



Analogues methods can be used to identify **trends** in the **circulation pattern** associated with a particular extreme weather event. We present an online tool that enables rapid assessment of circulation analogues from ERA5 for a specific event.

Methodological choices are required, for heatwaves we provide scientifically supported guidelines to ensure analogues best capture the surface impacts.

There are **limitations**. The method cannot attribute an extreme event to specific drivers, such as anthropogenic causes. For many event types the circulation pattern alone is not enough to determine whether an event is impactful. For example, for rainfall associated with cut-off low pressure systems over Europe, many circulation analogues do not exhibit extreme rainfall¹.

As the climate changes there may be extreme weather events with no past analogues – such as cyclones in unprecedented location.

Compute analogues of a given event in the chosen field

Event date: (format YYYY-MM-DD)

Latitude: °N - °N

Longitude: °E - °E

Past year range: - (format YYYY)

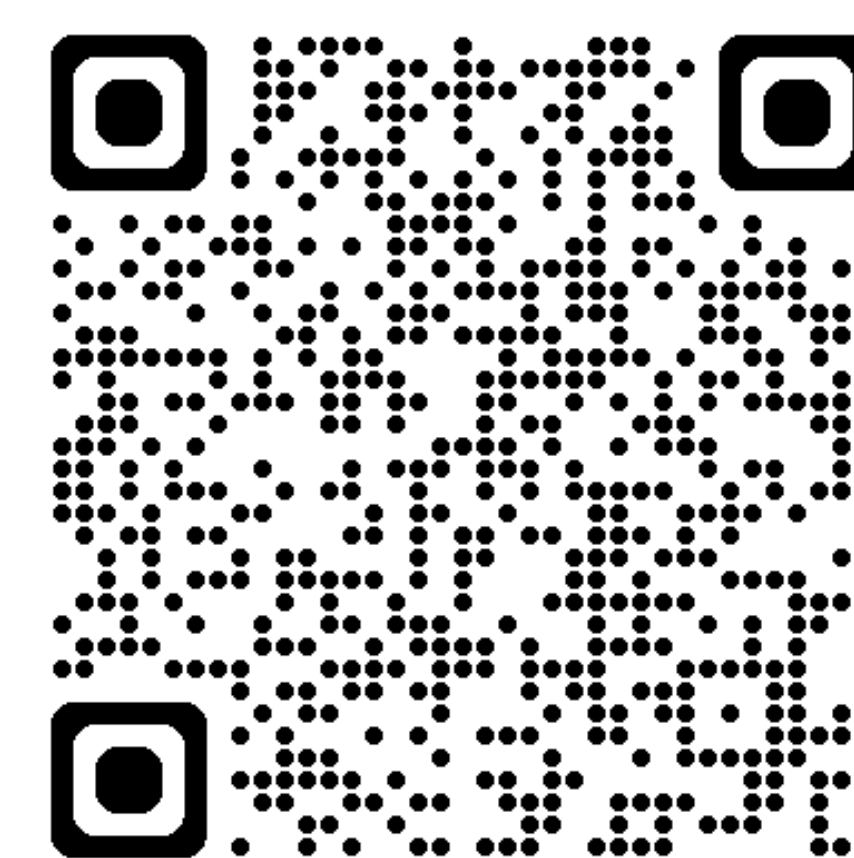
Present year range: - (format YYYY)

N analogues to find:

