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Assessment of the 2018 main cropping season in the Democratic People's Republic of Korea

Concerns over the main crop production due to high temperatures and localised floods

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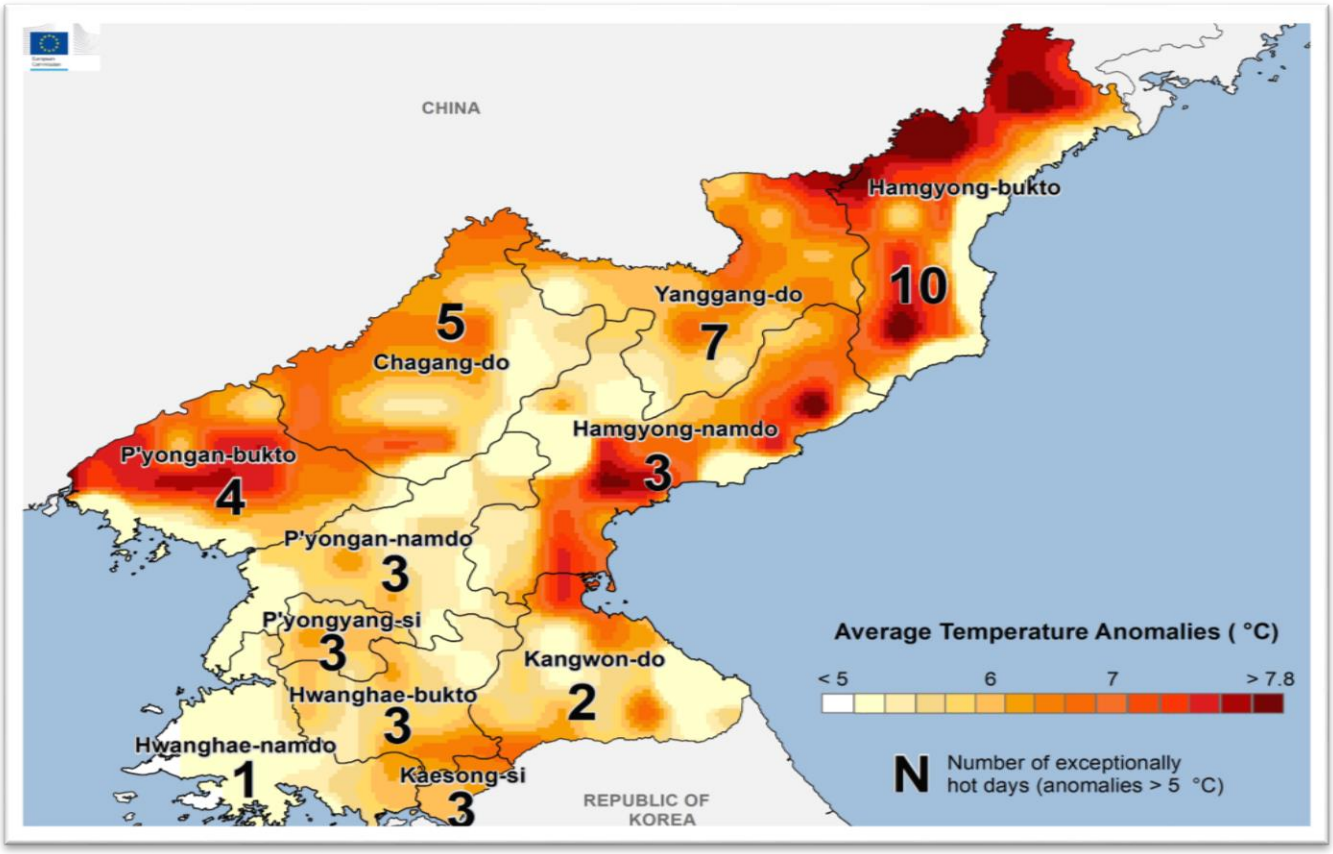
September 2018



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CONTENTS

Highlights:

- Main season crop production prospects for 2018 has been negatively affected by the combined effect of rainfall deficits at the beginning of August, high temperatures from mid-July to mid-August and floods at the end of August.
- The heatwave between mid-July and mid-August, with temperature anomalies above 5 degrees almost in the whole country, affected mainly rain-fed maize and potato crops.
- A reduction in maize production is expected because of the combined effects of yield reduction due to hot and dry weather and increased post-harvest losses due humidity brought by late abundant rains.
- Potato yield in the northern provinces is expected to decline by 20%.
- Excessive rains at the end of August led to localised flooding in the southern parts affecting irrigated paddy fields.

1 INTRODUCTION

Most of the DPRK agricultural production is concentrated in the southern and central provinces, accounting for about 62% of the annual farm production. The bulk of their production is mainly located in the so-called rice bowl area, i.e. North and South Pyongyang, Pyongyang, and North and South Hwanghae provinces (Figure 1 left). Paddy and maize are by far the major main season crops, contributing to about 80% of the national cereal production.

The main crop season extends from April to September/October, when harvest takes place (Figure 1 right). DPRK also has a secondary season that even though it is relatively small, with only 7% of the total annual production, it is important in terms of food security. In this secondary season, winter wheat and barley are sown in October-November and spring wheat, barley and potatoes are sown in March-April. Harvest takes place between June and early July, depending on the geographic location within the country.

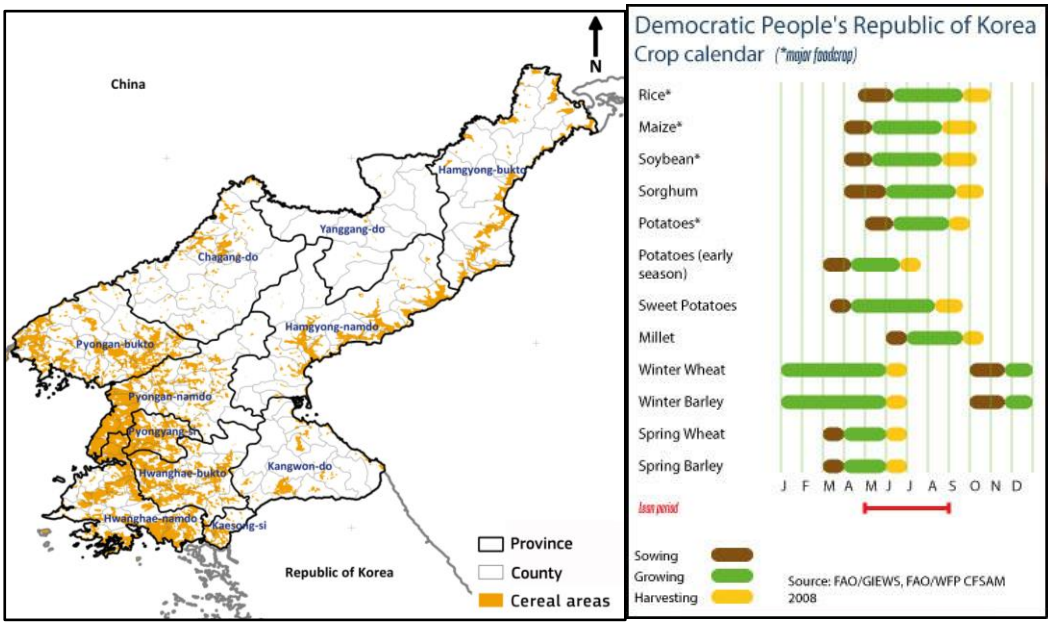

Figure 1. Left: Administrative regions and main cereal areas (MARS-JRC crop mask based on topography indicating areas with a slope <5°. **Right:** crop calendar of DPRK (source: www.fao.org/giews).

