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). Rainfall, temperature, and radiation indicators are compared to their average value for the same period over the last fifteen years (called the "average"), while BIOMSS is compared to the indicator's average of the recent five years. Indicator values for all MRUs are included in Annex A table A.1. For more information about the MRUs and indicators, please see Annex C and online CropWatch resources at www.cropwatch.com.cn.

1.1 Overview

CropWatch Agroclimatic Indices (CWAIs) are averages of climatic variables over agricultural areas only (refer to Annex A for definitions and to table A.1 for October 2018 to January 2019 (JASO) numeric values.) Although they are expressed in the same units as the corresponding climatological variables, they are spatial averages, weighted by the agricultural production potential. For instance, in the "Sahara to Afghan desert" area, only the Nile valley and other cropped areas are considered. "Sahara to Afghan desert" is one of the 65 CropWatch Mapping and Reporting Units (MRU), which are the largest monitoring units adopted to identify global climatic patterns. They are listed in annex C.

We also stress that the reference period, referred to as "average" in this bulletin covers the 15 year period from 2004 to 2018. Although departures from the 2004-2018 are not anomalies (which, strictly, refer to a "normal period" of 30 years), we nevertheless use that terminology. The listed departures from average differ from but are consistent with other sources such as NOAA or COPERNICUS which use longer and less recent reference period of 30 or 100 years. 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 agronomic indicators (such as BIOMSS and other indicators used in subsequent chapters) we adopt an even shorter reference period of 5 years (i.e. 2014-2018). 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) at MRU scale derive directly from climatology. For instance, the positive correlation (R=0.373) between rainfall and temperature results from high rainfall in equatorial, i.e. in warm areas. Therefore, this description of very large global climatic patters focuses on departures from average variables, i.e. anomaly patterns which characterize the current reporting period more meaningfully than the averages themselves (Figure 1.1). During the current ONDJ period, rainfall anomalies show a weak positive correlation with TEMP anomalies (R=-0.211), but a stronger link with RADPAR anomalies (-0.522), indicating the expected association between cool temperature and rainfall and between drought and above average sunshine. For BIOMSS departures the stronger association (R=0.806) results directly from the definition of the indicator. It is noted, however, that only 64% of BIOMSS variability can be assigned to rainfall, which is a relatively low value in comparison to previous monitoring periods.

Figure 1.1. Relations between anomalies over the 65 MRUs

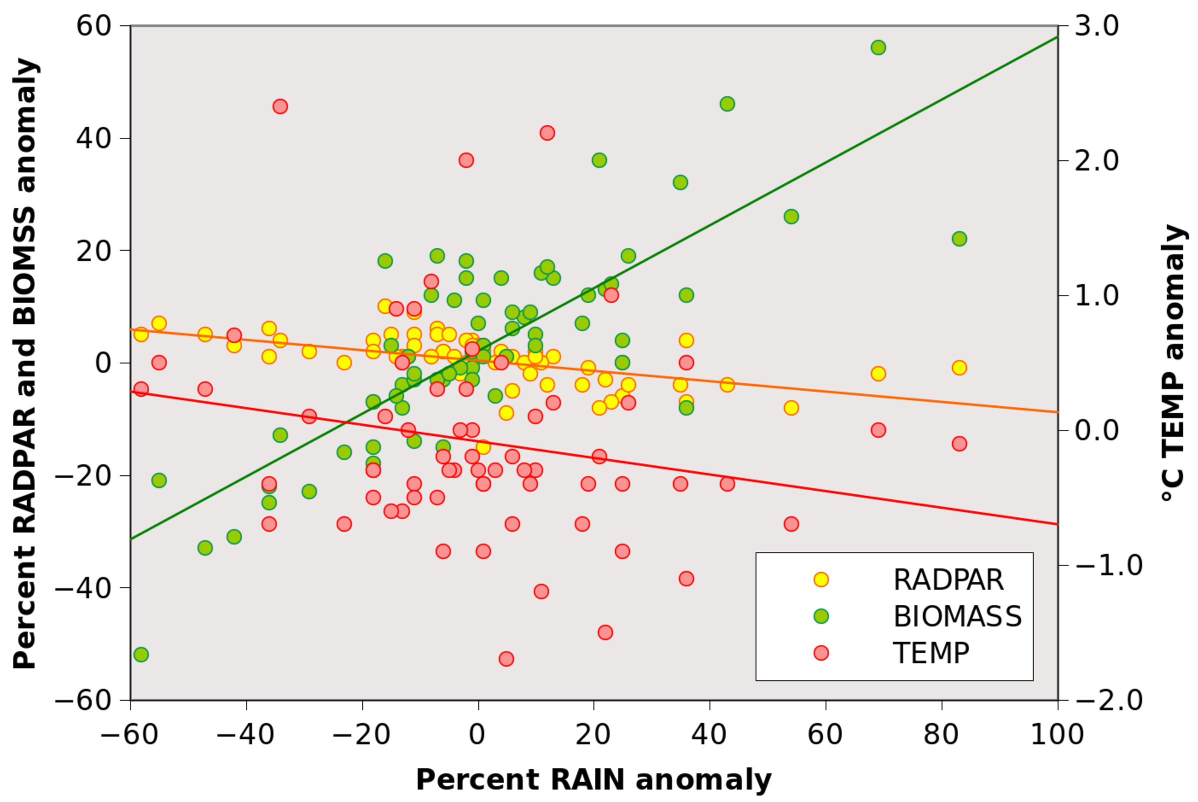
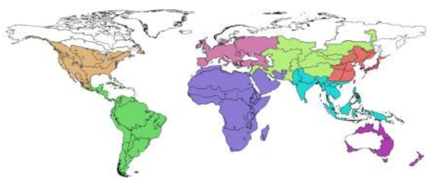


