ASIS

Agriculture Stress Index System

MONITORING AGRICULTURE DROUGHT WITH REMOTE SENSING DATA

Global Near Real Time Cropland & grassland Agricultral Stress Index

vito
vision on technology

GIEWS
Global Information and early Warning System on food and Agriculture

Roel Van Hoolst
Herman Eerens
Dominique Haesen
Lieven Bydekerke (now EUMETSAT)
Antoine Royer (now JRC)
Paul Racionzer
Oscar Rojas
Yanyun Li

Timeline

vito
vision on technology

Methodology for drought monitoring with satellites

- METOP
- Global
- Near Real Time
- FAO server

- Rainfall data
- More anomalies
- Maps and graphs for GIEWS website
- Per country output

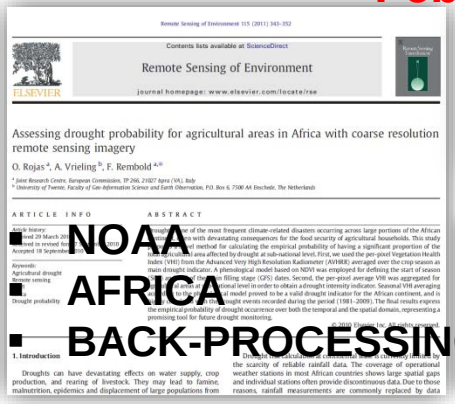
- Global adaptations
- Stand alone tool

Rojas et al. 2011 — Feb ‘12

ASIS I — Mar ‘13

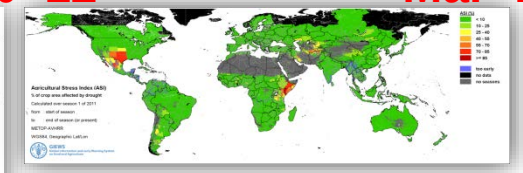
ASIS I bis — Jun ‘14

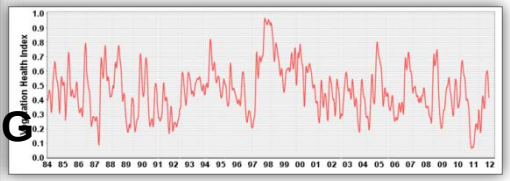
ASIS II — TODAY end ‘15

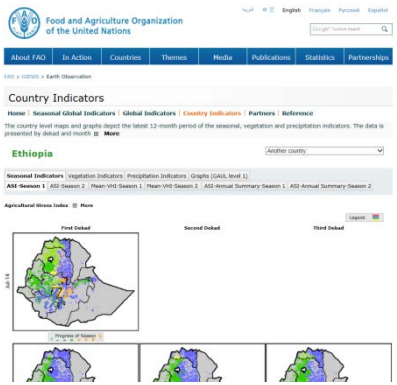

Remote Sensing of Environment

Assessing drought probability for agricultural areas in Africa with coarse resolution remote sensing imagery

O. Rojas, A. Vrieling, F. Rembold






Food and Agriculture Organization of the United Nations

Country Indicators

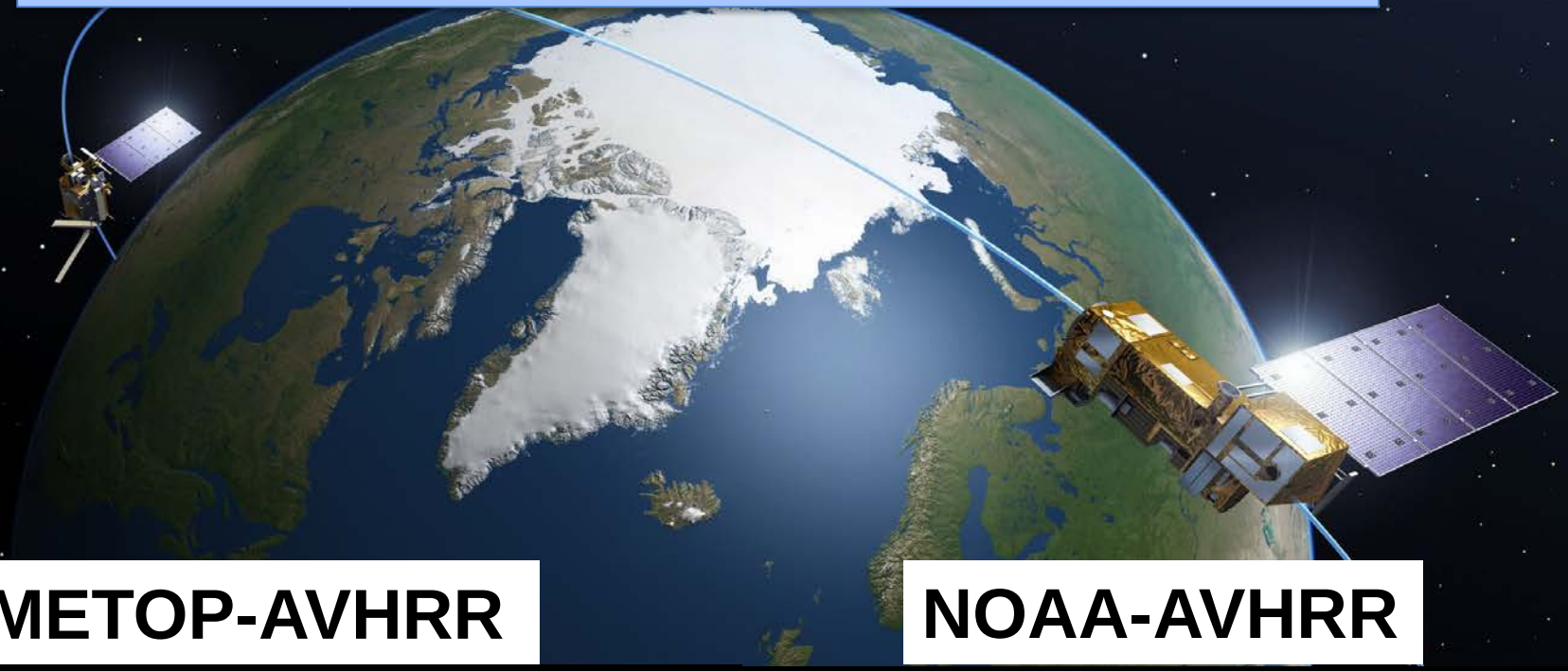
Ethiopia

- NOAA
- AFRICA
- BACK-PROCESSING

Definition of new drought indicator

The ASI or Agricultural Stress Index represents the percentage of the "**cropped or grassland areas**" within each "**administrative region**", which are affected by "**drought**", as derived from "**EO-observations**" and defined over the course of the "**growing season**".

“EO-observations”



METOP-AVHRR

- Raw data from EUMETSAT
- Processing at VITO permises
- 10-daily at 1 km
- [2007-TODAY]
- Expected: continued delivery untill mid 2020’s
- metops10.vito.be

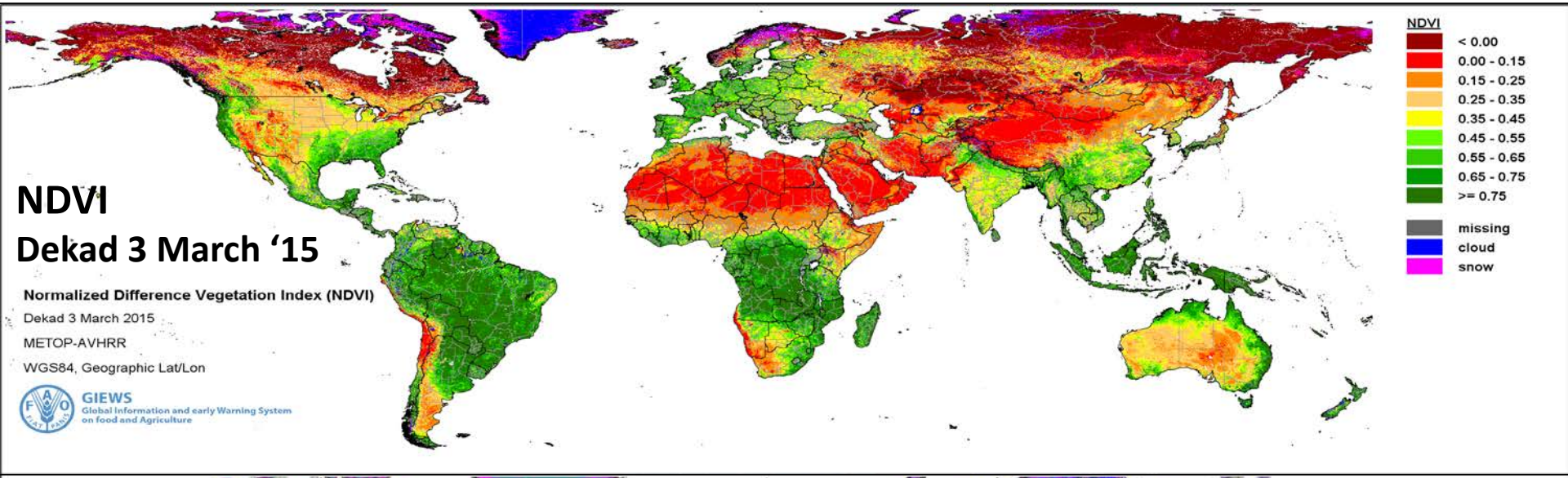
NOAA-AVHRR

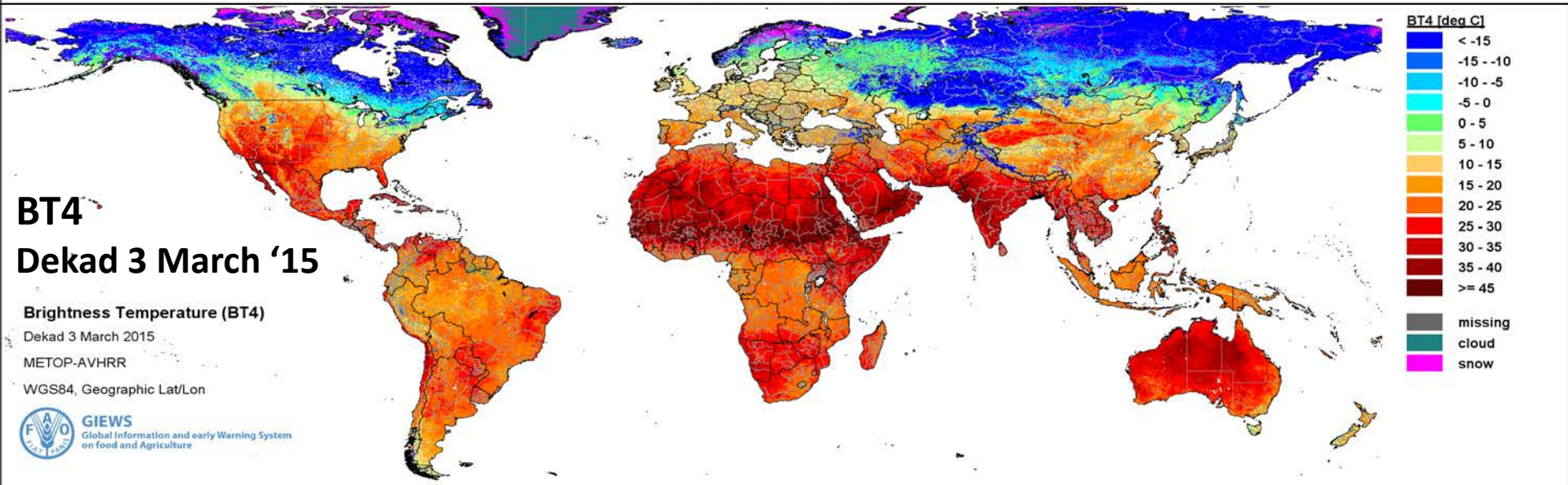
- Used in Rojas et al. (2011)
- In ASIS to extent METOP archive
- Center for Satellite Applications and Research (STAR)
- [1984-TODAY]
- Combination of different NOAA’s
- Weekly at 16 km
- star.nesdis.noaa.gov

“EO-observations”

- **NDVI:**
  - Normalized Difference Vegetation Index
  - Combination of RED and NIR reflectances
  - A good indicator of the amount of green vegetation
- **BT4:**
  - Brightness Temperature
  - In thermal infrared band of 10.3 – 11.3 µm
  - A good indicator of land surface temperature

“EO-observations”





NOAA-AVHRR and METOP-AVHRR in ASIS

- How to implement NOAA and METOP in ASIS?
- Vegetation Condition Index (VCI) and Temperature Condition Index (TCI) are anomalies using historical minima/maxima
- METOP time series is too short: 2007-2011
- Use NOAA data to extend METOP archive
- 5 methods
  1. Copy of NOAA min/max to METOP
  2. Spatial interpolation of NOAA min/max to METOP
  3. Separate ASIS for NOAA and METOP
  4. Spatial unmixing historical minima/maxima from NOAA to METOP
  5. Spatial unmixing NOAA images to METOP standard
- After an extensive discussion by mail method 5 was selected and its limitations documented.

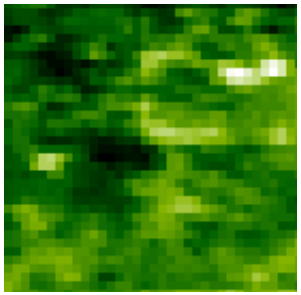
Spatial unmixing NOAA images to METOP standard

- The NOAA data set from 1984-2007 is hereby remapped and rescaled to the METOP standards (resolution and spectral values).

NOAA 16 km
July 2000

spatial weighting matrix based on the relation between the long term average of METOP and NOAA.

Simulated METOP 1 km
July 2000



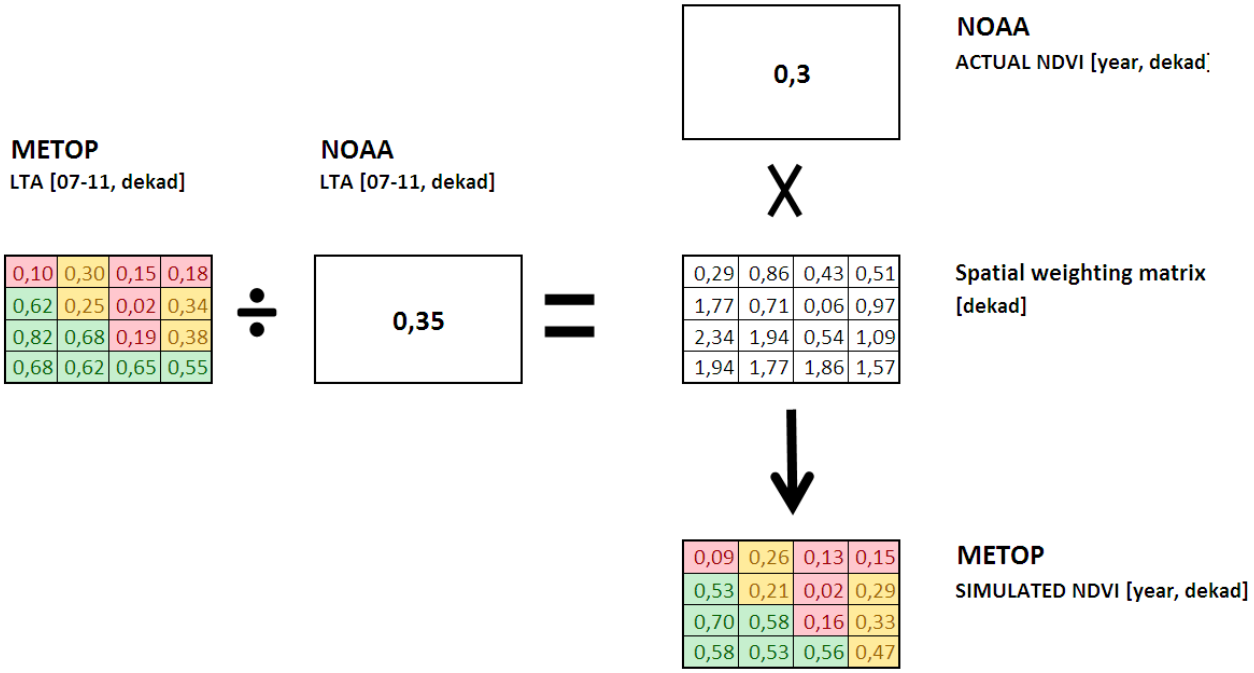
- Two datasets are combined for the use in ASIS:
  - Simulated METOP images from NOAA [1984-march 2007]
  - True METOP images [march 2007-today]
- Pro's:
  - It is a one-time operation on NOAA STAR. There will be only one processing chain for METOP, there is no need to maintain a processing chain for NOAA STAR.
  - There is no need for an intercalibration study
  - The dataset offers more flexibility for changes in the algorithm

Example of NOAA unmixing

case for 4 by 4 pixels

$$\frac{Y_{(year,dek)}}{\mu_{Y_{(dek)}}} = \frac{X_{(year,dek)}}{\mu_{X_{(dek)}}} \rightarrow Y_{(year,dek)} = \frac{\mu_{Y_{(dek)}}}{\mu_{X_{(dek)}}} * X_{(year,dek)}$$

- Y = METOP at 1 km, X = NOAA-STAR converted to 1 km
- $Y_{(year,dek)}$, $X_{(year,dek)}$ are the actual values for a given year/dekad.
- $\mu_{Y_{(dek)}}$, $\mu_{X_{(dek)}}$ are the long term averages, calculated for the period march 2007 – end 2011 for both sensors, for the concerned dekad.

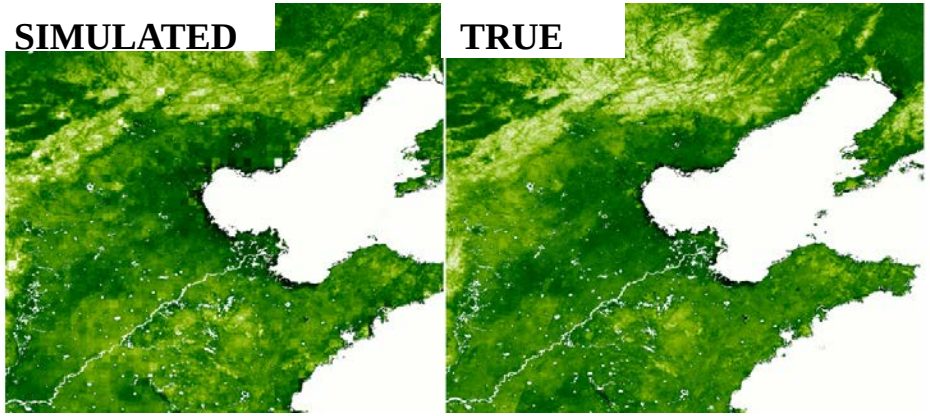


Validation

North China Plain

SIMULATED

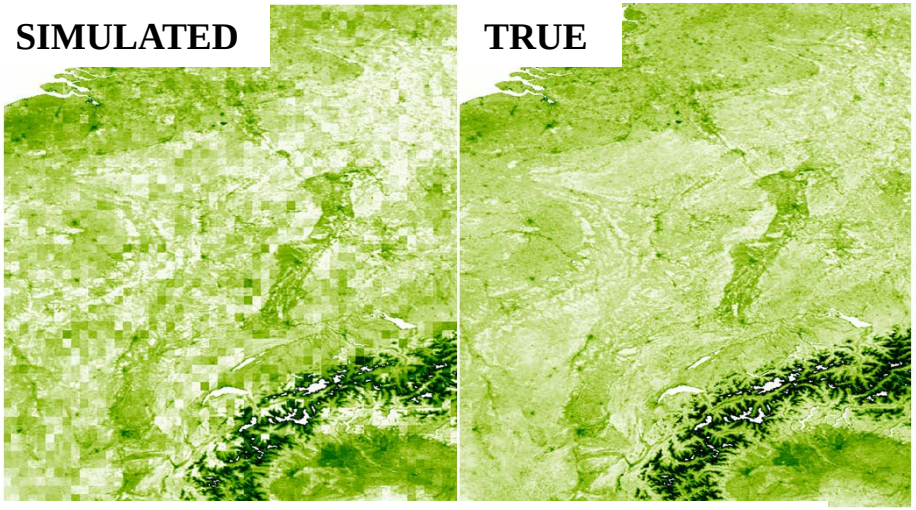
TRUE



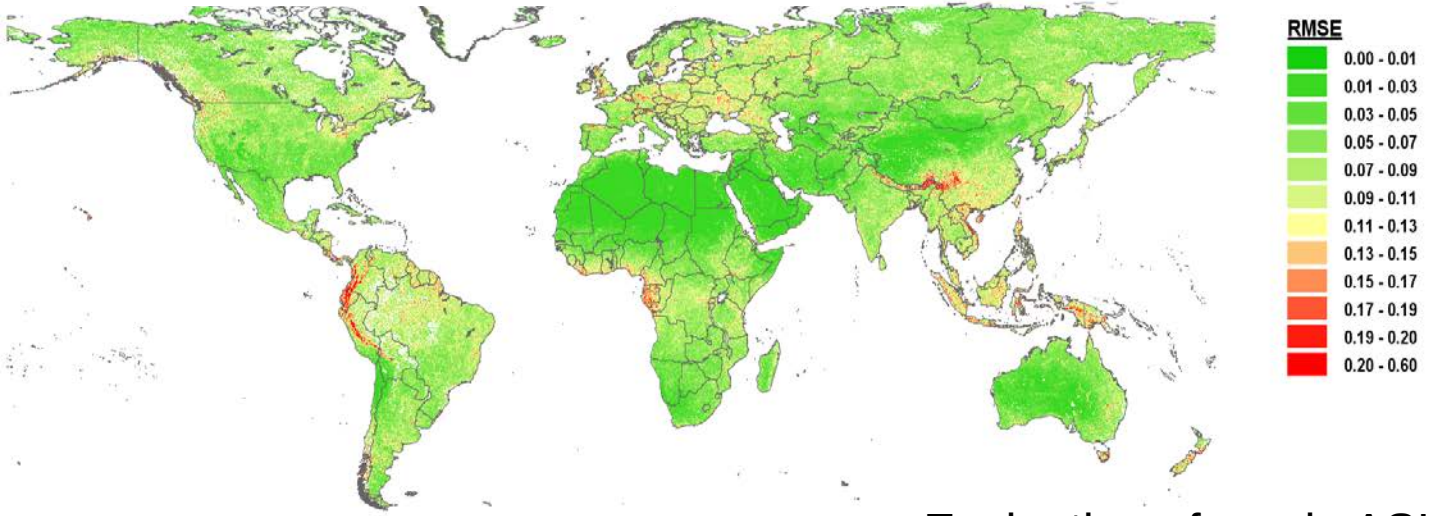
EU

SIMULATED

TRUE



Root Mean Squared Error for simulated vs true NDVI images for 36 dekads of 2008



Evaluation of use in ASIS see further

- ***Limitations of method 5***
  - *Inter-annual landscape variability*
    - The method assumes that the distribution of the 1 km METOP LTA [2007-2011] did not change over the last 30 years. So it assumes a stable inter-annual landscape variability.
  - *non-linear scaling of NDVI*
    - The method assumes a linear scaling. This assumption is true for the individual red and NIR values but not for the resulting NDVI's. The result is that the calculated NDVI values within the 16 km blocks have a narrower range than would be expected when applying the method on red and NIR values. However, they are highly correlated ($R^2 > 0.99$).
  - *No independent validation possible*
    - The spatial weighting matrix was derived from the same time period (2007-2011) as the validation period.

