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 Correlations between CropWatch agroclimatic indicators (CWAIs)

CWAIs are averages of climatic variables over agricultural areas only (refer to Annex XXXX for definitions and to table A.1 for 2018 AMJJ 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.

Correlations between variables (RAIN, TEMP, and RADPAR) at MRU scale derive directly from climatology. For instance, the positive correlation between rainfall and temperature (R=0.469 for the current AMJJ 2018 period) results from high rainfall in equatorial, i.e. in warm areas. Therefore, departures from average variables, i.e. anomaly patterns characterize the current reporting period more meaningfully than the averages themselves.

RAIN was above average in about 52% of the MRUs, resulting in RAIN just 3% above the average value of the 15-year reference period (2003-2017) over agricultural areas. TEMP was slightly below average (-0.2°C) in most MRUs while RADPAR was below average in the majority of MRUs (45 out of 65, or 69%) resulting in a more significantly below the average value of -2%. Because MRUs are large areas, and because sunshine tends to be less variable than rainfall and temperature, the 2% departure for RADPAR is more significant than it would be for rain. Finally, the biomass production potential BIOMSS depends on rainfall and temperature. During the current reporting period, 75% of its variations can be ascribed to RAIN variations and about 7% only to TEMP. As a result, the global average is 2% above normal, but 0% if weighted by agricultural areas.

During the current AMJJ reporting period, rainfall anomalies tend to be negatively correlated with TEMP and with RADPAR departures, indicating the expected association between drought and high temperature and sunshine.

Above average RAIN and lower than average RADPAR are the continuation of a pattern that started in 2017 (Table 1.1) and which is bound to have agricultural consequences as sunshine is the major driver of photosynthesis. It remains to be seen if the increased precipitation can compensate reduced sunshine, especially in semi-arid areas, which include most rangelands.

Table 1.1. Departure from recent 15 year average of the RAIN, TEMP and RADPAR indicators over the last year (average of 65 MRUs)

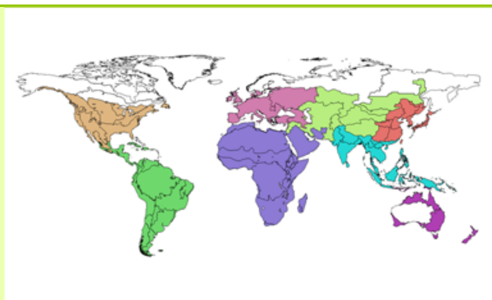
Reporting period	year	CropWatch Indicator		
		RAIN	**TEMP**	**RADPAR**
JFMA	2017	+13%	-0.2°C	-2%

AMJJ	2017	+9%	-0.1°C	-2%
JASO	2017	+6%	+0.1°C	-3%
ONFJ	2017-2018	+8%	-0.1°C	-4%
JFMA	2018	+8%	-0.1°C	-5%
AMJJ	2018	+5%	-0.2°C	-3%

Most of the semi-arid areas in Africa and Asia continued the now pluri-annual trend of above-average precipitation. In fact, the largest positive rainfall departures occurred in Africa, central Asia, and South Asia while the largest deficit affects Oceania which recorded about half the amounts that fell over the recent 15 years (Table X2). Above-average temperature prevailed mostly over Europe while cool weather affected central and southern Asia. Below average sunshine seems to have become an Asian phenomenon, especially eastern Asian (i.e. mostly Chinese) with a very significant 7% drop compared to the long-term average. The largest biomass potential drops occur in (1) south and central America (-10%) as a result of low rainfall and cool weather and in (2) Oceania (-37%) where the precipitation deficit was severe, as mentioned.

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 right map.

	RAIN %	TEMP °C	RADPAR %	BIOMSS %
Africa	19	−0.5	−4	11
America S + C	−8	−0.5	1	−10
America N	−2	−0.1	−2	−1
Asia centre	13	−0.8	−5	8
Asia East	1	0.2	−7	2
Asia South	9	−0.6	−4	3
Europe	−1	0.9	2	−4
Oceania	−46	0.1	3	−37
Others	4	0.9	−2	−2
World	3	−0.2	−2	0



1.2 Rainfall and BIOMSS anomalies

In the MRUs listed below, BIOMSS departure patterns closely follow those of RAIN, take or give some percent. Some areas, however, that have atypical behaviors are specifically mentioned.

