SPECIAL FOCUS – August 2021

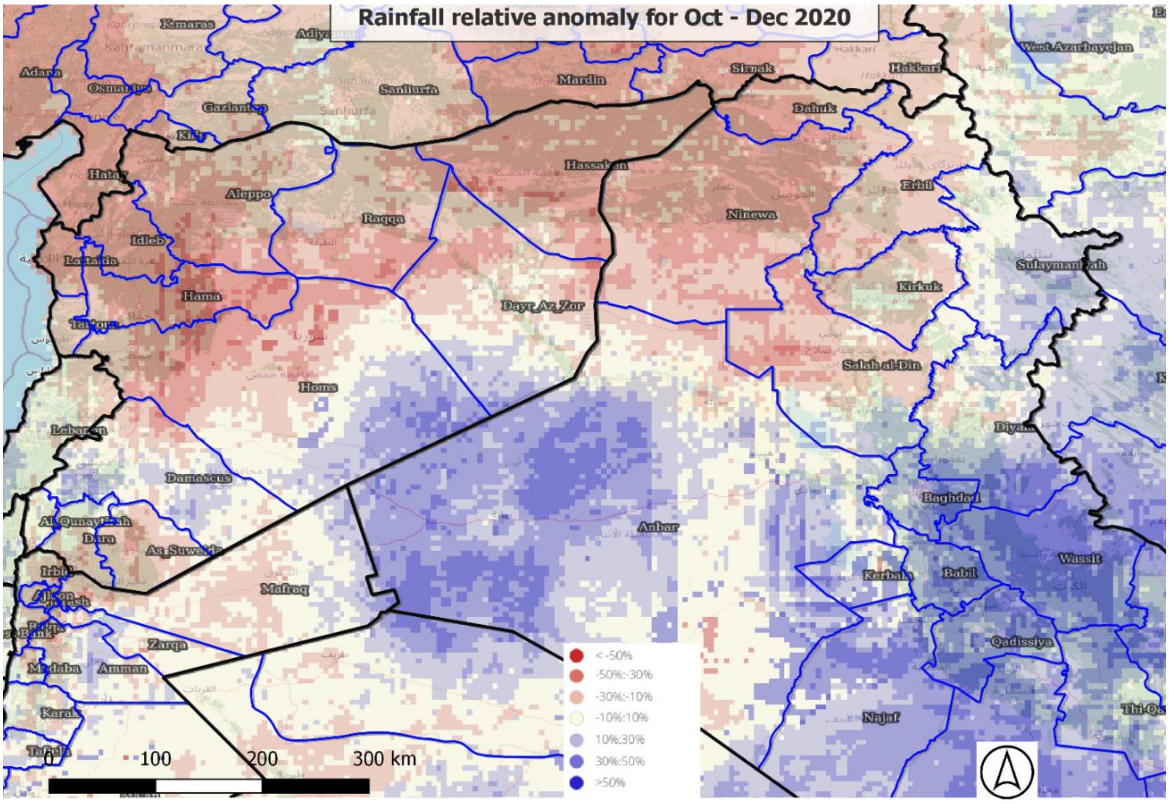
Failed winter crops in northern Syria and Iraq

The 2020-2021 season has been a failure for rainfed winter cereals in northern Syria and northern Iraq, particularly in Hassakeh and Ninewa, the most productive regions of Syria and Iraq, respectively. Instead, crops prospects are average to favourable in the southern halves of both countries, although conflict and economic downturn are expected to reduce yields in Syria.

According to CHIRPS rainfall estimates, the 2020-21 winter cereals season started with a moderate rainfall deficit with respect to the normal (deficit about 33%) for the period October-December in northern Syria and Iraq (*Figure 1*- top). This deficit reached 50% for the period spanning November 11th to December 10th, and 60% for December 20th-January 10th, at the time of cereals emergence. Despite close to average rainfall from January 10th to end-March (Hassakeh and Ninewa received ca. 95% of their average rainfall for these 8 dekads), and mild temperatures since mid-December (*Figure 3* and Hassakeh graphs in annex), crop biomass started to negatively depart from average in February in both regions as well as in the neighbouring governorates of Raqqa and, as from mid-March in Aleppo (*Figure 2* and NDVI profiles in annex), most likely as a result of the November to early December dry spell. In March, the contrast in crop biomass between Hassakeh or Ninewa and the neighbouring Turkish provinces of Mardin and Sanliurfa, which benefit from irrigation, stroke on S2 imagery[1]. As from April, the dry conditions became very severe with only 30% of the normal rainfall received in April and May in both regions (*Figure 1* - bottom). At the same time, in early April temperatures started to increase with respect to normal to reach 7°C above average at the end of April, increasing evapotranspiration demand in a context of low moisture (*Figure 3*). Actually, the total rainfall received from October to June is the 2nd and 3rd lowest of the last 30 years for Hassakeh and Ninewa, respectively. Moreover, the cumulated temperatures from October to June, as well as the temperatures of April-May, are the highest of the last 30 years (see graphs in annex). These record high temperatures in April and May (*Figure 5*), combined with low rainfall, have accelerated grain filling and crop senescence. At the end of April, according to MODIS NDVI data, winter cereals biomass was strongly below-average, indicating crop failure for rainfed cereals in Hassakeh, Ninewa, and in parts of Raqqa, Aleppo and Idleb (*Figure 4*). In north-eastern Iraq, cereals biomass was from close to above-average up to the end of March – early April in Dahuk, Erbil and Sulaymaniyah. The high temperatures and low rainfall in April and May have accelerated cereals senescence, reducing the grain filling phase while easing the drydown of grains (see Sulaymaniyah NDVI profile in *Figure 2*).

INFO BOX 1 - NORMALISED DIFFERENCE VEGETATION INDEX (NDVI)
The NDVI (Normalised Difference Vegetation Index) is used as a green biomass indicator. It is a combination of the red and near-infrared bands registered by satellites and is used either at a specific date or cumulated over the whole season.

[1] See https://mars.jrc.ec.europa.eu/asap/s/fb96b299 for Hassakeh, https://mars.jrc.ec.europa.eu/asap/s/5102f3b3 for TR Mardin and https://mars.jrc.ec.europa.eu/asap/s/9950bebf for TR Sanliurfa



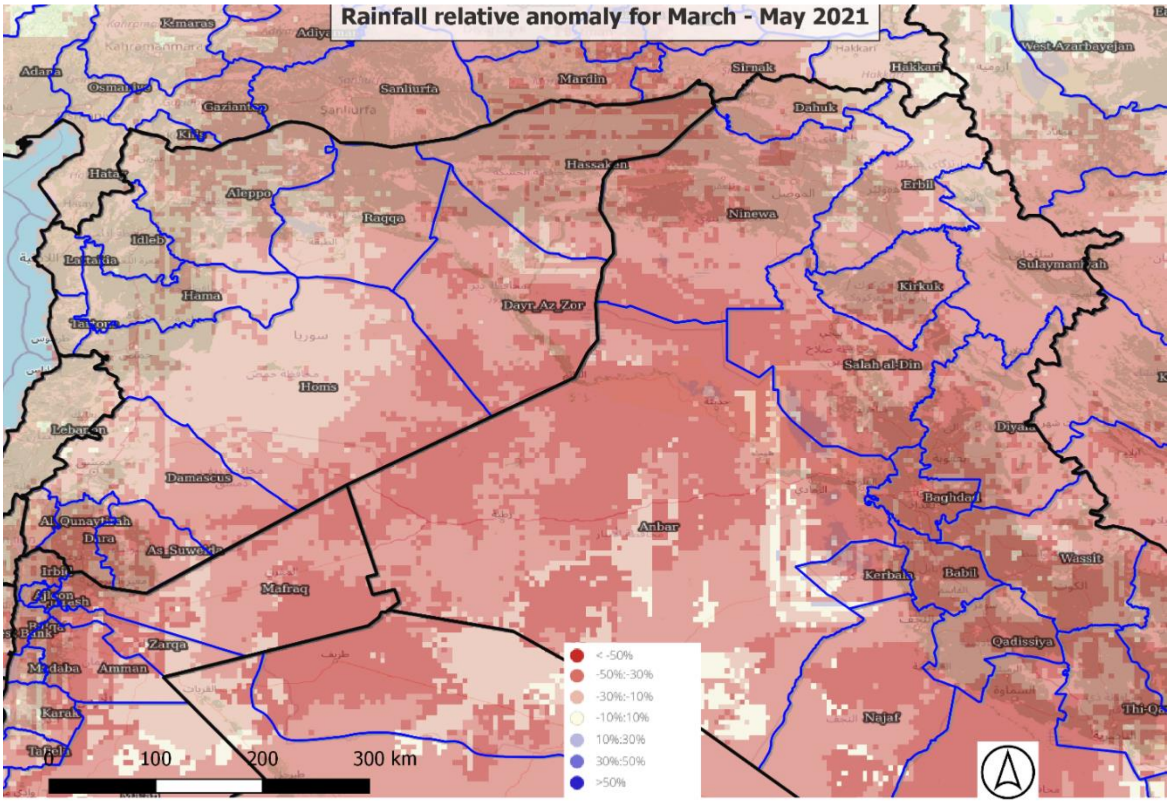


Figure 1. CHIRPS Rainfall relative anomaly for Oct-Dec 2020 (top) and March-May 2021 (bottom). While the autumn rainfall deficit was moderate (33% deficit for October-December) and localized to the northern parts of Syria and Iraq (mainly Hassakeh and Ninewa), the March-May rainfall deficit affected the middle east region and was very severe (actually Hassakeh and Ninewa received about 85% of their average rainfall in March but 30% for both April and May).

