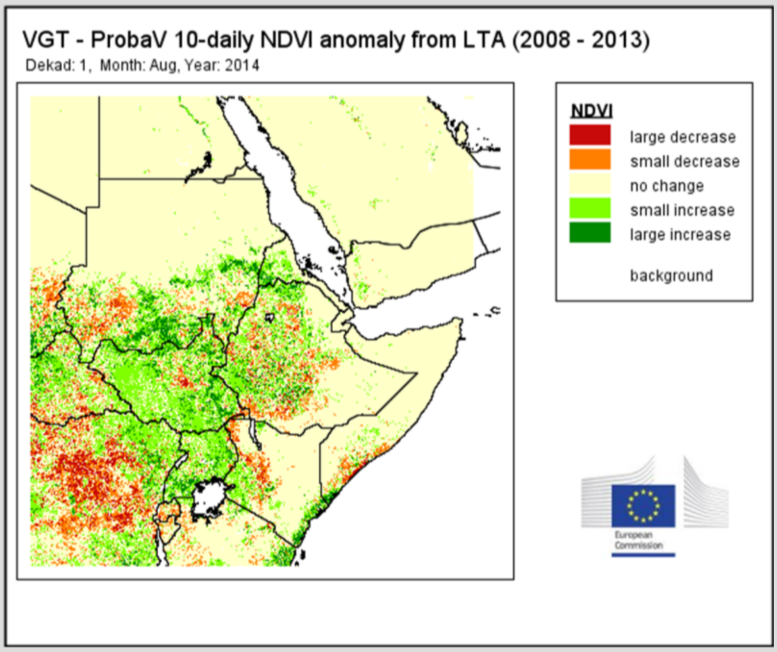
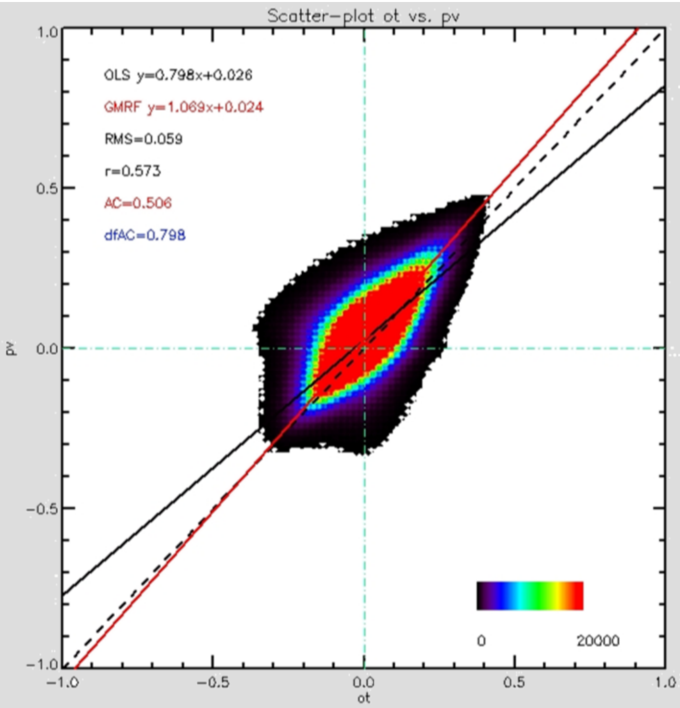
JRC TECHNICAL REPORT





Comparison of PROBA-V, METOP and eMODIS NDVI anomalies over the Horn of Africa

Evaluation of PROBA-V satellite data quality

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Abstract
After 15 years of operational service, the VGT instrument has reached its end-of-life in May 2014. Before this date, the PROBA-V satellite (PV) was launched in May 2013 by ESA, as a "gap filler", i.e., between the SPOT VGT and the future Sentinel 3 satellite, foreseen to be launched in mid-2015. In order to evaluate the quality and usability for operational crop monitoring of the new PV satellite NDVI data we compared it to other moderate to low spatial resolution instruments. The analysis has been performed over the Horn of Africa using TAMSAT rainfall estimates and NDVI from METOP and MODIS instruments as term of comparison.

We found large disagreement (up to more than 40% according to the proposed classification scheme) between NDVI anomaly derived from PV the one hand, and METOP or eMODIS on the other hand. The disagreement between METOP and eMODIS is lower and normally within 30%. The analysis also shows that in case of disagreement, the difference between paired anomalies is biased when PV is compared with one of the other two sensors. That is, when PV and one of the two sensors do not agree on the sign of the anomaly, it is PV indicating a positive anomaly and the other sensor a negative one in 80% of the cases.

Visual inspection of anomalies support these findings and highlight the fact that this agreement has indeed operational implications. That is, PV appears to deliver a contrasting information regarding vegetation status as compared to METOP and eMODIS, especially in some specific dekads (e.g., dekads 25 to 28).

Performing the same comparison for the year 2013 when NDVI data were provided by VGT instead of PV, we confirm that major differences among the three sensors were not present and we corroborate the hypothesis that the cause of the problem is related to the use of PV NRT data with VGT LTA data to compute the anomalies.

Finally, rainfall estimates time series of 2014 were used as an additional and qualitative check for the observed differences. The visual inspection of rainfall anomalies suggests that the anomalies shown by PV are generally too positive while METOP and eMODIS are showing a better convergence with the rainfall estimates.

The results of this preliminary comparison call for further analysis to understand the cause of the observed seasonality of the agreement between the PV anomalies and those of other comparable sensors (METOP and eMODIS). Also it is not known at the moment whether this situation is specific for the East African window or if similar patterns can also be observed in other regions of the world.

Before this clarification is made and corrective actions are taken, we recommend to follow a conservative approach and use eMODIS or METOP for the operational monitoring of FOODSEC.

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Motivation of the analysis

The visual inspection of NDVI anomaly products for 2014 and from different instruments (Proba-V (PV), METOP, eMODIS) highlighted some major differences between them. In this report we summarise the results of a systematic analysis of such difference. In order to avoid possible inconsistencies arising from the different temporal windows used to compute the LTA (Long Term Average) with the different sensors, we first computed a common LTA period (2008-2013) for all of them.

Data, pre-processing and study area

Table 1 specifies the data used in the present analysis and summarises the basic processing applied to NDVI data before the analysis.

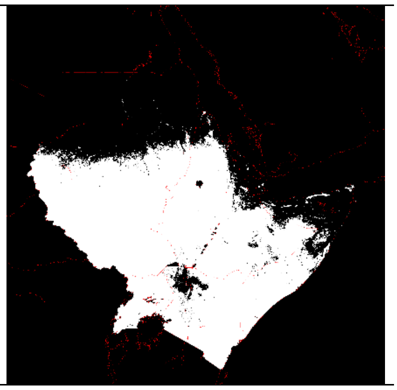
Year of comparison	2014
Target area	
Countries	Somalia, Kenya, Uganda, Sudan, South Sudan, Ethiopia, Eritrea
Country mask	Extracted from GAUL (S:\Actions\FOODSEC\base_data\remote_sensing\ROI IGA per Felix\HoAcountries.shp)
Vegetation mask	In order to exclude desert, bare soils and other non-vegetated surfaces we used a Vegetation / No Vegetation mask from phenology algorithm of Meroni et al. (2014) 
RS data	
MODIS	eMODIS 10-day composite (250 m resolution) resampled to 1 km VGT/PV grid
METOP	Standard METOP NDVI product at 1 km resolution
PV/VGT	PV NDVI v. 2.1 is used for 2014, SPOT-VGT for the computation of the LTA
Anomaly	Difference $NDVI_i$ – $NDVI\_LTA_i$ (also called “absolute difference anomaly”)
LTA temporal range, Long Term Averages	2008-2013 for all sensors (based on length of the METOP time series)
Smoothing	All analysis has been performed with smoothed data. PV, VGT and METOP were smoothed at JRC with the Swets algorithm, eMODIS was smoothed at USGS using the Swets algorithm as well
Spatial resolution	1 km grid of METOP and PV. eMODIS 250 m is resampled on such grid
Seasonality	Temporal evolution of mean NDVI by country is shown in Annex I for METOP and PV just to have an idea of the seasonality in the area.

Table 1: Data and main preproccessing used in the analysis

Agreement evaluation

Visual inspection of anomalies

Annex II reports the anomaly maps for each dekad of 2014. PV anomalies appear to be in average significantly more positive in both amplitude and spatial extent than those of METOP and eMODIS. The METOP derived maps show large areas of strong negative differences in the tropical areas (mainly DRC) not visible in the other two products. On the contrary, PV often shows positive anomalies where the other two show negative values.
The differences among the products appear to increase along the year reaching a maximum in the period ranging from dekad 24 to 29. It is important to observe that during this period, the analyst would have drawn different conclusions about the status of vegetation.

Anomaly class agreement

In order to stress the differences between anomalies from an analyst point of view, the agreement was quantitatively evaluated using the anomaly classes of Table 2 and by computing the occurrence of the agreement classes reported in Table 3.

NDVI abs difference	Label	Colour
< - 0.125	large decrease	
- 0.125 : -0.05	small decrease	
-0.05 : 0.05	no change	
0.05 : 0.125	small increase	
> 0.125	large increase	

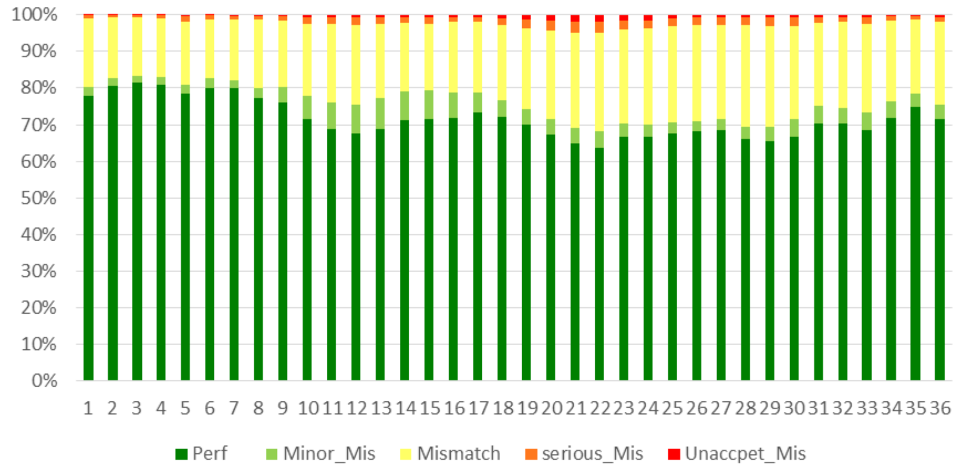
Table 2: Classification of absolute difference anomalies

Label	Condition
Unacceptable mismatch	sensors indicates anomaly with opposite sign ("increase" vs. "decrease", no matter the magnitude)
Serious mismatch	one sensor indicates "no change" and the other indicates "large" change (either "increase" or "decrease")
Mismatch	one sensor indicates "no change" and the other indicates "small" change (either "increase" or "decrease")
Minor mismatch	both sensors have the same sign of the anomaly ("increase" or "decrease") but different magnitude ("small" vs. "large")
Agreement	both sensors indicate in the same class

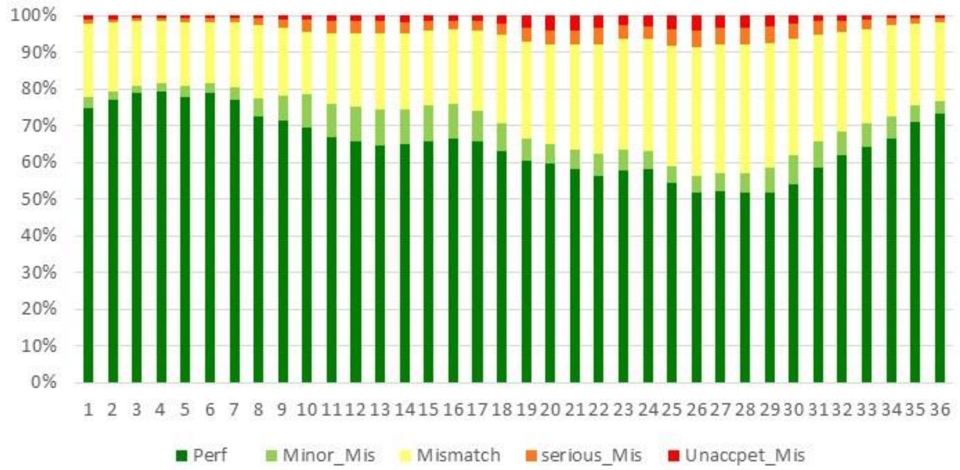
Table 3: Classification of agreement of anomaly classes

This classification was applied at all couples of NDVI anomalies (METOP vs. PV, METOP vs. eMODIS and eMODIS vs. PV) considering the pixels belonging to the vegetation mask. Results are reported in Table 4.

