November 22-23, 2017

Supplemental Climate Information: Bar U Ranch National Historic Site

Parks Canada Parcs Canada

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Preface

This is a supplement to the "Let's Talks about Climate Change: Mountain Region" report (Parker, 2017) and is intended to support discussions on climate change adaptation for Bar U Ranch National Historic Site in November 2017.

Disclaimer

Views, statements, findings and conclusions are solely those of the author and do not necessarily reflect the views and policies of Parks Canada. Although the author has made every effort to ensure that the information is accurate, complete and correct, neither Parks Canada nor the author can guarantee its integrity. Readers are encouraged to review original sources.

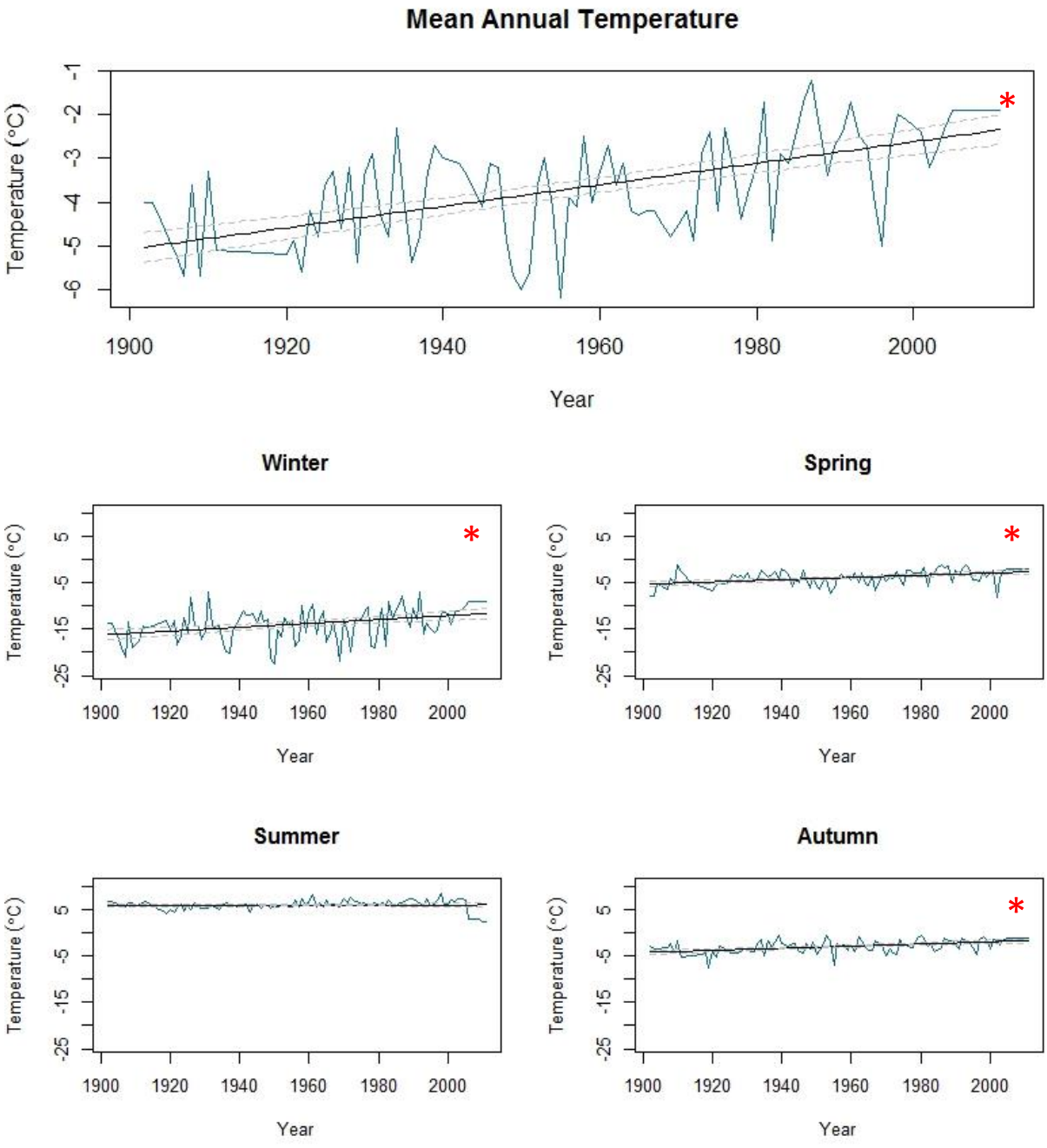
Highlights

- Mean annual temperature has increased by ~2.7°C since 1902. All seasons, except summer have demonstrated a statistically significant increase. Winter (Dec, Jan, Feb), demonstrated the greatest trend, ~4.6°C since 1902.
- Total annual precipitation has increased by ~175 mm (39%) since 1903. Autumn (Sep, Oct, Nov) has shown a statistically significant increase, ~46 mm (61%).
- Total annual rain has demonstrated a statistically significant increase, ~184 mm (65%) since 1903. Total annual snow has not demonstrated a statistically significant trend, it however appears to be showing s slight decline.
- Mean annual and seasonal wind speeds have not demonstrated a statistically significant trend.
- Projections of future temperature indicate that Bar U Ranch will experience a 2.5 degree increase by 2071-2100 under a moderate climate change scenario, with a complete range of temperature increase of 1 to 6 degrees across three scenario (compared to 1980-2010 baseline temperatures).
- Projections of future precipitation show very little projected change in annual precipitation for Bar U Ranch (compared to 1980-2010 baseline precipitation).
- Projected rainfall intensity, duration and frequency indicate an increase in heavy rainfall events.
- The growing season is projected to increase across all scenarios. Climate moisture (drought) is not projected to change substantially.
- The wildfire season is projected to increase from 20 to 60 days by 2071-2100 under a range of scenarios (compared to 1981-2010 baseline).
- Species distributions are projected to change under all scenarios.
- Flooding has been identified as a hazard in the region, and will likely continue to be a hazard into the future. There is no additional data on the Alberta Flood hazard Map Application (http://maps.srd.alberta.ca/FloodHazard/).

