The Wild Hydrologic Cycle of 2021 and 2022

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Introduction

❖ Manitoba experiences cycles of water extremes from floods to droughts. These extremes can have devastating effects on many socio-economic variables.

❖ Frequent spring flood led to the construction of the Manitoba Flood Control System. Some notable flood years include 1826, 1950, 1997, 2009, and 2011. In contrast, notable drought events tend to be multi-year occurrence such as the dirty '30s and the 1980s drought.

❖ The multi-facet aspects of drought – from meteorological drought (dry weather patterns dominant over an area) to agricultural drought (limited water impacting crop and livestock production), can make it difficult to determine the onset, peak or end of a drought cycle. Water shortage from drought depletes soil moisture reserve, impact streamflow and diminish groundwater.

❖ Building on the below-normal precipitation in 2020, the agricultural regions of Manitoba experienced severe drought during the 2021 growing season with record high temperatures and low precipitation.

2021 Drought and Crop Water Demand

❖ An average growing season precipitation in Manitoba does not meet the crop water demand. Therefore, antecedent soil moisture from the previous fall is required to reduce the moisture deficit.

❖ In Manitoba, short season crops such as wheat, in a typical year will have about 29 mm (1.1 inches) of water deficit and long season crops like soybean will have about 108 mm (4.2 inches) moisture deficit based on antecedent water holding in a clay loam soil, climate normal precipitation, and typical crop water use (Ojo, 2018).

❖ The historical timing of highest monthly total precipitation (June) does not match the period when crop water use is greatest (July).

❖ The difference between the crop water demand and precipitation (not accounting for antecedent soil moisture at the start of the growing season) indicated a deficit of 160 mm (6.3 inches) and 250 mm (9.8 inches) in late July of 2020 and 2021, respectively (Figure 1).

❖ Groundwater level monitored at Winkler, MB (Figure 2) showed historical lows in the 1980s and early 1990s. The water level in the last two decades have been mostly high. However, there was no recharge from snowmelt or spring/summer precipitation throughout 2021 and the groundwater level was the lowest it has been since 1995.