This report provides an early assessment of the ongoing 2018 main crop season in DPRK by analysing the meteorological and vegetation conditions until mid-September 2018. The analysis is based on time series of operational model data (0.25° grid) from ECMWF (OPE) for precipitation (P), average temperature (T_{av}) and maximum temperature (T_{max}), as well as NDVI time series derived from METOP-AVHRR satellite imagery (1 km grid). Precipitation and average temperature were the main climatic factors affecting crop yield in DPRK, whereas the NDVI informs on the actual crop development as observed by satellite-borne sensors.

2 RAINFALL

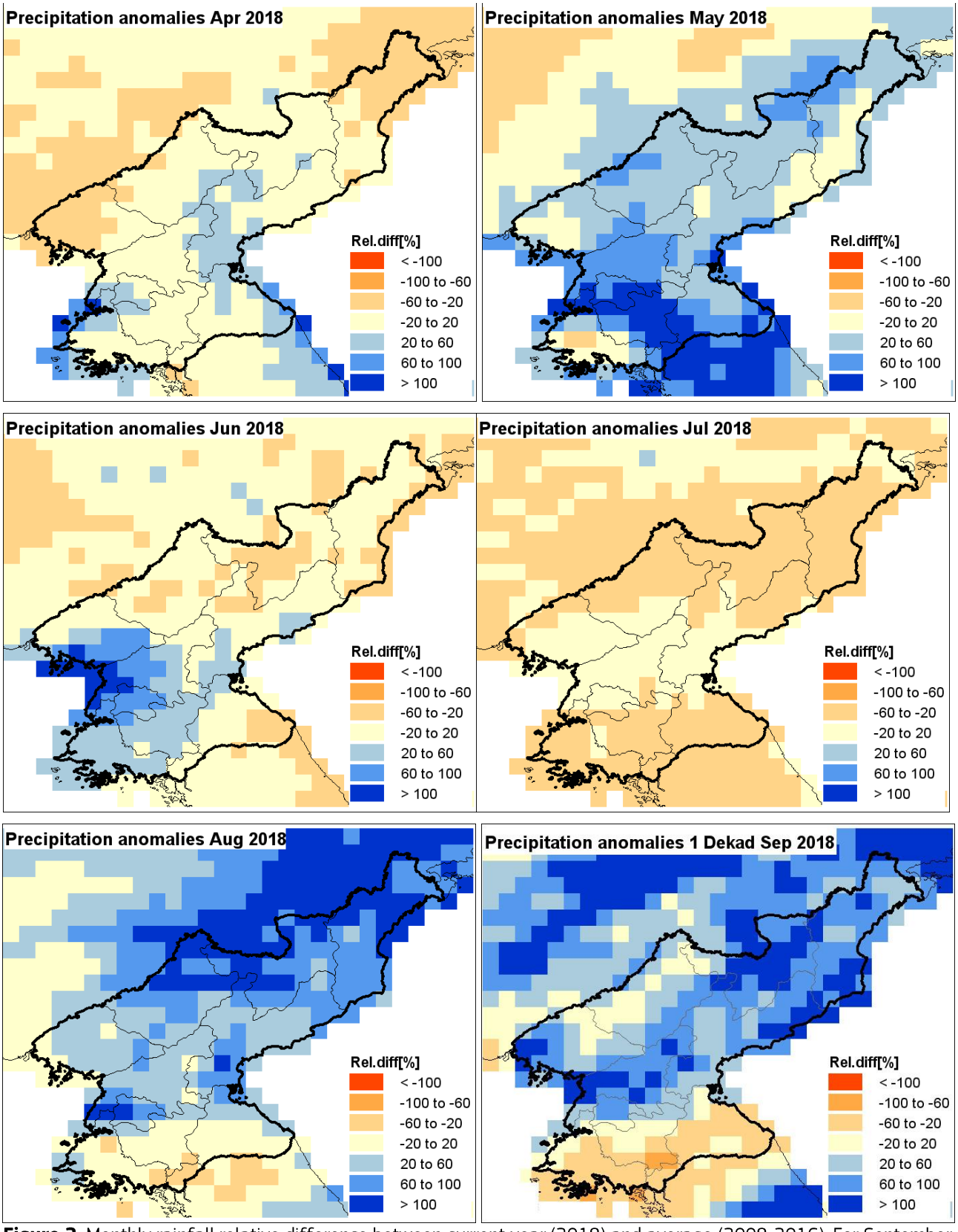

Figure 2. Monthly rainfall relative difference between current year (2018) and average (2008-2016). For September, only the first 10-day period is reported (Source: JRC, based on ECMWF OPE model data).

The 2018 total seasonal rainfall was slightly above average in the main agricultural areas, although erratic and irregular. The agriculture season begins in April, when planting of rice and maize takes place and can be prolonged until June, depending on water availability. The 2018 season had a timely onset at the beginning of April with rainfalls ranging from 10 to 50 mm, received over most of the country.

From May to early July, wetter and close to normal conditions prevailed in most parts of the country, benefiting planting and early development of crops. Situation deteriorated since mid-July with drier-than-normal conditions mainly in the most productive areas. At least, two consecutive dekads with below-average precipitation were recorded and even three in the rice bowl area (i.e. North and South Hwanghae provinces and North and South Pyongan provinces), resulting in soil moisture deficits (Figure 2). This was particularly concerning, as the dry spell coincided with unusual high temperatures across the country.

Cumulative precipitation remained average to above average during the 2018 cropping season (Figure 3), with an irregular distribution. Relative to last year, that was a dry one, there was an increase in the total amount. Figure 3 shows that precipitation volumes from April until end of June were generally average to above average, benefiting planting activities and development of vegetation in these early stages. At the beginning of August, a decrease in the total amount of rainfall is observed because of rainfall deficits. Indeed, cumulated precipitation amounts fell below average values at the beginning of August in almost all the regions, except in South Pyongan.