A. Drought

With few exceptions, dry conditions prevailed at high latitudes in both hemispheres, including some areas of limited agricultural relevance such as sub-boreal America (MRU-15), boreal Eurasia (MRU-57), eastern Siberia (MRU-51) and MRU-63, the Australian desert with deficits between 13% and 24%. The most severe deficits affected Australia and Mediterranean southern Africa which all recorded less than half of the average amounts which are in the range of 160 mm to 250 mm: MRU-10, Western Cape in South Africa (average: 157 mm); MRU-53, Northern Australia (average: 242 mm) and MRU-54 , Queensland to Victoria (average: 168 mm). Somewhat less severe, but significant deficits between -20% and -40% occurred in MRU-56, New Zealand (average: 307 mm) and MRU-55, Nullarbor to Darling (average: 213 mm).

Parts of China (MRU-42, Taiwan), Korea and Japan (MRU-43, East Asia) normally record precipitation in excess of 500 mm but this season rainfall was so far short by -28% and -24%, respectively. In the Caucasus (MRU-29) where the precipitation average is usually 229 mm, -14% less was recorded.

In South America, the tropical areas of Brazil were the most affected with MRU-23 (Central eastern Brazil) recording 177 mm instead of the average of 249 mm, down 29% and the semi-arid Nordeste (MRU-22) being down 22% (164 mm instead of 210 mm). Finally, in MRU-27 (Western Patagonia), which is a major supplier of sheep products in Chile and Argentina precipitation was down 27% below the average of 452 mm. BIOMSS, however, remained about average (-2%) as a result of below average temperature (-1.1°C).

In North America, MRU-16, the deficit on the US West coast was 23%, while it reached about 10% in MRU-17 (Sierra Madre) and MRU-13, the Corn Belt.

B. Wet conditions

Wet conditions prevailed over the area which was highlighted starting in 2016, i.e. the semi-arid areas from Africa to Central Asia, this time including MRU-07 (North African Mediterranean, +30%), MRU-09 (Southern Africa, +36%), MRU-04, the Horn of Africa (+51%), MRU-64 (Sahara to Afghan deserts, +63%), MRU-32 (Gansu-Xinjiang, +43%), MRU-47 (Southern Mongolia, +84%) as well as adjacent areas to the north (European Mediterranean, MRU-59) and east (e.g. Inner Mongolia, MRU-35) where departures were lower. Some of the listed areas are mentioned under “floods” in the section on disasters (Chapter 5.X). In Southern Mongolia, the BIOMSS departure reaches just 38%, less than half of the precipitation deficit.

Southern Asia also recorded seasonally abundant rainfall from Punjab to Gujarat (MRU-48, +26%) to Hainan island in southern China (MRU-33, +53%) across India (MRU-45, Southern Asia, +36%) and continental South-East Asia (MRU-50, +15%) and local floods were reported. In Hainan, a tropical island, a temperature deficit of 1.3°C resulted in a BIOMSS increase of just 17%.

Finally, two areas in South America deserve the semi-arid Southern Cone (MRU-28 where the average of 72 mm was exceeded by 38% and especially MRU-25 (Central-north Argentina) where the excess reached 71% (199 mm instead of the average of 116 mm). In the latter MRU, however, the BIOMSS departure did not exceed +28%.

Figure 1.1. Global map of April - July 2018 rainfall anomaly (as indicated by the RAIN indicator) by MRU, departure from 15YA (percentage)

