

## Information on the climate in 2019

Station: Luxembourg/Findel-Airport (WMO 06590, 376 m, a.s.l.)

Reference period: WMO normal period 1981 to 2010 (tables: 1981 to 2010 and 1961 to 1990)

### 1. Air temperature

#### Anomalies with respect to 2019

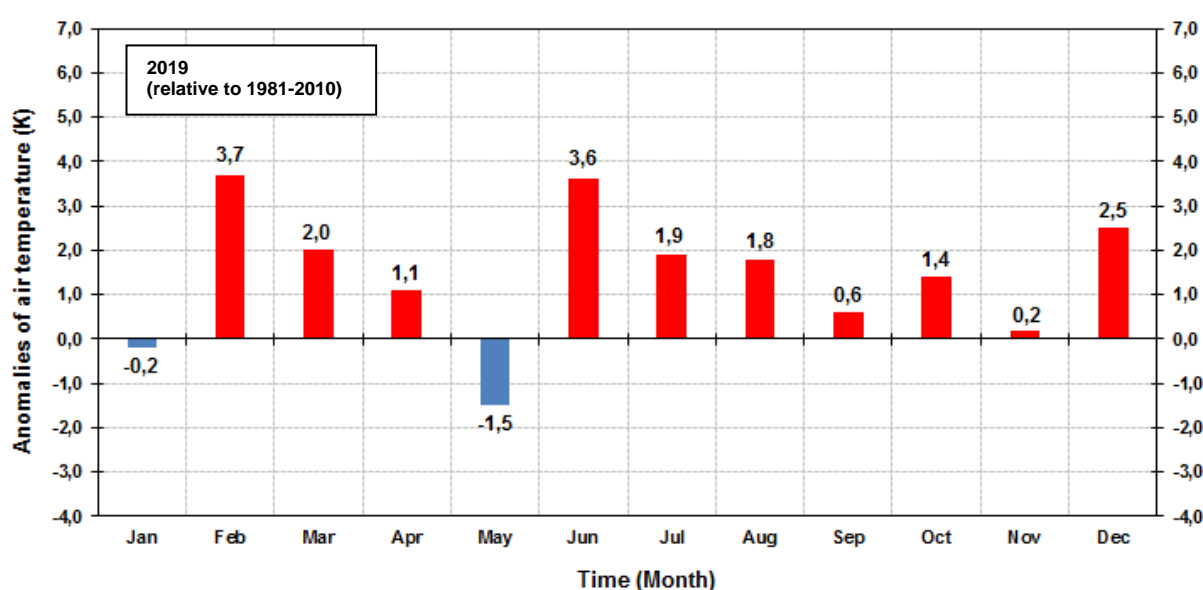
The annual mean air temperature for 2019 calculated by MeteoLux for its station at Luxembourg/Findel-Airport was 10.7 °C. The anomaly of the annual mean air temperature relative to the average of the reference period from 1981 to 2010 resulted in plus 1.4 K. The total number of 52 frost days was above the long-term climate normal (44 days) and the number of 6 ice days was considerably lower than the normal (12 days). In 2019 the number of summer days (49) and hot days (16) exceeded the normal significantly by 15 days, respectively 12 days.

#### Anomalies with respect to seasons

The winter 2018/2019 showed a mean air temperature of 3.2 °C, deviating plus 1.8 K from the normal. In winter 2018/2019 the days with frost (40) were below the normal of 51 days and the number of ice days (10) was significantly below the average of 16 ice days for the reference period 1981–2010. Spring mean air temperature (9.5 °C) was 0.5 K above the normal. The spring season was characterized by 6 frost days and no ice days. The number of frost days was below the long-term average (13 days). No summer days were observed in spring. The normal for this period is three days. The summer mean air temperature in 2019 was 19.7 °C, deviating by plus 2.4 K from the normal. During this summer 47 summer days and 16 hot days occurred. This significantly exceeds the climate normal (19, respectively 12 days). The seasonal average in autumn was 10.1 °C, which is 0.7 K above the long-term average (1981–2010).

#### Anomalies with respect to single months

In 2019 the majority of months except for January and May exceeded the 1981–2010 normal (Figure 1).