Table 1.1 Departure from recent 15 year average of the RAIN, TEMP and RADPAR indicators over the last year (in % and °C as indicated in the table, average of 65 MRUs, unweighted)

Reporting period	Year	CropWatch indicators		
		RAIN %	TEMP °C	RADPAR %
JFMA	2017	+13	-0.2	-2
AMJJ	2017	+9	-0.1	-2
JASO	2017	+6	+0.1	-3
ONDJ	2017-2018	+8	-0.1	-4
JFMA	2018	+8	-0.1	-5
AMJJ	2018	+5	-0.2	-3
JASO	2018	+12	-0.1	1
ONDJ	2018-2019	+1	-0.1	0

Table 1.2 Departures from the recent 15-year average of CropWatch agroclimatic indicators over regional MRU groups. Within each group, averages are weighted by the agricultural area of individual MRUs. "Others" include five non agricultural areas shown in white in the map.

	RAIN %	TEMP °C	RADPAR %	BIOMSS %
Africa	4	-0.2	2	3
America S+C	-2	-0.5	2	-1
America N	33	-0.5	-5	12
Asia Centre	10	0.2	-1	9
Asia East	-17	0.3	-3	-7
Asia South	-9	-0.1	2	0
Europe	2	-0.2	3	6
Oceania	-10	0.5	1	-7
Others	-1	0.8	0	11
World	**4**	**-0.2**	**1**	**3**



1.2 Abnormal rainfall patterns

RAIN was below average in about 52% of the MRUs, with RAIN being 1% above the average value of the 15-year reference period (2004-2018) over agricultural areas [FOOTNOTE 3] (Table 1.1). The globally average value nevertheless includes some large positive and negative departures, essentially in Asia (East and south, -17% and -9%, respectively) and Oceania (-10%) and in North America (+33%); refer to table 1.2. Additional detail is provided below. The globally average rainfall contrasts with both the situations during the previous reporting period (+12%) and the corresponding period in 2017-18 (+8%).

Most below average rainfall areas are consistent with El Niño patterns (refer to section 5.4) with deficits more severe than 20% occurring in Western Cape in South Africa (MRU 10, -58%), Australia (MRU 55, Nullarbor to Darling at 23%), maritime Southeast Asia (MRU 45, -29) and the Caribbean (MRU 20, -36%). Eastern Asia and China had several areas with unfavourable precipitation, especially the island of Hainan (MRU 33, -55%), Southern Japan and the southern fringe of the Korea peninsula (MRU 46, -47 %), Inner Mongolia (MRU 35, -42%), Qinghai-Tibet (MRU 39, -36%) and North-east China (MRU 38, -34%). Several of the listed areas practice winter crop cultivation and will start their growing season with insufficient soil moisture storage if rainfall will be short in February and subsequent months.

Figure 1.2 shows that some other areas also experienced water deficits, especially central America with northern South America and southern Asia. Although their rainfall deficits were less severe (-11% to -13%) Southern Africa (MRU 44) and especially the East African Highlands (MRU 02) and the Horn of Africa (MRU 04) are also mentioned because of the ongoing humanitarian emergencies which will be made worse in case of poor harvests.

