FAO-Agriculture Stress Index System (ASIS)

Developed by:

In collaboration with:

Presented by: **Oscar Rojas (FAO)**

FAO
ASIS
Agriculture Stress Index System

Monitoring Agriculture Drought with Remote Sensing Data

> FAO's Global Information and Early Warning System (GIEWS) and the Climate, Energy and Tenure Division are developing a system for detecting agricultural areas with a high likelihood of water stress (drought) at global, regional or country level.

> The **Agricultural Stress Index System** (ASIS) is based on 10-day (dekadal) satellite data of vegetation and land surface temperature from the METOP-AVHRR sensor at 1 km resolution.

GLOBAL WATCH
GIEWS

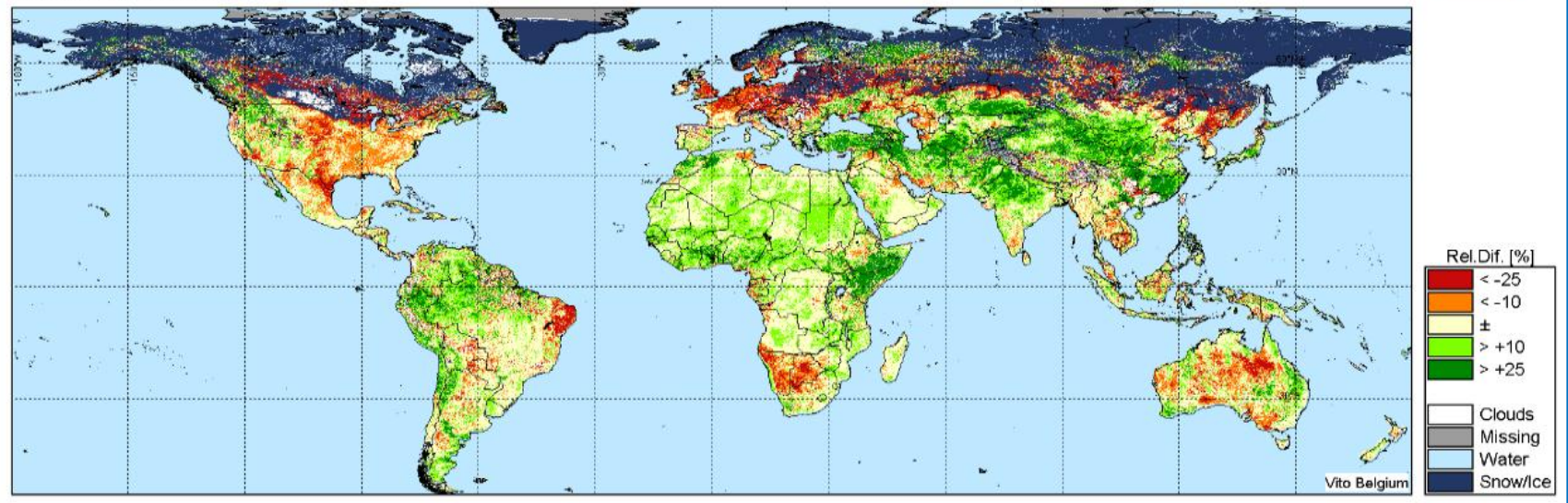# Classical remote sensing analysis based on anomalies

Region: The GLOBE
Period: April, 2013, Dekad 1/3
Theme: Normalized Difference Vegetation Index (NDVI)
        Relative difference w.r.t. historical mean: 100% x (Act. - Hist.)/Hist.
Source: SPOT-VEGETATION

Agricultural Stress Index System is based on the Vegetation Health Index (VHI) (Kogan et al. 1995)

Vegetation condition index (VCI)

Temperature condition index (TCI)

$$VCI_i = \frac{NDVI_i - NDVI_{\min}}{NDVI_{max} - NDVI_{min}}$$

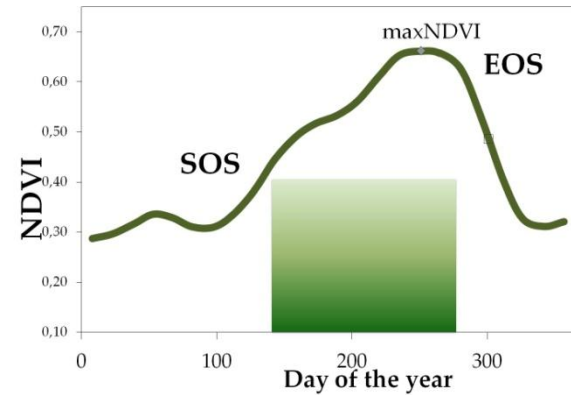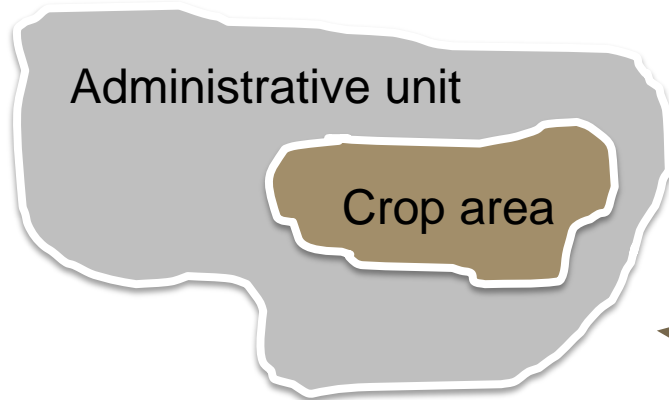$$TCI_i = \frac{BT_{max} - BT_i}{BT_{max} - BT_{min}}$$

Vegetation Health Index (VHI)
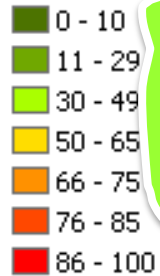
low VHI

VHI = a*VCI + (1-a)* TCI

high VHI

ASIS assess the severity (intensity, duration and spatial extent) of the agricultural drought

Administrative unit

Crop area

Percentage of the agriculture areas with VHI below 35

- 0 - 10
- 11 - 29
- 30 - 49
- 50 - 65
- 66 - 75
- 76 - 85
- 86 - 100

% of **crop area** affected by drought
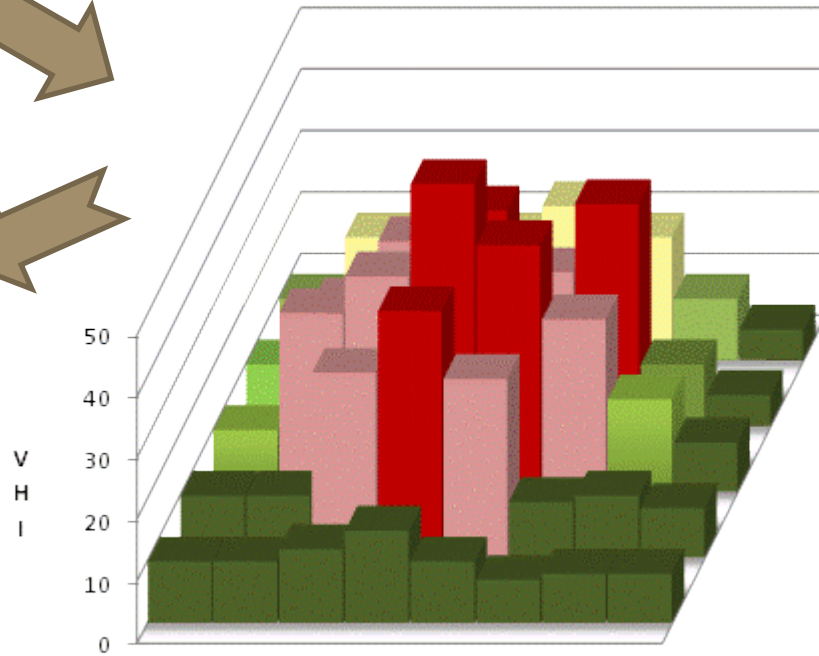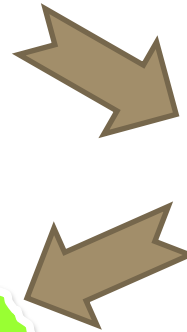
VHI temporal average value
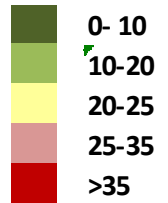
- 0- 10
- 10-20
- 20-25
- 25-35
- >35
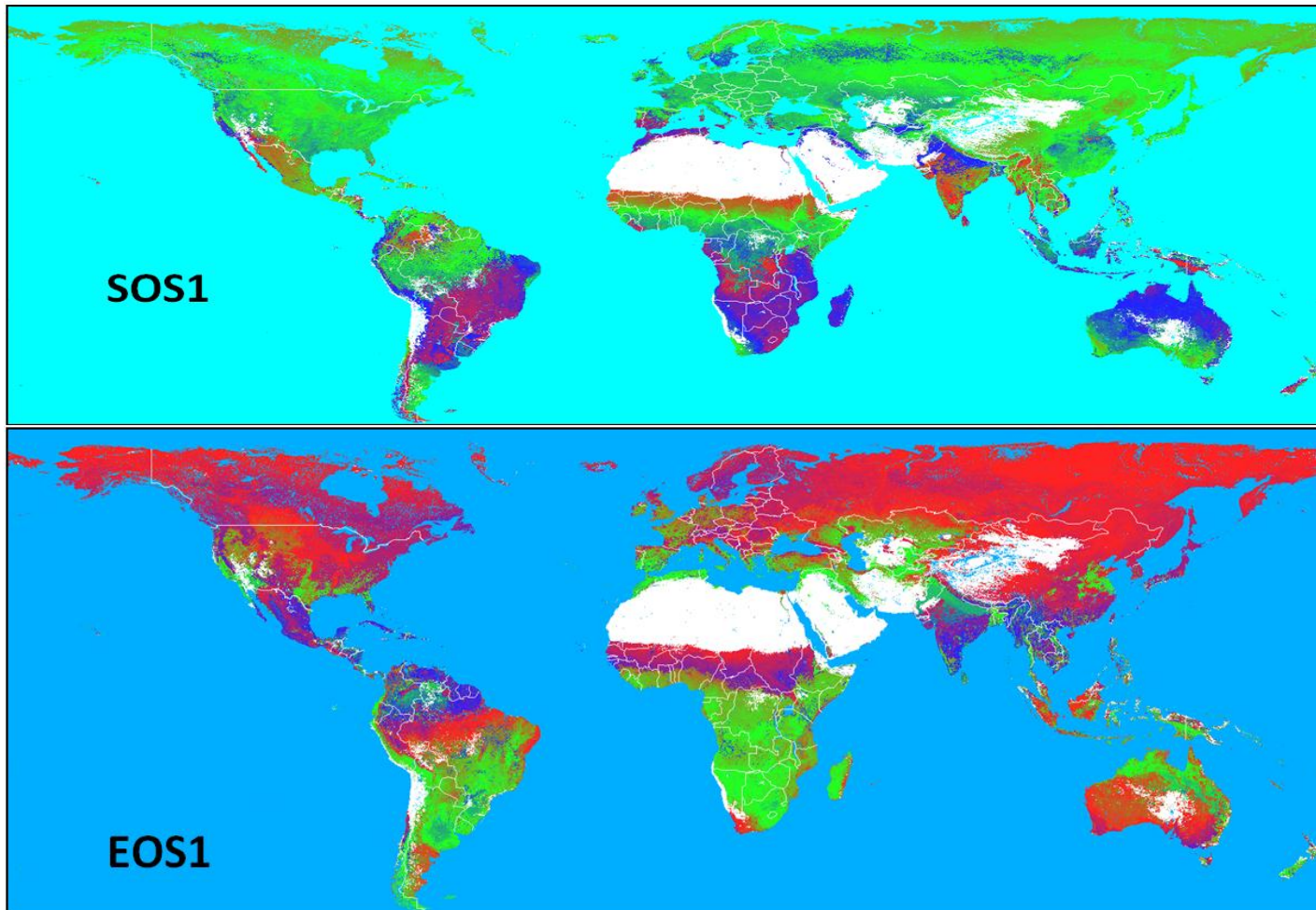
*SOS and EOS of the **first season**, as derived from the long term NDVI averages of SPOT-VGT (roi GLD, 21 km resolution).*