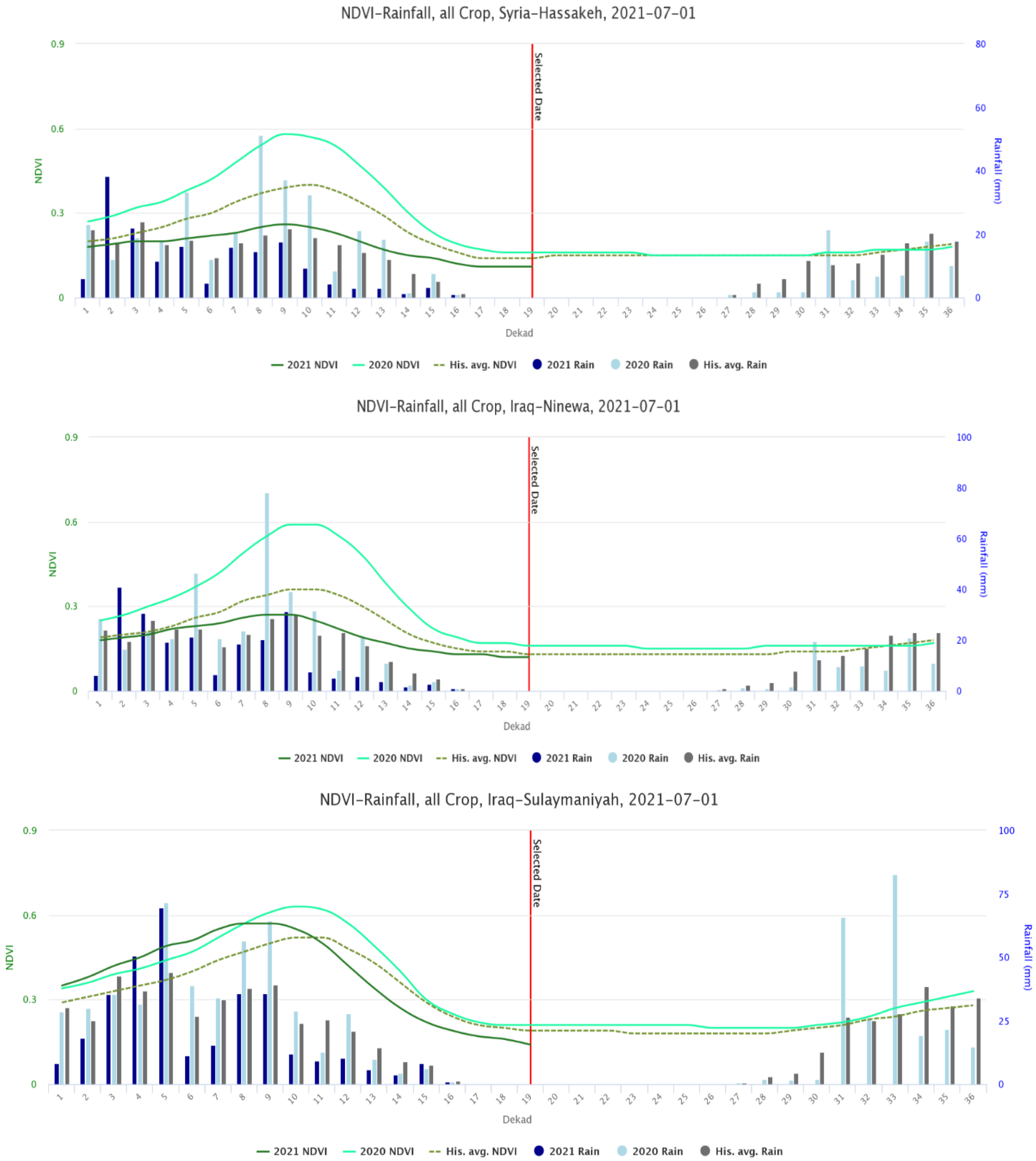


Figure 2. MODIS NDVI – CHIRPS rainfall time profiles for cropland areas of Hassakeh (top), Ninewa (middle) and Sulaymaniyah (bottom) governorates. In Hassakeh and Ninewa, while 2021 rainfall strongly drops with respect to average as from April (dekad 10), NDVI departs from average in February in both regions. In contrast in Sulaymaniyah, winter cereals show above-average crop biomass till early April, before starting a fast senescence due to high temperatures and low rainfall.

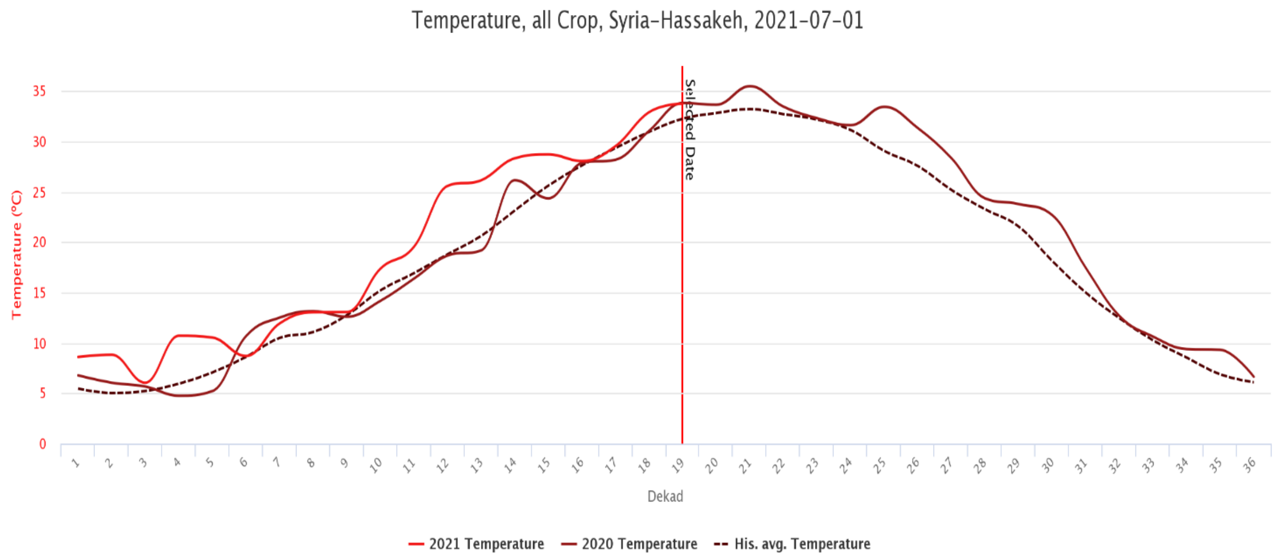


Figure 3. ECMWF (ERA5 and HRES) temperature profile for Hassakeh cropland area. This season, temperatures have been close to or above-average since autumn 2020, with record highs in April - May (7°C difference with the long-term average). The neighbouring provinces have similar profiles.