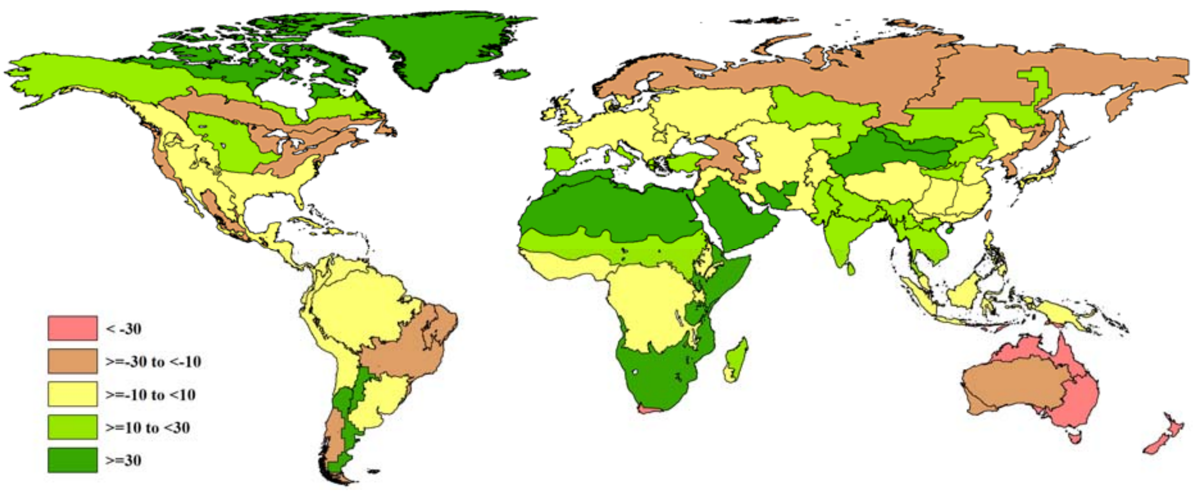
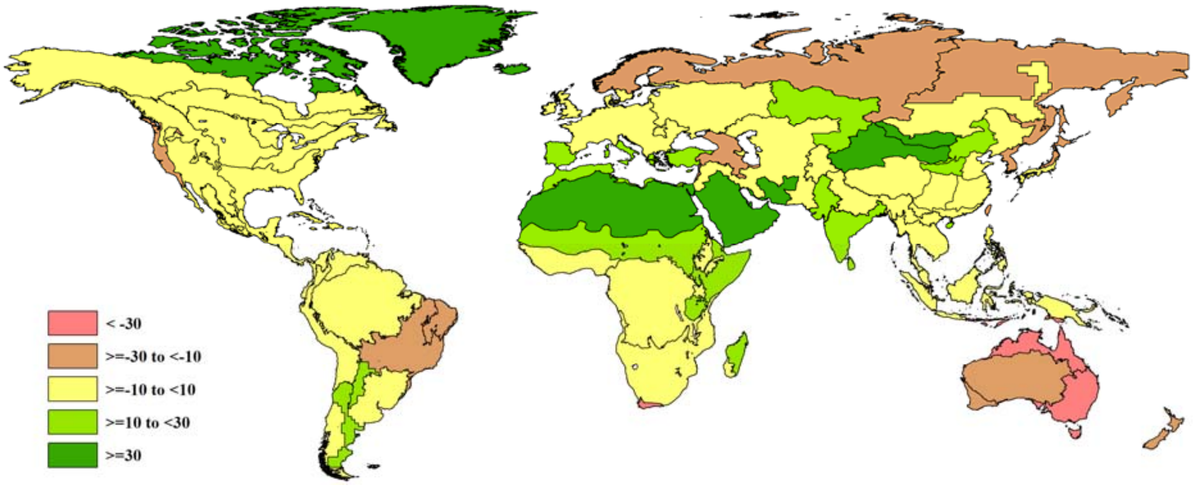


Figure 1.2. Global map April - July 2018 biomass accumulation (BIOMSS) by MRU, departure from 5YA, (percentage)



1.3 Temperature anomalies

Temperature anomalies to some extent follow rainfall anomalies (R=-0.302).

C. Below average temperature

Temperatures were below average in six areas that have been mentioned above. They do not, however, belong to the same clusters of anomalies as those noted for rainfall. In other words, some extremes of rainfall and temperatures overlap, but the spatial patterns are different. Low temperatures affect roughly the northern tropics from South America to Africa, and southern Asia to the mainland and maritime south-east Asia.

The largest negative departure was recorded over MRU-62 (Ural to Altai Mountains, where the departure was -1.8°C). The area is followed, in terms of the magnitude of the departure, by MRU-07 (North Africa-Mediterranean, -1.5°C) and the Horn of Africa (MRU-04, -1.2°C).