Choose Field: ☐ OMSL ☒ Z500 ☐ ED ☐ OCC

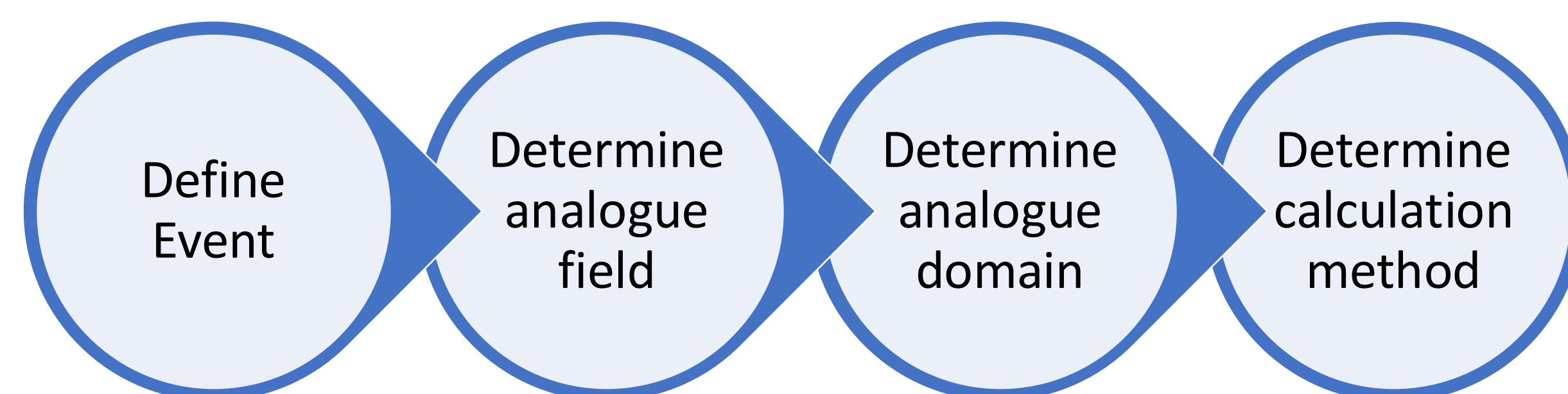
Choose Method: ☐ ED ☐ OCC

Find analogues

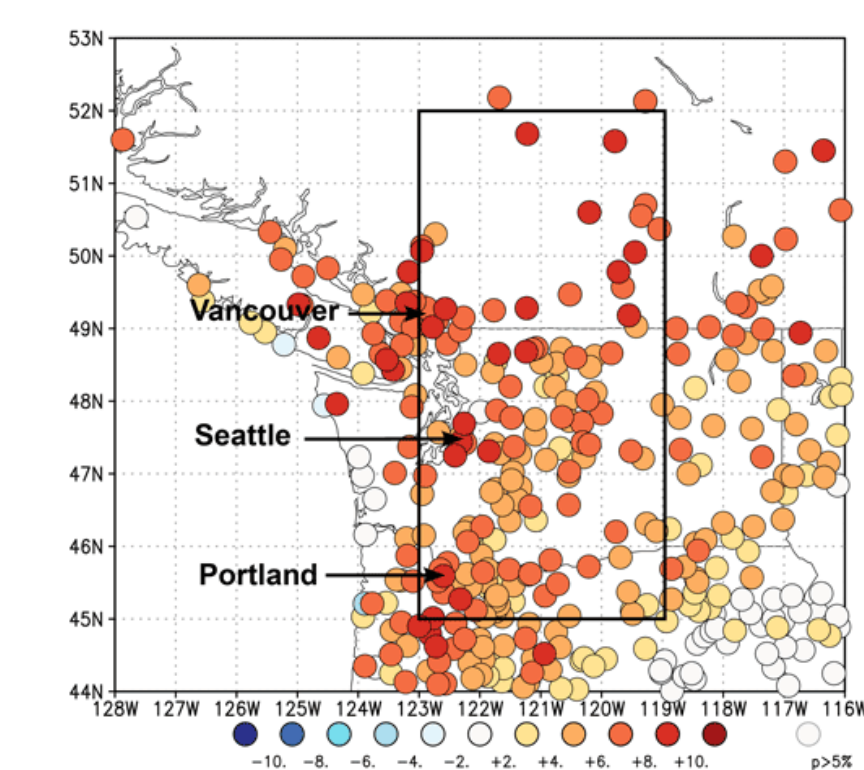


Scan here to try out
the online tool

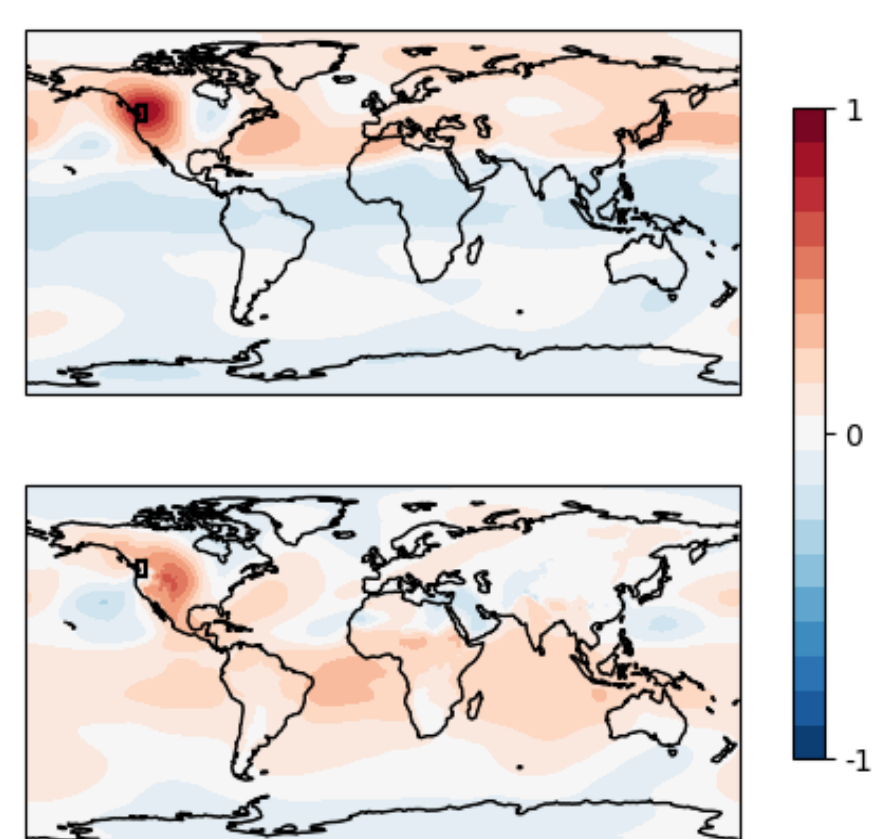