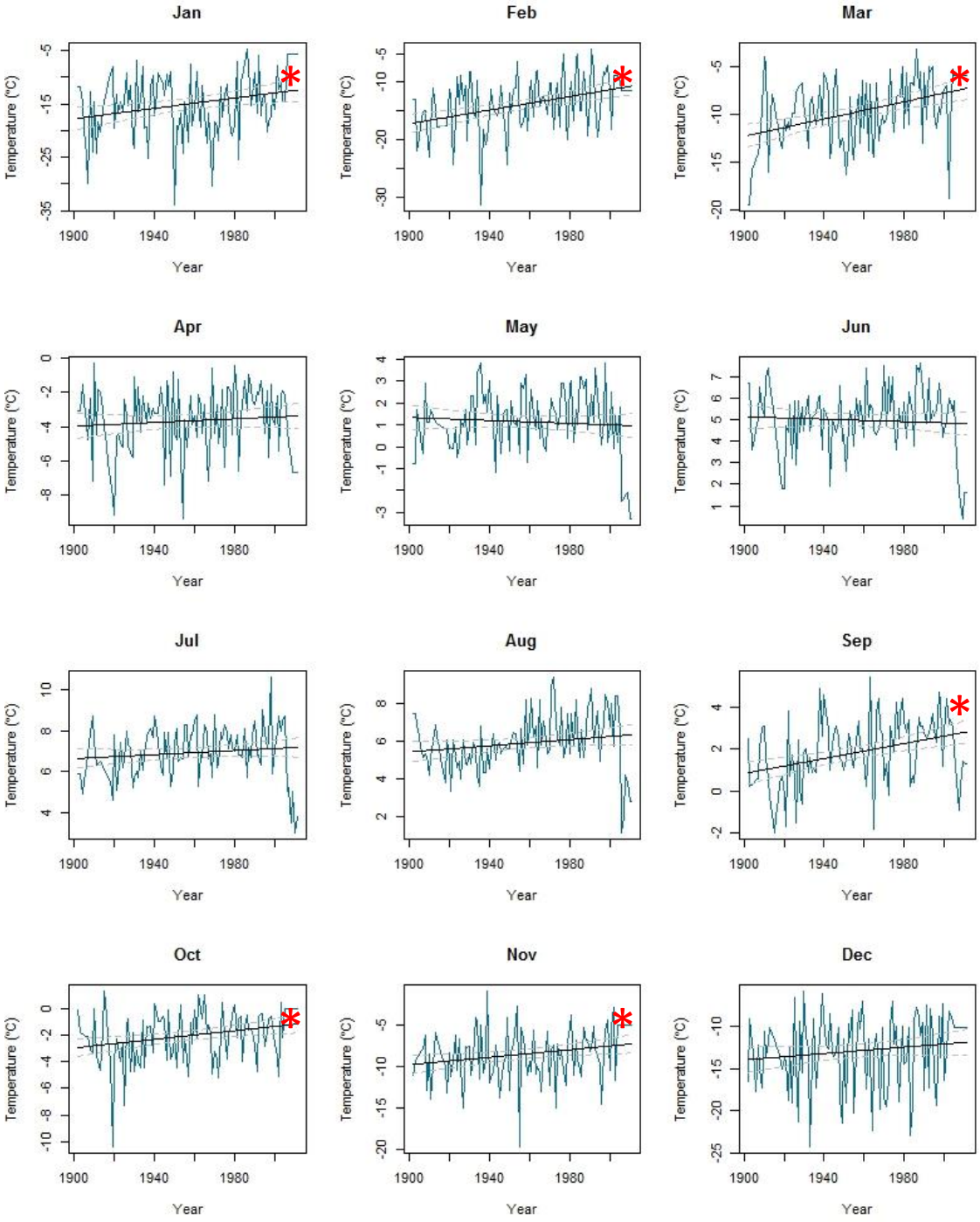
1. Observed Climate Trends

1.1 Temperature

Mean monthly temperature at High River climatological station (3033250) from 1902 to 2011 (ECCC, 2017). Trend determined using a generalized linear model (R Core Team, 2014) including 95% confidence intervals. "*" = statistically significant trend (P<0.05).

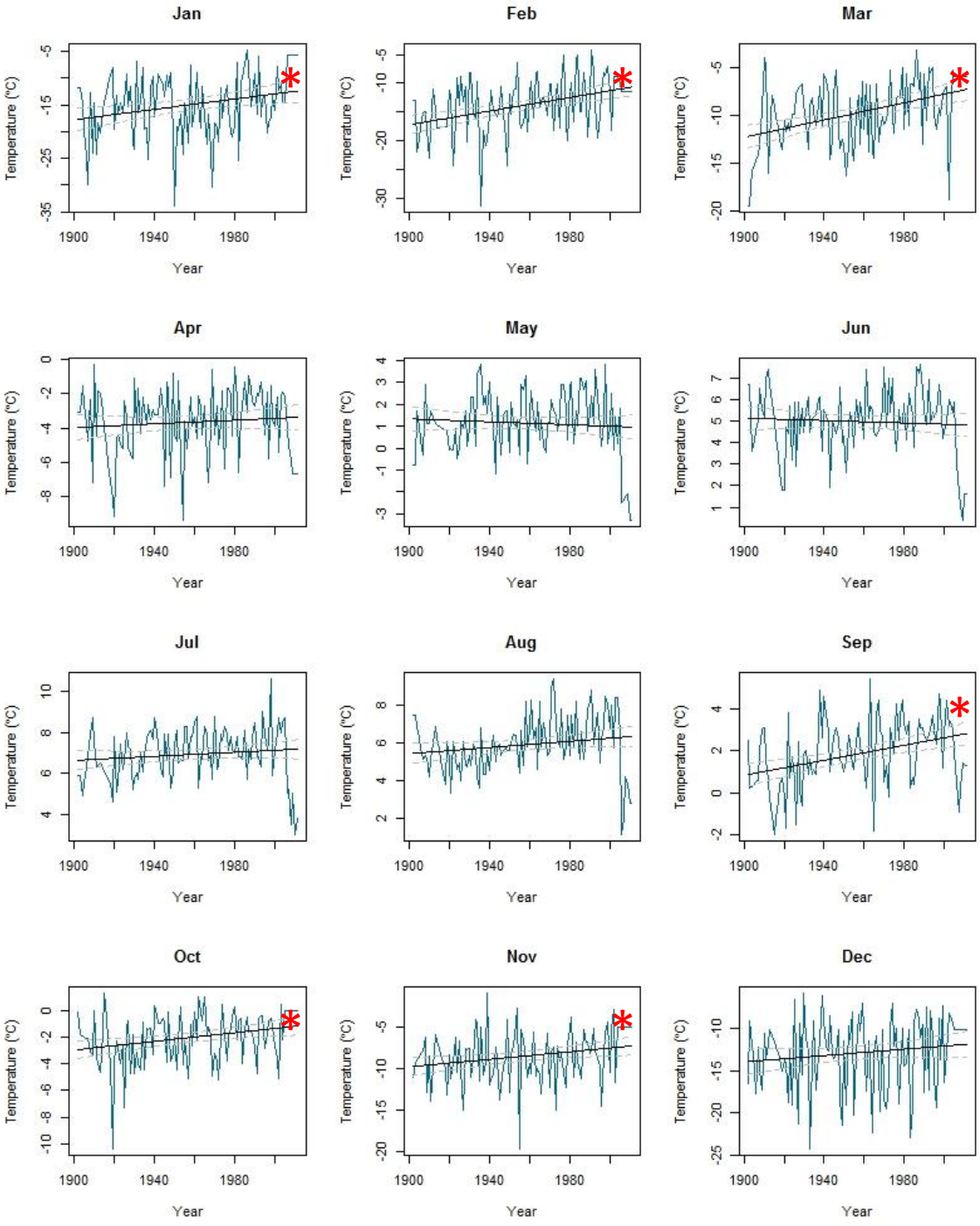


Mean annual temperature has increased by ~2.7°C since 1902. All seasons, except summer have demonstrated a statistically significant increase. Winter (Dec, Jan, Feb), demonstrated the greatest trend, ~4.6°C since 1902.



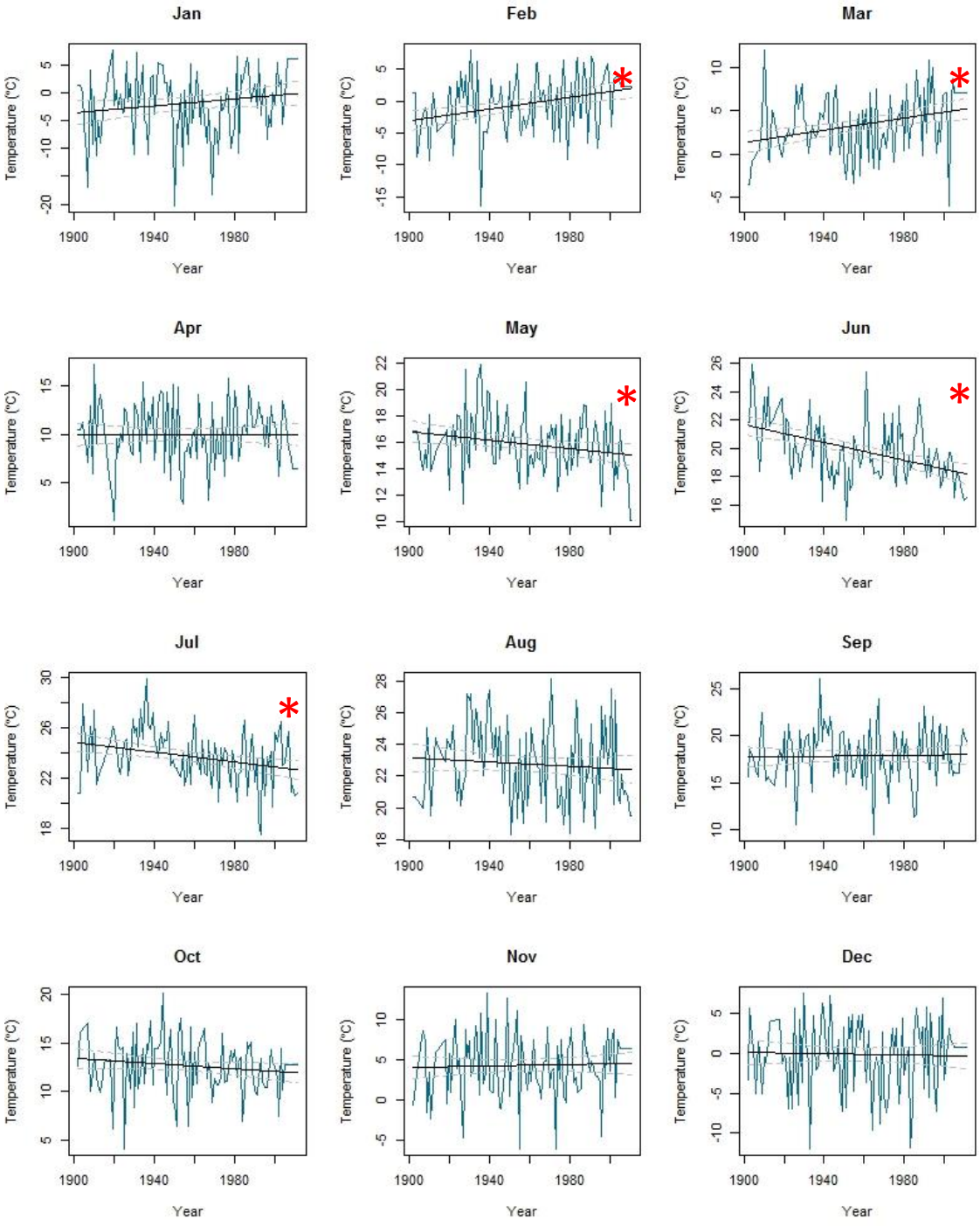
Greatest increase observed for Feb, ~6.5°C since 1902.