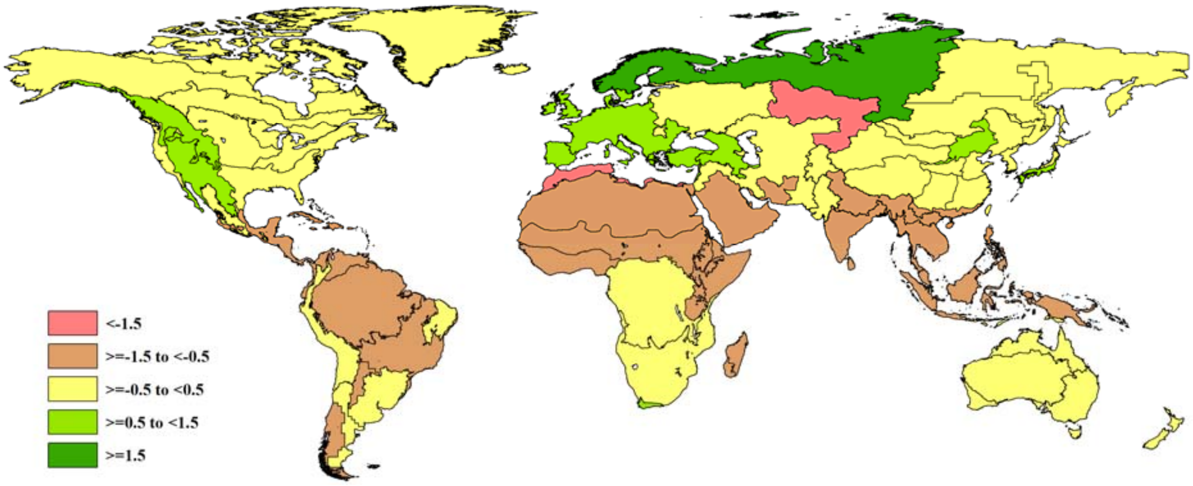
In MRU-33 (Hainan) and MRU-50 (Mainland South-east Asia) the respective deficits were -1.3°C and -1.1°C)

Finally, MRU-27 (Western Patagonia) recorded an average of 5.8 °C, 1.1°C below average.

D. Above average temperature

Above-average temperature relatively consistently affected the western north-American coast and the Rocky Mountains (departures in the range of 0.5°C), and Western Europe to the Caspian Sea. In the second area, more significant departures occurred in MRU-59(Mediterranean Europe and Turkey, 1.0°C) and Western Europe as a whole (MRU-60, +1.4°C).

Figure 1.3. Global map of April - July 2018 air temperature anomaly (as indicated by the TEMP indicator) by MRU, departure from 15YA (degrees Celsius)



1.4 Radiation RADPAR anomalies

E. Below average sunshine

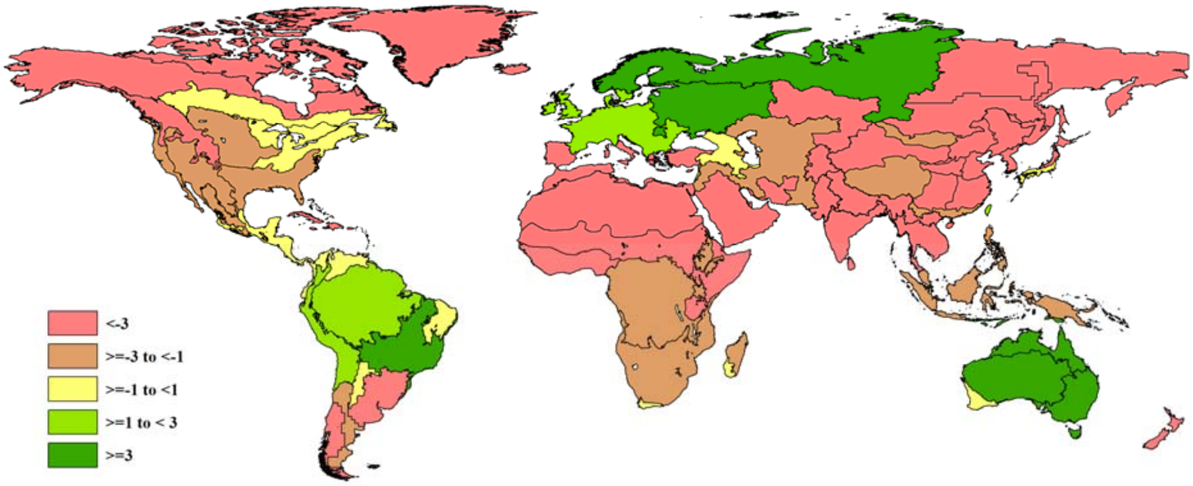
Below average sunshine has been the norm over most of North America and the Caribbean, southern South America, Africa and all of Asia except the west. The largest departures consistently occurred in China, in particular, MRU-34 (Huanghuaihai, -15%), MRU-36 (Loess region, -14%), MRU-32 (Gansu-Xinjiang, -9%), MRU-35 (Inner Mongolia, -8%) and MRU-38 (North-east China -7%). The MRU bordering this area to the north (MRU-52, Eastern Central Asia) suffered a deficit of 9%. To the south, the sunshine deficit area extends to India, the south-east Asian Islands, and New-Zealand. The MRUs affected are too numerous to be listed in detail. Suffice it to say that MRU-48 (Punjab to Gujarat, -7%) recorded the lowest sunshine in the area.