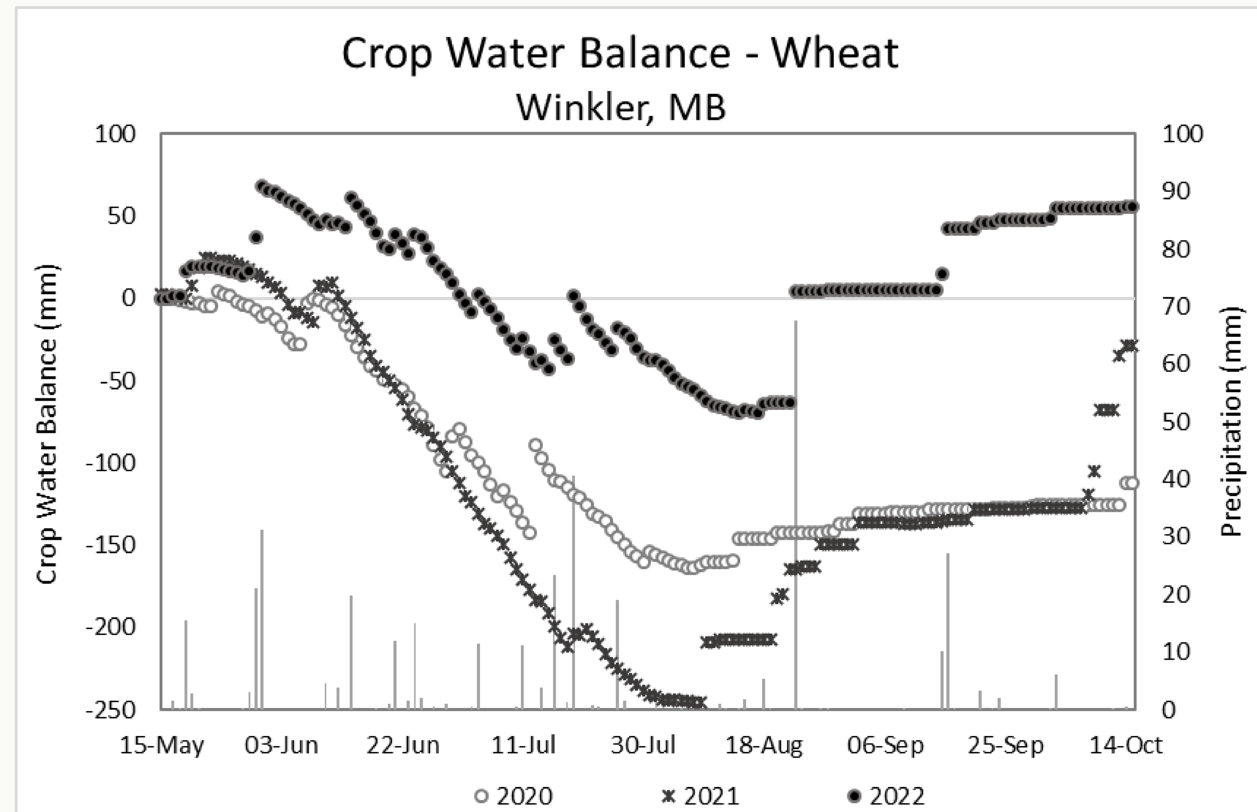

Figure 1: Crop water balance (difference between precipitation an crop water demand) for wheat from 2020 – 2022 at Winkler. Bars on secondary axis shows 2022 precipitation