Mean Monthly Minimum Temperature



One possibility is to compare minimum (night-time) temperatures to maximum (day-time) temperatures. For example, minimum temperatures for Sep have increased by ~2°C since 1902, while maximum temperatures have only increased by ~0.2°C.

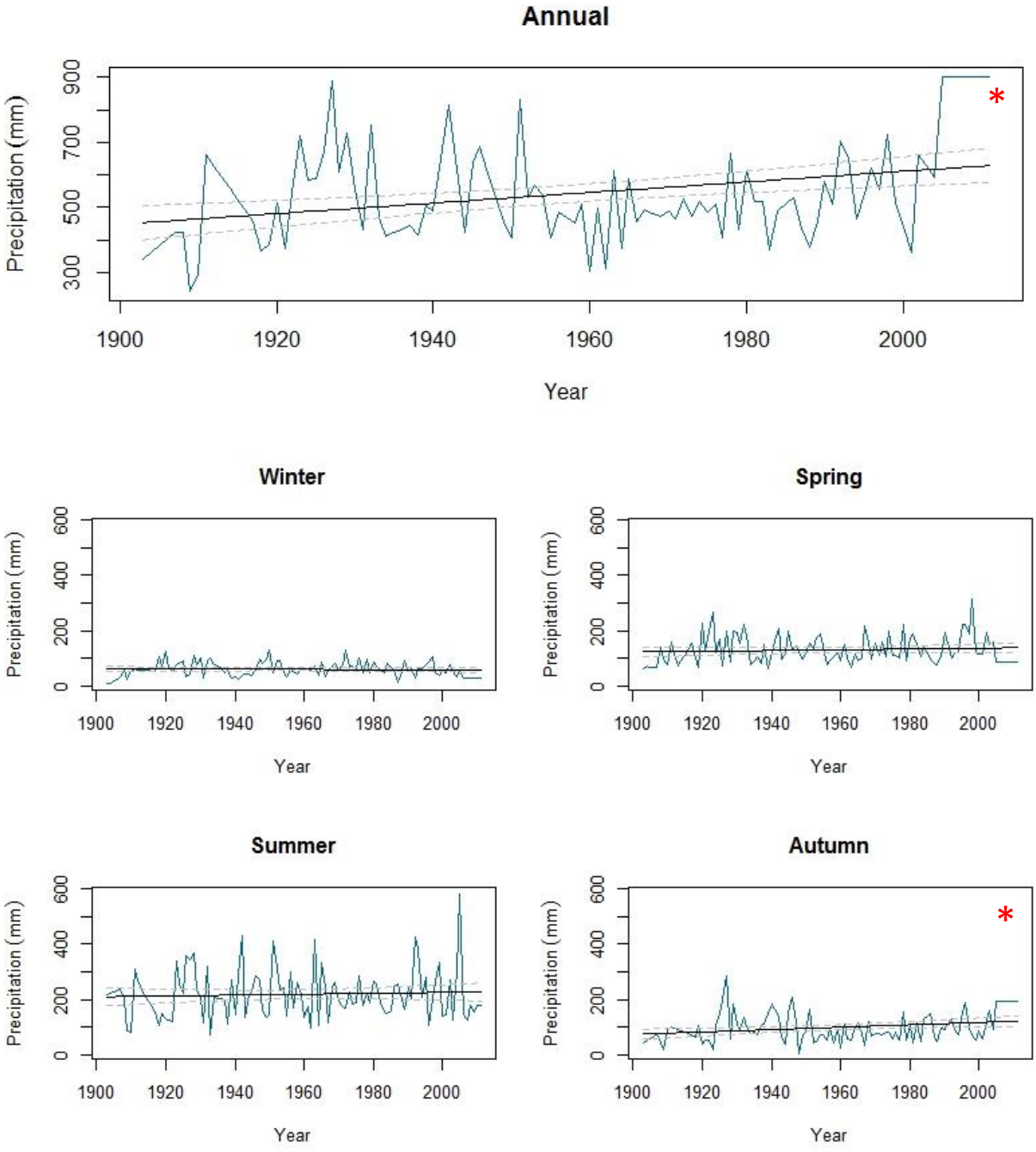
Mean Monthly Maximum Temperature



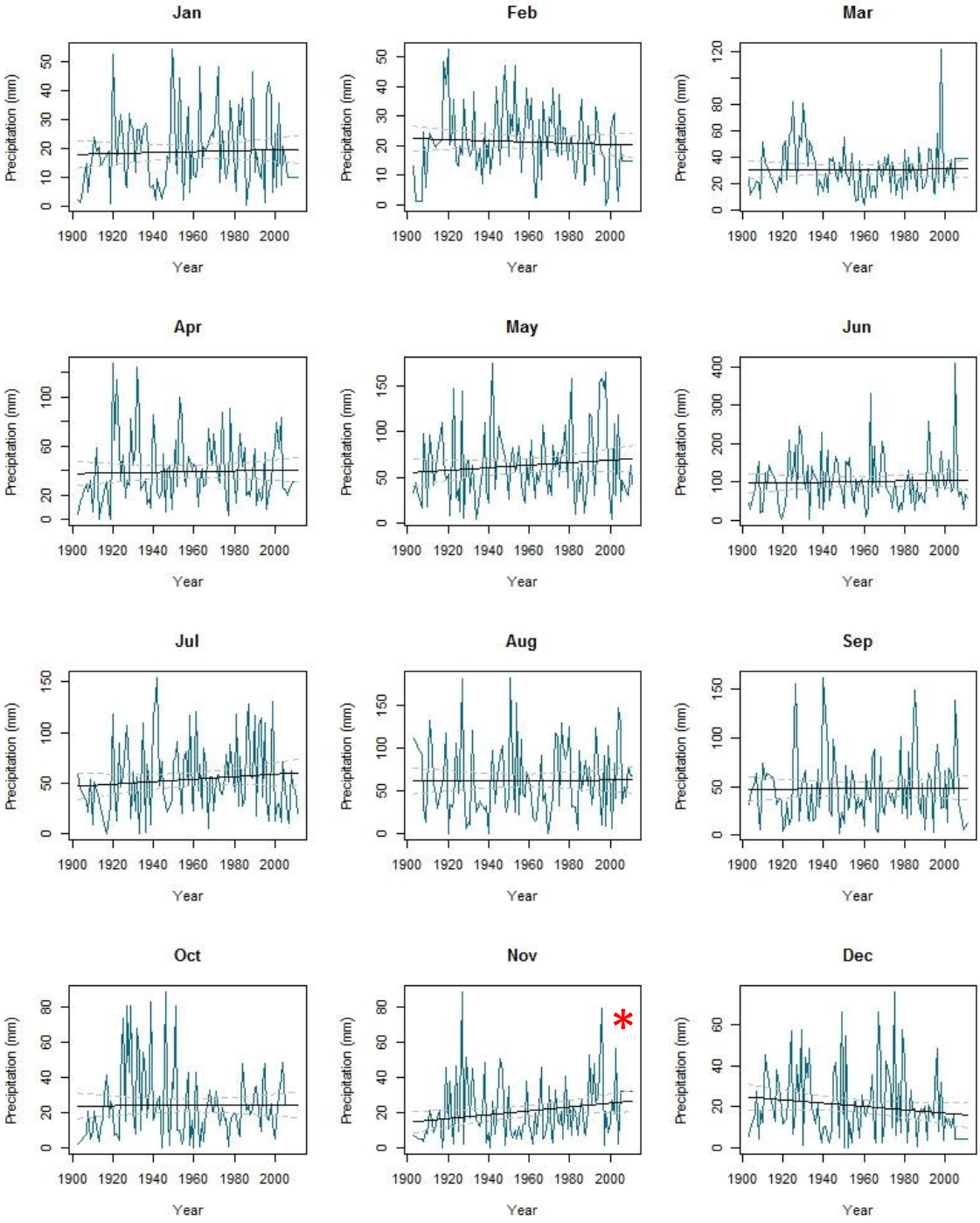
Unlike monthly mean or minimum temperatures, the maximum temperatures are demonstrating a statistically significant decrease in the spring/summer months of May, Jun and Jul and no statistically significant trend in the autumn months. For example, in Jun maximum (day-time) temperatures have decreased by ~3.4°C since 1902.