METOP vs. eMODIS



METOP vs. PV



eMODIS vs. PV

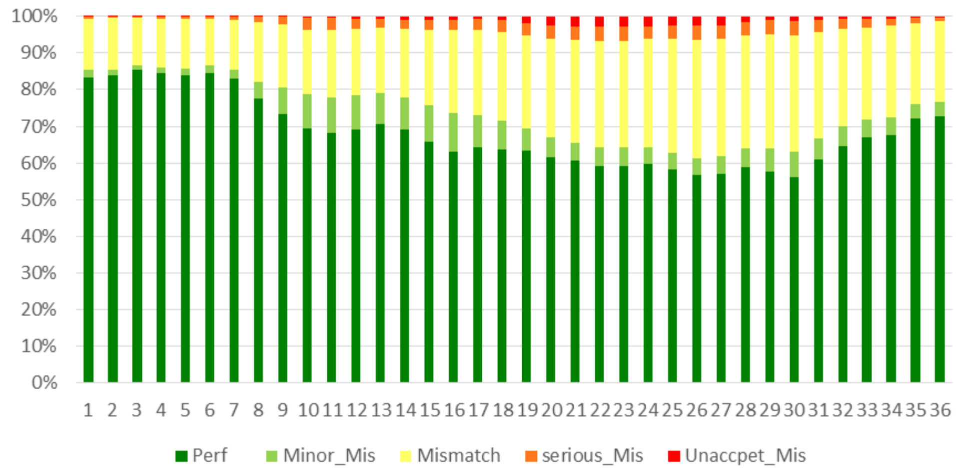


Table 4: Temporal evolution of the agreement among anomaly classes, year 2014

The agreement between METOP and PV appears to be the lowest of the three paired comparisons (METOP vs. PV, eMODIS vs. PV, METOP vs. eMODIS). When comparing PV with the two other instruments, a decrease of agreement is observed from dekad 8 to dekad 29-30 when the agreement increases again. During the period of lowest agreement (dekads 25-28), the total mismatch between anomaly classes is greater than 40% (47.5% and 42.3% with METOP and eMODIS, respectively). During the same period the total mismatch between METOP and eMODIS is 32.4%. By considering this temporal window and only the three classes representing the highest mismatch (i.e., “mismatch”, “serious” and “unacceptable mismatch”), the METOP-eMODIS shows a 29.3% mismatch whereas the couples METOP-PV and eMODIS-PV show 42.7 and 37.5% mismatch.

Anomaly scatterplot

We pooled all 36 dekads together and we analysed the overall agreement with a scatterplots of one instrument against the others. OLS (Ordinary Least Square) linear and GMRF (Geometric Mean Functional Relationship) regression models, the Agreement Coefficients (AC), the R^2, the agreement coefficient internally developed dfAC (Dominique Fasbender, personal communication), are used here to evaluate the relationships between sensors. In addition we performed the same analysis dekad by dekad and we reported the temporal evolution of the various agreement indicators.

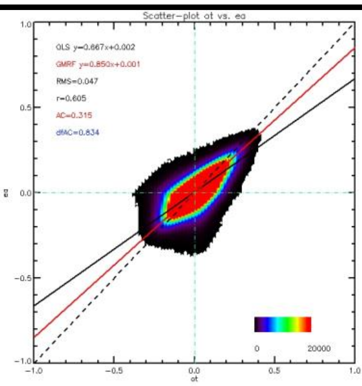
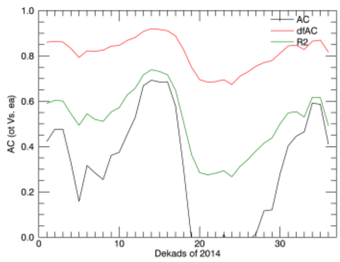
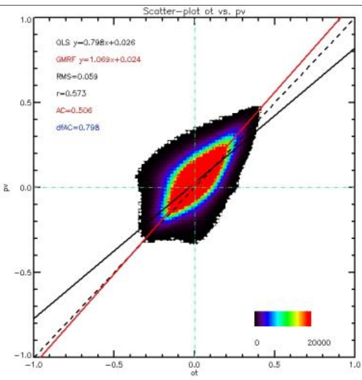
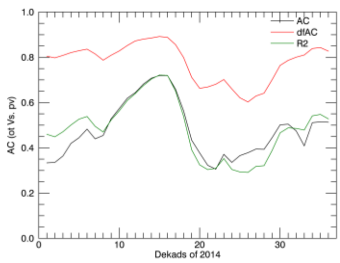
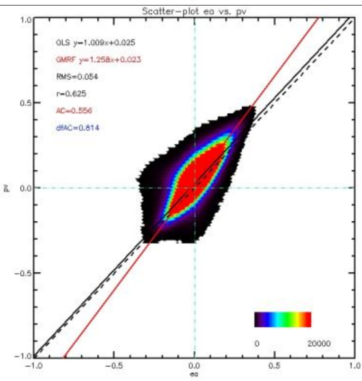
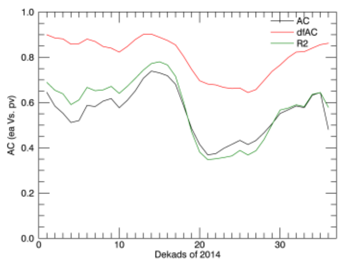
	Overall agreement	**Temporal evolution of agreement**
METOP vs. eMODIS		
METOP vs. PV		
eMODIS vs. PV		

Table 5: Scatterplot statistics

Although the agreement between eMODIS and PV is the highest according to the various agreement coefficient considered, this does not prevent the anomalies to provide different information. In fact, we expect the anomalies not only to be well correlated but we require that they do agree on the sign and magnitude.
In fact, let us focus on the cases where a pair of instruments indicates opposite anomalies: one is positive and the other negative. This condition is met by the data points falling in the first and third quadrants of the scatterplots. Table 6 reports the percentages of such occurrences (first column). Table 6 reports, in case of disagreement on the sign of the anomaly, the percentages of cases having the first instrument indicating a positive (and the second a negative one), and the other way around (column two and three). Note that this exercise is rather general as the values of a pixel can disagree on the sign even if they are very close to zero. The reader interested in the % of cases where the values are diverging in sign and with a magnitude greater than 0.1 may refer to Table 4.

	% of pixel with anomaly of opposite sign (% of total number of points)	**% of pixel where X anomaly is + and Y is – (% of pixels having opposite sign)**	**% of pixel where X anomaly is - and Y is + (% of pixels having opposite sign)**
METOP (X) vs. eMODIS (Y)	14.75	48.59	51.41
METOP (X) vs. **PV (Y)**	17.32	18.38	**81.61**
eMODIS (X) vs. **PV (Y)**	14.50	15.96	**84.04**

Table 6: Analysis of the sign of the anomalies

Table 6 shows that the percentage of complete sign disagreement (first column) is comparable among sensors. However, the disagreement appears to be evenly distributed in the two possible cases (first sensor positive and the other negative and the other way around) only for the couple METOP - eMODIS. When PV is one of the sensors of the comparison, the great majority of disagreement cases are represented by PV showing a positive anomaly and the other sensor a negative one. From the analyst point of view, this is an indication that when the anomaly of PV does not agree with that of one of the other sensors, it delivers preferentially an "optimistic" evaluation of vegetation status. In these conditions (see also the anomaly quick-looks for these dekads) the analyst would actually draw seriously different conclusions on vegetation status depending on the data source used.

Decomposition of anomaly into current and LTA NDVI

In order to investigate the possible origin of the observed differences in the anomalies, Table 7 reports the scatterplot of the smoothed NDVIs. The agreement between paired NDVIs is maximum for the couple eMODIS-PV and is anyhow comparable for the three couples. However, it can be observed that PV overestimates the NDVI value as compared to eMODIS (mean bias PV-eMODIS = 0.03).

METOP vs eMODIS	METOP vs PV	eMODIS vs PV

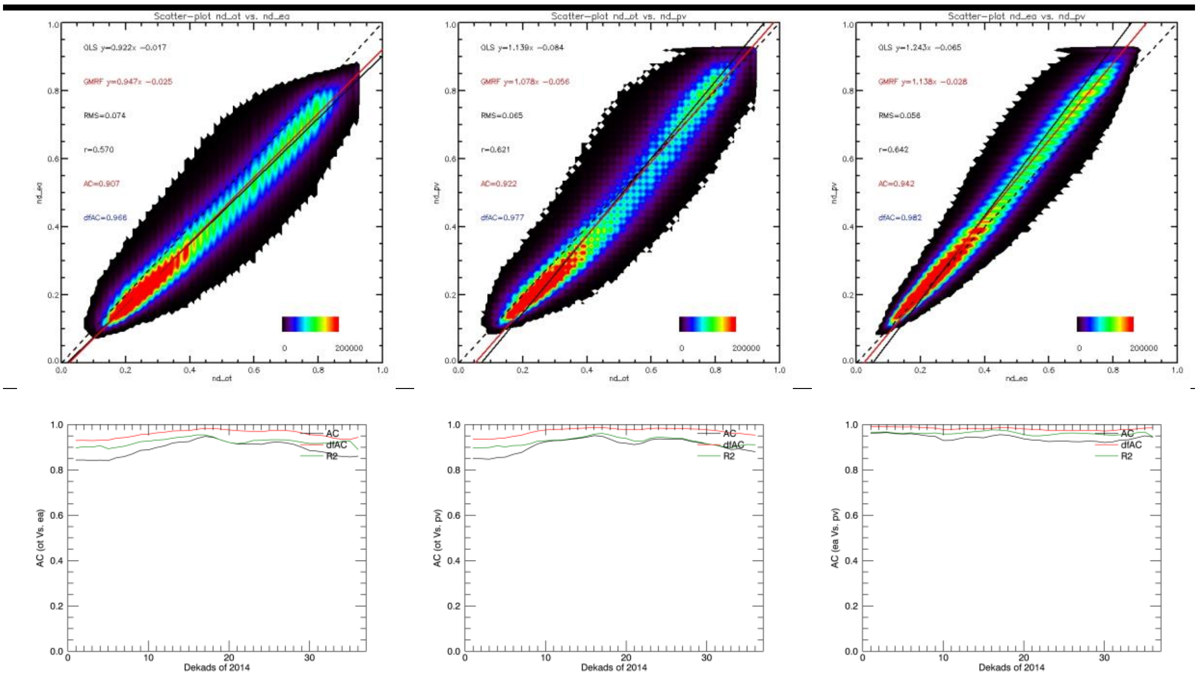


Table 7: 2014 NDVI scatterplots

When PV anomalies are computed, the use of the LTA from VGT is likely to amplify such differences. Table 8 reports the scatterplots of the LTA NDVI (36 dekads) between the various sensors. For instance, when comparing PV with eMODIS we observed a general overestimation of anomalies by PV (Table 5 and Table 6). By inspecting NRT NDVI and LTA scatterplots (Table 7 and Table 8) we observed that this is likely to be originated by a NRT PV NDVI that is generally higher (above the 1:1 line) than that of eMODIS whereas the PV LTA NDVI is aligned with that of eMODIS.

