Chapter 1. Global agroclimatic patterns

Chapter 1 describes the CropWatch Agroclimatic Indicators (CWAIs) rainfall (RAIN), temperature (TEMP), and radiation (RADPAR), along with the agronomic indicator for potential biomass (BIOMSS) in sixty-five global Monitoring and Reporting Units (MRU). RAIN, TEMP, RADPAR and BIOMSS are compared to their average value for the same period over the last fifteen years (called the “average”). Indicator values for all MRUs are included in Annex A table A.1. For more information about the MRUs and indicators, please see Annex B and online CropWatch resources at **www.cropwatch.com.cn**.

1.1 Introduction to CropWatch agroclimatic indicators (CWAIs)

This bulletin describes environmental and crop conditions over the period from April 2021 to July 2021, AMJJ, referred to as "reporting period". In this chapter, we focus on 65 spatial "Mapping and Reporting Units"(MRU) which cover the globe, but CWAIs are averages of climatic variables over agricultural areas only inside each MRU. For instance, in the "Sahara to Afghan desert" MRU, only the Nile valley and other cropped areas are considered. MRUs are listed in annex C and serve the purpose of identifying global climatic patterns. Refer to Annex A for definitions and to table A.1 for 2021 AMJJ numeric values of CWAIs by MRU. Although they are expressed in the same units as the corresponding climatological variables, CWAIs are spatial averages limited to agricultural land and weighted by the agricultural production potential inside each area.

We also stress that the reference period, referred to as "average" in this bulletin covers the 15-year period from 2006 to 2020. Although departures from the 2006-2020 are not anomalies (which, strictly, refer to a "normal period" of 30 years), we nevertheless use that terminology. The specific reason why CropWatch refers to the most recent 15 years is our focus on agriculture, as already mentioned in the previous paragraph. 15 years is deemed an acceptable compromise between climatological significance and agricultural significance: agriculture responds much faster to persistent climate variability than 30 years, which is a full generation. For "biological" (agronomic) indicators used in subsequent chapters we adopt an even shorter reference period of 5 years (i.e. 2016-2020) but the BIOMSS indicator is nevertheless compared against the longer 15YA (fifteen-year average). This makes provision for the fast response of markets to changes in supply but also to the fact that in spite of the long warming trend, some recent years (e.g. 2008 or 2010-13) were below the trend.

Correlations between variables (RAIN, TEMP, RADPAR and BIOMSS) at MRU scale derive directly from climatology. For instance, the positive correlation between rainfall and temperature results from high rainfall in equatorial, i.e. in warm areas.

Considering the size of the areas covered in this section, even small departures may have dramatic effects on vegetation and agriculture due to the within-zone spatial variability of weather.

1.2 Global overview

Global temperatures set alarming records during this monitoring period according to the National Oceanic and Atmospheric Administration (NOAA) of the USA. June 2021 was the fifth-warmest June, and the warmest for Earth's land area. Temperatures were 0.88 ºC above the 20thcentury average. North America and Africa had their hottest June on record; Europe and Asia had their second hottest June on record. Subsequently, NOAA declared July 2021 as the Earth's hottest month on record (+0.93ºC).

The increase in average temperatures by 1ºC may not sound alarming. However, these temperature increases cause prolonged and more intense droughts and heat waves. Intensity of rainfall events also increases, while the number of rainy days' decreases. As a consequence, floods are more likely to occur. In its newest report on the science of climate change on lands, the Intergovernmental Panel on Climate Change (IPCC) included a chapter on weather extremes for the first time. These extreme weather events will more and more have a negative impact on the stability and level of crop production around the globe.

Figure 1.1 shows unweighted averages of the CropWatch Agroclimatic Indicators (CWAIs), i.e. the arithmetic means of all 65 MRUs, which are relatively close to average. CWAIs are computed only over agricultural areas, and they display a relatively average situation, globally.