1.2 Precipitation

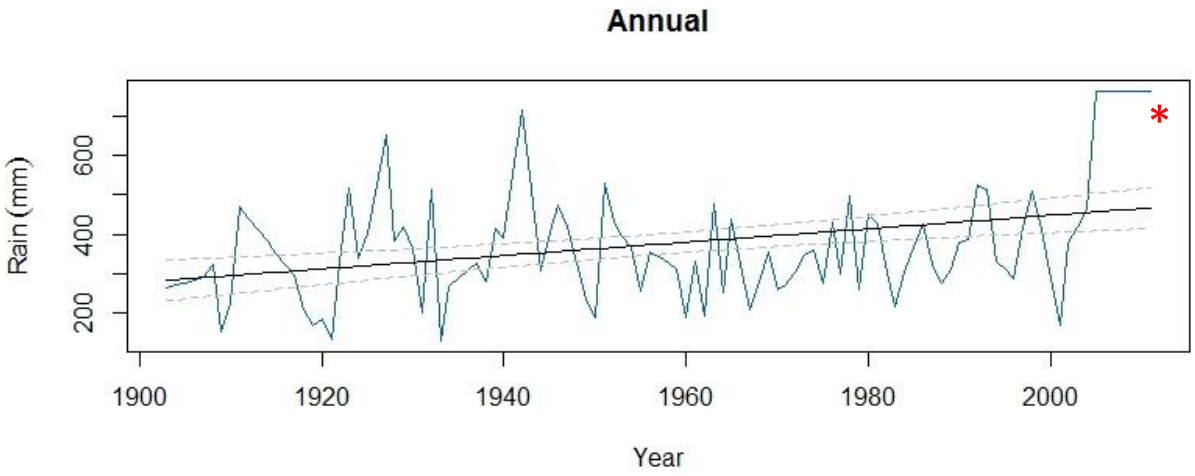
Total precipitation at Highwood climatological station (3053250) from 1903 to 2011 (ECCC, 2017). Trend determined using a generalized linear model (R Core Team, 2014) including 95% confidence intervals. "*" = statistically significant trend (P<0.05).



Total annual precipitation has increased by ~175 mm (39%) since 1903. Autumn (Sep, Oct, Nov) has shown a statistically significant increase, ~46 mm (61%).

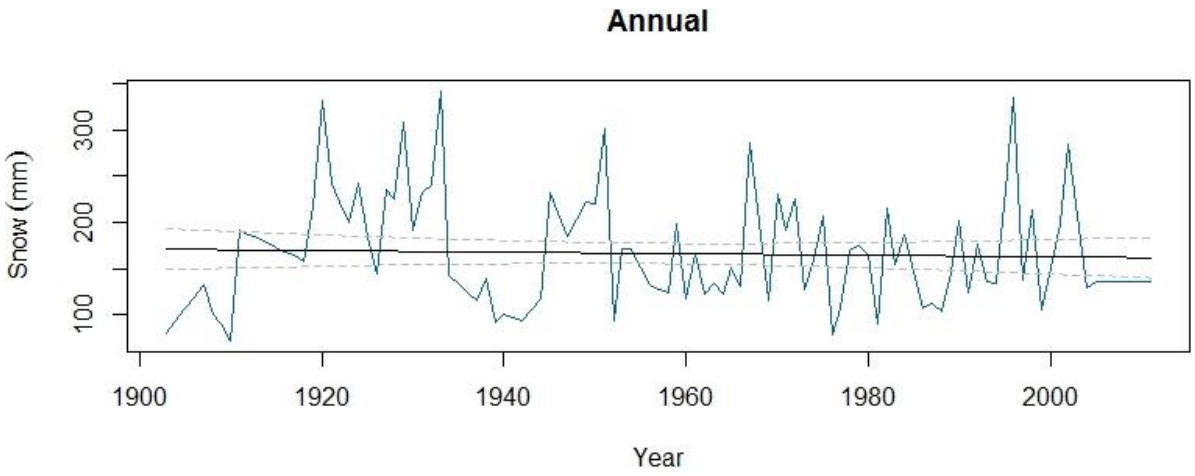

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Precipitation (mm)
Year
1900 1920 1940 1960 1980 2000
*

Total Annual Rain



Total annual rain has demonstrated a statistically significant increase, ~184 mm (65%) since 1903.

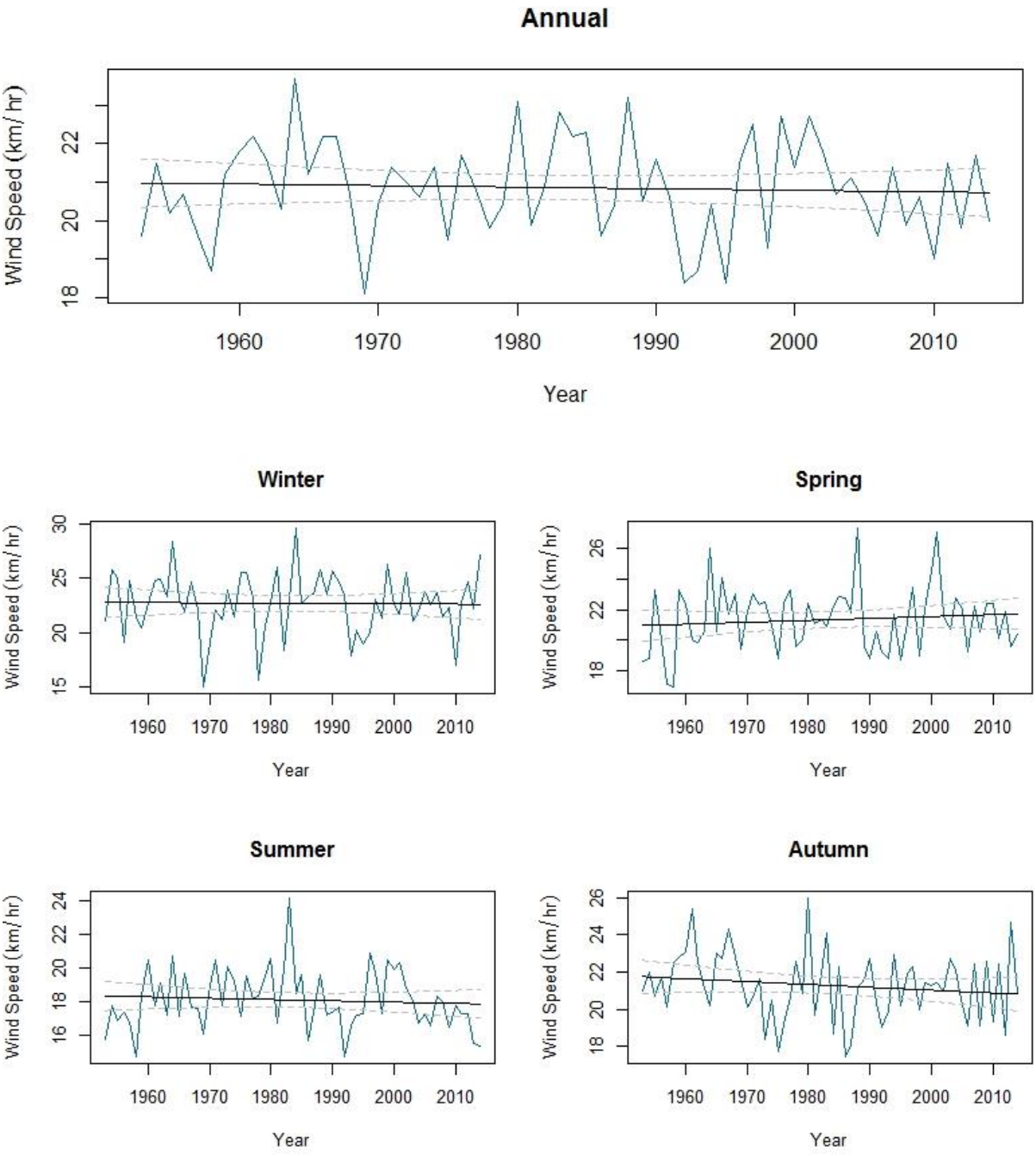
Total Annual Snow



Total annual snow has not demonstrated a statistically significant trend, it however appears to be showing s slight decline.