METOP vs eMODIS	METOP vs PV	eMODIS vs PV

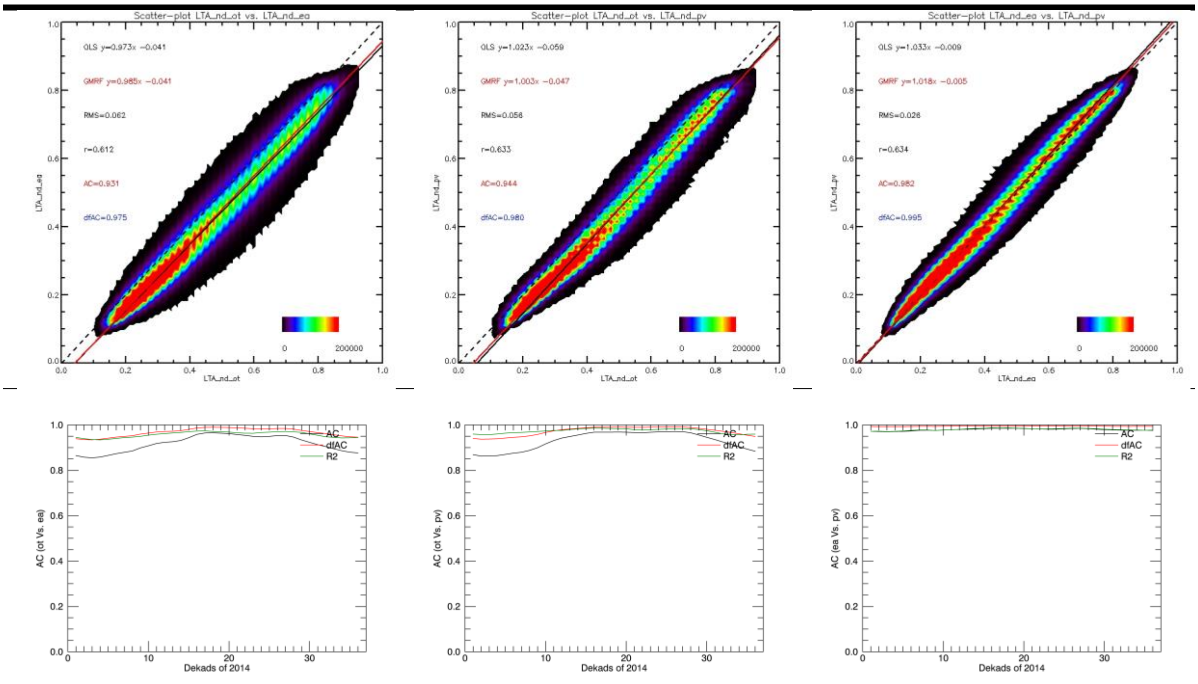
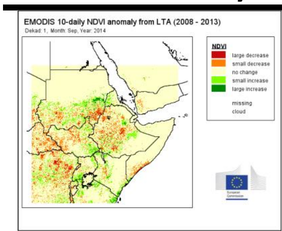
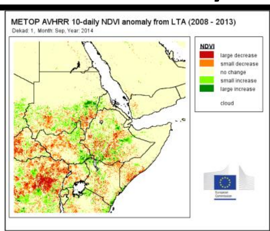
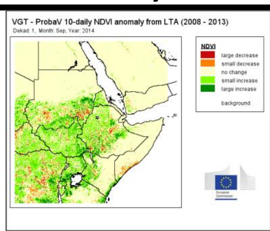
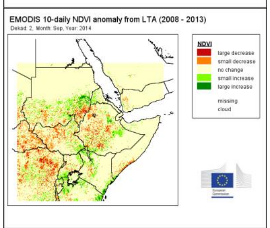
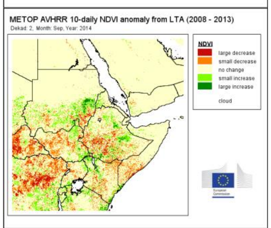
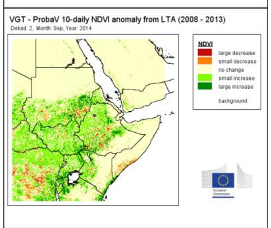
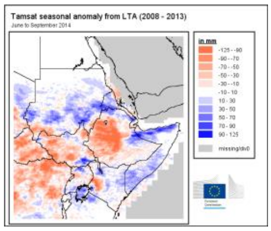
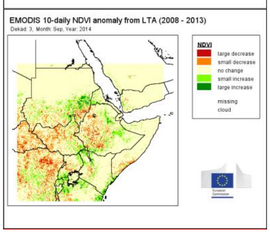
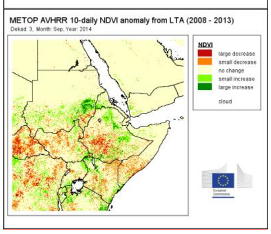
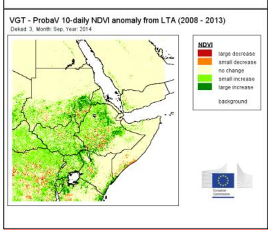
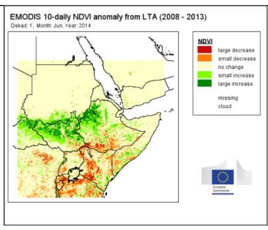
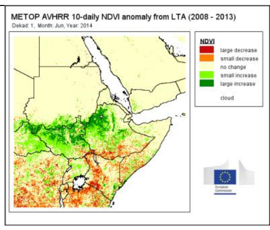
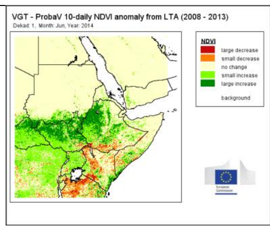
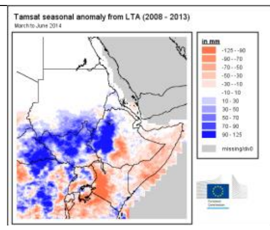


Table 8: LTA NDVI scatterplots

Comparison with rainfall anomalies

In order to confirm the information provided by the NDVI, analysts often compare NDVI anomalies with the anomalies of cumulated rainfall estimates. The assumptions behind this approach are: *i)* rainfall estimates are accurate enough, and *ii)* an NDVI positive or negative anomalies should temporally follow (with some delay) a surplus (up to a defined extent) or a deficit of precipitation, respectively. We followed as similar approach to qualitatively evaluate which NDVI anomalies were in agreement with rainfall estimates. That is, relevant cumulative values of TAMSAT rainfall estimates were visually compared to NDVI anomalies from the various sources in an attempt to further test the differences by comparing them to an independent data source. Three temporal windows were used for cumulating rainfall: June-September for the comparison in the mono-modal areas, March-June and September-December for the comparison in the bimodal areas. In Table 9, such anomalies were compared to the three dekadal anomalies corresponding to the last month used for the accumulation of rainfall.

	eMODIS anomaly	**METOP anomaly**	**PV anomaly**	**Rainfall anomaly**
25				
26				
27				
16				

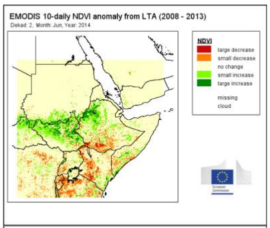
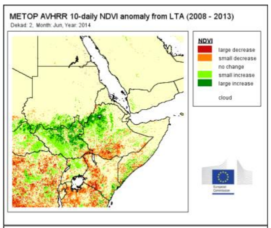
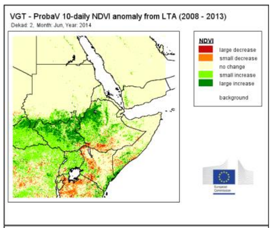
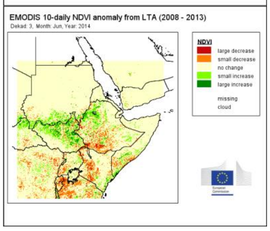
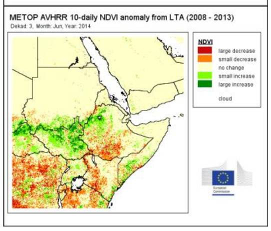
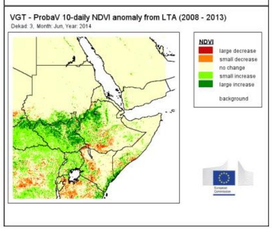
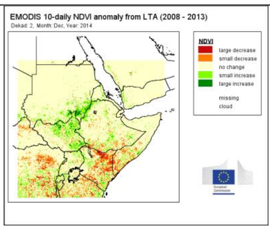
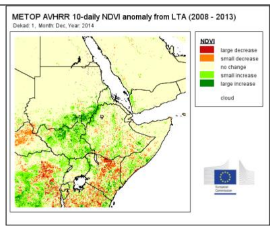
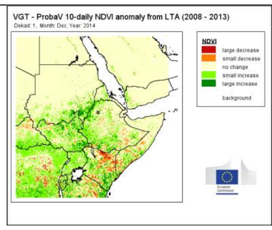
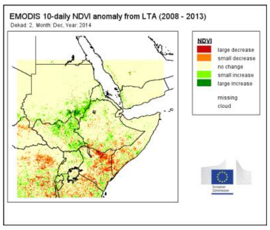
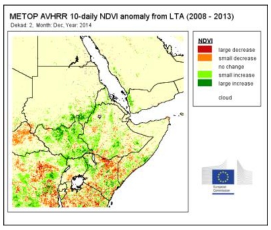
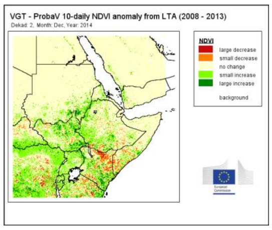
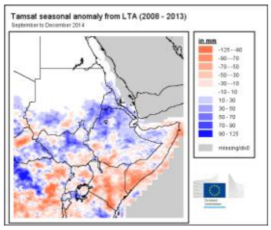
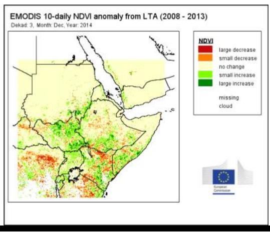
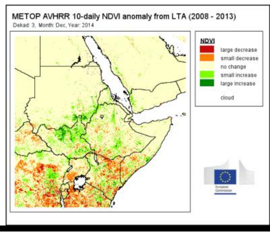
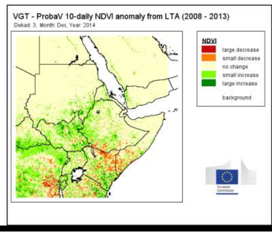
17				
18				
34				
35				
36				

Table 9: Comparison between NDVI (eMODIS, METOP, PV) and rainfall anomalies (TAMSAT), first column refers to dekad number.

In the comparison referring to the three dekads of September (dekads 25, 26 and 27 for NDVI; period June-September for rainfall) and falling in the period of lowest agreement between NDVI anomalies, rainfall anomalies agree to a greater extent with NDVI anomalies of eMODIS and METOP, while the correspondence with PV anomaly is reduced. Contrarily to the other two, PV shows a positive NDVI anomaly over large areas of negative rainfall anomaly in Ethiopia, South Sudan, Central African Republic and DRC.

By looking at the agreement in the other two periods (March-June and September-December) it is possible to note that the agreement between eMODIS and METOP on the one hand and PV on the other follows that reported in Table 4: still low in June and improving again in December.

VGT agreement during year 2013

In order to confirm that the observed problem is related to the use of PV for the NRT data (and the VGT for the LTA), we checked the agreement among the NDVI anomalies from the three sensors in 2013, thus using VGT data only for both NRT and LTA.

