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.cn**.

1.1 Introduction to CropWatch agroclimatic indicators (CWAIs)

This bulletin describes environmental and crop conditions over the period from July 2021 to October 2021, JASO, 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 JASO 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. It is important to note that we have adopted an improved calculation procedure of the biomass production potential in the bulletin based on previous evaluation. The improved approach includes sunshine (RADPAR), TEMP and RAIN.

1.2 Global overview

July 2021 was the Earth's hottest month on record. It was also the hottest month for Asia. August to October also ranked at the very top of hottest months every recorded. Considering only land area,

October was the warmest October recorded since 142 years, mainly due to unusual warmth across the Northern Hemisphere's land area.

Climate change not only impacts the temperatures, it also affects precipitation and wind. It causes prolonged and more severe droughts, such as the one that occurred in the West of the USA. On the other hand, rainfall intensities tend to increase. On July 20, more than 200 mm of rainfall were recorded over the city of Zhengzhou between 4 and 5 pm. This was the heaviest hour of rainfall ever reliably recorded in China. Many other parts of the world were also affected by floods during this monitoring period. Some of them are described in more details in Chapter 5.2. DISASTER EVENTS. Fertile agricultural land is often located in flood plains. Thus, not only droughts, but also floods, amplified by climate change, can pose a major threat to food security.

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.

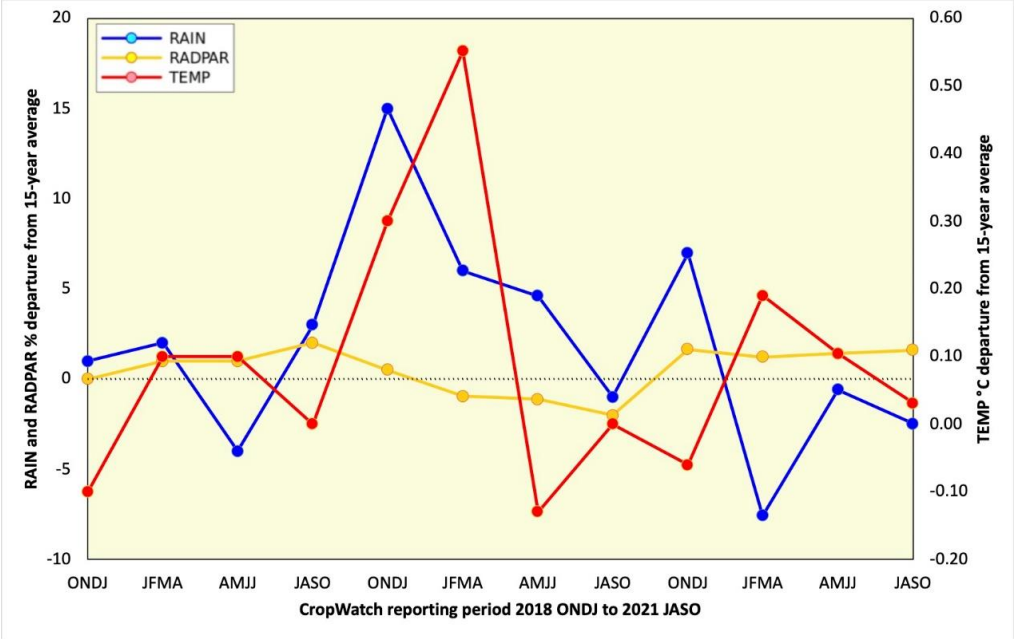

Figure 1.1 global departure from recent 15 year average of the RAIN, TEMP and RADPAR indicators. The last period covers July to October (JASO) 2021 (average of 65 MRUs, unweighted) .