1.3 Surface Wind Speed

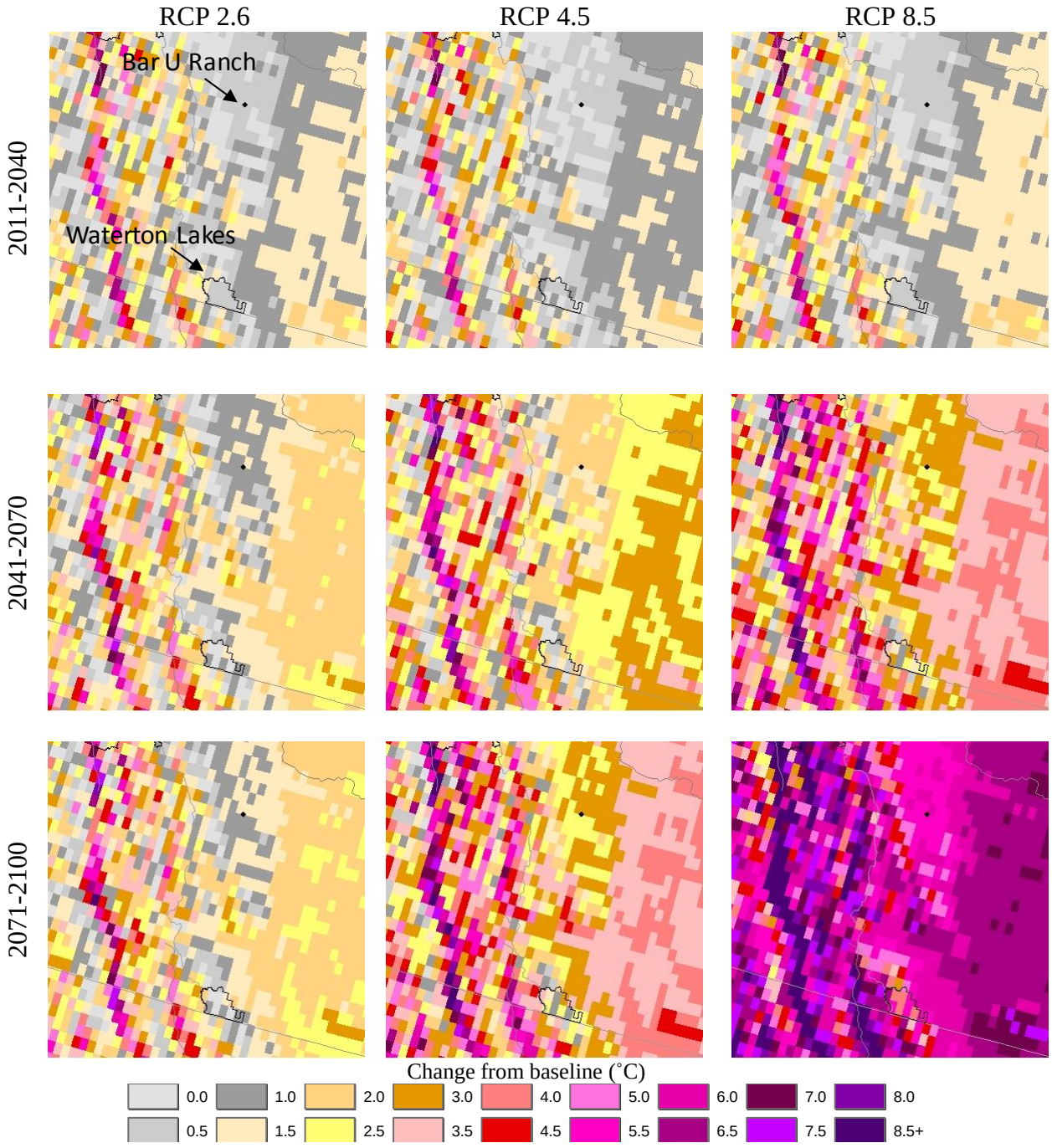
Mean wind speeds at Lethbridge climatological station (3033880) from 1953 to 2014 (ECCC, 2017). Trend determined using a generalized linear model (R Core Team, 2014) including 95% confidence intervals. "*" = statistically significant trend (P<0.05).



Mean annual and seasonal wind speeds have not demonstrated a statistically significant trend since 1953.

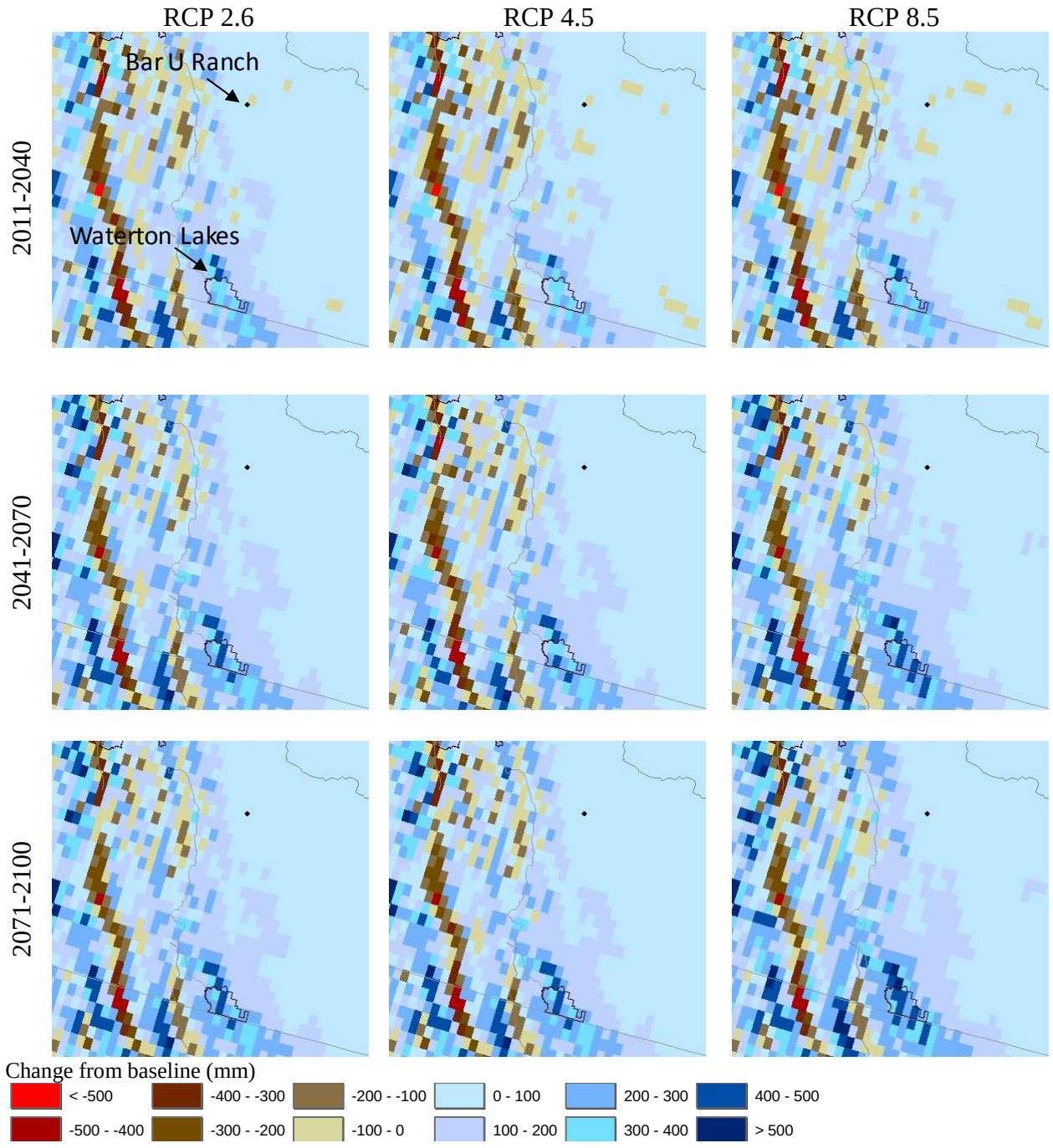
2. Projected Climate Trends

2.1 Temperature



Mean annual temperature increase for Bar U Ranch – Waterton Lakes area from 1980-2010 baseline. Composite projection of CanESM2, CESM1CAM5, HADGEM2ES and MIROCESM. Natural Resources Canada, Canadian Forest Service, http://cfs.nrcan.gc.ca/projects/3 (Price *et al.*, 2011).

