

Climate and Weather Advisory Committee Meeting

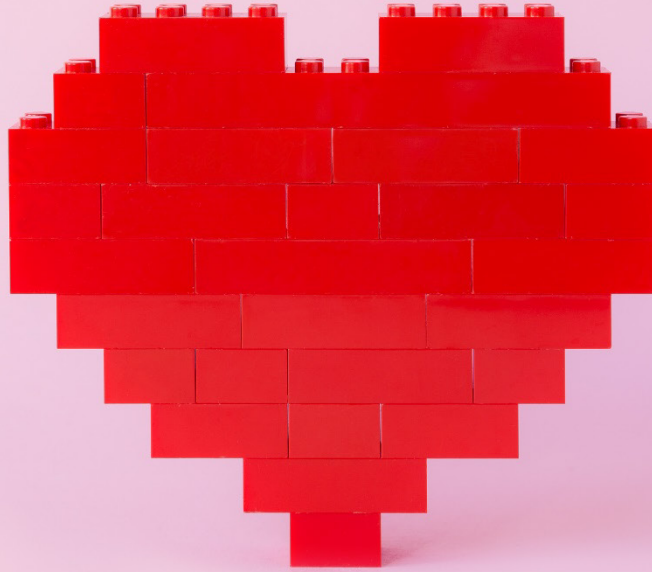
Daniel Hua & Christian Douglass

August 1, 2024



Northwest **Power** and
Conservation Council

WE



OUR

COMMITTEE MEMBERS!

Agenda (I)

- Meeting logistics
- Climate data used in the Power Plan
 - 2021 Power Plan
 - Streamflow data - RMJOC
 - Temperature data – RMJOC (4 cities)
 - Wind data – Climatology Lab (3 locations)
 - Solar data – historical (2 locations)
 - Upcoming Power Plan
 - Streamflow data – RMJOC (*no change*)
 - Temperature data – RMJOC (*among 29 locations*)
 - Wind data – climatology Lab (*same 3 locations and additional locations, work in progress*)
 - Solar data – climatology Lab (*same 2 locations and additional locations, work in progress*)

Agenda (II)

- Extreme regional weather in historical and climate scenario data
 - Extreme temperatures at 4 cities
 - Very low seasonal streamflows
- Preview of topics for the next Climate and Weather Advisory Committee
- Discussions and inputs on
 - climate scenarios selection (add scenario J?)
 - climate scenario years (2020 to 2049?)
 - topics of interests



Climate Scenario Streamflows

Climate Scenario Streamflows

- Climate scenario modified daily streamflows available for 76 hydro-projects and gauging stations
- They are used directly in the Council's resource adequacy models

A Sample List of Hydro-Projects



Climate Trends in Streamflow

<https://www.bpa.gov/-/media/Aep/power/hydropower-data-studies/rmjoc-ll-report-part-l.pdf>

https://www.nwcouncil.org/2021powerplan_trends-in-historical-and-climate-change-river-flows/

Climate Trends in Streamflow

- Compare daily 2020 Level modified streamflows at The Dalles (TDA)
 - First 30-years, 1929 to 1958, of historical streamflows
 - Last 30-years, 1989 to 2018, of historical streamflows
 - 2020 – 2049 climate scenarios A, C, and G streamflows

A: *CanESM2_RCP85_BCSD_VIC_P1*

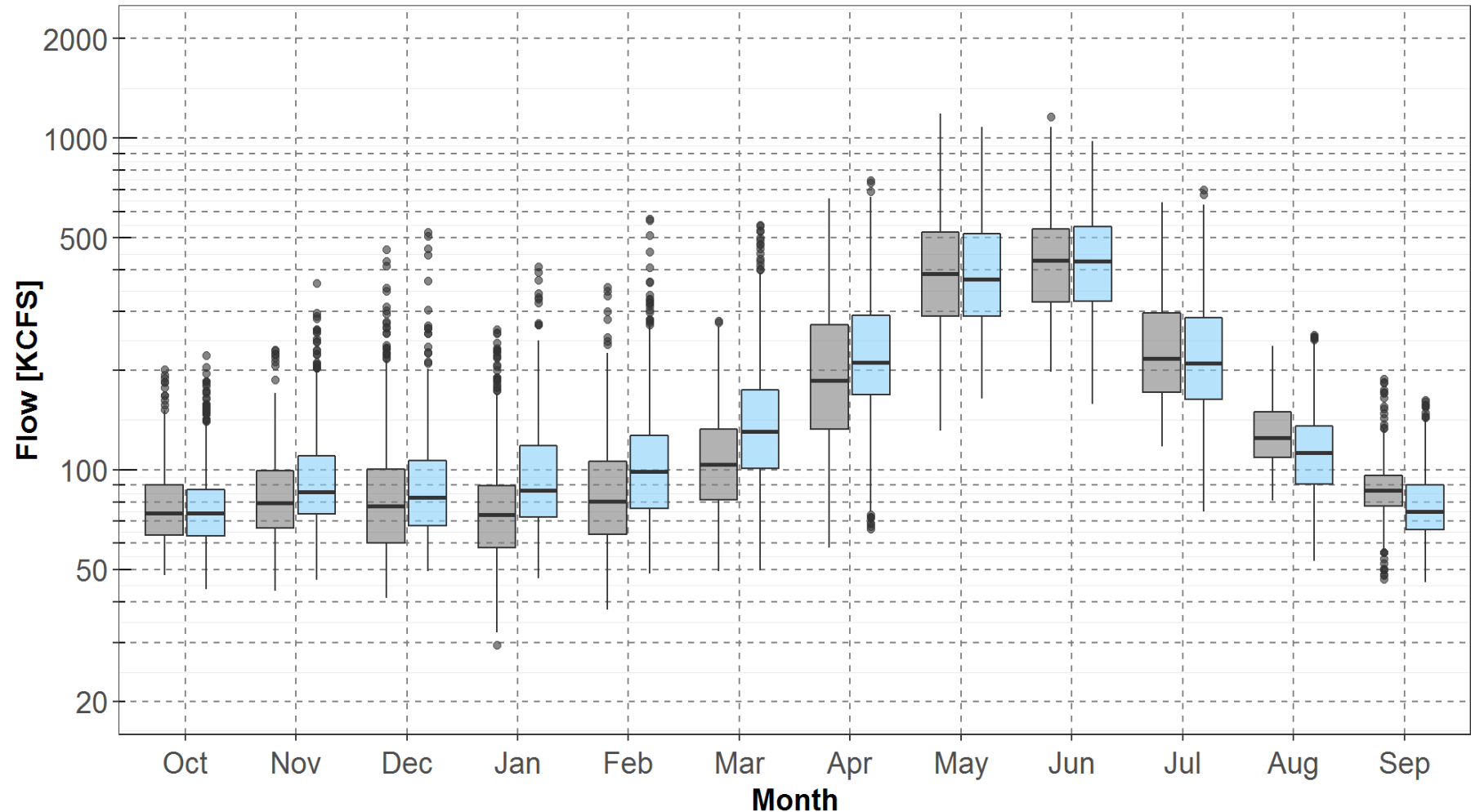
C: *CCSM4_RCP85_BCSD_VIC_P1*

G: *CNRM-CM5_RCP85_MACA_VIC_P3*

First 30-years vs Last 30-years of Historical Streamflow

- Comparisons of the boxes
- For Nov to Apr
- Streamflows for the *last 30-years* are *higher* than streamflows for the *first 30-years*
- For May, Jul, Aug and Sep
- Streamflows for the *last 30-years* are *lower* than streamflows for the *first 30-years*

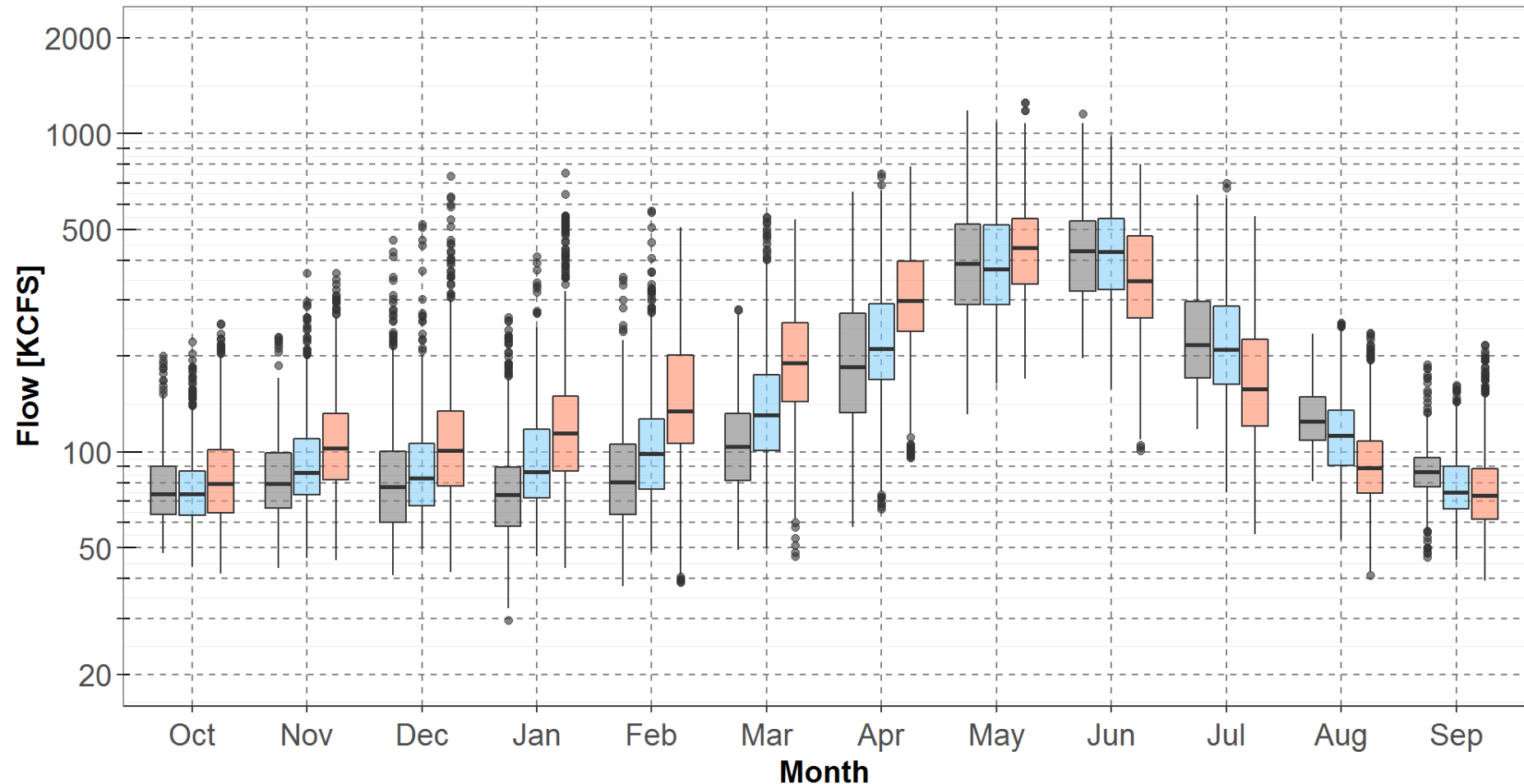
Monthly Distribution of Daily TDA 2020L Modified Flows for Two Historical Time Periods



First 30-years, Last 30-years And Climate Scenario A

Monthly Distribution of Daily TDA Modified Flows for 2020L Historical (1929 - 1958), (1989 - 2018) and CanESM2 (2020 - 2049)

- Comparisons of the boxes
- For Oct to May
- Streamflows for climate *scenario A* are *higher* than streamflows for the *last 30-years*
- For Jun to Sep
- Streamflows for climate *scenario A* are *lower* than streamflows for the *last 30-years*

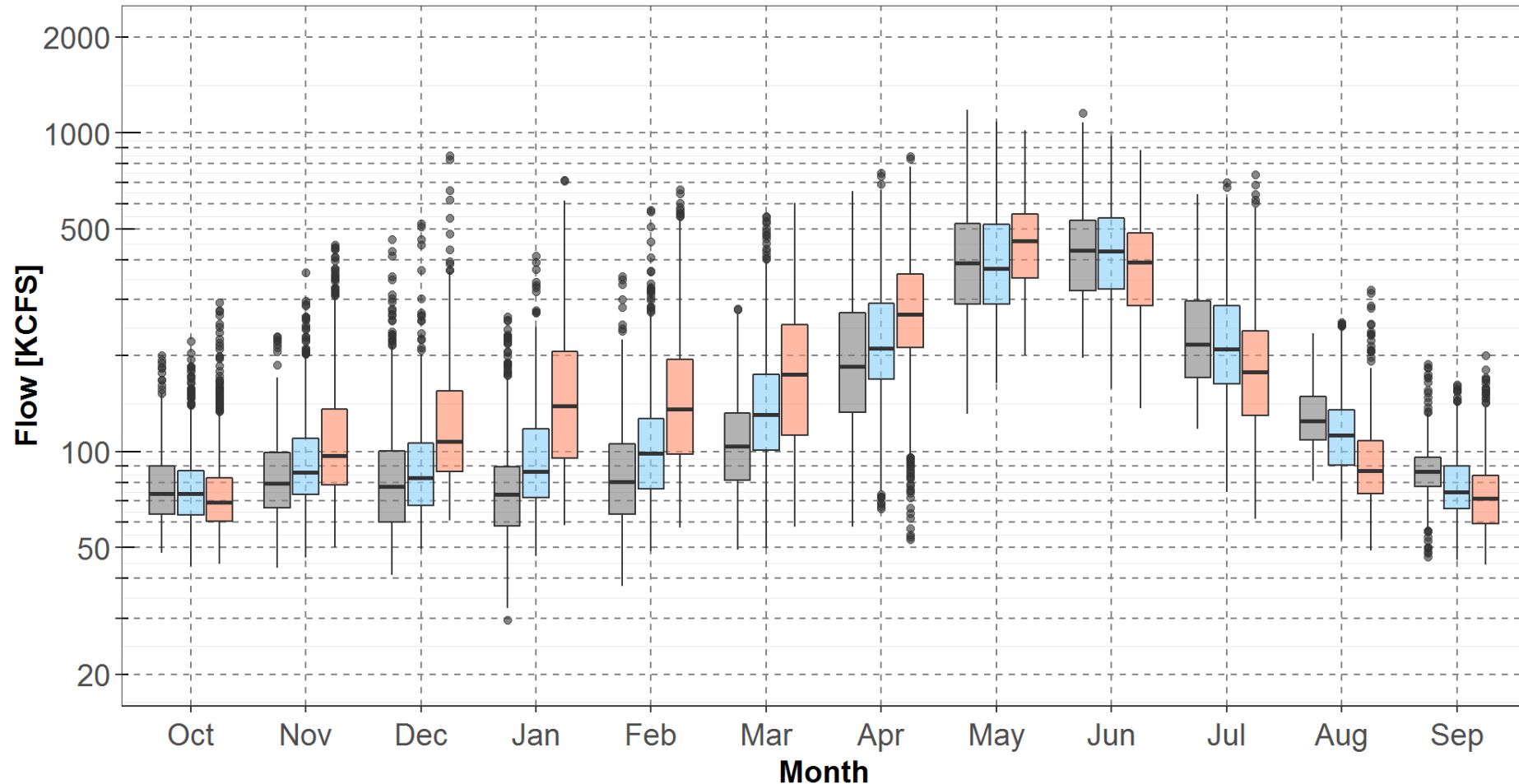


Type: Historical (1929 - 1958) Historical (1989 - 2018) CanESM2 (2020 - 2049)

First 30-years, Last 30-years And Climate Scenario C

Monthly Distribution of Daily TDA Modified Flows for 2020L Historical (1929 - 1958), (1989 - 2018) and CCSM4 (2020 - 2049)

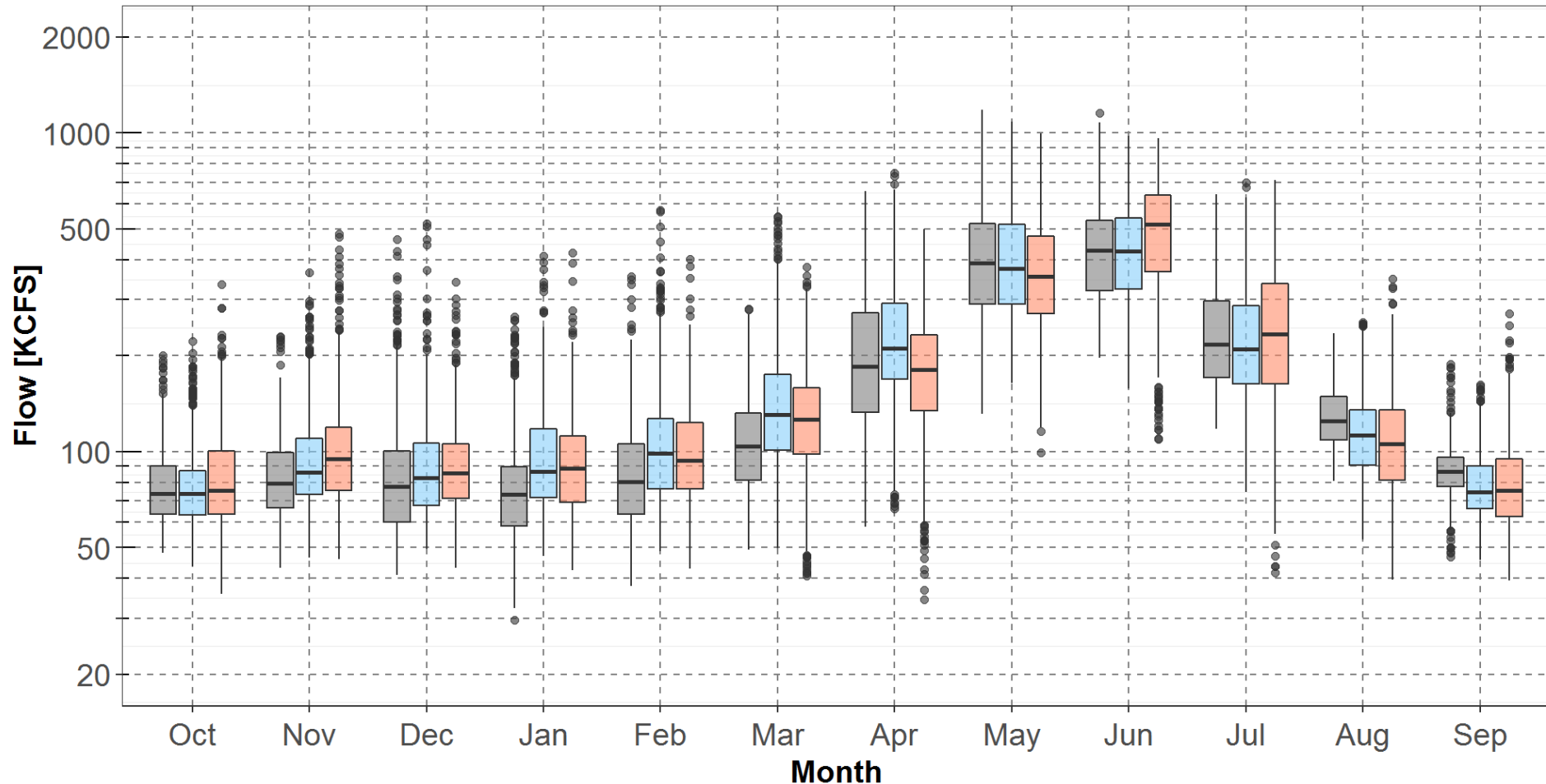
- Comparisons of the boxes
- For Nov to May
- Streamflows for climate *scenario C* are *higher* than streamflows for the *last 30-years*
- For Jun to Oct
- Streamflows for climate *scenario C* are *lower* than streamflows for the *last 30-years*



Type: Historical (1929 - 1958) Historical (1989 - 2018) CCSM4 (2020 - 2049)

First 30-years, Last 30-years And Climate Scenario G

Monthly Distribution of Daily TDA Modified Flows for 2020L Historical (1929 - 1958), (1989 - 2018) and CNRM (2020 - 2049)



- Comparisons of the boxes
- For Oct to Jan, *Jun* and *Jul*
- Streamflows for climate *scenario G* are *higher* than streamflows for the *last 30-years*
- For *Feb to May*, and Aug
- Streamflows for climate *scenario G* are *lower* than streamflows for the *last 30-years*

Type: Historical (1929 - 1958) Historical (1989 - 2018) CNRM (2020 - 2049)

An aerial photograph of a large, calm lake with several forested islands. The shoreline on the left is densely wooded, and a road or path is visible. The sky is filled with large, white clouds. The overall scene is serene and natural.