ii. Only crop pixels → Crop Mask
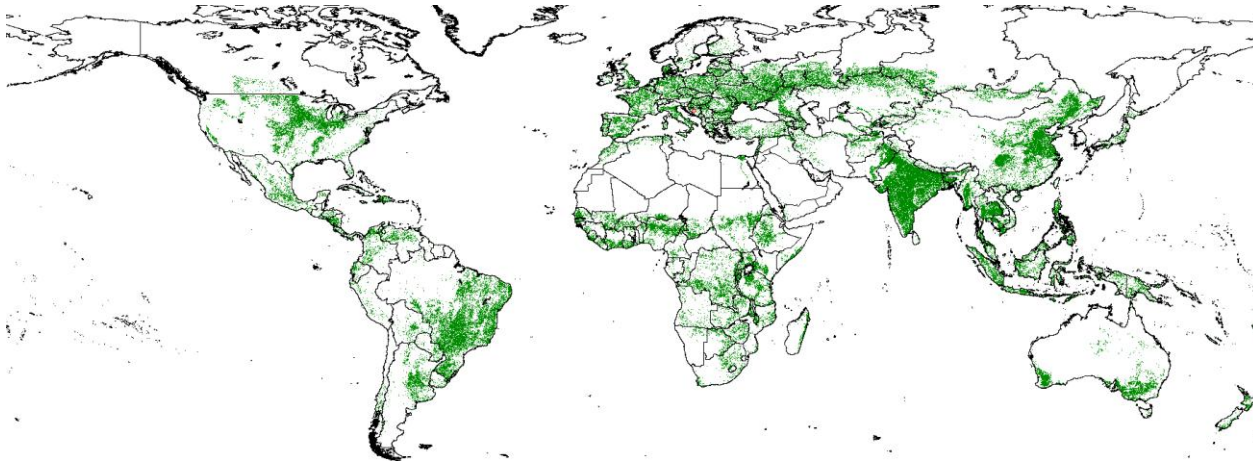
Compiled by JRC-FoodSec from:
- GlobCover V2.2
- Corine-2000
- AfriCover
- ...

iii. Per administrative unit → Spatial Aggregation on GAUL1 level

GAUL1 → Global Administrative Unit Layers

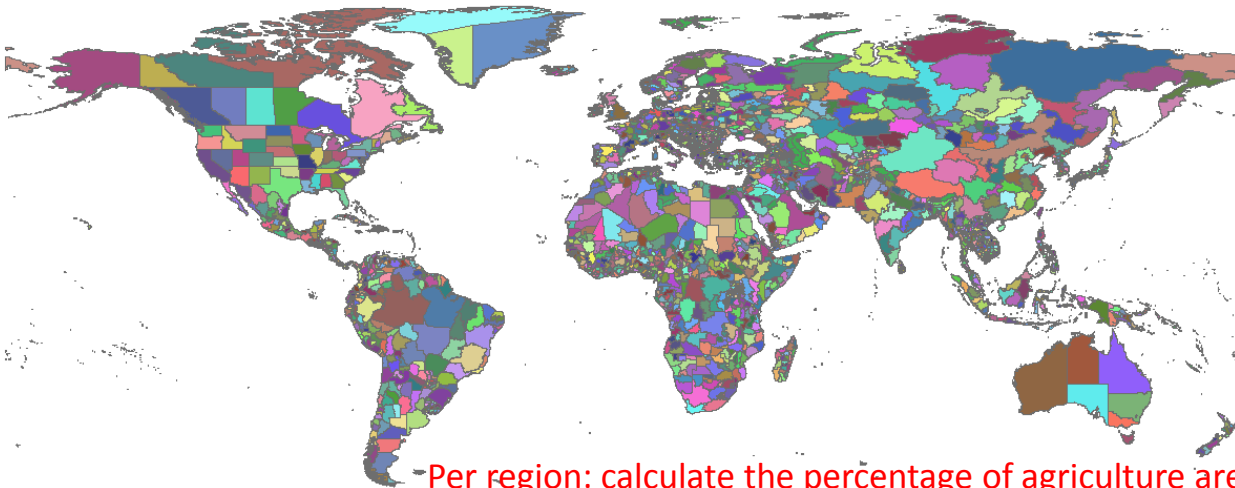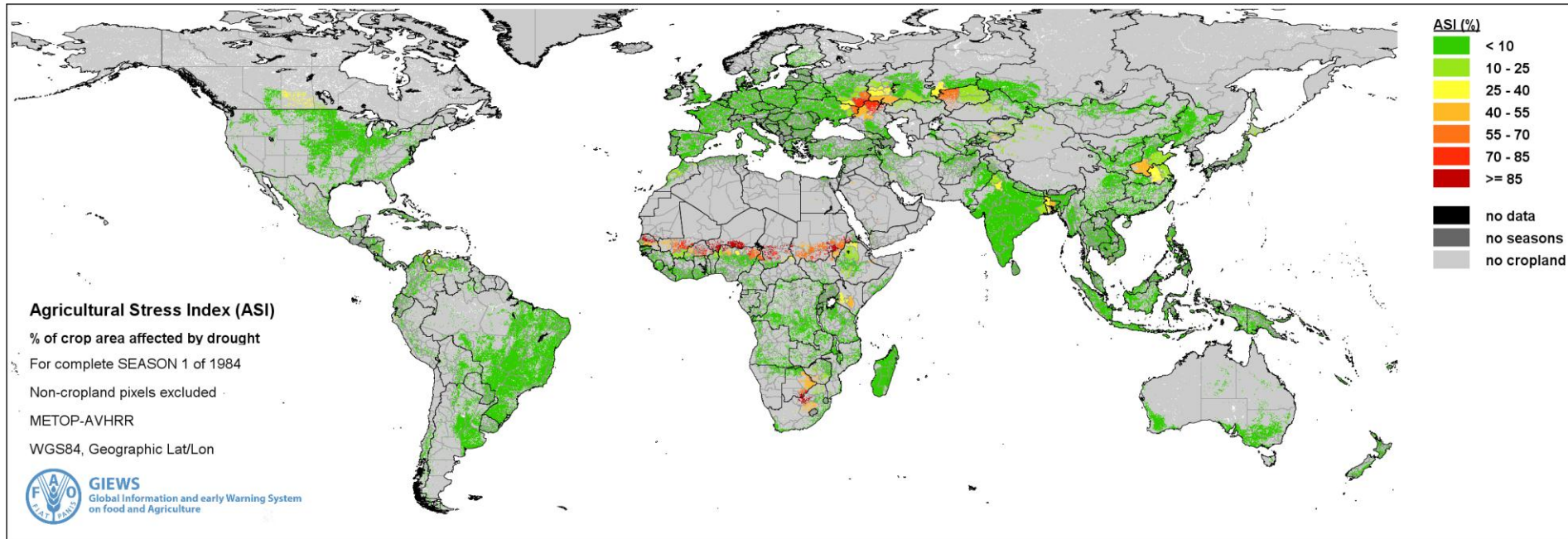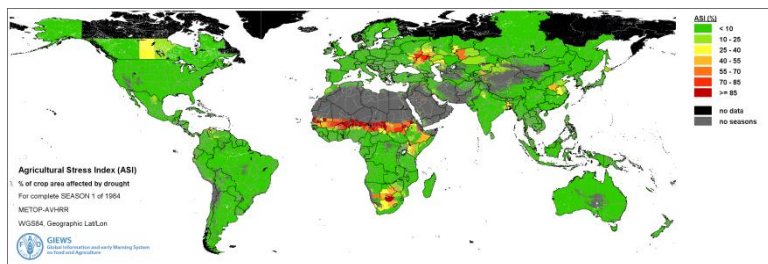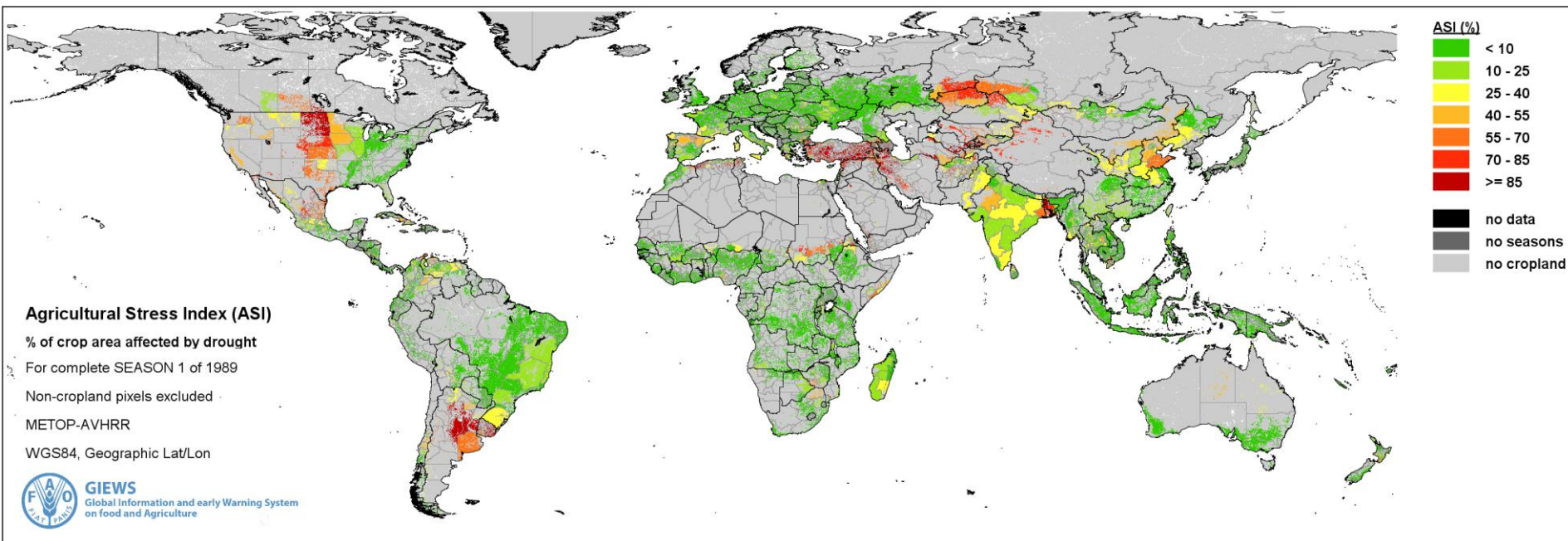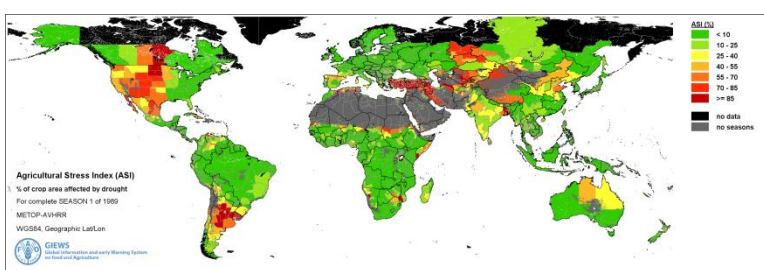Per region: calculate the percentage of agriculture area affected by drought
→ Pixels with Vegetation Health Index < 35 %

