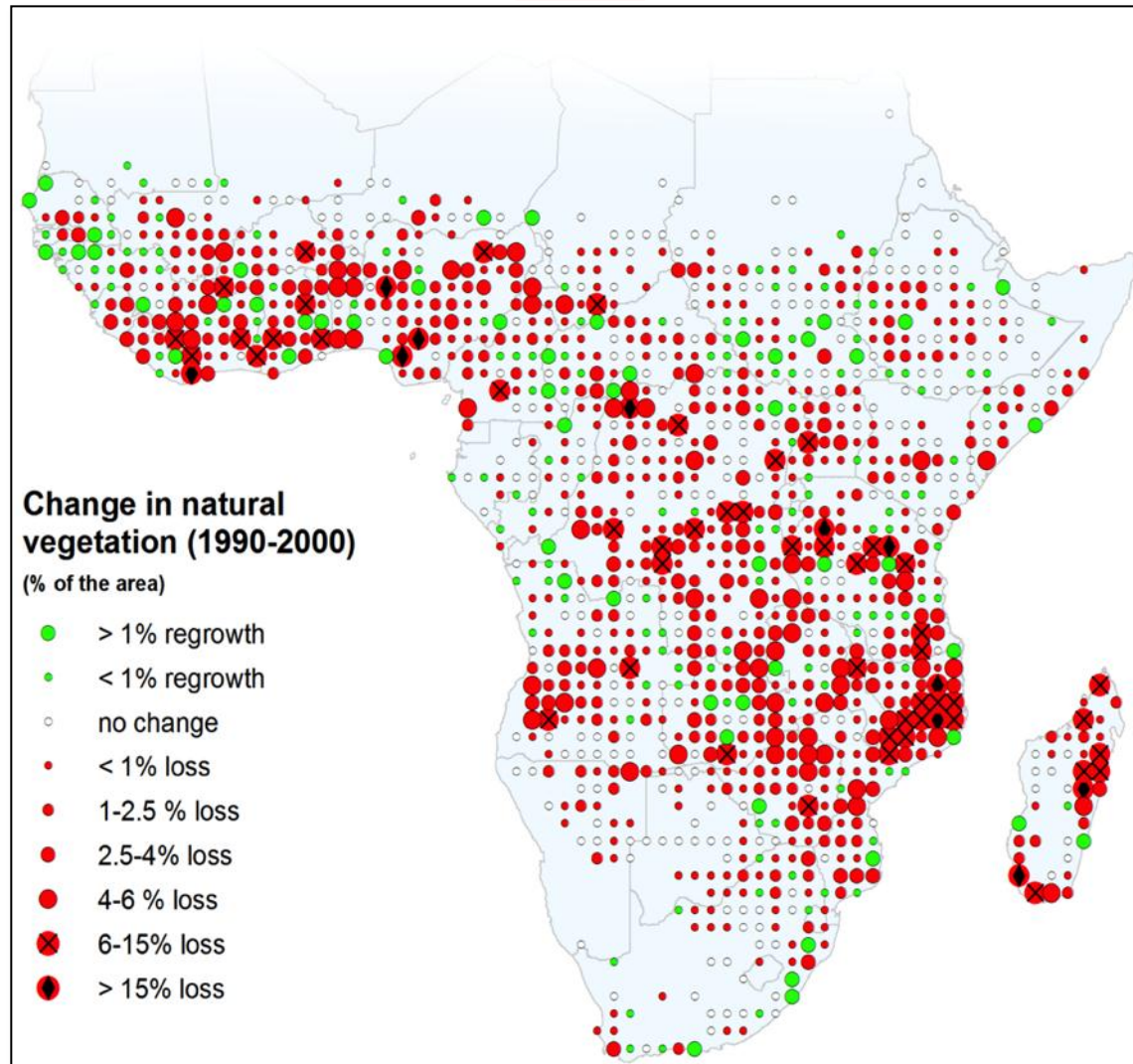
- ① Forests and semi natural vegetation account for 50% of all areas where land-productivity is increasing
- ② Agriculture accounts for 35% of the strongly declining area and 50% of areas exhibiting early-signs of decline - land under permanent crops is more affected than other agricultural classes
- ③ Less than 1% of EU arable land is coincident with declining land-productivity, and 0.2% of pastures, but over 10% of the most productive soils are affected – particularly The Western and Mediterranean regions
- ④ Almost all Member States are affected by declining land-productivity to some degree
- ⑤ Without an accepted indicator, we cannot yet confirm if the EU is Land Degradation Neutral or not