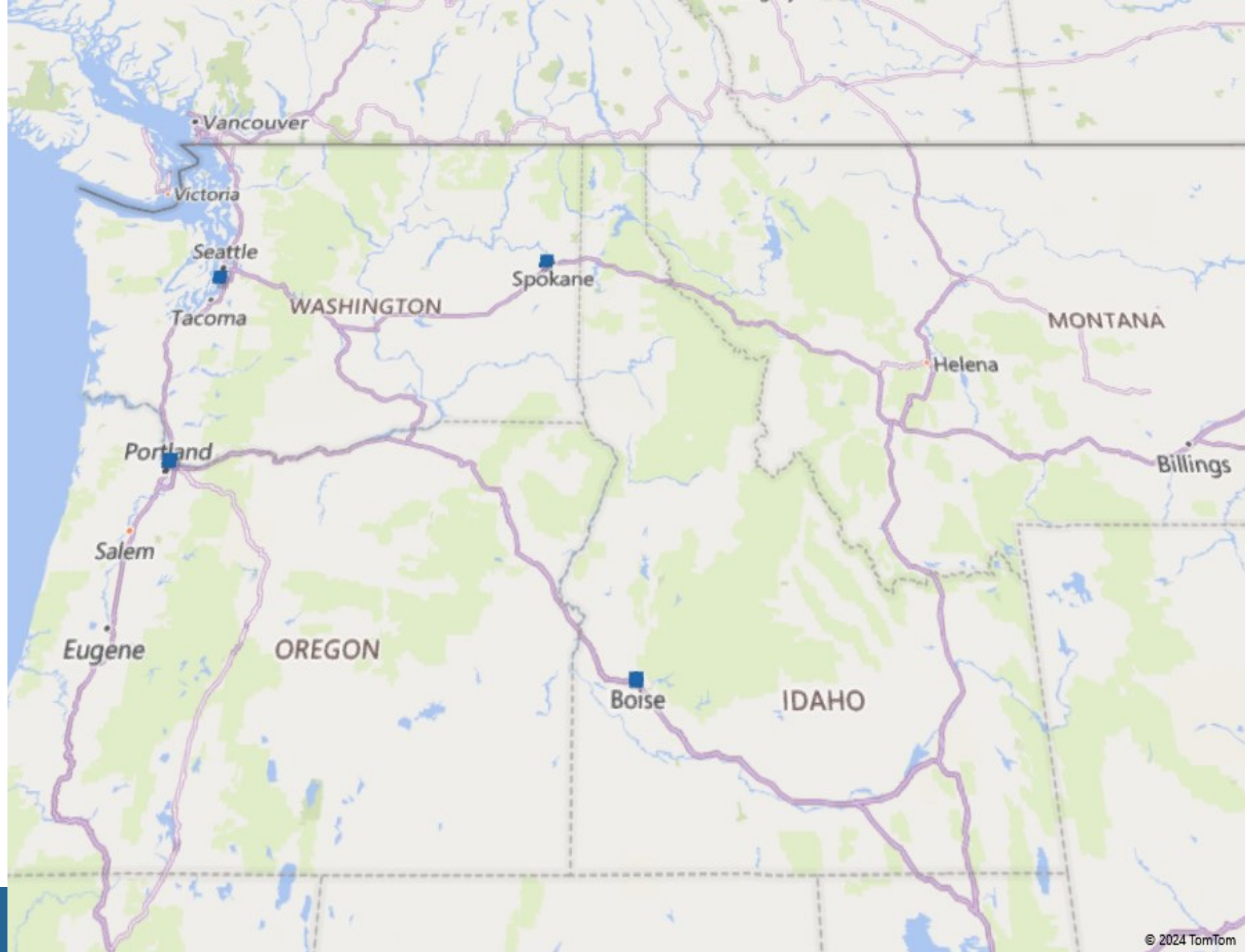
Climate Scenario Temperatures

Previous Power Plan

Climate Scenario Temperatures

■ Airport at

- Boise
- Portland
- Seattle
- Spokane



Climate Scenario Regional Temperature

- RMJOC Climate scenario temperatures $T_{Seattle}$, $T_{Portland}$, $T_{Spokane}$, T_{Boise} are daily minimum and maximum temperatures from

- Define a *regional* temperature T :

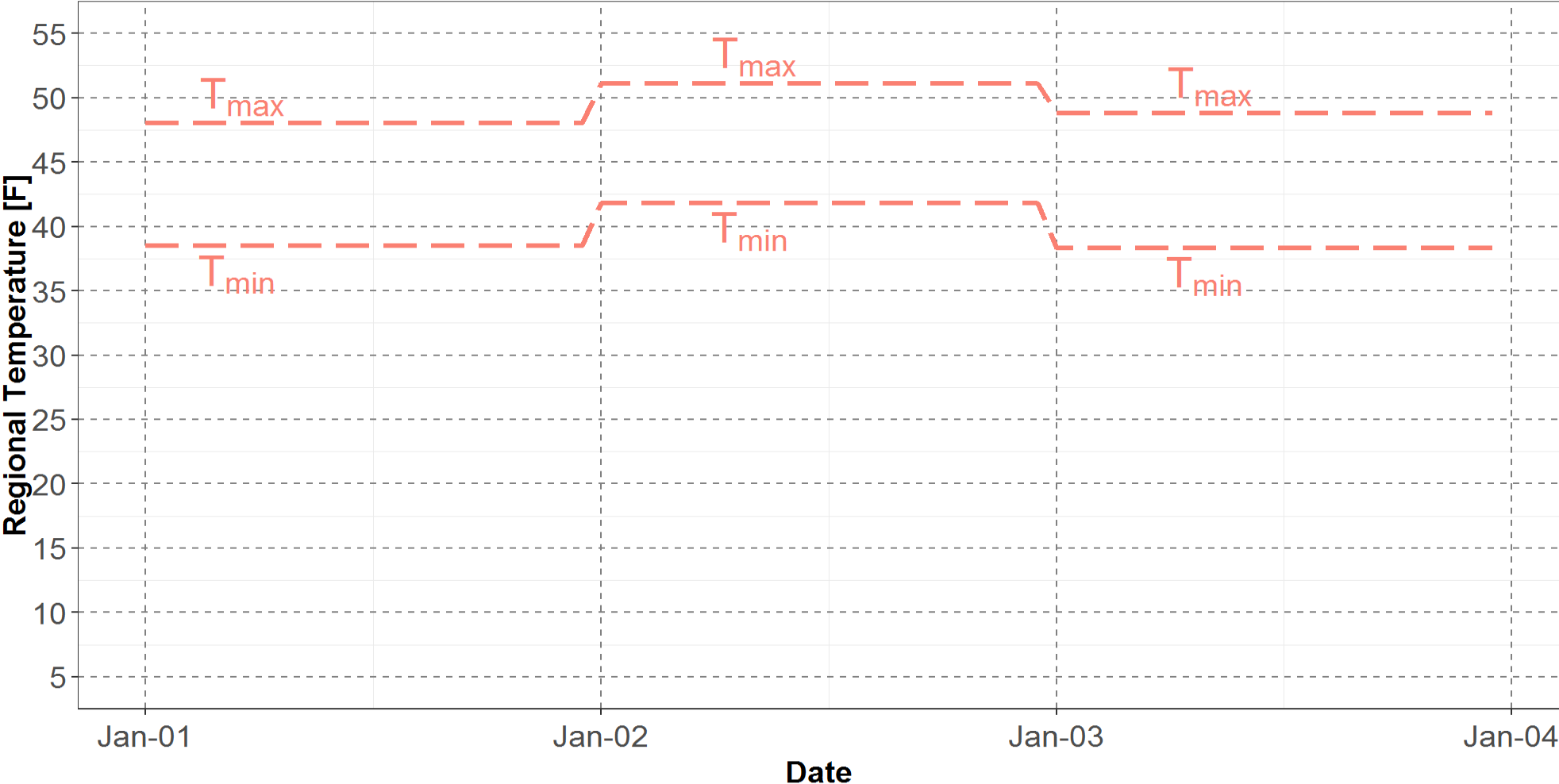
$$T = a \times T_{Seattle} + b \times T_{Portland} + c \times T_{Spokane} + d \times T_{Boise} + \text{constant}$$

(a, b, c, d , vary by month. For example, $a = 0.49, b = 0.26, c = 0.22, d = 0.06, \text{constant} = -2.54$, for Jan to Apr)

- Therefore, T is daily minimum and maximum

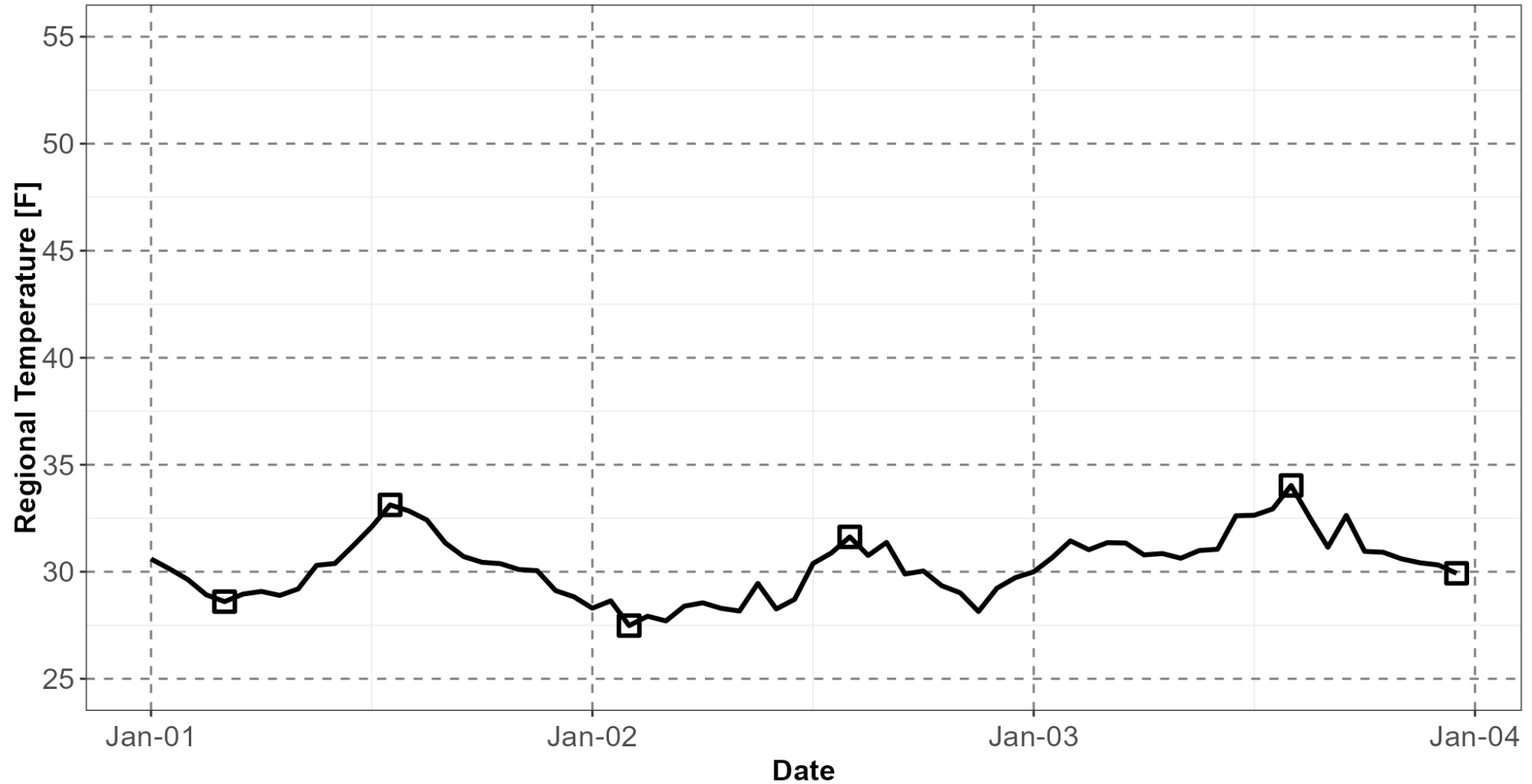
CCSM4 BCSD Climate Scenario Daily Temperatures

2035 CCSM4 BCSD Max and Min Regional Temperatures



The Historical 1982 Hourly Temperatures

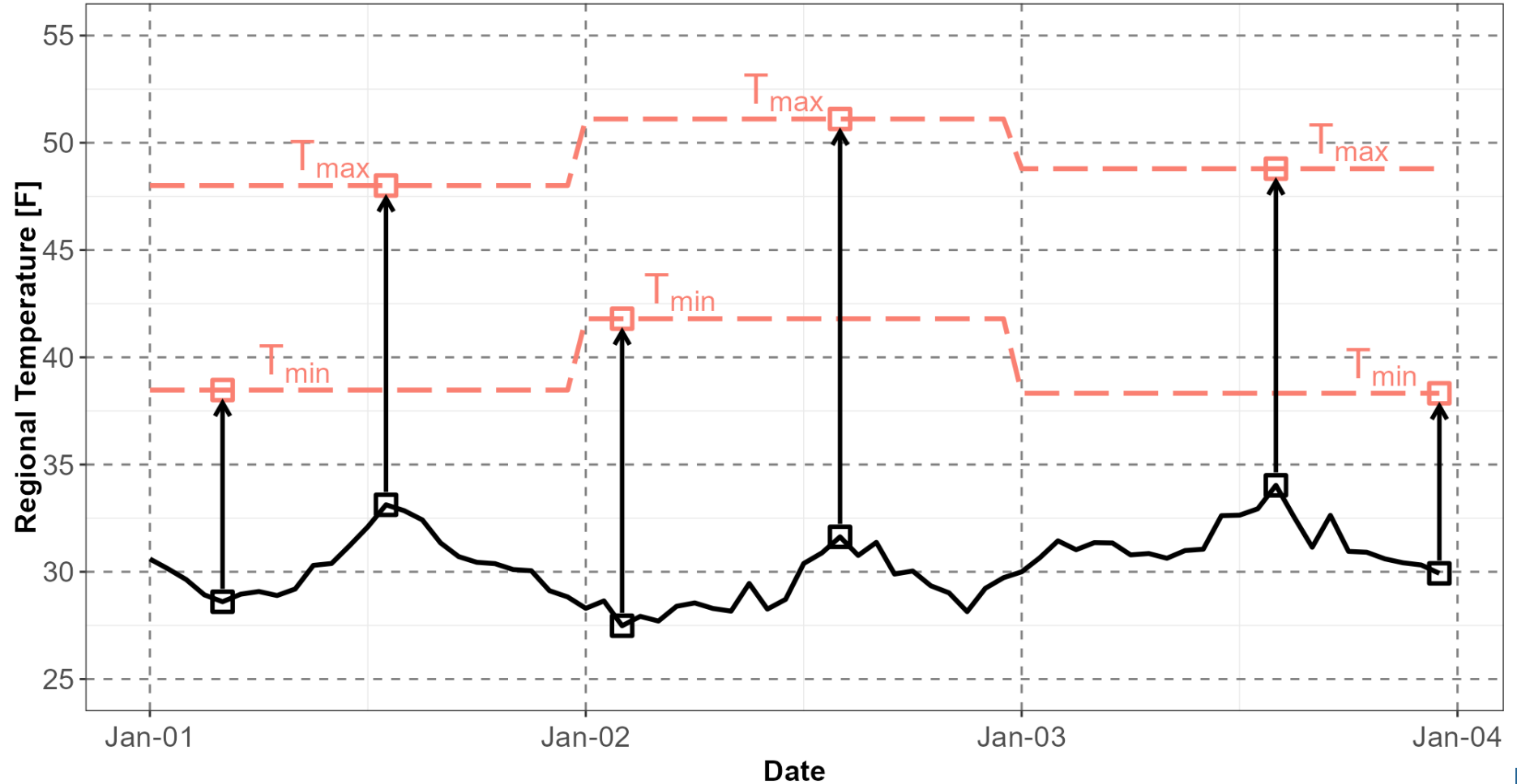
1982 Historical Regional Hourly Temperatures



Type: — Historical

Mapping Historical 1982 Temperatures to Climate Scenario Daily Temperatures

2035 CCSM4 BCSD Max and Min and 1982 Historical Hourly Regional Temperatures



- historical T_{min} is transformed to scenario C T_{min} at the same historical hour
- historical T_{max} is transformed to scenario C T_{max} at the same historical hour

Transforming Historical 1982 Temperatures to Climate Scenario **Daily** Temperatures