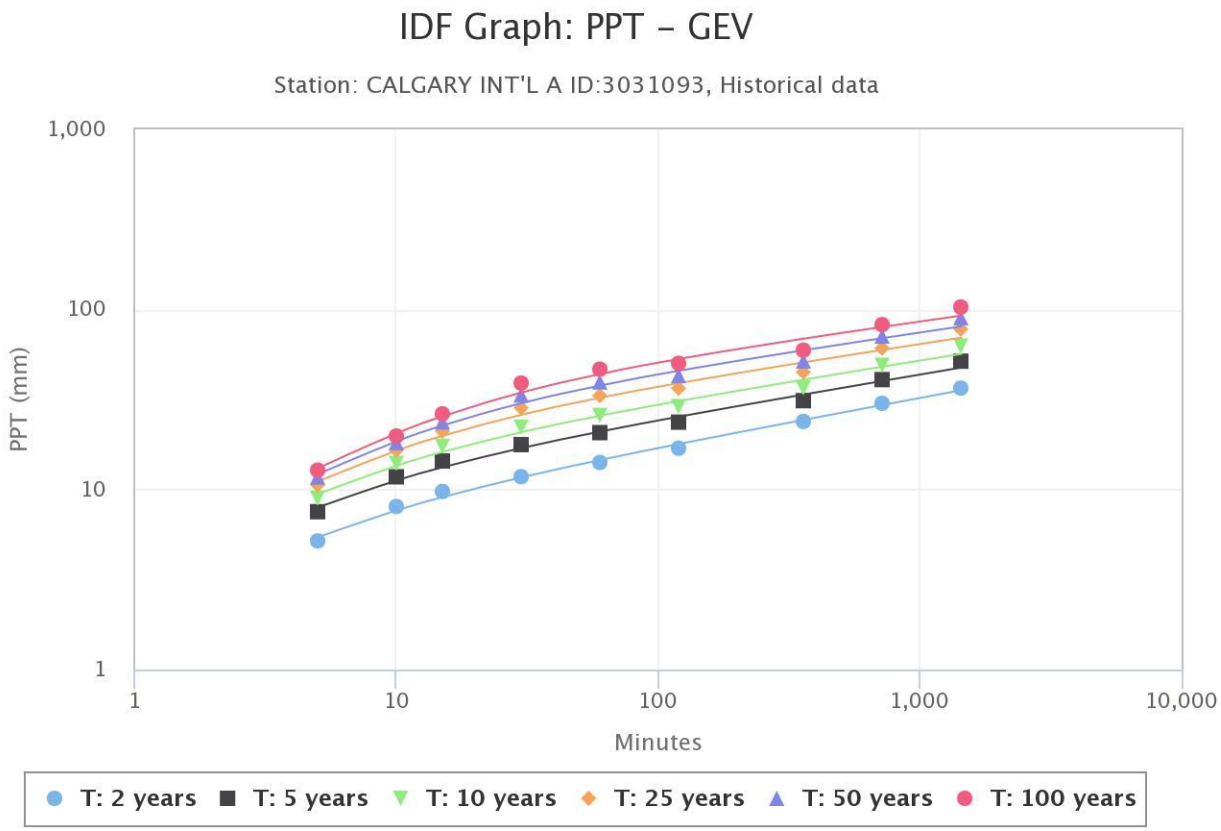
2.2 Precipitation



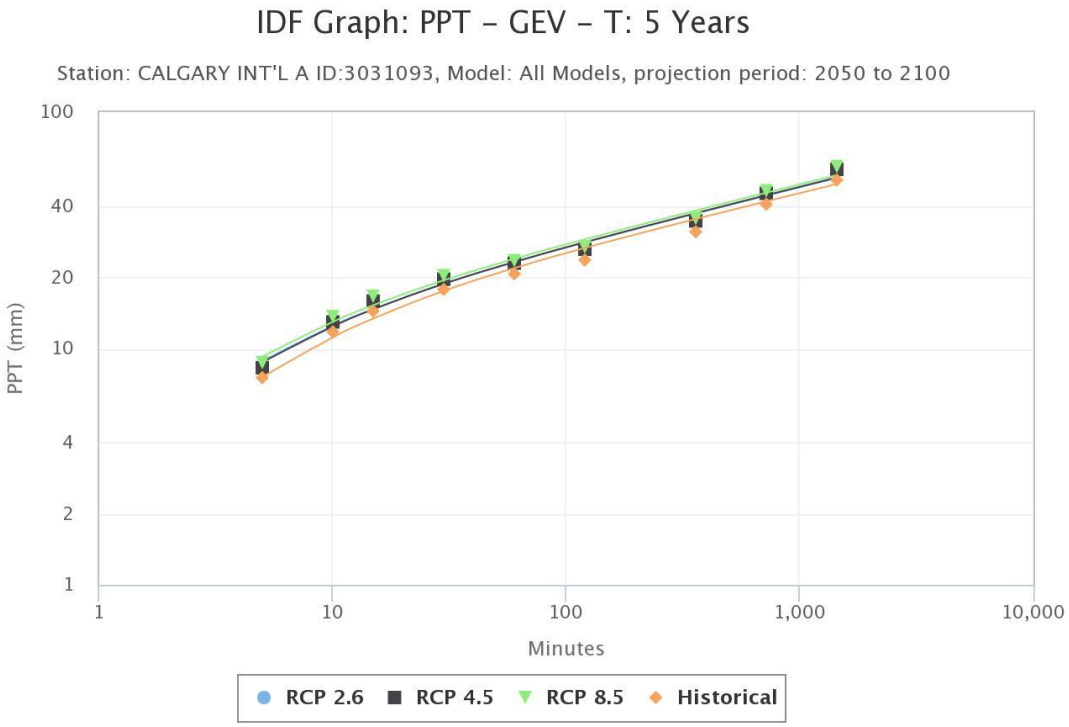
Total annual precipitation change for Bar U Ranch – Waterton Lakes area from 1980-2010 baseline. Composite projection of four spatially interpolated downscaled Global Circulation Models: CanESM2, CESM1CAM5, HADGEM2ES and MIROCESM. Data source Natural Resources Canada, Canadian Forest Service, http://cfs.nrcan.gc.ca/projects/3 (Price *et al.*, 2011).

2.3 Rainfall Intensity, Duration and Frequency (IDF)

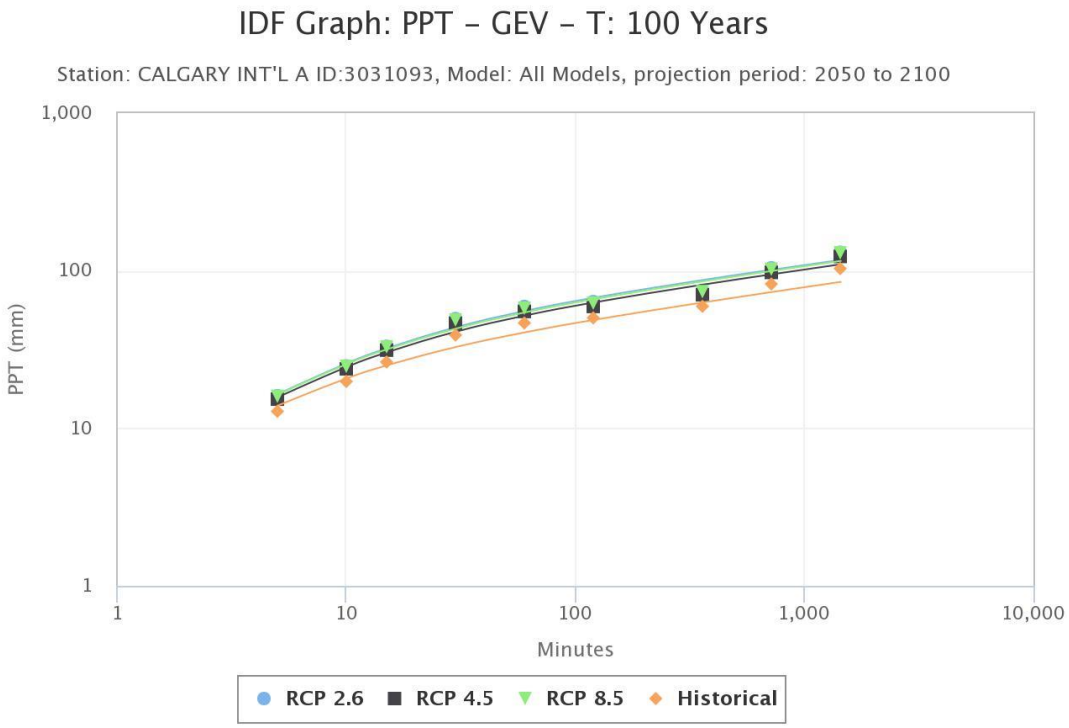
Extreme rainfalls calculated in IDF_CC Tool 2.0 (http://beta.idf-cc-uwo.ca/). The tool uses a Generalized Extreme Values (GEV) distribution. For more details on extreme rainfall events, see Simonovic *et al.* (2017).



Baseline total precipitation amounts for Calgary climatological station (3031093) from 1947-2009 for different return periods (T).