Comparing Table 10 with Table 4 it is possible to observe that the agreement between PV and METOP or eMODIS is reduced compared to the agreement between VGT and the METOP or eMODIS. For instance, when comparing PV and VGT to eMODIS, all the disagreement categories represent in average over the year the 31.8% (peak at 43.9%) in case of PV and 19.3% (peak at 28.2 %) in case of VGT. The occurrence of the last two classes (serious + unacceptable mismatch) is also increased when using PV instead of VGT in the comparison with eMODIS: PV average = 3.62% and peak = 6.71%, VGT average = 0.80% and peak = 2.27%.

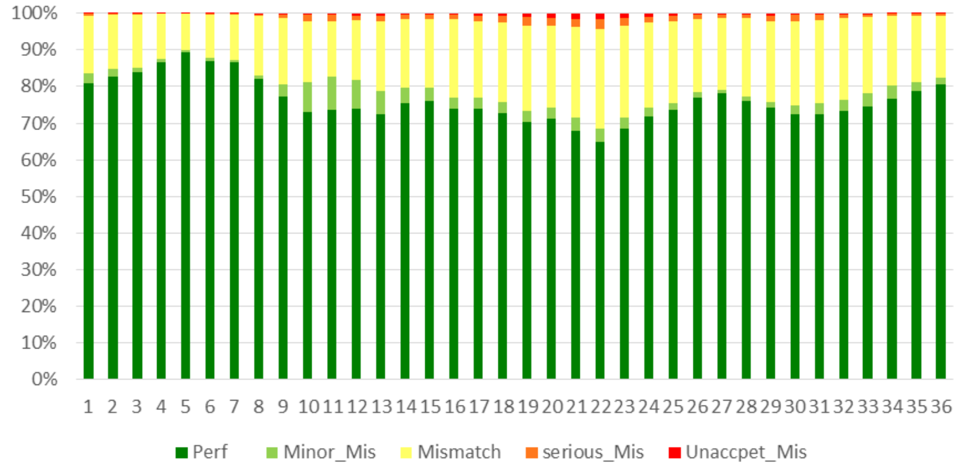
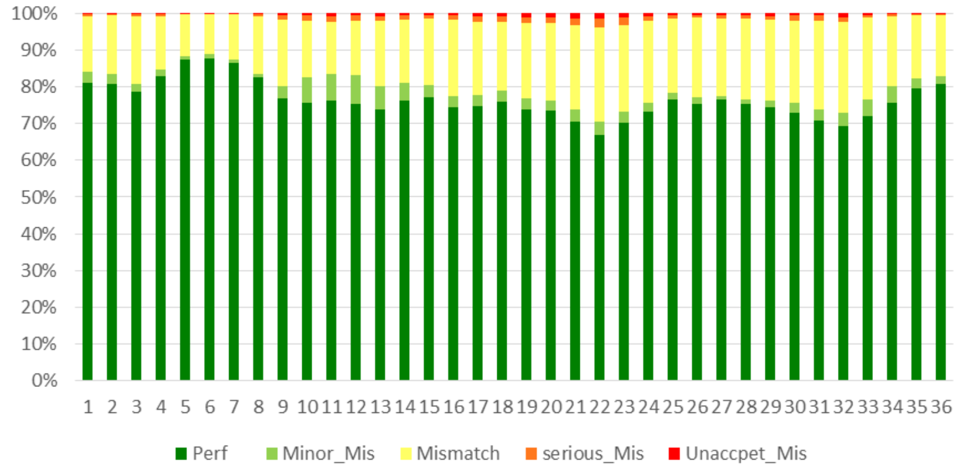
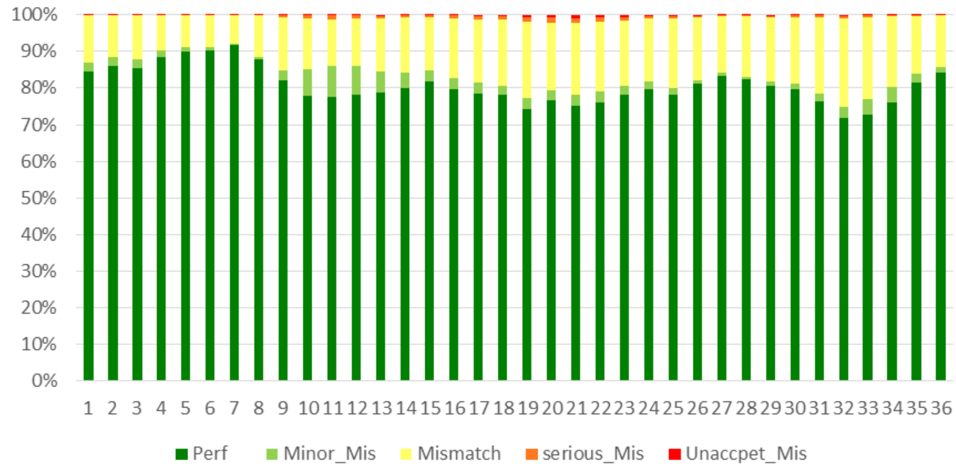
METOP vs. eMODIS	
METOP vs. VGT	
eMODIS vs. VGT	

Table 10: Temporal evolution of the agreement among anomaly classes, year 2013

Conclusions

We found large disagreement (up to more than 40% according to the proposed classification scheme) between NDVI anomaly derived from PV the one hand, and METOP or eMODIS on the other hand. The disagreement between METOP and eMODIS is lower and normally within 30%. The analysis also shows that in case of disagreement, the difference between paired anomalies is biased when PV is compared with one of the other two sensors. That is, when PV and one of the two sensors do not agree on the sign of the anomaly, it is PV indicating a positive anomaly and the other sensor a negative one in 80% of the cases.

Visual inspection of anomalies support these findings and highlight the fact that this agreement has indeed operational implications. That is, PV appears to deliver a contrasting information regarding vegetation status as compared to METOP and eMODIS, especially in some specific dekads (e.g., dekads 25 to 28).

Performing the same comparison for the year 2013 when NDVI data were provided by VGT instead of PV, we confirm that major differences among the three sensors were not present and we corroborate the hypothesis that the cause of the problem is related to the use of PV NRT data with VGT LTA data to compute the anomalies.

Finally, rainfall estimates time series of 2014 were used as an additional and qualitative check for the observed differences. The visual inspection of rainfall anomalies suggests that the anomalies shown by PV are generally too positive while METOP and eMODIS are showing a better convergence with the rainfall estimates.

Looking at the agreement over time one is tempted to think that a temporal pattern or a seasonality does exists, with the agreement of METOP and eMODIS with PV being progressively reduced along the year, reaching a minimum around dekads 25-28 and then increasing again. We thought about the possible problem of the incorrect Sun-Earth distance in VGT archive (and thus in the LTA used to compute PV anomalies), however the temporal pattern of the agreement does not match that expected because of this incorrect modelling. In fact, the impact of this error should be maximum around DOY 190 (http://www.vgt.vito.be/pdf/Reflectance_communication_letter_V1.0.pdf) while we observe the lowest agreement later on in the year. Also, because the differences are strongest after dekad 25 we assume that these differences are not visible or underestimated in the SPOT VGT/PROBA V intercalibration period from October 2013 to May 2014.

The results of this preliminary comparison call for further analysis to understand the cause of the observed temporal degradation of the agreement between the PV anomalies and those of other comparable sensors (METOP and eMODIS). Also it is not known at the moment whether this situation is specific for the East African window or if similar patterns can also be observed in other regions of the world.

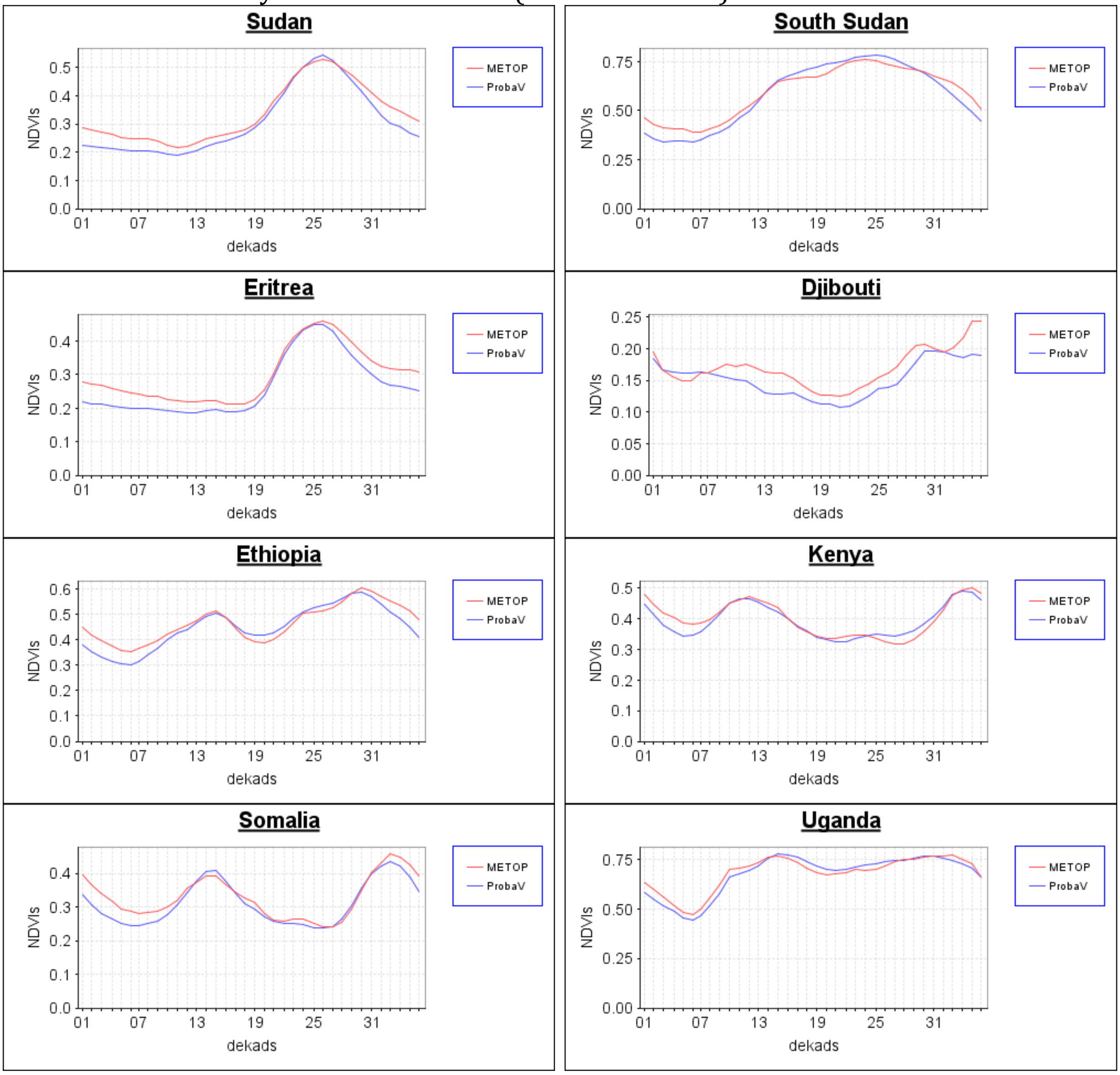
Before this clarification is made and corrective actions are taken, we recommend to follow a conservative approach and use eMODIS or METOP for the operational monitoring of FOODSEC using NDVI anomalies.

References

Meroni, M., Verstraete, M.M., Rembold, F., Urbano, F., Kayitakire, F. (2014), A phenology-based method to derive biomass production anomaly for food security monitoring in the Horn of Africa. International Journal of Remote Sensing, 37, 7, 2472-2492.