Evaluation of ASIS results

- ASIS has been applied on three datasets:
  - NOAA STAR [84-11]
  - METOP [07-11]
  - METOP [07-11] + simulated METOP [84-07]

i. Results on NOAA STAR are compared with Rojas et al. 2011
   → evaluation of algorithm

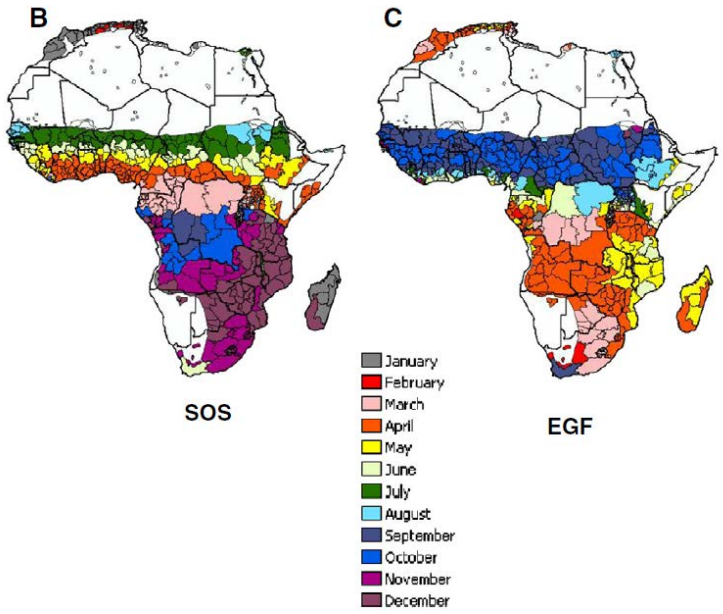
ii. Results on the three datasets are compared mutually
   → evaluation of the use of simulated METOP images in ASIS on METOP

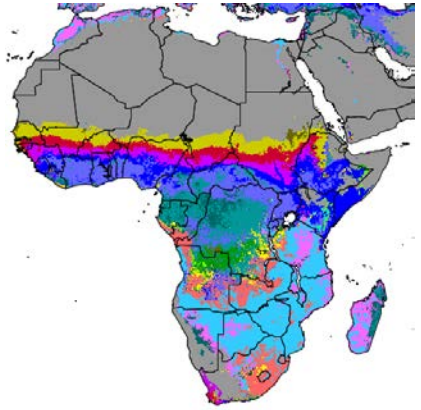
i. Comparisson ASIS - STAR with Rojas et al. 2011

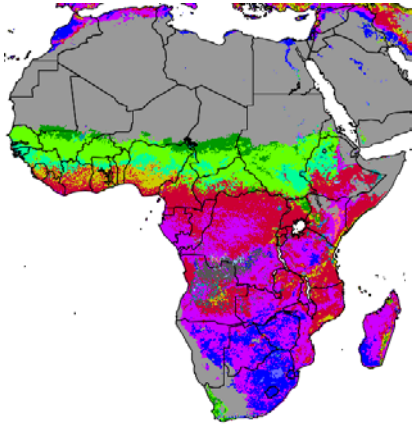
- Over Africa, 1985-2009
- Differences in methodology:

Methodology	ASIS	Rojas et al. 2011
# growing seasons in integration period	2	1
Definition SOS/EOS	SOS: 0.25 min-max EOS: 0.75 min-max •Previous/next year allowed •Calculated on LTA per pixel	SOS: 0.50 min-max EOS: 0.50 min-max EGF: EOS – 6 weeks •Limited to actual year •Average of calculation on individual years, aggregated per administative unit
Smoothing	Modified Swets	STAR
Crop mask	JRC crop mask	FAO GIEWS main crop zones and the GLC2000 land cover map

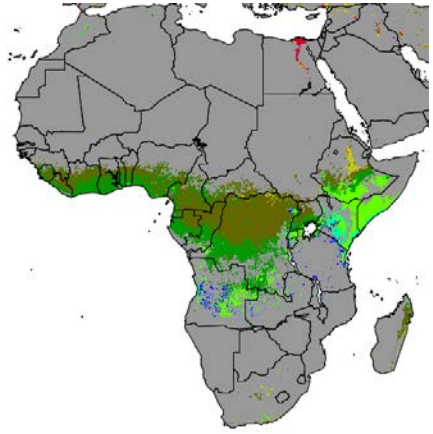
i. Comparisson ASIS - STAR with Rojas et al. 2011 PHENOLOGY

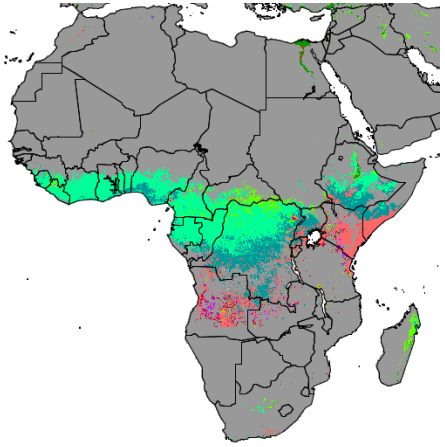






Start Of Season
- Sep Y -1
- Oct Y -1
- Nov Y-1
- Dec Y -1
- Jan
- Feb
- Mar
- Apr
- May
- Jun
- Jul
- Aug
- Sep
- Oct
- Nov
- Dec
- No Seasonality

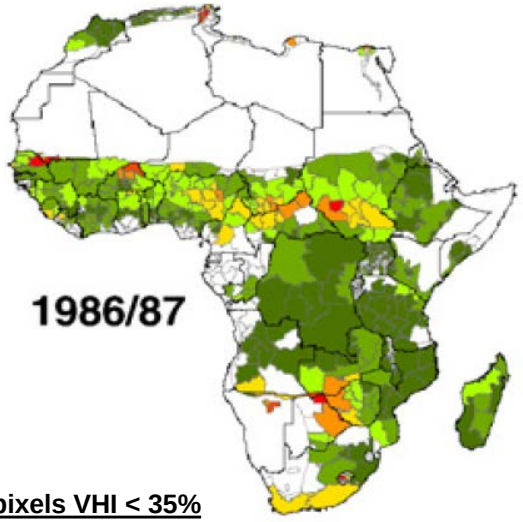




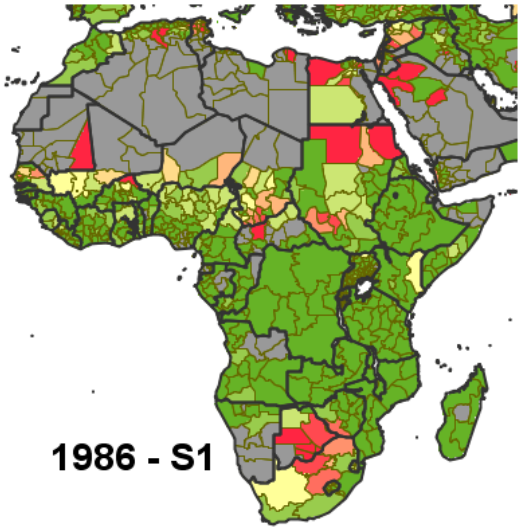
End Of Season
- Jan
- Feb
- Mar
- Apr
- May
- Jun
- Jul
- Aug
- Sep
- Oct
- Nov
- Dec
- Jan Y + 1
- Feb Y + 1
- Mar + 1
- No Seasonality

i. Comparison ASIS - STAR with Rojas et al. 2011 FINAL RESULTS

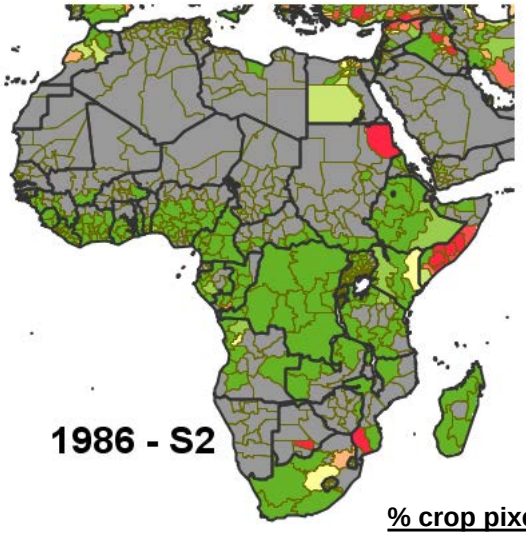
Rojas et al. 2011



ASIS – S1

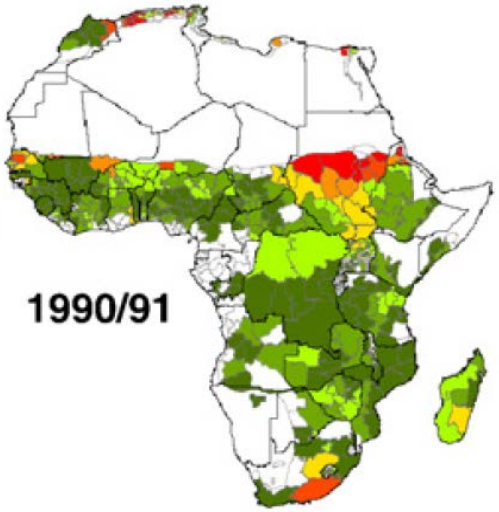


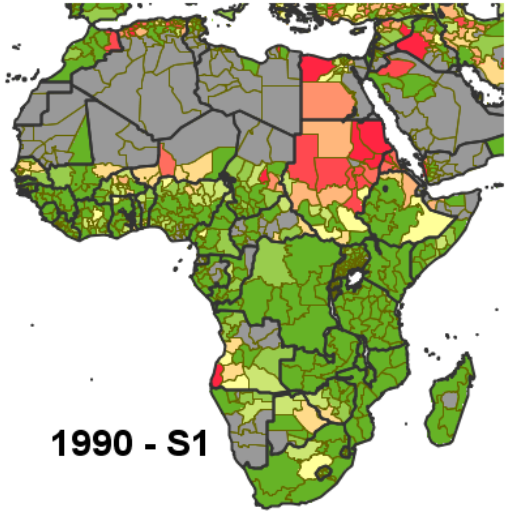
ASIS – S2

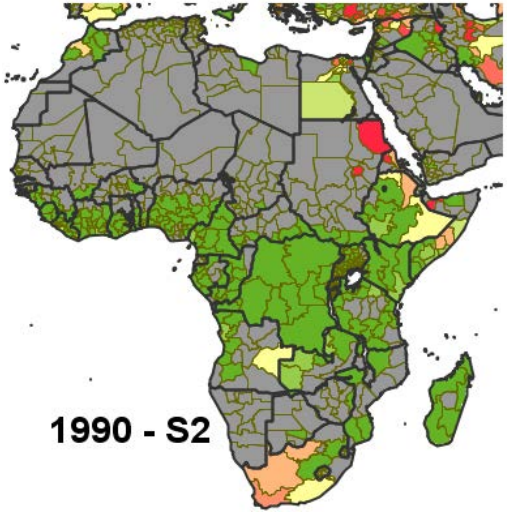


% crop pixels VHI < 35%
colourscale Rojas et al. 2011

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







% crop pixels VHI < 35%
colourscale ASIS

0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100

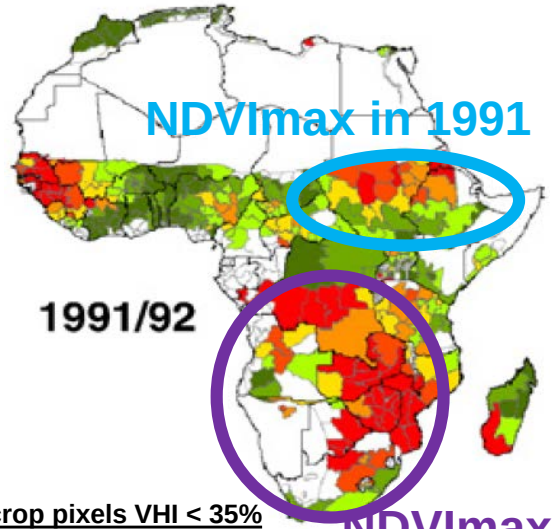
NO DATA

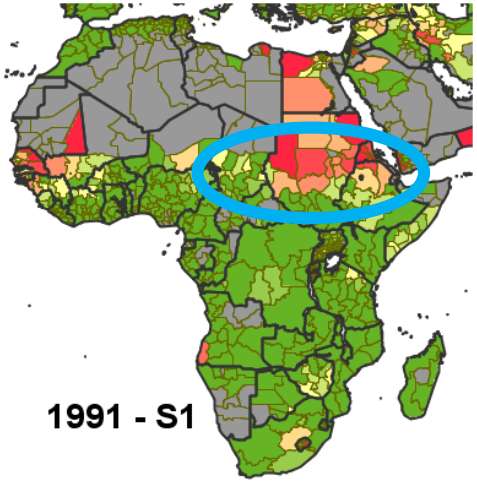
i. Comparison ASIS - STAR with Rojas et al. 2011 FINAL RESULTS

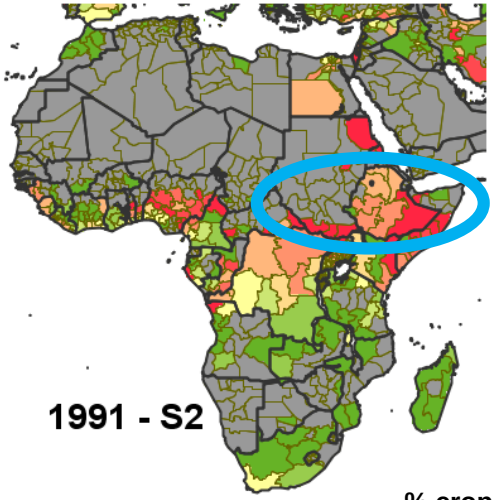
Rojas et al. 2011

ASIS – S1

ASIS – S2



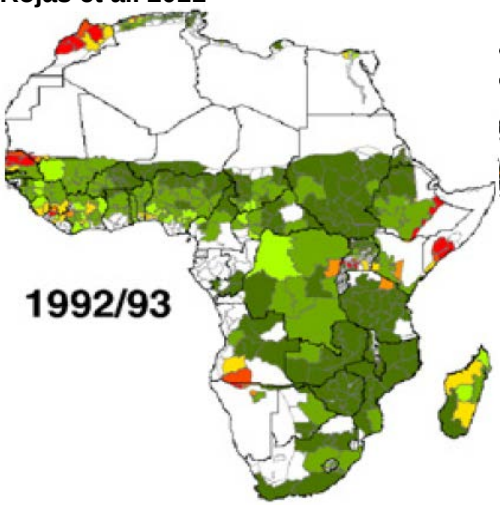


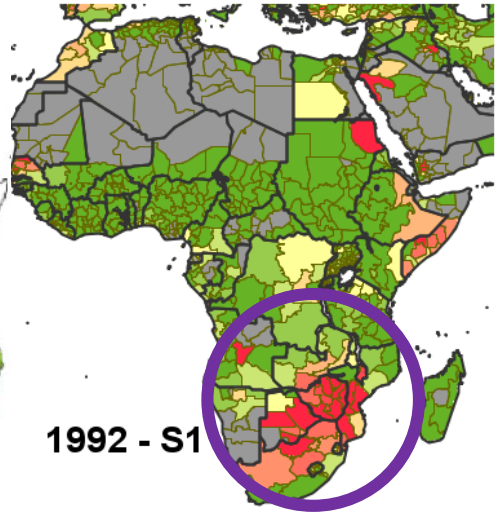


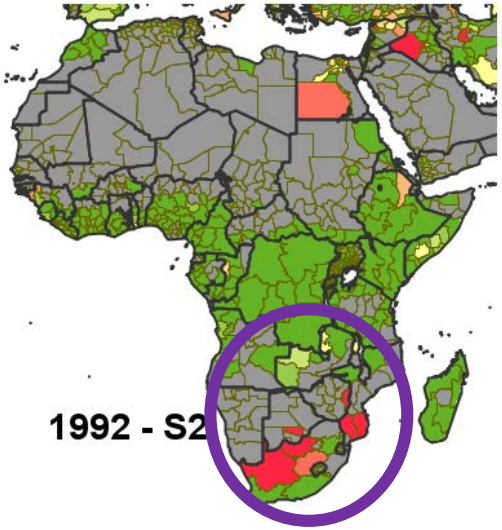
% crop pixels VHI < 35%
colourscale Rojas et al. 2011

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

NDVImax in 1992





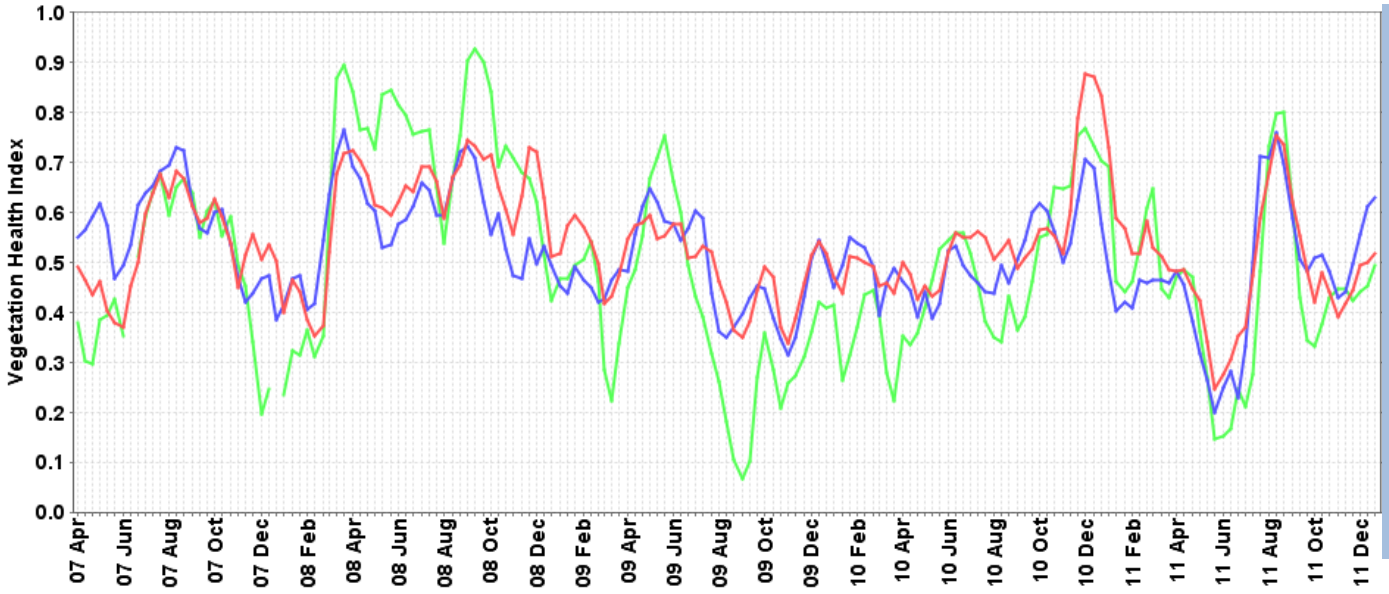


% crop pixels VHI < 35%
colourscale ASIS

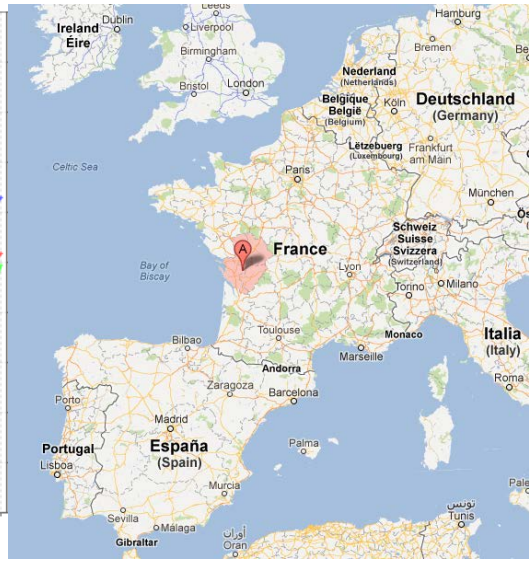
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- NO DATA

ii. Evaluation unmixing methodology

Region Unmixed Mean (RUM) – chart of Vegetation Health Index [07-11]
Only pixels with >25% crop are considered



Region: Poitou - Charentes



NOAA

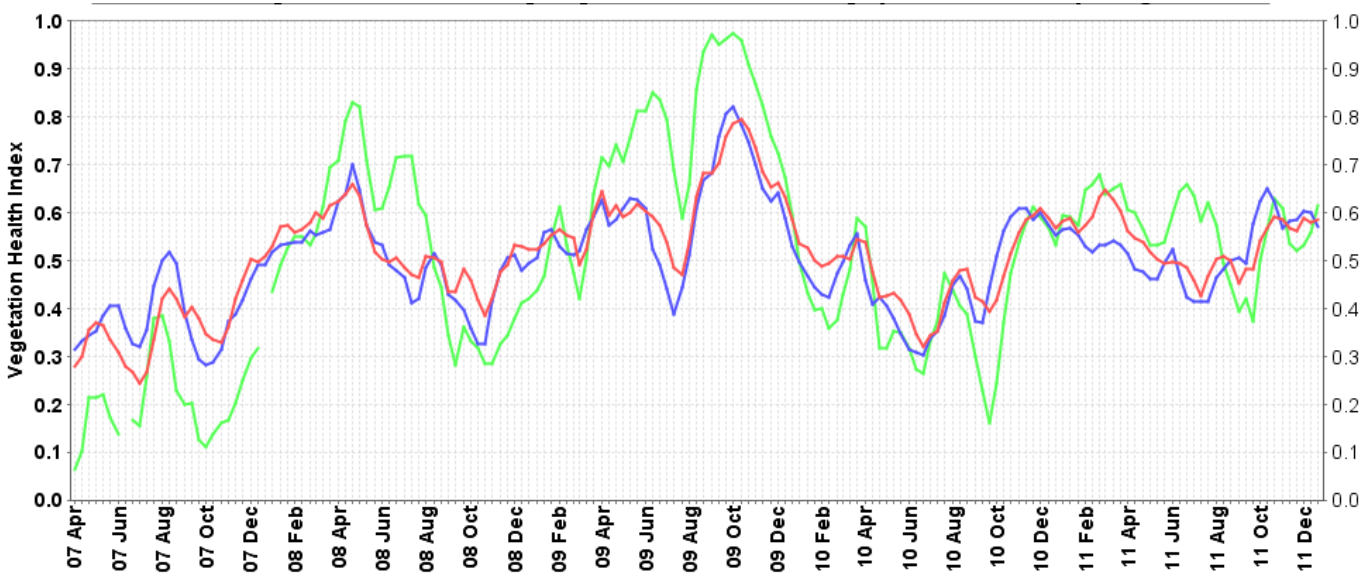
METOP

METOP + simulated from NOAA

Conclusion:
The METOP time series are too short. The anomalies TCI,VCI and VHI are too sensitive for small interannual changes. Adding the simulated METOP images to the METOP dataset adds more reliability to detect anomalies.

ii. Evaluation unmixing methodology

Region Unmixed Mean (RUM) – chart of Vegetation Health Index [07-11]
Only pixels with >25% crop are considered



Region: Goias

NOAA

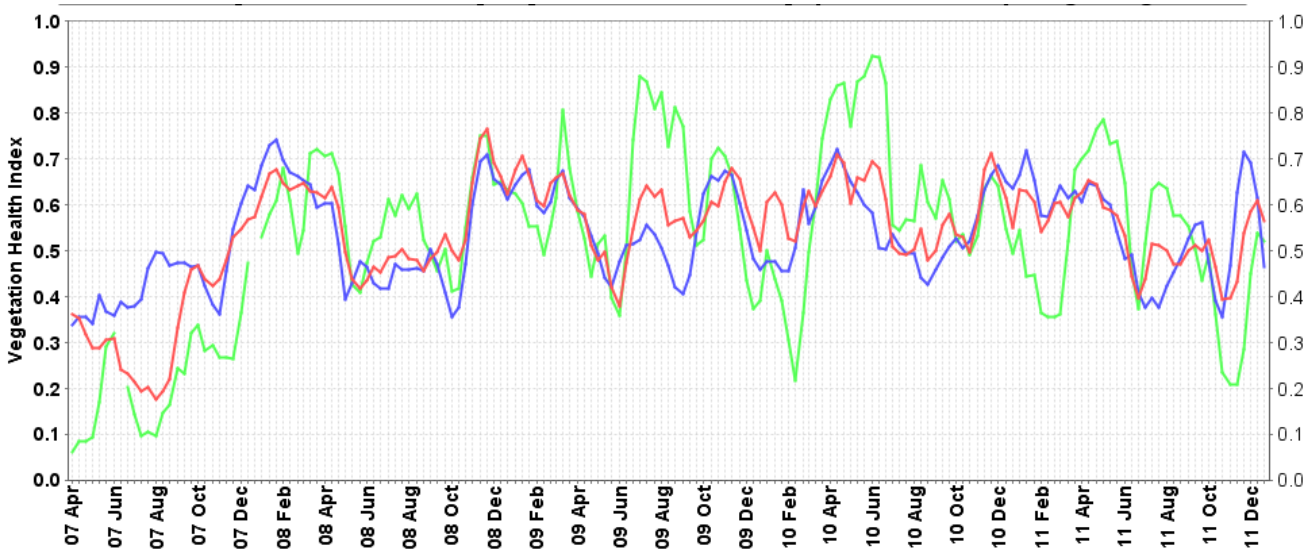
METOP

METOP + simulated from NOAA

Conclusion:
The METOP time series are too short. The anomalies TCI,VCI and VHI are too sensitive for small interannual changes. Adding the simulated METOP images to the METOP dataset adds more reliability to detect anomalies.

ii. Evaluation unmixing methodology

Region Unmixed Mean (RUM) – chart of Vegetation Health Index [07-11]
Only pixels with >25% crop are considered



Region: Ngamiland

NOAA

METOP

METOP + simulated from NOAA

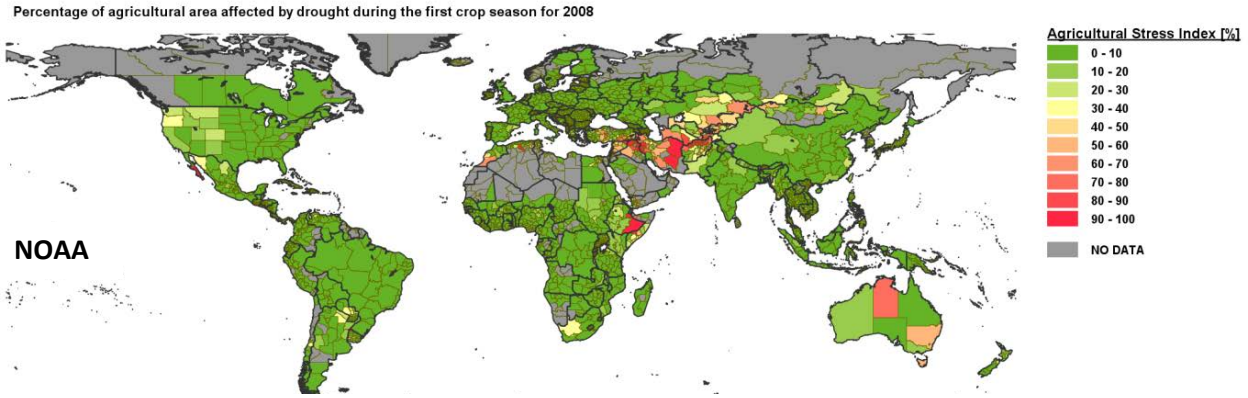
Conclusion:
The METOP time series are too short. The anomalies TCI,VCI and VHI are too sensitive for small interannual changes. Adding the simulated METOP images to the METOP dataset adds more reliability to detect anomalies.