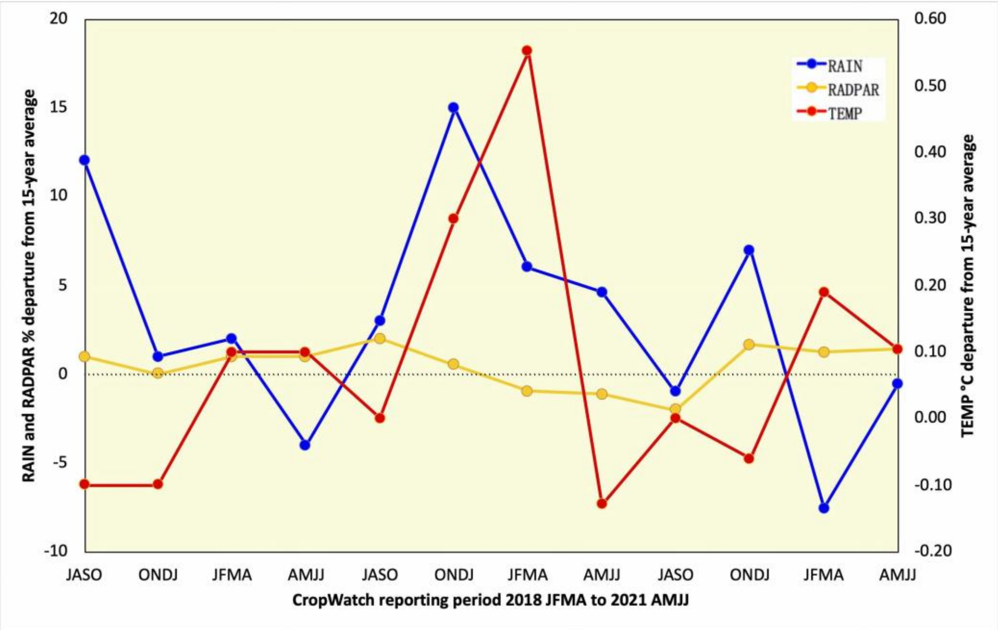

Figure 1.1 Global departure from recent 15 year average of theRAIN, TEMP and RADPAR indicators since 2018 ONDJ period (average of 65 MRUs, unweighted)

1.3 Rainfall (Figure 1.2)

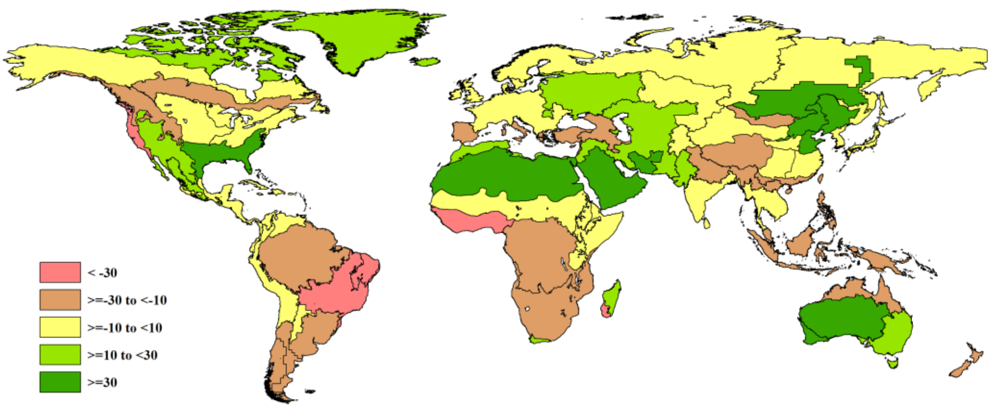

Figure 1.2 Global map of rainfall anomaly (as indicated by the RAIN indicator) by CropWatch Mapping and Reporting Unit: departure of April to July 2021 total from 2006-2020 average (15YA), in percent.