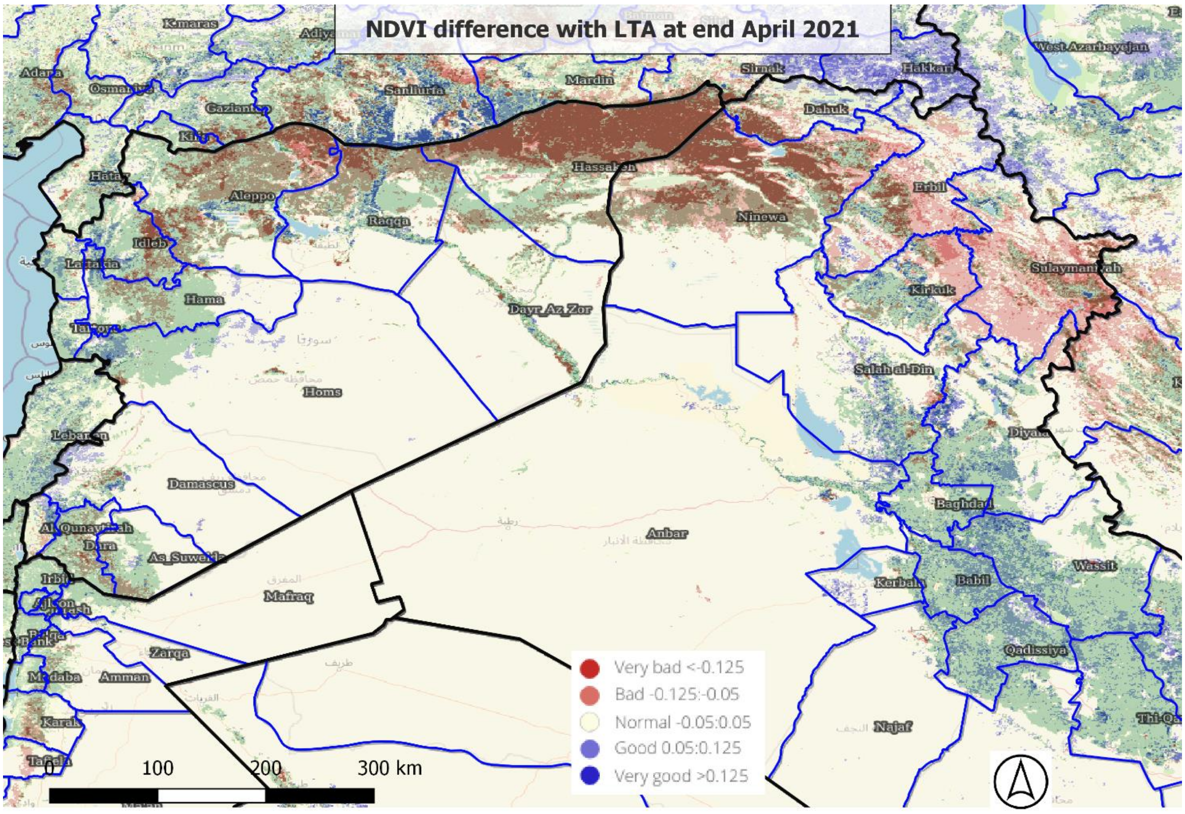
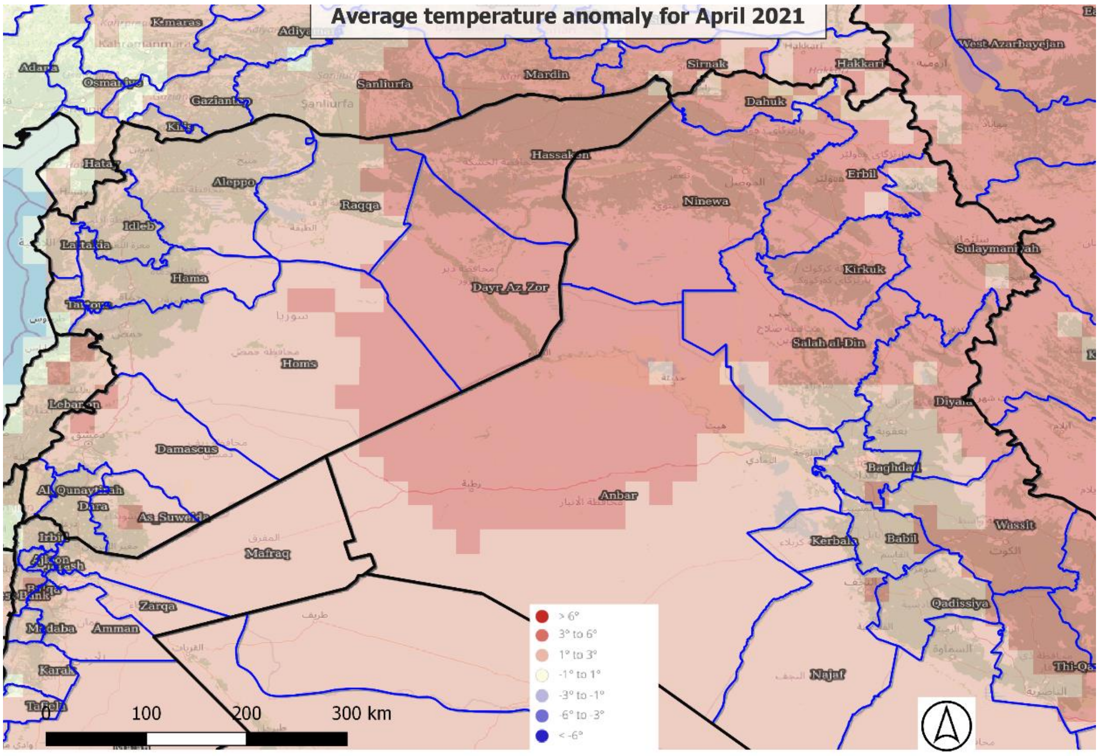


Figure 4. Difference between NDVI and its Long Term Average (LTA) at the end of April 2021, showing strong biomass deficit in northern Syria and Iraq, particularly in Hassakeh and Ninewa governorates, as well as in parts of the neighbouring governorates of Raqqa, Aleppo and Idleb in Syria and Dahuk, Erbil and Sulaymaniyah in Iraq.



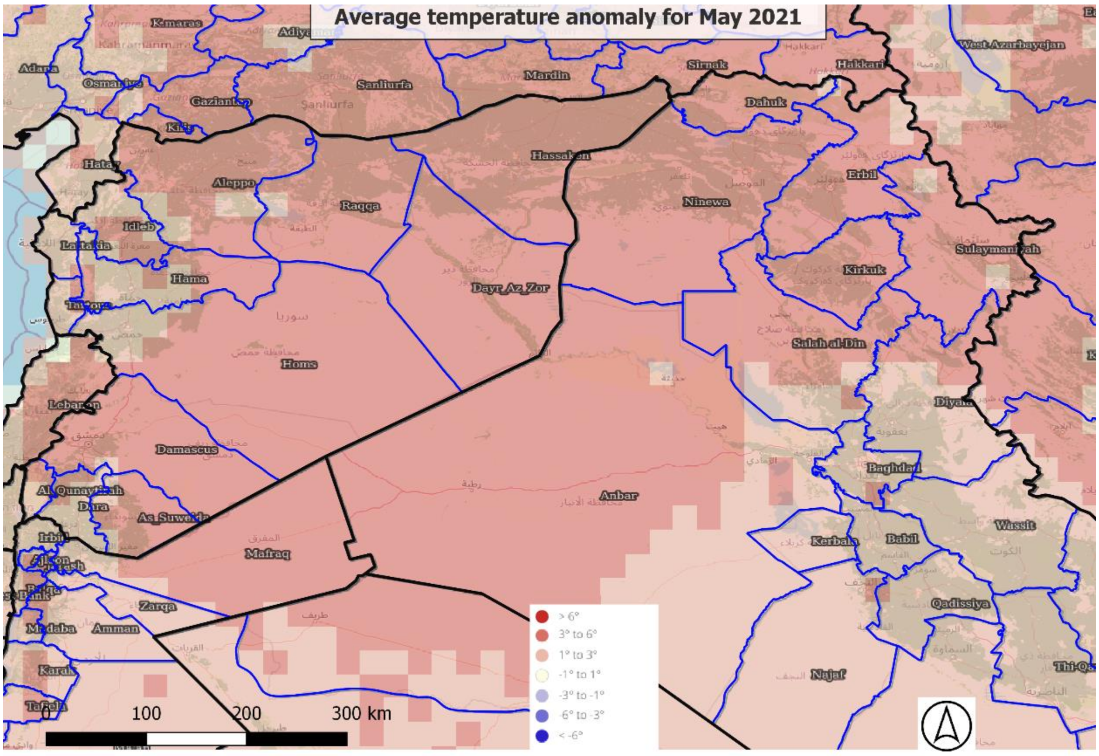


Figure 5. Average temperature relative anomaly for April (top) and May (bottom) 2021 showing 3°-6°C above-average temperatures in eastern Syria and Iraq in April and for the whole region in May.

High-resolution imagery of the Sentinel 2 sensor allows zooming at field scale for the agricultural areas most concerned by drought, and to compare crop conditions with reference years. The images from Sentinel 2 presented in this report are false-color composites with (i) red showing active vegetation, (ii) blueish - light green corresponding to bare or sparsely vegetated soil or dry vegetation, and (iii) black indicating water bodies; the reference year is the previous season (2020), which was very rainy.

The Sentinel2 images of April 2021 show a very strong difference in crop biomass with April 2020 for Hassakeh (*Figure 6*) and Ninewa (*Figure 9*), but also large parts of Raqqa (*Figure 7*), Aleppo (*Figure 8*) and

Erbil (*Figure 10*) where rainfed cereals failed at sowing, hence the extent of bare soil or dry vegetation areas in light blue. Only fields that could benefit from irrigation are green (i.e. reddish on the images). These images clearly confirm the information derived from the MODIS 1 km NDVI data, i.e. the failure of rainfed cereals and pastures for the 2020/2021 season and show the difference in crop extent when weather conditions are favourable.

INFO BOX 2 – SENTINEL

Sentinel is an Earth observation mission from the European Space Agency's Copernicus Program that provides accurate, timely and easily accessible information to improve the management of the environment, understand and mitigate the effects of climate change and ensure civil security (ESA). Sentinel 2 acquires optical imagery at high spatial resolution over land and coastal waters. Sentinel's data are available to the public at no cost.