1984

Agricultural Stress Index (ASI)

% of crop area affected by drought

For complete SEASON 1 of 1984

Non-cropland pixels excluded

METOP-AVHRR

WGS84, Geographic Lat/Lon

GIEWS
Global Information and early Warning System
on food and Agriculture

ASI (%)
- < 10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 70 - 85
- >= 85
- no data
- no seasons
- no cropland

Africa: 1981 – 1984. During the crisis, an astounding 20 nations of Africa were under severe drought. Entire rivers and lakes completely dried up. Up to 20,000 people starved to death each month. Although the total number of people who perished is not completely known, it is estimated that over 1 million people died as a direct result of the drought. **Sahel:** The worst drought in the Sahel during the early-mid 1980's occurred the year 1984 affecting most Sahel countries. **Botswana:** It is a country that is prone to drought. Since independence, drought has occurred in the following years: 1968-70; 1974-75; 1979-80: **1981-87**: 1990-92.

1989

Agricultural Stress Index (ASI)

% of crop area affected by drought

For complete SEASON 1 of 1989

Non-cropland pixels excluded

METOP-AVHRR

WGS84, Geographic Lat/Lon

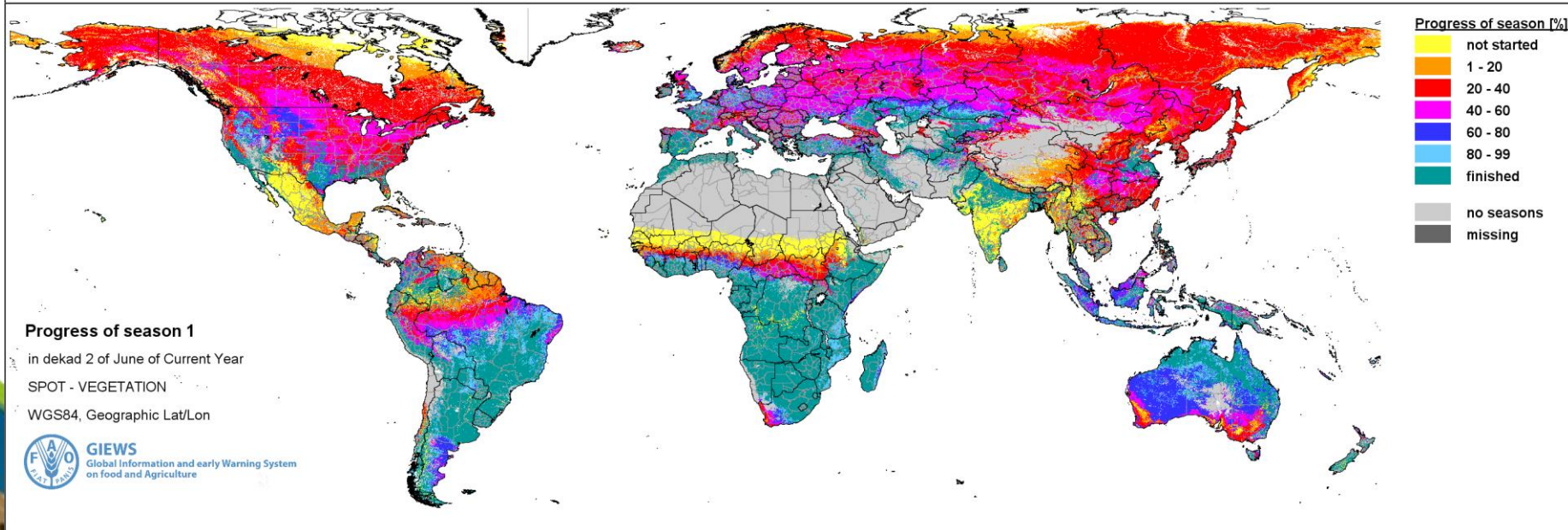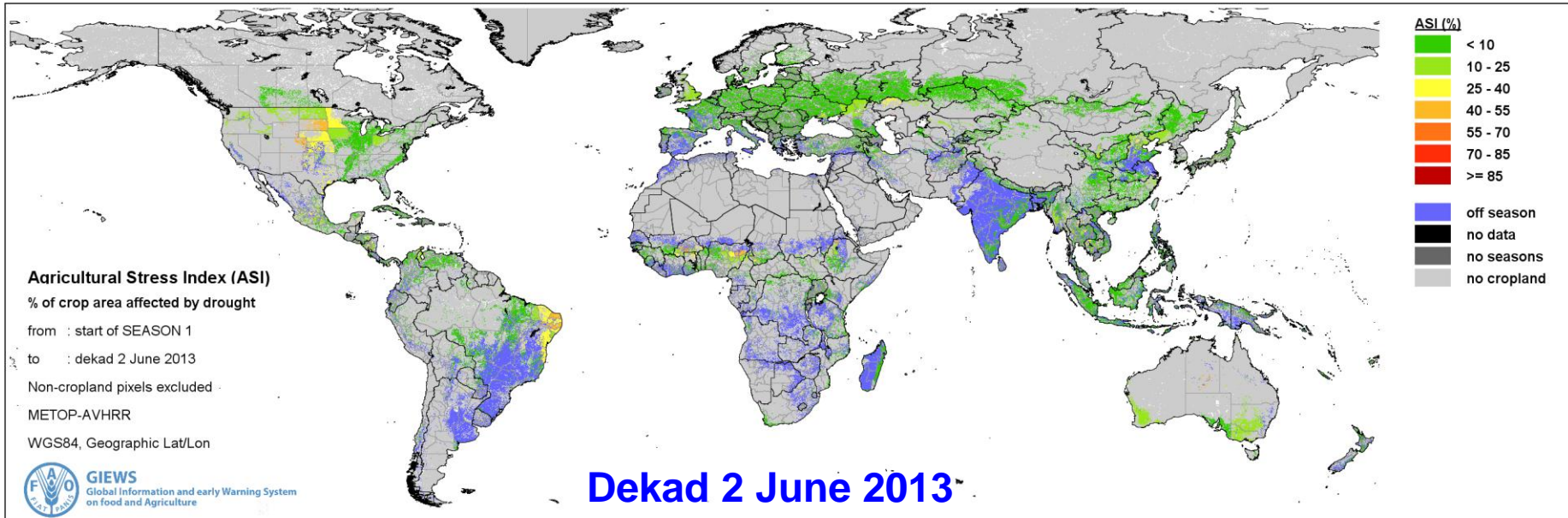**GIEWS**
Global Information and early Warning System
on food and Agriculture