- For January 1st,

$$\alpha_{Jan-1} \times (28.60) + \beta_{Jan-1} = 38.47$$

$$\alpha_{Jan-1} \times (33.12) + \beta_{Jan-1} = 48.01$$

So $\alpha_{Jan-1} \cong 2.110$ and $\beta_{Jan-1} \cong -21.88$

- For January 2nd,

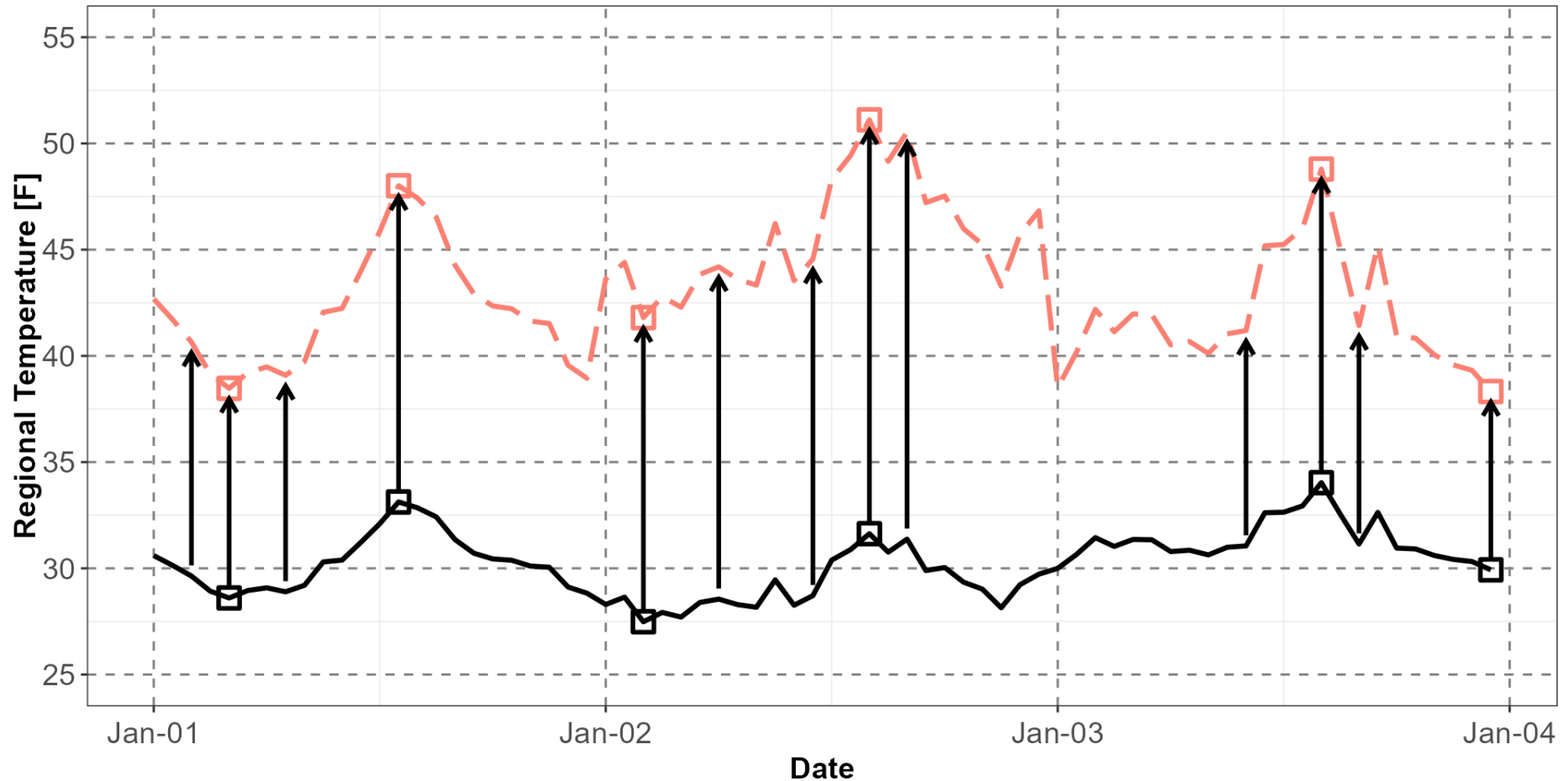
$$\alpha_{Jan-2} \times (27.48) + \beta_{Jan-2} = 41.80$$

$$\alpha_{Jan-2} \times (31.63) + \beta_{Jan-2} = 51.11$$

So $\alpha_{Jan-2} \cong 2.246$ and $\beta_{Jan-2} \cong -19.95$

Climate Scenario Hourly Temperatures with Historical 1982 Hourly Shape

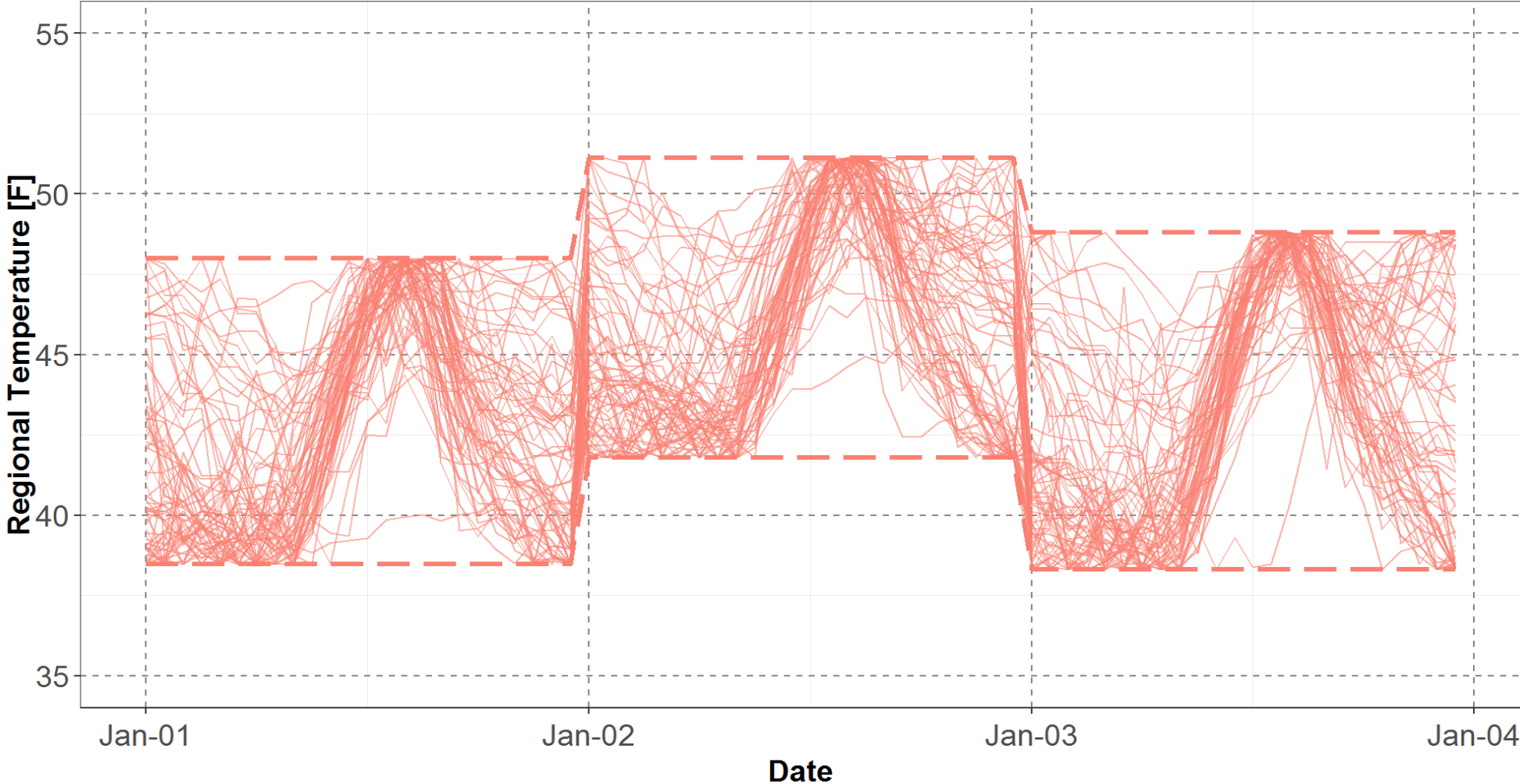
2035 CCSM4 BCSD (with 1982 Historical Hourly Shape) and 1982 Historical Hourly Regional Temperatures



- The equation for Jan 1st that transforms historical T_{min} and T_{max} to scenario C T_{min} and T_{max}
- is also used to transform other historical hourly temperatures to scenario C hourly temperatures
- And so on for Jan 2nd, Jan 3rd, ..., etc.,

Which Historical Year to Pick for Hourly Shape? (A)

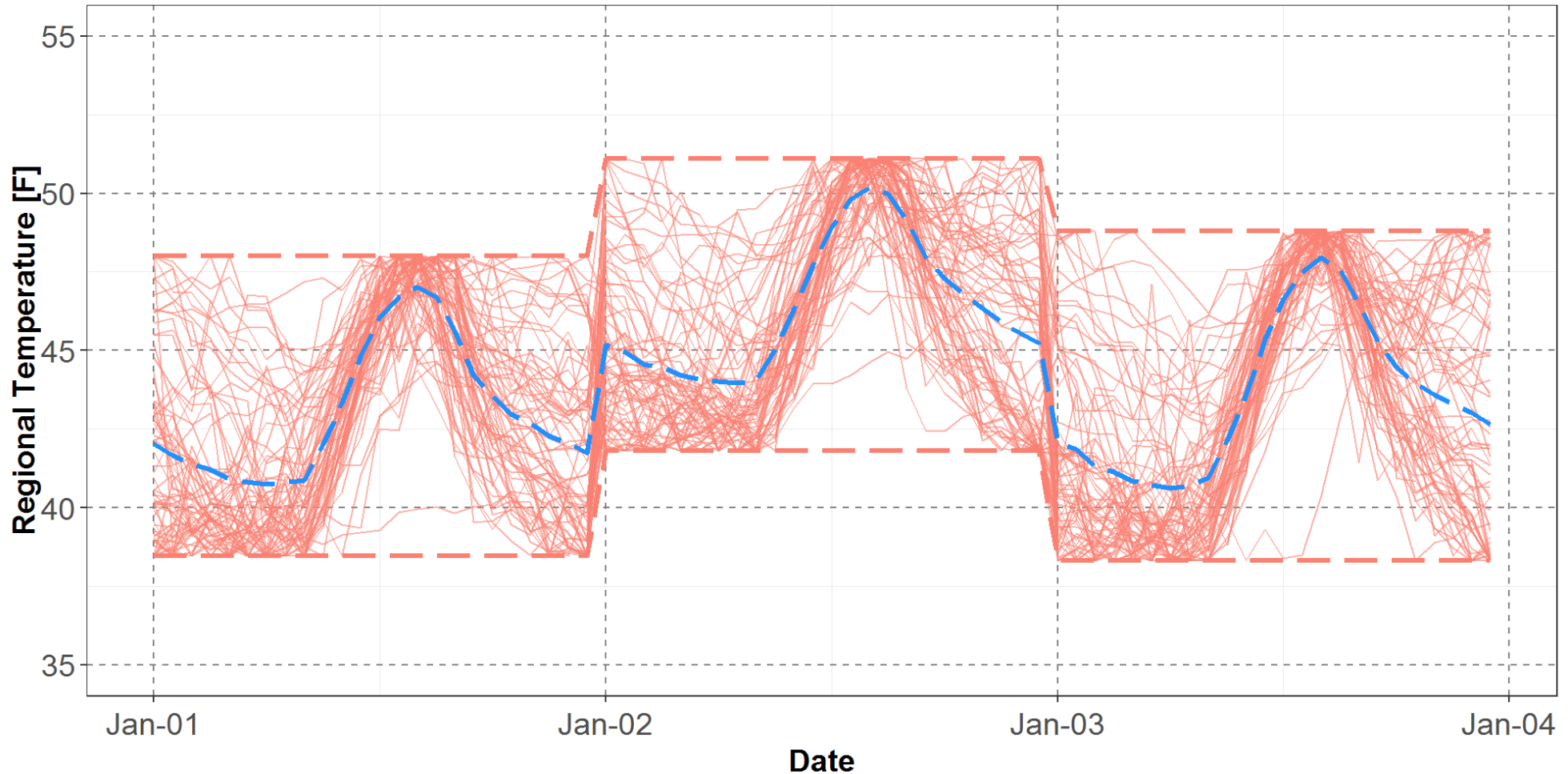
2035 CCSM4 BCSD Hourly Regional Temperatures Using (1948 - 2018) Historical Hourly Shapes



Type: — Climate Model Temperatures with 71 Years of Historical Shapes

Which Historical Year to Pick for Hourly Shape? (B)

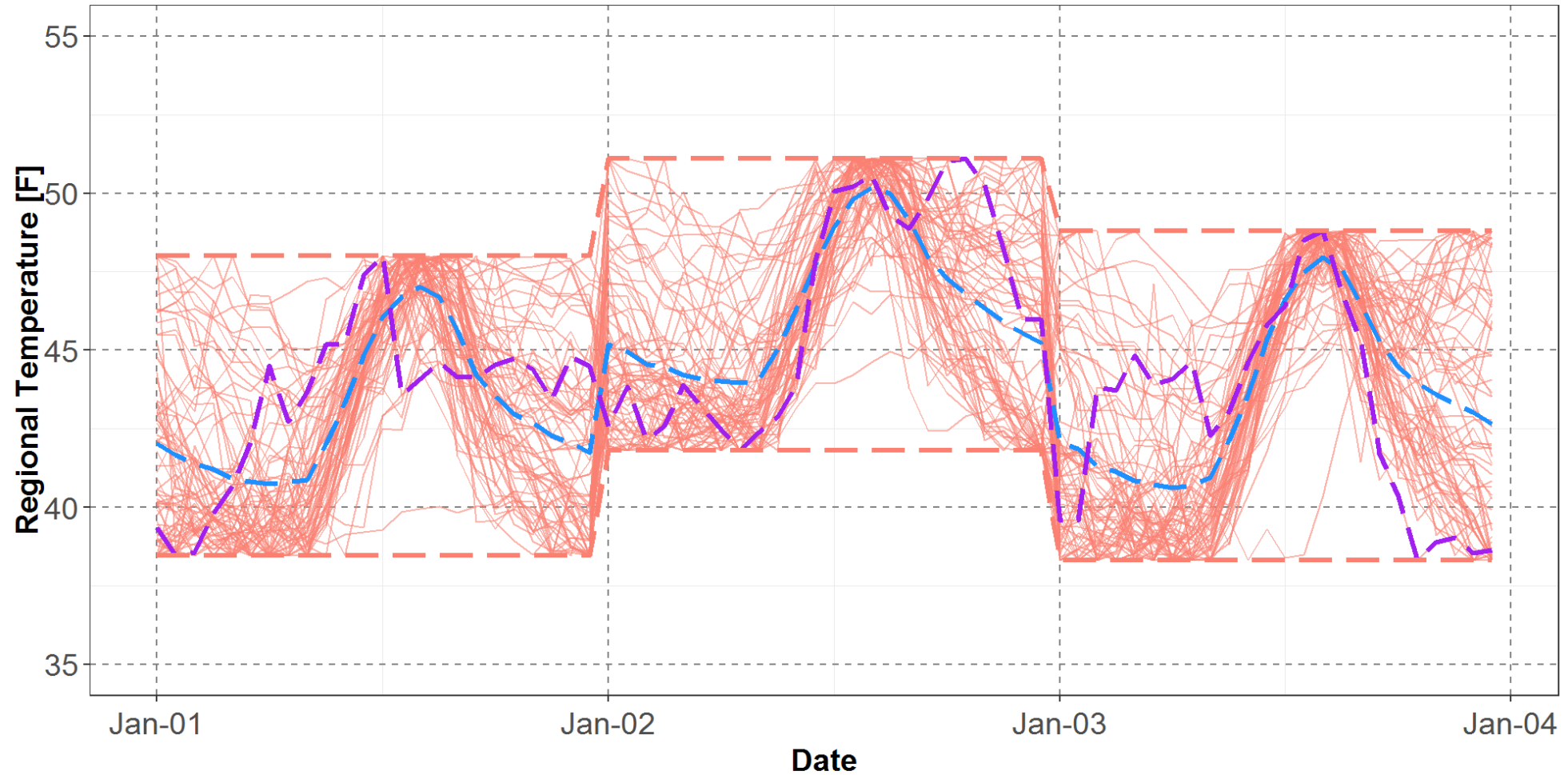
2035 CCSM4 BCSD Hourly Regional Temperatures Using (1948 - 2018) Historical Hourly Shapes and Their Average



Type: — 71 Historical Hourly Shapes — Average of the 71 Historical Hourly Shapes

Pick A Historical Year “Closest” to the Average

2035 CCSM4 BCSD Hourly Regional Temperatures Using (1948 - 2018) Historical Hourly Shapes and Their Average

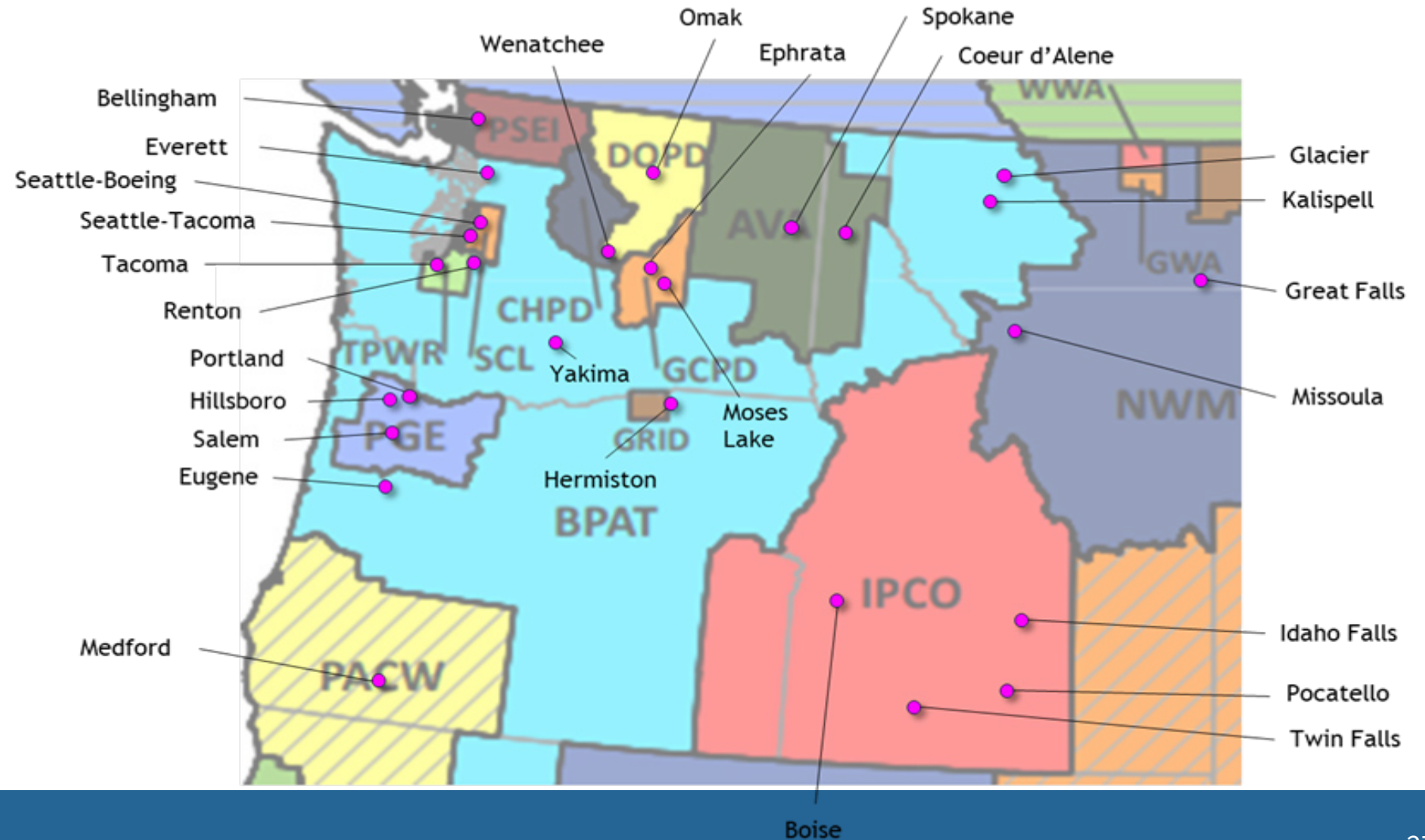


Type: — 71 Historical Hourly Shapes — Average of the 71 Historical Hourly Shapes — Year-1987 Hourly Shape