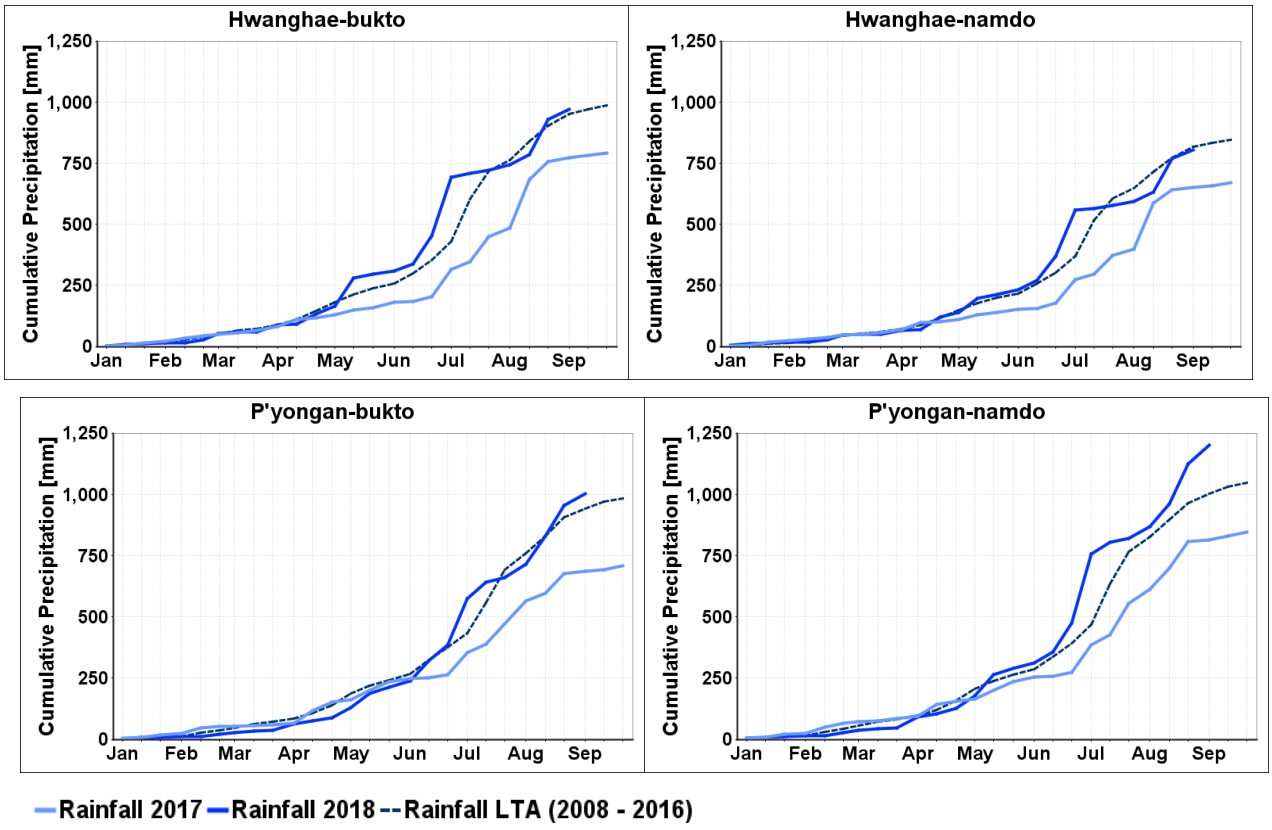

Figure 3. Profiles of cumulated precipitation in 2017 and 2018, and the long-term average (LTA). Profiles calculated as mean of all pixels within each province.

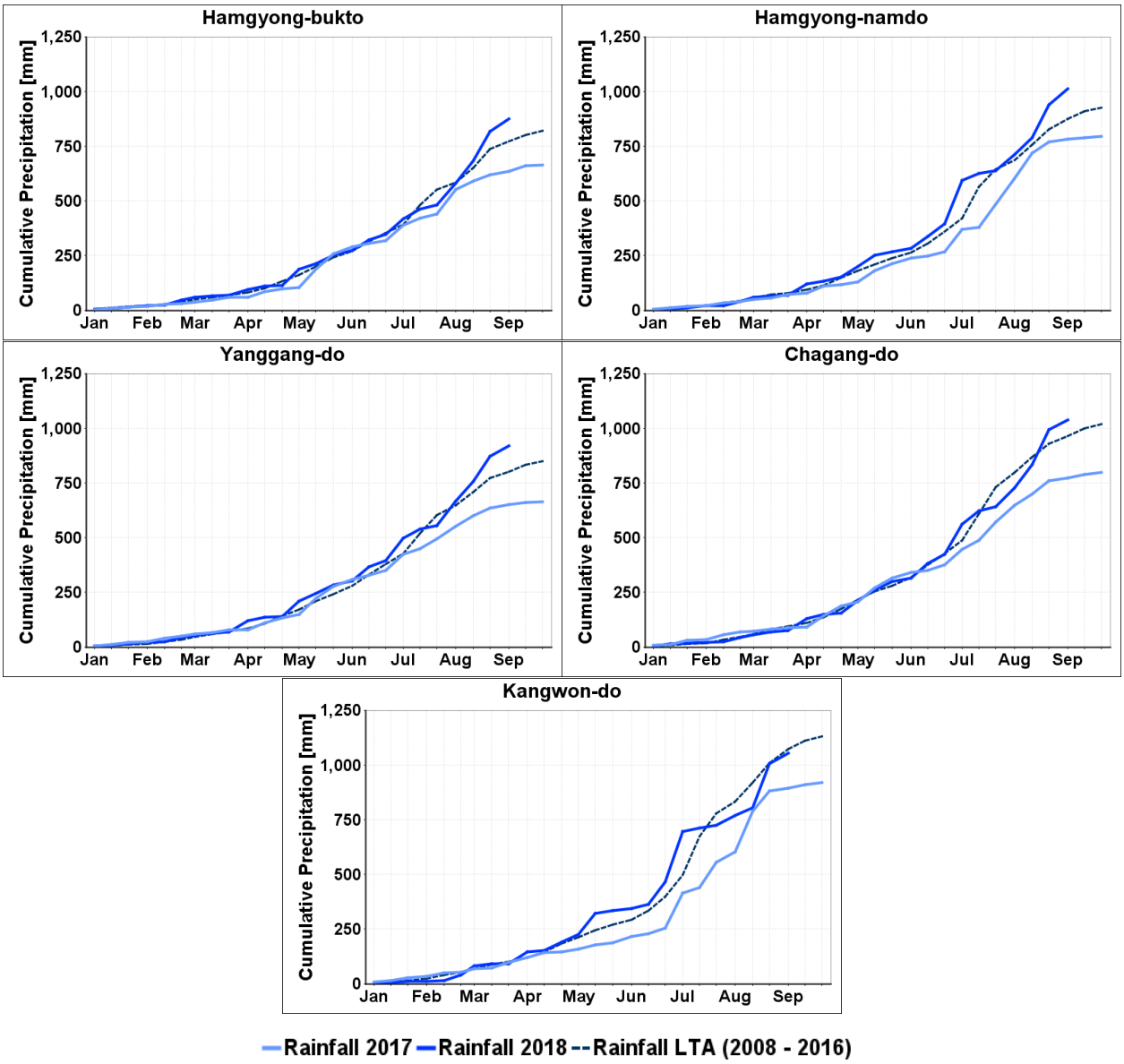

Figure 3 (ctd). Profiles of cumulated precipitation in 2017 and 2018, and the long-term average (LTA). Profiles calculated as mean of all pixels within each province.