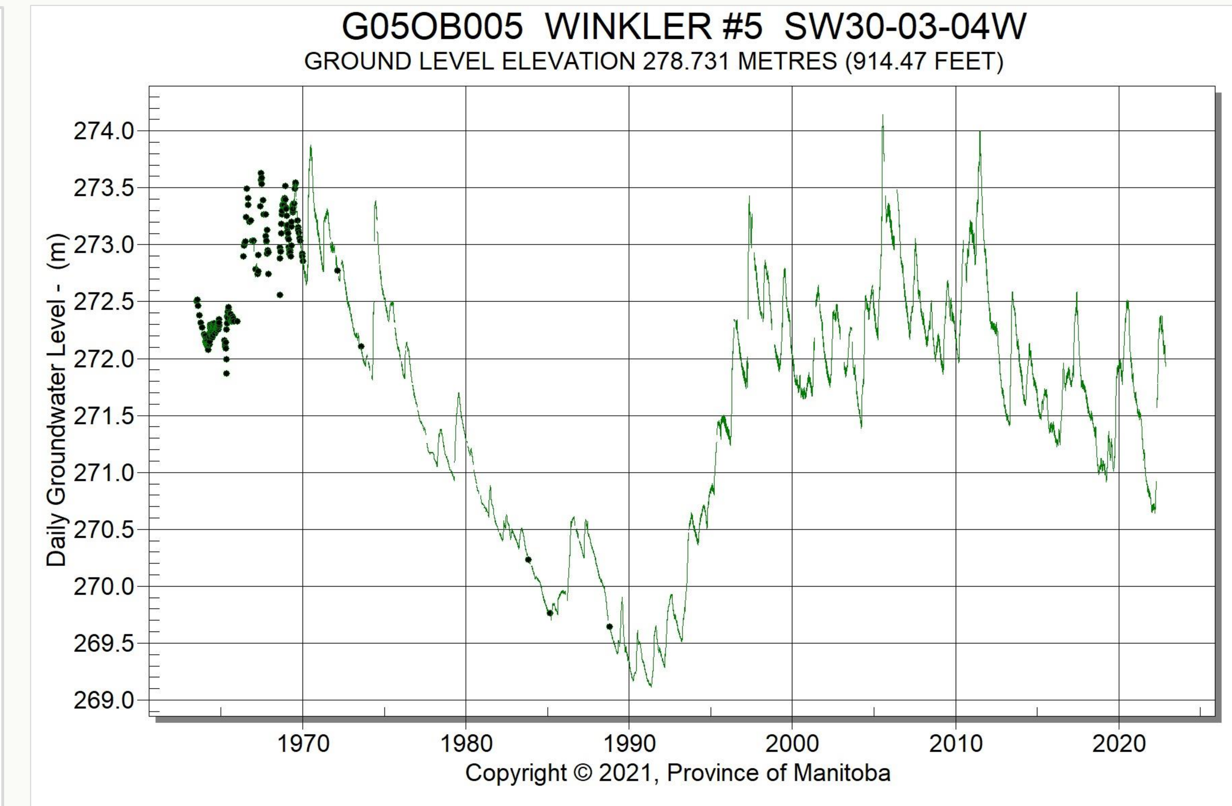

Figure 2: Groundwater level monitoring station at Winkler until November 2022

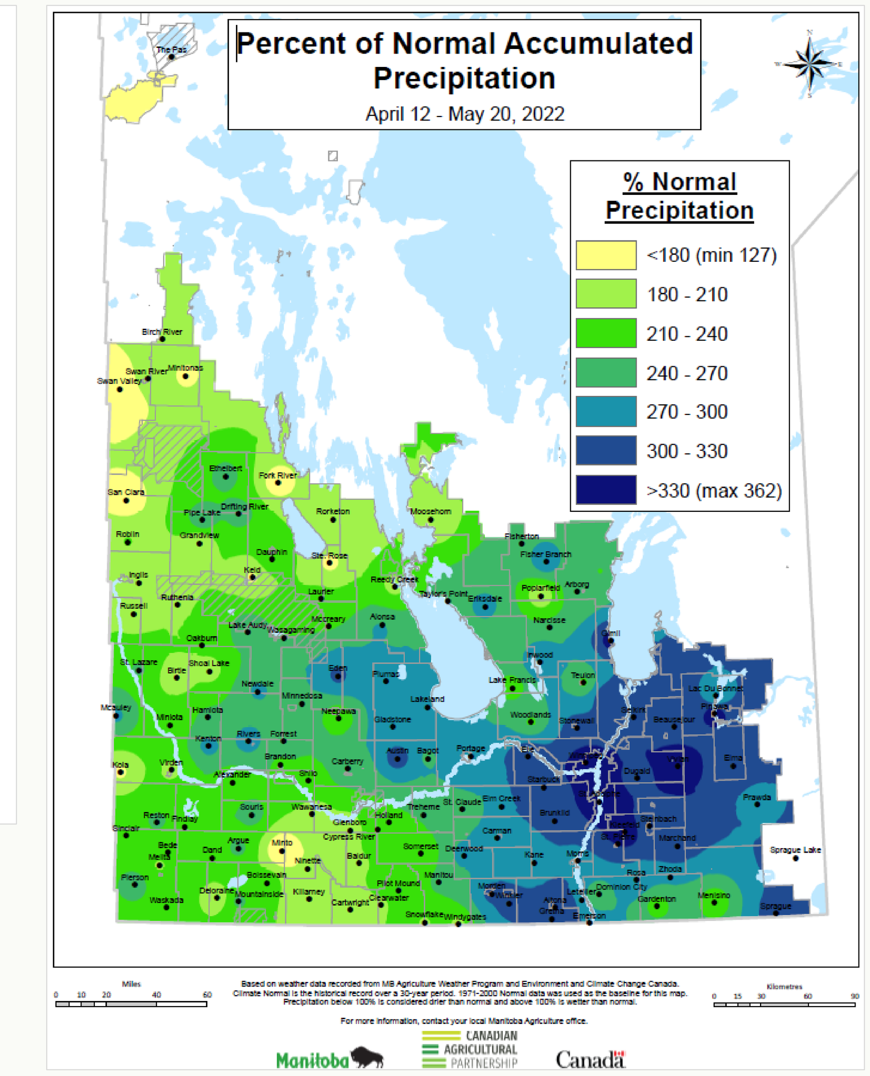

Figure 3: Map showing percent of normal accumulated precipitation

From Deficit to Excess

❖ October 2021 precipitation recharged soil moisture but did not have any direct impact on groundwater. The 2021 growing season ended with a less severe crop water deficit than the previous season (Figure 1).

❖ Building on the previous fall's precipitation amounts, Manitoba, especially, in the Red River valley, received above normal precipitation in the spring of 2022. Some areas received more than 3 times the average precipitation amount (Figure 3). This resulted in delayed seeding.

❖ Throughout the 2022 growing season, many areas received a good precipitation distribution. At the end of July, and not accounting for the initial soil moisture, the crop water balance for wheat at Winkler showed 35 mm (1.5 inches) deficit compared to 154 mm (6.1 inches) deficit in 2020 and 241 mm (9.5 inches) deficit in 2021.

❖ The Water Holding Capacity (WHC) of a soil is mainly determined by the soil texture and the amount of organic matter. Clay soils have higher WHC than sandy soils due to larger surface area and higher total porosity. However, the percent available WHC standardizes the observations regardless of the soil type.