Upcoming Power Plan

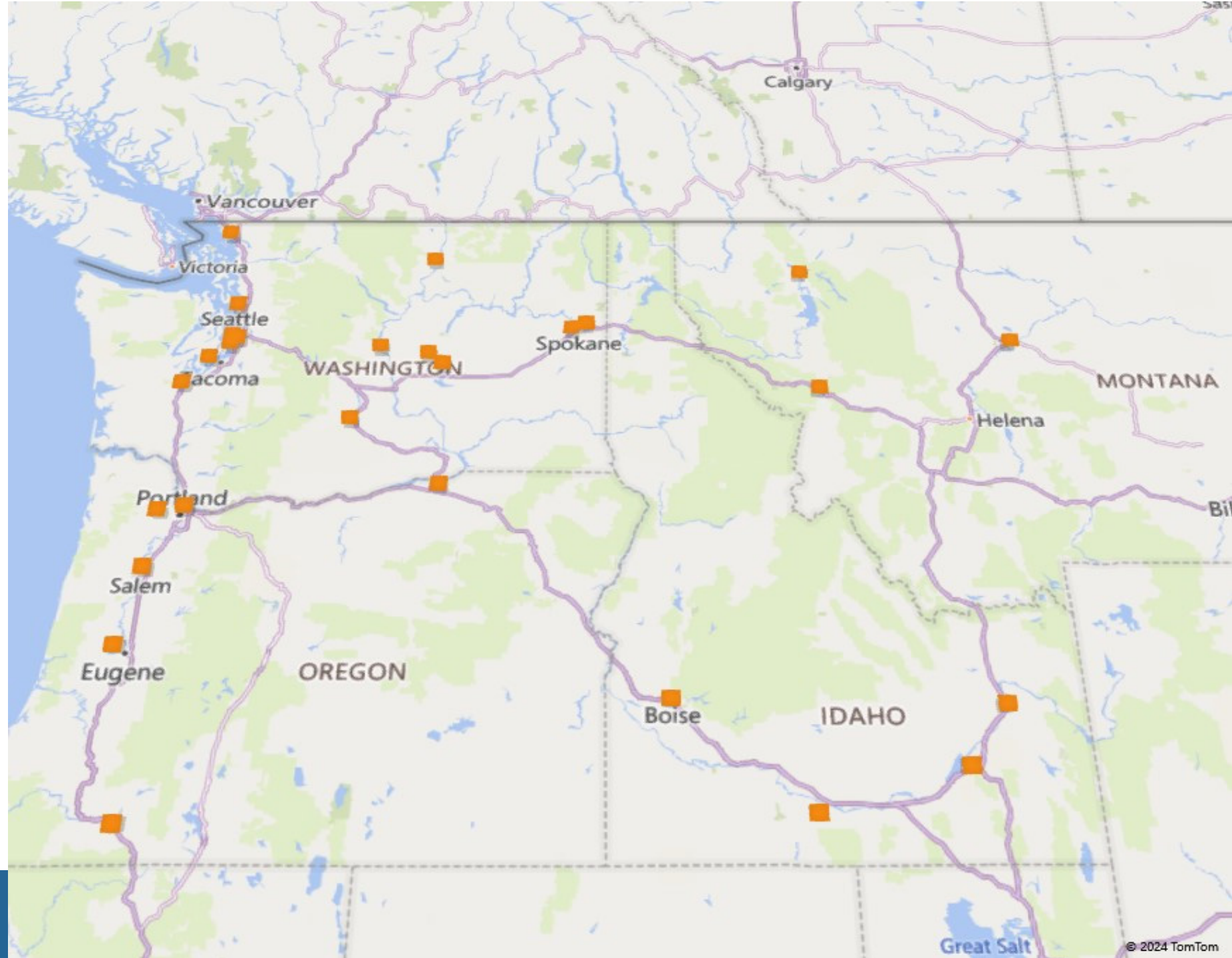
Climate Scenario Temperatures for Upcoming Power Plan

- RMJOC Climate scenario temperatures among 29 locations that represents the 13 Balancing Areas



Climate Scenario Temperatures

- 29 locations





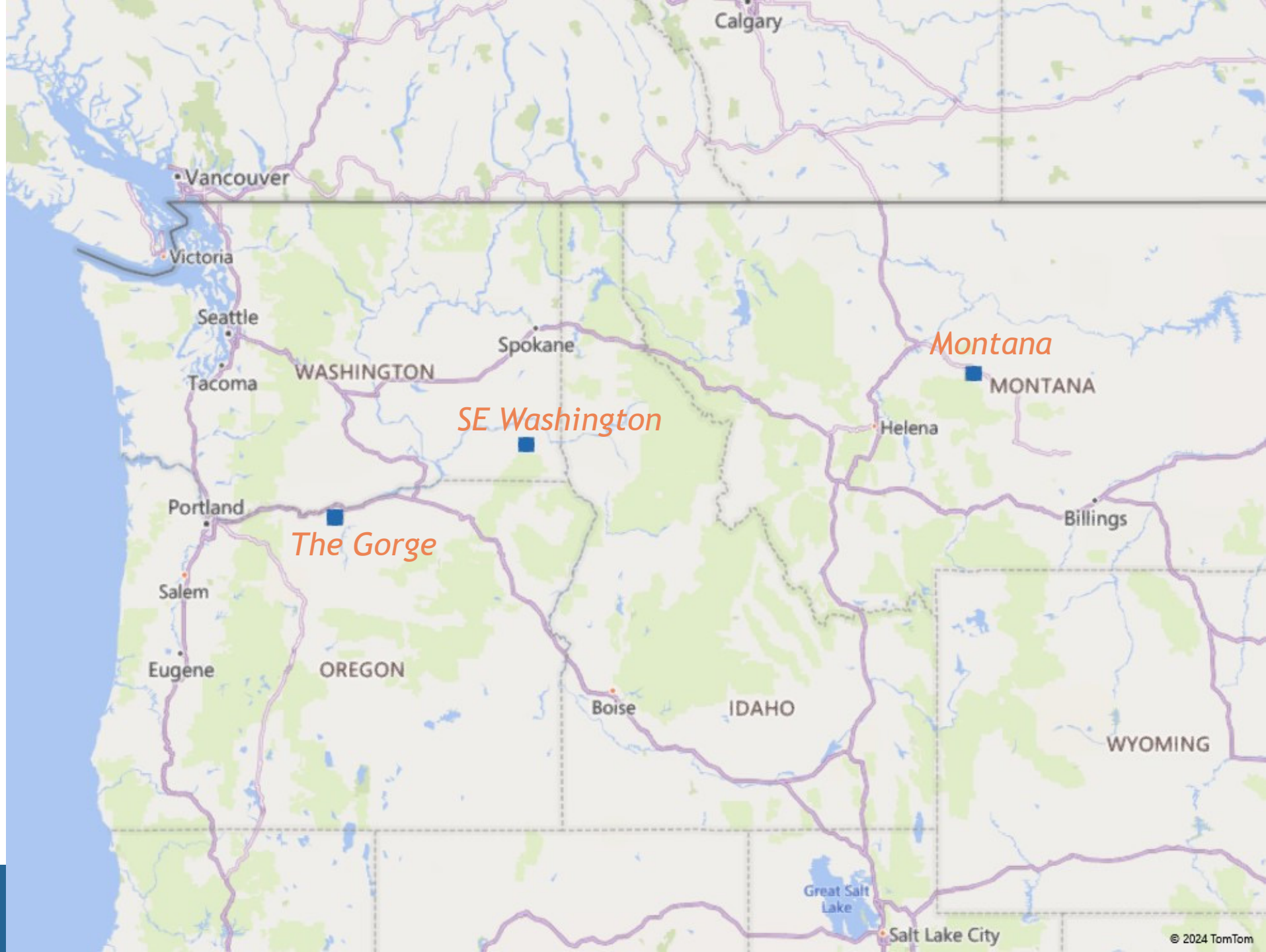
Climate Scenario Wind

Previous Power Plan

Northwest Wind Fleets

- 3 representative sites

- The Gorge
- SE Washington
- Montana



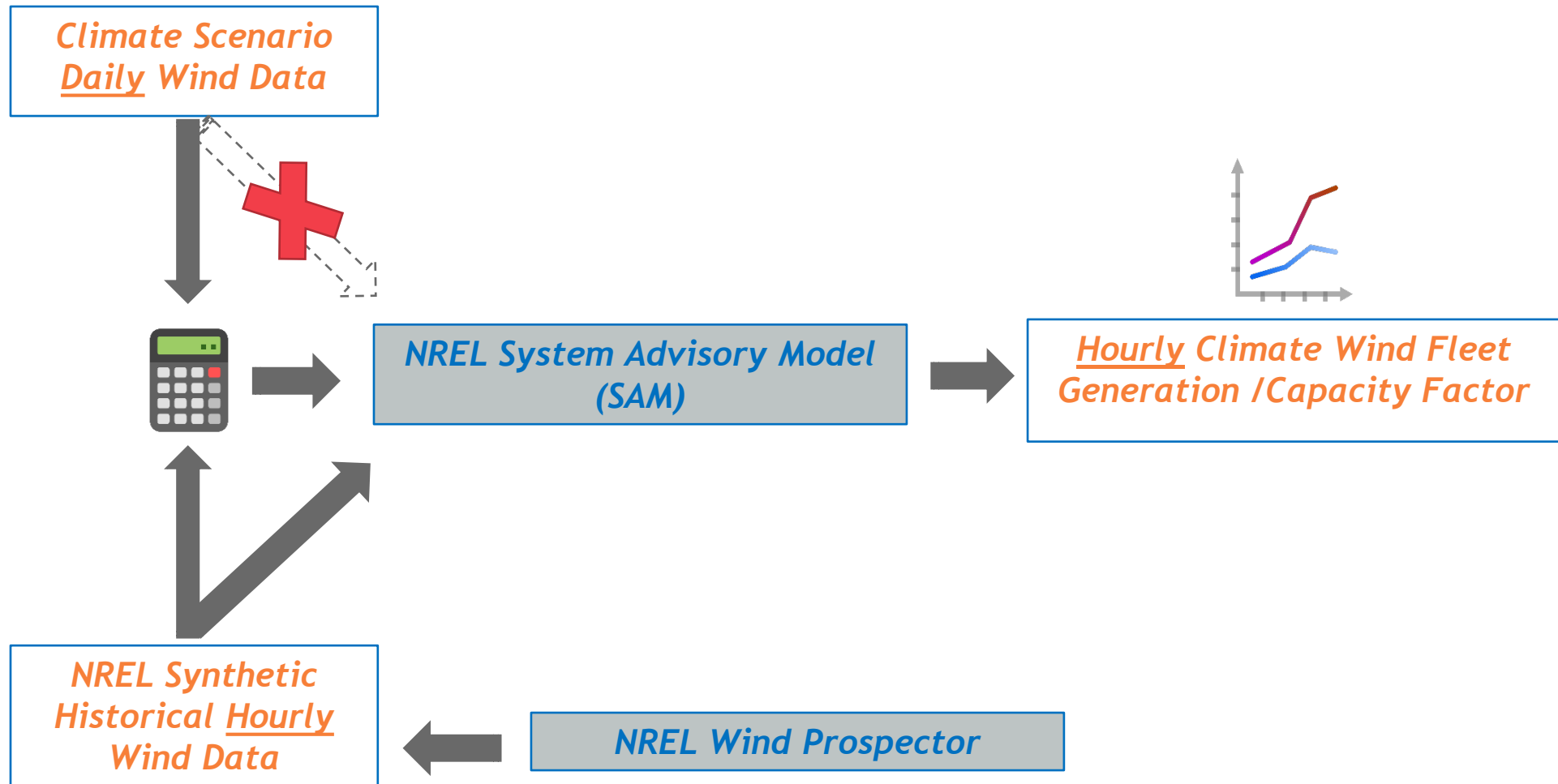
Climate Scenario Wind Data

- The RMJOC climate scenario data consist of temperature and streamflow
- For CMIP5 climate scenario wind data: download from **Climatology Lab**
 - at the Gorge, SE Washington and Montana
 - *daily* averaged **eastward** wind vector
 - *daily* averaged **northward** wind vector
 - at **10 m** height
 - **MACA** downscaled data only



- How to use climate wind data to calculate climate wind generation?

Climate Wind Data to Wind Generation

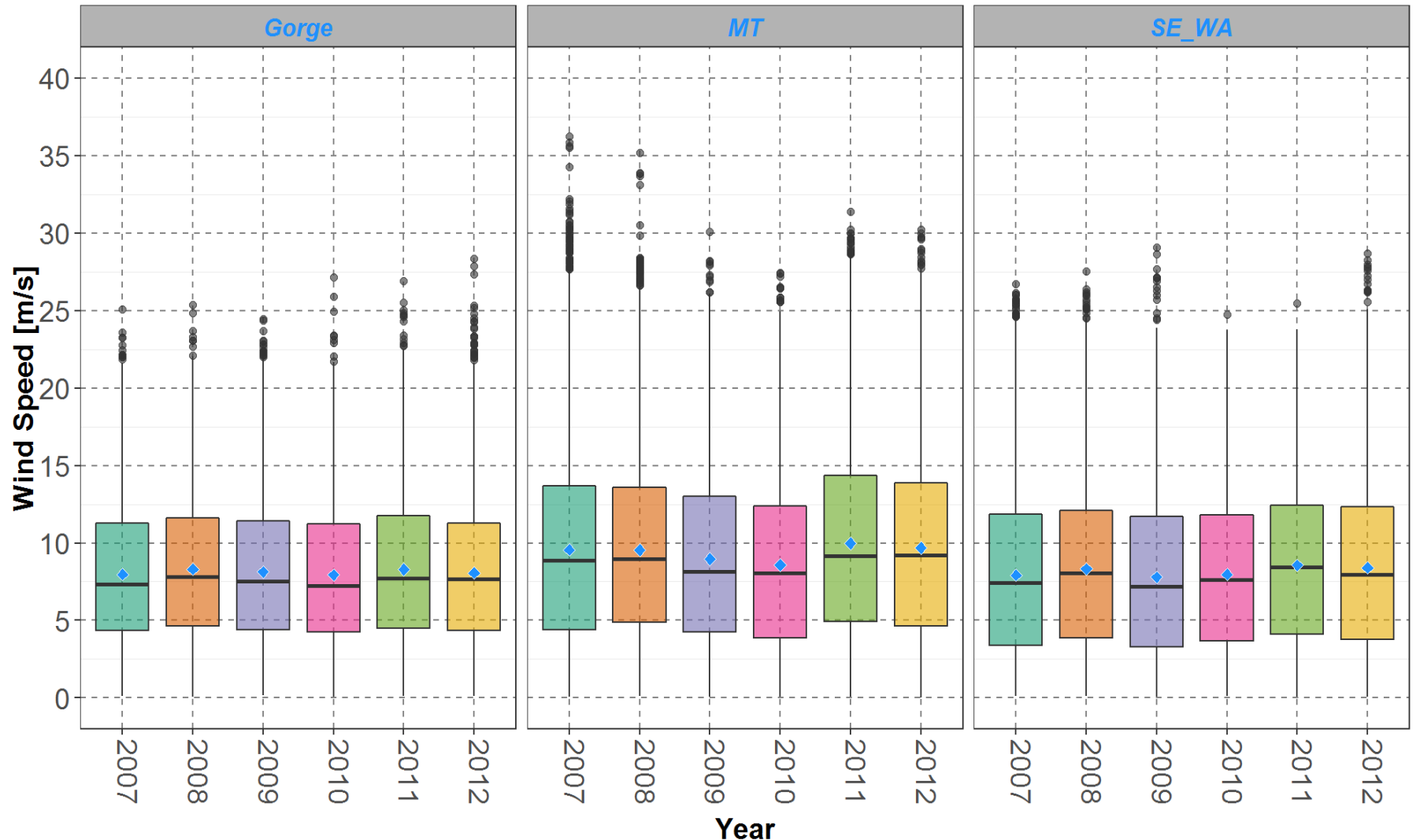


NREL Synthetic Historical Hourly Data from Wind Prospector

- Download NREL synthetic historical *hourly* wind data at the Gorge, SE Washington and Montana*
 - *temperature*
 - *pressure*
 - *wind speed*
 - *wind direction*
- NREL historical wind data:
 - 2007 to 2012 (6 years)
 - at 100 m height
- These hourly data are in input format for the System Advisory Model (SAM)[†]

NREL Synthetic Historical Wind Speeds

Distribution of NREL Historical Wind Speed at 100 m by Year and Location



- Wind speeds at the Gorge are similar to those at SE Washington

- Wind speeds at Montana are higher than those at the Gorge and SE Washington

Transformation of Climate Wind Data for SAM

- i. *daily* averaged eastward and northward wind vectors transformed to *daily* wind speed and direction
- ii. *daily* wind speed at 10 m height transformed to wind speeds at 80 m and 100 m heights (two types of turbine hub heights)
- iii. At 100 m height, calibrate climate daily wind speed data for a historical period with NREL's synthetic historical daily wind speeds
- iv. calibrated *daily* wind speed transformed to *hourly* wind speed
- v. calibrated *daily* wind direction transformed to *hourly* wind directions
- vi. Input wind direction and calibrated climate hourly wind speed data into SAM

Transformation of Climate Wind Data (i)

- The climate model daily wind data

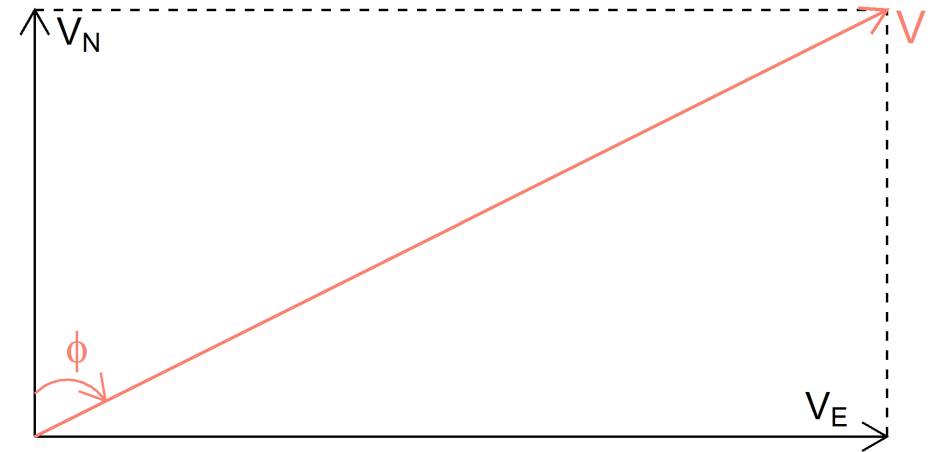
- northward wind vector V_N
- eastward wind vector V_E

are transformed into

- wind speed V ,
- wind direction ϕ ,
measured with respect to north, clockwise

$$V = \sqrt{V_N^2 + V_E^2}$$

$$\phi = \tan^{-1}(V_E/V_N)$$



Transformation of Climate Wind Data (ii A)

- Transform wind speed data from 10 m height to 80 m and 100 m heights

“Methodologies Used in the Extrapolation of Wind Speed Data at Different Heights and Its Impact in the Wind Energy Resource Assessment in a Region”

by

Francisco Bañuelos-Ruedas, César Angeles-Camacho and Sebastián Rios-Marcuello

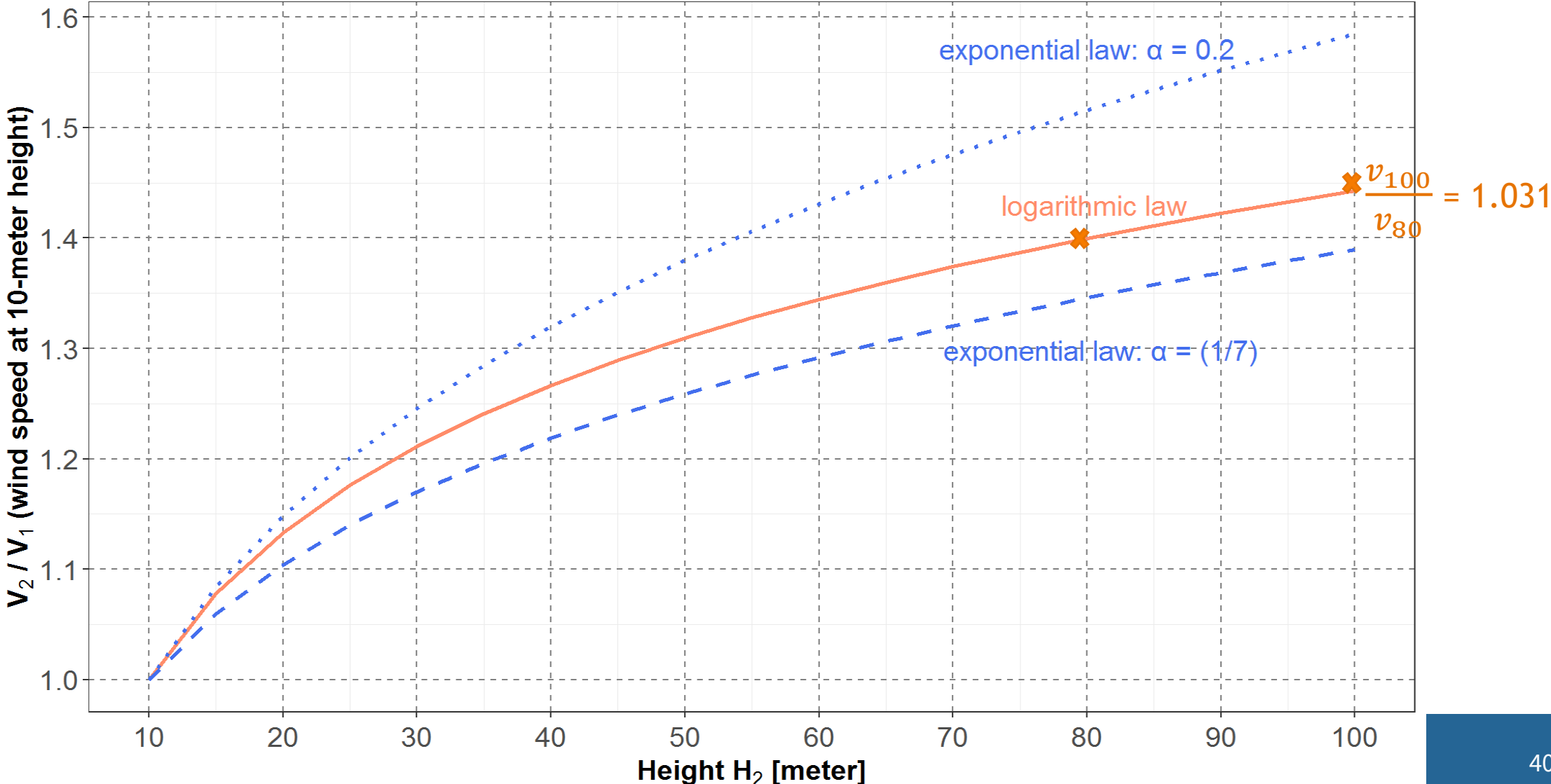
DOI: [10.5772/20669](https://doi.org/10.5772/20669)