In Africa, MRU-07 (North Africa-Mediterranean, -7%) and MRU-03, the Gulf of Guinea (-7%) need to be mentioned.

F. Positive sunshine departures

Positive sunshine departures are rare and their magnitude is much less than for sunshine deficits. MRU-60 (non-Mediterranean Western Europe) and MRU-58, the area encompassing Ukraine to the Ural Mountains recorded +3% and +4% increases above average, respectively. In South America MRU-23 (Central eastern Brazil) is listed with +4%, the same value as in Oceania, MRU-54, Queensland to Victoria.

Figure 1.4. Global map of April - July 2018 PAR anomaly (as indicated by the RADPAR indicator) by MRU, departure from 15YA (percentage)



1.5 combinations of extremes

For the following discussions, variables have been considered to be “extreme” when they fall into the upper or lower quintiles of the departures from average of RAIN, TEMP, and RADPAR.

If we ignore Boreal Eurasia (MRU-57), only two MRUs are characterized by extreme values for the three above-mentioned CWAIS: The Mediterranean coast of North Africa (MRU-07) and Hainan. Both were characterized by excess precipitation (+30% and +53, respectively), below average TEMP (-1.5°C and 1.3°C) and low sunshine (7% and -6%). In the case of Hainan, the abundant precipitation derives from tropical cyclone Son-Tinh, which crossed the island twice (refer to the section on disasters for more detail).

Combined abnormal RAIN and TEMP occurs in three MRUs and corresponds to three different situations: low rainfall (-53%) and high temperature (+0.8°C) in Western Cape (MRU-10) in South Africa; low rainfall (-27%) and low temperature (-1.1°C) in Western Patagonia and high rainfall (+51%) and low TEMP (-1.2°C) in the Horn of Africa.

Not surprisingly, numerous combinations of anomalous RADPAR with anomalous RAIN and TEMP do occur.

In the case of RAIN and PAR, temperature departures are mostly weak and comprised between 0.6°C and +0.3°C. A first group includes essentially three MRUs with a shortage of RAIN (24% to -51%) and positive RADPAR departures (+1% to +4%): MRU-54 (Queensland to Victoria), MRU-23 (Central eastern Brazil) and MRU-42 (Taiwan). The second group, with high RAIN (+26% and +43%) and low RADPAR (-7% and 9%) includes MRU48 (Punjab to Gujarat) and MRU-32 (Gansu-Xinjiang).

The group of MRUs with abnormal TEMP and RADPAR includes 8 MRUs but there is, otherwise, little homogeneity. A first typical pattern includes the Gulf of Guinea countries (MRU-03) and the Sahel (MRU-08) where precipitation was relatively abundant with low TEMP and low RADPAR. A second pattern is characterised by positive TEMP departures (0.4°C to 1.4°C) while RADPAR underwent positive of negative departures: MRU-58 (Ukraine to Ural Mountains) and MRU-60 (Western Europe) with high sunshine and MRU-34 (Huanghuaihai) and MRU-38 (North-east China) with negative RADPAR (-15% and -7%, respectively).