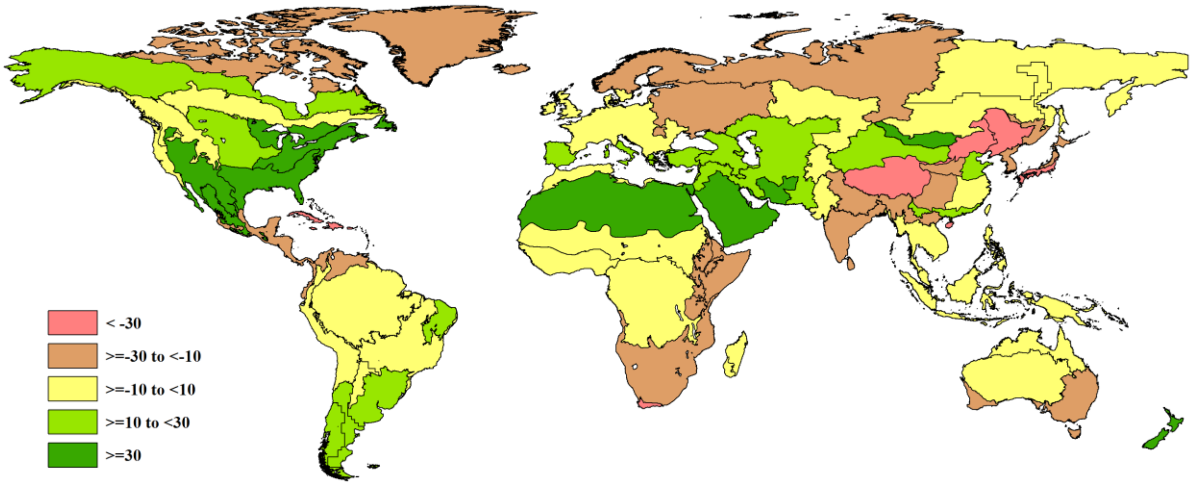
High precipitation volumes sometimes resulting in floods, destruction and loss of life (refer to section 5.3 on disasters) are reported from all continents. In Asia excesses affected Southern China 21% (MRU 40), Gansu-Xinjiang +25% (MRU 32), Western Asia +26% (MRU 31) and MRU 47 (Southern Mongolia) at +83% (175 mm instead of 96 mm). MRU 64 is adjacent to this area and covers the large area from the Afghan desert to the Sahara (+69%).

In America we need to mention some northern continental areas such as MRU 12 (Northern Great Plains +25%), two MRUs with excesses close to 35% (MRU 13, the Corn Belt; MRU 18, SW U.S. and N. Mexican highlands), MRU 17 (Sierra Madre +43%) and MRU 14 (Cotton Belt to Mexican Nordeste with +54%). In the southern continent, the Semi-arid Southern Cone (MRU 28) was at +22%.

Similar values are reported from MRU 29 in Europe (+23%)

Finally, Oceania suffered from both drought and floods, with New Zealand reaching a net excess of +36%, after along run of water deficit periods.

Figure 1.2. Global map of rainfall anomaly (as indicated by the RAIN indicator) by country and sub-national areas, departure from 15YA between between October 2018 and January 2019



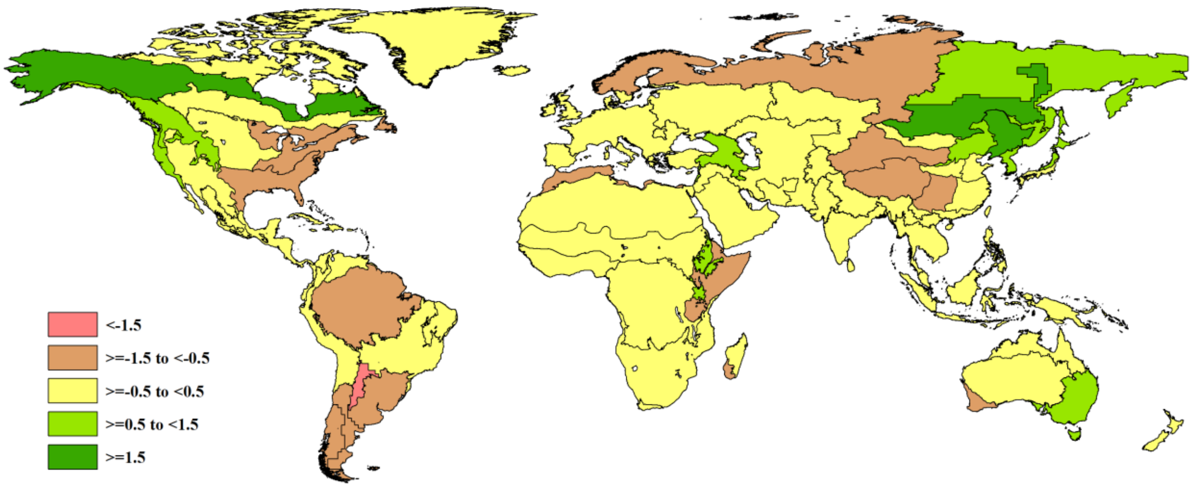
1.3 Abnormal temperature patterns

TEMP was close to average almost everywhere (-0.1°C and -0.2°C, respectively for unweighted and weighted averages; Tables 1.1 and 1.2), showing more significant negative departures in the American continent and positive ones in Oceania. 60% of MRUs had below average temperature.

