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April 7, 2020

MEMORANDUM

TO: Power Committee

**FROM: Daniel Hua, Power System Analyst
John Fazio, Senior Systems Analyst**

SUBJECT: Updates on Climate Scenario Selection

BACKGROUND:

Presenter: Daniel Hua

Summary: A preliminary set of climate scenarios selected for the 2021 Power Plan was presented to the Power Committee during the meeting in November 2019. After further analysis over the past few months, council staff have selected an updated set of scenarios for the Power Plan. At this meeting, staff will brief the Power Committee on the updated scenarios, as well as comparing relevant resource adequacy parameters such as seasonal hydro-generation, heating degree-days and cooling degree-days (which are proxies for temperature-sensitive loads), among the selected scenarios with corresponding historical data.

Relevance: Using historic variations in river flows and temperatures will likely bias the outlook for future regional resource needs. Climate scenarios from the River Management Joint Operating Committee (RMJOC) generally forecast higher winter river flows (leading to greater hydro generation), which when combined with higher winter temperatures (lower load) should lead to lower resource needs. Projections for summer, however, go in the opposite direction, with generally lower hydroelectric generation, which when combined with higher electricity demand should lead to higher resource needs. Not accounting for forecasted climate changes could lead to inappropriate resource strategies.

Workplan: A.5.2 Updates to models to get ready for 2021 power plan modeling

Background: Anticipated changes in future climate will affect both resources and demand in the Pacific Northwest. Anticipated increases in temperature will alter the pattern of electricity use. Higher temperatures and more precipitation tend to result in more rain and less snow during winter months, which reduces the snow pack and subsequent summer flow. Finally, state laws enacted to reduce greenhouse gases will limit future resource choices. The Council has an obligation to account for all of these factors when developing its resource strategy in order to maintain the adequacy, reliability, efficiency and economy of the regional power supply.

More Info: November 2019 Power Committee Presentation:
<https://nwcouncil.box.com/s/4raa0jdb6679mkqg0dngbcchvsqt063o>,

Climate and Hydrology Datasets for RMJOC Long-Term Planning Studies:
Second Edition (RMJOC-II) Part I: Hydroclimate Projections and Analyses
<https://www.bpa.gov/p/Generation/Hydro/hydro/cc/RMJOC-II-Report-Part-I.pdf>

Update on Climate Scenario Selection for The 2021 Power Plan

April 14, 2020



THE 2021
NORTHWEST
POWER PLAN

FOR A SECURE & AFFORDABLE
ENERGY FUTURE

Outline

- Latest climate scenarios selected for the 2021 Power Plan
- Compare the selected climate scenarios and historical hydro-generation, heating degree-days (HDDs) and cooling degree-days (CDDs)





The Climate Scenarios Selected for the 2021 Power Plan

The Selected Scenarios

Selected Scenarios	Winter Generation	Summer Generation	Winter HDD	Summer CDD
A	-	<u>low</u>	<u>low</u>	<u>high</u>
C	<u>high</u>	<u>low</u>	-	-
G	<u>near low</u>	<u>high</u>	<u>high</u>	<u>near low</u>

❖ The selected scenarios, **A**, **C** and **G** cover the adequacy boundary of highs and lows of:

- winter hydro generation
- summer hydro generation
- winter heating degree-days
- summer cooling degree-days



The Selection Criteria

Selected Scenarios	Winter Generation	Summer Generation	Winter HDD	Summer CDD
A	-	<u>low</u>	<u>low</u>	<u>high</u>
C	<u>high</u>	<u>low</u>	-	-
G	<u>near low</u>	<u>high</u>	<u>high</u>	<u>near low</u>

❖ Selection Criteria:

- The 19 RMJOC climate scenarios – ensemble
- high - scenario with the most population in top-10 percentile of ensemble
- low - scenario with the most population in bottom-10 percentile of ensemble



The background features an abstract graphic composed of several overlapping geometric shapes. On the left, there is a small light green trapezoid. In the center, a large teal pentagon is partially overlaid by a light blue trapezoid. To the right, a large light green rectangle is partially overlaid by the light blue trapezoid. The overall composition is clean and modern, using a palette of muted greens and blues.