Following this dry period, heavy monsoon rains occurred in August and early September that caused some concerns to standing crops, including rice and maize. Furthermore, Typhon *Soulik* that struck east DPRK on 23 and 24 August resulted in exceptionally high precipitations, with total rainfall of up to twice the long-term average (125-150 mm) at the end of August. The most affected areas were South Hamgyong, Kangwon and with surpluses of more than 75 mm above the long-term average. Several crop damages were reported due to rains following the typhoon, mainly maize fields. In addition, rural infrastructures, irrigation systems and farmland were damaged, as well as housing, health and social infrastructures[1]. Moreover, the excessive rains flooded the paddy fields in the valleys in the period of crop maturation (Figure 4). In Hwanghae-bukto and Hwanghae-namdo, heavy rains affected a total of 17,000 hectares of agricultural land according to Government reports[2].

Satellite images of the beginning of September show also that in North and South Hwanghae the harvest of the rainfed crops on the hillsides was very well advanced compared to the usual calendar (brown colors

[1] Asia and the Pacific: Weekly Regional Humanitarian Snapshot (28 August- 3 Sept 2018) https://reliefweb.int/sites/reliefweb.int/files/resources/ROAP_Snapshot_180903.pdf

[2] DPRK Korea: North and South Swanghae Flood (7 September 2018 ocha) https://reliefweb.int/sites/reliefweb.int/files/resources/DPRK_Flood_TY_Soulik_180907.pdf

in Figure 4), probably because failed maize crops due to the hot and relatively dry weather in July and August have been harvested for animal feeding. A significant reduction of maize yield (the main rainfed crop) in those areas is expected because of the shortning of the grain-filling phase or failure of the ear formation due to water stress.

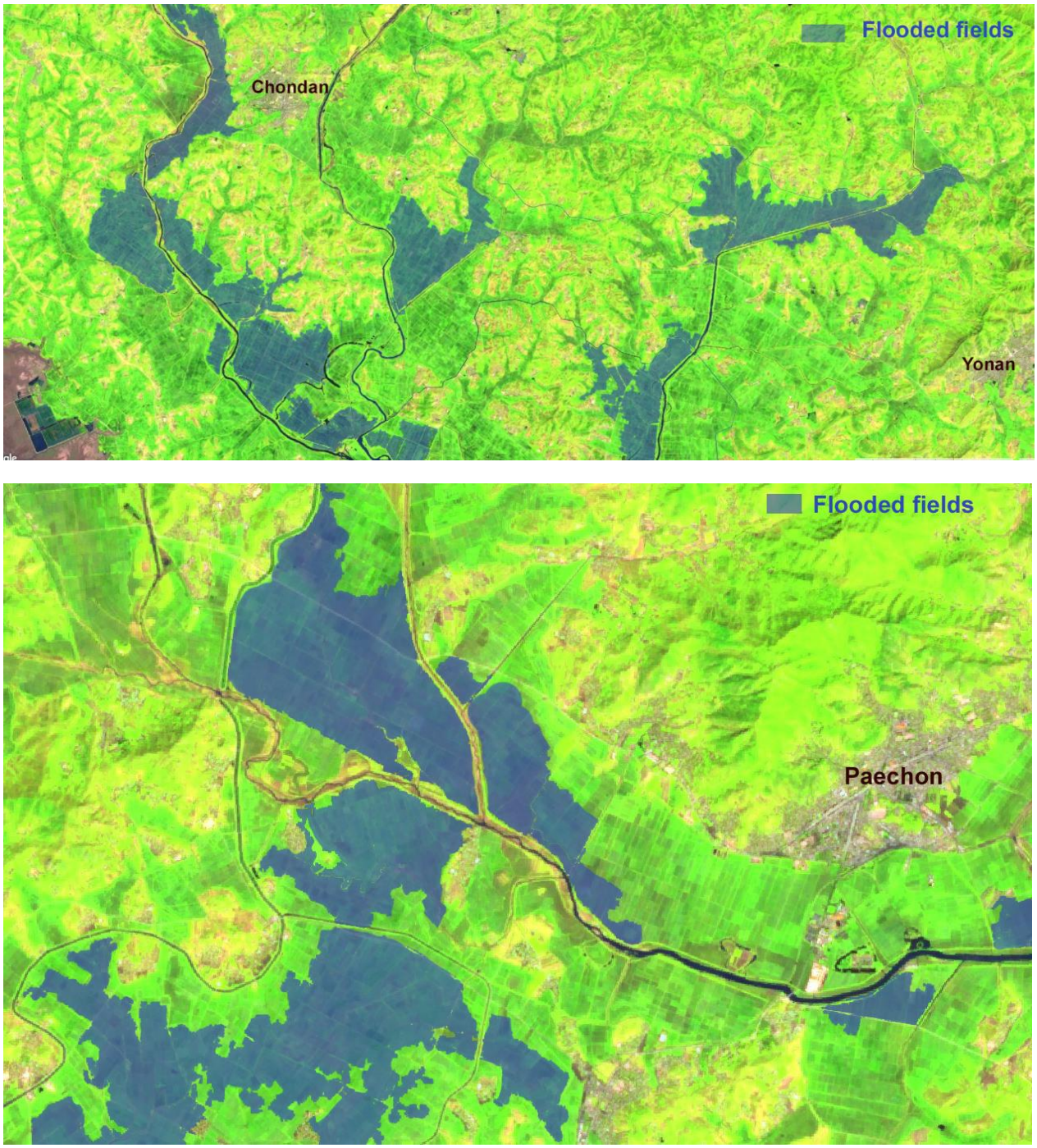

Figure 4. Fields in the valleys were flooded in the crop maturing period. Example of flooded areas in South Hwanghae as seen by Sentinel-2 satellite beginning of September 2018.