1.3 Rainfall

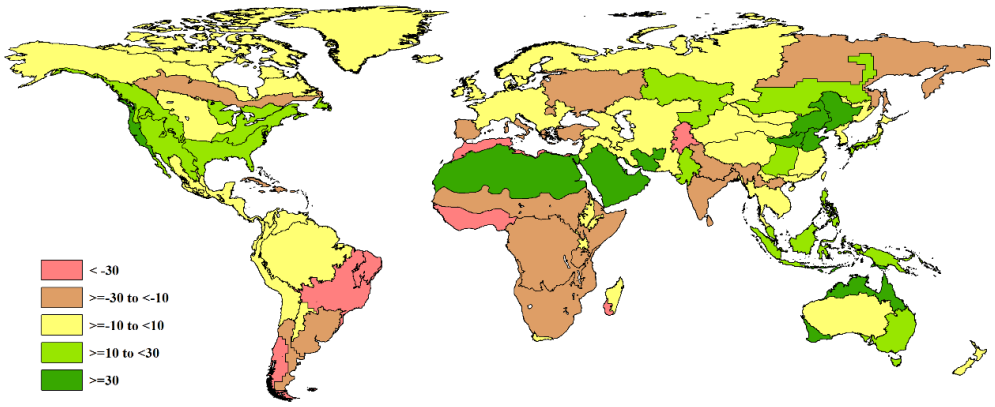

Figure 1.2 Global map of rainfall anomaly (as indicated by the RAIN indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2021 total from 2006-2020 average (15YA), in percent.

Below average rainfall conditions persisted for most of Brazil, Argentina, the south of Madagascar and California. A heavy storm caused flooding conditions in some parts of California on October 26 and brought rainfall levels up to average. However, most of the state is still under exceptional or extreme drought. A significant negative departure in rainfall was also observed for Westafrica and the Maghreb. Most of Sub-Saharan Africa received below average rainfall as well. The severe drought also continued in the Hindukush, causing a food crisis in Afghanistan. The entire Mediterranean region was also plagued by drought conditions. Rainfall was below average in Eastern Europe, Russia west of the Ural, the Himalayas and most of India. Eastern China as well as Australia received above average rainfall.

1.4 Temperatures

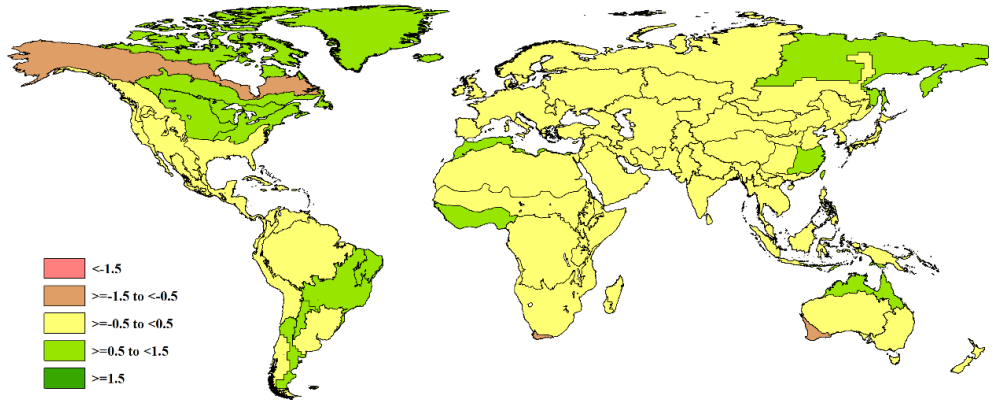

Figure 1.3 Global map of temperature anomaly (as indicated by the TEMP indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2021 average from 2006-2020 average (15YA), in ° C.

In the monitoring period, the average temperatures in most MRUs did not depart much from the long-term averages except Arctic regions The Mid-west of the USA and the Canadian Prairies experienced slightly warmer than average temperatures. The average temperature in the Boreal America region from Alaska to northern Canada was below average. Similarly, temperatures in the crop production regions of Brazil and Southeast of China were also above average.