Comparisons between Climate Scenarios and Historical Data

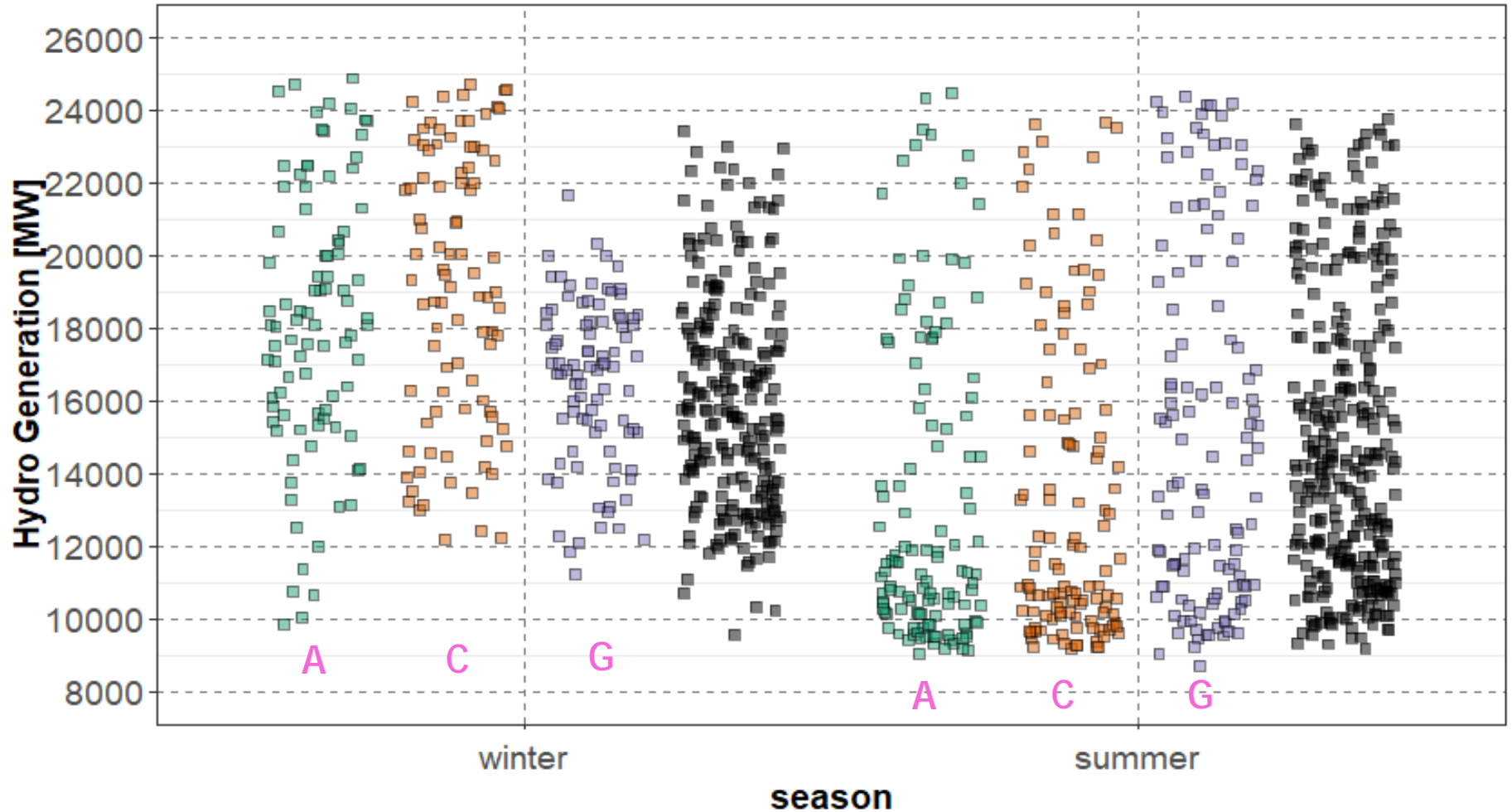
Comparing Climate Scenario and Historical Data