Transformation of Climate Wind Data (ii B)

- In order to model wind turbines in SAM, transform climate wind speeds at 10 m to wind speeds at 80 m and 100 m
- **Log Law:** $(V_2 / V_1) = \ln(H_2 / H_0) / \ln(H_1 / H_0)$
 - H_0 = roughness length
 - $H_0 = 0.055$, for farming land dotted with some houses and 8 m tall sheltering hedgerows within a distance of 1,250 m
- **Power Law:** $(V_2 / V_1) = (H_2 / H_1)^\alpha$
 - α = the friction coefficient or Hellman exponent
 - $\alpha = (1/7) = 0.143$, usually
 - $\alpha = 0.2$, for tall crops, hedges and shrubs

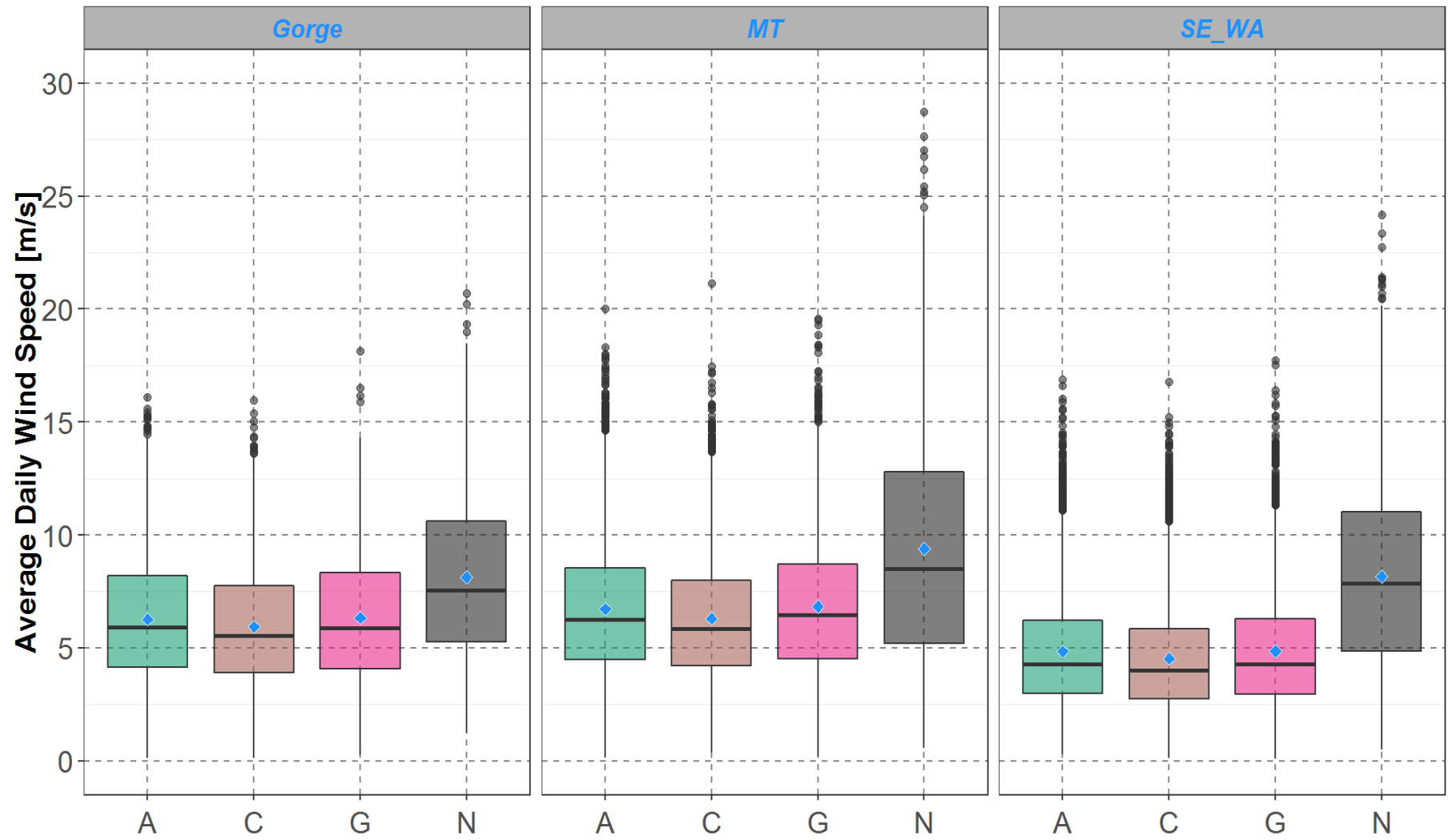
Transformation of Climate Wind Data (ii C)

Wind Speed Ratio vs Height



Transformation of Climate Wind Data (iii A)

Distributions of (2007 - 2012) NREL and (2006 - 2015) Climate Scenario Average Daily Wind Speed at 100 m by Location



- For comparable historical periods: NREL synthetic historical data (2007 – 2012), and climate models (2006 – 2015)
- For all 3 locations, the distribution of synthetic historical NREL wind speeds are higher than the distributions of climate model wind speeds
- Calibrate the climate model data to be more comparable

Wind Power Curve From SAM

Wind Turbine

Select a turbine from the library
 Define turbine design characteristics

Rated output: 2300 kW
Rotor diameter: 93 m
Hub height: 80 m
Shear coefficient: 0.14

Filter: Name

Name	KW Rating
Nordex N90-2300	2300
Siemens SWT 2.3 MW-93	2300
Siemens SWT-2.3MW-101m	2300
Siemens SWT-2.3MW-108m	2300
Enercon E70 71m 2300kw	2310
Bonus 82.4m 2.3MW	2311.11
Enercon E82 82m 2300kw	2350
Mitsubishi MWT 92 2.4	2400

Turbine power curve

The graph displays the power output of a turbine as a function of wind speed. The y-axis represents Turbine Power in kilowatts (kW), ranging from 0 to over 2000. The x-axis represents Wind Speed in meters per second (m/s), ranging from 0 to 40. The curve shows a cut-in speed of approximately 4 m/s, a power ramp-up region between 4 and 14 m/s, a constant power region at 2300 kW between 14 and 25 m/s, and a cut-out speed of approximately 25 m/s.

- Screen shot from SAM for a Siemens Turbine

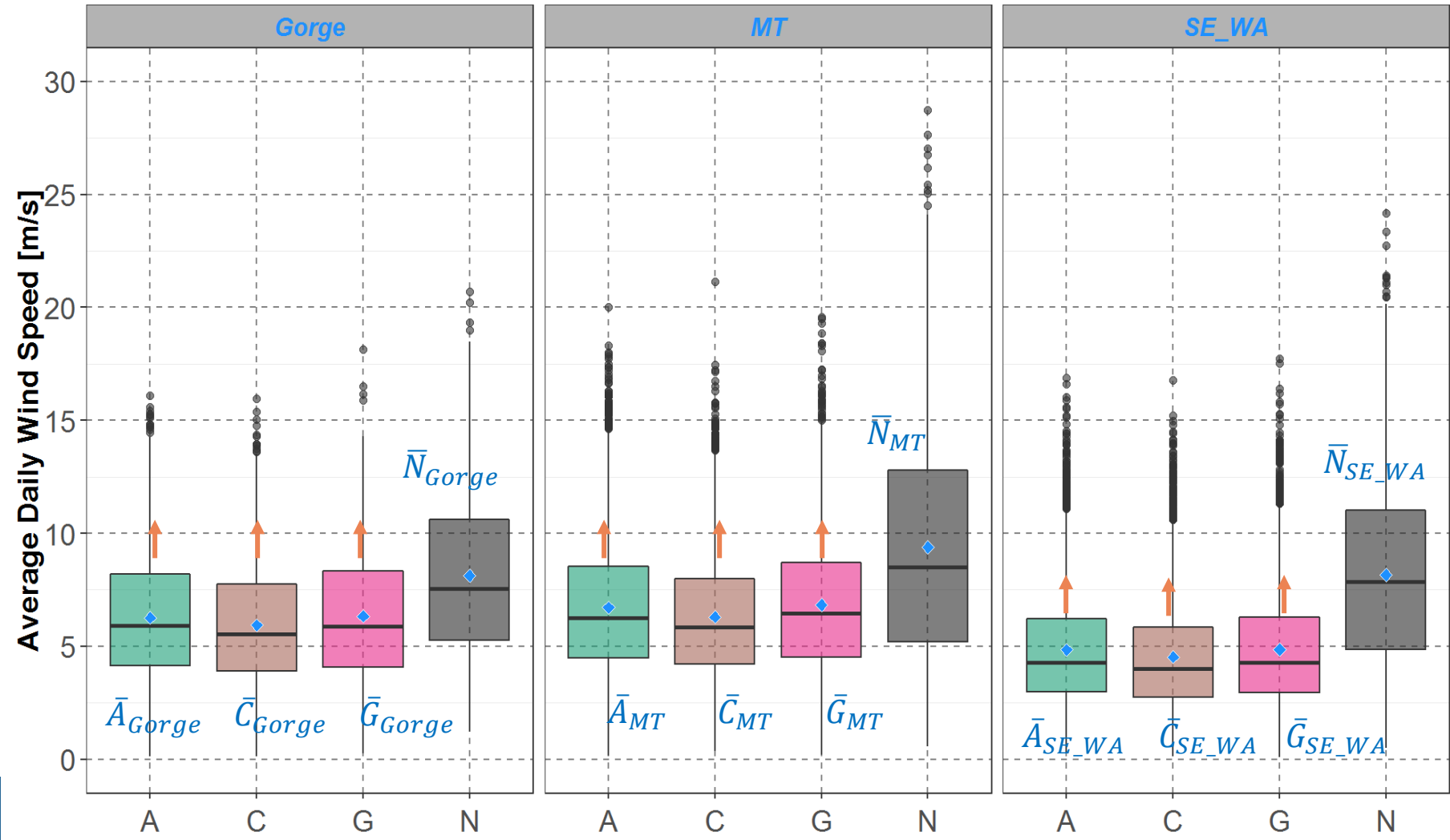
- Turbine generation increases rapidly for wind speeds > 5 m/s

Transformation of Climate Wind Data (iii B)

- Method I:** use 1 parameter, α , to minimize S , the sum of square-difference between the NREL average and the climate model averages for all 3 locations:

$$\begin{aligned}
 S = & (\alpha \bar{A}_{Gorge} - \bar{N}_{Gorge})^2 \\
 & + (\alpha \bar{C}_{Gorge} - \bar{N}_{Gorge})^2 \\
 & + (\alpha \bar{G}_{Gorge} - \bar{N}_{Gorge})^2 \\
 & + (\alpha \bar{A}_{MT} - \bar{N}_{MT})^2 \\
 & + (\alpha \bar{C}_{MT} - \bar{N}_{MT})^2 \\
 & + (\alpha \bar{G}_{MT} - \bar{N}_{MT})^2 \\
 & + (\alpha \bar{A}_{SE_WA} - \bar{N}_{SE_WA})^2 \\
 & + (\alpha \bar{C}_{SE_WA} - \bar{N}_{SE_WA})^2 \\
 & + (\alpha \bar{G}_{SE_WA} - \bar{N}_{SE_WA})^2
 \end{aligned}$$

Distributions of (2007 - 2012) NREL and (2006 - 2015) Climate Scenario Average Daily Wind Speed at 100 m by Location



Transformation of Climate Wind Data (iii C)

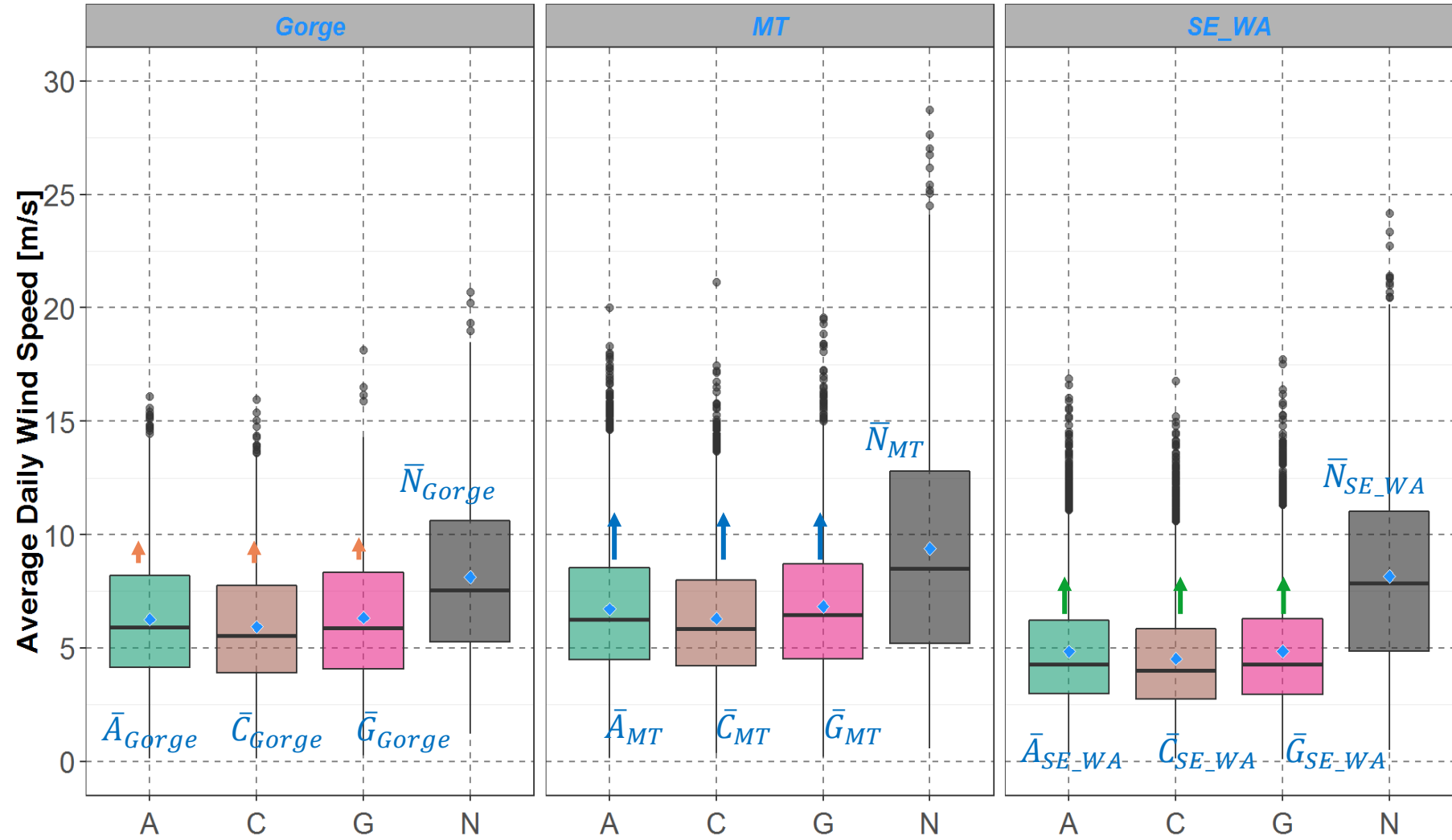
Distributions of (2007 - 2012) NREL and (2006 - 2015) Climate Scenario Average Daily Wind Speed at 100 m by Location

- Method II:** use 3 parameters, α_{Gorge} , α_{MT} , and α_{SE_WA} , to minimize S_{Gorge} , S_{MT} , and S_{SE_WA} respectively

$$S_{Gorge} = (\alpha_{Gorge} \bar{A}_{Gorge} - \bar{N}_{Gorge})^2 + (\alpha_{Gorge} \bar{C}_{Gorge} - \bar{N}_{Gorge})^2 + (\alpha_{Gorge} \bar{G}_{Gorge} - \bar{N}_{Gorge})^2$$

$$S_{MT} = \dots$$

$$S_{SE_WA} = \dots$$



Transformation of Climate Wind Data (iii D)

Distributions of (2007 - 2012) NREL and (2006 - 2015) Climate Scenario Average Daily Wind Speed at 100 m by Location