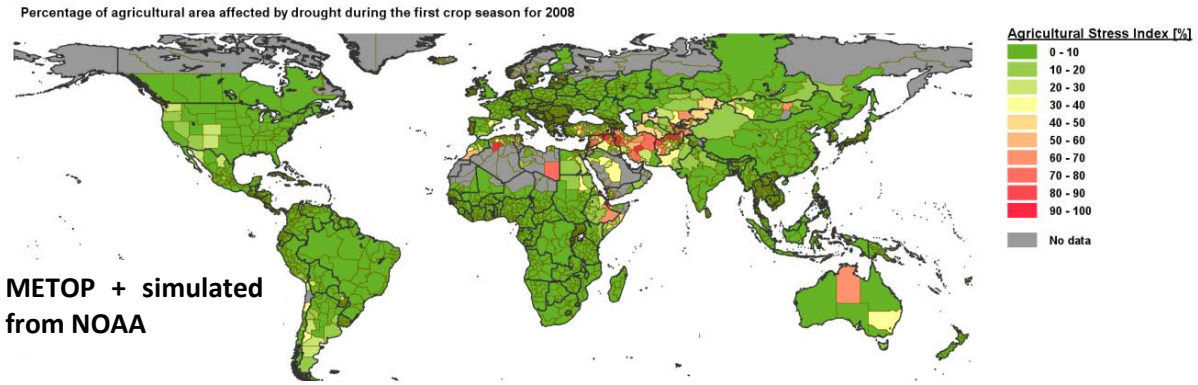
ii. Evaluation unmixing methodology

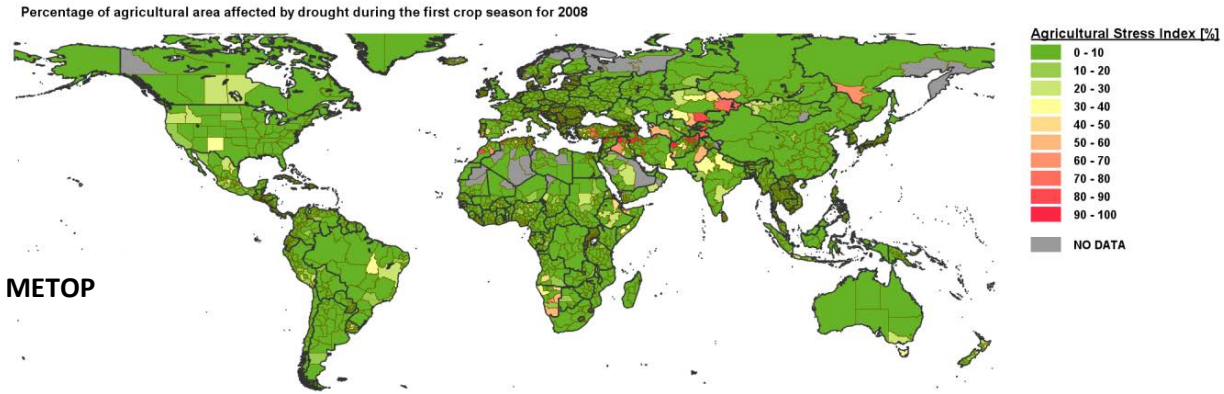
COMPARISON OF THE FINAL OUTPUT OF THE THREE DATASETS.

- Results for the first growing season of **2008**
- Same SOS/EOS used, derived from NOAA STAR LTA
- Only pixels considered with at least 25% of crop area
- No treshold applied on minimum nr. of pixels in GAUL1 unit

Only some of the drought affected regions are detected by ASIS on METOP only



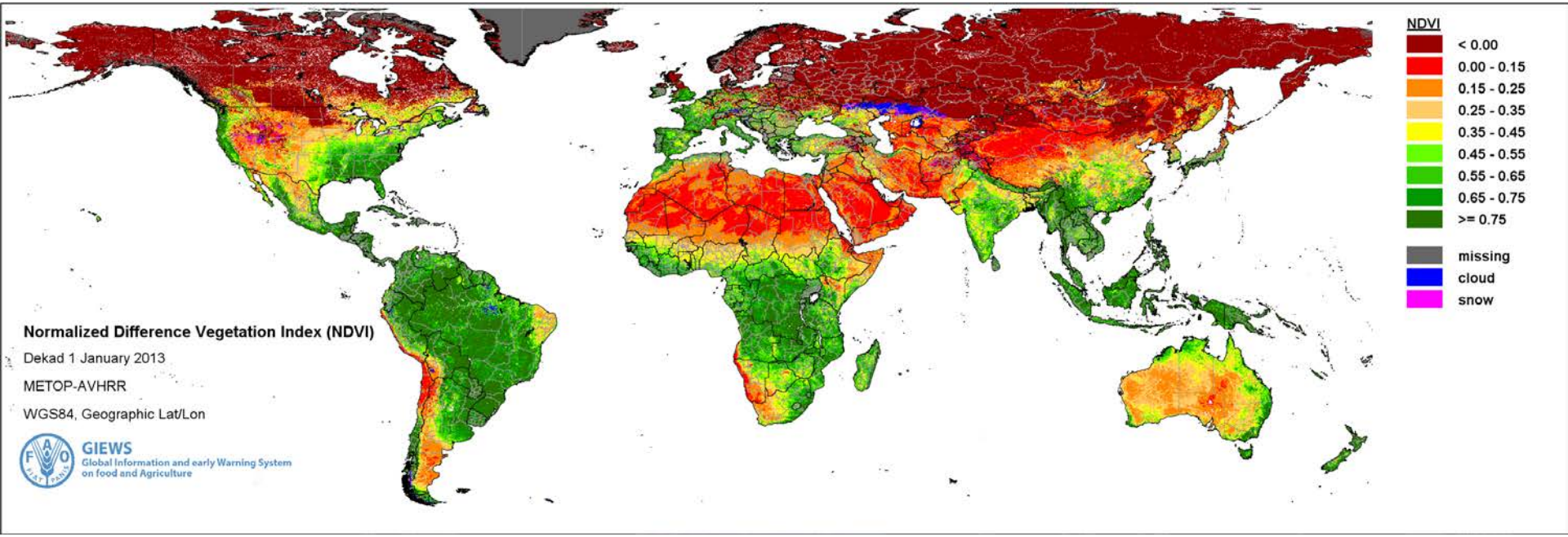




Definition of new drought indicator

The ASI or Agricultural Stress Index represents the percentage of the "**cropped or grassland areas**" within each "**administrative region**", which are affected by "**drought**", as derived from "**EO-observations**" and defined over the course of the "**growing season**".

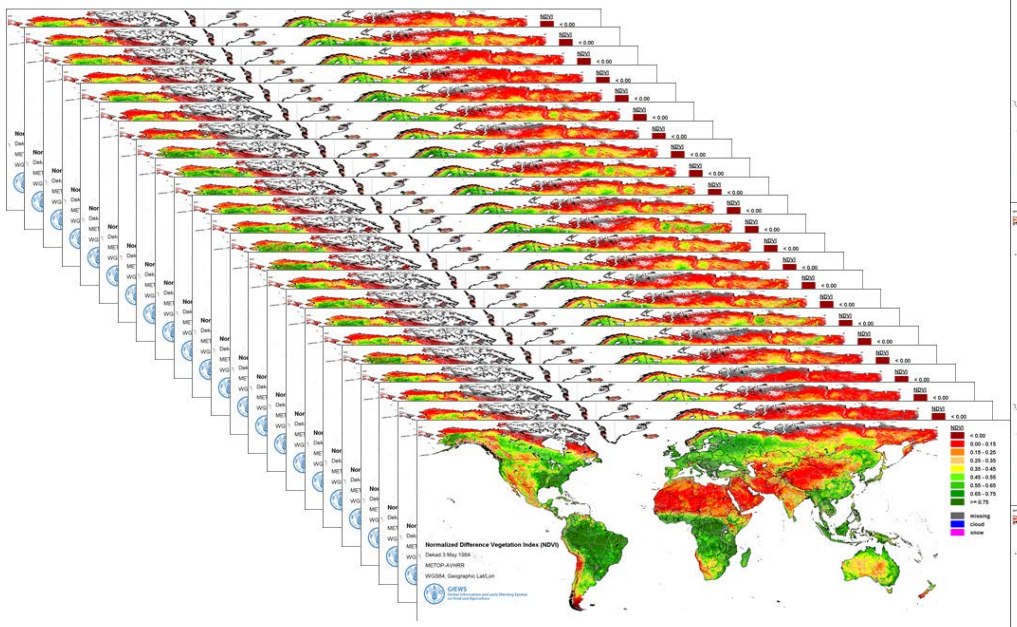
Time series of “EO-observations”



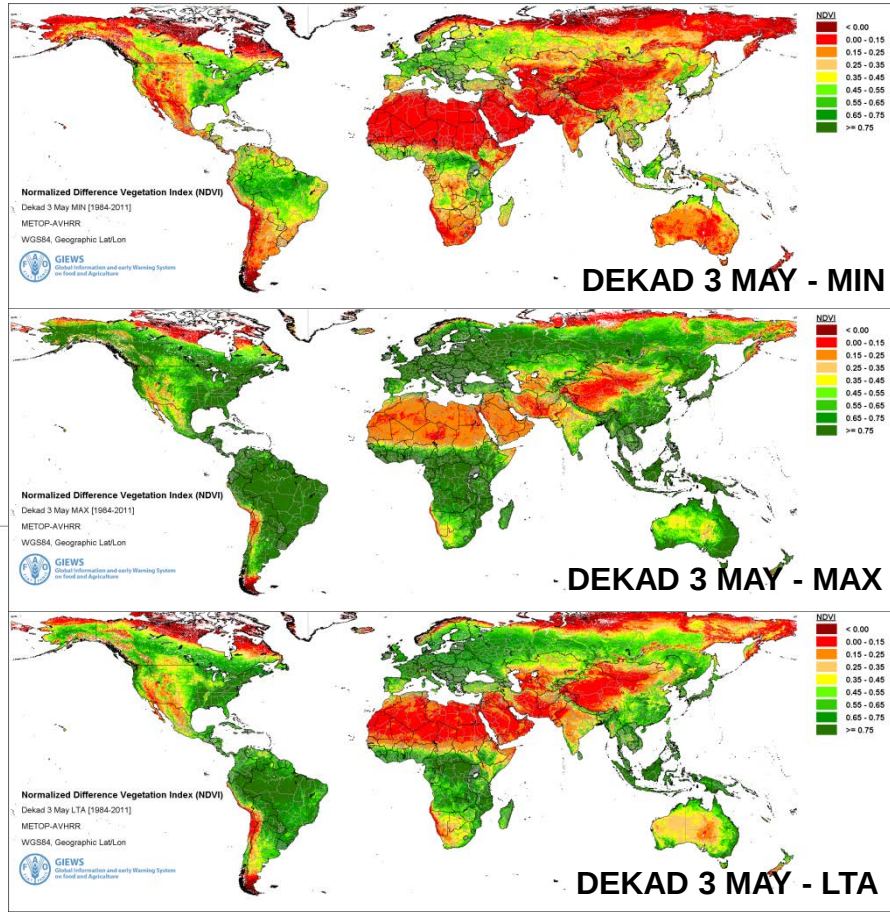
- Building a 30 year archive, data fusion:
  - NOAA [16km] since 1984 → METOP “alike” at 1 km
  - METOP [1km] since 2007

Time series of “EO-observations”

1984 – dekad 3 MAY



2013 – dekad 3 MAY



- **30 years of data → Long Term Statistics (LTS)**
  - **For each dekad: historical minimum/maximum/average**
- **LTS used for:**
  - **phenology (average) “growing season”**
  - **anomalies (min&max) “drought”**

“drought” = low plant activity & high temperatures

Anomalies: Compare actual values with historical minimum/maximum based on +-30 years of observation

Vegetation condition index (VCI)

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

Temperature condition index (TCI)

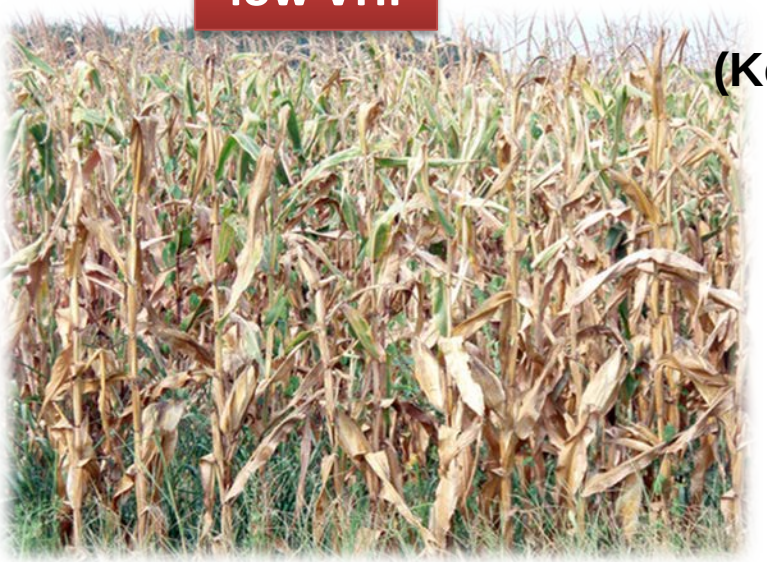
$$TCI_i = \frac{BT_{max} - BT_{\mathrm{i}}}{BT_{max} - BT_{min}}$$

Vegetation Health Index (VHI)

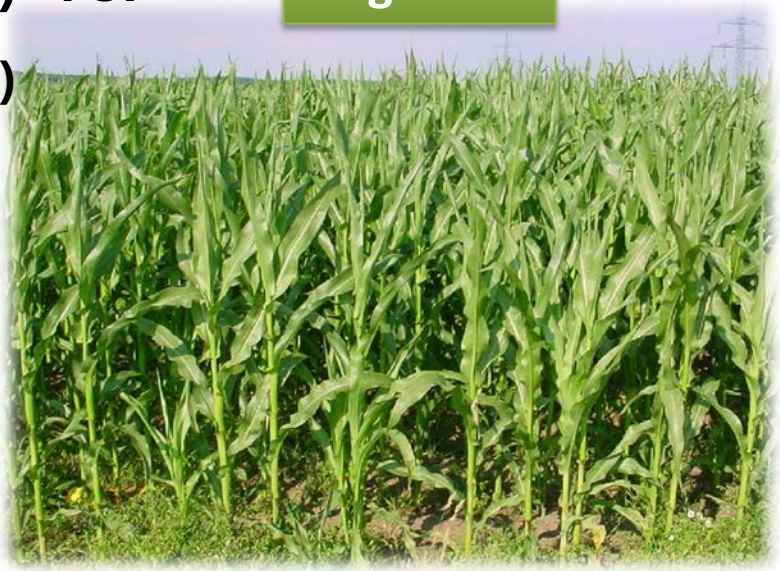
VHI = w*VCI + (1-w)* TCI

(Kogan et al. 1995)

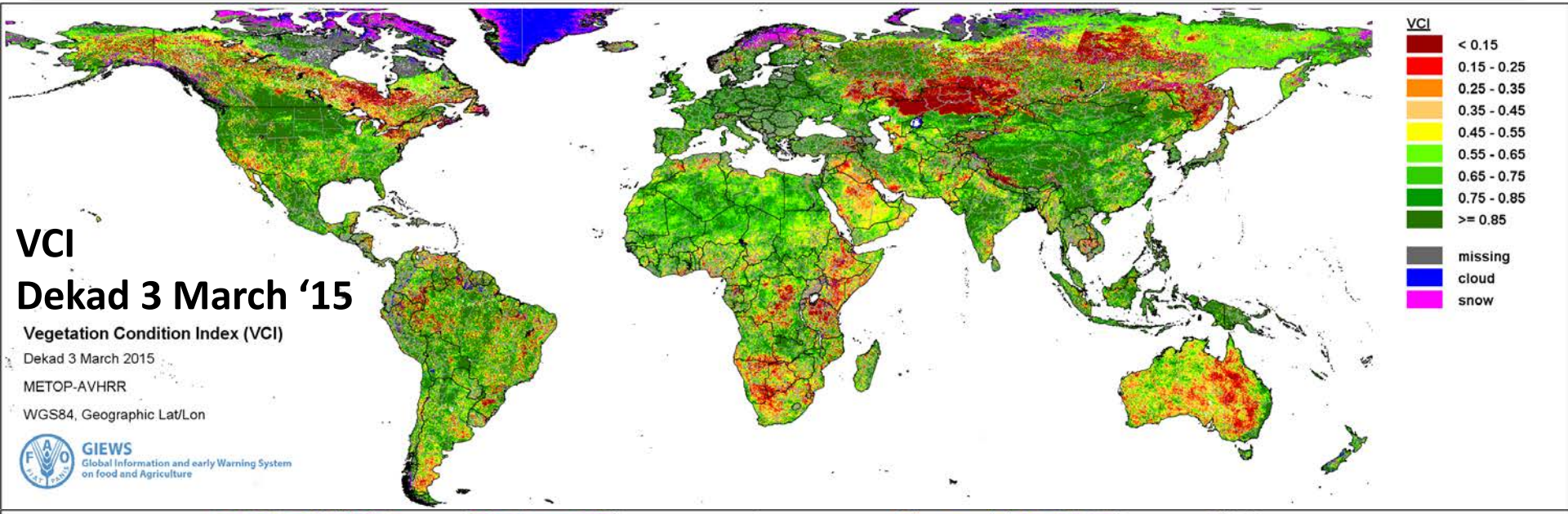
low VHI

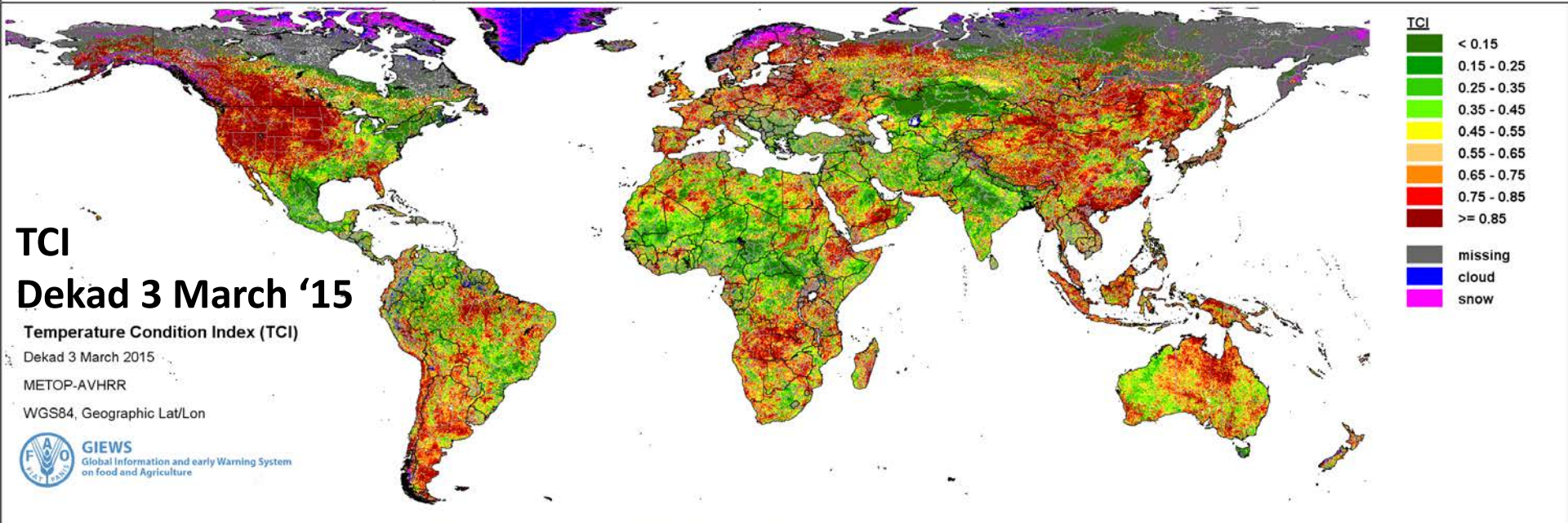


high VHI



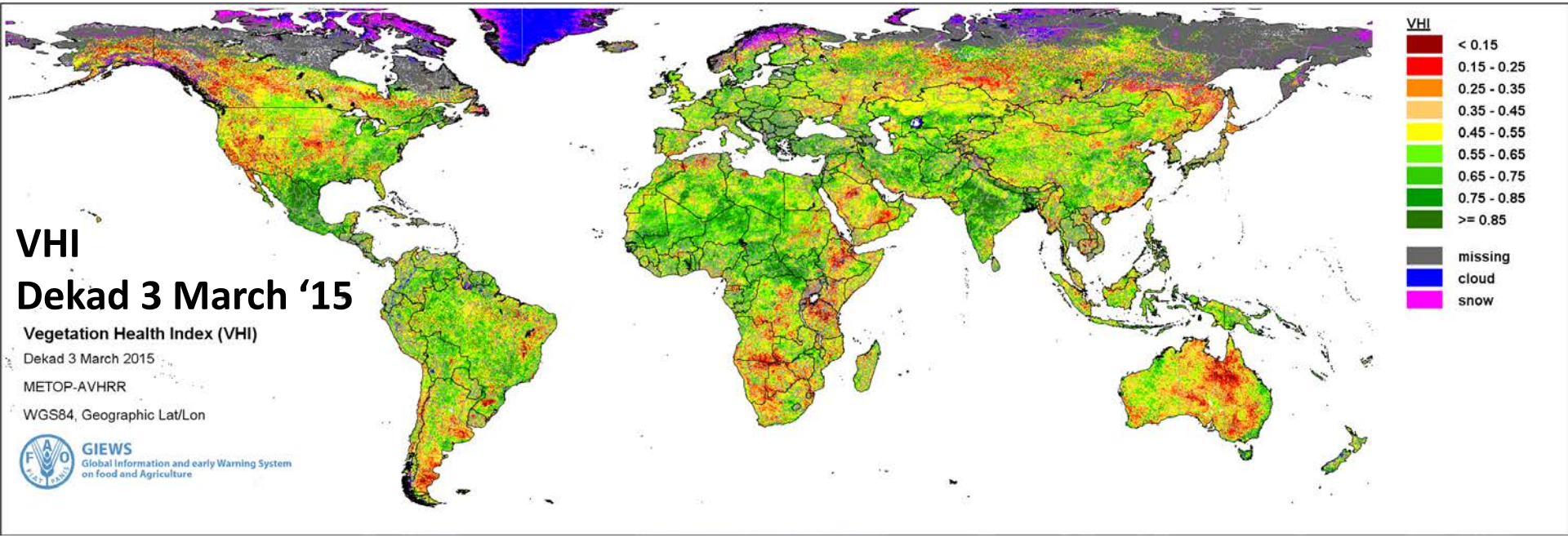
“drought” = low plant activity & high temperatures