Annex I

Seasonal evolution by selected countries (under the mask)



Annex II

Anomaly maps

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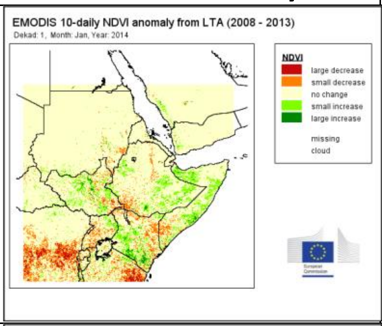
<td>
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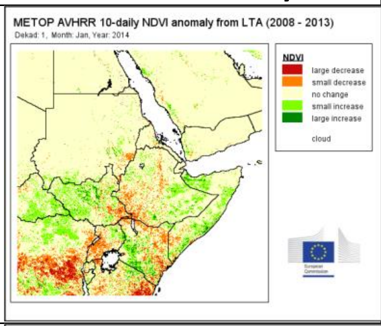
<td>
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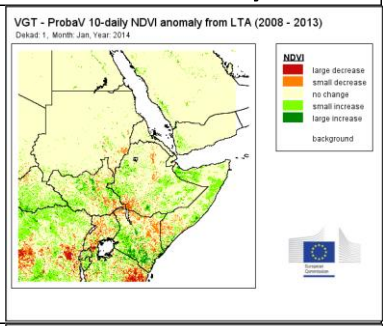
<td>
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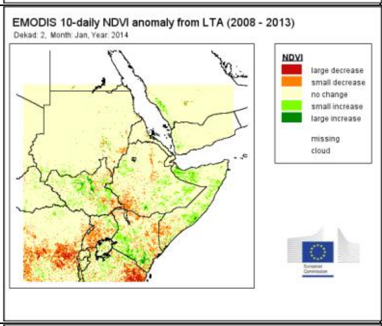
<td>
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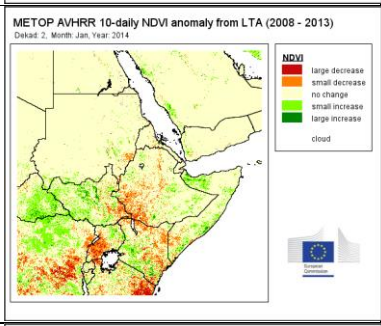
<td>
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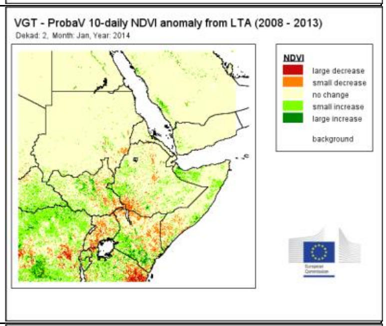
<td>
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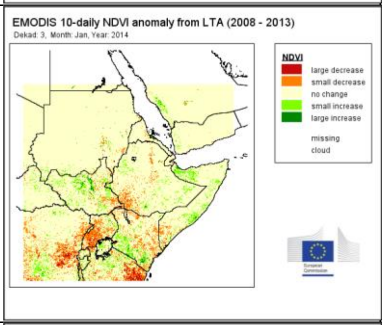
<td>
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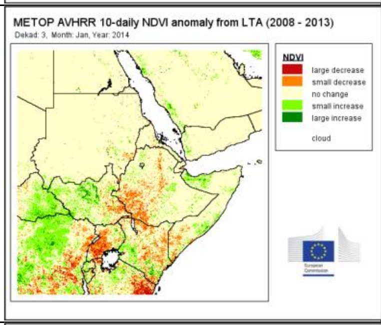
<td>
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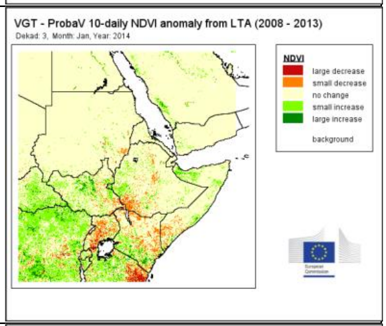
<td>
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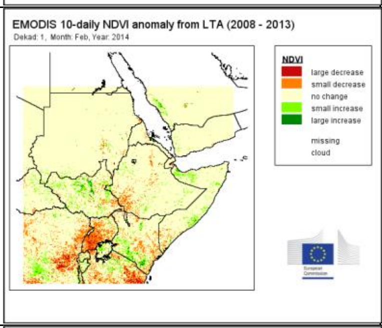
<td>
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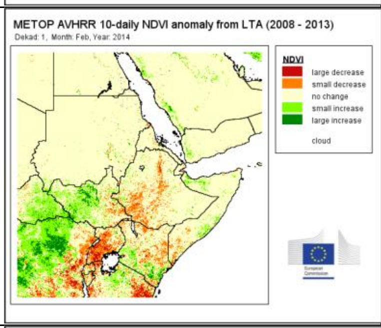
<td>
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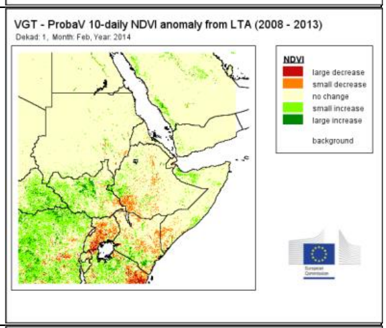
<td>
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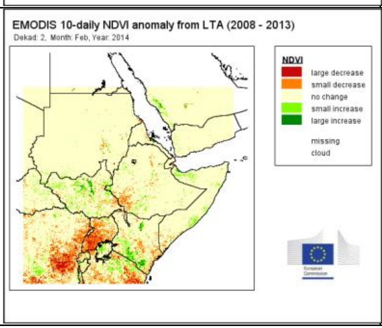
<td>
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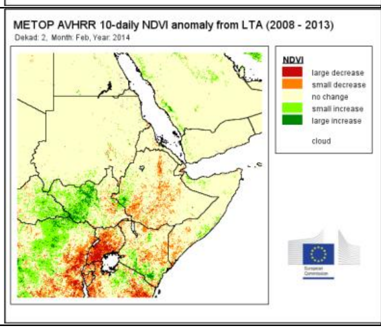
<td>
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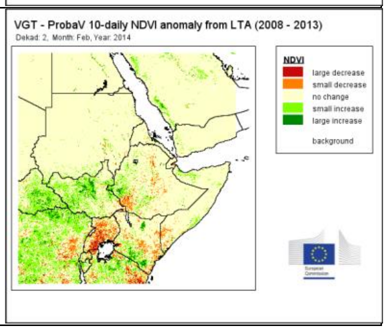
<td>
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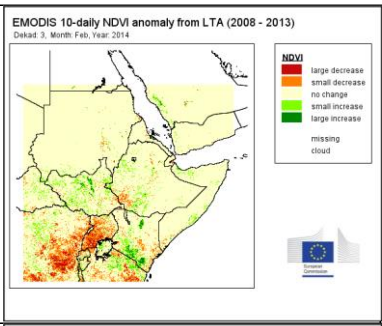
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small decrease
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small increase
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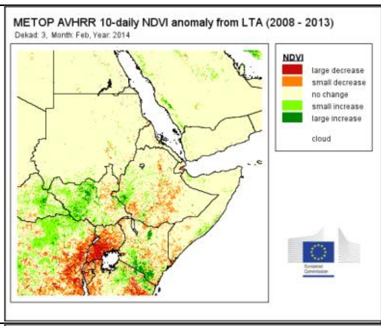
missing
cloud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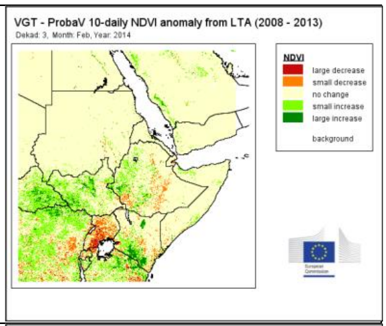
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
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NDVI
large decrease
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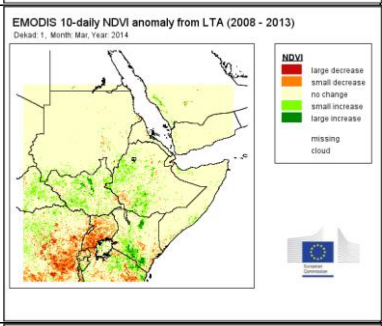
no change
small increase
large increase
background

7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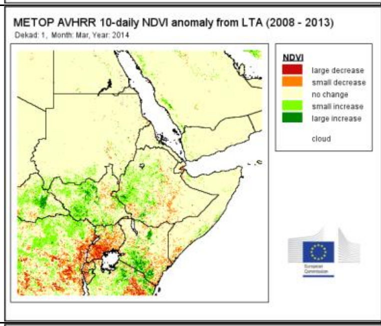
cloud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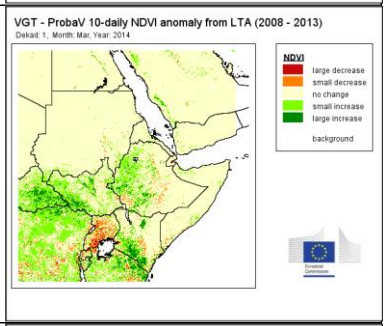
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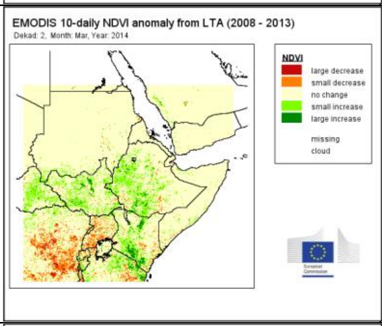
large increase
background

8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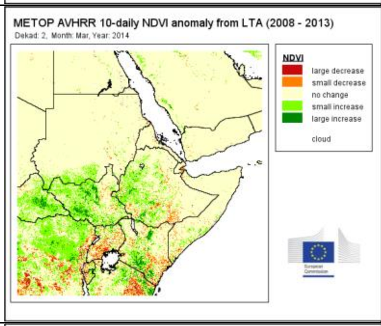
cloud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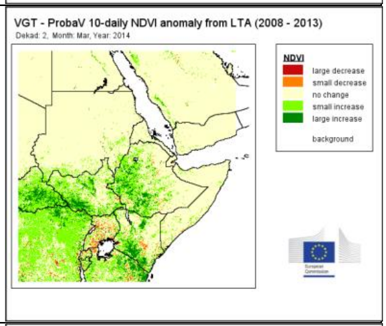
cloud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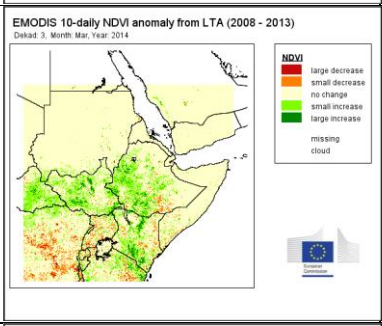
small increase
large increase
background

9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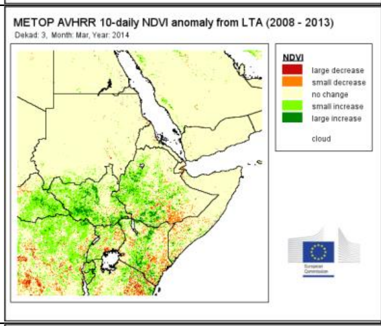
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small increase
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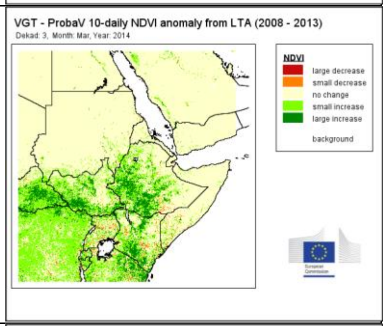
cloud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background