Lower than normal temperatures concentrate in America, especially central-north Argentina (MRU 25) 1.7°C below average, the semi-arid Southern Cone (MRU 28, -1.5°C), Western Patagonia (MRU 27, 1.2°C) and the Corn Belt (1.1°C below seasonal norms ion MRU 13). Some adjacent areas are affected as well.

Unseasonally high temperature occurred in the Caucasus (MRU 29, +1.0°C), in north-eastern China (MRU 38, +2.4°C) and in some agriculturally less important areas.

Figure 1.3. Global map of temperature anomaly (as indicated by the TEMP indicator) by country and sub-national areas, departure from 15YA between October 2018 and January 2019



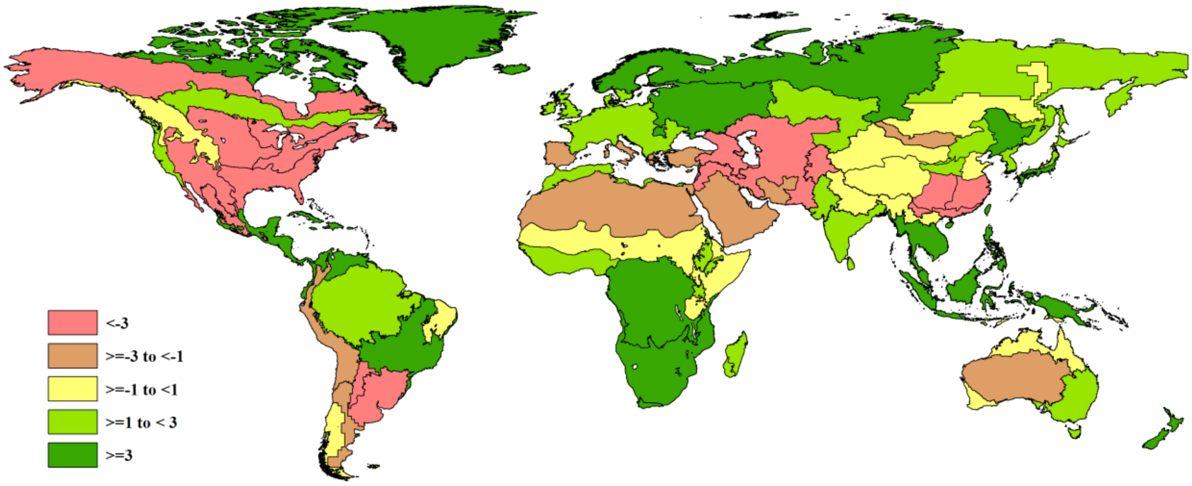
1.4 Photosynthetically Active Radiation (PAR) patterns

RADPAR was above average in 69% of the MRUs. The departures were mostly weak and the global average sunshine departure reaches 0% and 1%, respectively, for unweighted and weighted averages (Tables 1.1 and 1.2). The largest negative departures occurred in North America (−5%) and in eastern Asia (−3%) while Europe recorded the largest positive anomaly (+3%). The previous CropWatch bulletin covering the JASO period stressed that the RADPAR departure was positive after a run of negative values.

Therefore, the last six months constitute the first close to average sunshine period after a run of negative departures. Because MRUs are large areas, and because sunshine tends to be less variable than rainfall or temperature, small departures are more significant than they are for other variables.

Unusually low values in Asia affected MRU 37 (Lower Yangtze, -15%), MRU 40 (Southern China -8%) and MRU 41 (Southwest China -7%). In the American continent, areas with poor sunshine include (in the south) MRU 25 (Central-north Argentina -9%) and MRU 14 (Cotton Belt to Mexican Nordeste -8%) and in the north the Corn Belt -7% (MRU 13) and the Northern Great Plains -6% (MRU 12). In Eurasia low values occur in the Caucasus (-7%, MRU 29) and in the Pamir area (-5%, MRU 30).

Figure 1.4. Global map of PAR anomaly (as indicated by the RADPAR indicator) by country and sub-national areas, departure from 15YA between October 2018 and January 2019.