**Fig. 1:** Anomalies of monthly mean air temperatures (K) relative to the WMO normal period from 1981 to 2010 at Luxembourg/Findel (WMO 06590, 376 m, a.s.l.) in 2019.

Luxembourg was dominated by high-pressure periods in January. Air temperatures dropped significantly above snow-covered surfaces, in particular during the second half of the month. Monthly mean air-temperatures in January were 0.2 K below the climate normal. High-pressure over Western Europe caused warm southerly winds from the sub-tropics and exceptionally high air temperatures in February, especially during the third decade of the month. Air temperatures rose 3.7 K above the long-term average. The first half of March the weather in Central and Western Europe was dominated by low-pressure systems. During the second half of the month the high-pressure areas over Southern Europe moved more northward, causing also dry and calm weather in Luxembourg. Monthly mean air-temperatures in March were 2.0 K above the climate normal. Low-pressure systems during the first and third decade of April resulted in unsettled weather. The calm high-pressure periods during the middle of the month caused air temperatures to rise 1.1 K above the normal in April. In May air temperatures in Luxembourg were much below average (-1.5 K). This was due both to a cold northwesterly air flows from the Arctic region and due to lower solar radiation, respectively more cloudiness. The northwesterly circulation was driven by a high-pressure area over Greenland and a low-pressure area over the Atlantic Ocean west of Ireland. The average air temperature in June 2019 was higher than the 1981-2010 average for the month. Towards the end of the month Luxembourg experienced a short but record-breaking heat wave. Due to an extensive omega block that developed over Europe hot air masses from Africa were transported over the Mediterranean to Europe. Monthly mean air-temperatures in June were exceptionally high, thus 3.6 K above the climate normal. Like the previous heat wave in June, the high air temperatures resulted from an extensive omega block developed over Europe. With a low-pressure system west of Ireland and high pressure in the eastern part of Europe, hot air from the Sahara was transported over Western Europe. Compared to June, the July anomalies were lower in magnitude (1.9 K above normal), because during the first and second decade of July Atlantic lows impacted the weather in Luxembourg. Due to unsettled weather in August Luxembourg experienced air temperatures moderate above the 1981-2010 average for August (plus 1.8 K). Predominant high-pressure caused a steady decline of air temperatures in September. At the beginning of the second decade ground frost was observed in some parts of the country. Thus, air temperatures in Luxembourg were only slightly above the average (0.6 K). From the end of September Atlantic low-pressure systems prevailed and caused the advection of warm air into Central Europe. Monthly mean air-temperatures in October were 1.4 K above the climate normal. A change in the large-scale synoptic weather situation in November led to a monthly mean air temperature of 4.9 °C, deviating just plus 0.2 K from the long-term average. With only a few exceptions at the beginning and end of the month, low-pressure systems with generally moderate warm air prevailed in December 2019, resulting in a significant positive anomaly of 2.5 K.

**Table 1:** Monthly and annual mean air temperatures (°C) as well as anomalies (K) relative to the WMO normal periods from 1981 to 2010 and from 1961 to 1990 at Luxembourg/Findel (WMO 06590, 376 m, a.s.l.) in 2019.

2019	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Air temperatures (°C)</b>	0.6	5.3	7.2	9.8	11.5	19.5	20.1	19.5	14.5	10.9	4.9	4.3	10.7
<b>Normals (1981-2010)</b>	0.8	1.6	5.2	8.7	13.0	15.9	18.2	17.7	13.9	9.5	4.7	1.8	9.3
<b>Anomalies (K)</b>	-0.2	3.7	2.0	1.1	-1.5	3.6	1.9	1.8	0.6	1.4	0.2	2.5	1.4
<b>Normals (1961-1990)</b>	0.0	1.1	4.0	7.5	11.8	14.9	16.9	16.4	13.4	9.1	3.8	1.0	8.3
<b>Anomalies (K)</b>	0.6	4.2	3.2	2.3	-0.3	4.6	3.2	3.1	1.1	1.8	1.1	3.3	2.4

### Extremes and peculiarities

Air temperatures in 2019 (10.7 °C) were exceptional, 2019 was the third-warmest year since weather records began in 1947. With maximum air temperatures of 19.8 °C a new station record was established at Luxembourg/Findel-Airport on February 27, 2019. This value can be referred to as unprecedented.