USA Another significant drought in the United States occurred during 1988 and 1989. Following a milder drought in the Southeastern United States and California the year before, this drought spread from the Mid-Atlantic, Southeast, Midwest, Northern Great Plains and Western United States. This drought was widespread, unusually intense and accompanied by heat waves which killed around 4800 to 17000 people across the United States and also killed livestock across the United States.[citation needed] One particular reason that the Drought of 1988 became very damaging was farmers might have farmed on land which was marginally arable. Another reason was pumping groundwater near the depletion mark. The Drought of 1988 destroyed crops almost nationwide, residents' lawns went brown and water restrictions were declared many cities. This drought was very catastrophic for multiple reasons; it continued across the Upper Midwest States and North Plains States during 1989, not officially ending until 1990.[28] **Canada;** The drought also affected Canada in certain divisions. **Argentina:** Al haber más precipitaciones se reducen los riesgos de ocurrencia de sequías severas, pero aún suceden de manera excepcional, como los casos de **1989** y 1997. **Sudan**: The same period witnessed a series of localized droughts during 1987, **1989,** 1990, 1991 and 1993 in different parts of the country but mainly in western Sudan (HCENR, 199). All had adverse effects on vegetation resources, man (displacement and famine), livestock and agricultural production systems. Turkey: Moreover, in 1915, the 1930s and between 1970 and 1974, Turkey experienced serious drought hazards. Also, 1988 and **1989** were the hardest drought years for the south-eastern Anatolia Region. The flow of the Euphrates River decreased to 50 m3/s in these drought years.
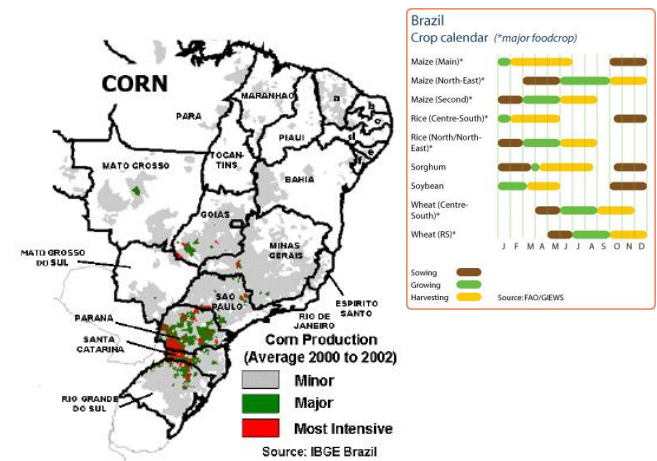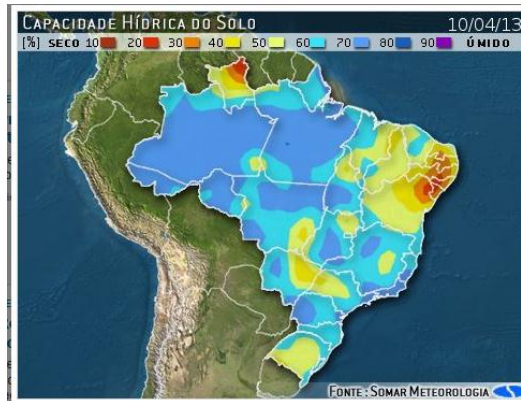
Agricultural Stress Index (ASI)

% of crop area affected by drought

For complete SEASON 1 of 2011

Non-cropland pixels excluded

METOP-AVHRR

WGS84, Geographic Lat/Lon

GIEWS
Global Information and early Warning System
on food and Agriculture
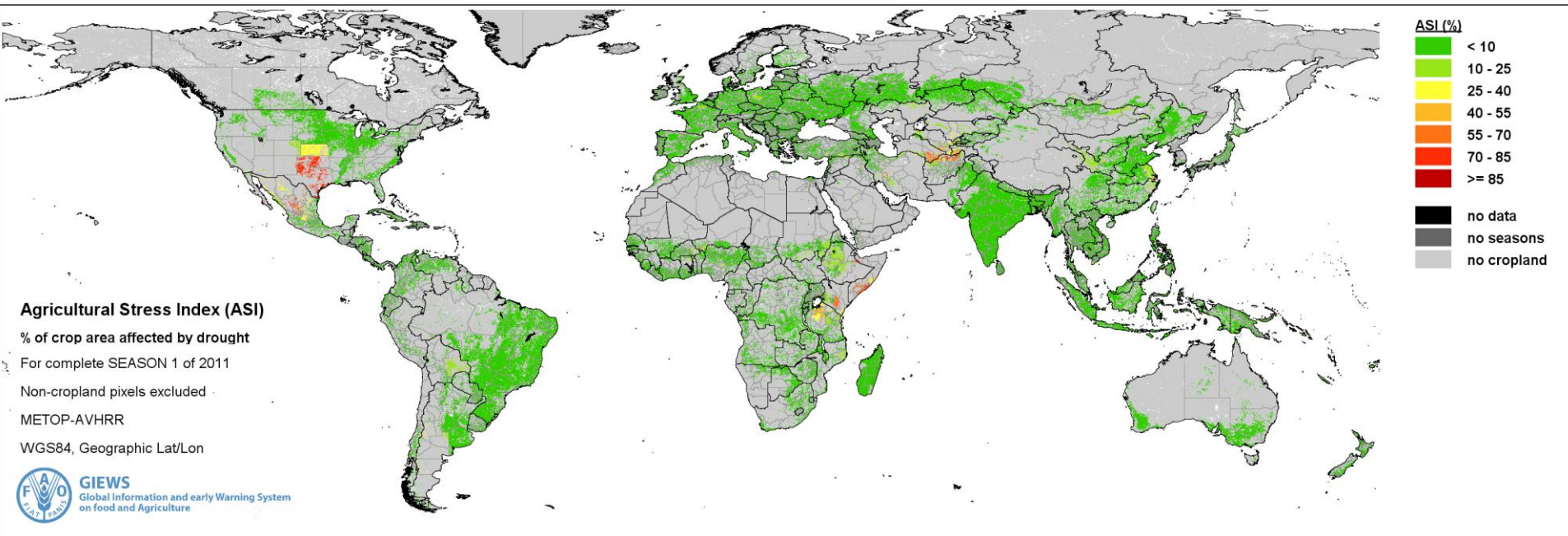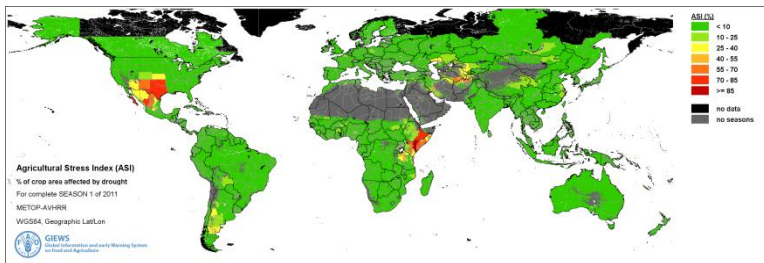
Eastern Africa: Since mid-July 2011, a severe drought has been affecting the entire East Africa region.[6] Said to be "the worst in 60 years",[7] the drought has caused a severe food crisis across Somalia, Djibouti, Ethiopia and Kenya that threatens the livelihood of 9.5 million people **United States:** Much of Texas is bone dry, with scarcely any moisture to be found in the top layers of soil. Grass is so dry it crunches underfoot in many places. The nation's leading cattle-producing state just endured its driest seven-month span on record, and some ranchers are culling their herds to avoid paying supplemental feed costs. **Mexico**: Mexico is being battered its worst drought in seven decades, which has devastated farm life and is expected to continue into next year. The lack of rainfall has affected almost 70 percent of the country and northern states like Coahuila, San Luis Potosi, Sonora, Tamaulipas and Zacatecas have suffered the most acute water shortage.

ASIS: Real time analysis

Agricultural Stress Index (ASI)

% of crop area affected by drought

from   : start of SEASON 1

to   : dekad 2 June 2013

Non-cropland pixels excluded

METOP-AVHRR

WGS84, Geographic Lat/Lon

GIEWS
Global Information and early Warning System
on food and Agriculture

ASI (%)

	< 10
	10 - 25
	25 - 40
	40 - 55
	55 - 70
	70 - 85
	>= 85
	off season
	no data
	no seasons
	no cropland

Dekad 2 June 2013

Progress of season 1

in dekad 2 of June of Current Year

SPOT - VEGETATION

WGS84, Geographic Lat/Lon

GIEWS
Global Information and early Warning System
on food and Agriculture

Progress of season [%]

	not started
	1 - 20
	20 - 40
	40 - 60
	60 - 80
	80 - 99
	finished
	no seasons
	missing

Brazil (Semi-arido)

Semi-arido of Brazil affected by drought however the most productive agriculture areas are in good conditions

ASIS Future Plans

- ASIS Stand Alone for countries

- At country level could be used in developing remote sensing-based index for crop insurance

- ASIS can be customized for pasture areas

Agriculture area affected by drought 1984

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1984

ASI (%)
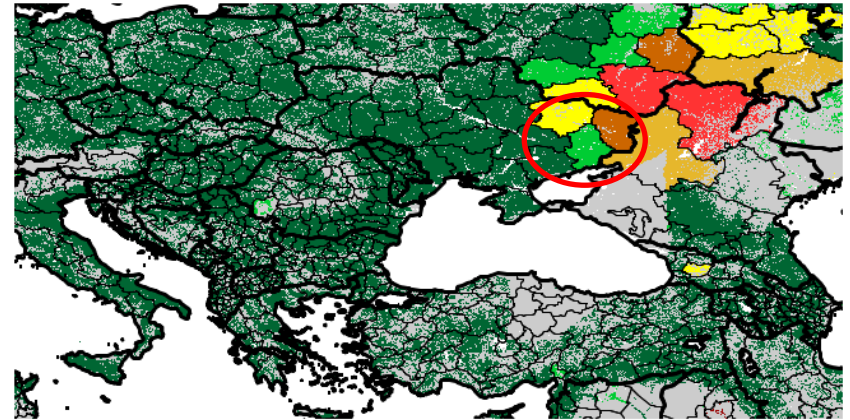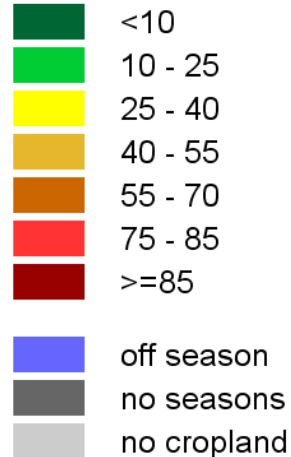
(dark green)	<10
(green)	10 - 25
(yellow)	25 - 40
(tan)	40 - 55
(orange)	55 - 70
(red)	75 - 85
(dark red)	>=85
(blue)	off season
(dark gray)	no seasons
(light gray)	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 1985

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1985

ASI (%)

■ (dark green)	<10
■ (green)	10 - 25
■ (yellow)	25 - 40
■ (tan)	40 - 55
■ (orange)	55 - 70
■ (red)	75 - 85
■ (dark red)	>=85
■ (blue)	off season
■ (dark gray)	no seasons
■ (light gray)	no cropland