“drought” = low plant activity & high temperatures

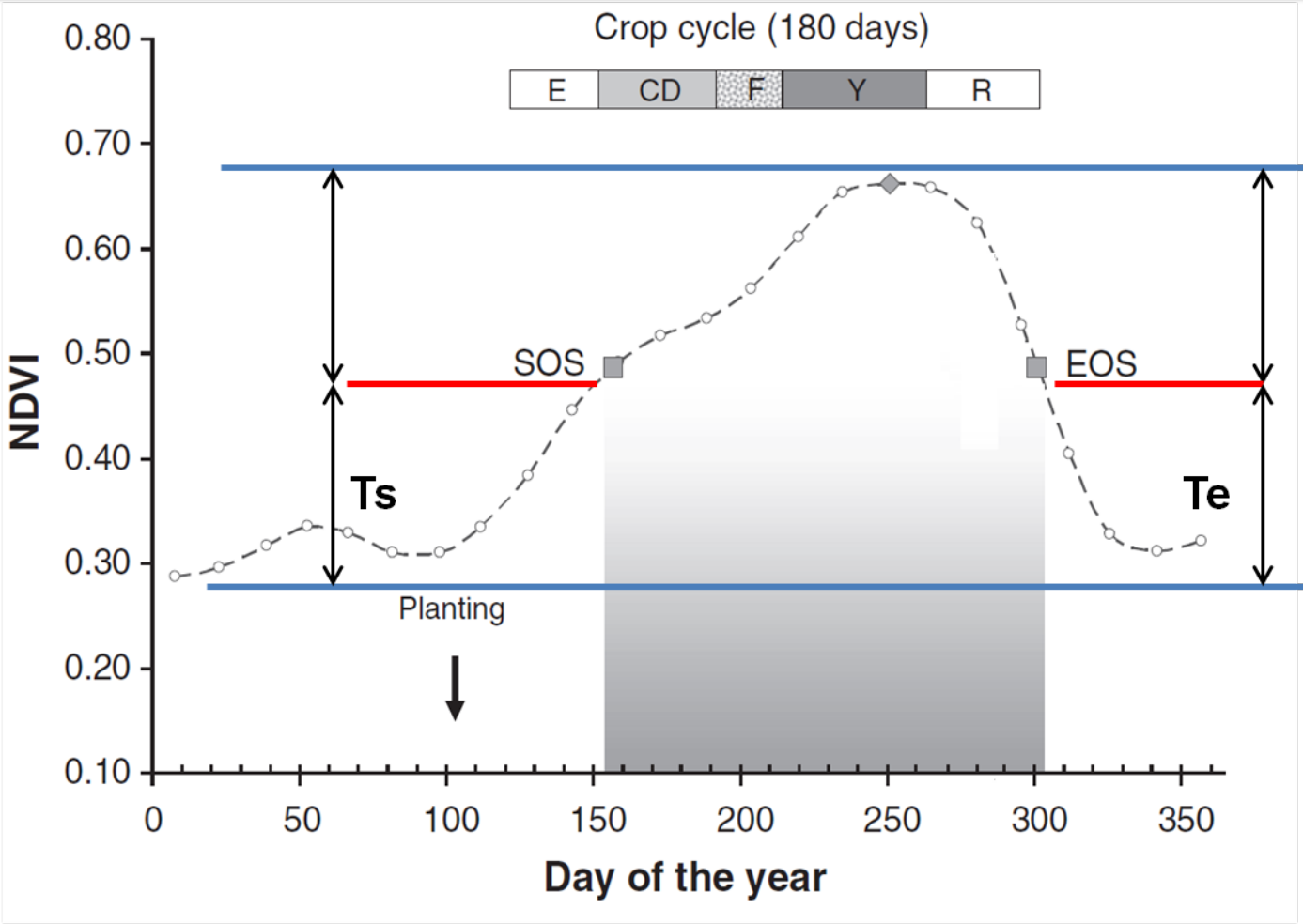
VHI = combination of VCI & TCI



Definition of new drought indicator

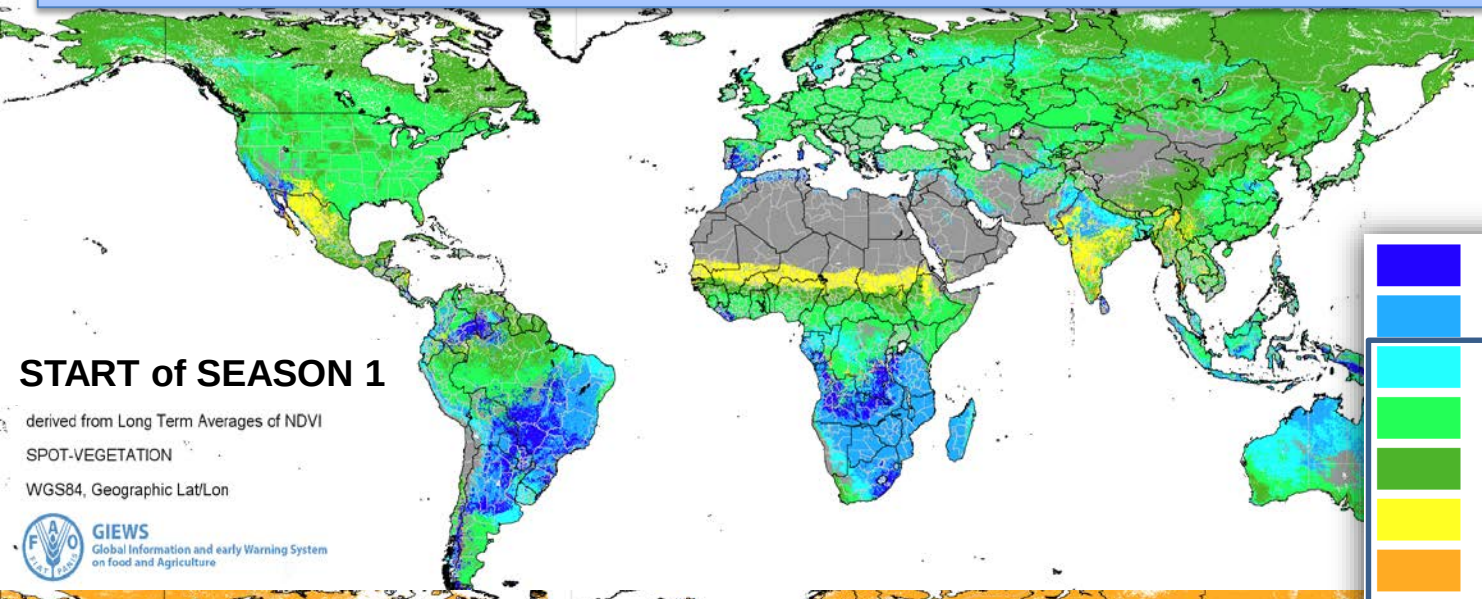
The ASI or Agricultural Stress Index represents the percentage of the "**cropped or grassland areas**" within each "**administrative region**", which are affected by "**drought**", as derived from "**EO-observations**" and defined over the course of the "**growing season**".

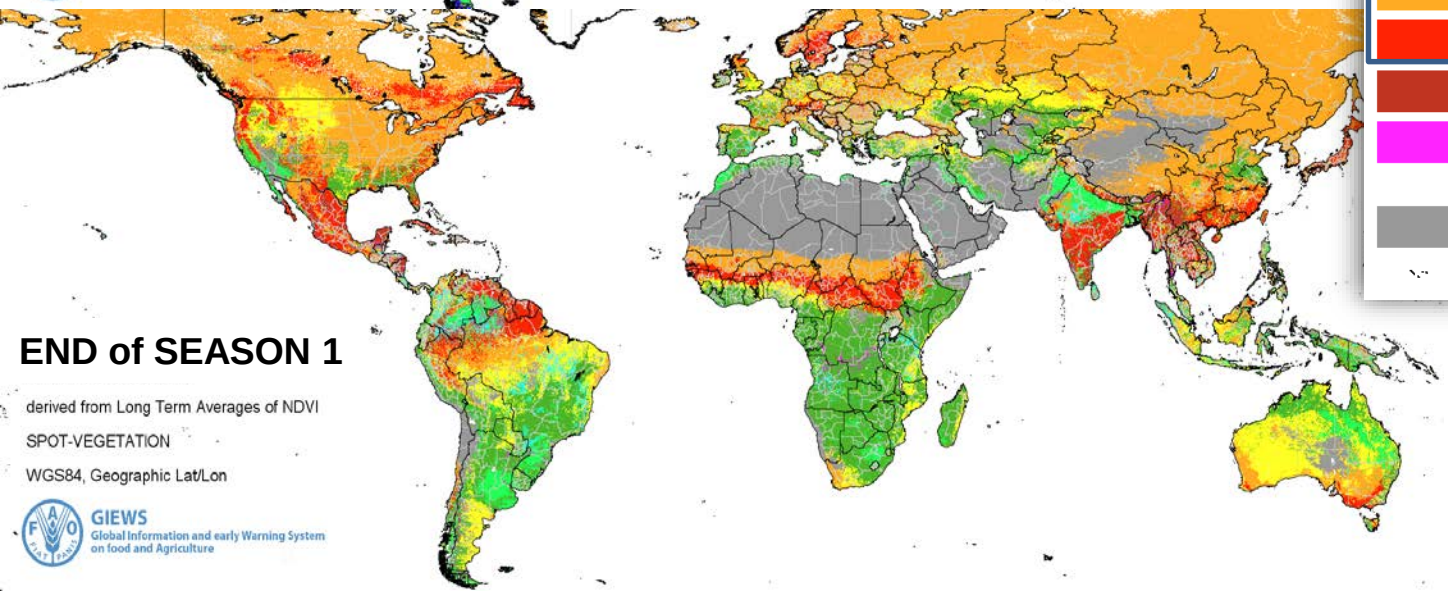
“growing season”: define start and end date



- Using SPOT VGT Long Term Average
- Based on modified methodology of White et al. 1997
- A season is assigned to the year where the MAXIMUM NDVI occurs
- Two growing seasons allowed

“growing season”: define start and end date



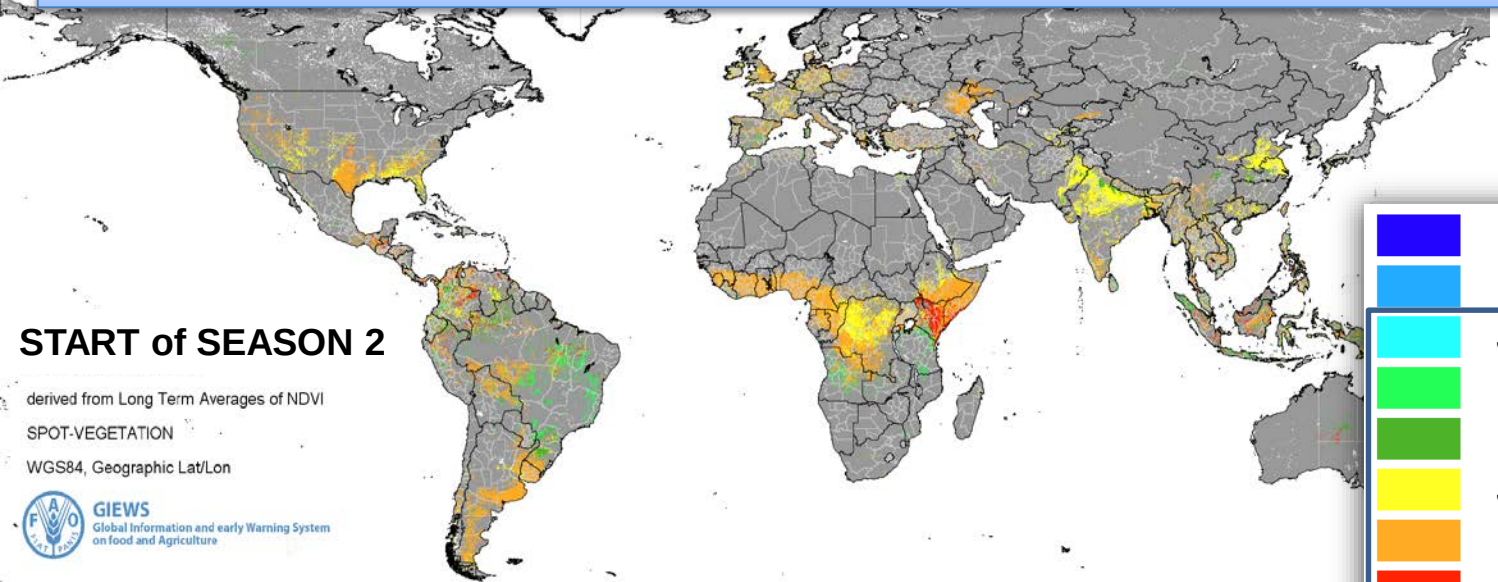


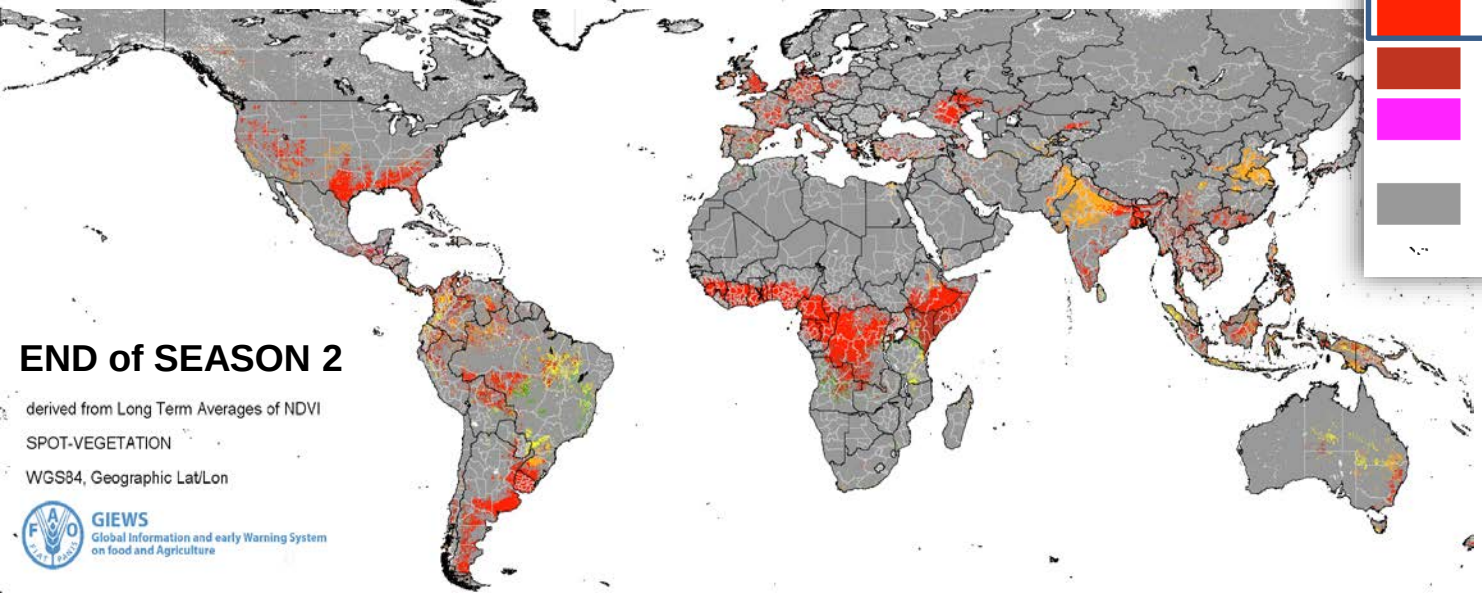
*SOS and EOS of the **first season**, as derived from the long term NDVI averages of SPOT-VGT*

Y-1 = season with MAX NDVI in current year starts in previous year

Y+1 = season with MAX NDVI in current year ends in next year

“growing season”: define start and end date





=< October Y-1
November - December Y-1
January - February
March - April
May - June
July - August
September - October
November - December
January - February Y+1
=> March Y+1

no seasons

*SOS and EOS of the **second season**, as derived from the long term NDVI averages of SPOT-VGT*

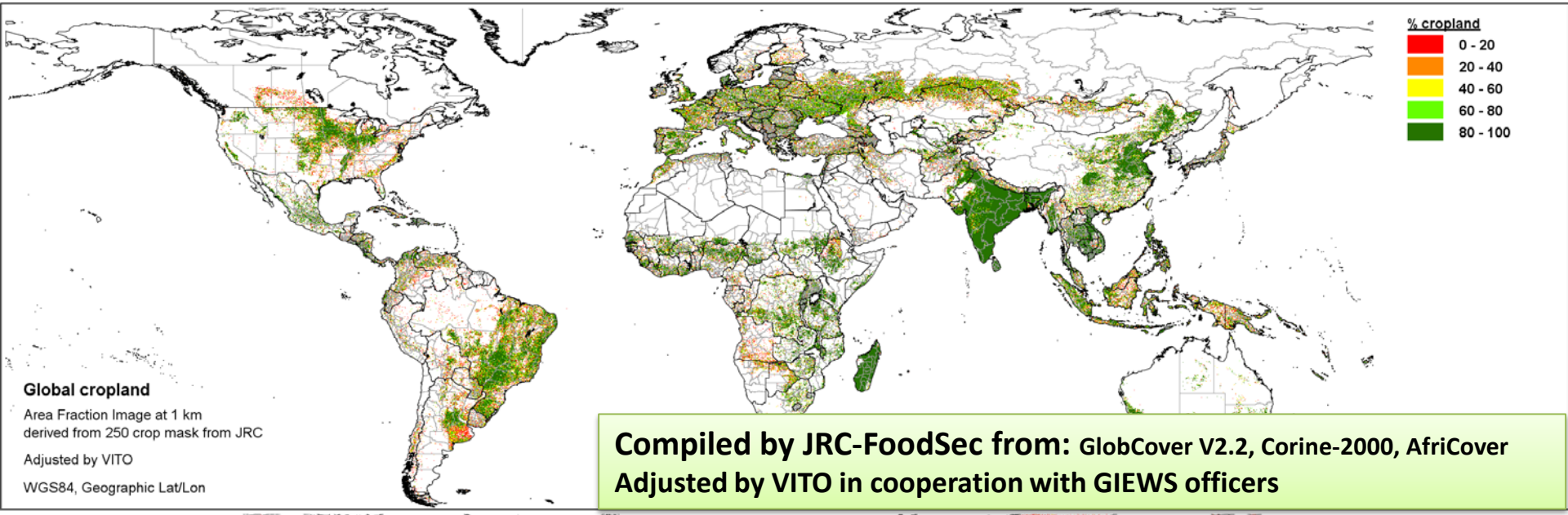
Y-1 = season with MAX NDVI in current year starts in previous year

Y+1 = season with MAX NDVI in current year ends in next year

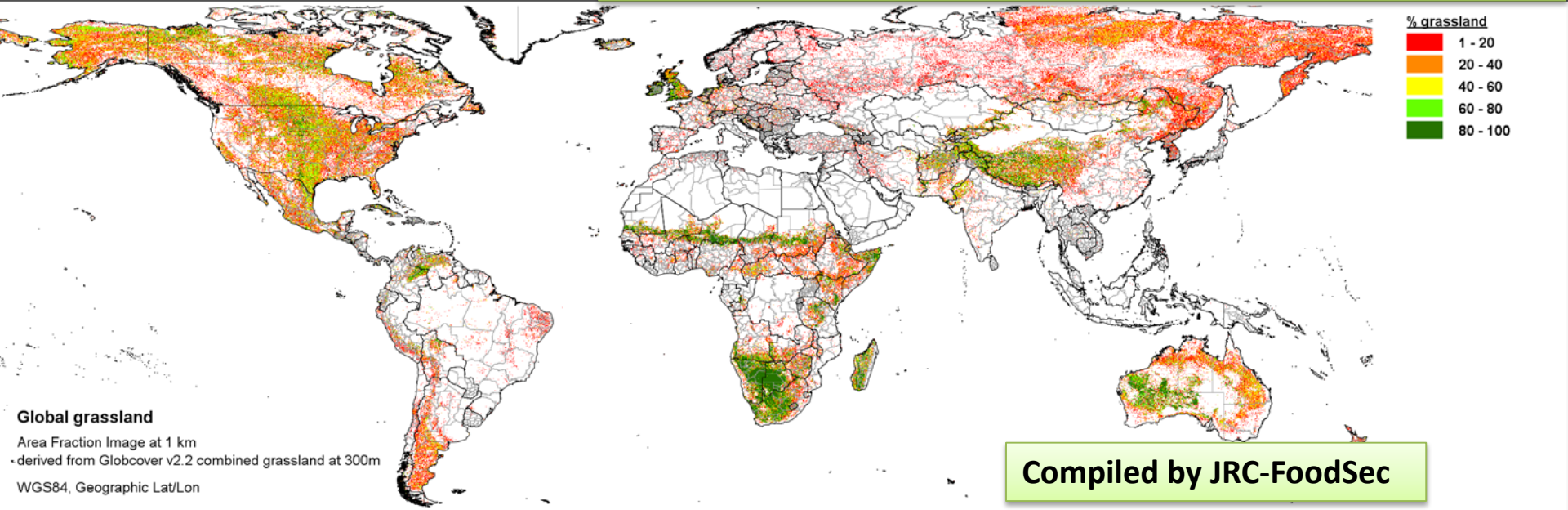
Definition of new drought indicator

The ASI or Agricultural Stress Index represents the percentage of the "**cropped or grassland areas**" within each "**administrative region**", which are affected by "**drought**", as derived from "**EO-observations**" and defined over the course of the "**growing season**".

“cropped or grassland areas”



Compiled by JRC-FoodSec from: GlobCover V2.2, Corine-2000, AfriCover
Adjusted by VITO in cooperation with GIEWS officers



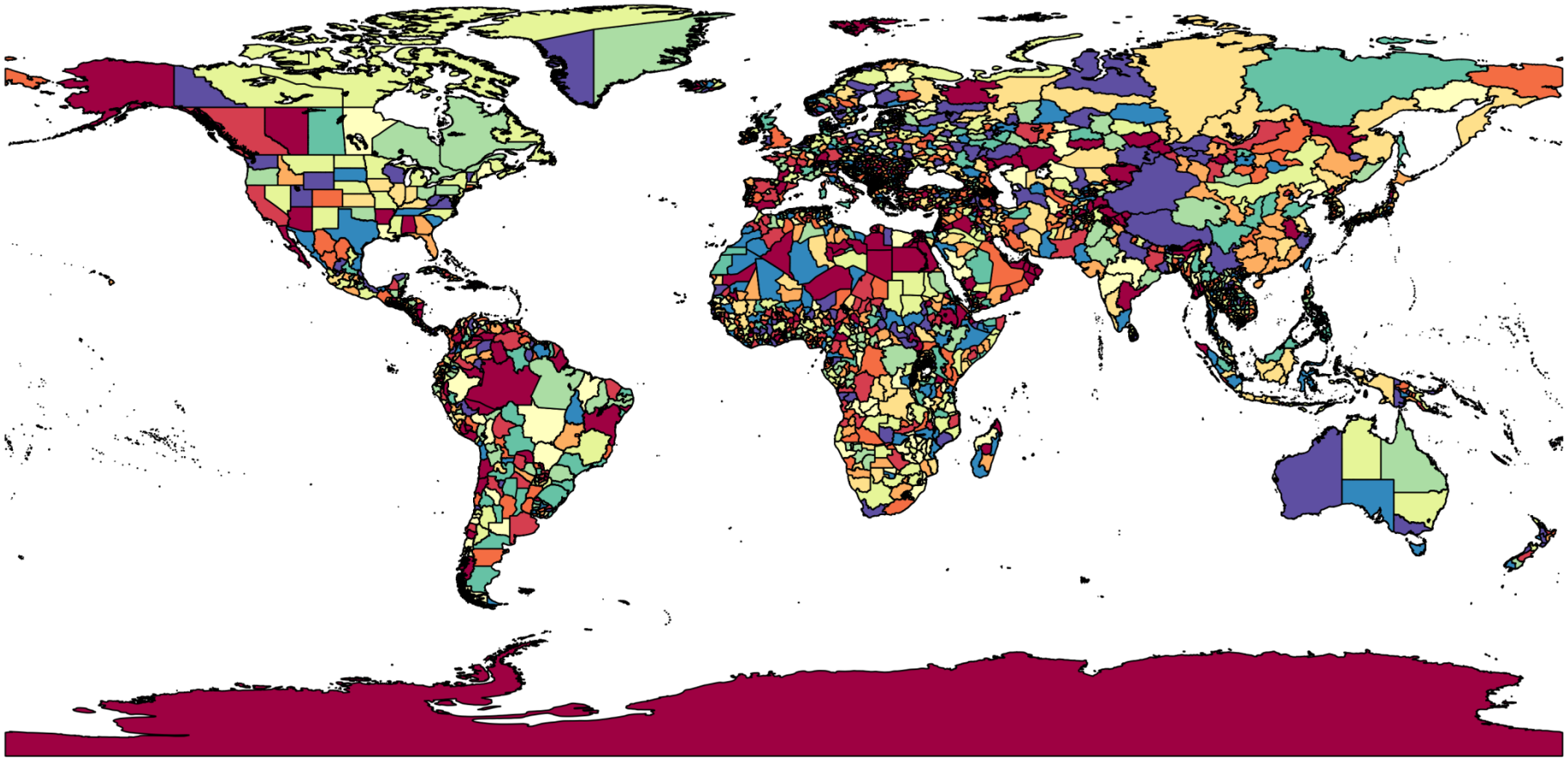
Compiled by JRC-FoodSec

Definition of new drought indicator

The ASI or Agricultural Stress Index represents the percentage of the "**cropped or grassland areas**" within each "**administrative region**", which are affected by "**drought**", as derived from "**EO-observations**" and defined over the course of the "**growing season**".