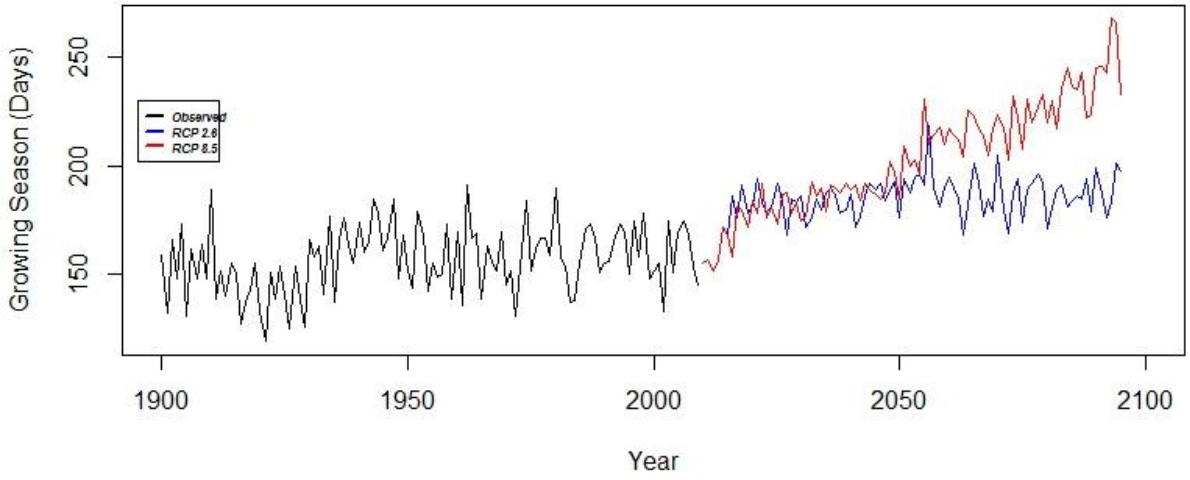
Projected total precipitation for **one in 5-year** events for the period 2050-2100 using an ensemble of models.

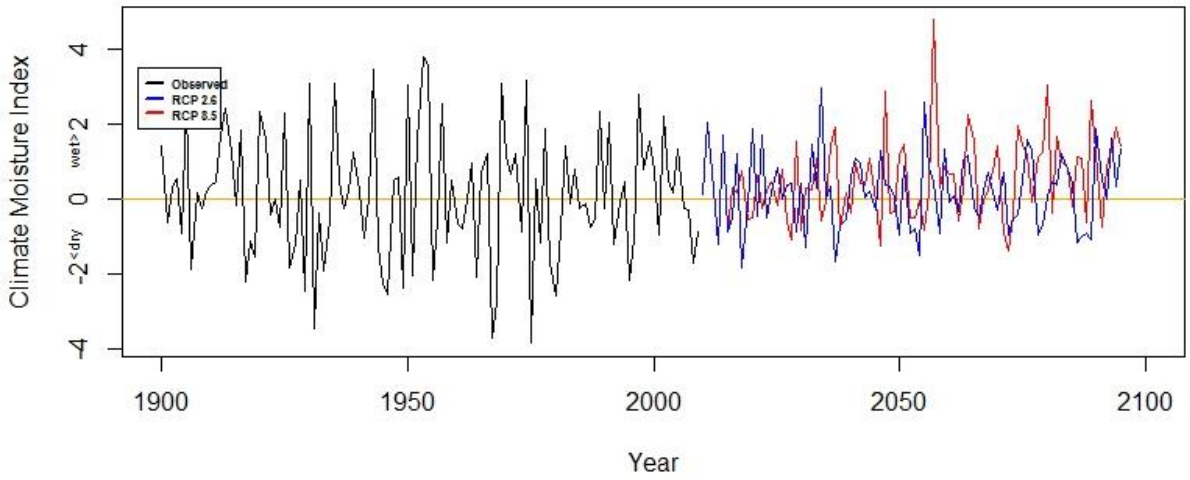


Projected total precipitation for **one in 100-year** events for the period 2050-2100 using an ensemble of climate models. One way to consider this, is that today's "one in 100 year" event (i.e., 103 mm/day) is projected to become a "one in 40 year" event and the future "one in 100 year" event is projected to increase 129 mm/day.

2.4 Growing Season and Climate Moisture Index

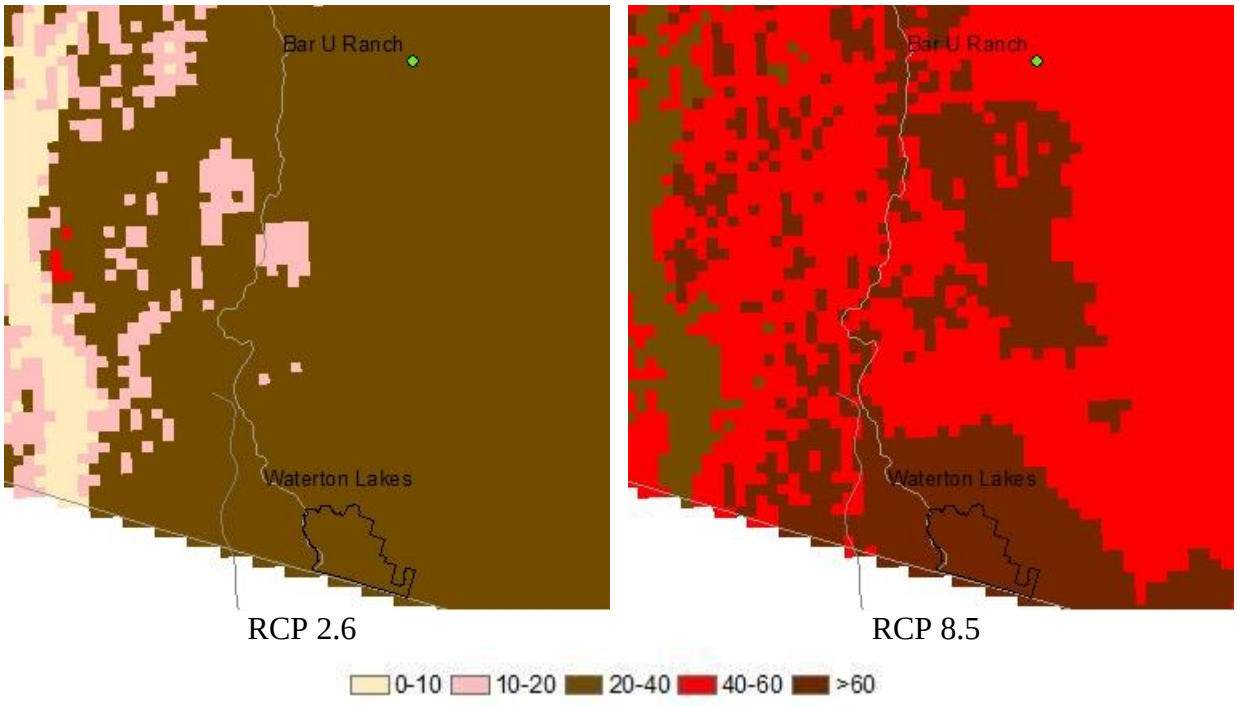
The Climate Moisture Index (CMI) is calculated as the difference between annual precipitation and potential evapotranspiration – the potential loss of water vapour from a landscape covered by vegetation (http://www.nrcan.gc.ca/forests/climate-change/forest-change/17772). A positive CMI value indicates wet or moist conditions and a negative indicates dry conditions.