FAO/GIEWS
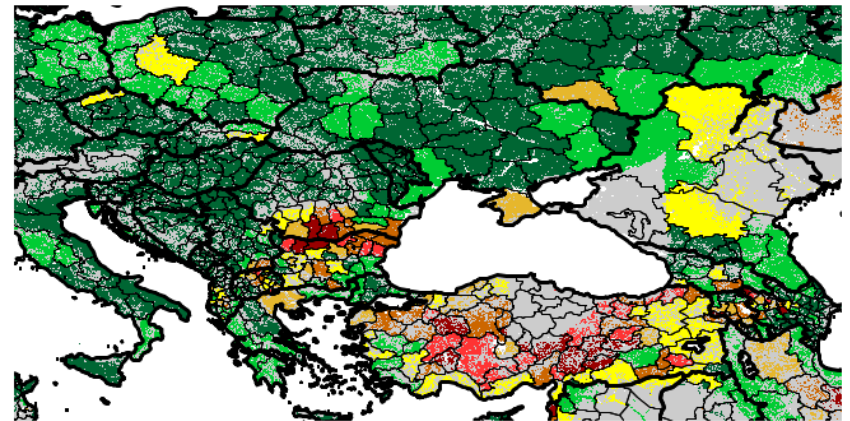Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 1986

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1986

ASI (%)

	<10
	10 - 25
	25 - 40
	40 - 55
	55 - 70
	75 - 85
	>=85
	off season
	no seasons
	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
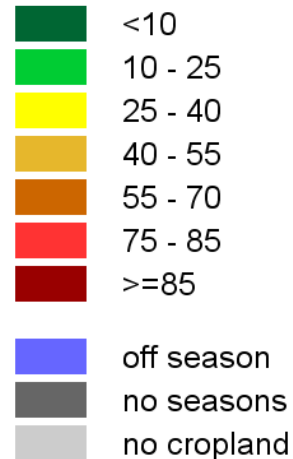
Agriculture area affected by drought 1987

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1987

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
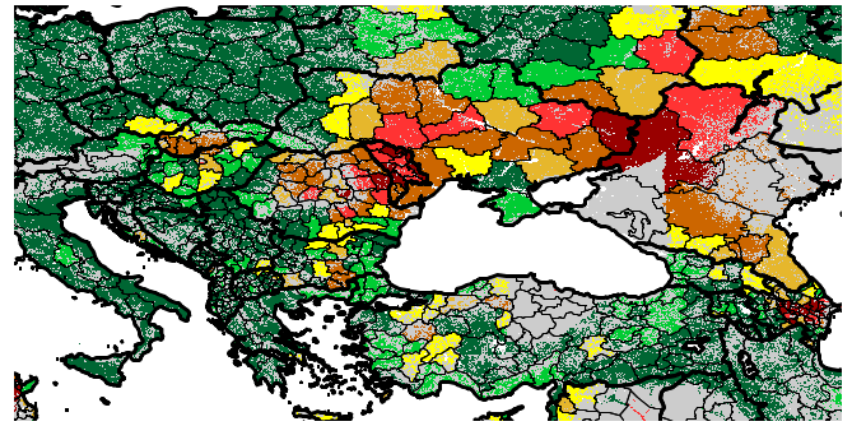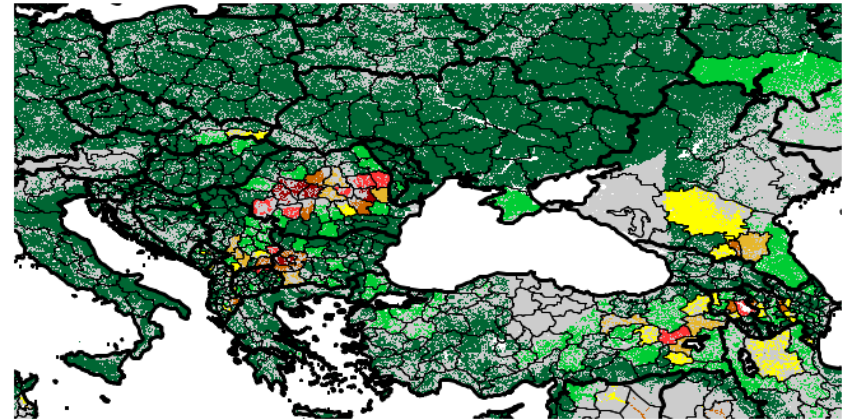
Agriculture area affected by drought 1988

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1988

ASI (%)

- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
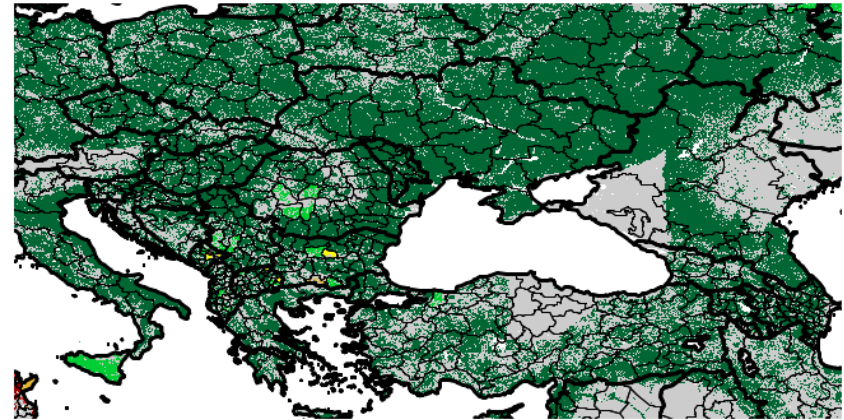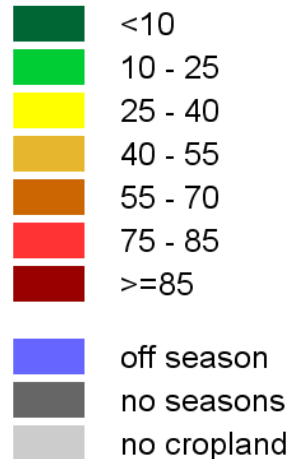
Agriculture area affected by drought 1989

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1989

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
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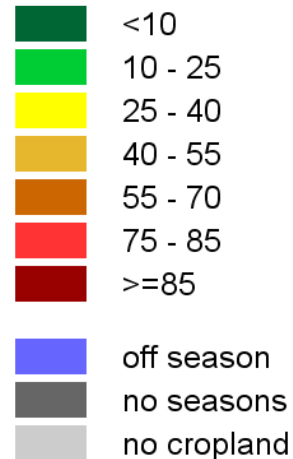
Agriculture area affected by drought 1990

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1990

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
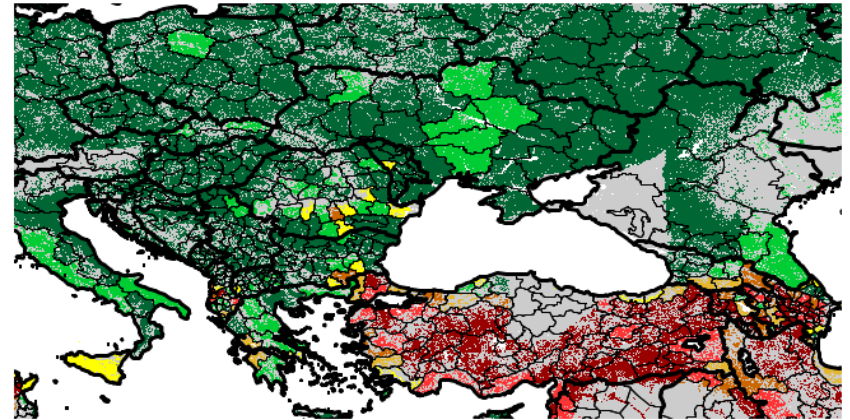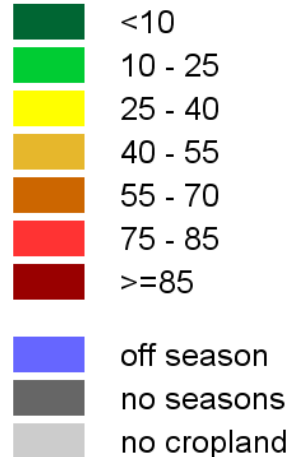
Agriculture area affected by drought 1991

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1991

ASI (%)

- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
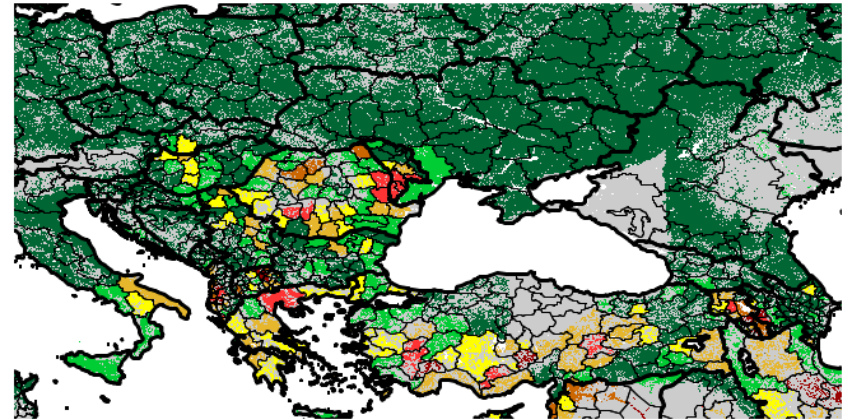Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 1992

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1992

ASI (%)
<10
10 - 25
25 - 40
40 - 55
55 - 70
75 - 85
>=85

off season
no seasons
no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
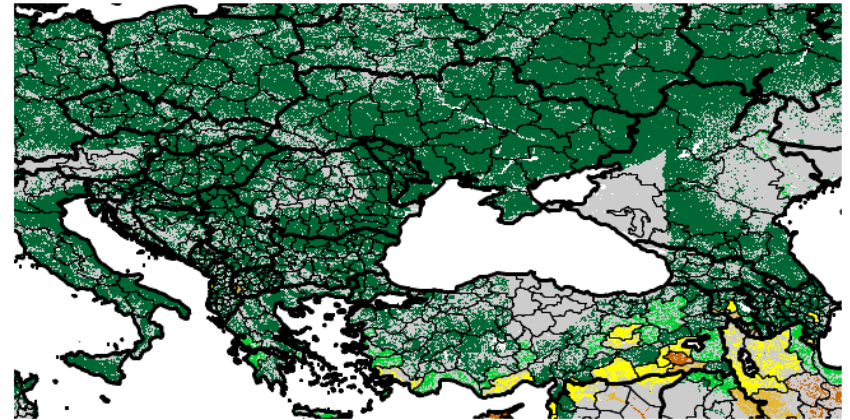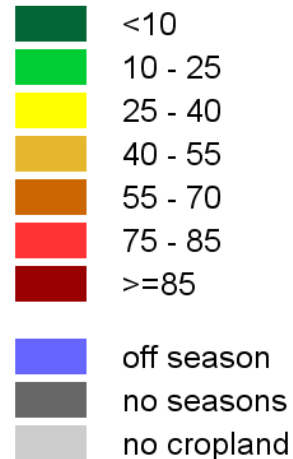
Agriculture area affected by drought 1993