- Winter: Jan, Feb and Mar
- Summer: Jun, Jul and Aug
- 30 Climate years: 2020 – 2049
- 80 Historical years of streamflows: 1929 - 2008
- 70 Historical years of hourly temperatures: 1948- 2017
- Each scenario plot has 90 data points
- Historical plot has either 210 or 240 data points



Comparing Hydro Generation of Selected Scenarios with Historical – *Jitter*

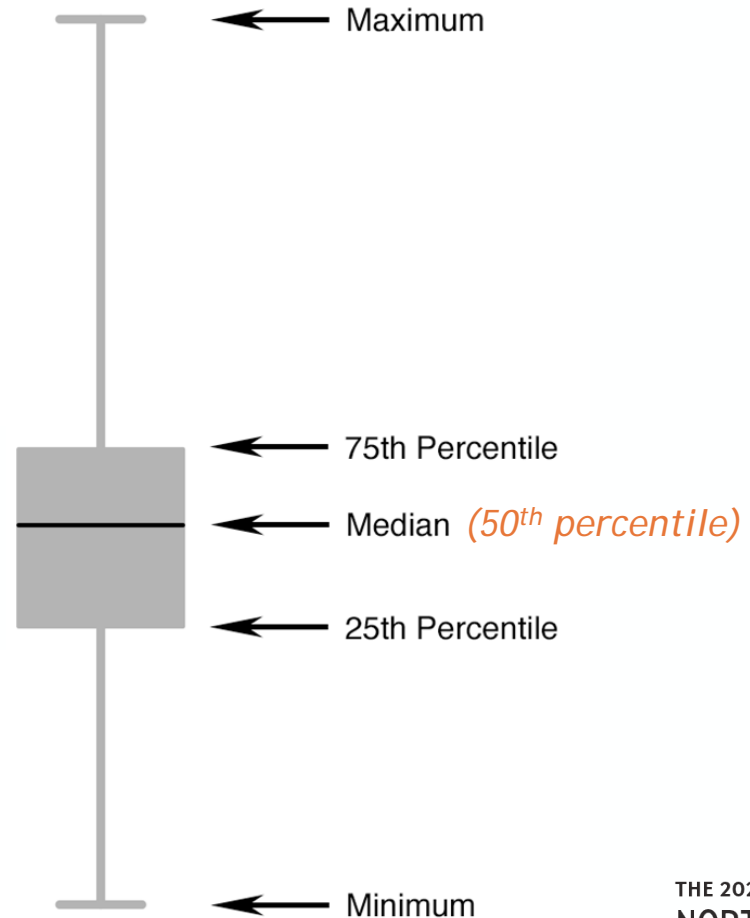
Distribution of Selected Climate Scenarios and Historical Generation