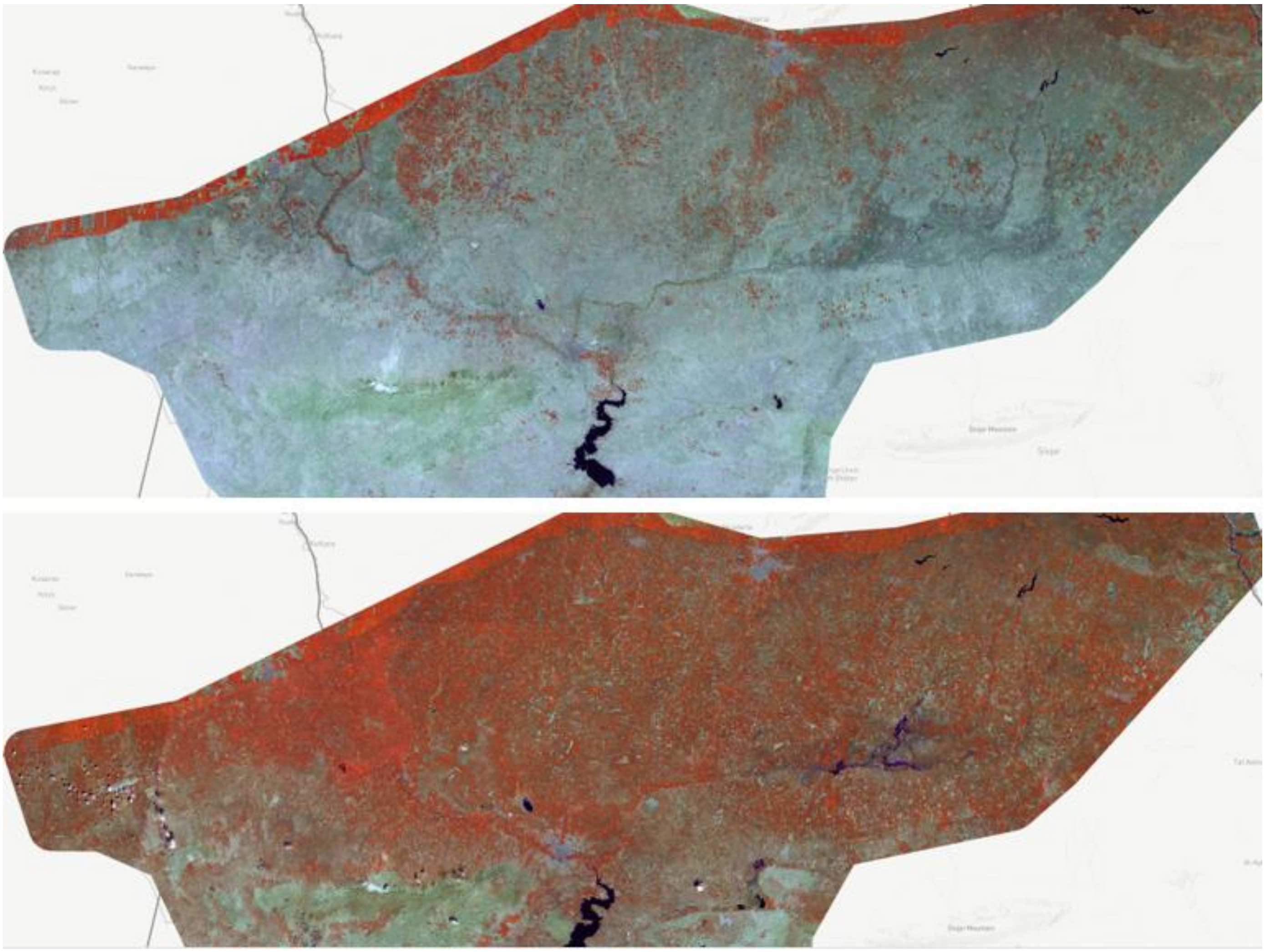


Figure 6. Hassakeh governorate (Syria) in April 2021 (top) versus April 2020 (bottom) on S2 imagery. The contrast with 2020 (which was a rainy year) is striking; in 2021, it seems that only a few irrigated fields are green (i.e. red; see more at the ASAP High-Resolution Viewer). Also note the contrast with the irrigated fields of the Turkish northern border.

INFO BOX 3 – False Color Composite

The display colour assignment for any band of a multispectral image can be done in an entirely arbitrary manner and in this case, the colour of a target in the displayed image does not have any resemblance to its actual colour (CRISP). The resulting product is known as a false colour composite image. There are many different false-colored composites that can be used to highlight different features. For agriculture monitoring applications a widely used band combination is: NIR (Near Infrared) - SWIR (Short wave Infrared) - R(red). In this false-color composite, healthy vegetation appears red and bare, or sparsely vegetated soil appears green.

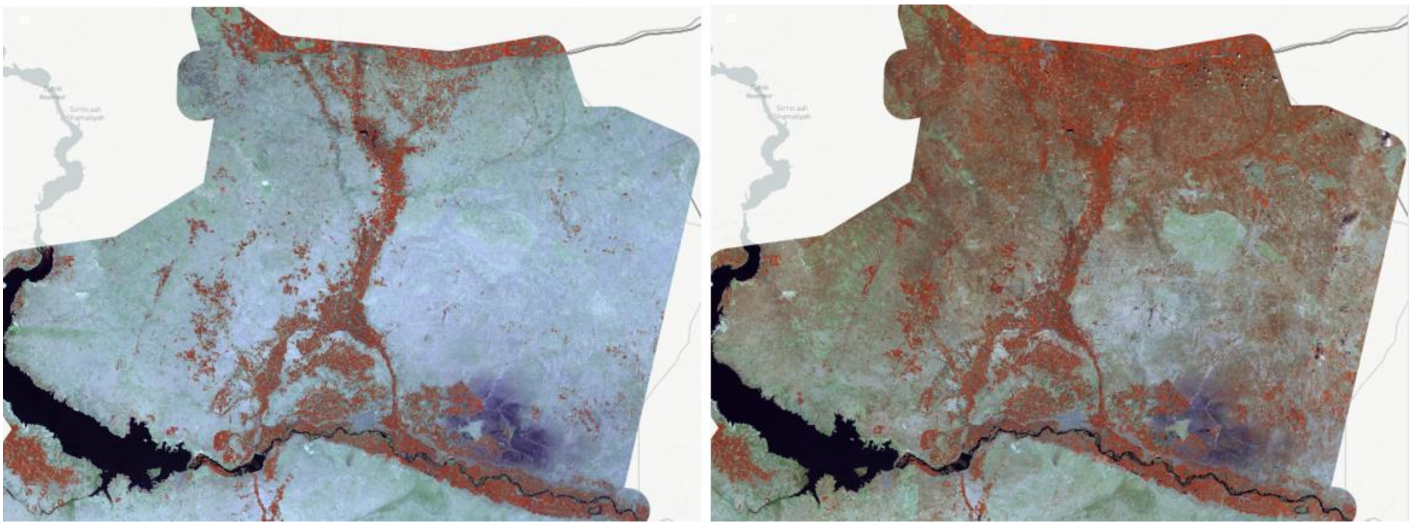


Figure 7. Raqqa governorate (Syria) in April 2021 (left) versus April 2020 (right) on S2 imagery. Only irrigated crops (in red) are growing in 2021 (see more at the ASAP High-Resolution Viewer).

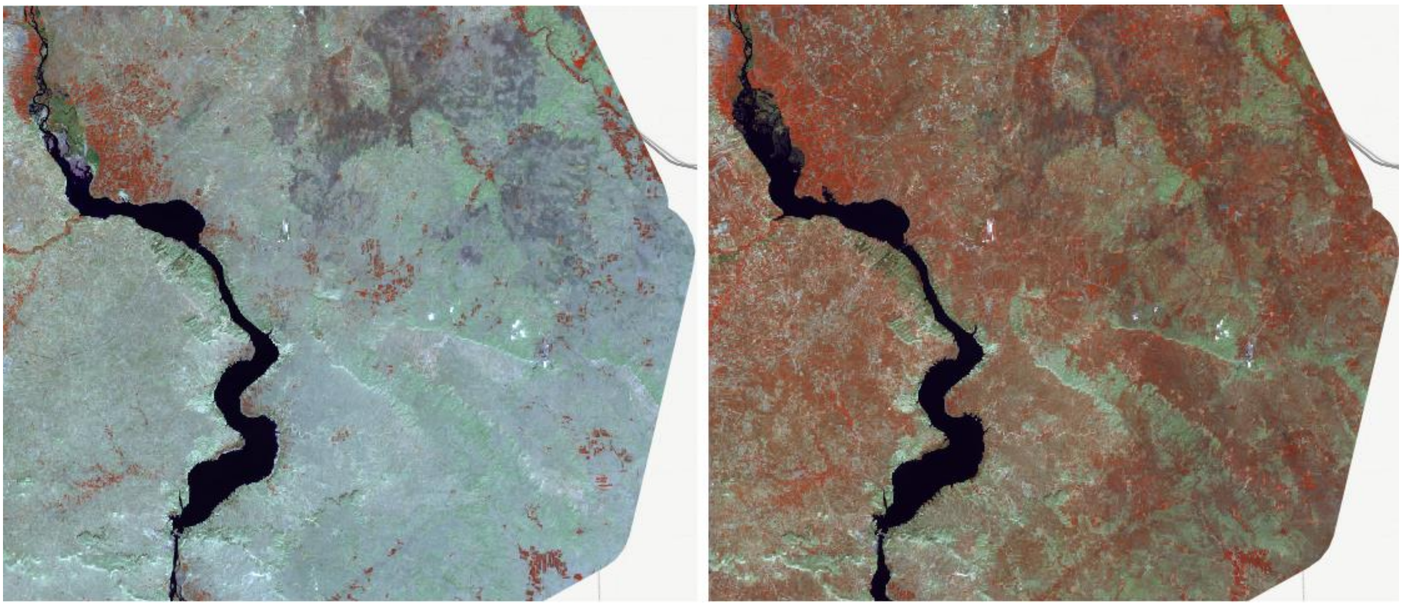


Figure 8. Aleppo governorate (Syria) in April 2021 (left) versus April 2020 (right) on S2 imagery showing few irrigated crops in 2021 (see more at the ASAP High-Resolution Viewer).