3 TEMPERATURE

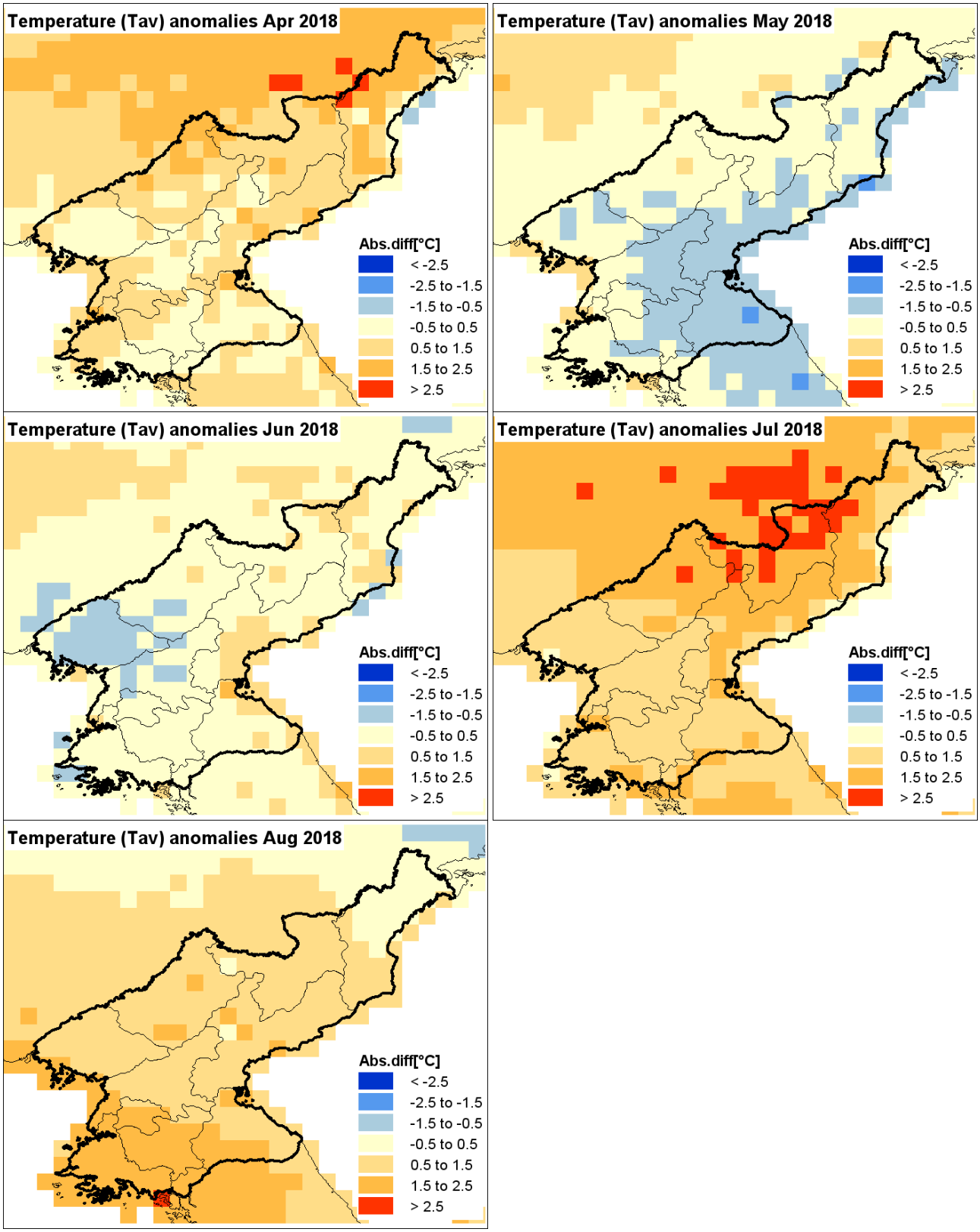

Figure 5. Monthly mean temperature anomalies compared with their long-term average (2008-2016) (ECMWF OPE).

Temperature plays an important role in crop development in DPRK. During the winter months, the rice bowl area in the western and south-western part of DPRK faced average to above average, especially in February. Temperatures during spring were generally favourable for crop development with above average

temperatures, only some areas remained cooler than average in May (Figure 5). The most relevant concern this season is the heatwave that hit DPRK from mid-July until mid-August, a critical development period.

Figure 6 shows a detailed analysis of the 2018 heatwave, based on the dekadal (10-day) anomalies of the daily mean temperature (Tav) from mid-July to mid-August. High temperatures, reaching even 5°C above the historical average were observed across the country. End of July was the most critical period with highest temperatures, mainly in the north-eastern provinces (Ryanggang and South Hamgyong). These regions that mainly rely on potato production are chronically the most affected by food insecurity. High temperatures affect negatively potato yield. The optimal growing conditions for potato require daily mean temperatures in the 18°C to 20°C range. Daily mean temperatures greater than 30°C reduce sharply the yield. The conditions observed in DPRK during this crop season indicate a possible 20% reduction of the potato yield.

The most productive south-western regions counted more than twenty consecutive days with daily mean temperatures of more than 2.5°C above the average. As a consequence, slower development of maize is expected. Indeed, field reports indicate that maize crop was especially affected with growth faltering, poor cob size and grain-fill.