Data Type: ■ A ■ C ■ G ■ historical

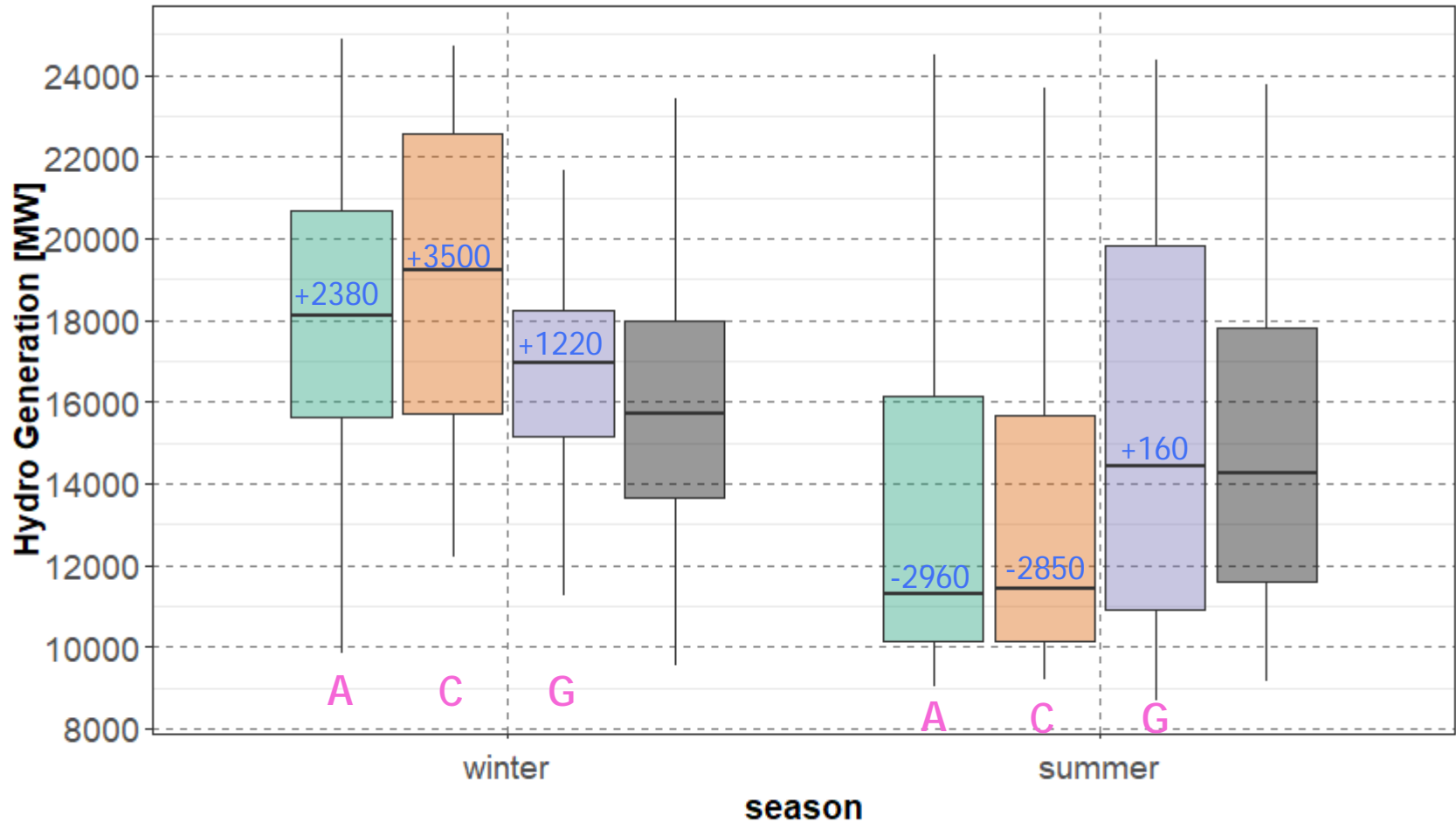
Interpreting Box-and-Whiskers Plot

For many of the box-and-whisker plots in this presentation, the upper and low whiskers have this simple interpretation: maximum and minimum



Comparing Hydro Generation of Selected Scenarios with Historical – *Box-Whiskers*