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1993

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
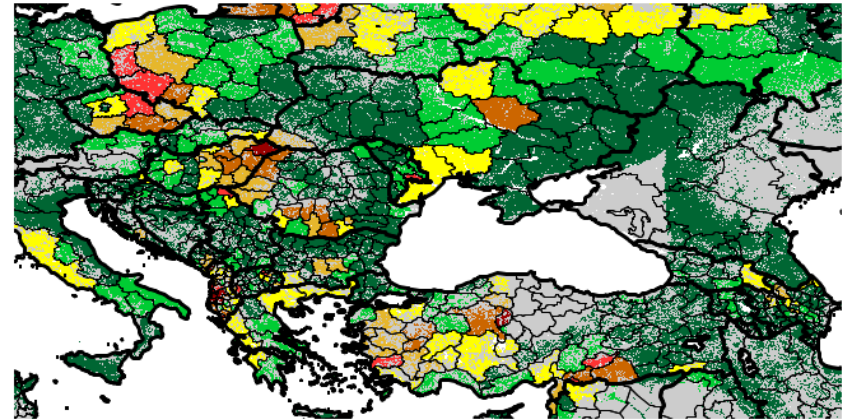
Agriculture area affected by drought 1994

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1994

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 1995

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1995

ASI (%)

- ■ <10
- ■ 10 - 25
- ■ 25 - 40
- ■ 40 - 55
- ■ 55 - 70
- ■ 75 - 85
- ■ >=85

- ■ off season
- ■ no seasons
- ■ no cropland

FAO/GIEWS
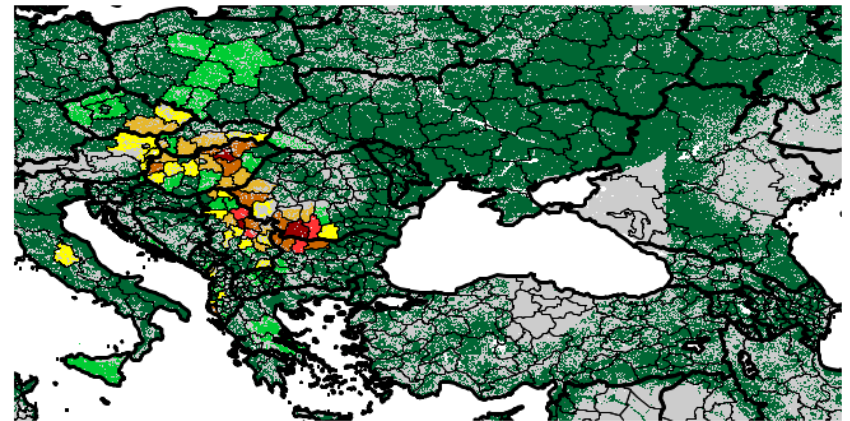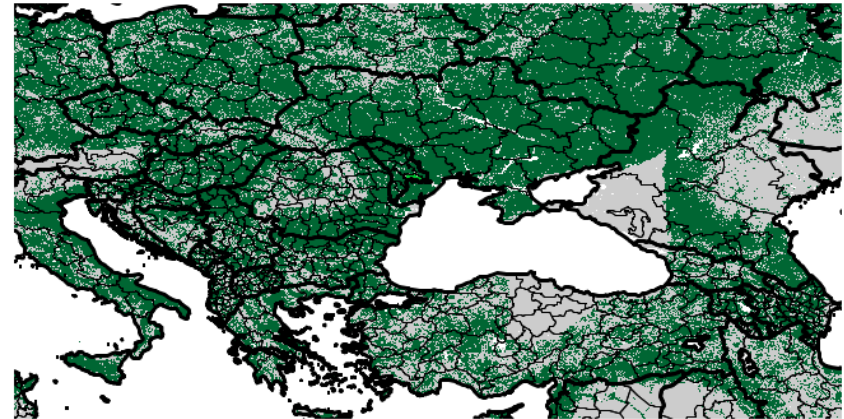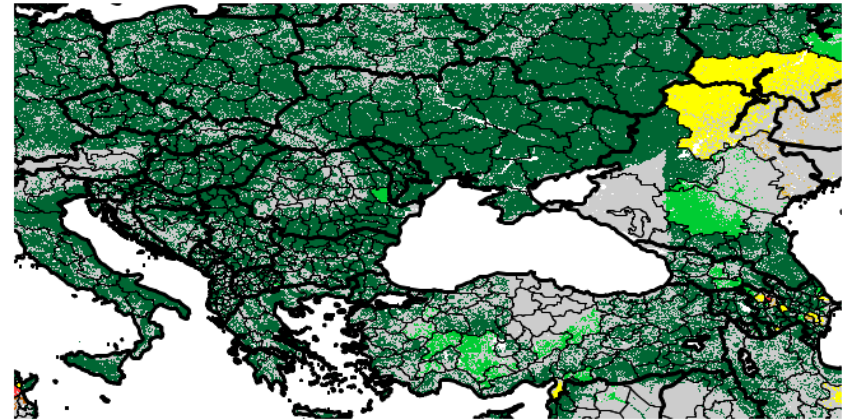Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

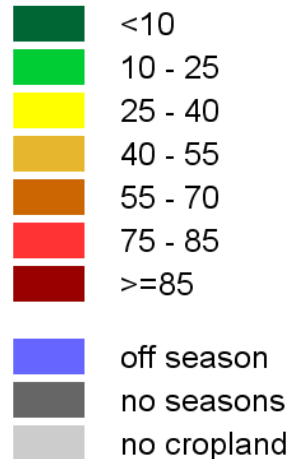# Agriculture area affected by drought 1996

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1996

ASI (%)

	<10
	10 - 25
	25 - 40
	40 - 55
	55 - 70
	75 - 85
	>=85
	off season
	no seasons
	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 1997

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1997

ASI (%)

■ (dark green)	<10
■ (green)	10 - 25
■ (yellow)	25 - 40
■ (tan)	40 - 55
■ (orange)	55 - 70
■ (red)	75 - 85
■ (dark red)	>=85
■ (blue)	off season
■ (dark grey)	no seasons
■ (light grey)	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
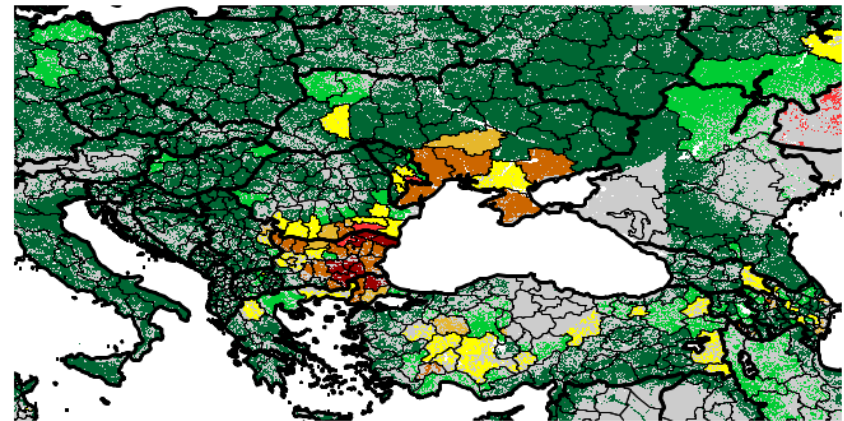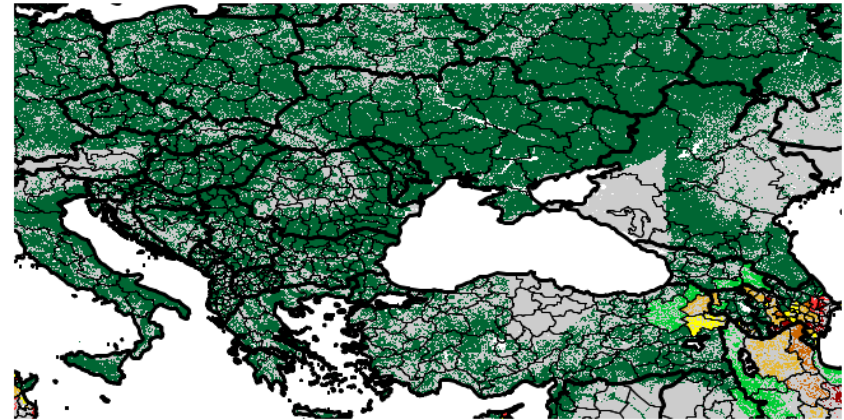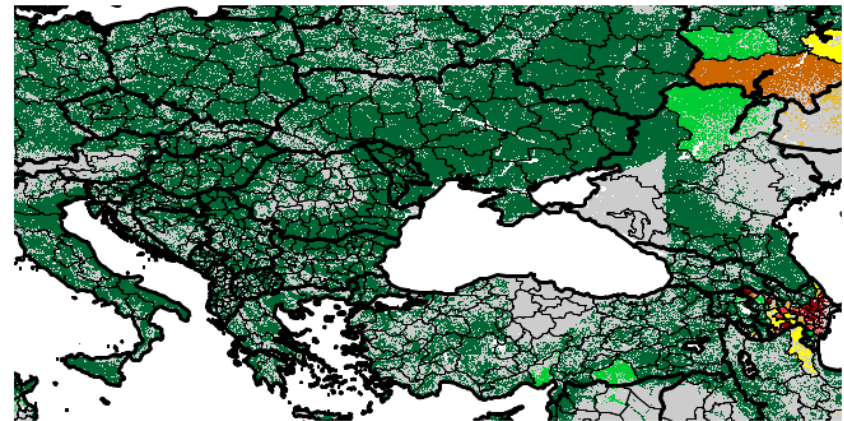
Agriculture area affected by drought 1998