“administrative region”

GAUL = Global Administrative Unit Layer



GAUL0 (country)**, GAUL1** (province)**, GAUL2** (district)

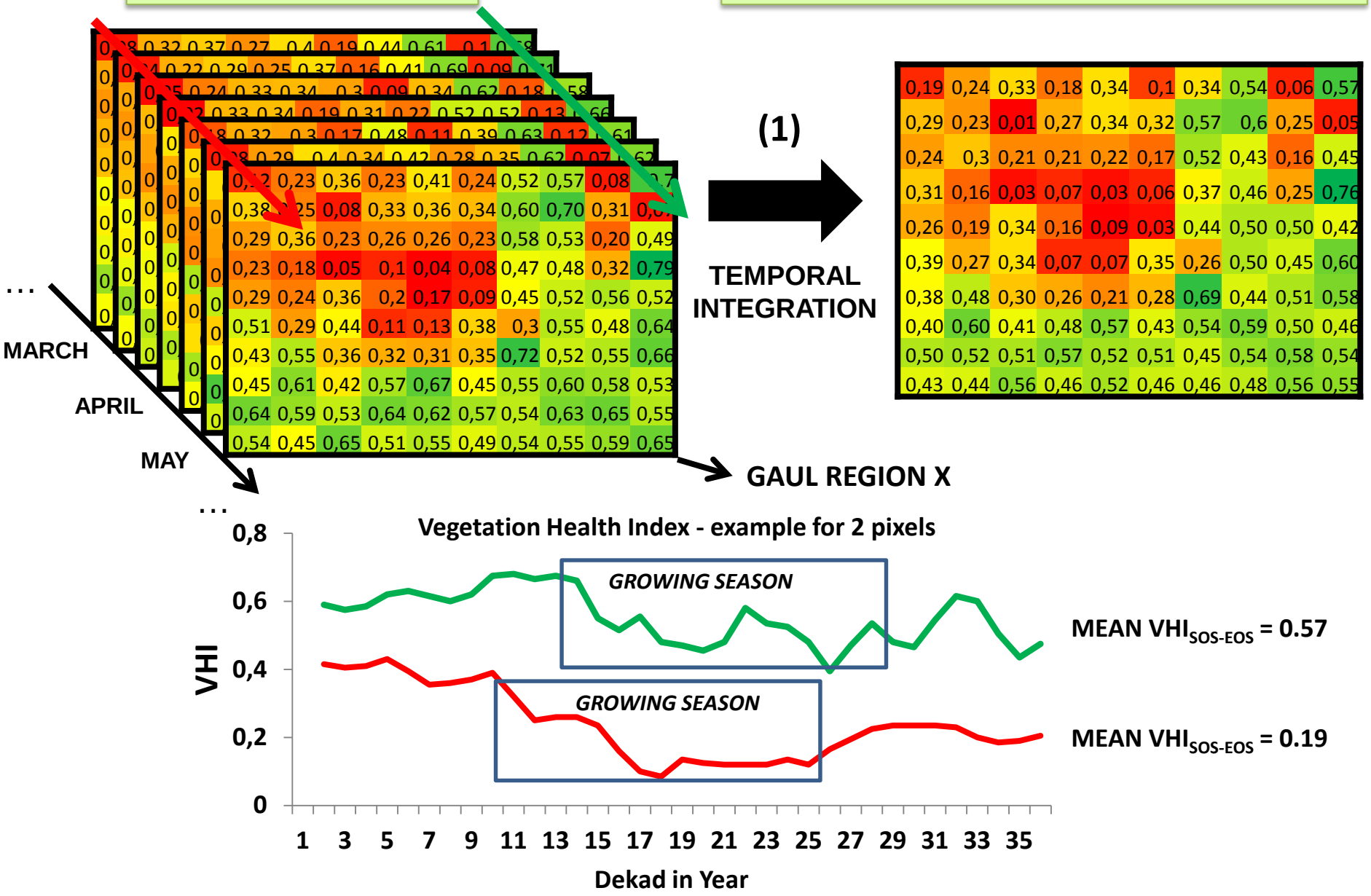
Definition of new drought indicator

The ASI or Agricultural Stress Index represents the percentage of the "**cropped or grassland areas**" within each "**administrative region**", which are affected by "**drought**", as derived from "**EO-observations**" and defined over the course of the "**growing season**".

“Agriculture Stress Index”

Dekadal VHI images

Mean VHI image over the crop season



“Agriculture Stress Index”

Mean VHI image over the crop season

0,07	0,24	0,33	0,18	0,34	0,10	0,34	0,54	0,06	0,66
0,29	0,23	0,01	0,27	0,34	0,32	0,57	0,6	0,25	0,05
0,24	0,30	0,21	0,21	0,22	0,17	0,52	0,43	0,16	0,45
0,31	0,16	0,03	0,07	0,03	0,06	0,37	0,46	0,25	0,76
0,26	0,19	0,34	0,16	0,09	0,03	0,44	0,50	0,50	0,42
0,39	0,27	0,34	0,07	0,07	0,35	0,26	0,50	0,45	0,60
0,38	0,48	0,30	0,26	0,21	0,28	0,69	0,44	0,51	0,58
0,40	0,60	0,41	0,48	0,57	0,43	0,54	0,59	0,50	0,46
0,50	0,52	0,51	0,57	0,52	0,51	0,45	0,54	0,58	0,54
0,43	0,44	0,56	0,46	0,52	0,46	0,46	0,48	0,56	0,55

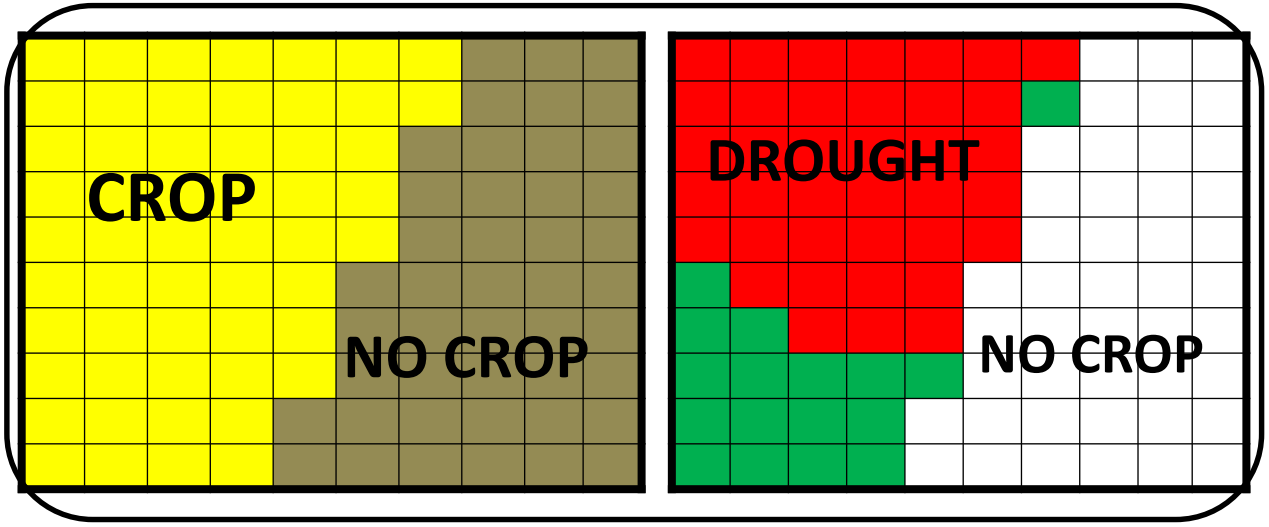
(2) THRESHOLD

PIXELS with MEAN VHI < 35%

DROUGHT

0,07	**0,24**	**0,33**	**0,18**	**0,34**	**0,10**	**0,34**	0,54	**0,06**	0,66
0,29	**0,23**	**0,01**	**0,27**	**0,34**	**0,32**	0,57	0,60	**0,25**	**0,05**
0,24	**0,3**	**0,21**	**0,21**	**0,22**	**0,17**	0,52	0,43	**0,16**	0,45
0,31	**0,16**	**0,03**	**0,07**	**0,03**	**0,06**	0,37	0,46	**0,25**	0,76
0,26	**0,19**	**0,34**	**0,16**	**0,29**	**0,03**	0,44	0,50	0,50	0,42
0,39	**0,27**	**0,34**	**0,07**	**0,07**	**0,34**	**0,26**	0,50	0,45	0,60
0,38	0,48	**0,3**	**0,26**	**0,21**	**0,28**	0,69	0,44	0,51	0,58
0,40	0,60	0,41	0,48	0,57	0,43	0,54	0,59	0,50	0,46
0,50	0,52	0,51	0,57	0,52	0,51	0,45	0,54	0,58	0,54
0,43	0,44	0,56	0,46	0,52	0,46	0,46	0,48	0,56	0,55

(3) ONLY CROP AREA



(4) PIXEL COUNTING

Agricultural Stress Index

ASI

70%

$$\frac{\#\text{drought pixels (38)}}{\#\text{total crop pixels (55)}} = \pm 70\% \text{ of crop area affected by drought}$$

“Agriculture Stress Index”

Mean VHI image over the crop season

0,07	0,24	0,33	0,18	0,34	0,10	0,34	0,54	0,06	0,66
0,29	0,23	0,01	0,27	0,34	0,32	0,57	0,6	0,25	0,05
0,24	0,30	0,21	0,21	0,22	0,17	0,52	0,43	0,16	0,45
0,31	0,16	0,03	0,07	0,03	0,06	0,37	0,46	0,25	0,76
0,26	0,19	0,34	0,16	0,09	0,03	0,44	0,50	0,50	0,42
0,39	0,27	0,34	0,07	0,07	0,35	0,26	0,50	0,45	0,60
0,38	0,48	0,30	0,26	0,21	0,28	0,69	0,44	0,51	0,58
0,40	0,60	0,41	0,48	0,57	0,43	0,54	0,59	0,50	0,46
0,50	0,52	0,51	0,57	0,52	0,51	0,45	0,54	0,58	0,54
0,43	0,44	0,56	0,46	0,52	0,46	0,46	0,48	0,56	0,55

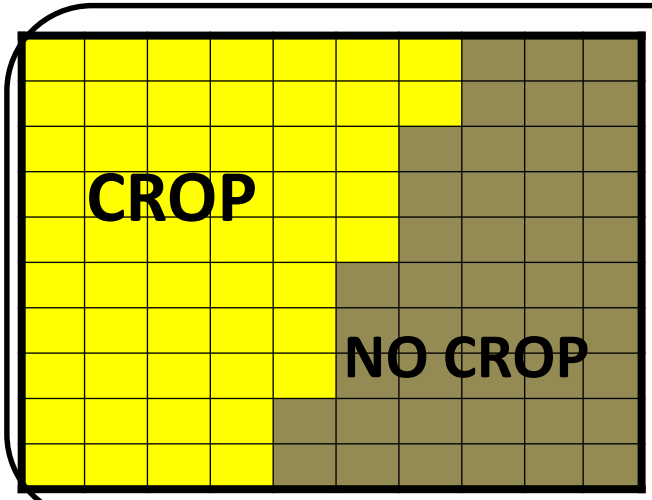
(2)
THRESHOLD

PIXELS with MEAN VHI < 35%

DROUGHT

0,07	**0,24**	**0,33**	**0,18**	**0,34**	**0,10**	**0,34**	0,54	**0,06**	0,66
0,29	**0,23**	**0,01**	**0,27**	**0,34**	**0,32**	0,57	0,60	**0,25**	**0,05**
0,24	**0,3**	**0,21**	**0,21**	**0,22**	**0,17**	0,52	0,43	**0,16**	0,45
0,31	**0,16**	**0,03**	**0,07**	**0,03**	**0,06**	0,37	0,46	**0,25**	0,76
0,26	**0,19**	**0,34**	**0,16**	**0,29**	**0,03**	0,44	0,50	0,50	0,42
0,39	**0,27**	**0,34**	**0,07**	**0,07**	**0,34**	**0,26**	0,50	0,45	0,60
0,38	0,48	**0,3**	**0,26**	**0,21**	**0,28**	0,69	0,44	0,51	0,58
0,40	0,60	0,41	0,48	0,57	0,43	0,54	0,59	0,50	0,46
0,50	0,52	0,51	0,57	0,52	0,51	0,45	0,54	0,58	0,54
0,43	0,44	0,56	0,46	0,52	0,46	0,46	0,48	0,56	0,55

(3) ONLY CROP AREA



0.07	**0.24**	**0.33**	**0.18**	**0.34**	**0.10**	**0.34**
0.29	**0.23**	**0.01**	**0.27**	**0.34**	**0.32**	0.57
0.24	**0.30**	**0.21**	**0.21**	**0.22**	**0.17**	
0.31	**0.16**	**0.03**	**0.07**	**0.03**	**0.06**	
0.26	**0.19**	**0.34**	**0.16**	**0.29**		
0.39	**0.27**	**0.34**	**0.07**	**0.07**		
0.38	0.48	**0.30**	**0.21**			
0.40	0.60	0.41	0.48			
0.50	0.52	0.51				
0.43	0.44	0.56				

DROUGHT

NO CROP

(4) PIXEL COUNTING

μ*VHI

28%

0.07	**0.24**	**0.33**	**0.18**	**0.34**	**0.10**	**0.34**
0.29	**0.23**	**0.01**	**0.27**	**0.34**	**0.32**	0.57
0.24	**0.30**	**0.21**	**0.21**	**0.22**	**0.17**	
0.31	**0.16**	**0.03**	**0.07**	**0.03**	**0.06**	
0.26	**0.19**	**0.34**	**0.16**	**0.29**		
0.39	**0.27**	**0.34**	**0.07**	**0.07**		
0.38	0.48	**0.30**	**0.21**			
0.40	0.60	0.41	0.48			
0.50	0.52	0.51				
0.43	0.44	0.56				

μ*VHI

28%

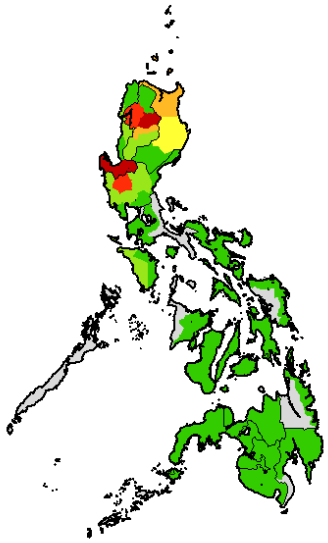
Drought categories (μ*VHI)

- Extreme (<35)
- Severe (35-45)
- Moderate (45-55)
- Dry (55-65)
- None (>65)

***Table 4.26**: Fictive example for a region with 10 pixels belonging to the concerned class (cropland, pasture,...). The μ_{VHI} values (here sorted in ascending order) hold for a specific date in one of both seasons. In this case, three μ_{VHI} categories are discerned (n=1-N, with N=3). **ASI(n)** is the frequency of the pixels in each group, relative to the total (10). And **μ^*_{VHI}(n)** is the mean of the pixels in category n. By definition $\mu^*_{VHI}(n)$ must lie within the μ_{VHI} range of category n. The bottom line with "category 0" shows the overall spatial mean of μ_{VHI}, called **μ^*_{VHI}**. In this example: μ^*_{VHI}=0.60. NB: ASI(1) or 0.10 corresponds with the former definition of ASI (frequency of pixels with μVHI ≤ 0.35).*

PIX	μ_{VHI}	CAT (n)	μ_{VHI}-RANGE	ASI(n) [-]	μ^*_{VHI}(n)
1	0.18	1	$0.00 \leq \mu_{VHI} \leq 0.35$	0.10	0.18
2	0.37	2	$0.35 < \mu_{VHI} \leq 0.50$	0.40	0.42
3	0.38				
4	0.44				
5	0.48				
6	0.52	3	$0.50 < \mu_{VHI} \leq 1.00$	0.50	0.84
7	0.79				
8	0.94				
9	0.97				
10	0.99				
MEAN	**0.60**	**0**	**$0.00 \leq \mu_{VHI} \leq 1.00$**	**1.00**	**0.60**

Philippines



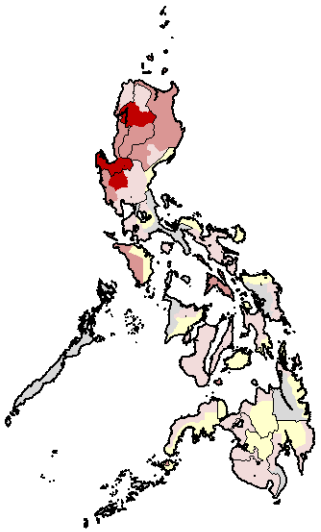
Agricultural Stress Index (ASI)
% of area affected by drought
Complete season 2 of 1995
ALL LAND COVER TYPES
METOP-AVHRR
WGS84, Geographic Lat/Lon

ASI
- < 10
- 10 - 25
- 25 - 40
- 40 - 55
- 55 - 70
- 70 - 85
- >= 85
- off season
- no data
- no season 2

Food and Agriculture Organization of the United Nations

Global Information and Early Warning System – GIEWS

Philippines



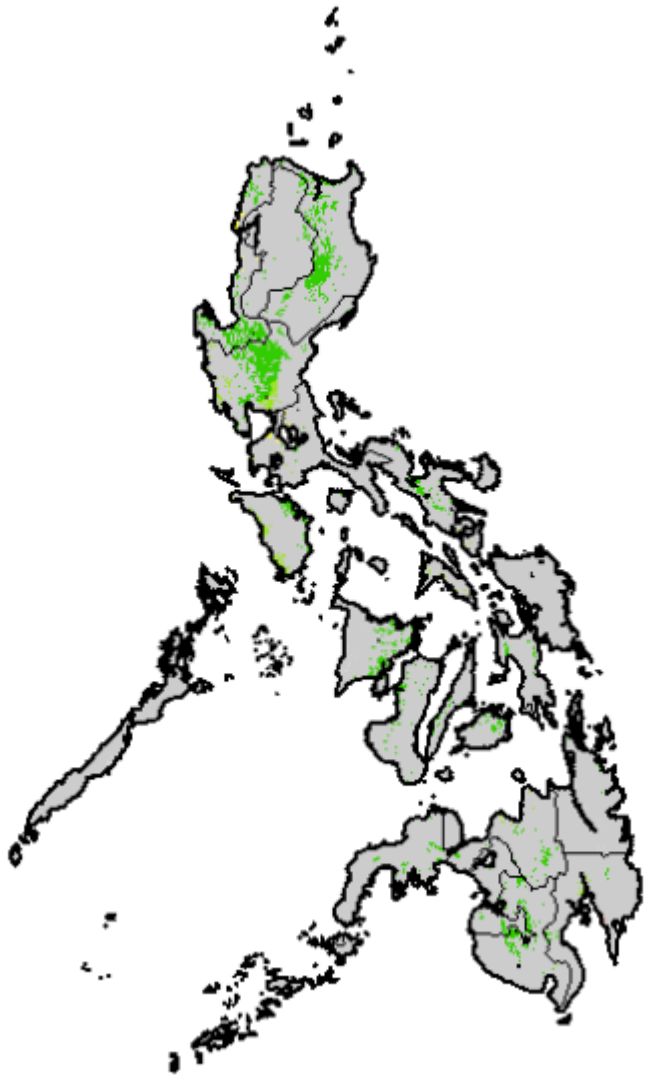
Mean VHI Class 1
Complete season 2 of 1995
Averaged per region
METOP-AVHRR
WGS84, Geographic Lat/Lon

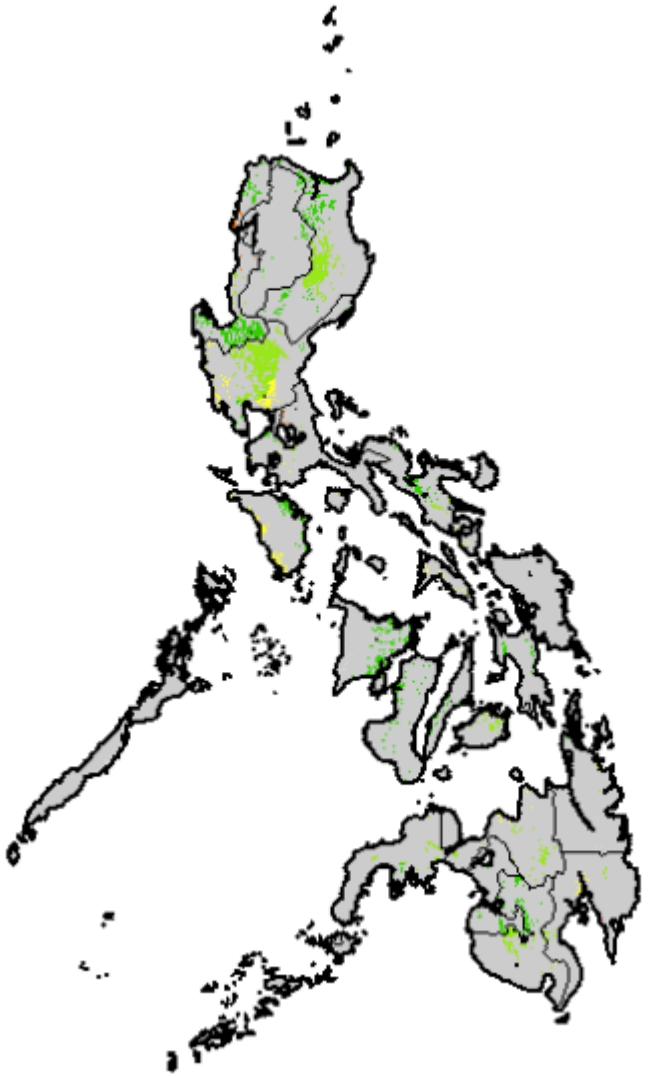
Drought Category (μ*VHI)
- Extreme (< 0.35)
- Severe (0.35-0.45)
- Moderate (0.45 - 0.55)
- Dry (0.55 - 0.65)
- None (>0.65)
- off season
- no data
- no season 2

Food and Agriculture Organization of the United Nations

Global Information and Early Warning System – GIEWS

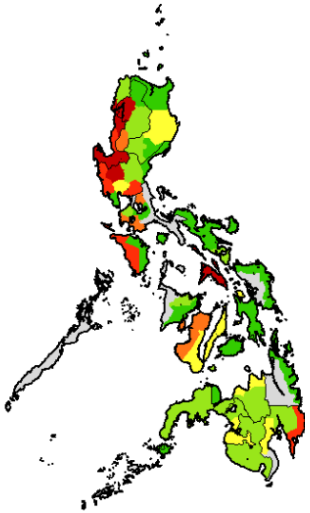

Crop calendar
Philippines
Maize (Main)
Maize (Second)
Potatoes
Rice (Main)
Rice (Second)
J F M A M J J A S O N D
Key
Sowing
Growing
Harvesting
Source: FAO/GIEWS