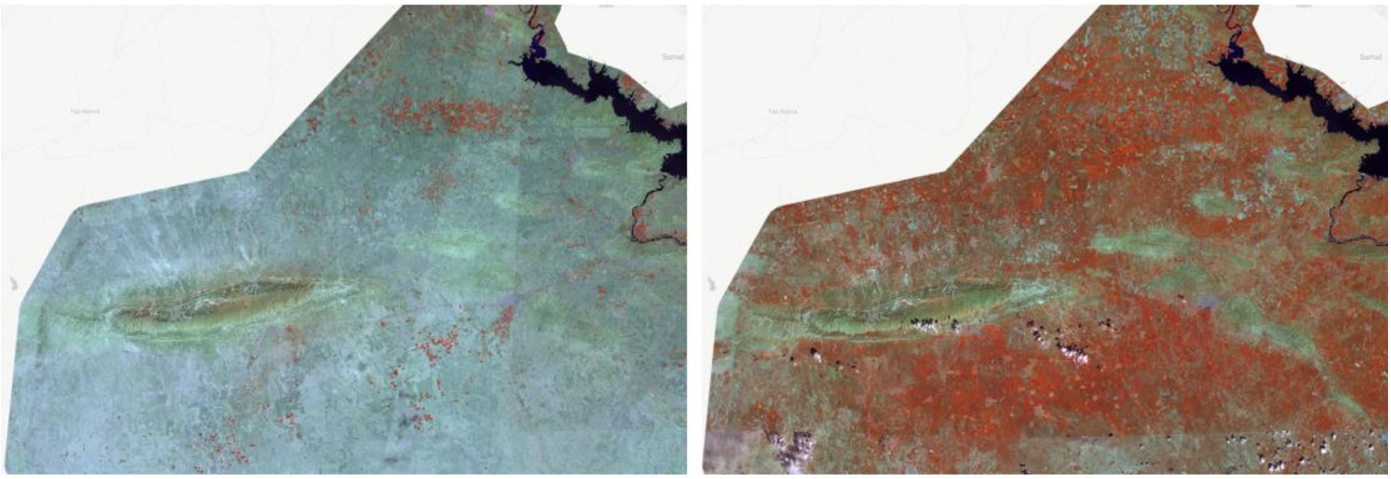


Figure 9. Ninewa governorate (Iraq) in April 2021 (left) versus April 2020 (right) on S2 imagery. The biomass deficit west of the Tigris river (at the northeast of the image) is striking (see more, in particular, the good crop conditions to the east of the Tigris river at the [ASAP High-Resolution Viewer]).

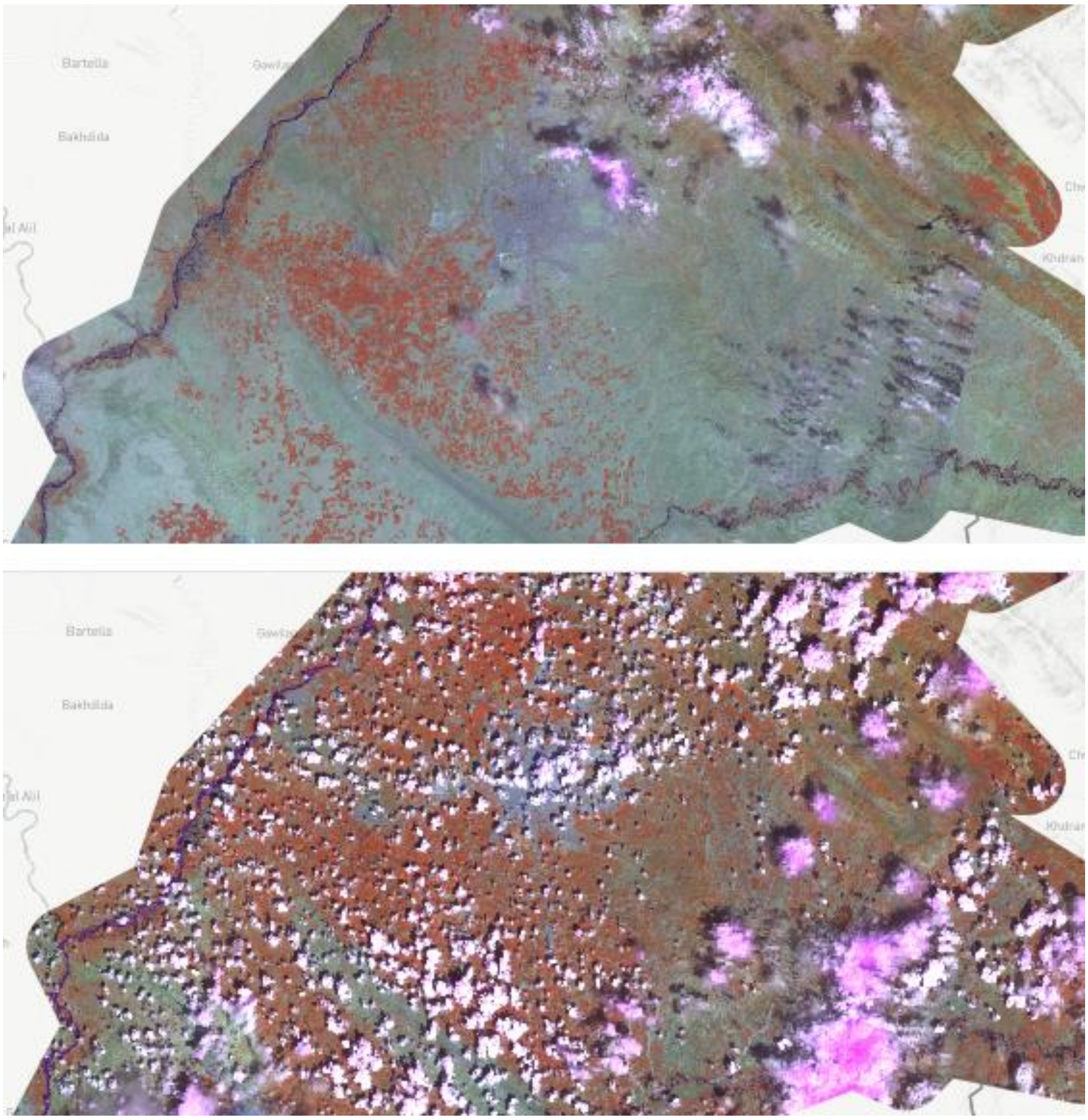


Figure 10. Erbil governorate (Iraq) in April 2021 (top) versus April 2020 (bottom) on S2 imagery. Only fields benefitting from irrigation are green (i.e. red) in April 2021 (see more at the [ASAP High-Resolution Viewer]).

The situation observed by satellite and based on the agro-meteo info presented in this special focus is in line and integrates what has been reported by various organizations including WFP, OCHA, REACH, UNICEF, USAID, FAO (links to the reports at the end of the document).

In **Syria**, the drought conditions have affected the water levels in the Euphrates River resulting in reduced energy production capacity, decreased access to drinking water, and poor agricultural production, and loss of livelihoods (UNICEF). According to OCHA, informal crop forecasts point to a reduced barley production of 1.2 million tons, as low as in 2018. Additionally, failed barley crops are expected to affect the availability of animal feed (REACH). Also, close to 90% of the rain-fed wheat fields, representing about half of the entire crop, are expected not to produce anything in 2021 (USAID, Zamal News). According to WFP, food insecurity in Syria has hit its worst point since the start of the crisis, with 14.2 million Syrians at risk of food insecurity, up from 9.8 million in 2020 (UNICEF).

In **Iraq**, according to a recent FAO report, winter cereals in rainfed areas in the Ninewa Governorate have failed completely. According to this report, wheat output was forecasted in May 2021 at 394,000 tons, 70% below last year's output. Moreover, the 2021 barley crop failed completely and production is forecast at 11,510 tons, down from the 1.36 million tons harvested in 2020.

Both countries are vulnerable and have limited coping capacity after years of devastating wars. According to the Global report on Food Crises, Iraq is still recovering from conflict, and economic factors such as the declining income from oil, and the devaluation of the Iraqi Dinar, remain drivers of acute food insecurity. Similarly, in Syria, the decade of conflict has destroyed livelihoods and infrastructure, and still, according to the report, the absence of a lasting peace agreement, sanctions, a war-torn economy, and the effects of currency depreciation, will continue to fuel the humanitarian crisis, particularly in the north-west areas.