**At least
2bn
people
depend
entirely
on wood
energy**

**Almost 90% of all wood removals in Africa
are used for energy**

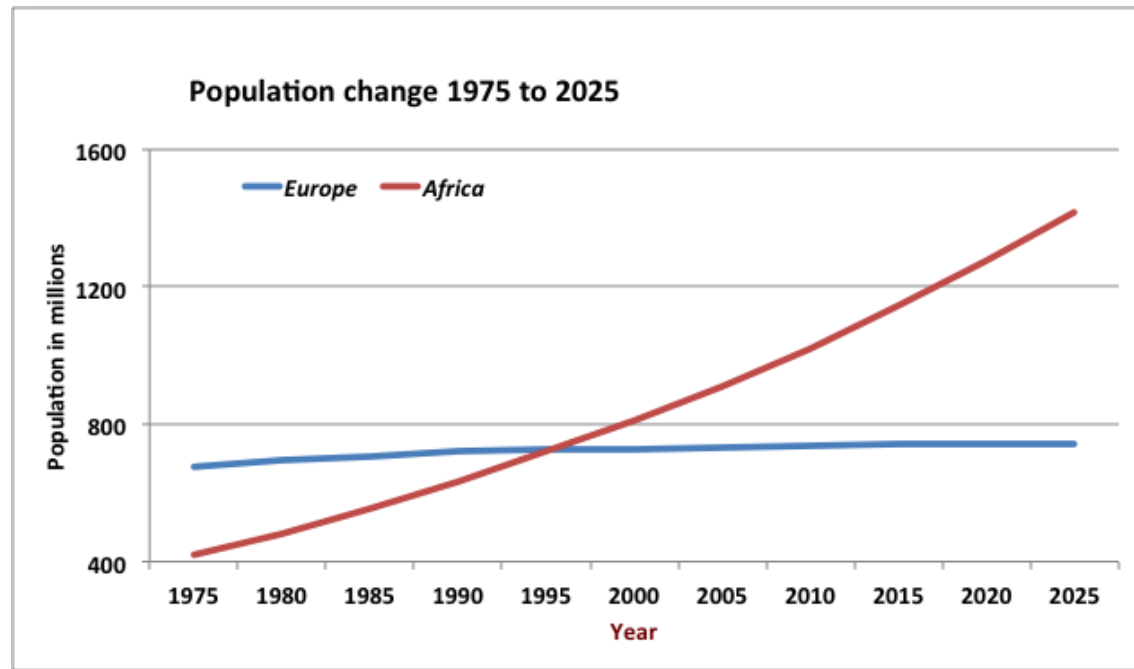
**Fuelwood meets 85% of rural energy
demands, charcoal most of the rest**





Africa's population has doubled since 1970s

- 25% less agricultural land per person today than in 1975
- Increasing pressure on environment *and* resources
- Food insecurity
- Conflict and migration





**Habitat loss; threat to biodiversity, forces
climate system, drives degradation...**

**key factor in landscape service supply,
demand and land management actions**



Tropical forest; major biodiversity/ carbon reservoirs + economic/social value

Deforestation; emissions $\sim 1.2 \text{ Pg C yr}^{-1}$



4 billion ha of Earth's surface is forested

**13 million ha converted to other use or lost
per year**



net loss is c.a. 5.2 to 5.8 million ha per year

...around 3 seconds to clear a sports field



c.a. 3 seconds to clear a sports field...

every 3 seconds of every day

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