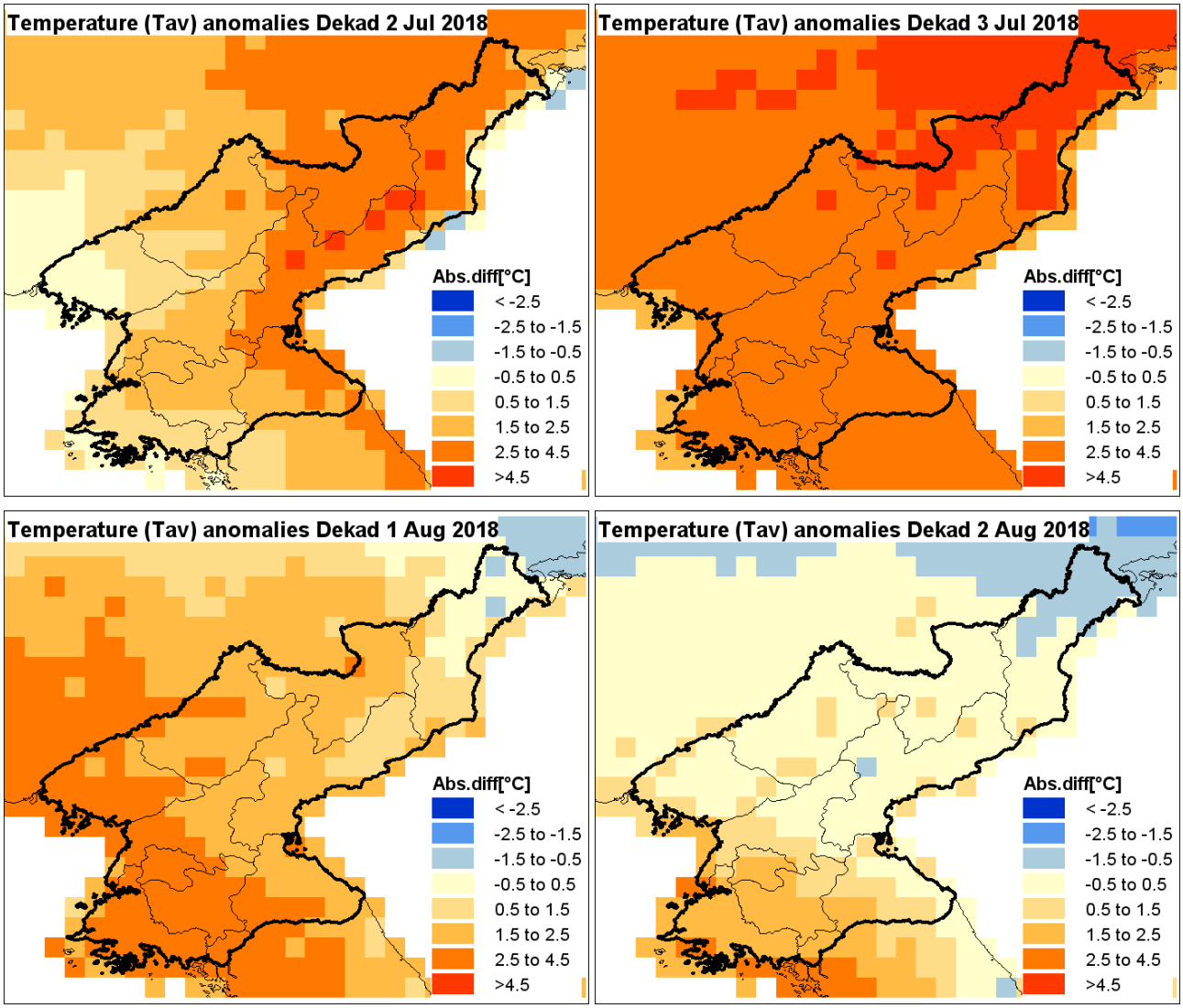

Figure 6. Daily mean temperature anomalies compared with their long-term average (2008-2016) on a 10-daily (dekad) basis.

Although the highest temperatures were observed as expected in the provinces of North and South Hwanghae, the largest anomalies in the daily mean temperature were most marked in the northern and

eastern provinces (figure 7) as well as in North Pyongan. The most affected regions were North Hamgyong, Ryanggang, Chagang and North Pyongan.

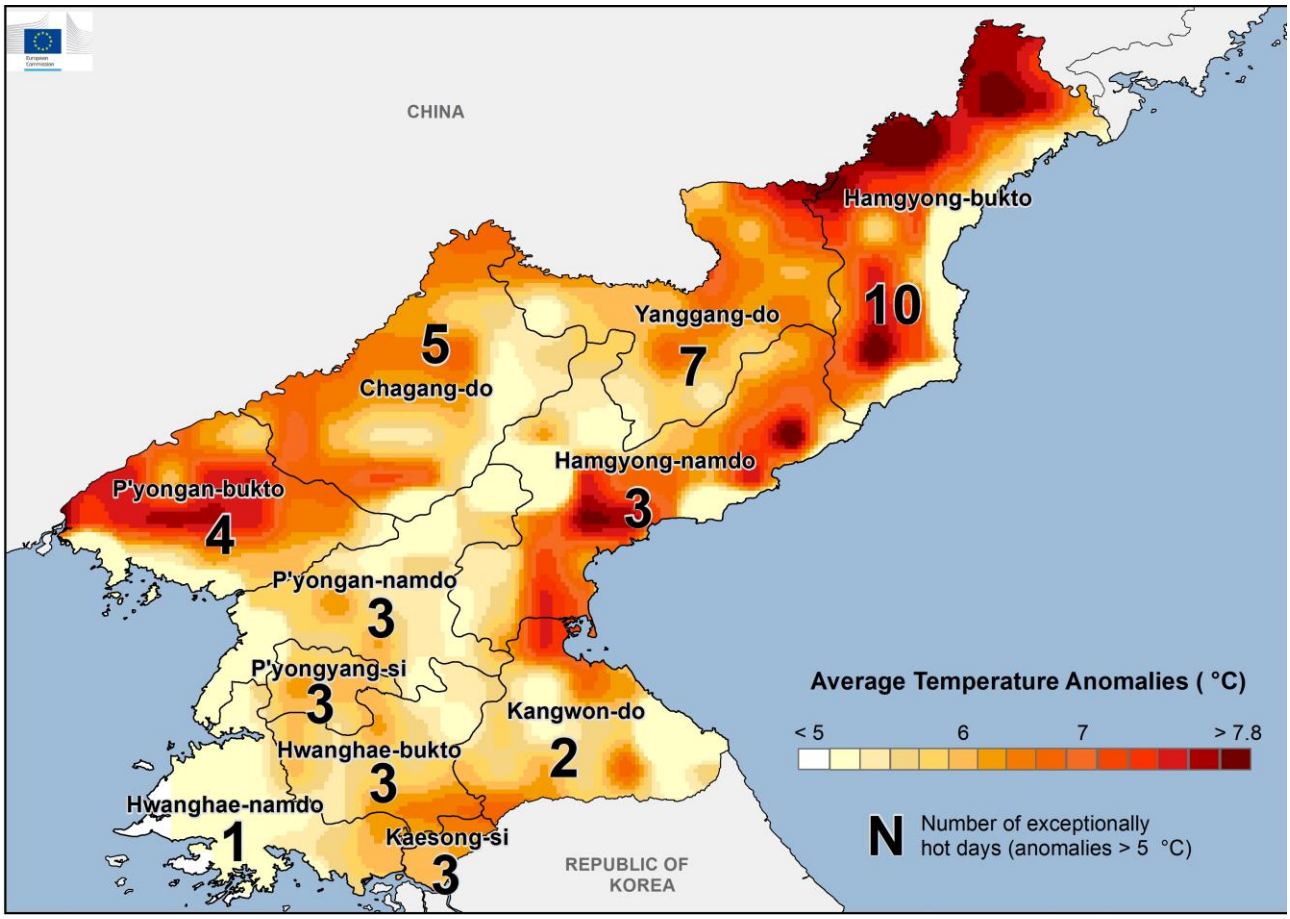

Figure 7. Hotspots of the exceptionally hot temperatures (daily mean temperatures anomalies exceeding 5°C) during the period of 15th July to 15th August in DPRK. The figures on the map are the number of exceptionally hot days by province during the period of the heatwave.

While the weather cooled down from August 4th in the northern and eastern parts of the country, high temperatures persisted in South and North Hwanghae but with daily maximum temperatures going down slightly (figure 8). In these provinces which collectively contribute with the largest share of the national cereal output, temperatures remained higher than average values (2 to 3 degrees above the average) during more than thirty consecutive days.

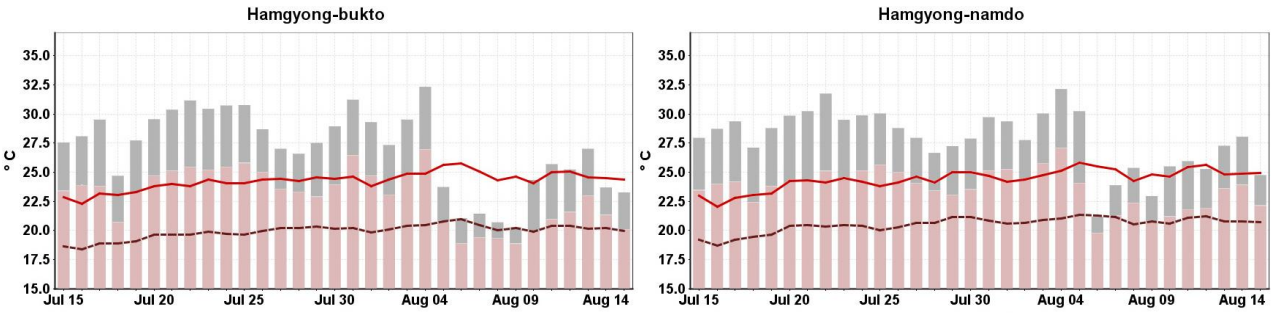

Figure 8. Daily maximum temperature (Tmax) and daily mean temperature (Tavg) and their respectve long-term average (LTA) in the period of 15 July to 15 August.