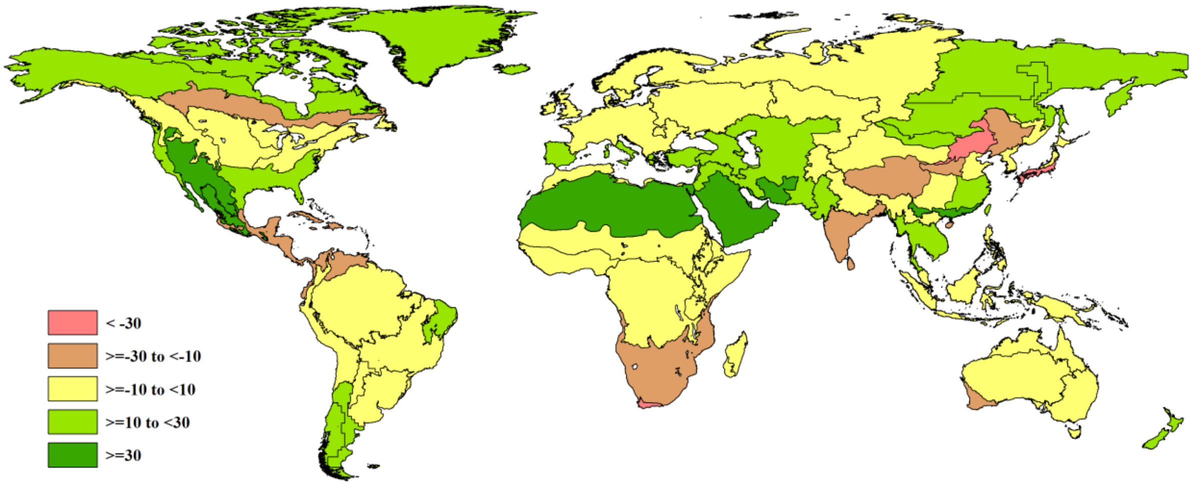


1.5 Biomass Production Potential (BIOMSS) patterns

Contrary to the indicators above, BIOMSS departures refer to the recent 5-year period, as mentioned above. Lower than average values occur in 41% of the monitored MRUs, with the count including the marginally agricultural areas referred to as “others” in Table 1.2. At 7%, both Oceania and East Asia recorded the lowest values. The most favourable values occur in Europe (+6%), central Asia (+9%) and the northern part of the American continent, mostly in the west and south (+12%). Because of the normally close association between RAIN and BIOMSS, the departures from average differ essentially when the recent five years experienced conditions that differ from the recent 15 years average, creating a short-term disruption in farming. Areas BIOMSS and RAIN vary in opposite directions are rare. They include the Corn Belt (MRU 13) where rainfall increased 36% over average (15 years) but the biomass production potential dropped 8% due to a combination of unfavourable conditions compared with recent years, including cold weather (-1.1°C) associated with low sunshine.

The opposite situation (i.e. increased BIOMSS combined with RAIN below average) mostly occurs in Boreal latitudes and, therefore, remains of limited impact on agriculture

Figure 1.5. Global map of October 2018 to January 2019 biomass anomally (as indicated by the BIOMSS indicator) by country and sub-national areas, departure from 5YA



1.6 Combinations of departures

The most notable combination of abnormal4 weather occurred in the already mentioned Corn Belt (MRU 13), one of the major global crop production areas. RAIN, TEMP and RADPAR recorded the following anomalies: +36%, -1.1°C and -7%, respectively. If less severe criteria are adopted, e.g. departures in the top or bottom 20%, additional areas to be listed include the Cotton Belt to Mexican Nordeste (MRU 14; +54%, -0.7°C, -8%, in the same order as above), the Caucasus (MRU 29; +23%, +1.0°C, 7%) and the southern Chinese island of Hainan (MRU 33; 55%, +0.5°C and +7%). When the analysis is limited to just rainfall and temperature, the most abnormal conditions prevailed in north-eastern China (MRU 38; -34%, +2.4°C, +4%). With less stringent criteria (top and bottom 20), four Chinese MRUs need to be added, making the country – together with the US – one of the places with most unusual agro-climate: Gansu-Xinjiang (MRU 32; +25%,-0.9°C, 0%), Qinghai-Tibet (MRU 39; -36%, -0.7°C+1%) , Inner Mongolia (MRU 35; -42%, -0.7°C, +3%) and North-east China (-34%, +2.4°C and +4%).

Exceptional weather also affected the southern hemisphere, in particular Oceania (MRU 55, Nullarbor to Darling in southern Australia with -23%, -0.7°C and 0%; MRU 56, i.e. New Zealand at +36%, +0.5°C and +4%) and south America (MRU 56; +22%, -1.5°C and -3%).