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1998

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
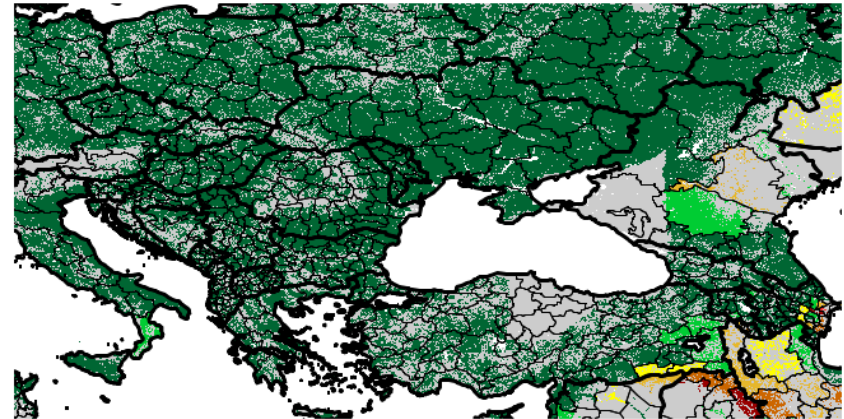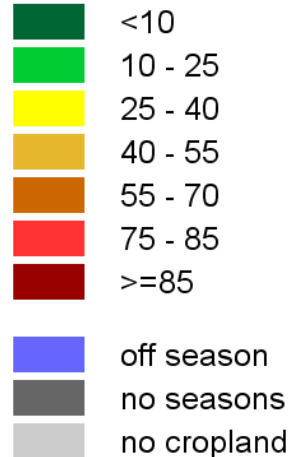Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 1999

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 1999

ASI (%)

■ (dark green)	<10
■ (green)	10 - 25
■ (yellow)	25 - 40
■ (tan)	40 - 55
■ (orange)	55 - 70
■ (red)	75 - 85
■ (dark red)	>=85
■ (blue)	off season
■ (dark grey)	no seasons
■ (light grey)	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
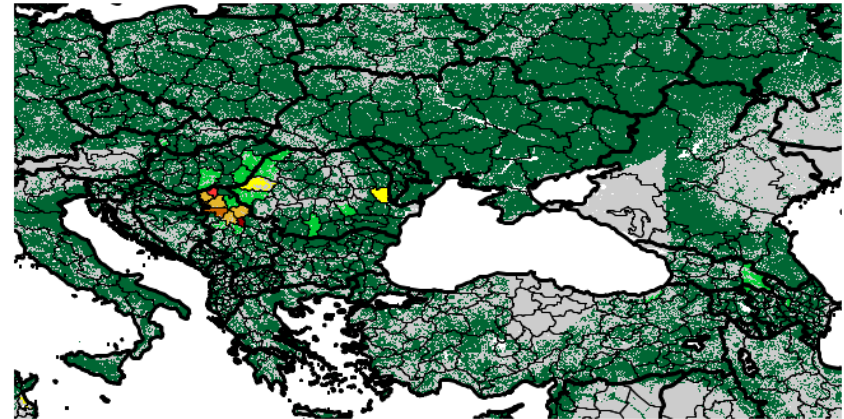
Agriculture area affected by drought 2000

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2000

ASI (%)

- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
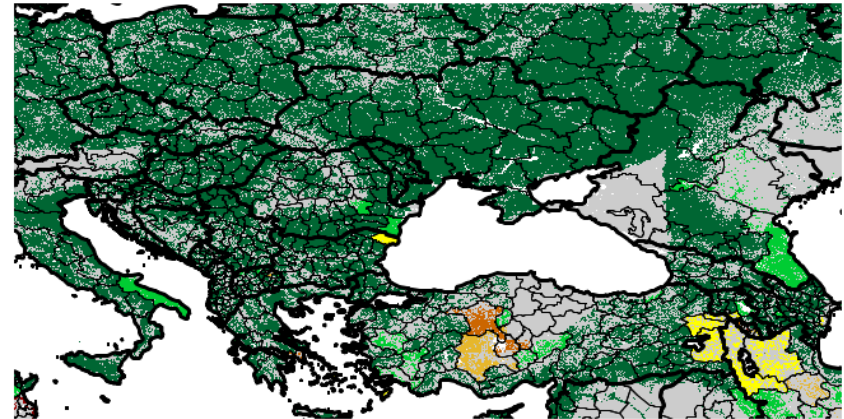Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 2001

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2001

ASI (%)

▮ (dark green)	<10
▮ (green)	10 - 25
▮ (yellow)	25 - 40
▮ (gold)	40 - 55
▮ (orange)	55 - 70
▮ (red)	75 - 85
▮ (dark red)	>=85
▮ (blue)	off season
▮ (dark grey)	no seasons
▮ (light grey)	no cropland

FAO/GIEWS
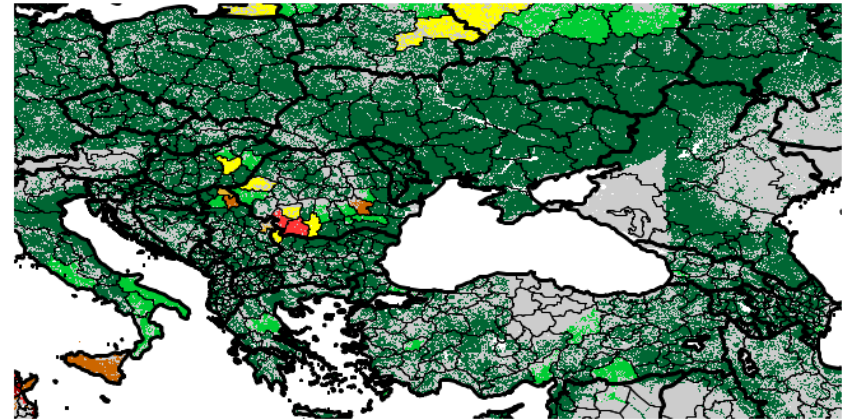Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 2002

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2002

ASI (%)
<10
10 - 25
25 - 40
40 - 55
55 - 70
75 - 85
>=85

off season
no seasons
no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
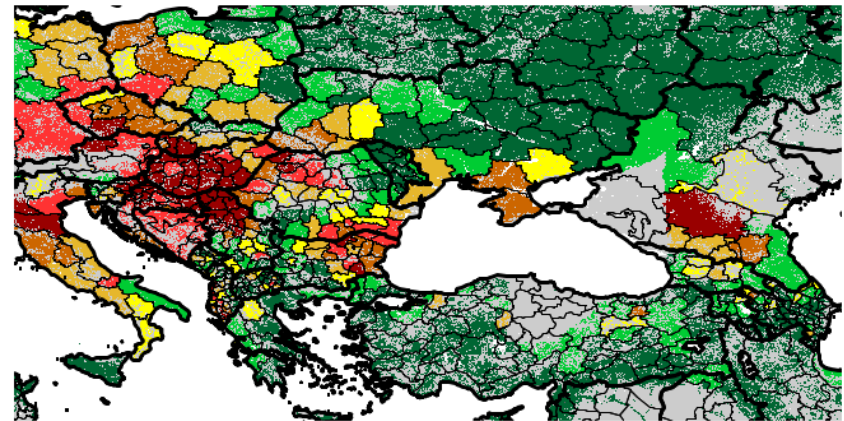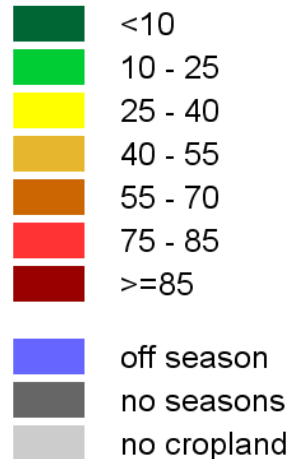
Agriculture area affected by drought 2003

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2003

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 2004

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2004

ASI (%)

	<10
	10 - 25
	25 - 40
	40 - 55
	55 - 70
	75 - 85
	>=85

	off season
	no seasons
	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
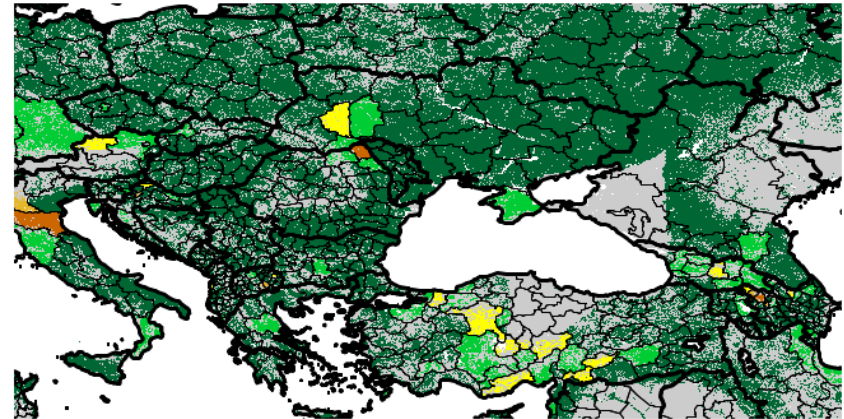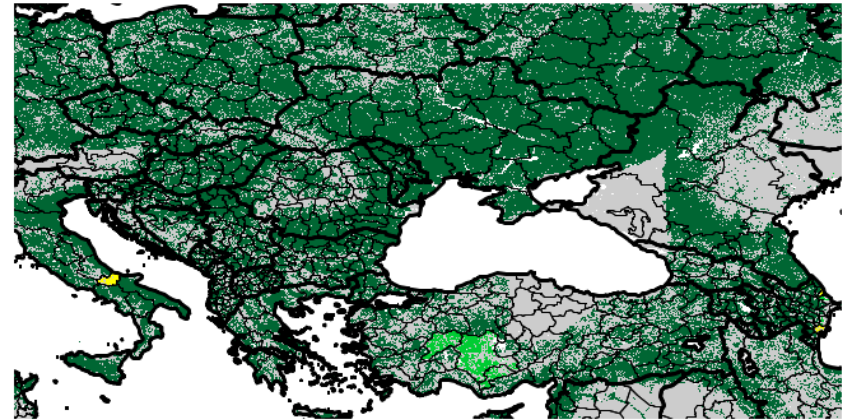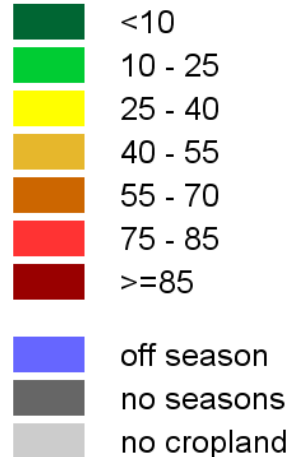
Agriculture area affected by drought 2005