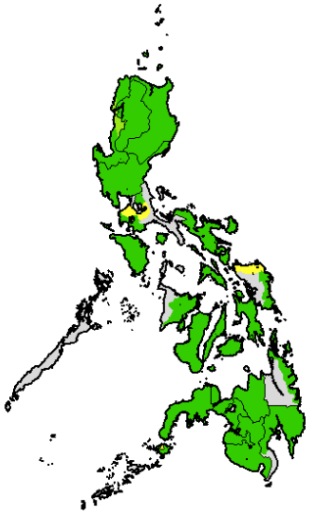


Historical drought probability of having >50% of rice affected by drought per region

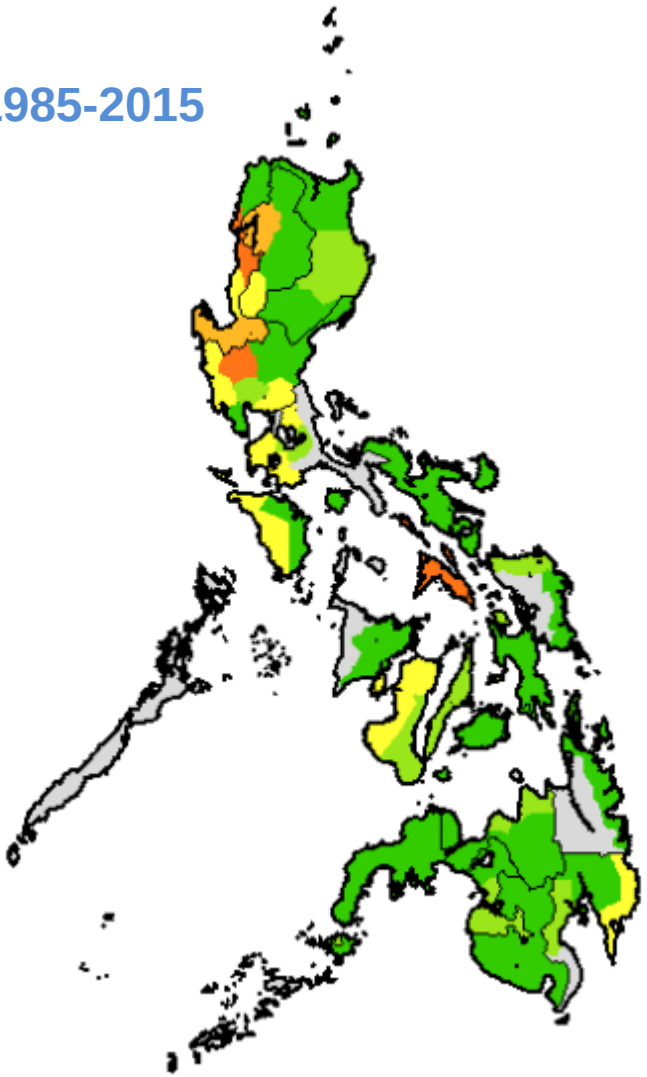
1985-1999



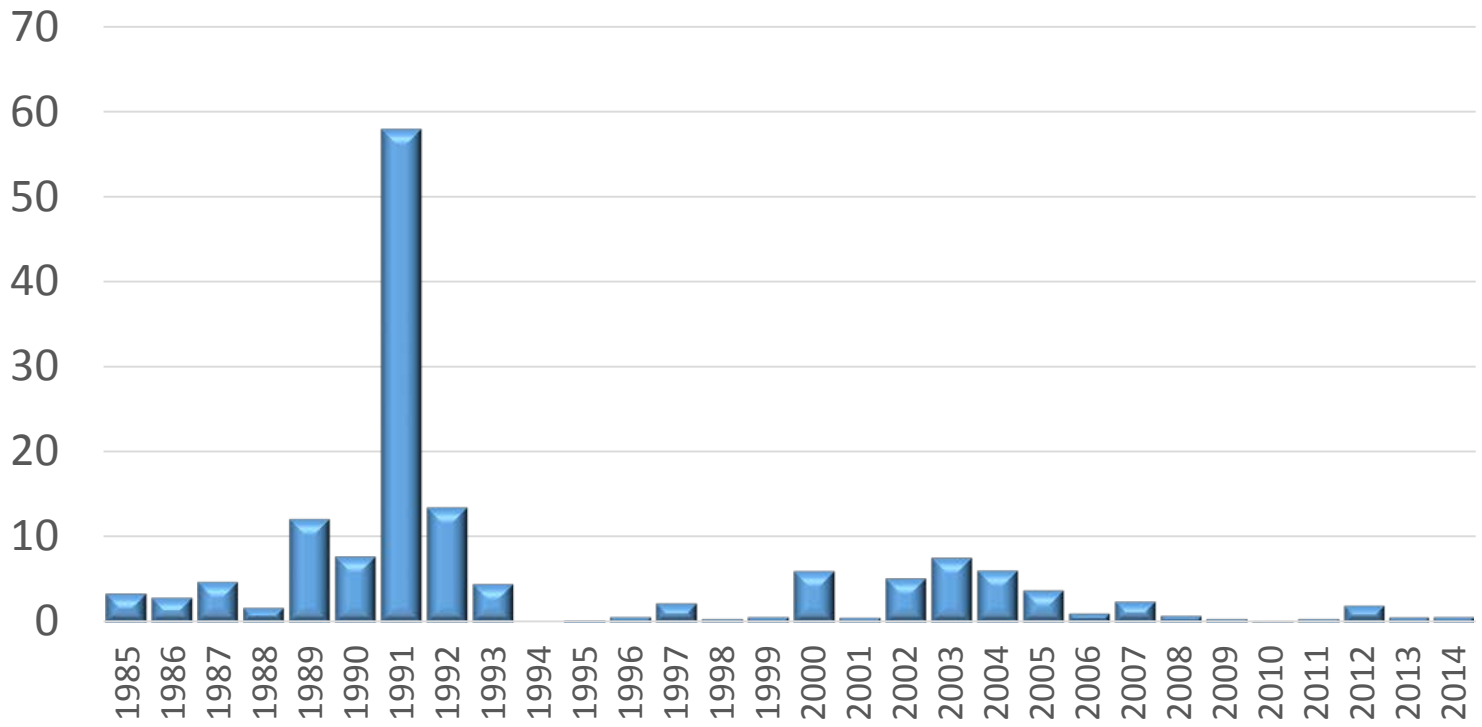
2000-2015



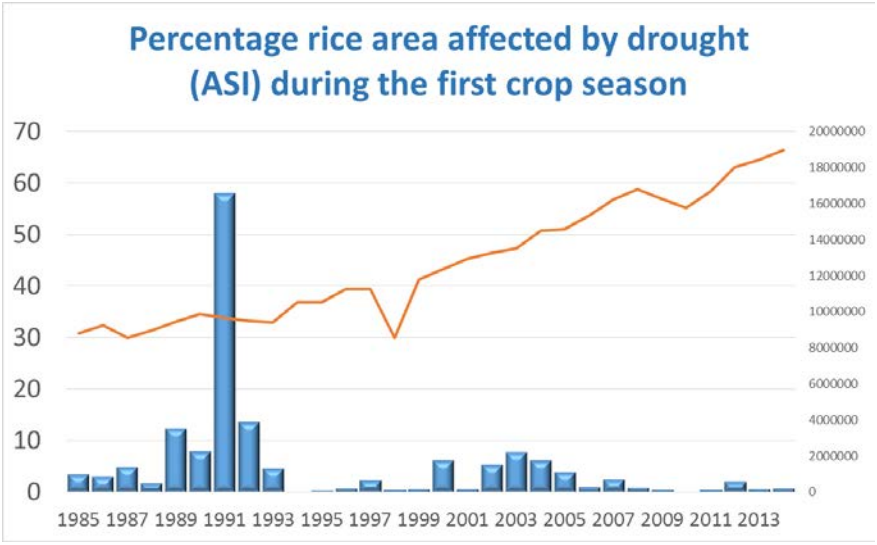
1985-2015

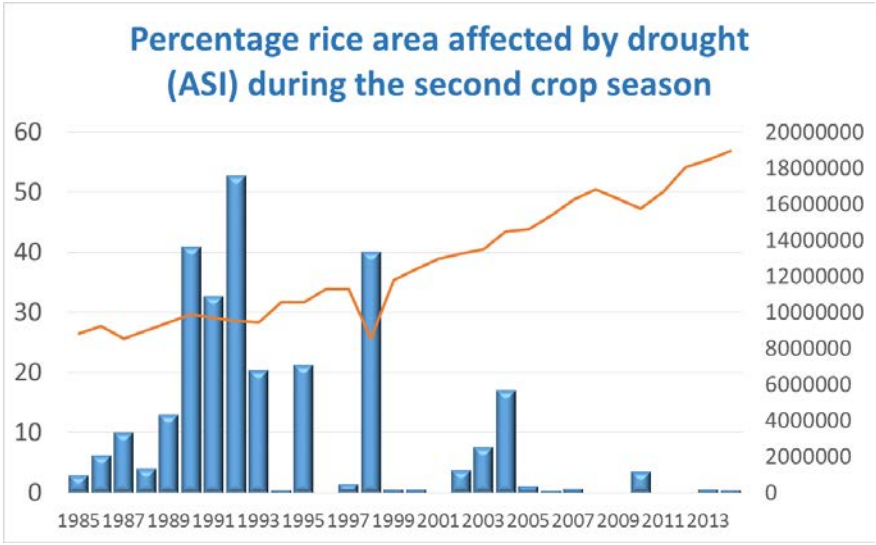


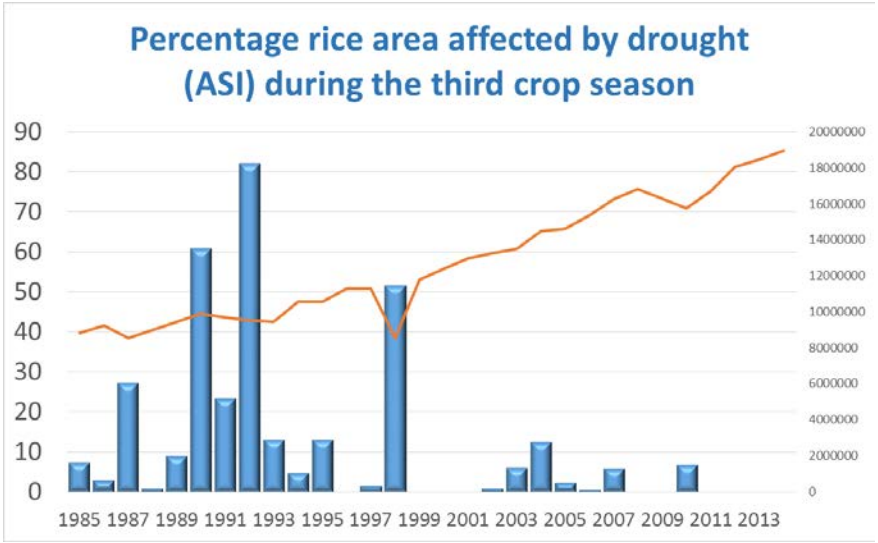
Percentage rice area affected by drought (ASI) during the first crop season



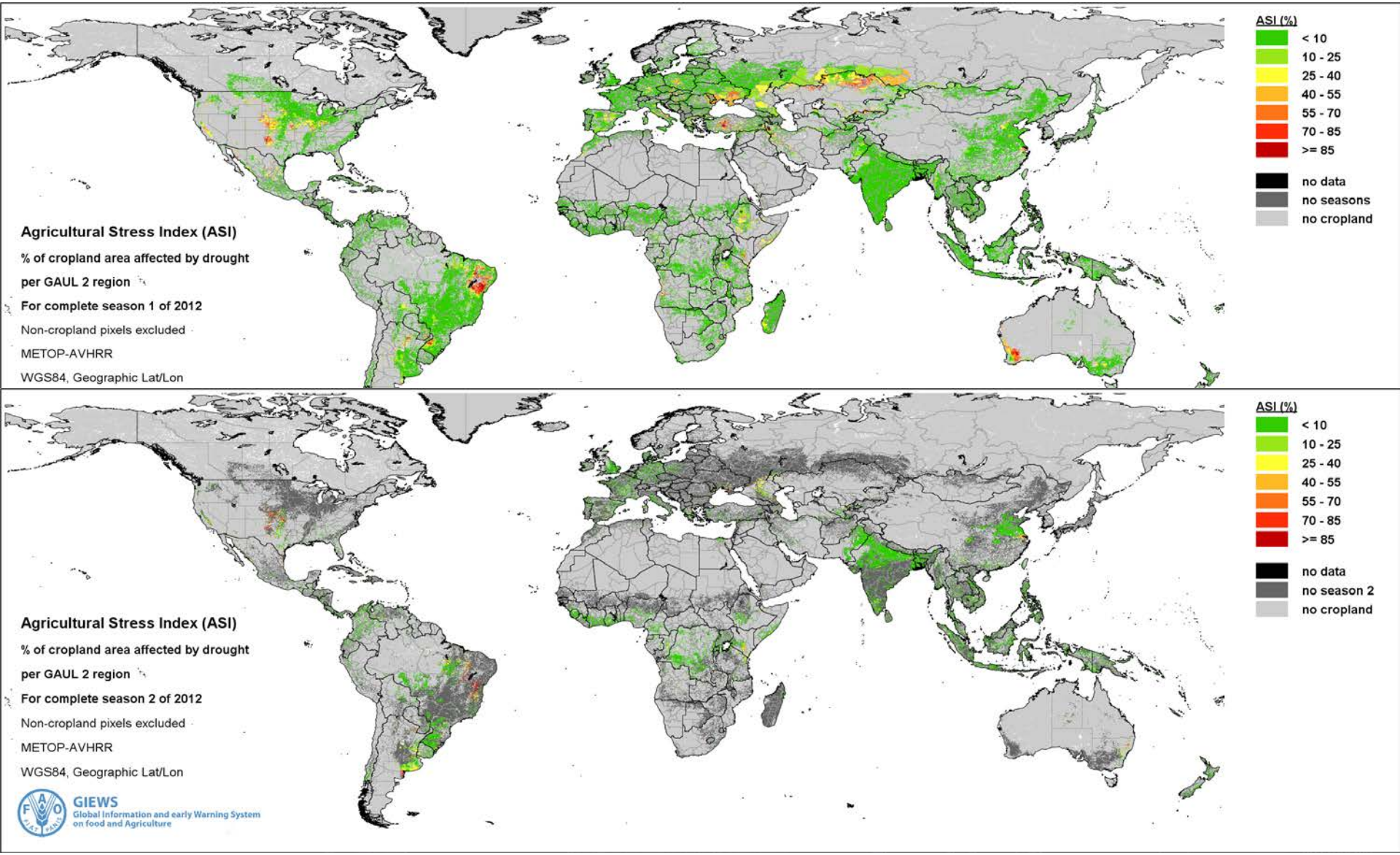
Percentage of rice area affected by drought in Philippines





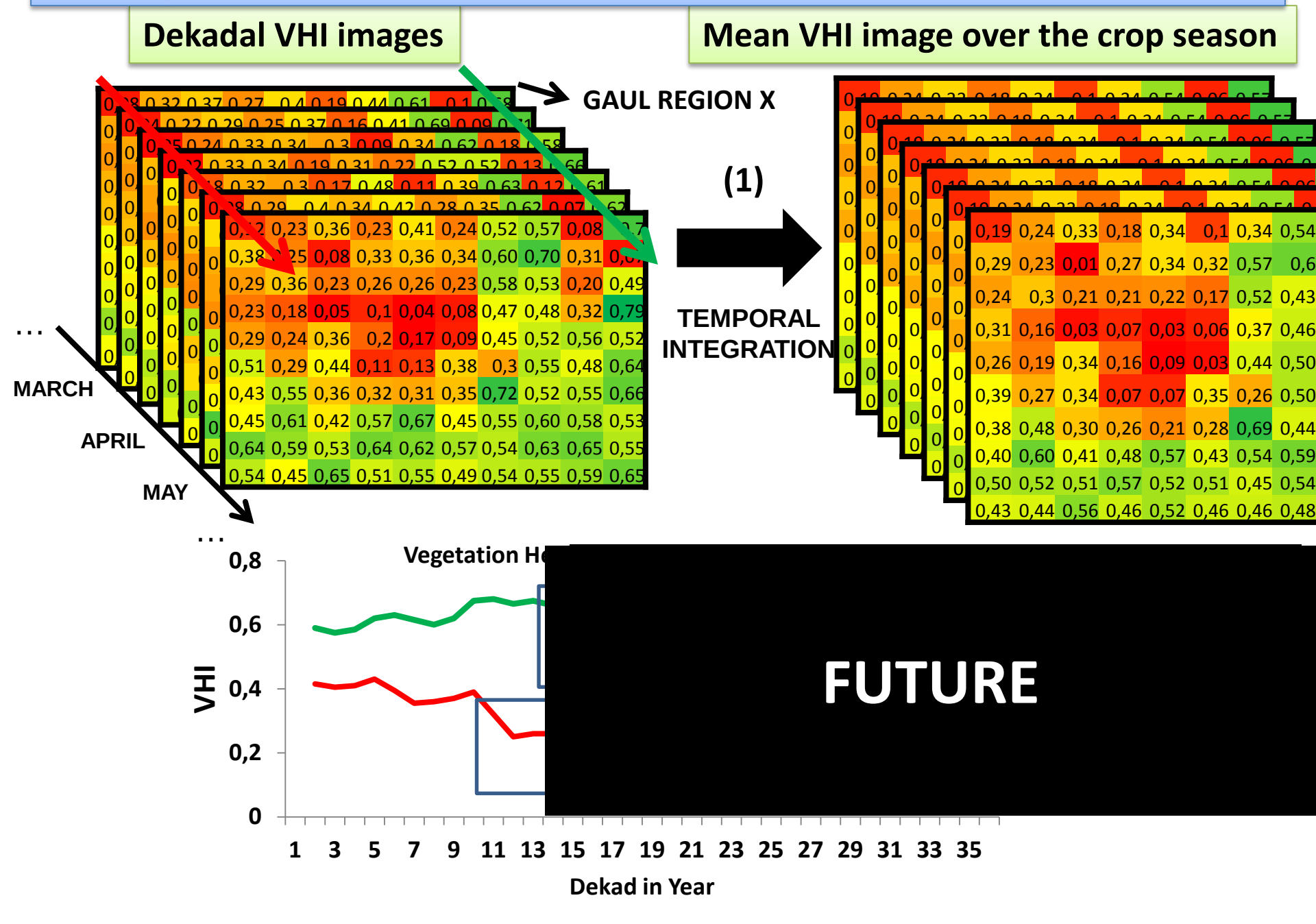


“Agriculture Stress Index”