More information can be found here:

- WFP Syria Situation Report: https://reliefweb.int/sites/reliefweb.int/files/resources/2021%2006%20WFP%20Syria%20External%20Situation%20Report%2006%20-%20June%202021.pdf
- 2020 Humanitarian response plan monitoring report, Syrian Arab Republic, OCHA: https://reliefweb.int/sites/reliefweb.int/files/resources/2020_syria_midyear_pmr.pdf
- Euphrates Water Crisis & Drought Outlook, Syrian Arab Republic, OCHA: https://reliefweb.int/sites/reliefweb.int/files/resources/Syrian%20Arab%20Republic%20-%20Euphrates%20water%20crisis%20and%20drought%20outlook%2C%20as%20of%2017%20June%202021.pdf
- Briefing Note: Humanitarian Situation Overview in Northeast Syria, REACH: https://reliefweb.int/report/syrian-arab-republic/briefing-note-humanitarian-situation-overview-northeast-syria-june-2021
- UNICEF: https://reliefweb.int/report/syrian-arab-republic/unicef-whole-syria-humanitarian-situation-report-mid-year-2021
- USAID: https://reliefweb.int/sites/reliefweb.int/files/resources/Final%20Copy%20%5Bfor%20publication%5D%20First%20Annual%20Review%20Syria%20Situation%20Analysis_June%202021.pdf
- The Republic of Iraq, FAO: http://www.fao.org/3/cb5144en/cb5144en.pdf
- Global report on food crises: https://docs.wfp.org/api/documents/WFP-0000127343/download/?_ga=2.117978121.1870512890.1628170843-1347315541.1621926011

For any feedback and questions please write to the address below.

Feedback can also be posted on Twitter by including the hashtag: #asapEU

JRC ASAP team

Jrc-asap@ec.europa.eu

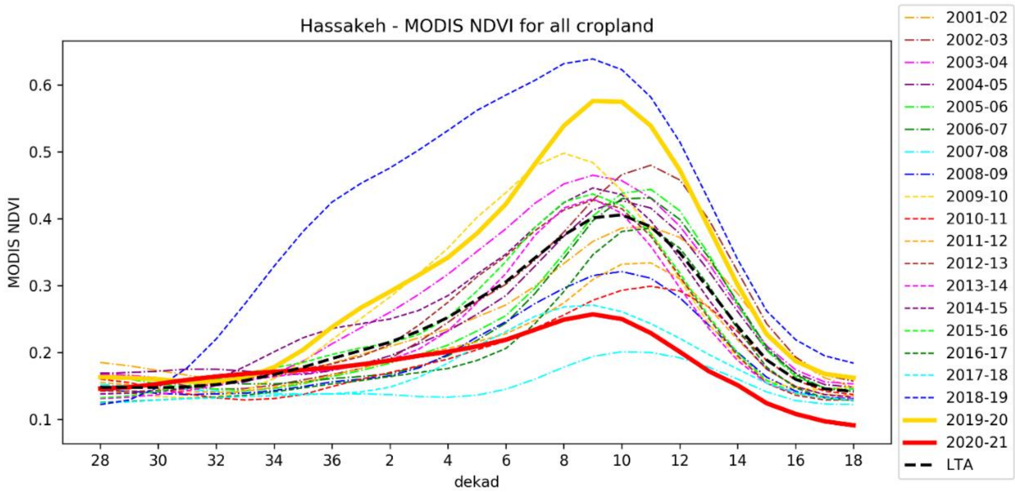
Annex

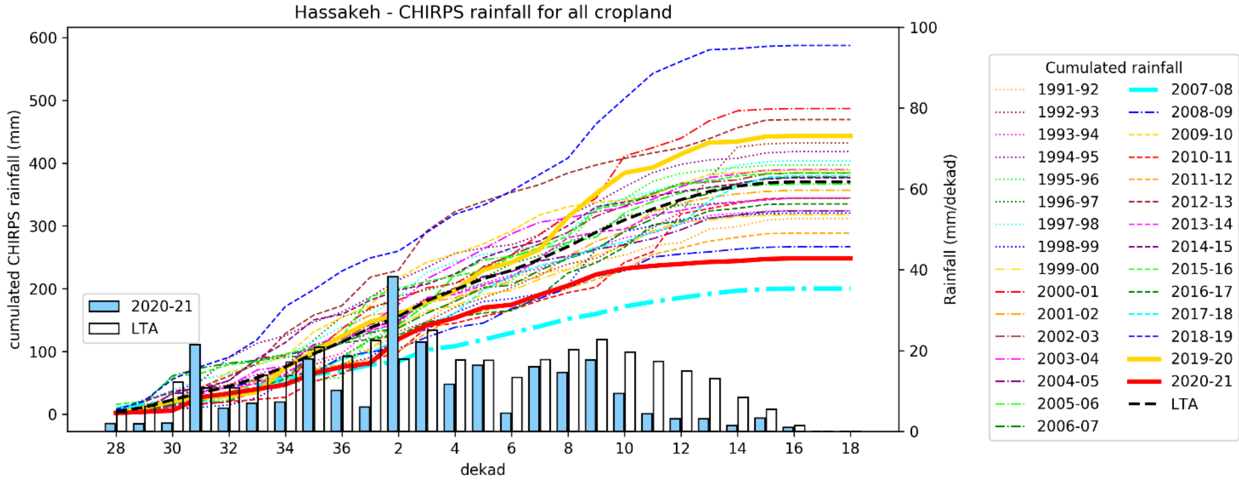
The following graphs show the NDVI, rainfall, SPI-3 months, and temperature time profiles of the last 20 or 30 years, including the current season, for NDVI, rainfall, SPI-3, and temperatures for Hassakeh, Raqqa, Aleppo, and Ninewa. These graphs, which show the range of response of the various variables over the years in our archive, allows assessing the severity of the 2020/2021 drought in terms of biomass, cumulated rainfall, and temperature in northern Syria and Iraq. For instance in Hassakeh, the cumulated rainfall from October to June is the second-lowest after 2007/2008 in the last 30 years and the cumulated temperature is the highest, with several periods with high (October, January, February) or record temperatures (April and May).

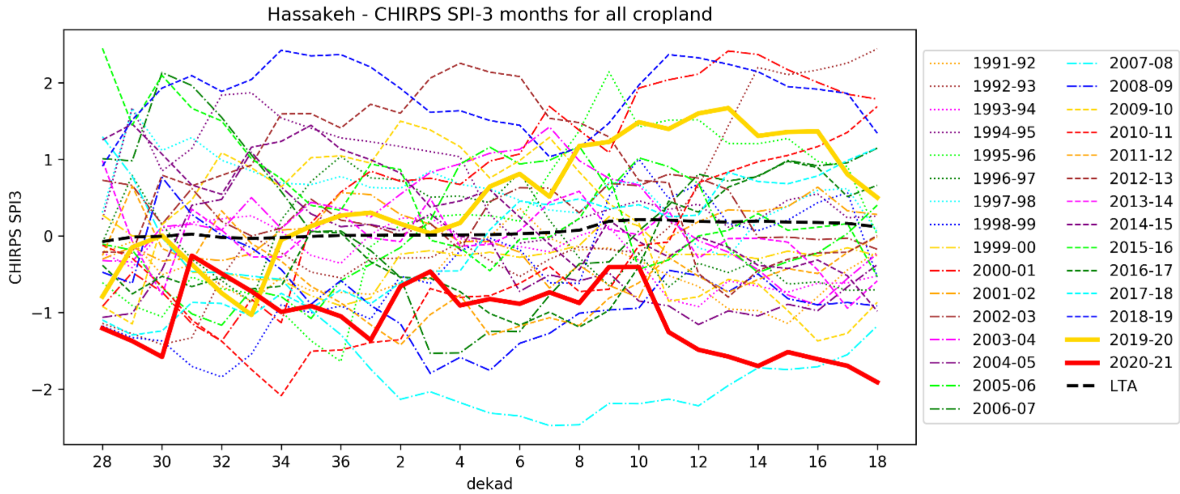
The SPI-3 graphs for Hassakeh and Ninewa do not depict very severe drought (below -2) before end June (corresponding to the April to June rainfall) because the November (dekads 32 to 34) and December (dekads 36 and 1) dry spells lasted less than three months; they were, however, sufficient to stop the growth of non-irrigated cereals. Temperature graphs for the other regions are similar to the ones of Hassakeh.