Method III: use 9

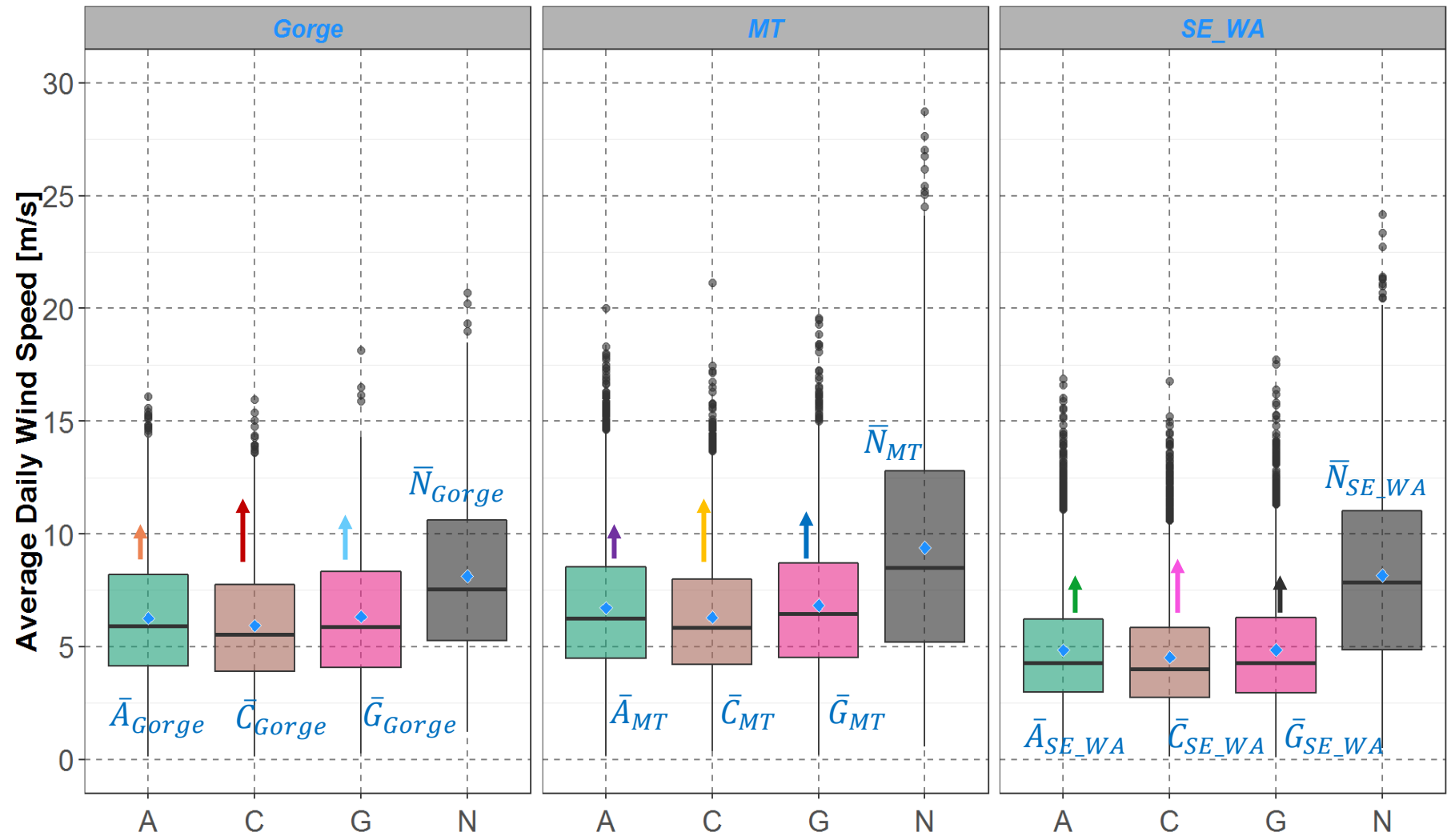
parameters, $\alpha_{Gorge}^A, \alpha_{Gorge}^C,$
 $\alpha_{Gorge}^G, \alpha_{MT}^A, \alpha_{MT}^C, \alpha_{MT}^G,$
 $\alpha_{SE_WA}^A, \alpha_{SE_WA}^C,$ and $\alpha_{SE_WA}^G,$
 to minimize $S_{Gorge}^A, S_{Gorge}^C,$
 $S_{Gorge}^G, S_{MT}^A, S_{MT}^C, S_{MT}^G,$
 $S_{SE_WA}^A, S_{SE_WA}^C,$ and $S_{SE_WA}^G$
 respectively

$$S_{Gorge}^A = (\alpha_{Gorge}^A \bar{A}_{Gorge} - \bar{N}_{Gorge})^2$$

$$S_{Gorge}^C = (\alpha_{Gorge}^C \bar{C}_{Gorge} - \bar{N}_{Gorge})^2$$

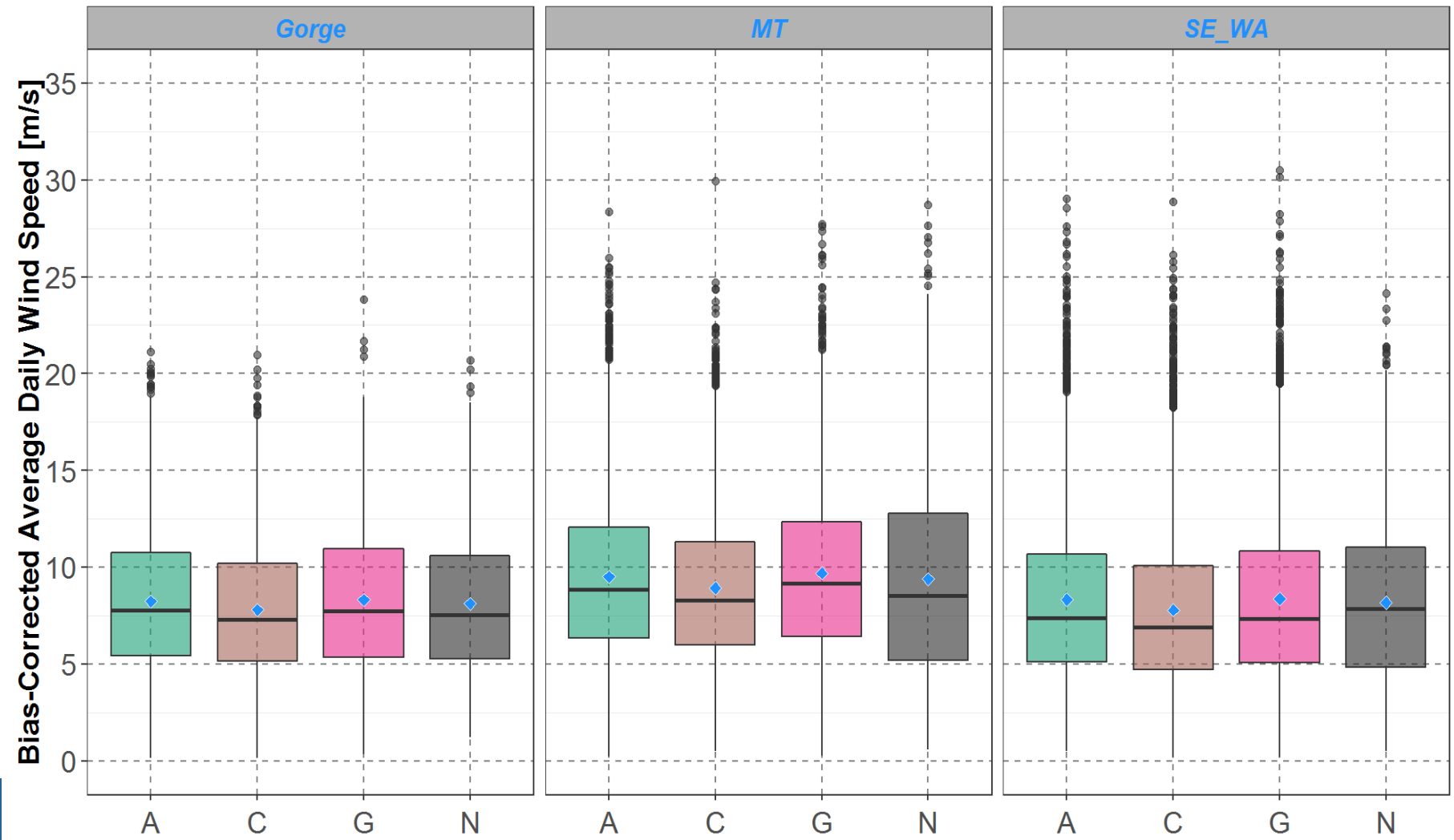
$$S_{Gorge}^G = (\alpha_{Gorge}^G \bar{G}_{Gorge} - \bar{N}_{Gorge})^2$$

etc., ...



Transformation of Climate Wind Data (iii E)

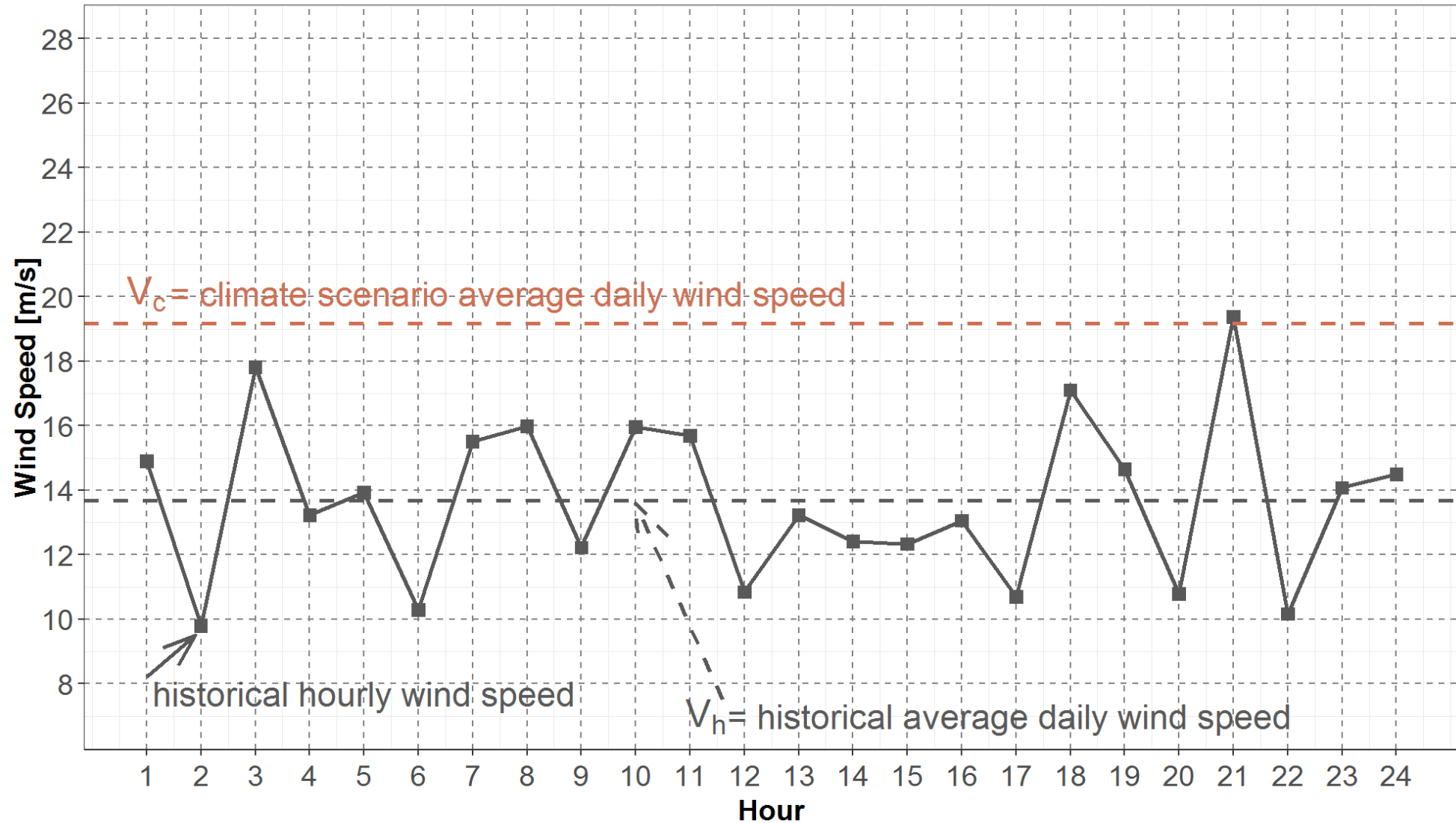
Distributions of (2007 - 2012) NREL and (2006 - 2015) Climate Scenario Bias-Corrected Average Daily Wind Speed at 100 m by Location



- Calibration results using Method II.
- where $\alpha_{Gorge} = 1.314$, $\alpha_{MT} = 1.417$ and $\alpha_{SE_WA} = 1.721$
- Then at respective locations, multiply corresponding parameters to climate model wind speeds for years 2020 to 2049

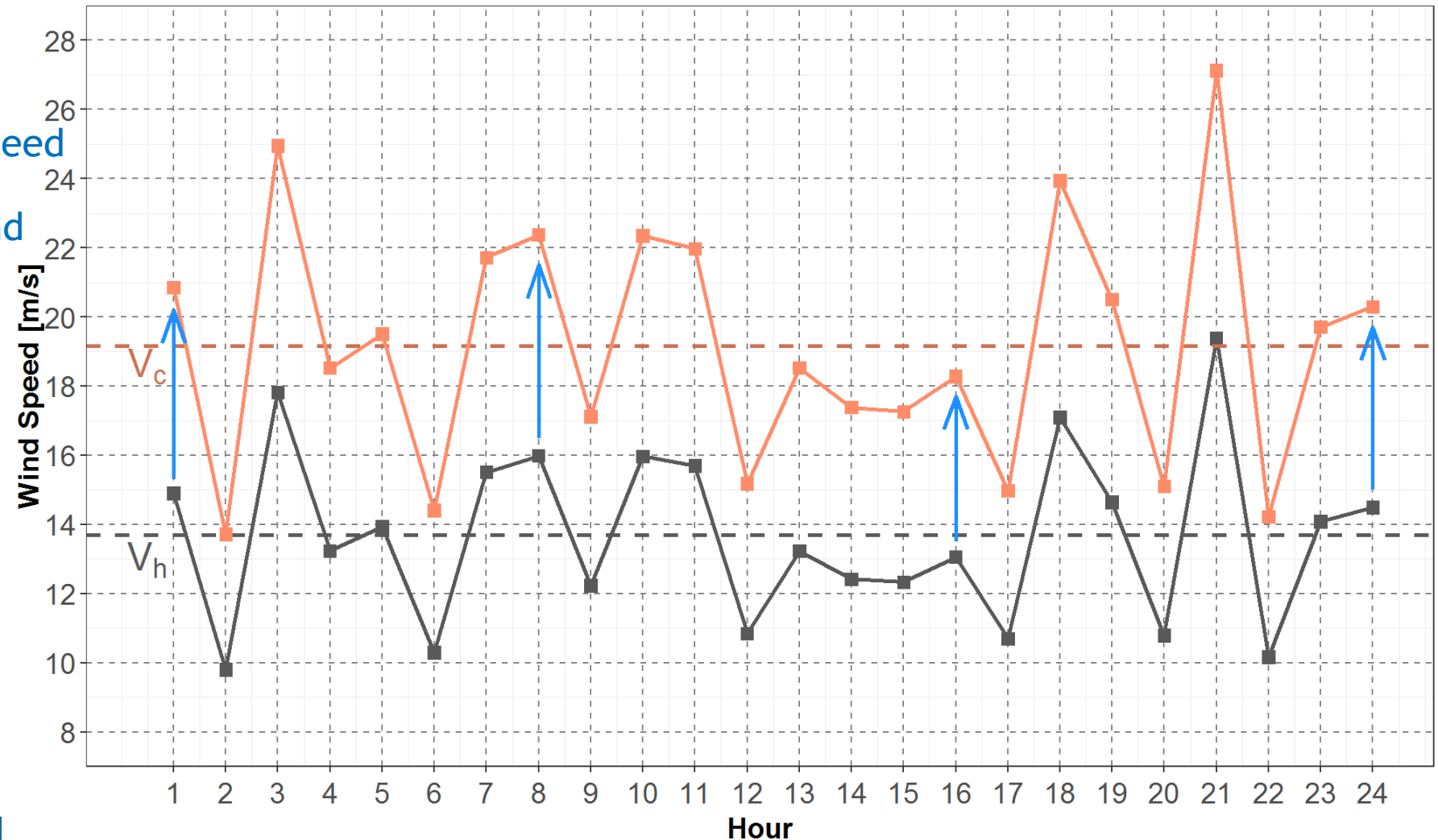
Transformation of Climate Wind Data (iv A)

Example of Transforming Climate Scenario Average Daily Wind Speed to Hourly Wind Speeds (I)



Transformation of Climate Wind Data (iv B)

Example of Transforming Climate Scenario Averagdg Daily Wind Speed to Hourly Wind Speeds (II)

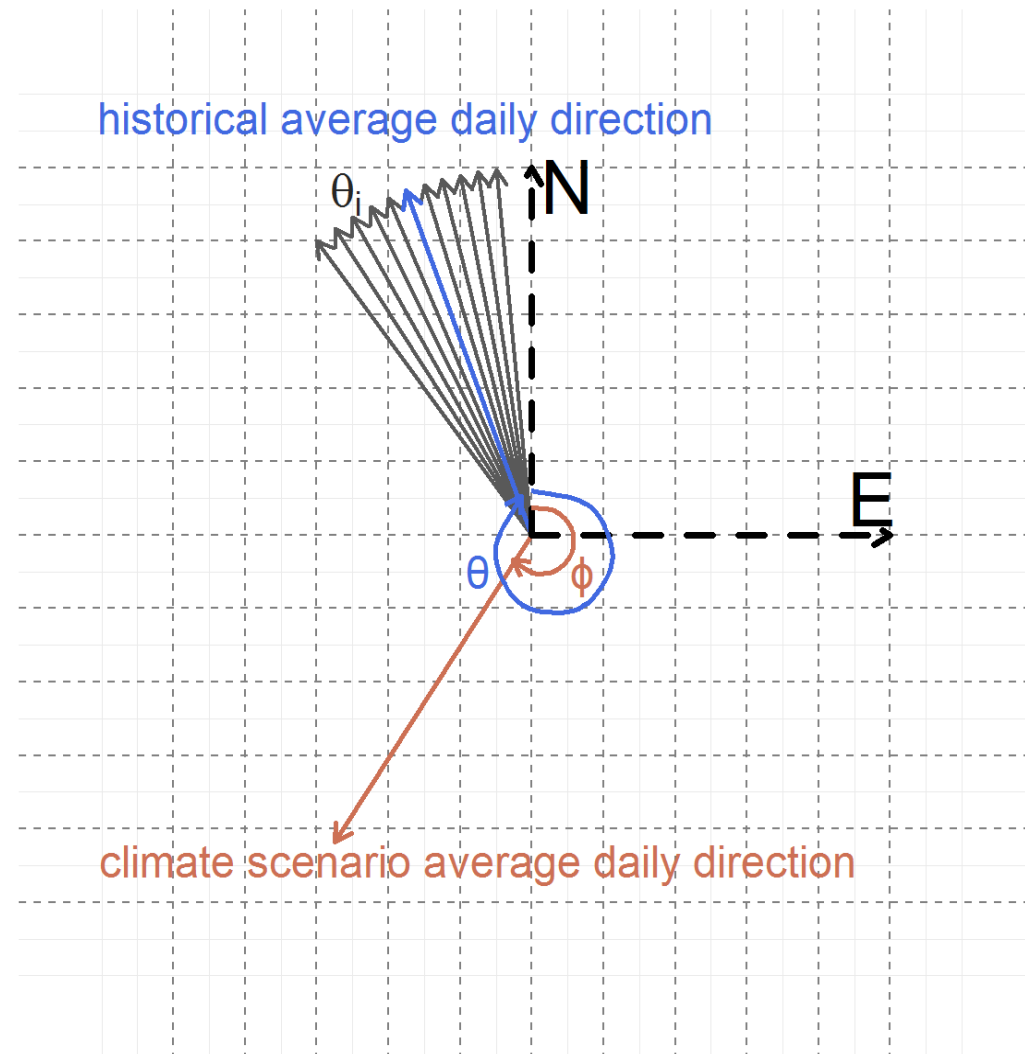


- Climate model hourly wind speed
 $= \left(\frac{V_c}{V_h}\right) \times$ historical hourly wind speed

Transformation of Climate Wind Data (v A)

Example of Transforming Climate Scenario Averagd Daily Wind Direction to Hourly Wind Directions (I)

- climate model daily averaged direction: ϕ
- historical hourly directions: $(\theta_1, \theta_2, \dots, \theta_{24})$
- calculate historical daily averaged direction: θ



Transformation of Climate Wind Data (v B)