1.5 RADPAR

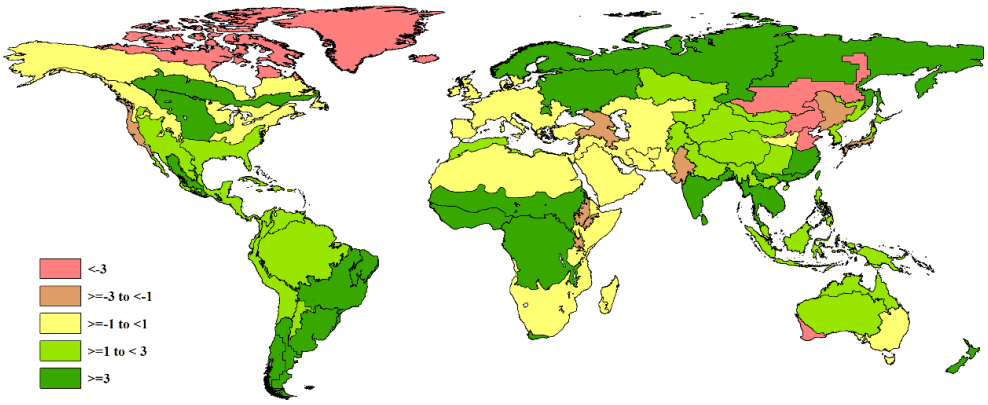

Figure 1.4 Global map of photosynthetically active radiation anomaly (as indicated by the RADPAR indicator) by CropWatch Mapping and Reporting Unit: departure of departure of July to October 2021 total from 2006-2020 average (15YA), in percent.

Radiation was above average for all of South America, Central America, the South and Great Plains of the USA and Sub-boreal America in the Canadian Prairies, the European region from Ukraine to Ural mountains, Boreal Eurasia to Eastern Siberia, the Asian region from Pamir area, Ural to Altai mountains, Southern Himalayas, Gansu-Xinjiang (China), Qinghai-Tibet (China) to Southern China, Mainland Southeast Asia and Maritime Southeast Asia. Most of central Africa also received higher solar radiation. Strong negative departures were observed for Inner Mongolia (China) and Huanghuaihai (China), as well as Nullarbor to Darling in the South West of Australia, where rainfall exceeded the average by more than 30%.

1.6 BIOMSS

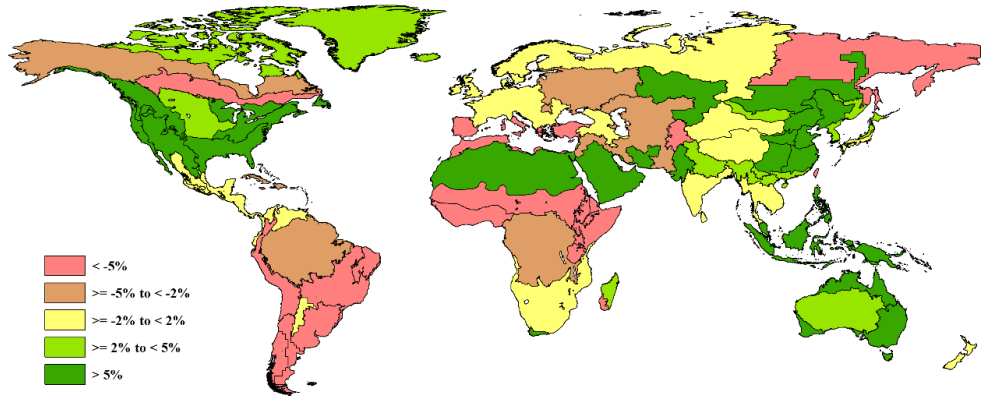

Figure 1.5 Global map of biomass accumulation (as indicated by the BIOMSS indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2021 from 2006-2020 average (15YA), in percent.

The Biomass product is calculated as a function of temperatures, rainfall and solar radiation. The map shows a strong positive departure for most of the USA, Eastern Asia and Australia. Apart from the western regions of the USA, the increase in biomass was fueled by positive rainfall departures. Biomass production was estimated to be below average in most of South America, South of the Sahara Desert in Africa, Ukraine to Ural mountains and Eastern Siberia in Eurasia, where rainfall was also below average.