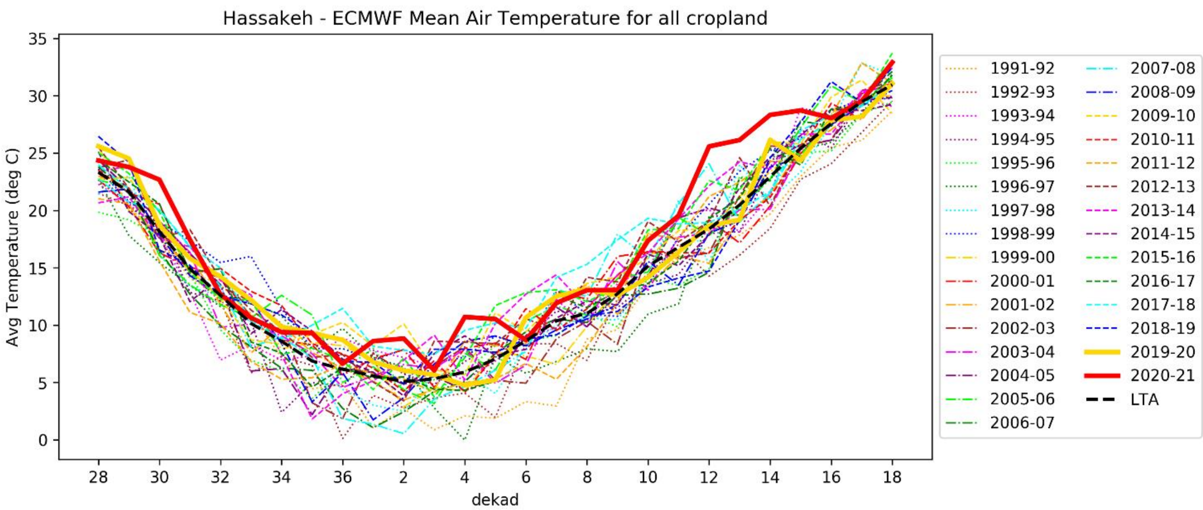
INFO BOX 4 – STANDARDIZED PRECIPITATION INDEX (SPI)
The Standardized Precipitation Index (SPI) is widely used to characterize meteorological drought for different timescales (1, 3, 6 months…). It is a way to transform precipitation data into a normal distribution, which allows interpreting a rainfall anomaly over a given timescale - anomaly expressed as an SPI value - as the number of standard deviations by which this rainfall anomaly deviates from the long-term mean. This way, we can derive the probability of occurrence of this anomaly and know if a given rainfall, deficit, or excess is rare or exceptional for a given location.

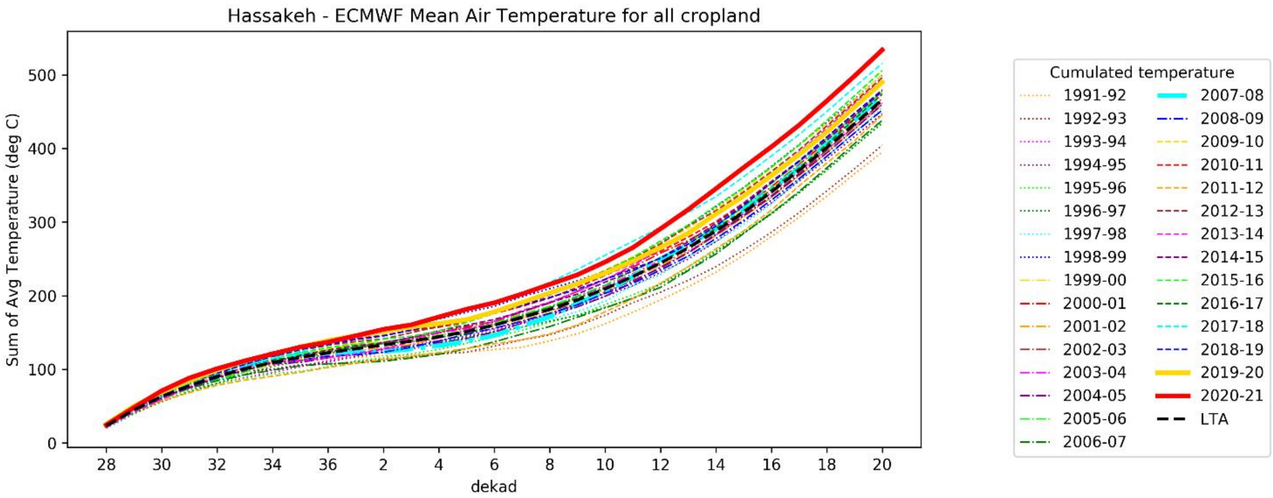
Additional graphs for Hassakeh



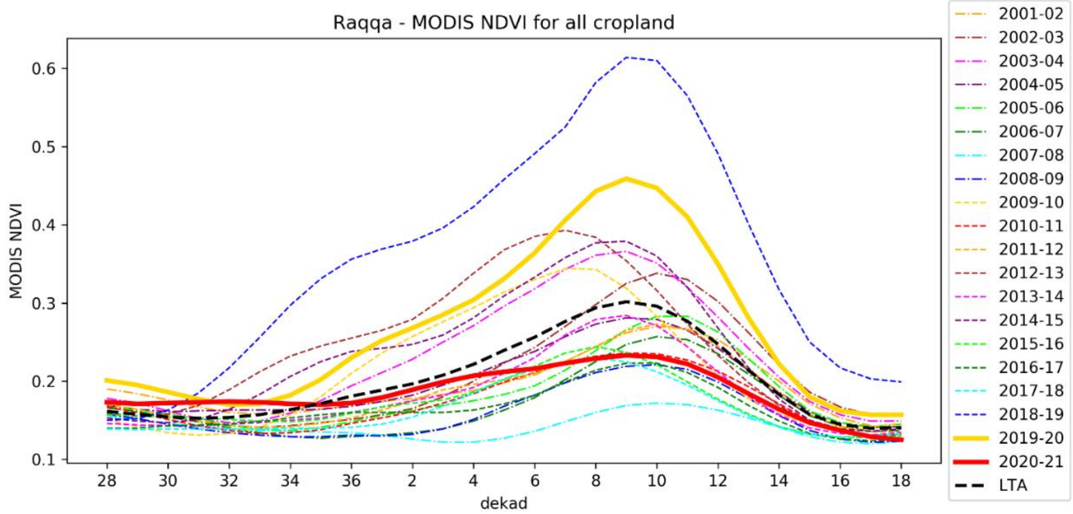

Hassakeh - CHIRPS rainfall for all cropland
cumulated CHIRPS rainfall (mm)
Rainfall (mm/dekad)
dekad
2020-21
LTA
Cumulated rainfall
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
LTA

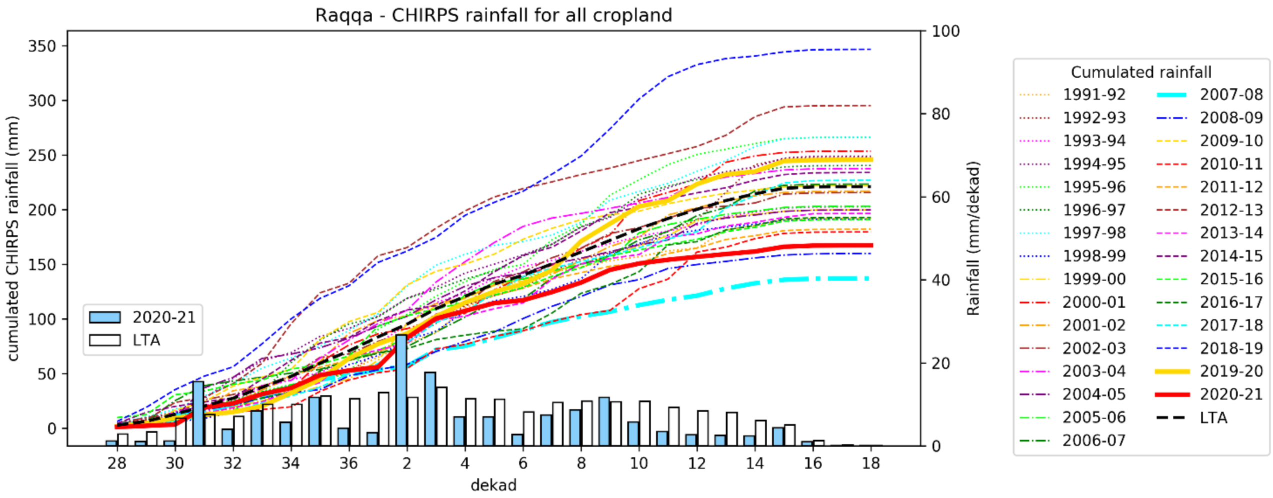

Hassakeh - CHIRPS SPI-3 months for all cropland
CHIRPS SPI3
dekad
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
LTA


Hassakeh - ECMWF Mean Air Temperature for all cropland
Avg Temperature (deg C)
dekad
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
LTA