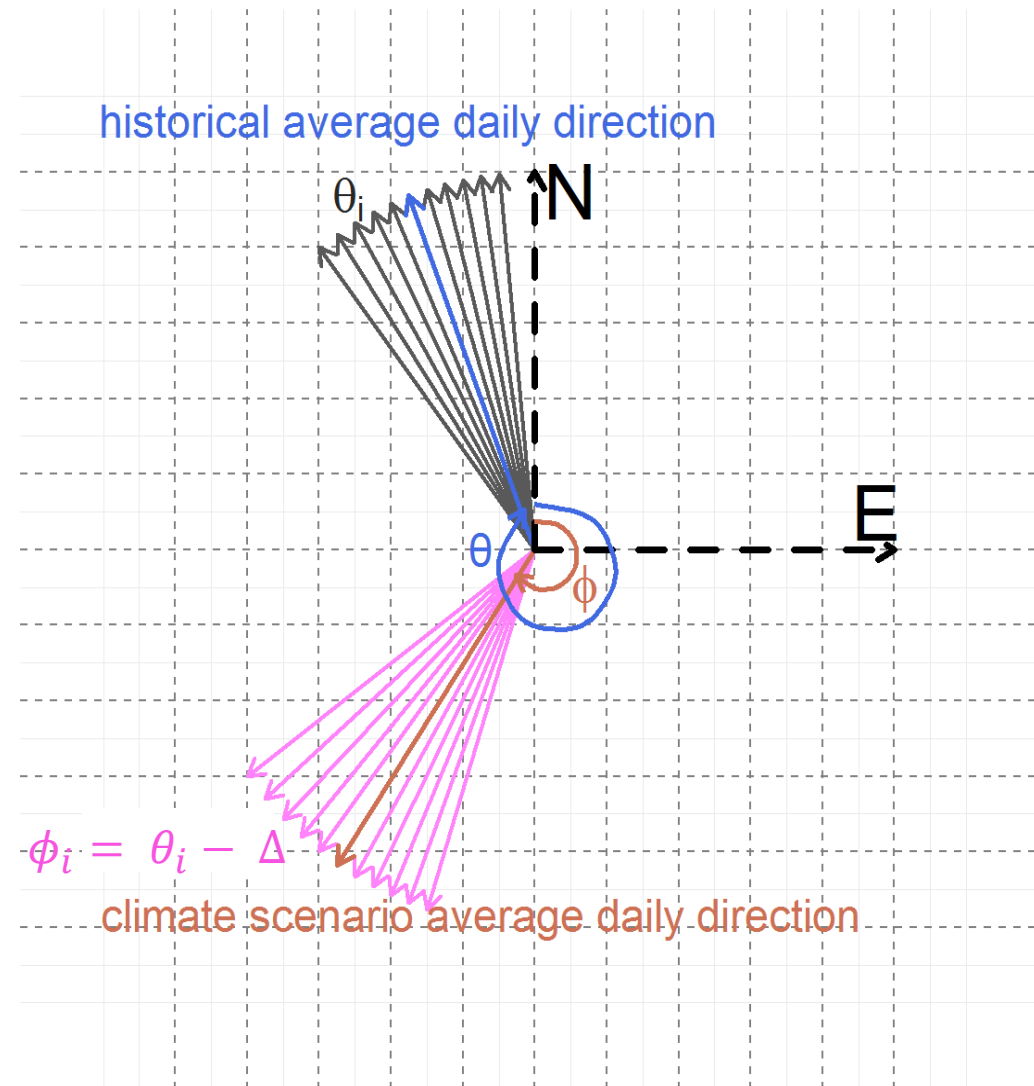
Example of Transforming Climate Scenario Averagd Daily Wind Direction to Hourly Wind Directions (II)

- calculate difference between θ and ϕ :

$$\Delta = \theta - \phi$$

- then climate model hourly directions:

$$\phi_i = \theta_i - \Delta$$



Upcoming Power Plan

- Add Additional Wind Fleet Locations
- Work in progress

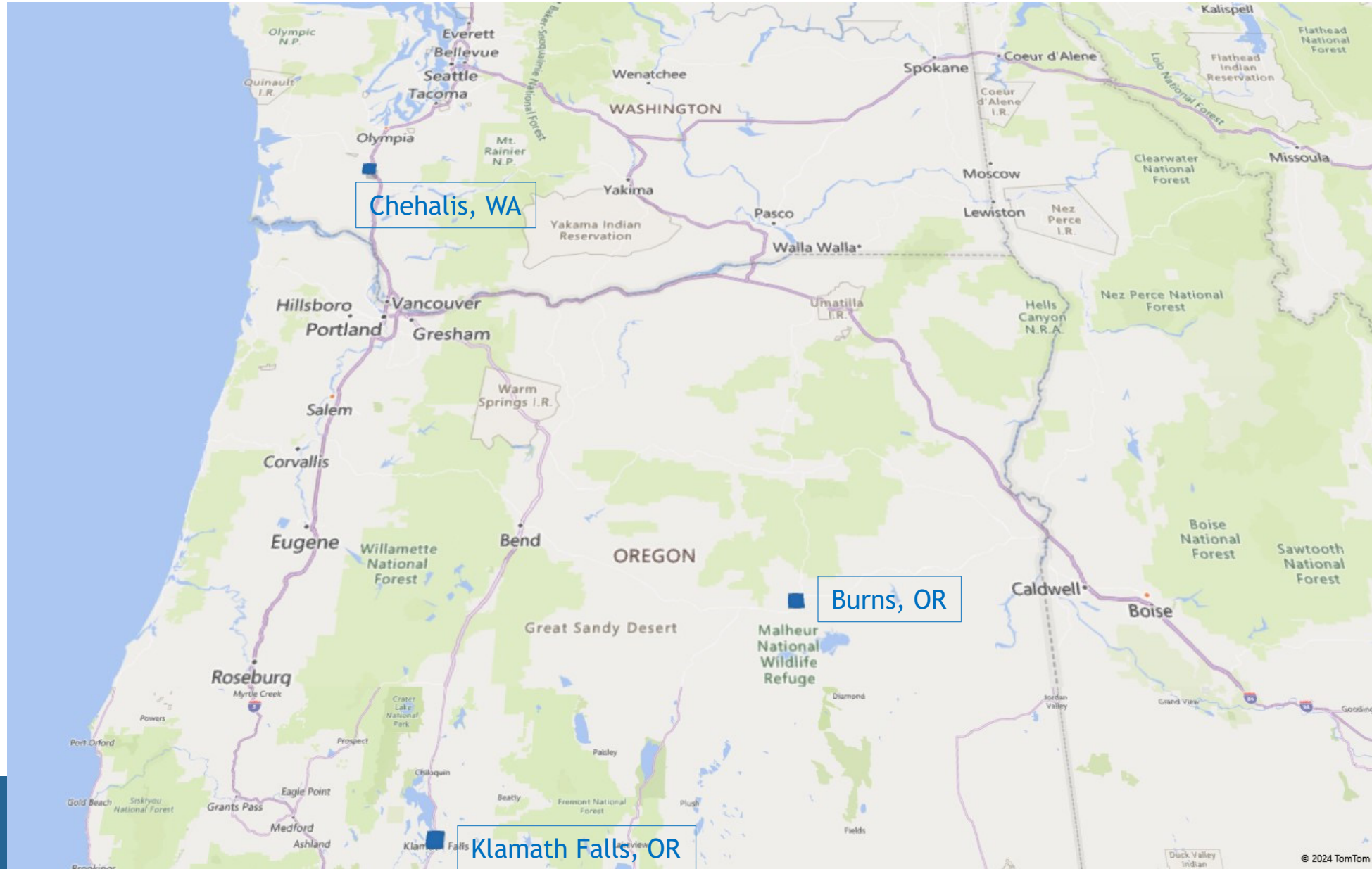
An aerial photograph of a large reservoir with several forested islands. A road or railway line runs along the left side of the reservoir. The sky is filled with large, white clouds. The overall scene is a natural landscape with water and land.

Climate Scenario Solar Generation

Previous Power Plan

Solar Generation

- Historical hourly solar data at Chehalis, WA
- And the average of the historical hourly solar data at Burns and Klamath Falls in OR



Upcoming Power Plan

- Add Additional Solar Farm Locations
- Work in progress



Extreme Weather in Climate Scenario Data

Extreme Temperatures in Northwest Region

- Temperatures at Boise, Portland, Seattle and Spokane

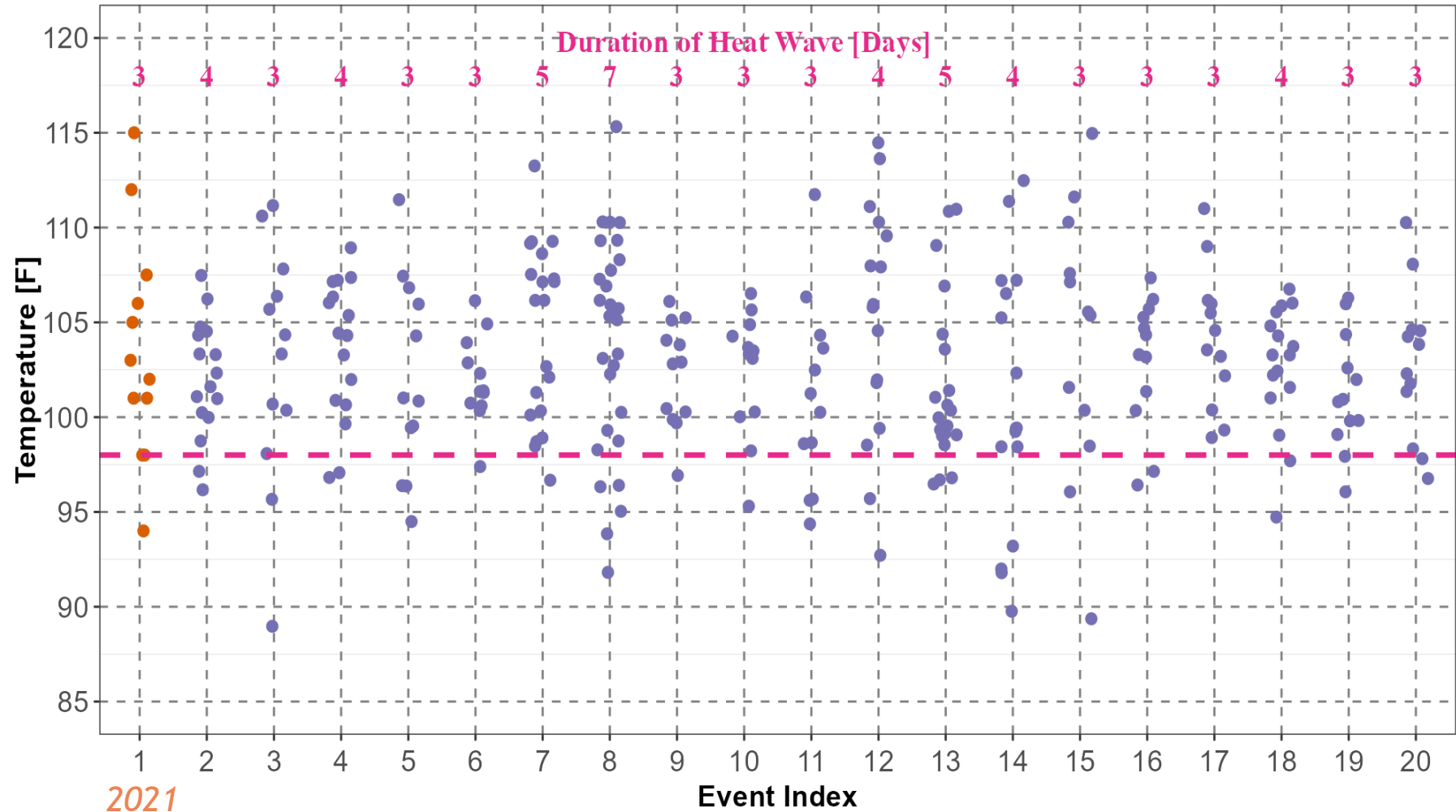
- Regional heat wave:
 - at least 3-day duration,
 - at least 3 cities where the maximum daily temperatures $\geq 98F$

- Regional cold snap
 - at least 3-day duration,
 - at least 3 cities where the maximum daily temperatures $\leq 30F$

Regional Heat Waves

Historical and Climate Model Heat Wave Daily Maximum Temperatures at 4 Cities

- historical time-period: 1995 to 2022, 28 years
- climate model time periods: 2020 to 2049, 30 years
- 1 historical heat wave (2021 heat dome)
- 19 climate model heat waves
- equal population comparison: about 3 vs 19

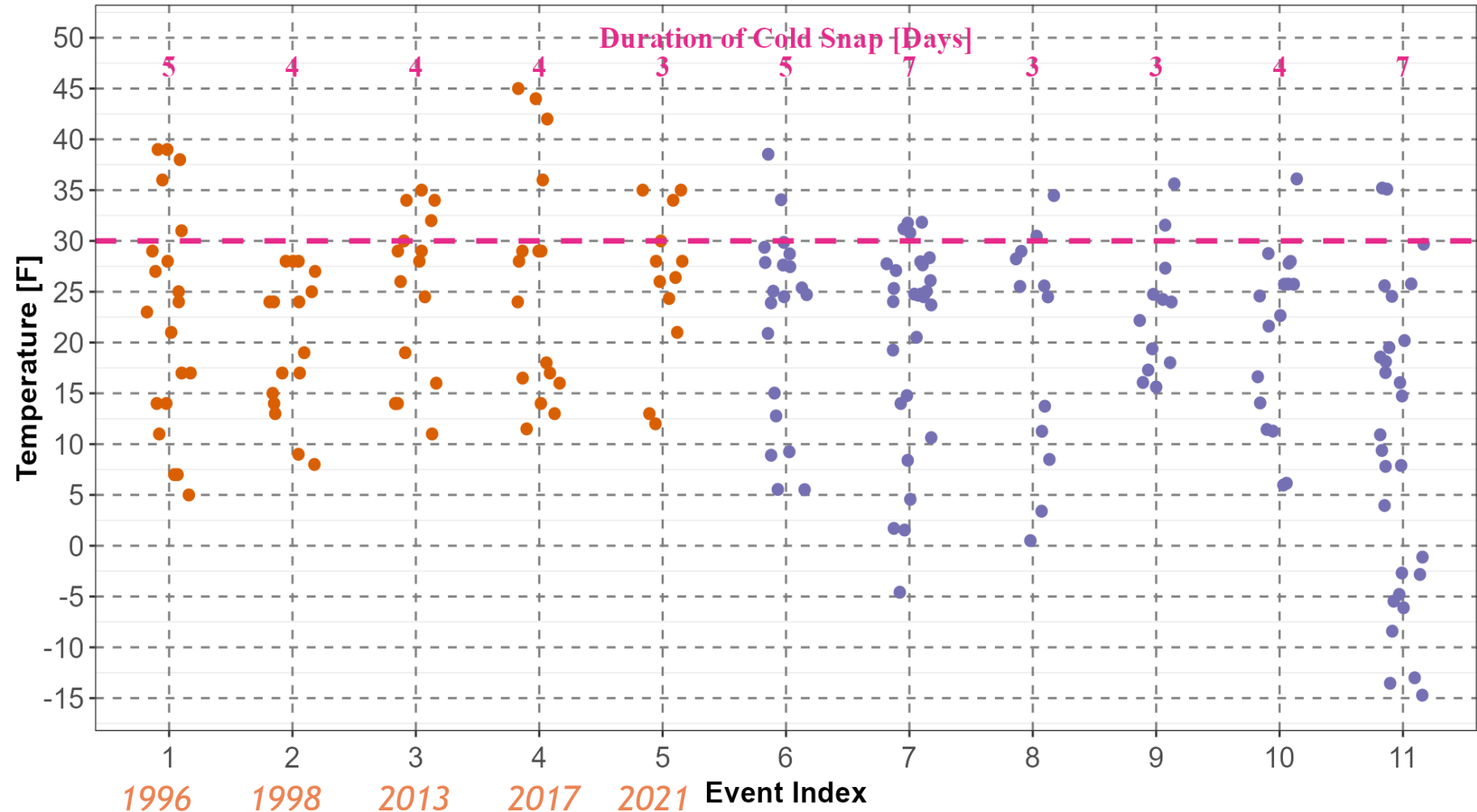


Time Period: ● Historical (1995 - 2022) ● Climate Model (2020 - 2049)

Regional Cold Snaps

Historical and Climate Model Cold Snap Daily Maximum Temperatures at 4 Cities

- historical time-period: 1995 to 2022, 28 years
- climate model time periods: 2020 to 2049, 30 years
- 5 historical cold snaps
- 6 climate model cold snaps
- equal population comparison: about 15 vs 6



An aerial photograph of a large reservoir or lake system. The water level is significantly low, exposing numerous islands and peninsulas that are densely forested with evergreen trees. The surrounding landscape consists of rolling hills and mountains, also covered in forest. The sky is filled with large, white, fluffy clouds. The overall scene conveys a sense of a dry season or a period of low precipitation.

Very Low Seasonal Streamflows

1937 Historical and Climate Scenario Water Years

TDA Modified Flow Traces for Historical 1937 Water Year and CanESM2 2025 Water Year

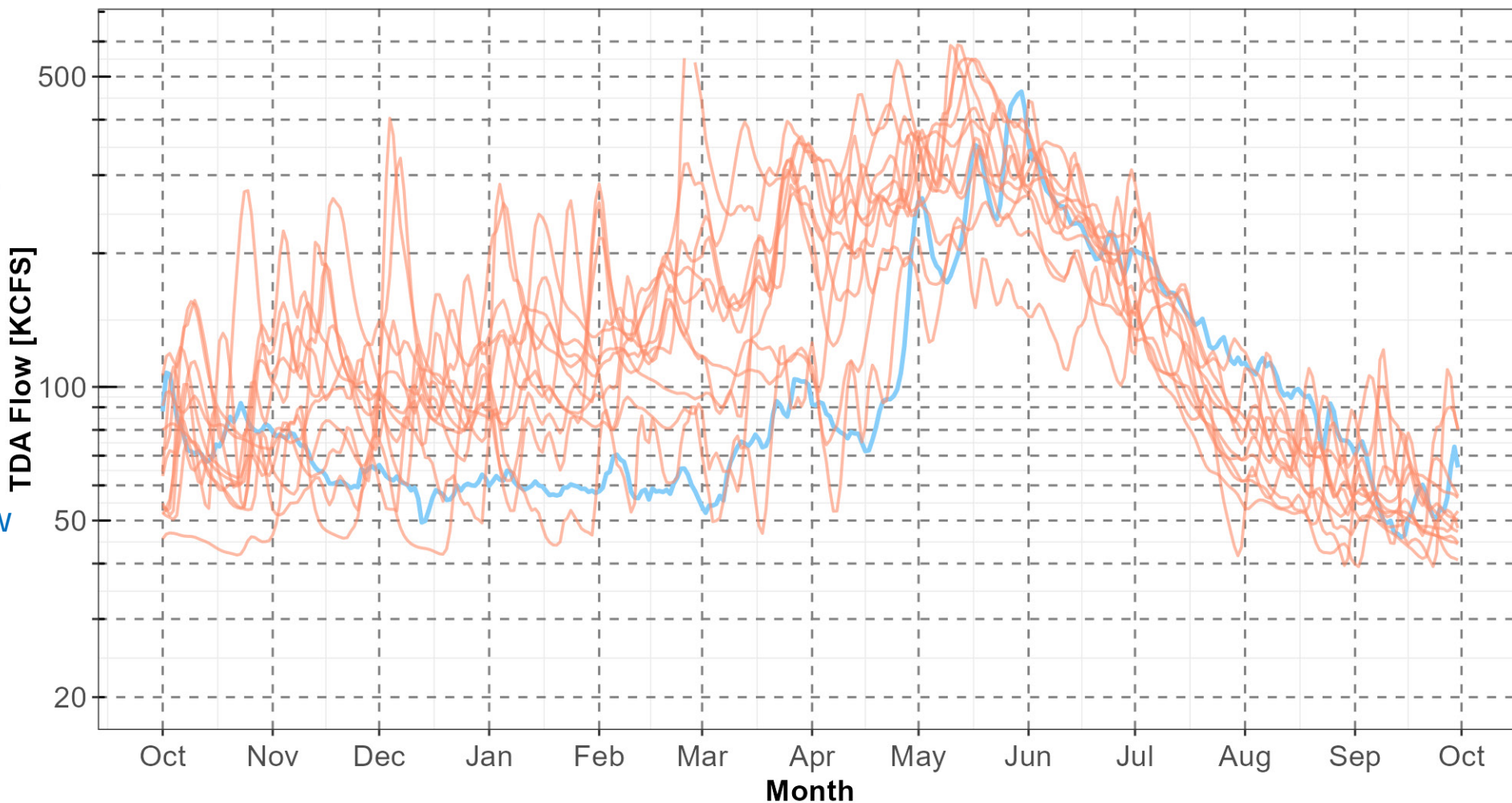


- For convenience, compare Oct to Feb streamflow volumes at The Dalles (TDA)
- 1937 Historical Water Year has the lowest streamflow volume
- CanESM2 2025 Water Year has the lowest streamflow volume among the 3 selected climate scenarios
- Climate scenarios do not have Oct to Feb streamflow volumes as low as that in historical 1937 Water year