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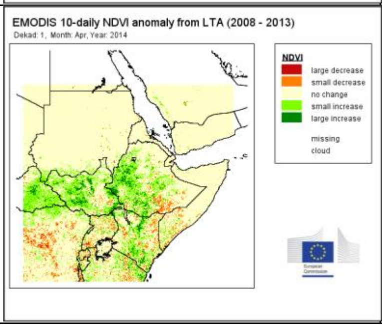
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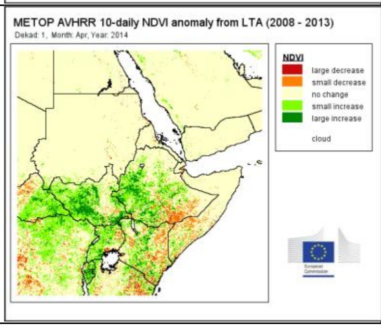
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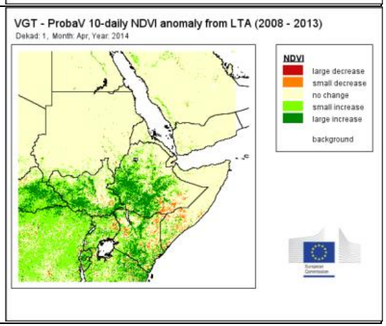
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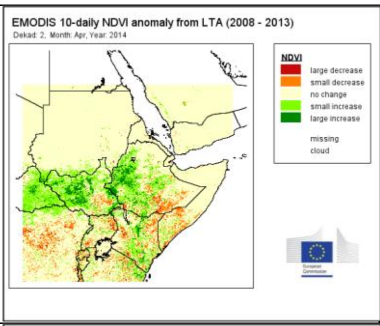
11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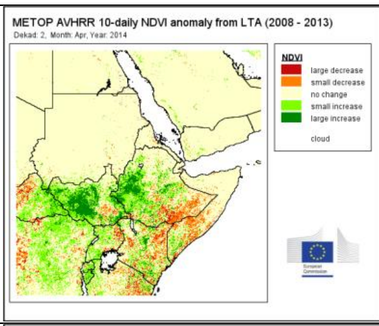
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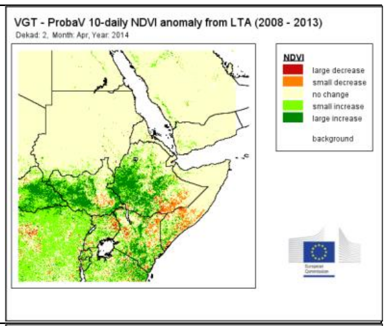
cloud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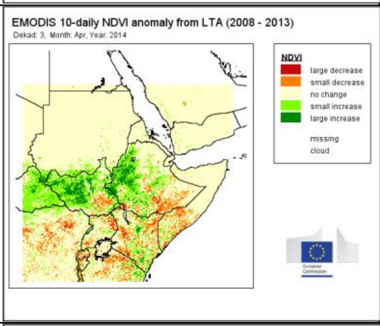
background

12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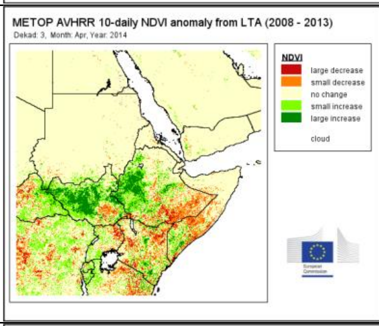
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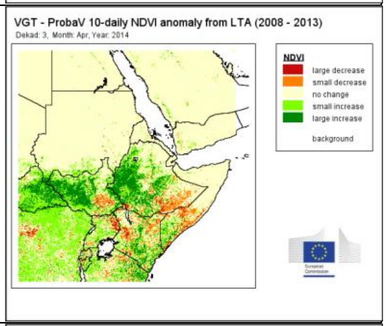
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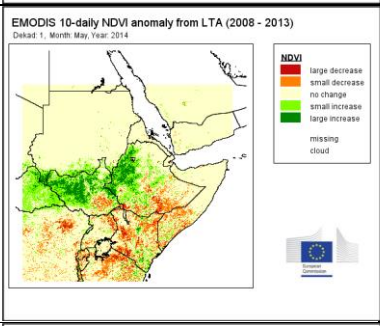
large increase
background

13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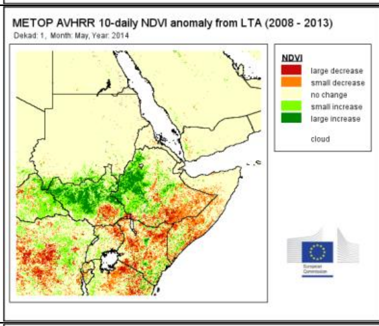
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NDVI
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small decrease
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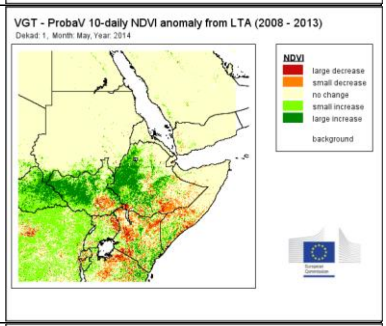
small increase
large increase
cloud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NDVI
large decrease
small decrease
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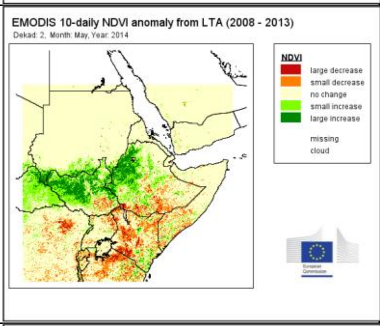
small increase
large increase
background

14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NDVI
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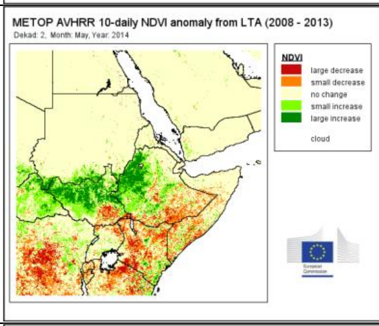
no change
small increase
large increase
missing
cloud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NDVI
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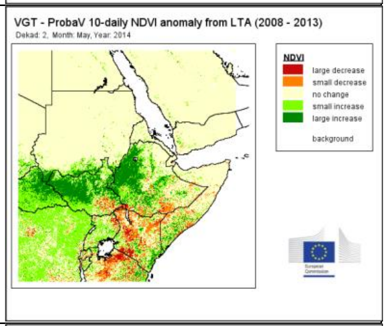
no change
small increase
large increase
cloud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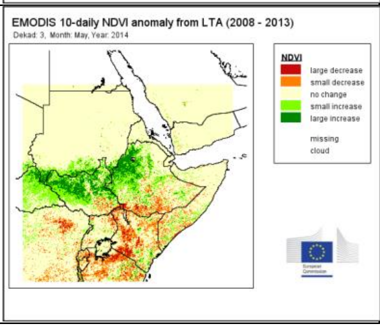
large increase
background

15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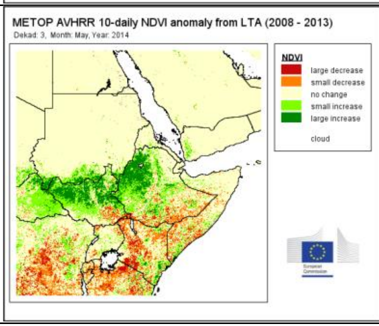
small increase
large increase
missing
cloud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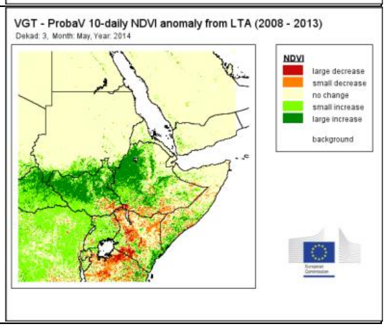
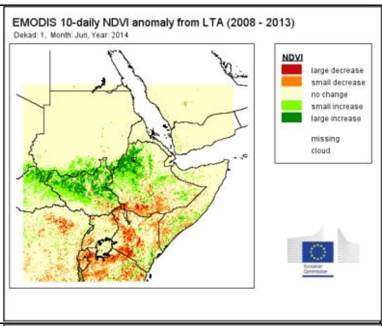
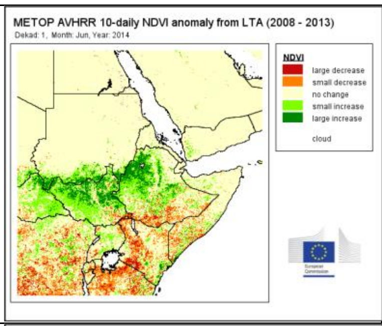
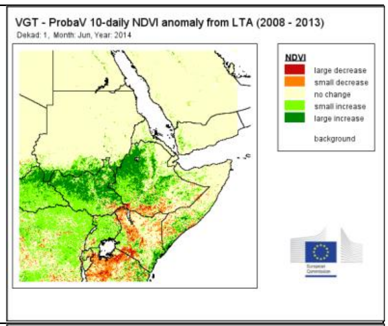
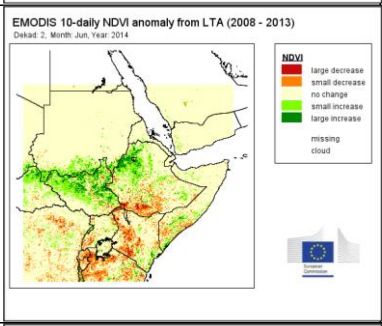
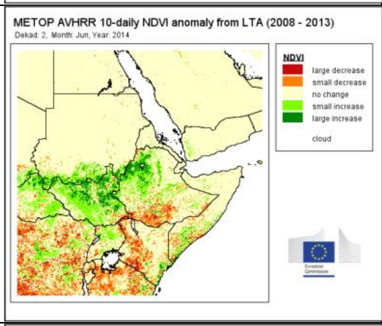
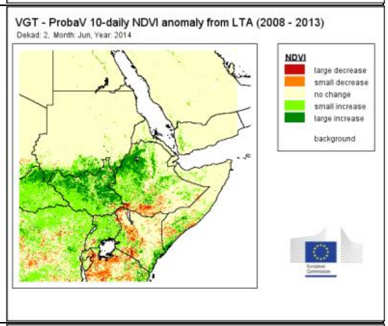
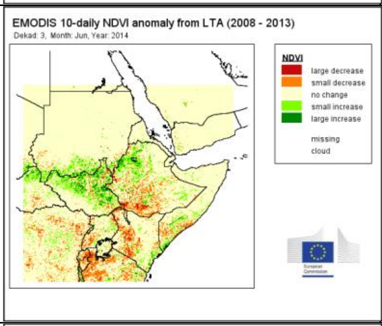
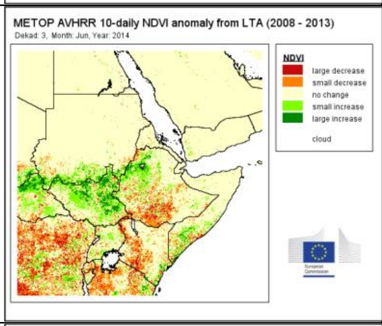
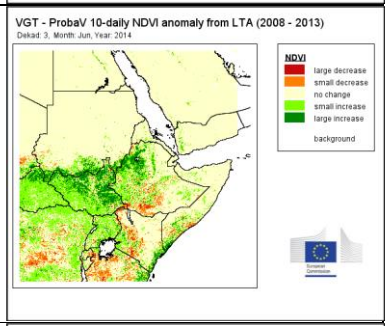
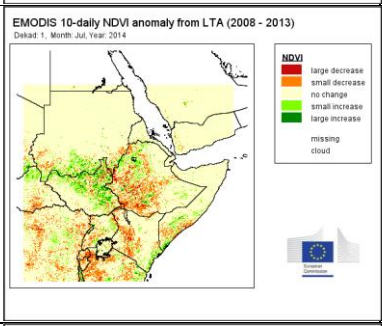
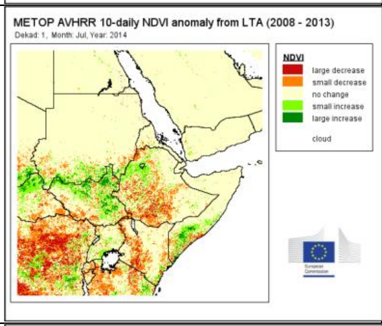
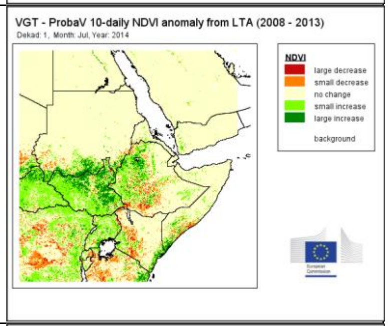
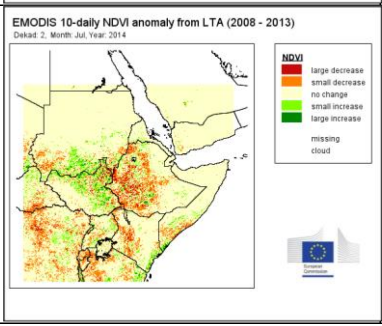
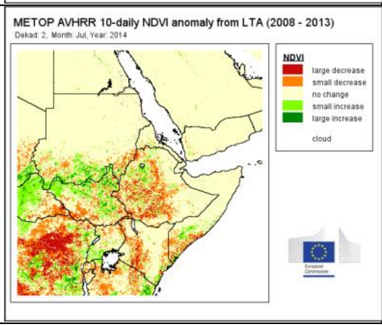
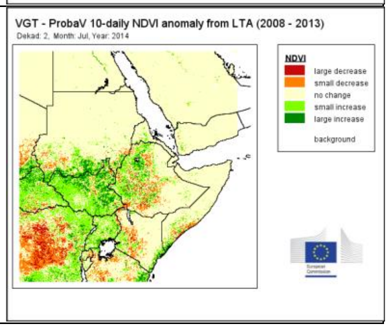
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: May, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