Below average rainfall conditions persisted for most of Brazil and the West coast of the USA. In both regions, the drop in rainfall departure was more than -50%. In Mexico, as well as in the south of the USA, above average monsoon rains put an end to the drought conditions of last winter. In Africa, Southwest Madagascar continued to be affected by the prolonged drought. Rainfall was more than 50% below average, but the other regions of the island received above average rainfall (+18%). In southern Africa, rainfall was 23% below average. A positive departure was observed for the Western Cape, which is important for its winter wheat production. It had received 255 mm of rain, which was 14% above the 15YA. The onset of the monsoon rains was delayed in the Gulf of Guinea, causing a decline by 36%. Rain in Europe was generally abundant, although the Caucasus, which had experienced a rainfall deficit already during the last monitoring period, continued to stay drier than usual (-17%). Most of the other wheat producing regions such as the Ukraine to the Ural had received slightly above average rainfall (+12%). In East Asia, for Huanghuaihai (China) a strong positive departure by +50% was observed. This was mainly due to a catastrophic rainfall event that had occurred in late July. All wheat production regions in Australia received above average rainfall.

1.4 Temperatures (Figure 1.3)

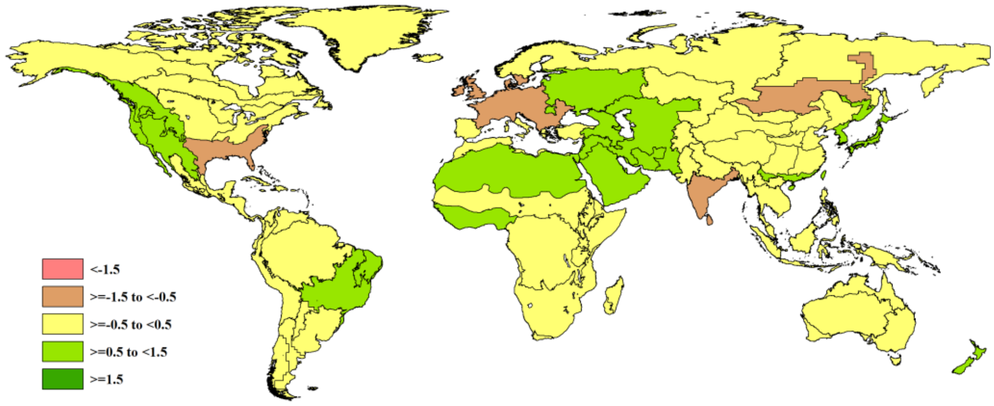

Figure 1.3 Global map of temperature anomaly (as indicated by the TEMP indicator) by CropWatch Mapping and Reporting Unit: departure of April to July 2021 average from 2006-2020 average (15YA), in °C

Temperatures can impact growth in different ways: Cooler than usual temperatures during the spring tend to delay crop growth and development. Above average temperatures, especially when they exceed 30-35ºC, can hasten senescence of the wheat crops and also cause male sterility in maize. Record setting heat waves hit the west of the USA and Canada. Average temperatures were more than 1ºC higher than the 30YA. However, the extremes were much higher. In British Columbia, temperatures reached 49.6ºC, whereas the old record was 45ºC. The drier than usual areas in Brazil also experienced above average temperatures. Western Europe experienced cooler than usual temperatures mainly in April and May, whereas the Caucasus and the region from the Ukraine to the Ural Mountains were much warmer than usual. In South Asia, the largest negative departure was recorded in the region from the Punjab to Gujarat (India). In the other regions, temperatures had stayed near average.