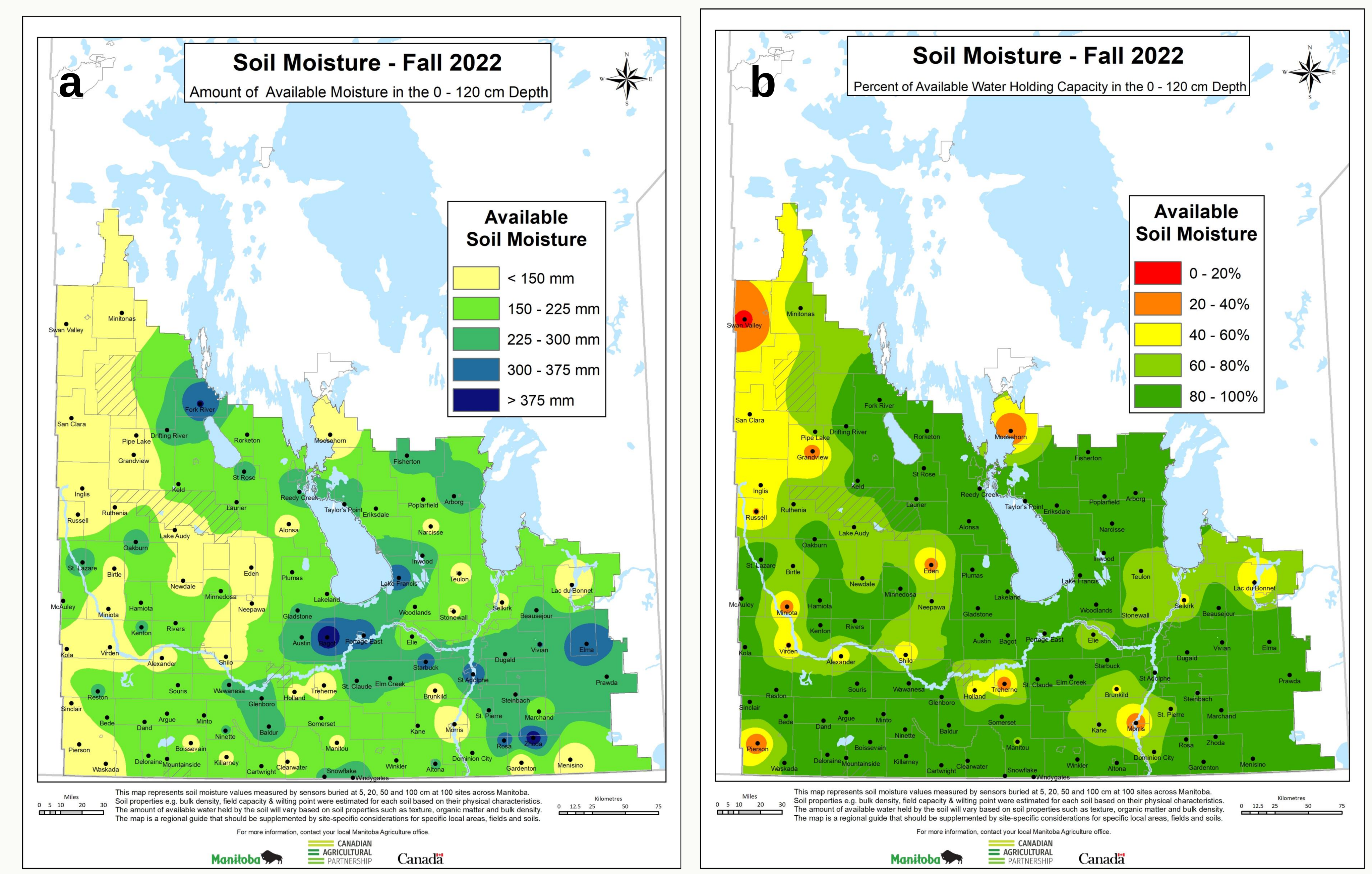

Figure 4: Soil moisture maps showing (a) the available water content and (b) the percent of available water holding capacity. The maps should be used as a regional guide only and not for site-specific inferences. Additional soil moisture maps prior to soil freeze-up can be found on the Manitoba Agriculture website: https://www.gov.mb.ca/agriculture/environment/soil-management/manitoba-fall-soil-moisture-survey.html .

Fall 2022 Soil Moisture Status

❖ The 2022 fall soil moisture maps were based on data from about 100 weather stations. Much of agro-Manitoba had 150 – 225 mm of available water with areas in the southeast region mostly between 225 – 300 mm. Most areas, except the Parkland region are mostly at 80 - 100% of available water holding capacity.

❖ Overall, the 2022 precipitation provided a critical and timely intervention which limited the downward trend in groundwater levels. Heading into 2023 spring, many locations within the agricultural region of Manitoba show good soil moisture reserve.

Reference: Ojo, E.R (2018): Bringing Crop Water Budget back to the Forefront. Manitoba Agronomists Conference, Winnipeg, MB.

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