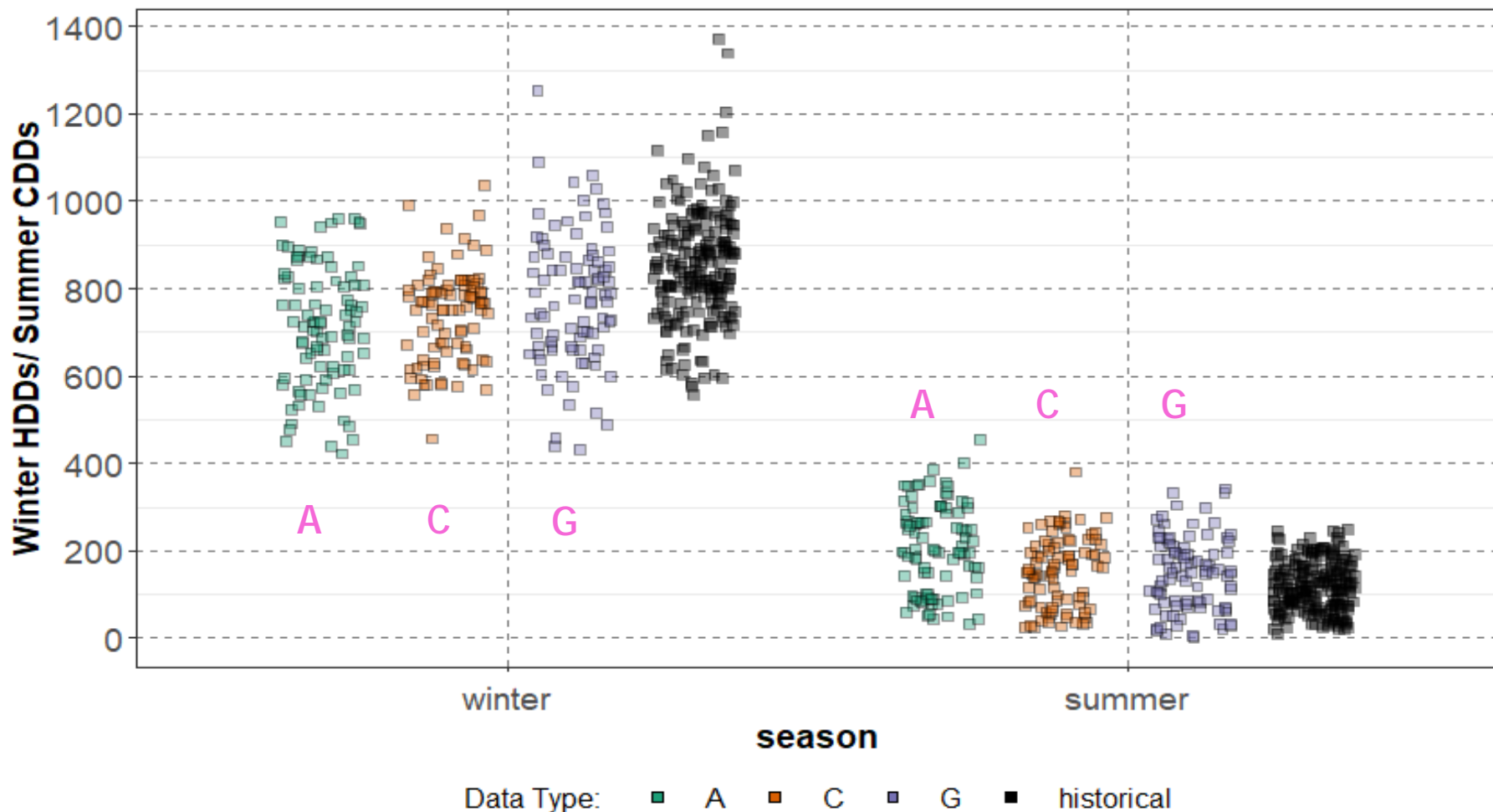
Distribution of Selected Climate Scenarios and Historical Generation