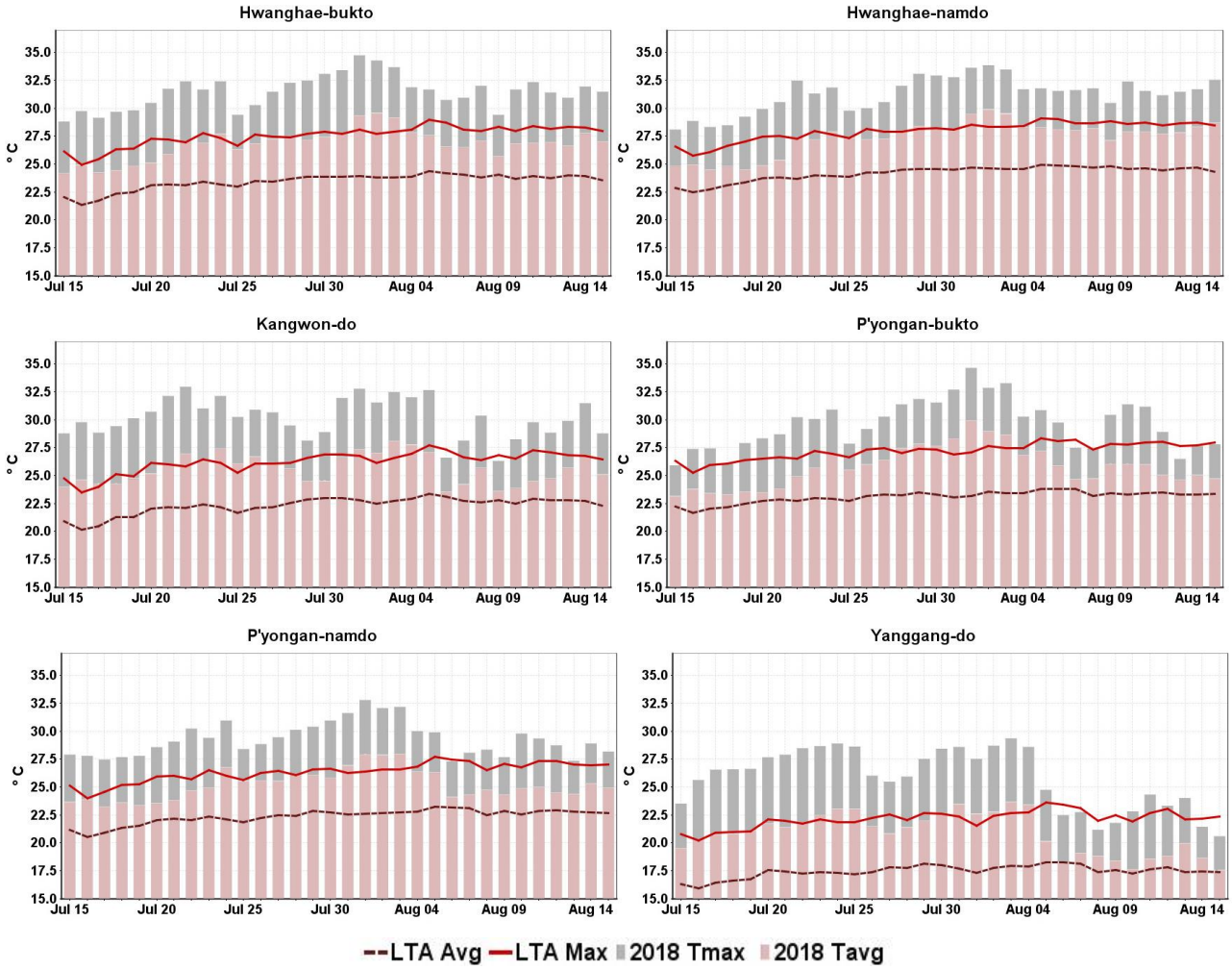

Figure 8 (ctd). Daily maximum temperature (Tmax) and daily mean temperature (Tavg) and their respectve long-term average (LTA) in the period of 15 July to 15 August.

4 Vegetation growth situation

Figure 9 shows the Normalized Difference Vegetation Index (NDVI) from April to August 2018 compared to its respective long-term average (2008-2016). The dry spell from mid-July to mid-August, coupled with high temperatures affected the development of 2018 food crops. In early August, an 8% of the average area cultivated was damaged. According to the estimates provided by the National Coordinating Committee (NCC), a total of 98,892 ha, of which 24,664 ha were rice and the rest maize, potatoes and other food crops were reported to be affected. Nonetheless, these negative effects on vegetation are not captured by the satellite vegetation index as there is no visible impact on biomass. This is most probably due to the fact that the dry and hot weather in July and August allowed satellite to capture clear images whereas the satellite images of that period are usually cloud-contaminated, thus tending to generate lower NDVI values. The positive NDVI anomalies observed in 2018 should be interpreted with caution.