	EMODIS	METOP AVHRR	VGT - ProbaV
16			
17			
18			
19			
20			

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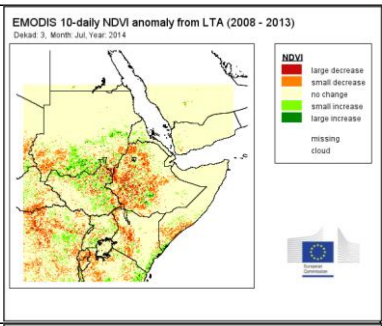
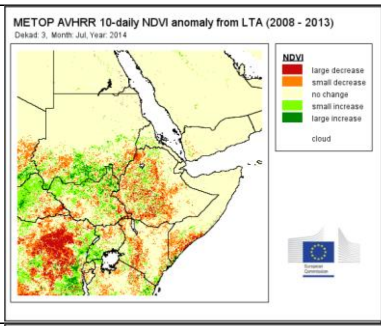
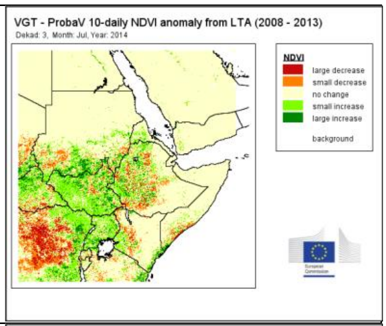
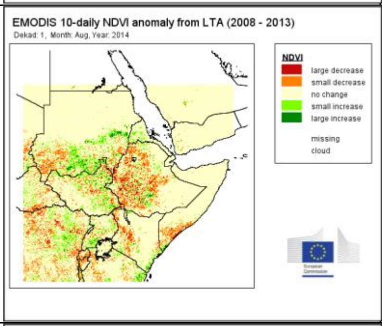
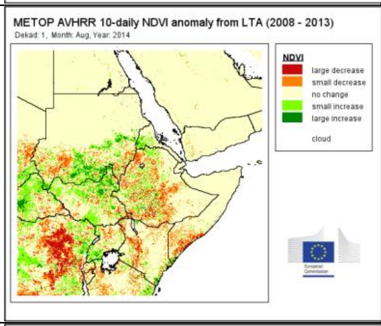

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Jul, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

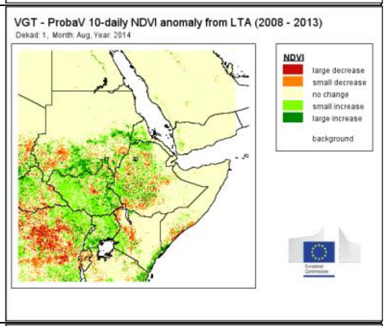

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Jul, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Jul, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

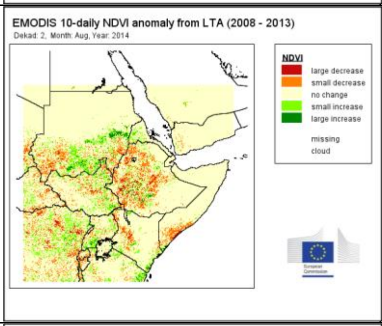
22

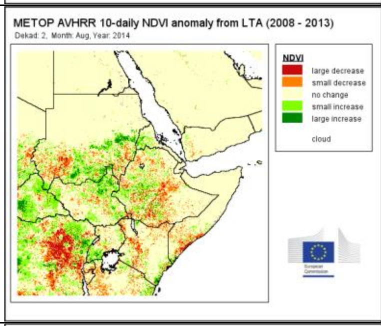

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

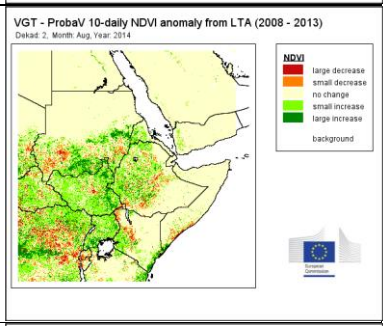

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

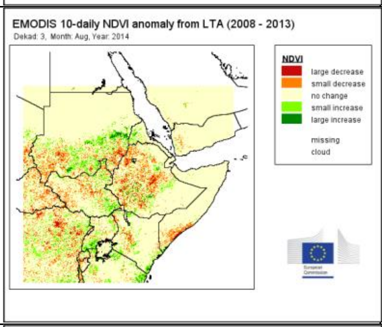
23

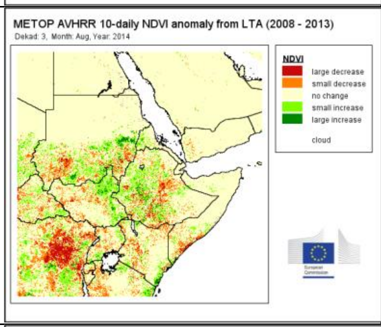

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

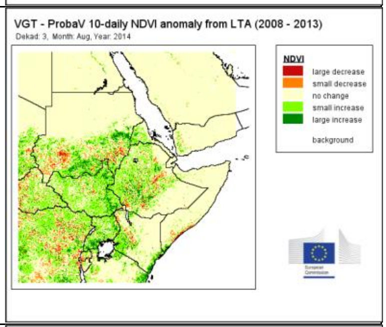

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

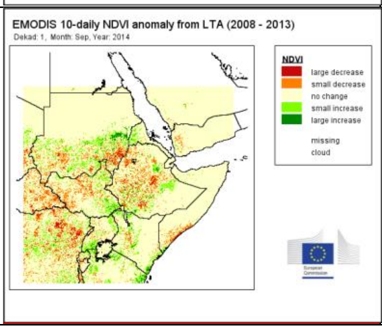
24

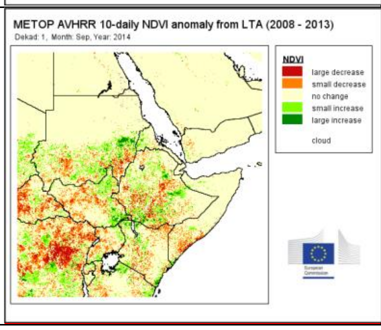

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

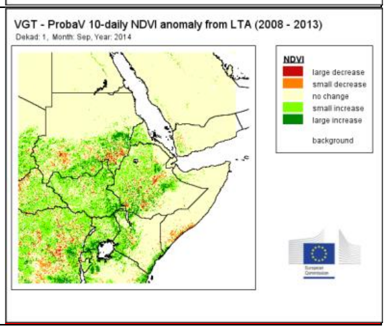

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Aug, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

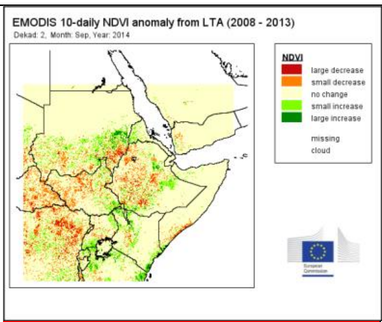
25

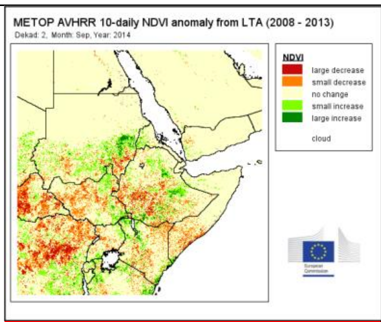

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

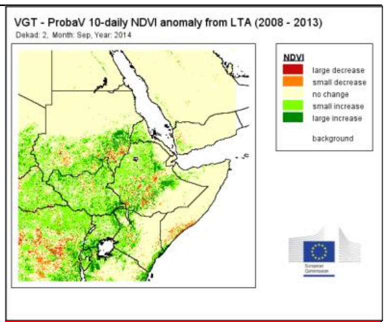

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

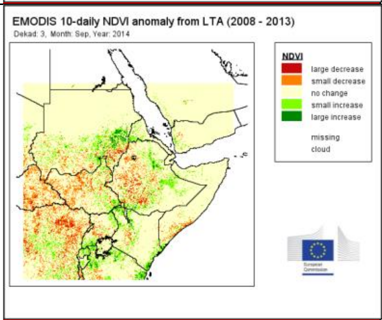
26

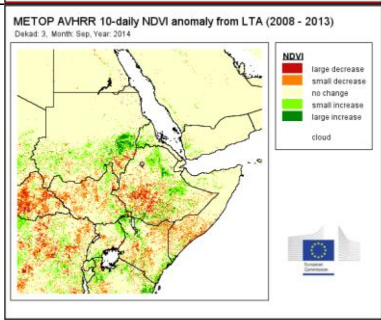

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

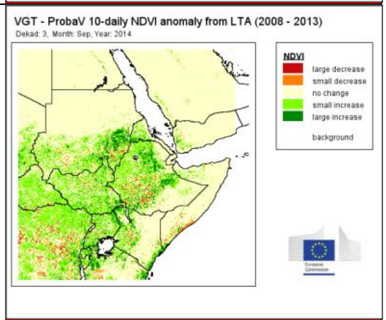

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

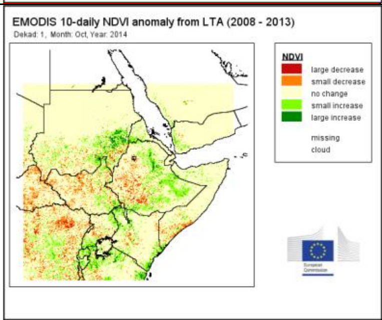
27

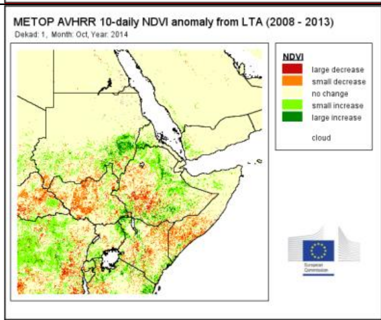

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

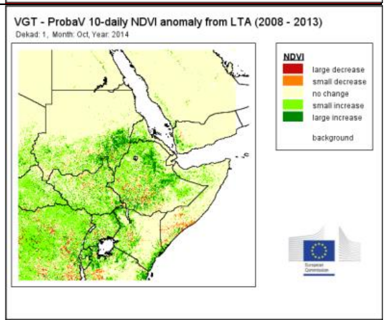

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Sep, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