Data Type: ■ A ■ C ■ G ■ historical

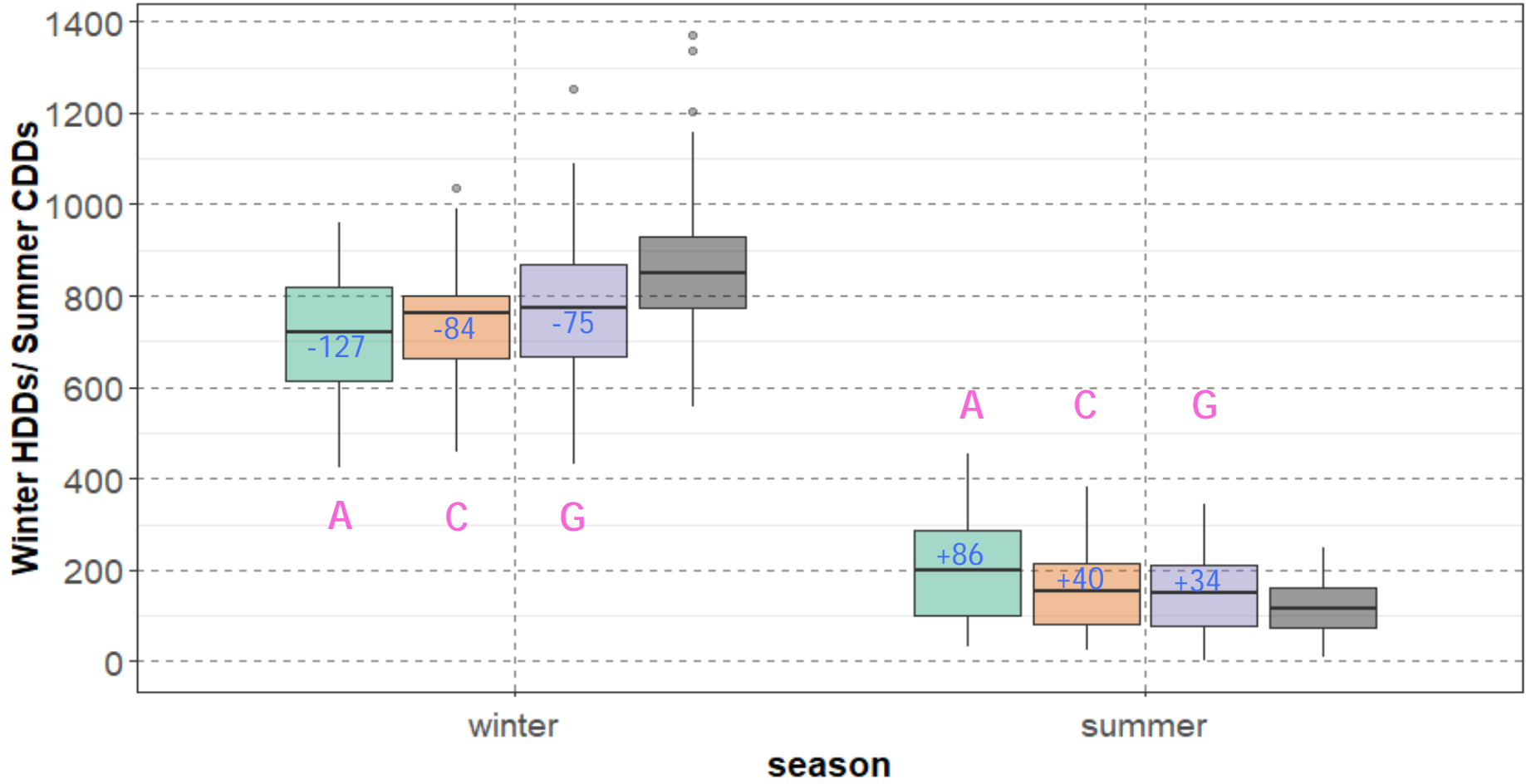
Comparing Winter and Summer DDs of Selected Scenarios with Historical - *Jitter*

Distribution of Selected Climate Scenarios vs Historical
Winter HDDs and Summer CDDs



Comparing Winter and Summer DDs of Selected Scenarios with Historical – *Box-Whiskers*

Distribution of Selected Climate Scenarios vs Historical
Winter HDDs and Summer CDDs



Data Type: A C G historical