February 2019 (5.3°C) was the third-warmest February in station history. The seasonal mean air temperature of 19.7 °C recorded during last summer at Findel Airport is the third-highest value ever recorded since 1947. This event can be referred to as exceptional. June 2019 (19.5°C) was the second-warmest June ever recorded since 1947. The maximum air temperatures, recorded at Luxembourg/Findel-Airport on July 25, 2019 (39.0 °C), exceeded the existing absolute record for August 8 and 12, 2003 (37.9 °C). This event can be referred to as unprecedented. In the morning hours of July 26, the highest minimum air temperature in station history (24.3 °C) has been measured at Luxembourg/Findel-Airport. With maximum air temperatures of 14.7 °C a new station record for the December was reached at Luxembourg/Findel-Airport on December 17, 2019. The maximum air temperatures slightly exceeded the existing absolute record from December 4, 1953 (14.6 °C). December 2019 (4.3°C) was the third-warmest December since records started in 1947.

## 2. Precipitation amount

In this report observed days of precipitation are based on daily sums between 06 UTC and 06 UTC on the following day.

### Anomalies with respect to 2019

The annual precipitation amount reached 781 mm in 2019. Annual rainfall was about 13.0% lower than the long-term average of 898 mm (1981 to 2010).

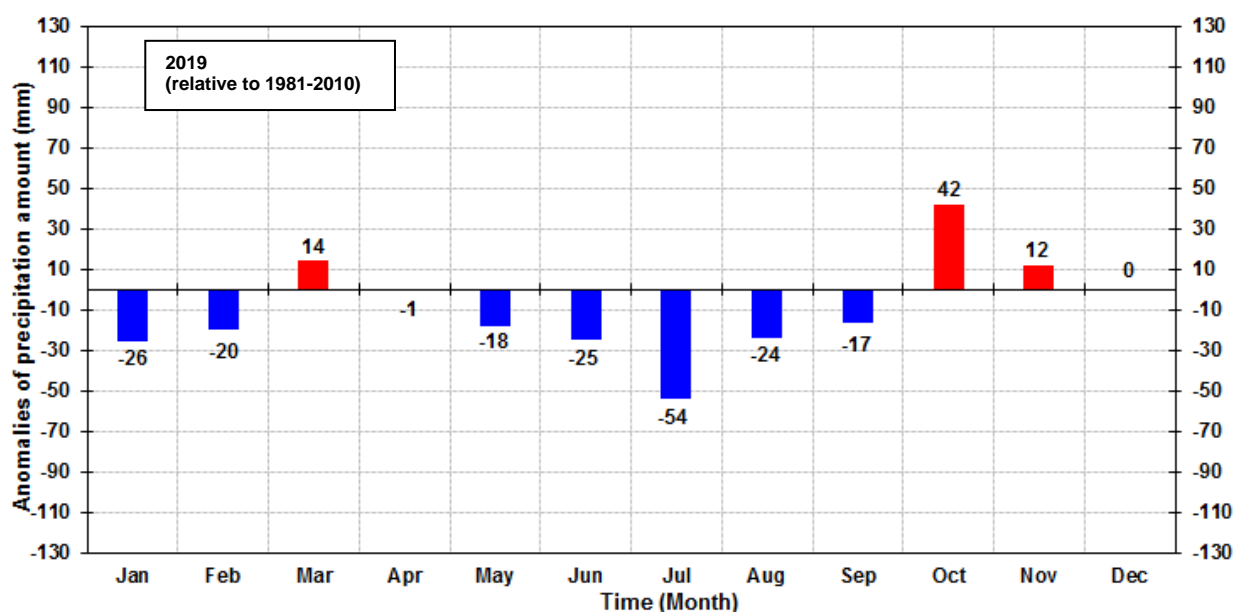
### Anomalies with respect to seasons

Seasonal precipitation in winter 2018/2019 amounted to a total of 262 mm at Luxembourg/Findel-Airport, about 16.0% above the long-term average (226 mm). In spring the precipitation amount reached 201 mm. The seasonal precipitation total was only slightly lower than the 1981 to 2010 climate normal (206 mm). Seasonal precipitation in summer amounted to just 123 mm, significantly below the normal (46%) for the 30-year period from 1981 to 2010 (226 mm). MeteoLux recorded 275 mm in autumn, thus above the normal (239 mm) at Findel-Airport. The number of precipitation days ( $\geq 0.1$  mm) in winter 2018/2019 reached 47, just close to the climate normal (48 days). During spring the precipitation days reached 48 days, slightly above than the long-term average (44 days). In summer the number of precipitation days (33) was below the climate normal (40 days). The number of precipitation days in autumn 2019 reached 48, thus slightly above the normal (46 days).

### Anomalies with respect to single months

With the exception of March, October, November, and December precipitation amounts throughout 2019 were all lower than the climate normal. Precipitation deficits occurred in January and February as well as during May and September, considerable deficits in July (Figure 2). Due to the partly blocked high-pressure patterns we experienced in general dry conditions over the month of January in Luxembourg. Single low-pressure systems throughout all decades of January 2019 caused some small amounts of precipitation. In January 51 mm of precipitation were measured, nearly 34% below the climate normal. Pronounced high-pressure periods during February still caused dry weather in Luxembourg. Precipitation amounts in February were only 43 mm, thus 32% below the climate normal. Intensive low-pressure systems throughout the first and mainly the second decade of March 2019 caused a series of strong winter storms and large amounts of precipitation.