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2005

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
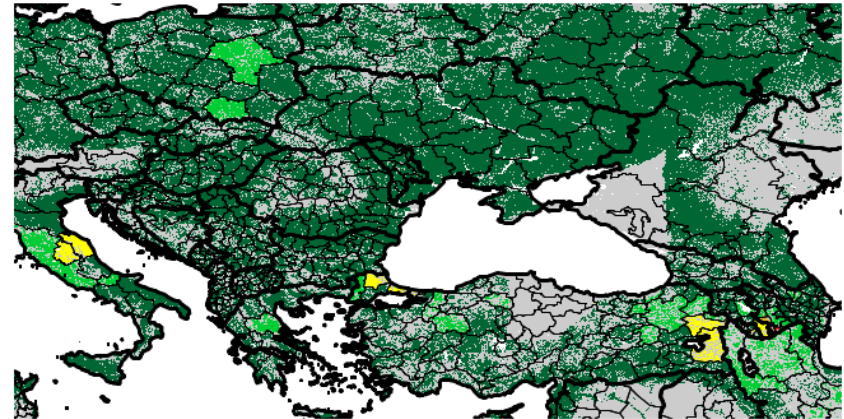
Agriculture area affected by drought 2006

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2006

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
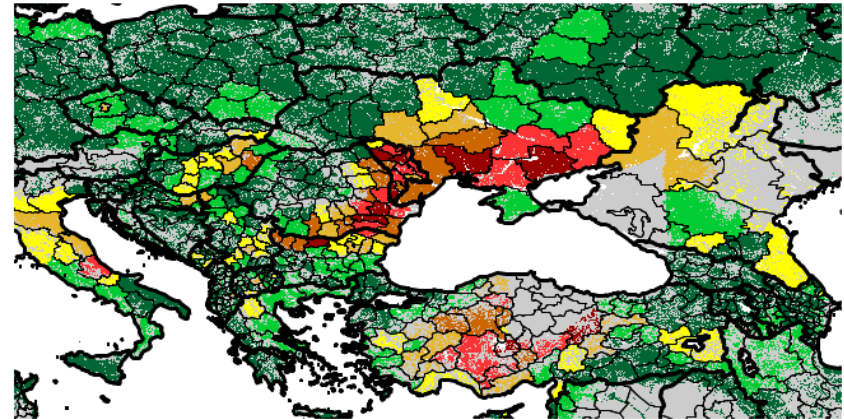Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 2007

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2007

ASI (%)

	<10
	10 - 25
	25 - 40
	40 - 55
	55 - 70
	75 - 85
	>=85
	off season
	no seasons
	no cropland

FAO/GIEWS
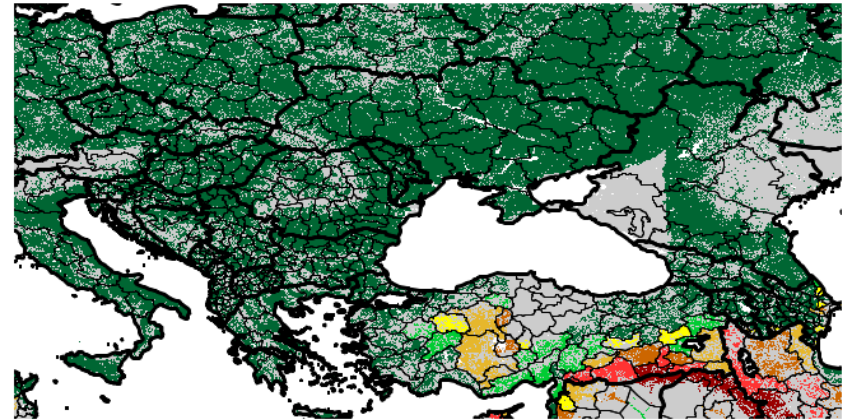Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

Agriculture area affected by drought 2008

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2008

ASI (%)
<10
10 - 25
25 - 40
40 - 55
55 - 70
75 - 85
>=85

off season
no seasons
no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

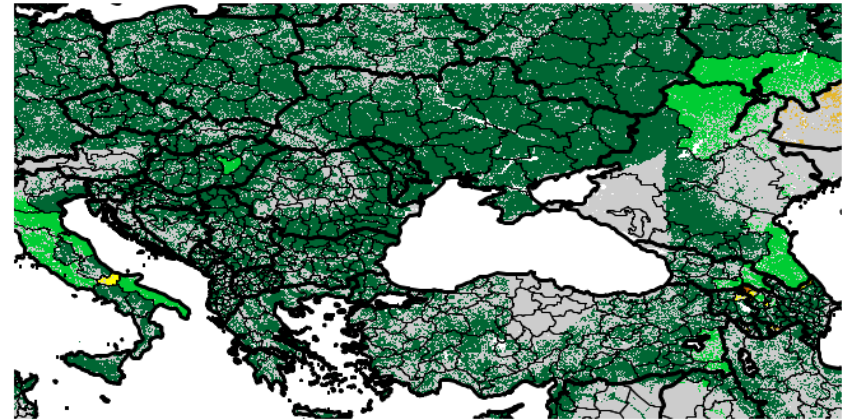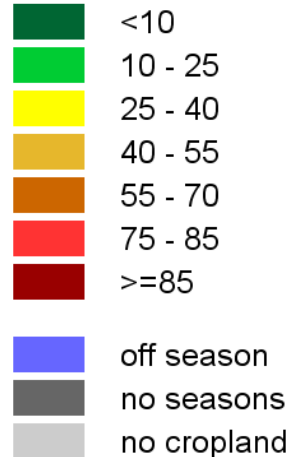# Agriculture area affected by drought 2009

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2009

ASI (%)

	<10
	10 - 25
	25 - 40
	40 - 55
	55 - 70
	75 - 85
	>=85
	off season
	no seasons
	no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
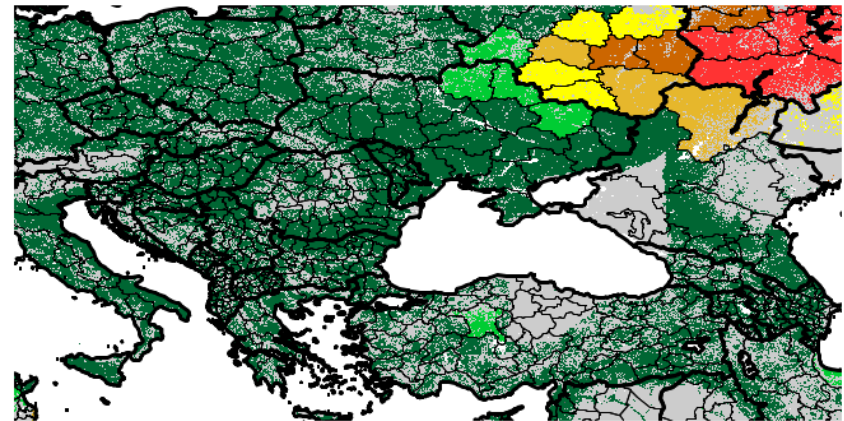
Agriculture area affected by drought 2010

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2010

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
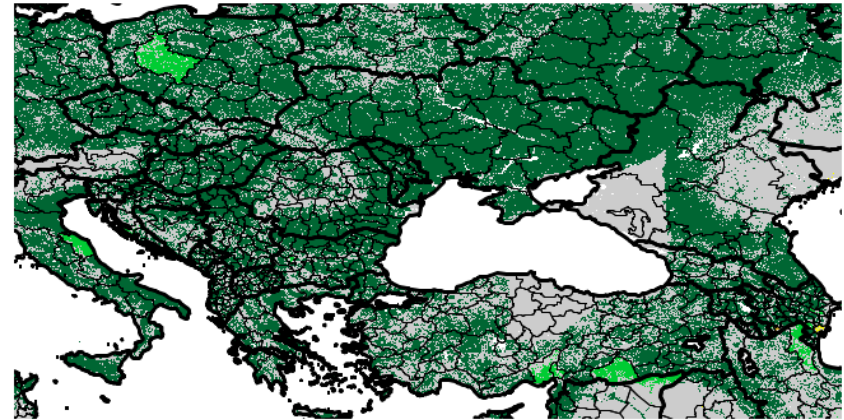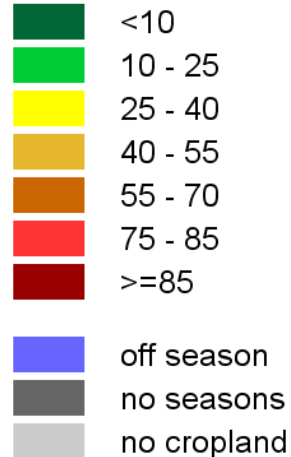
Agriculture area affected by drought 2011

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2011

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul
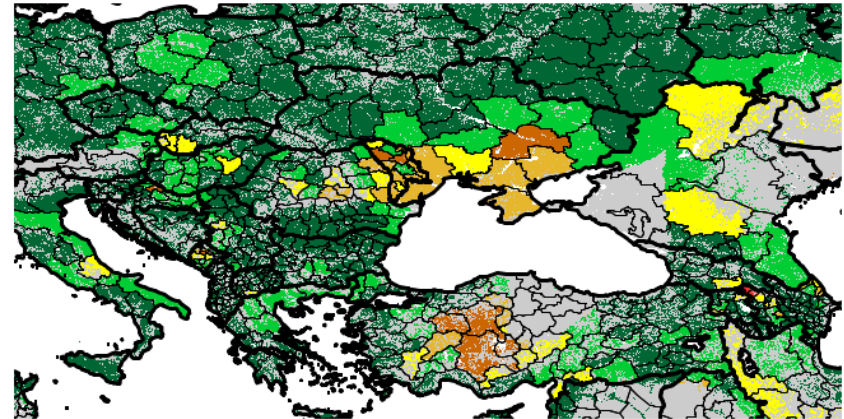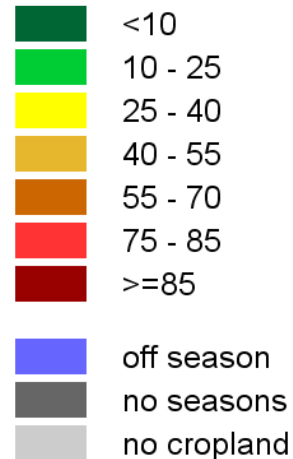
Agriculture area affected by drought 2012

Eastern Europa - % Crop area affected by drought (ASI)
SEASON 1, 2012

ASI (%)
- <10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 75 - 85
- >=85

- off season
- no seasons
- no cropland

FAO/GIEWS
Projection: Geographic, WGS 84 - Resolution: 1km
Sources : METOP/AVHRR - Vectors from FAO Gaul

2013