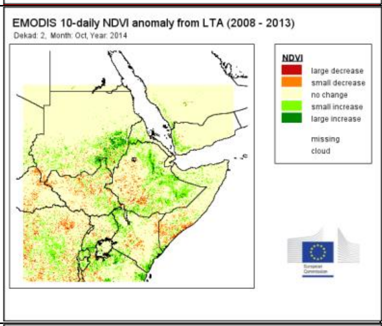
28

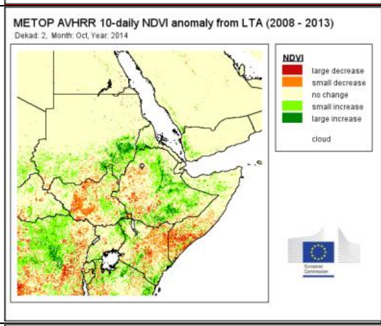

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

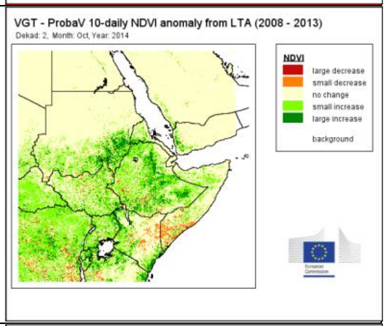

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 1, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

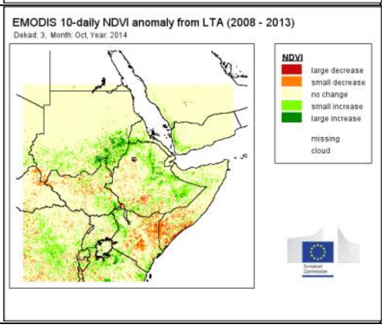
29

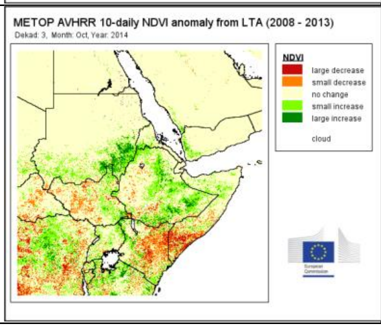

EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud

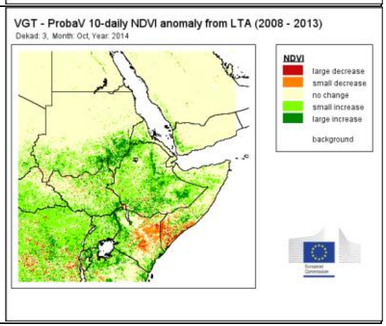

METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud

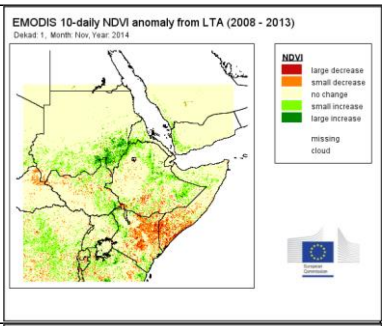
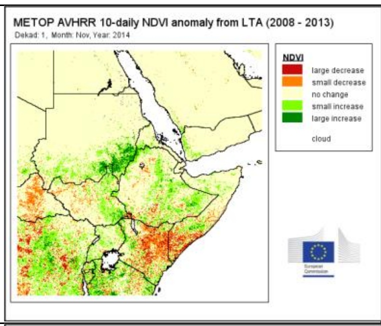
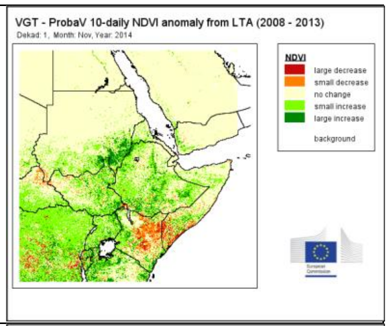
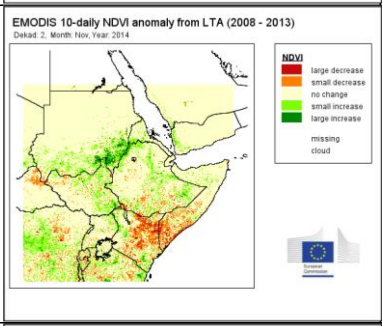
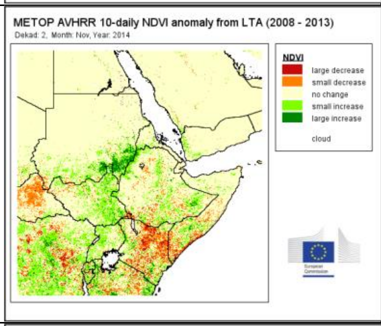
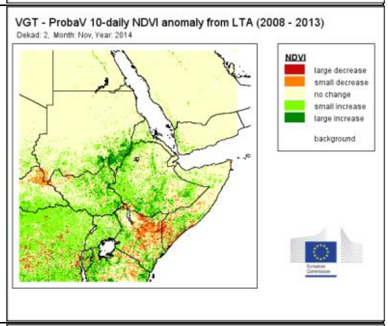
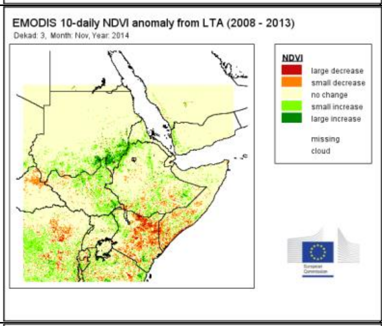
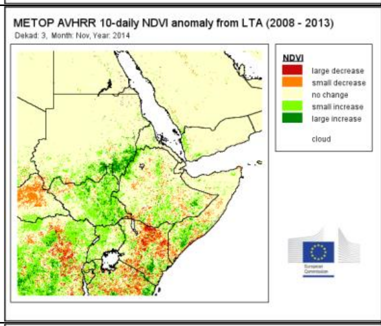
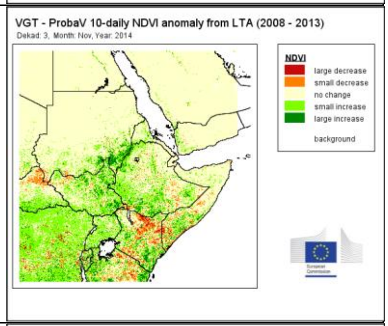
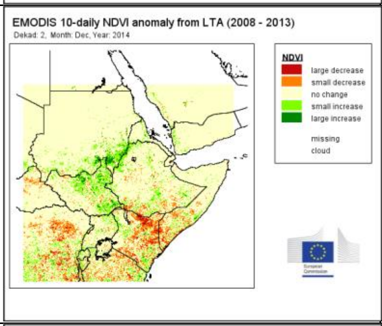
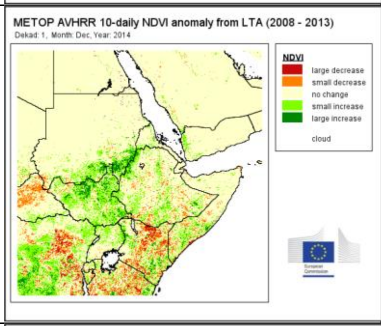
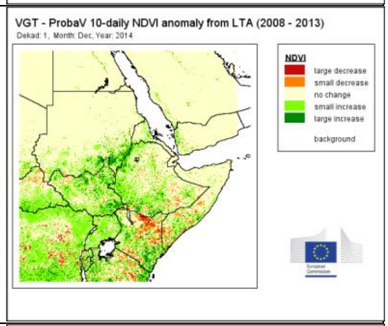
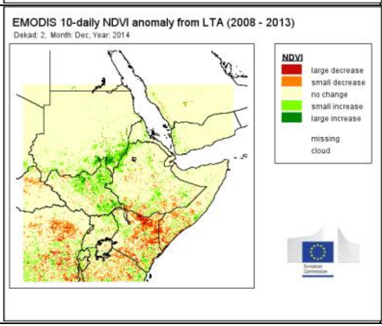
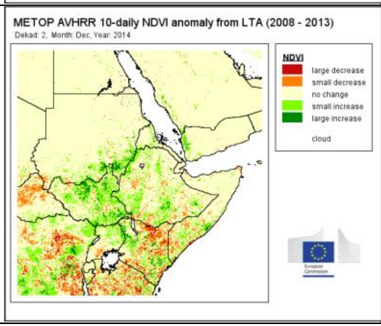
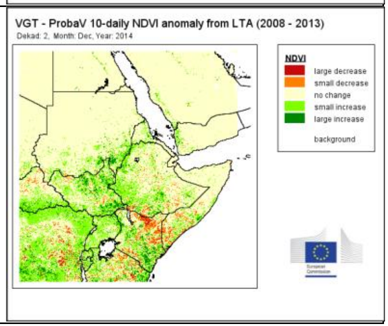

VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 2, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

30


EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
missing
cloud


METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
cloud


VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013)
Dekad: 3, Month: Oct, Year: 2014
NDVI
large decrease
small decrease
no change
small increase
large increase
background

31		EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 1, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase missing cloud	METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 1, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase cloud	VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 1, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase background
32		EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase missing cloud	METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase cloud	VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase background
33		EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 3, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase missing cloud	METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 3, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase cloud	VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 3, Month: Nov, Year: 2014 NDVI large decrease small decrease no change small increase large increase background
34		EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Dec, Year: 2014 NDVI large decrease small decrease no change small increase large increase missing cloud	METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 1, Month: Dec, Year: 2014 NDVI large decrease small decrease no change small increase large increase cloud	VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 1, Month: Dec, Year: 2014 NDVI large decrease small decrease no change small increase large increase background
35		EMODIS 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Dec, Year: 2014 NDVI large decrease small decrease no change small increase large increase missing cloud	METOP AVHRR 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Dec, Year: 2014 NDVI large decrease small decrease no change small increase large increase cloud	VGT - ProbaV 10-daily NDVI anomaly from LTA (2008 - 2013) Dekad: 2, Month: Dec, Year: 2014 NDVI large decrease small decrease no change small increase large increase background

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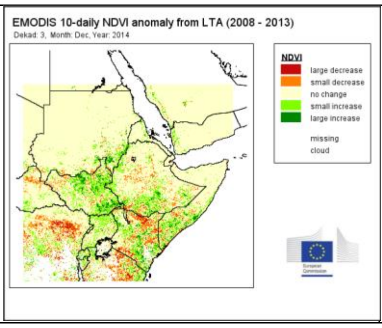
<td>
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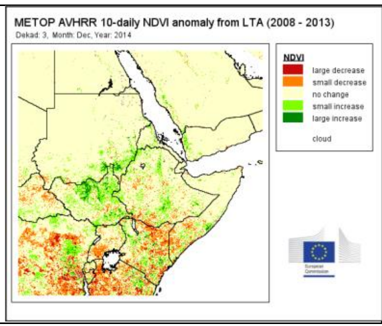
<td>
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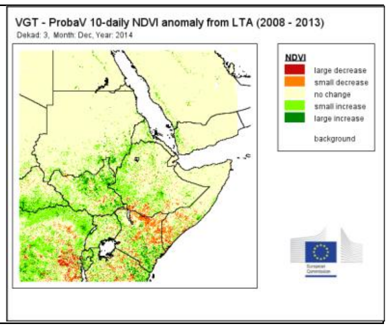
<td>
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