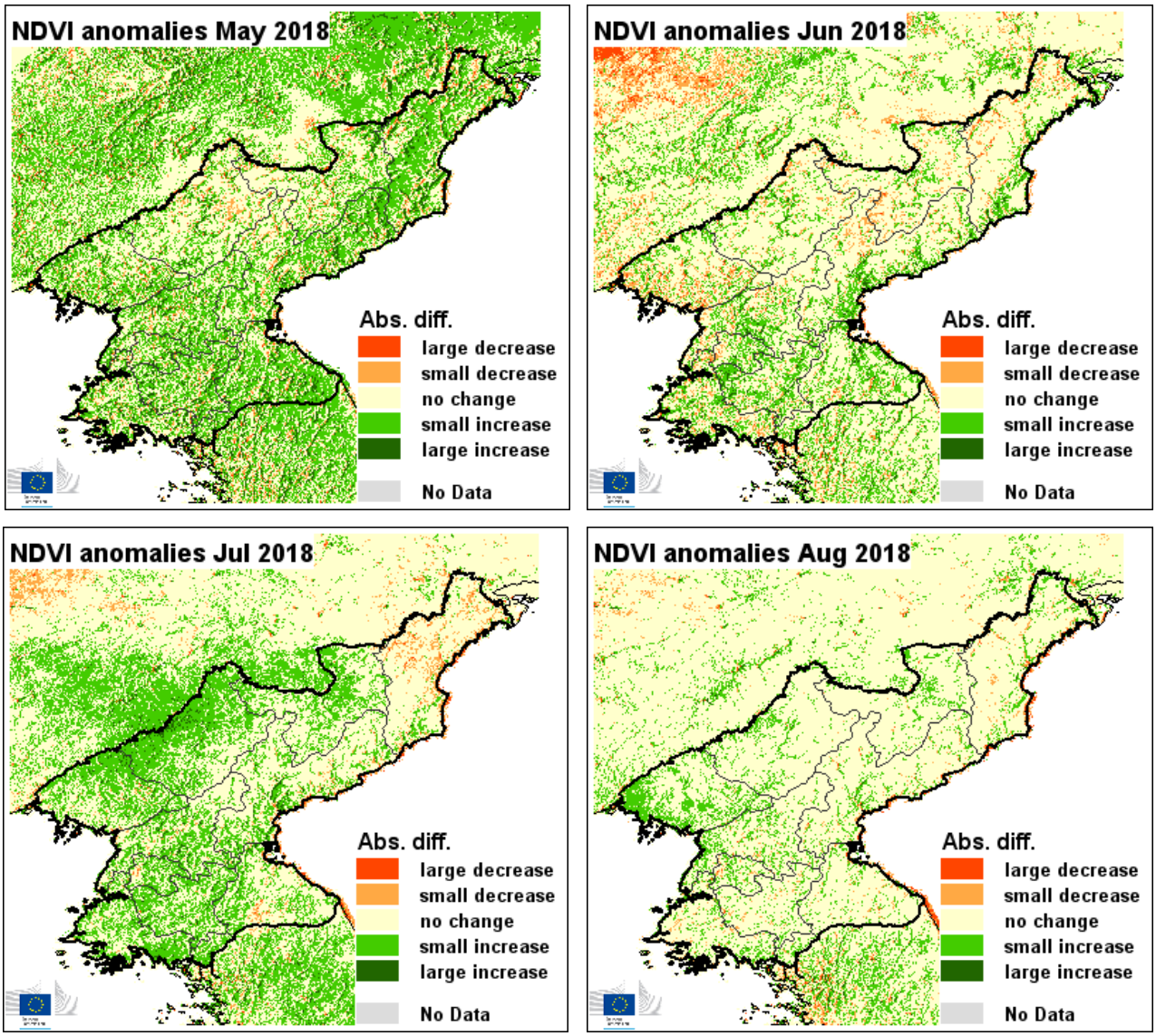

Figure 9. Monthly vegetation conditions (NDVI) in 2018 compared to the historical average (2008-2016), calculated from satellite imagery (METOP-AVHRR).

Figure 10 shows combined graphs for NDVI and rainfall for the provinces with a large acreage of cropland according to Figure 1, that is North Pyongan, South Pyongah, Pyongyang, North Hwanghae and South Hwanghae. The profiles of the present year 2018 are compared to the long term average (2008-2016) and the previous year 2017. The figures clearly show the erratic distribution of rainfall during the whole period, with dekads with large amounts of precipitation and dry spell dekads.

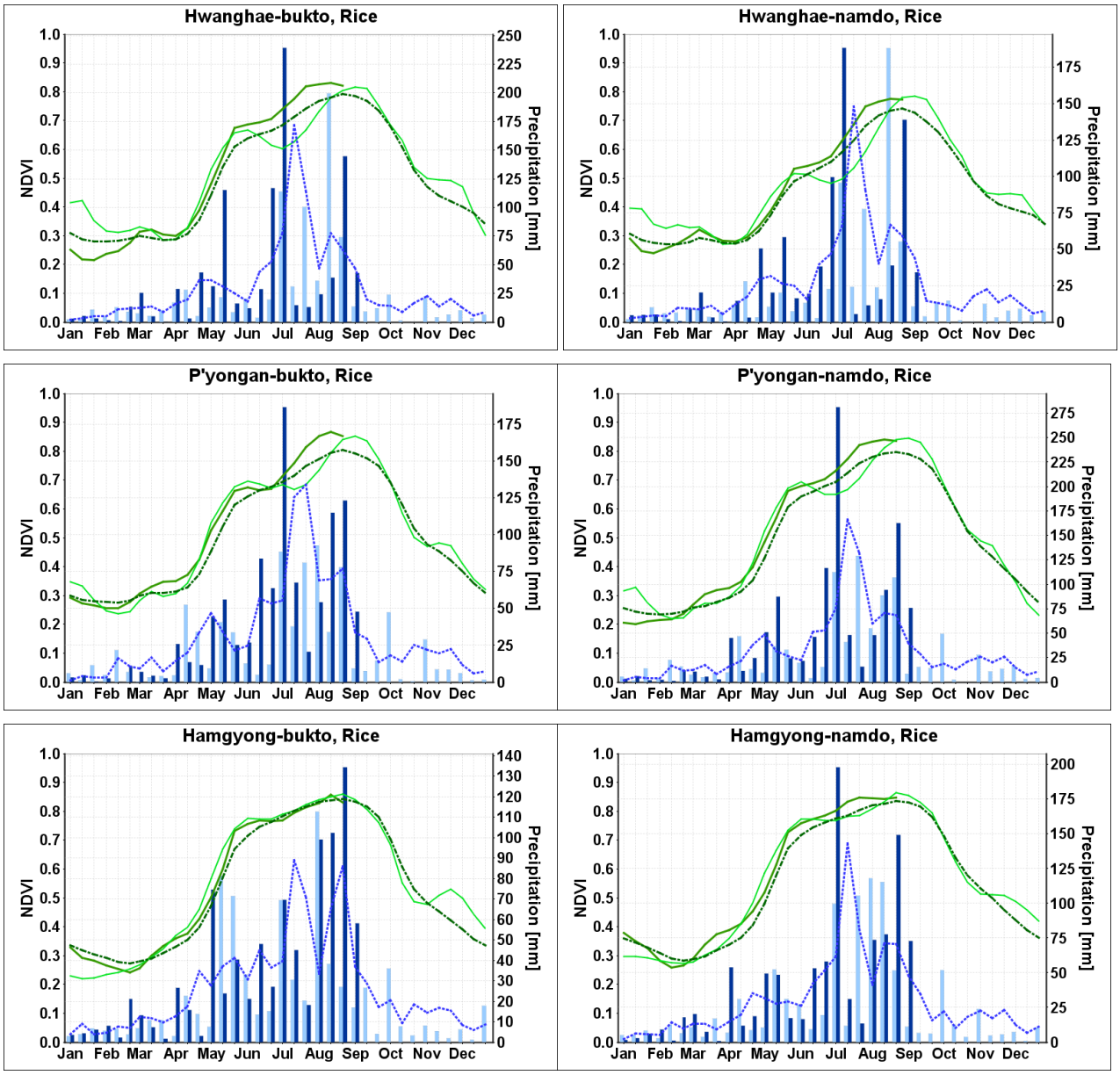

Figure 10. Precipitation and NDVI profiles of LTA, 2017, 2018 of selected provinces in DPRK (ECMWF, METOP-NDVI). Profiles calculated as mean of all pixels classified as cropland area within each province (JRC crop mask).

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