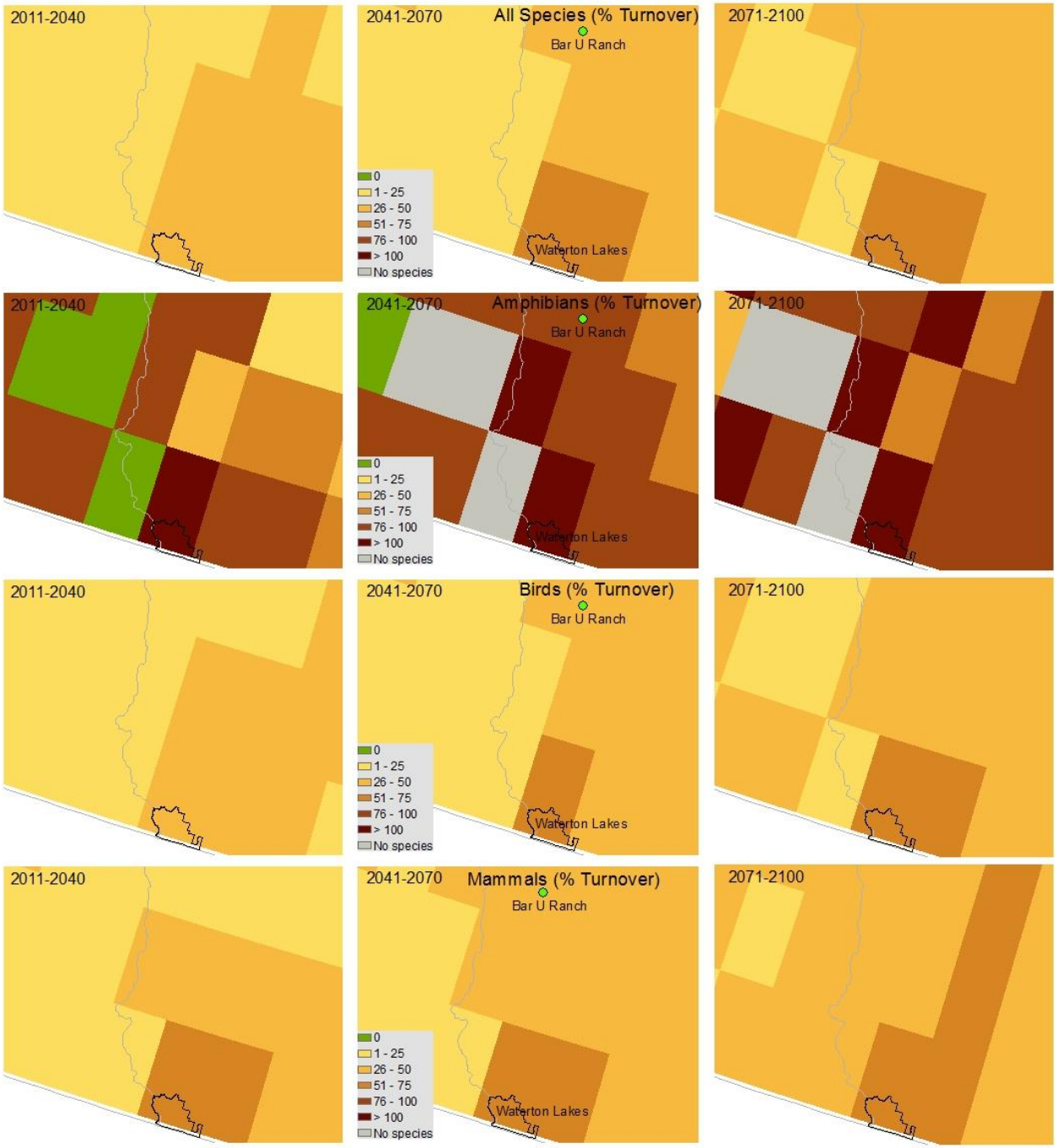
3. Climate Change Impacts

3.1 Wildfire



Projected increase in wildfire season for Bar U Ranch – Waterton Lakes area. Length in days from baseline (1981-2010) by 2071-2100 under RCP 2.6 and 8.5 scenarios. Data source Natural Resources Canada, http://cfs.nrcan.gc.ca/fc-data-catalogue.

3.2 Biodiversity



Percentage of projected species turnover (50 km x 50 km grid) relative to current species occurrence, assuming full dispersal (i.e., species can move into new areas) using ten coupled atmosphere-ocean general circulations models (AOGCMS) as in Lawler et al. (2009) and the A2 emission scenario. **Species turnover** is calculated as a composite measure of **species loss** (i.e., % of species currently in a cell whose projected future range does not include the cell) and **species gain** (i.e., % increase in species due to range expansion). Data and analysis discussed further in Lindsay et al. (2016).

3.3 Flood Hazard

The Municipal District of Foothills No. 31, which includes Bar U Ranch, has completed a flood scoping study and mitigation program (Advisian and EcoNomics, 2017; Amec Foster Wheeler and Advisian, 2017; IBI Group Inc., 2017).

No data on Alberta Flood hazard Map Application (http://maps.srd.alberta.ca/FloodHazard/).

Flooding at Bar U Ranch National Historic Site on June 20, 2013. Photo Credit: Friends of the Bar U.

4. References

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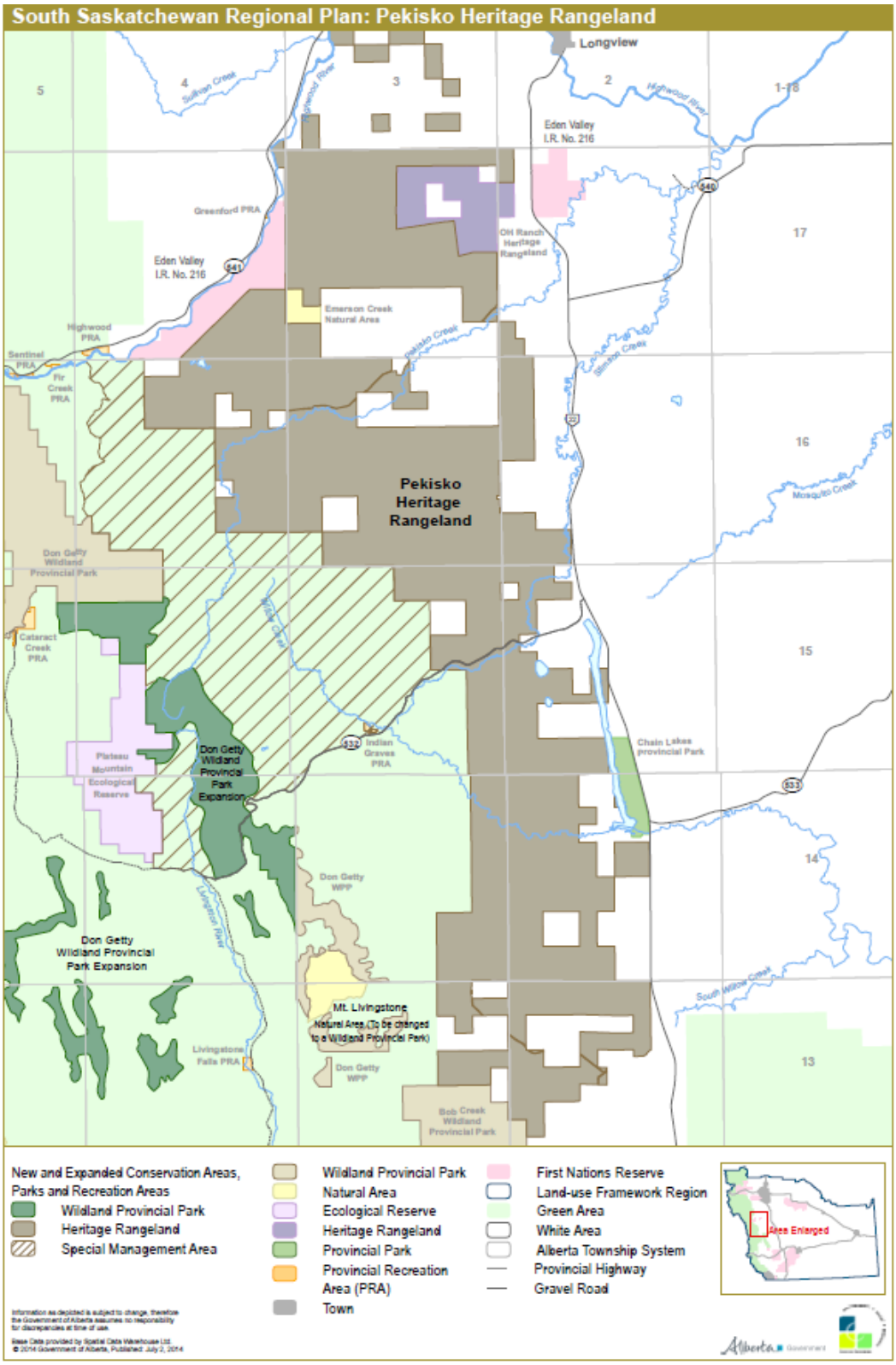
Bar-U Ranch National Historic Site
3
1
2
Township Rd 171A
1 - Harness Shop
- Blacksmith Shop
- Woodshed
- Cookhouse
- Dairy Barn
- Pearson's House
- Hay Shed
- Implement Shed
- Poultry
- Privy
- Root Cellar
- Saddle Hou\rse Barn
- Storage (Buildings 8, 9, and 10)
- Stud Horse Barn
- Work House Barn
2 - Livestock Shed
- Piggery Building
- Poultry Shed
- Self Feeder
- Tractor Garage
- Vehicle Garage (Building 35)
3 - Vehicle Garage (Building 24)
- Foreman's House
N



https://open.alberta.ca/dataset/b076a5c1-6f8f-4f31-8b84-2ee7eed04672/resource/dad97f02-3a88-43f0-89a6-81ffca4f4f8b/download/SSRP-Pekisko-Heritage-Rangeland.pdf