1.5 RADPAR (Figure 1.4)

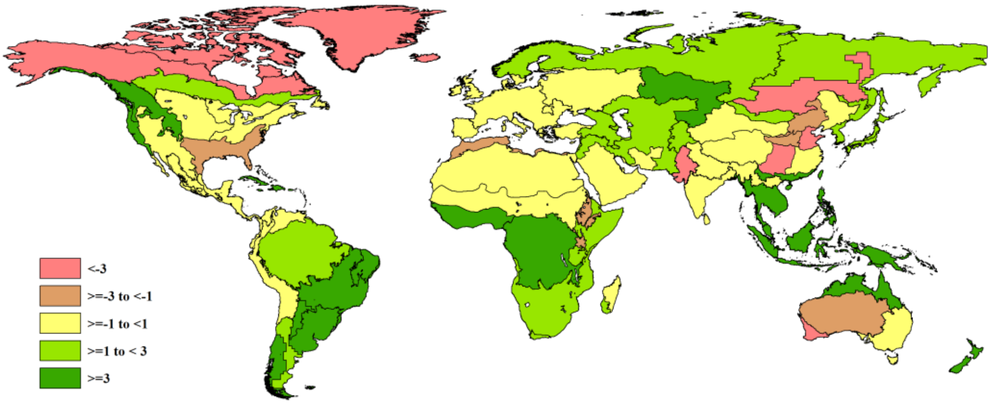

Figure 1.4 Global map of photosynthetically active radiation anomaly (as indicated by the RADPAR indicator) by CropWatch Mapping and Reporting Unit: departure of April to July 2021 total from 2006-2020 average (15YA), in percent.

The largest increase in solar radiation was observed for the Pampas in Argentina (+10%). Solar radiation was above average by more than 5% for most of Brazil and the West Coast of North America (+6%). Southern China experienced an increase by 9%. The strongest negative departures had been observed for Eastern Central Asia (-5.3%) and Huanghuaihai (China) (-4.3%). The AEZ from Nullarbor to Darling in Australia also experienced a sharp decline by -6.3%.

1.6 BIOMSS (Figure 1.5)

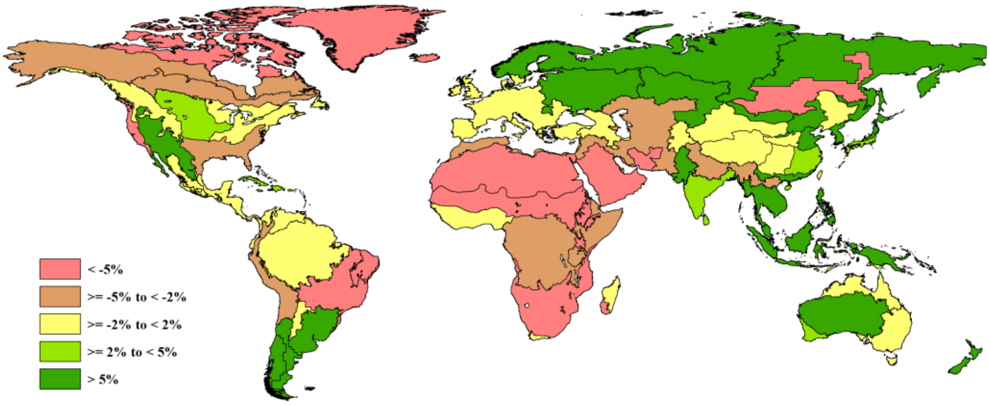

Figure 1.5 Global map of biomass accumulation (as indicated by the BIOMSS indicator) by CropWatch Mapping and Reporting Unit (MRU), departure of April to July 2021 total from 2006-2020 average (15YA), in percent.

The Biomass product is calculated as a function of temperatures, rainfall and solar radiation. In South America, a decline in BIOMSS estimates had been calculated for most of Brazil, affected by drought generated by significantly low precipitation. Similarly, the west coast of the United States was drought-stressed with a 23% lower potential cumulative biomass. Benefiting from favorable rainfall conditions, the Punjab to Gujarat region in South Asia has an 18% higher potential biomass with promising rice yields. Similar increases were seen in the Ukraine to Ural Mountains region, indicating a positive outlook for wheat production in Ukraine and Russia.