2001 Historical and Climate Scenario Water Years

TDA Modified Flow Traces for Historical 2001 Water Year and 3 GCMs (2020 - 2049) Water Years

- For convenience, compare Jun to Sep streamflow volumes at The Dalles (TDA)
- 2001 Historical Water Year has the lowest streamflow volume
- 11 Climate Scenario Water Years have lower streamflow volumes than 2001 Historical Water year



Type: — Historical 2001 — CanESM2 — CCSM4 — CNRM



Discussions and Inputs

Climate Scenario Selection

Selected Scenarios

Scenario\Metric	Winter Generation	Summer Generation	Winter HDD	Summer CDD
A			<u>low</u>	<u>high</u>
C	<u>high</u>	<u>low</u>	-	-
G	<u>low</u>	<u>high</u>	<u>high</u>	<u>low</u>

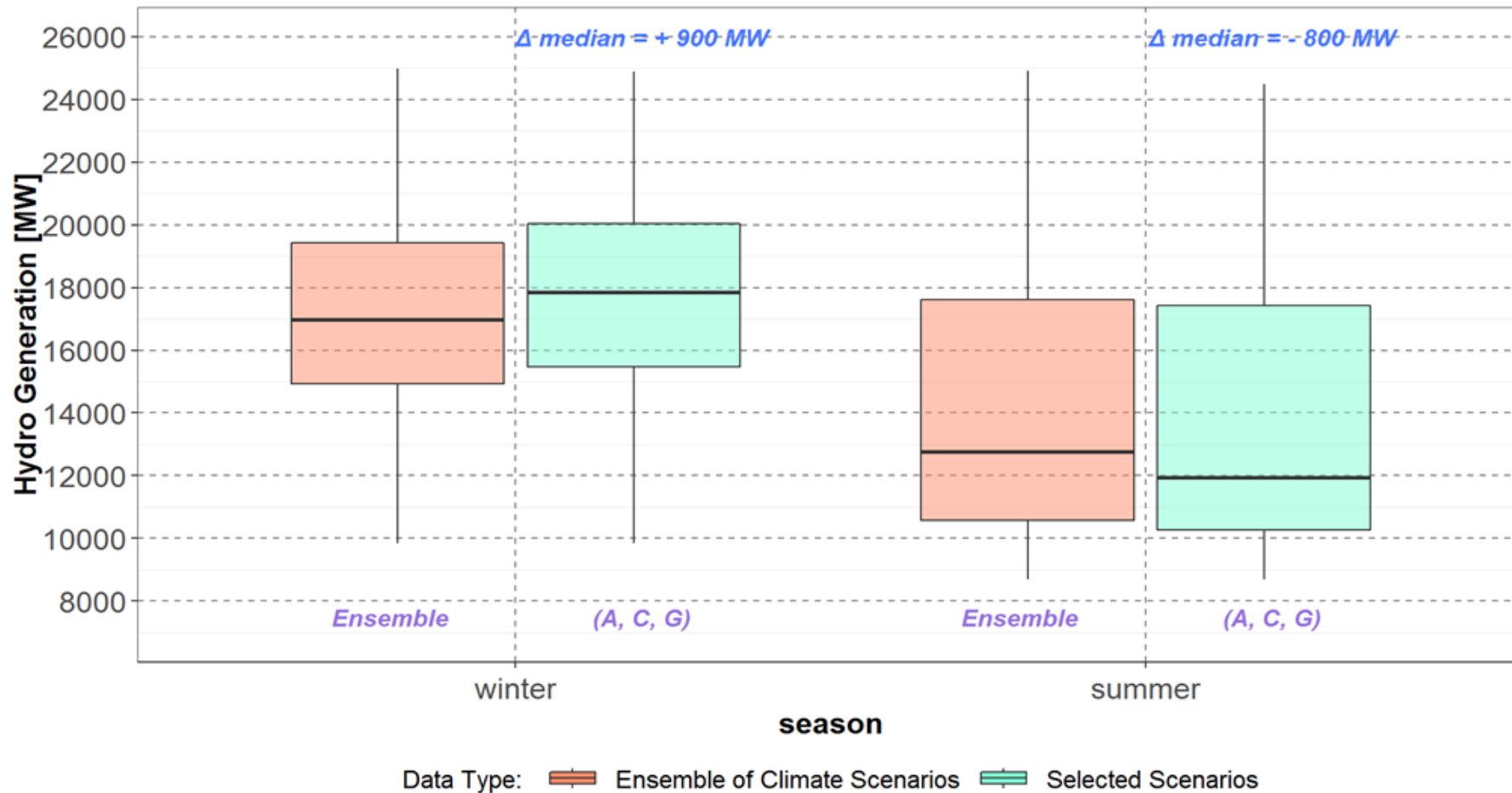
A: *CanESM2_RCP85_BCSD_VIC_P1*

C: *CCSM4_RCP85_BCSD_VIC_P1*

G: *CNRM-CM5_RCP85_MACA_VIC_P3*

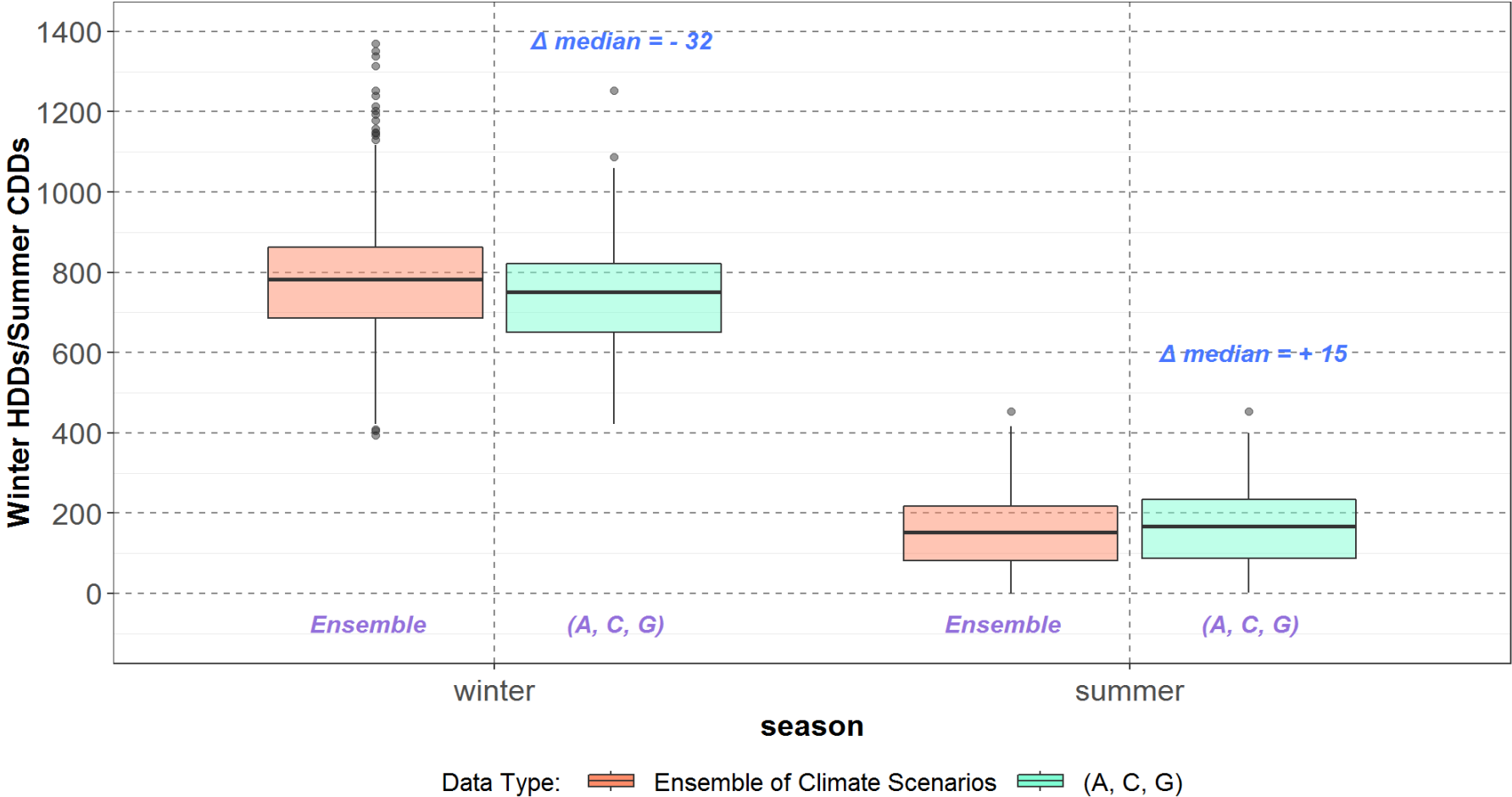
How Well do the Selected Scenarios represent the Ensemble Hydrogeneration?

Comparison of Winter and Summer Hydro Generation between the Ensemble and the Selected A and C and G Scenarios



How Well do the Selected Scenarios represent the Ensemble HDDs and CDDs?

Comparison of Winter HDDs and Summer CDDs between the Ensemble and the Selected A, C and G Scenarios



Adding back the “J” (GFDL) Climate Scenario

Selected Scenarios

Scenario\Metric	Winter Generation	Summer Generation	Winter HDD	Summer CDD
A			<u>low</u>	<u>high</u>
C	<u>high</u>	<u>low</u>		
G		<u>high</u>		
J	<u>low</u>		<u>high</u>	<u>low</u>

A: *CanESM2_RCP85_BCSD_VIC_P1*

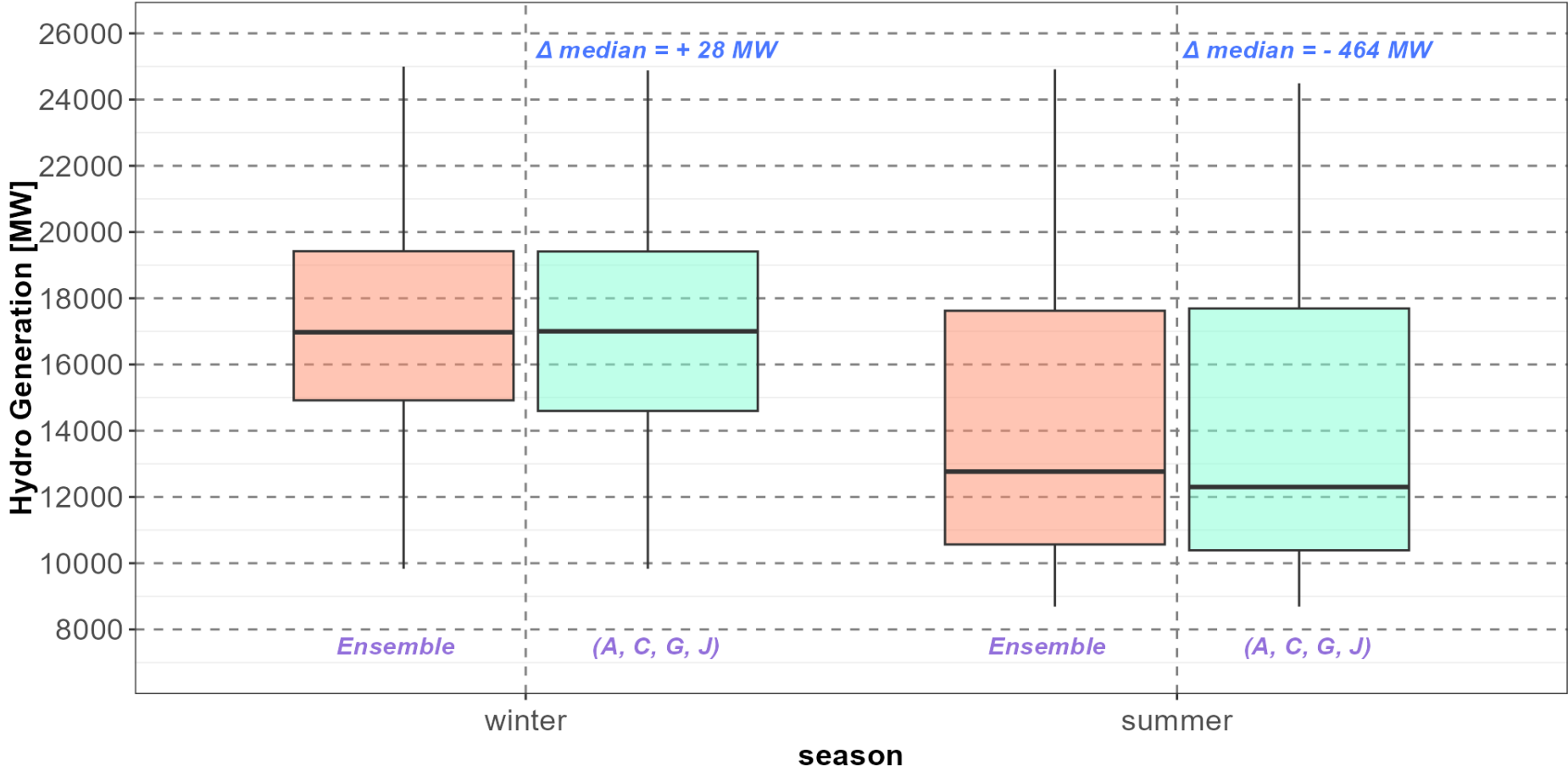
C: *CCSM4_RCP85_BCSD_VIC_P1*

G: *CNRM-CM5_RCP85_MACA_VIC_P3*

J: *GFDL_ESM2M_RCP85_MACA_VIC_P1*

How Well do the Selected Scenarios represent the Ensemble Hydrogeneration?

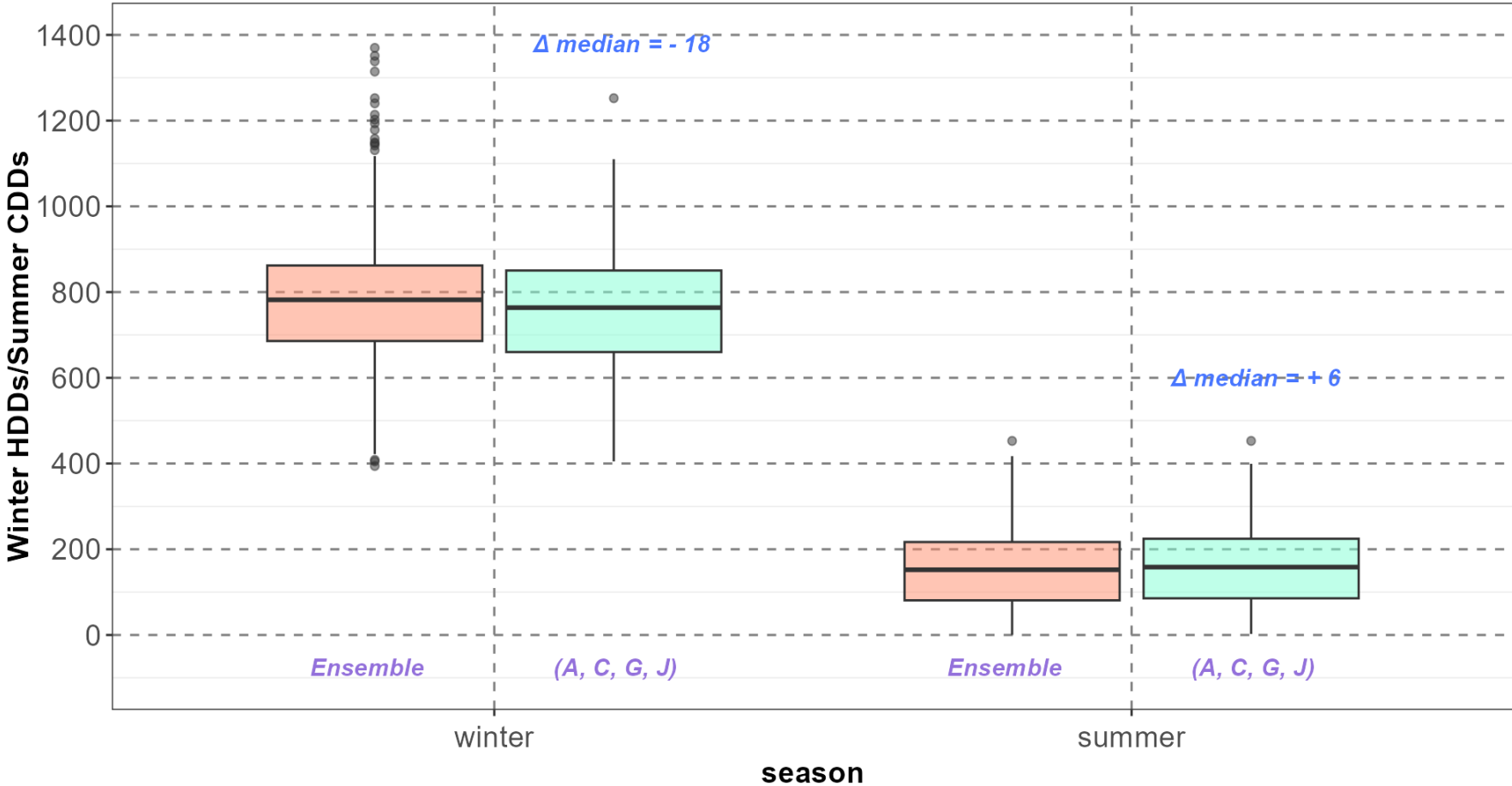
Comparison of Winter and Summer Hydro Generation between the Ensemble and the Selected A, C, G and J Scenarios



Data Type: ▬ Ensemble of Climate Scenarios ▬ Selected Scenarios

How Well do the Selected Scenarios represent the Ensemble HDDs and CDDs?

Comparison of Winter HDDs and Summer CDDs between the Ensemble and the Selected A, C, G and J Scenarios



Data Type: Ensemble of Climate Scenarios (A, C, G, J)

Climate Scenarios Selection

- Stay with the same 3 climate scenarios?

- A: *CanESM2_RCP85_BCSD_VIC_P1*
- C: *CCSM4_RCP85_BCSD_VIC_P1*
- G: *CNRM-CM5_RCP85_MACA_VIC_P3*

- Add a 4th scenario?

- A: *CanESM2_RCP85_BCSD_VIC_P1*
- C: *CCSM4_RCP85_BCSD_VIC_P1*
- G: *CNRM-CM5_RCP85_MACA_VIC_P3*
- J: *GFDL_ESM2M_RCP85_MACA_VIC_P1*

Climate Scenario Years

Power Plan Years and Climate Scenarios Years

- 2021 Power Plan years: 2022 to 2041
- Climate scenario years used: 2020 to 2049

- Upcoming Power Plan years: 2027 to 2046
- Proposed climate scenario years: 2020 to 2049



Topics for the Next Climate and Weather Advisory Committee

Combined CWAC/CRAC Meeting

- **CRAC: Conservation Resources Advisory Committee**
- Scheduled for Wednesday, August 21st from 2-4 PM Pacific
- Register for meeting here: <https://www.nwcouncil.org/meeting/climate-and-weather-and-conservation-resources-adv-comm-combined-meeting-2024-08-21/>
- Meeting topic: *Modeling Energy Efficiency with Future Climate Data for the 9th Plan*
 - Review methodology and data used for the 8th (2021) Plan
 - Propose methodology and data for the 9th Plan