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**Fig. 2:** Anomalies of monthly precipitation amount (mm) relative to the WMO normal period from 1981 to 2010 at Luxembourg/Findel (WMO 06590, 376 m, a.s.l.) in 2019. Observational days for precipitation are based on daily sums between 06 UTC and 06 UTC of the following day.

In March 83 mm of precipitation were measured, nearly 20% above the climate normal. Precipitation amounts in April (57 mm) were close to the climate normal (58 mm). At the end of the first and the beginning of the second decade in May Luxembourg was impacted by several low-pressure systems. Precipitation amounts of 61 mm in May were about 16% below the long-term average (79 mm). Due to the persistent omega block constellation over Europe during the second and third decade of June, precipitation amounts were only 55 mm, 25% below the normal (80 mm). Some high precipitation days occurred due to the eruption of heavy thunderstorms in the first part of June. Due to the extensive high pressure the dry conditions continued in July only 17 mm of precipitation was measured at Findel Airport, nearly 76% below the climate normal. The crossing of a deep low-pressure system, originating from the tropical Atlantic, caused some days with moderate precipitation and thunderstorms, including a F2 tornado in the southwest of Luxembourg at the end of the first August decade. August precipitation amounted to 51 mm, about 32% less than the long-term average.

**Table 2:** Monthly and annual precipitation amount (mm) as well as anomalies (mm) relative to the WMO normal period from 1981 to 2010 and from 1961 to 1990 at Luxembourg/Findel (WMO 06590, 376 m, a.s.l.) in 2019. Observational days for precipitation are based on daily sums between 06 UTC and 06 UTC of the following day.

2019	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation amount (mm)	51	43	83	57	61	55	17	51	59	129	88	87	781
Normals (1981-2010)	77	63	69	58	79	80	71	75	76	87	76	87	898
Anomalies (mm)	-26	-20	14	-1	-18	-25	-54	-24	-17	42	12	0	-117
Normals (1961-1990)	71	62	70	61	81	82	68	72	70	75	83	80	875
Anomalies (mm)	-20	-19	13	-4	-20	-27	-51	-21	-11	54	5	7	-94

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Predominant high-pressure in September caused below the average precipitation sums (-17 mm). From the end of September Atlantic low-pressure systems prevailed and caused unsettled weather for several weeks. Precipitation amounts in October were about 48% above the climate normal, in November 16% above the average. Due to frequent low-pressure systems, wet conditions prevailed in Luxembourg. Thus, precipitation amount in December 2019 reached 87 mm with no deviation from the climate normal.

### **Extremes and peculiarities**

No station records or extreme values regarding precipitation have been recorded at Luxembourg/Findel-Airport during 2019.