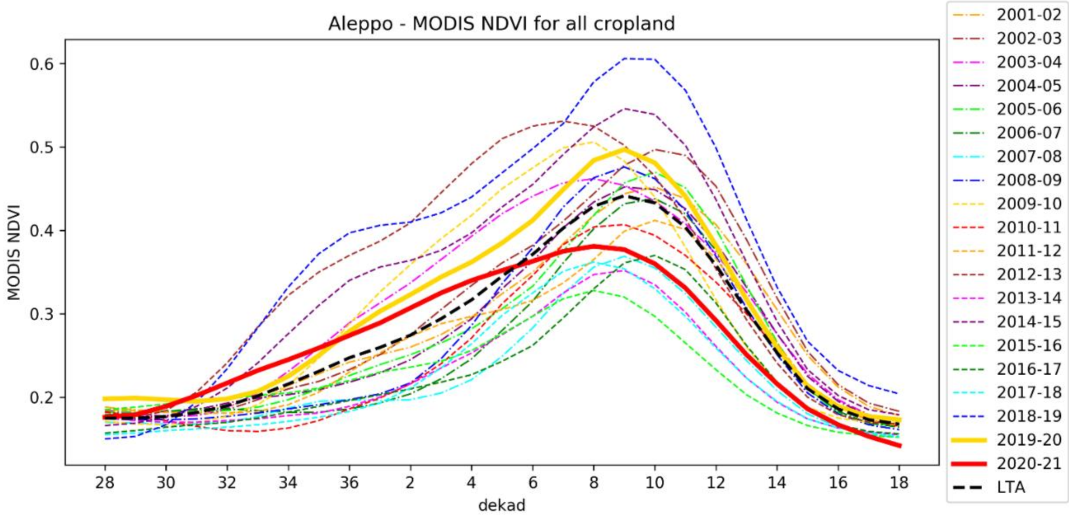


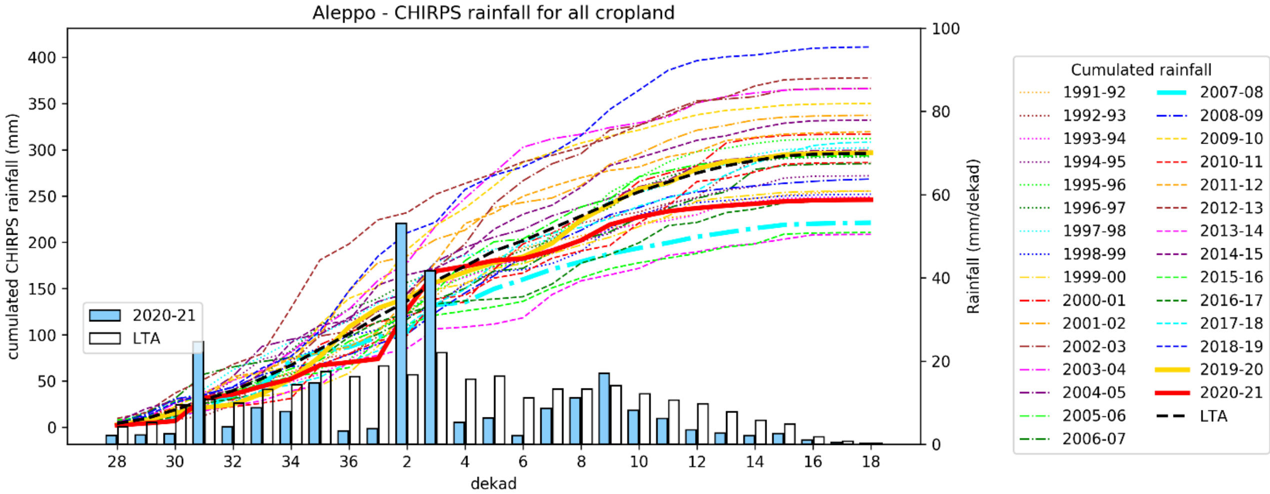
Additional graphs for Raqqa



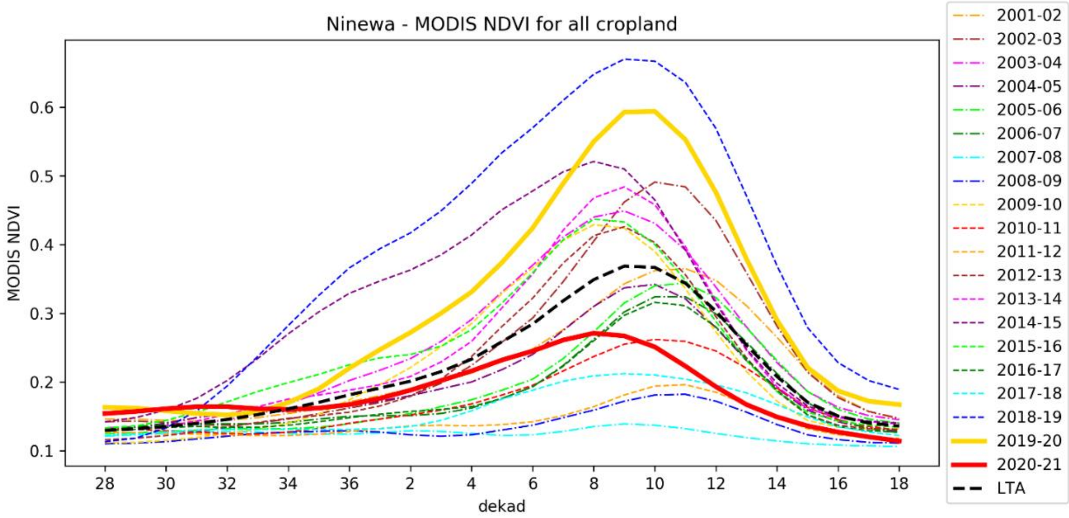


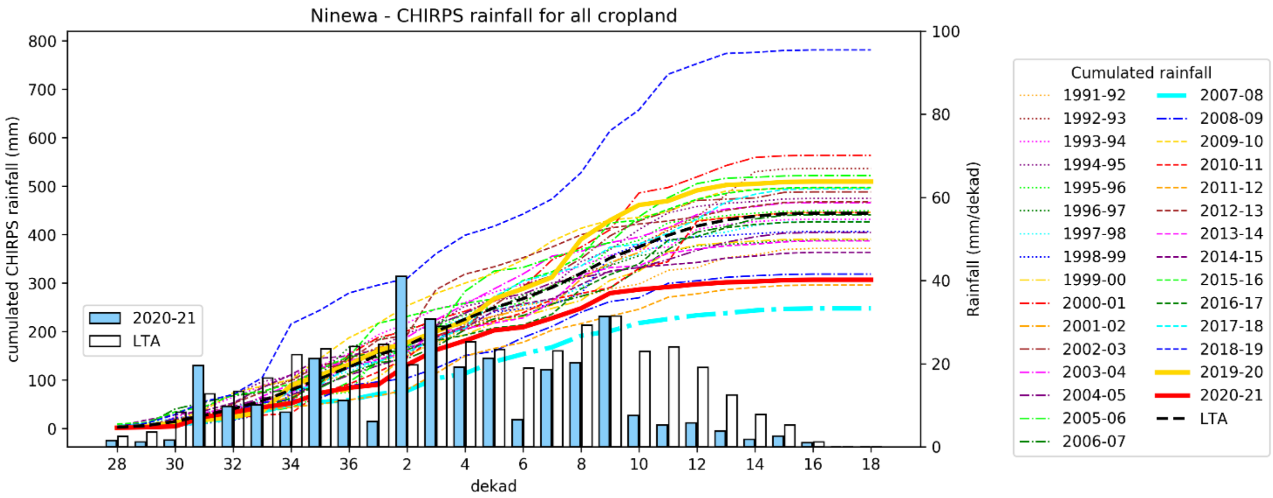
Additional graphs for Aleppo

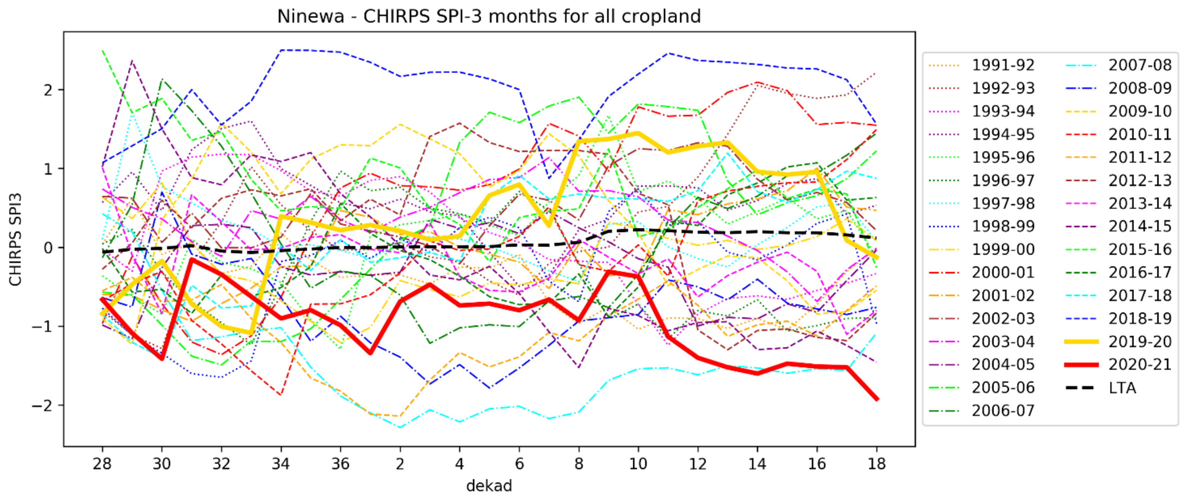




Additional graphs for Ninewa




Ninewa - CHIRPS rainfall for all cropland
cumulated CHIRPS rainfall (mm)
Rainfall (mm/dekad)
dekad
2020-21
LTA
Cumulated rainfall
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
LTA


Ninewa - CHIRPS SPI-3 months for all cropland
CHIRPS SPI3
dekad
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
LTA