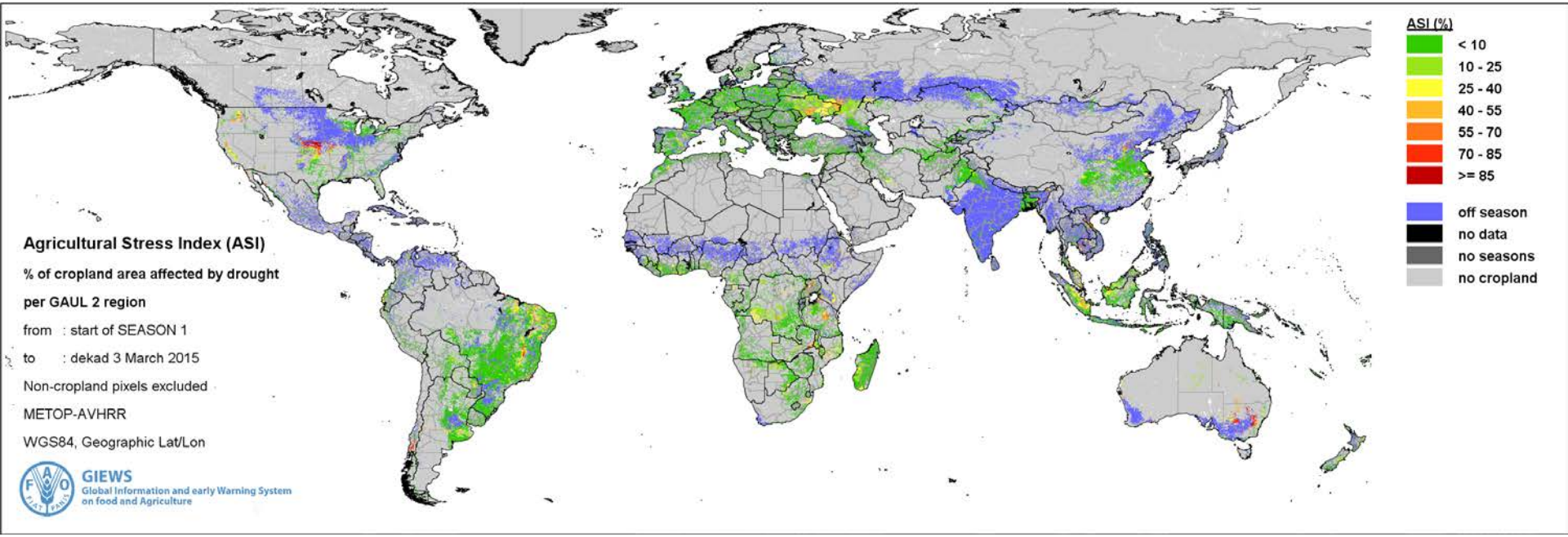


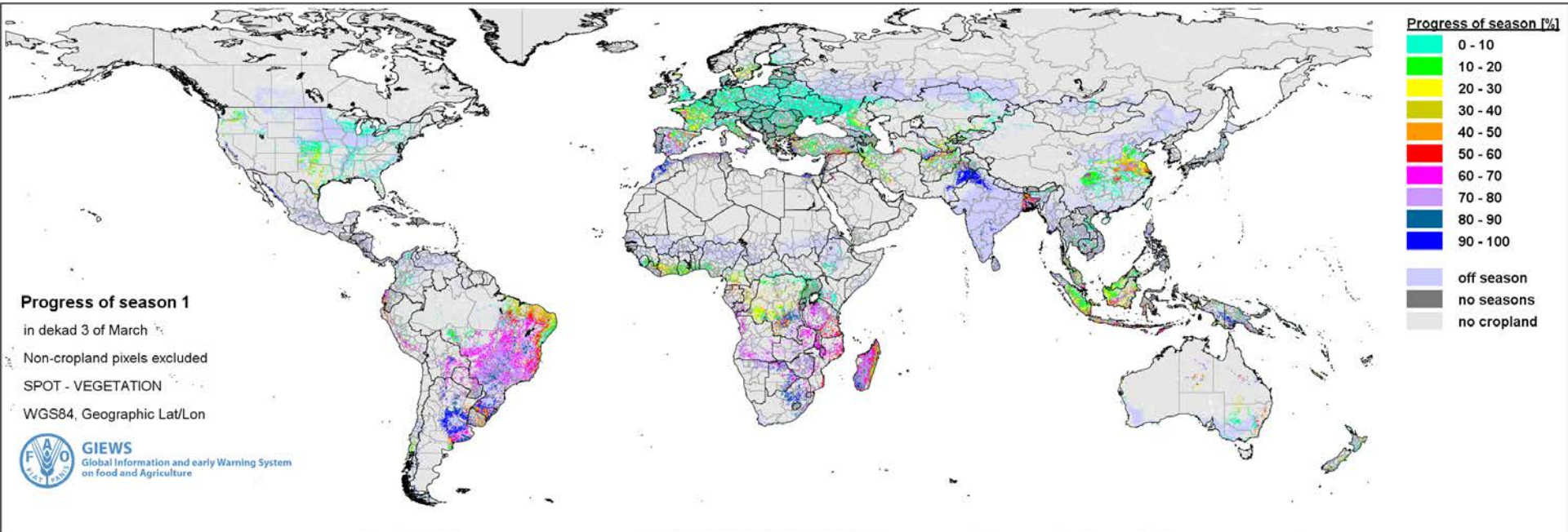
ARCHIVE CALCULATIONS →YEARLY OUTPUT

“Agriculture Stress Index” - NearRealTime

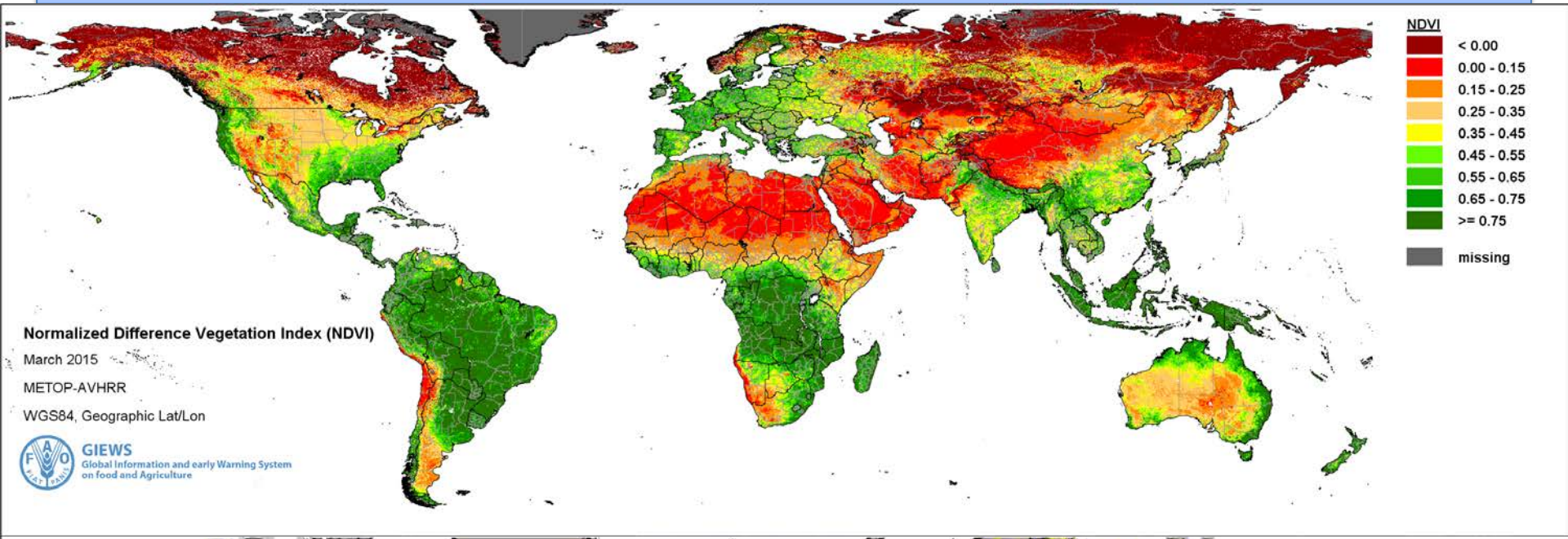


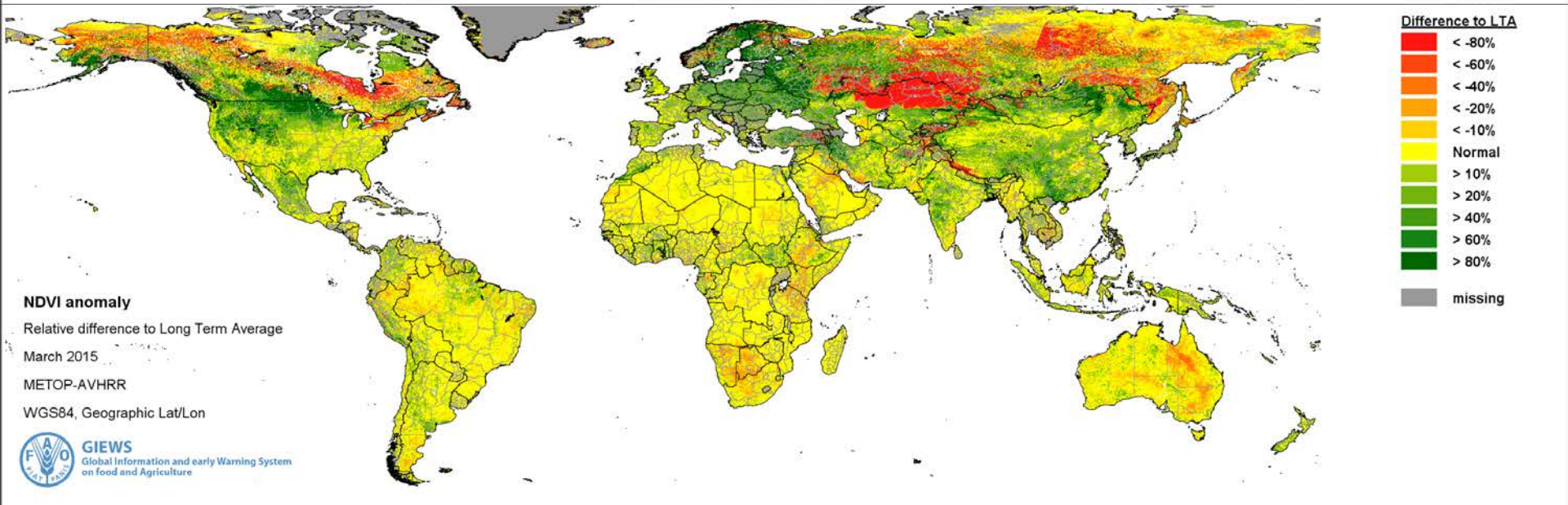
“Agriculture Stress Index” - NearRealTime



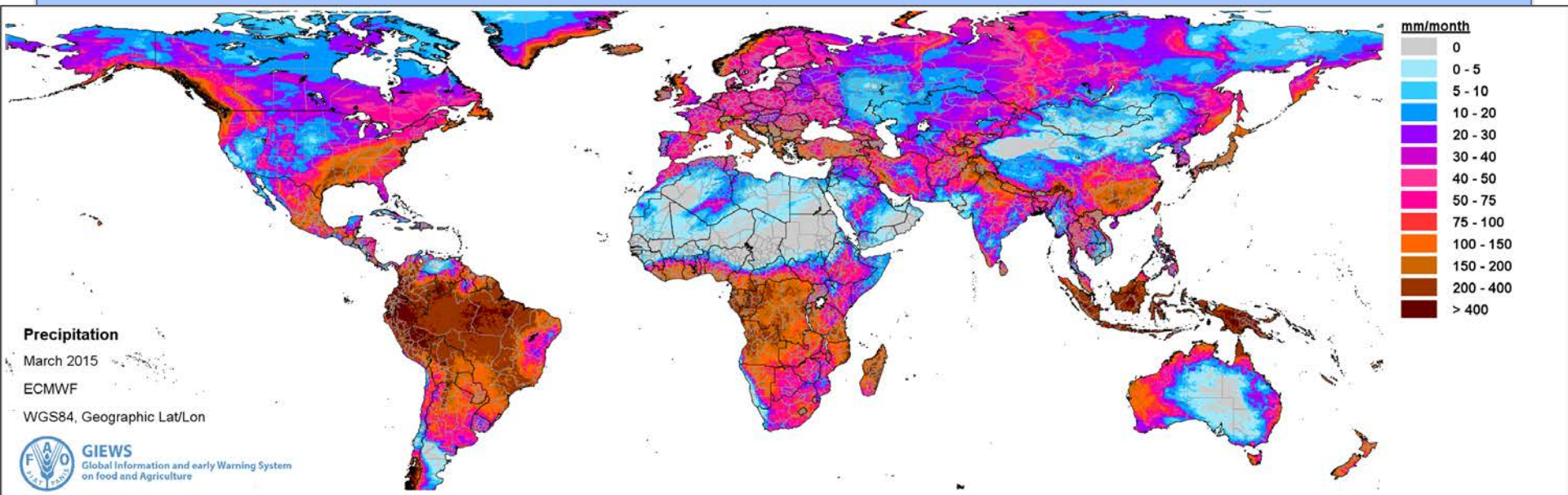


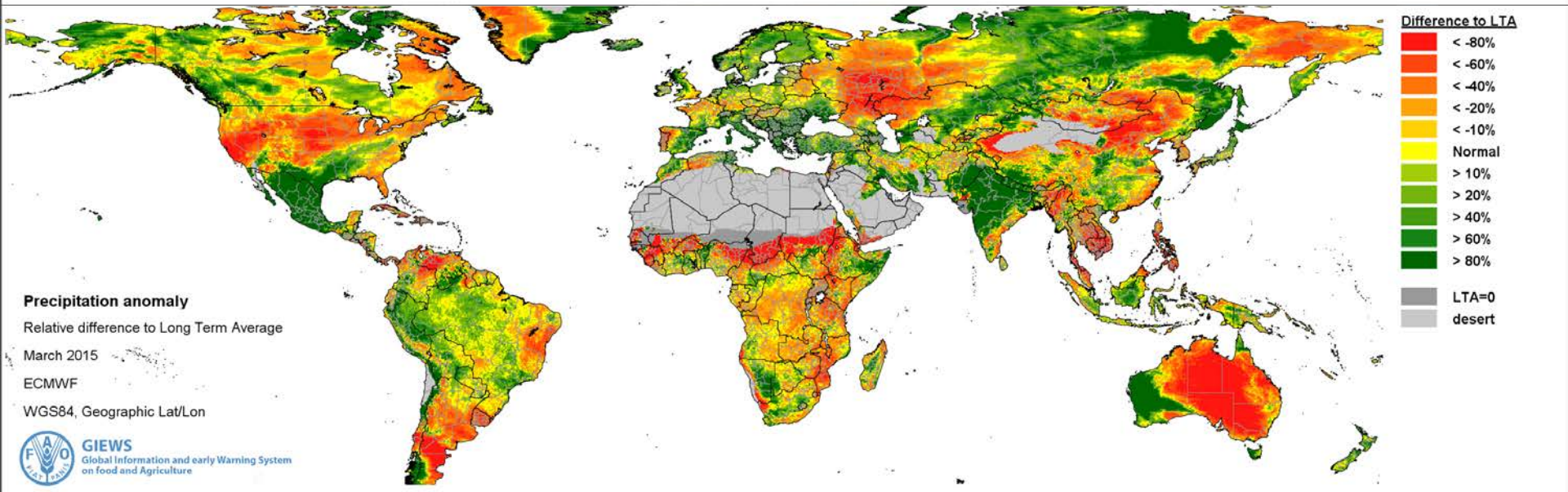
ASIS 1 bis – more anomalies, monthly data, rainfall data & ROIs



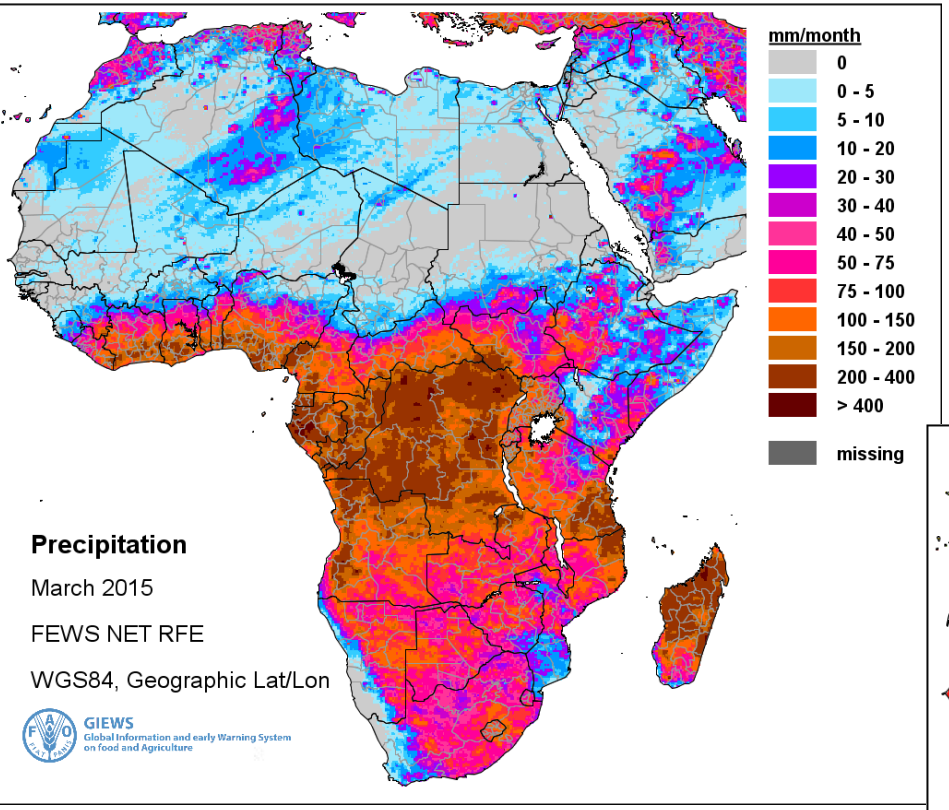


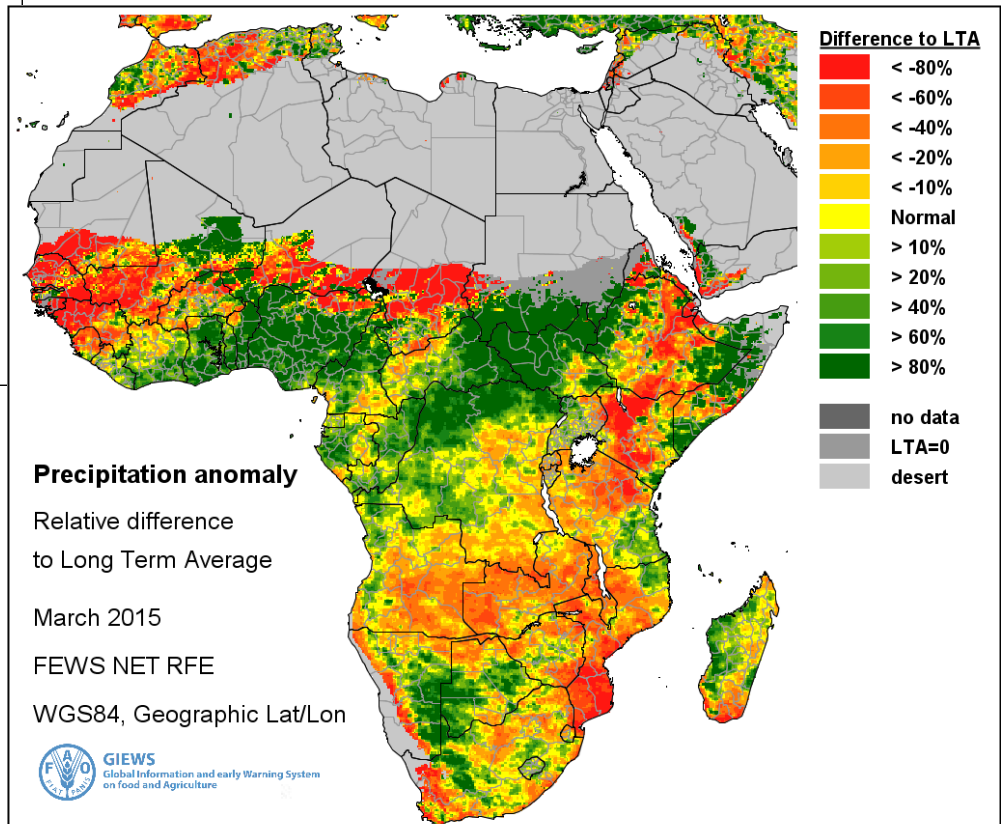
ASIS 1 bis – more anomalies, monthly data, rainfall data & ROIs



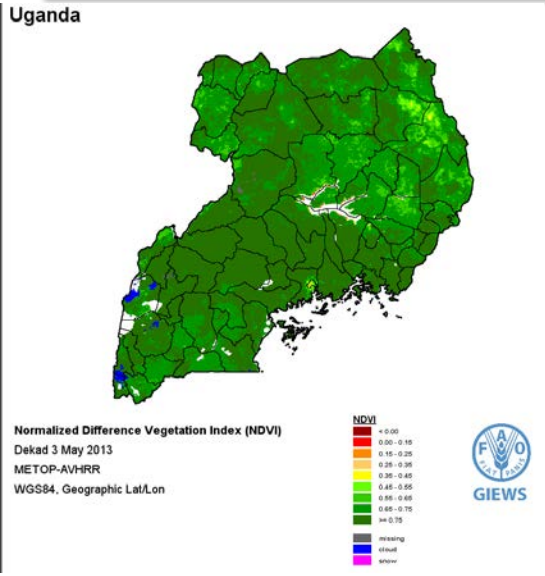


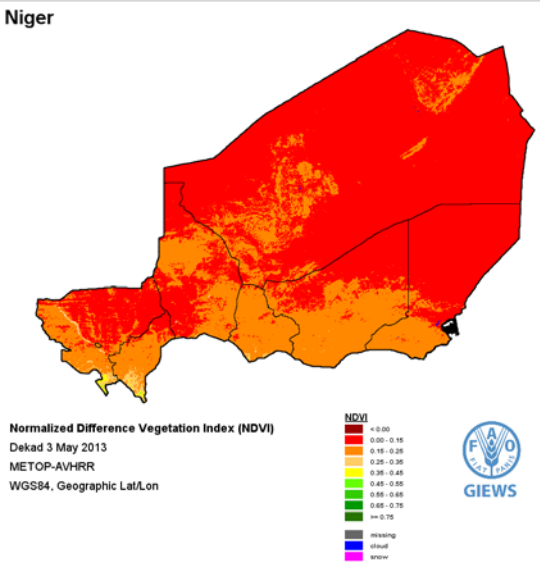
ASIS 1 bis – more anomalies, monthly data, rainfall data & ROIs

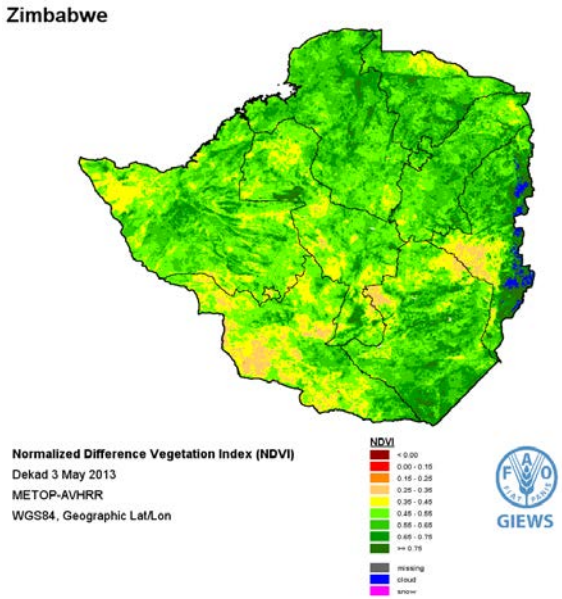


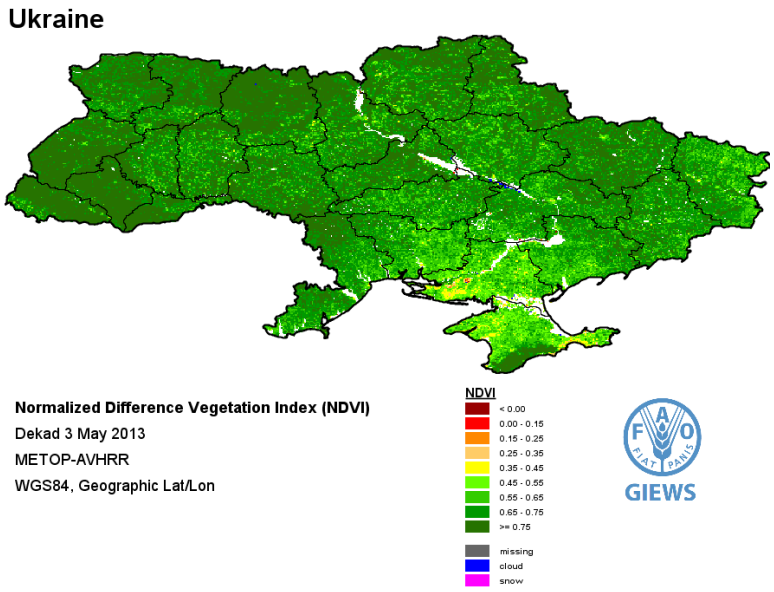


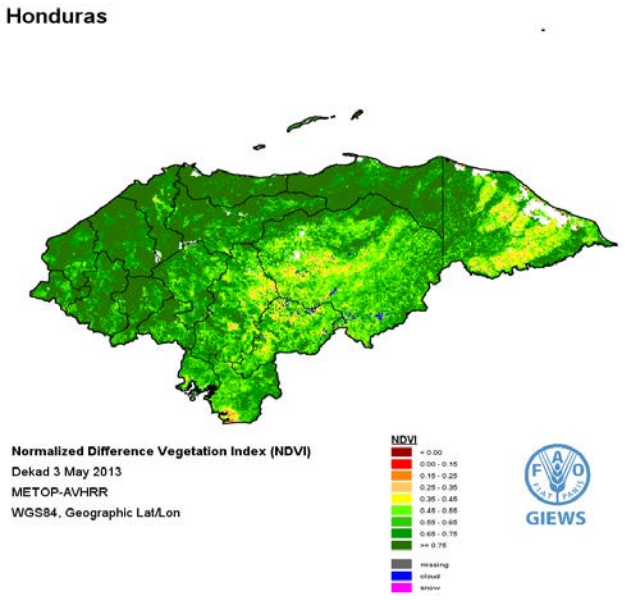
ASIS 1 bis – more anomalies, monthly data, rainfall data & ROIs











ASIS 1 bis – more anomalies, monthly data, rainfall data & ROIs

Food and Agriculture Organization of the United Nations

العربية 中文 English Français Русский Español

About FAO | In Action | Countries | Themes | Media | Publications | Statistics | Partnerships

FAO > GIEWS > Earth Observation

Country Indicators

Home | Seasonal Global Indicators | Global Indicators | Country Indicators | Partners | Referenc

The country level maps and graphs depict the latest 12-month period of the seasonal, vegetation and precipita presented by dekad and month ⊞ More

Ethiopia

Another country:

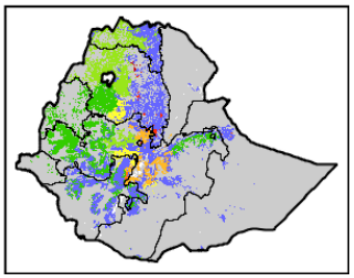
Seasonal Indicators | Vegetation Indicators | Precipitation Indicators | Graphs (GAUL level 1)

ASI-Season 1 | ASI-Season 2 | Mean-VHI-Season 1 | Mean-VHI-Season 2 | ASI-Annual Summary-Season 1 | ASI-An

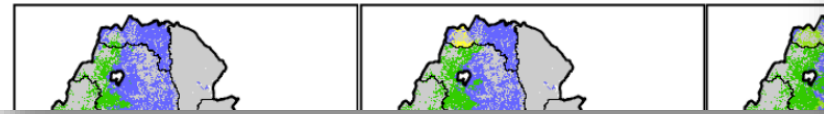
Agricultural Stress Index ⊞ More

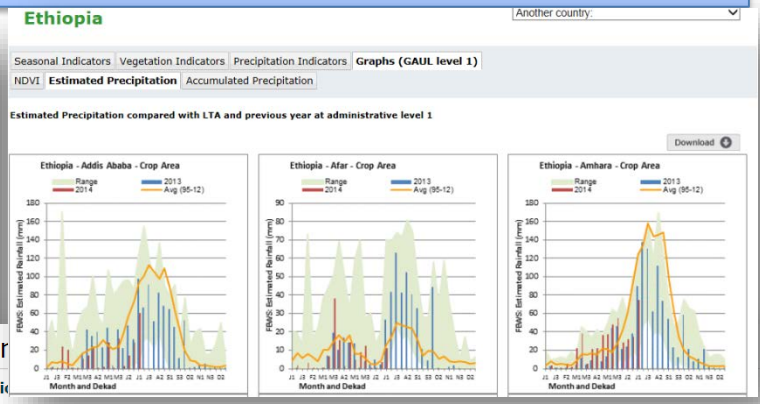
First Dekad | Second Dekad

Jul-14



Progress of Season





Country Indicator

Home | Seasonal Global Indi

The country level maps and graphs depict the latest 12-month period of the seasonal, vegetation and precipitation indicators. The data is presented by dekad and month ⊞ More

Ethiopia

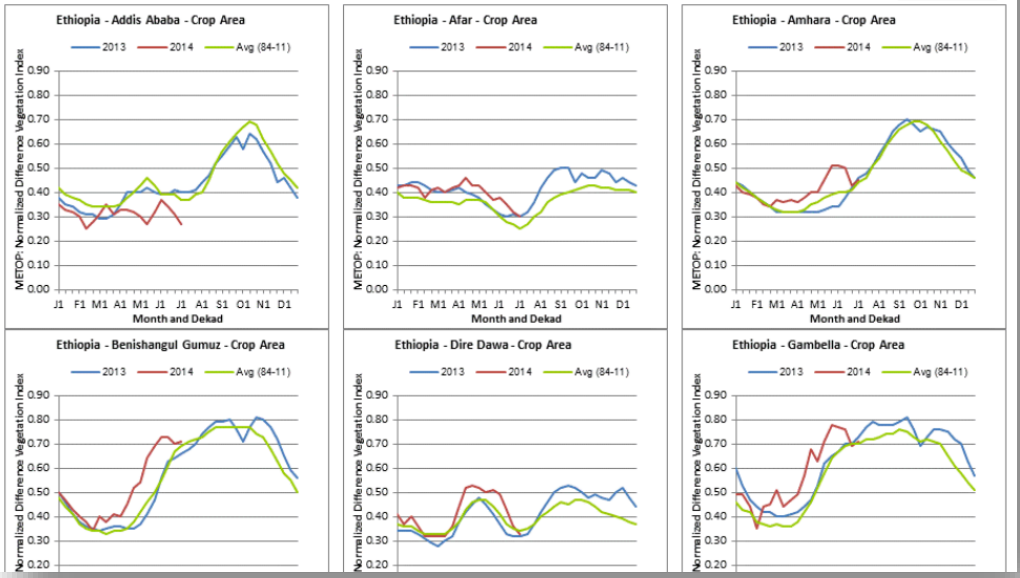
Another country:

Seasonal Indicators | Vegetation Indicators | Precipitation Indicators | Graphs (GAUL level 1)

NDVI | Estimated Precipitation | Accumulated Precipitation

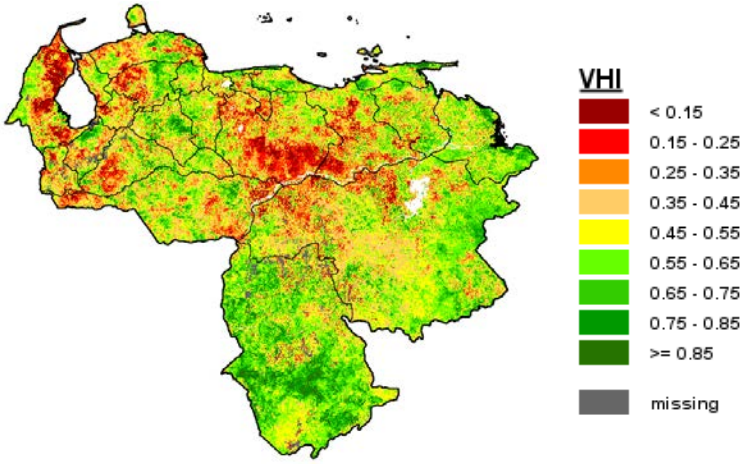
NDVI profile compared with LTA (1989-2012) and previous year at administrative level 1

Download

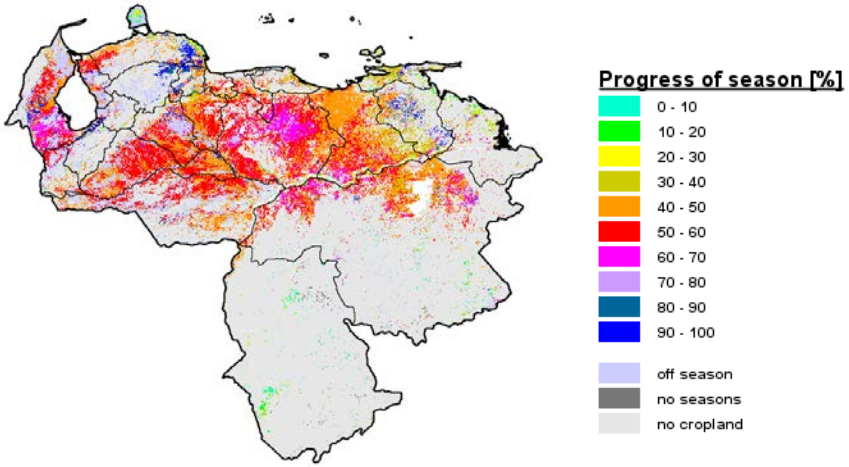


RECENT DROUGHT EVENTS – NRT ANALYSIS

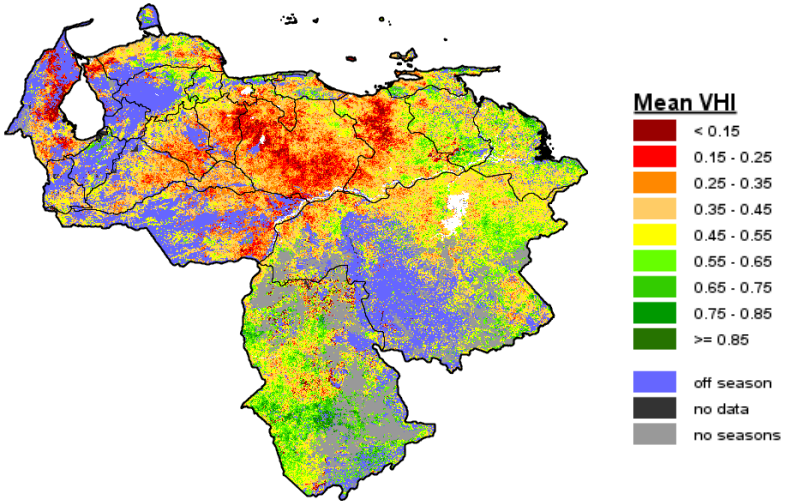
VENEZUELA – end of August 2014



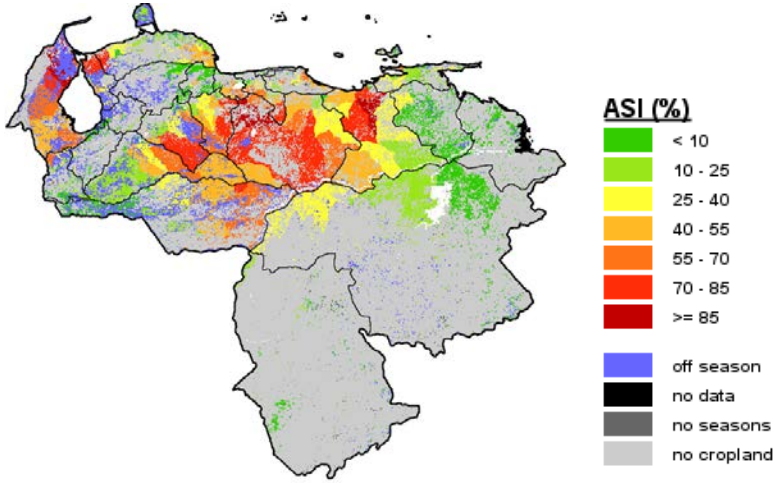
Vegetation Health Index



Progress of season



Mean VHI over the season



Agricultural Stress Index
% crop area affected by drought

Case Study

FAO: Watching Agricultural Drought Worldwide - from Space

In the framework of the EU/FAO Improved Global Governance for Hunger Reduction Programme, the Food and Agriculture Organization of

applied in many different environmental conditions around the globe, including in Asia, Africa, Europe, North America and South America.

partner in scientifi
development, simula
into the NOAA-AV
through an "inter-ca
obtain a time series f
The ASIS database
years of agricultural
with the year 1984 w
severely affected by

ASIS@fao.org
www.fao.org/climatechange/ASIS

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Deployment

The standalone version of ASIS is designed to be deployed at the national level in different institutions (Ministries of Agriculture, National Meteorological Services, Ministries of Environment, etc.) that can strengthen National Early Warning Systems for food security.

Capabilities

Possible applications include: assessing the impact of climate variability in agriculture (crops and pasture), supporting remote sensing-based insurance indexes, crop monitoring and yield forecasting.

FAO ASIS
Agriculture Stress Index System

The global ASIS will strengthen the crop and vegetation monitoring work of FAO's Global Information and Early Warning System (GIEWS). The standalone version of ASIS will support national food security early warning systems. The development of ASIS is included in the EU/FAO Programme on "Improved global governance for hunger reduction".

Partners in scientific and technical development:

vito

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

ASIS
Agriculture Stress Index System

MONITORING AGRICULTURE DROUGHT WITH REMOTE SENSING DATA

WHY ASIS?

Drought is the world's most destructive natural hazard, having devastating impacts on food security and damaging the food production base.

Episodes of drought increased in frequency and intensity over the past two decades as a result of climate change impacts, and this trend is expected to continue.

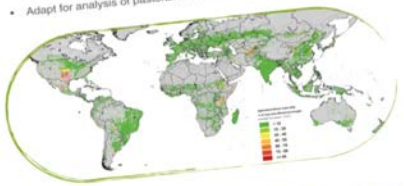
Timely and reliable information of the condition of food crops in all regions and countries in the world is essential to mitigate the impact of agricultural drought.

FAO's Global Information and Early Warning System (GIEWS) along with the Climate, Energy and Tenure Division are implementing a system for detection of agricultural areas with a high likelihood of water stress (drought) on a global scale.

Through monitoring vegetation indices across global crop areas during the growth season, ASIS will detect "hotspots" around the globe where crops may be affected by drought.

ASIS AS A MONITORING TOOL CAN:

- Show areas at risk from drought across the globe at a glance through map products
- Provide near real time analysis (every 10 days) based on METOP-AVHRR 1 km resolution data
- Adapt for analysis of pastoral or forest areas



POTENTIAL

Adaption of global ASIS to specific regional or country situations would support improved crop monitoring and yield forecasting at regional or national level and could provide input for index based crop insurance schemes.

vito

30 June 2014

GIEWS Update

Ethiopia: El Niño-Southern Oscillation (ENSO) and the main *Kiremt* rainy season

An assessment using FAO's Agricultural Stress Index System (ASIS)

1. DEFINITION

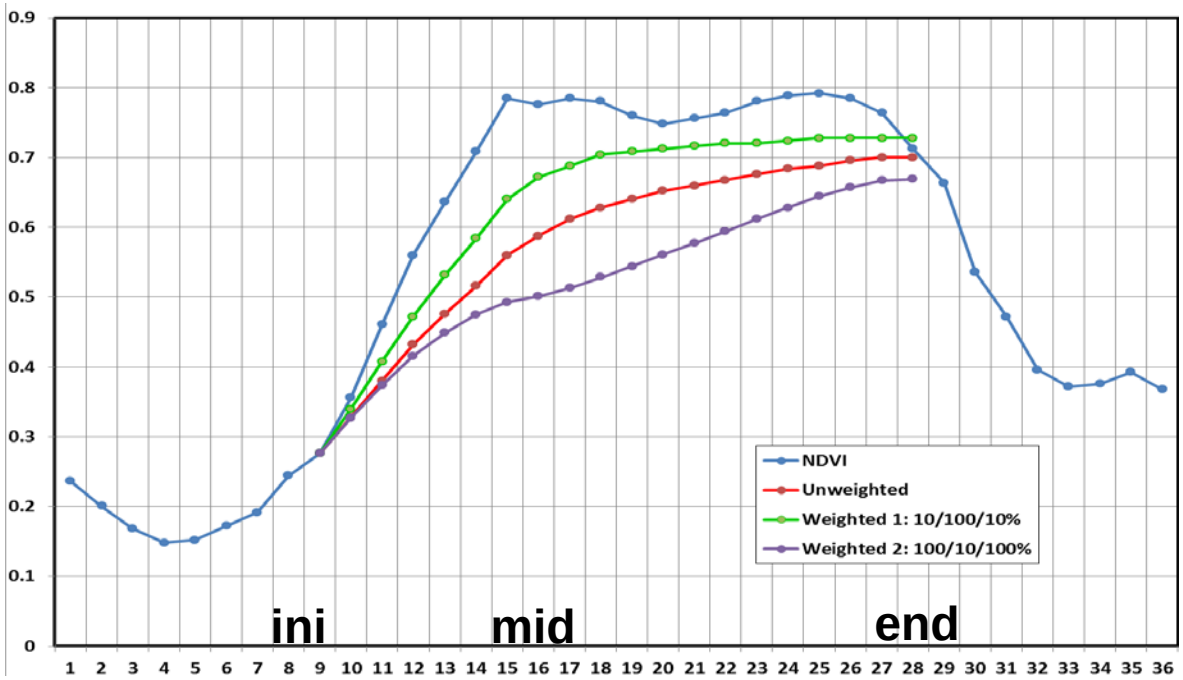
An El Niño is a recurrent weather phenomenon that takes place approximately every two to seven years and usually lasts between 12 and 18 months. An El Niño event is defined by a high Oceanic Niño Index (ONI), which is based on Sea Surface Temperature (SST)

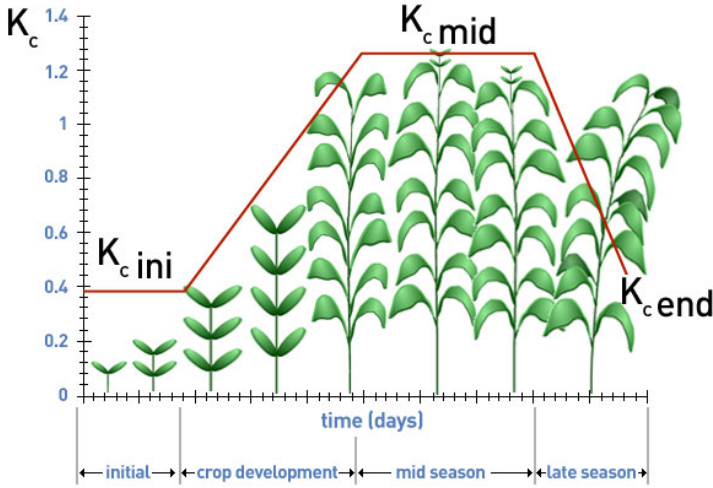
ASIS II

1. **Global improvements [in progress]:**
   - Distintion between cropland and grassland phenology
   - Local adaptation of VHI-weight
   - Include stress sensitivity of phenological stage
   - Weighted ASI (categorical instead of single threshold)
   - Updated land cover map (GLC-SHARE) & GAUL
2. **Estimation of probability of production deficit of ongoing season (Meroni et al. 2014) [to do]**
3. **Stand alone tool [to do]:**
   - FAO headquarter = global database
   - Local application of the ASIS
   - Graphical User Interface
   - Play with settings (phenology, crop masks, parameters,…)

ASIS 2 – developments – Kc factors

TEMPORAL WEIGHING ~ phenological stage region x land cover specific Kc's





ASIS 2 – developments – VHI weighing

Importance of temperature in “drought”

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

region x land cover specific w’s

e.g. Northern Europe ←→ Horn of Africa

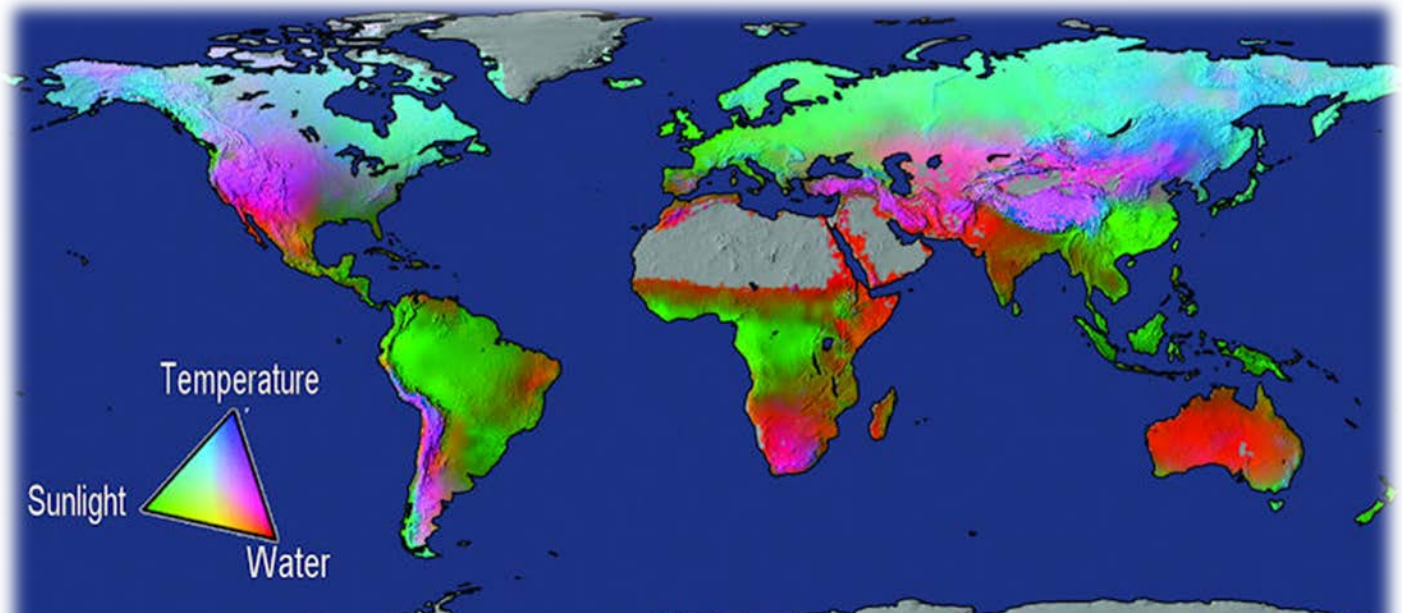
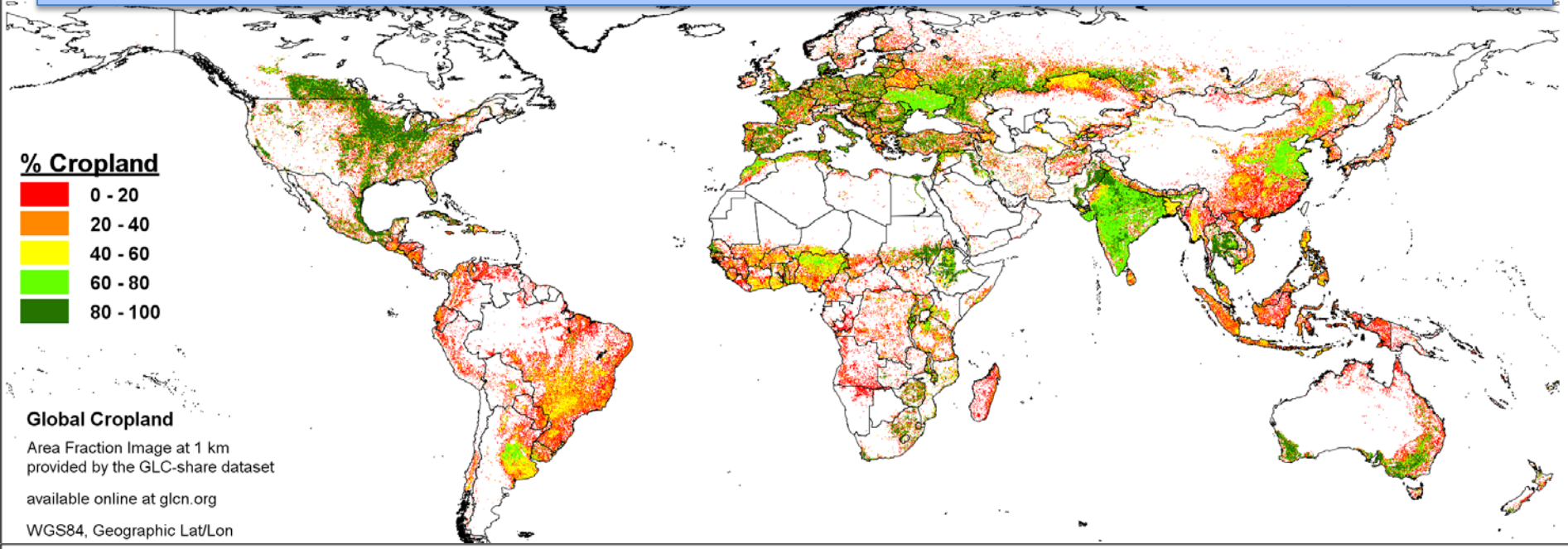
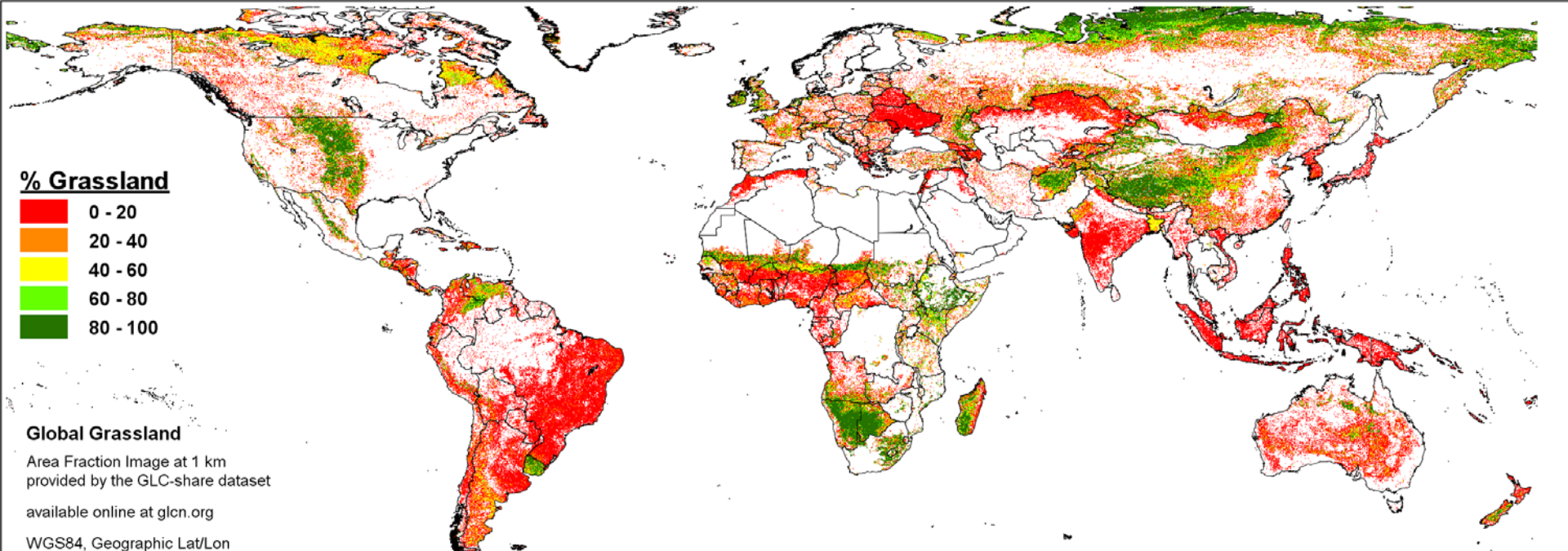


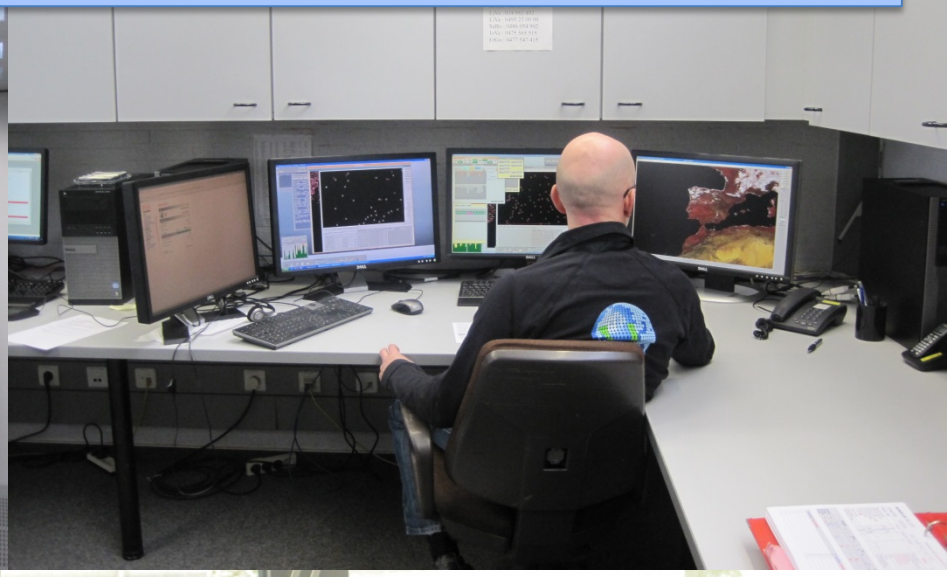
Illustration from MODIS: LIMITING FACTOR FOR VEGETATION GROWTH

ASIS 2 – developments – GLC-SHARE





Technical Workflow – At VITO



Technical Workflow – At FAO

VITO (Belgium – Mol)

BASIC DATA

FAO HQ (Italy – Rome)

ASIS SERVER

- Further processing
- Hardware: Windows 2008 server
- Software: GLIMPSE, batch, Python, etc.
- 2 x 10 TB hard disks
- User interface via scripts
- Connection with GIEWS website
- Close collaboration

http://www.fao.org/giews/earthobservation

hosts ASIS maps and graphs
For each country in the world

GIEWS
Global Information and early Warning System on food and Agriculture

vito
vision on technology