Tool Guidelines: Determining the methodological choices



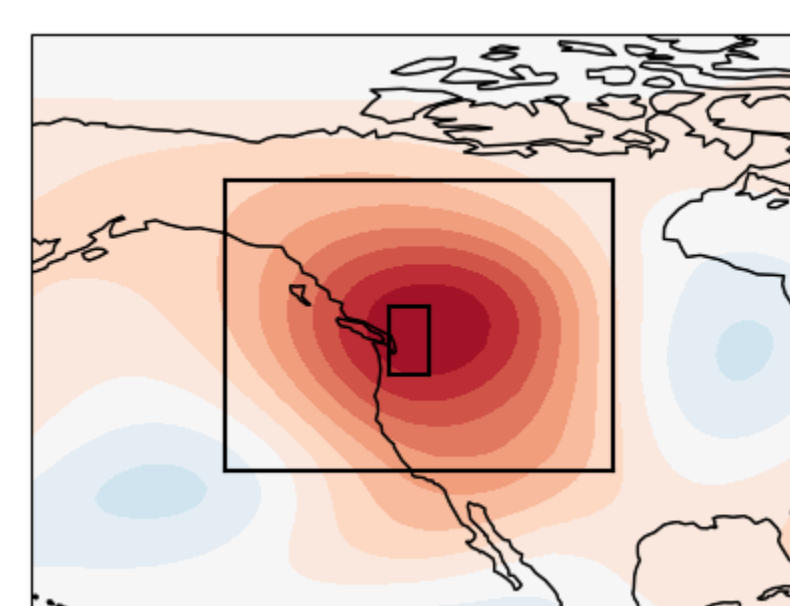
Event definition can come from another study – or from assessing the ERA5 field for the variable of interest (hazard).



Here we use the World Weather Attribution study².

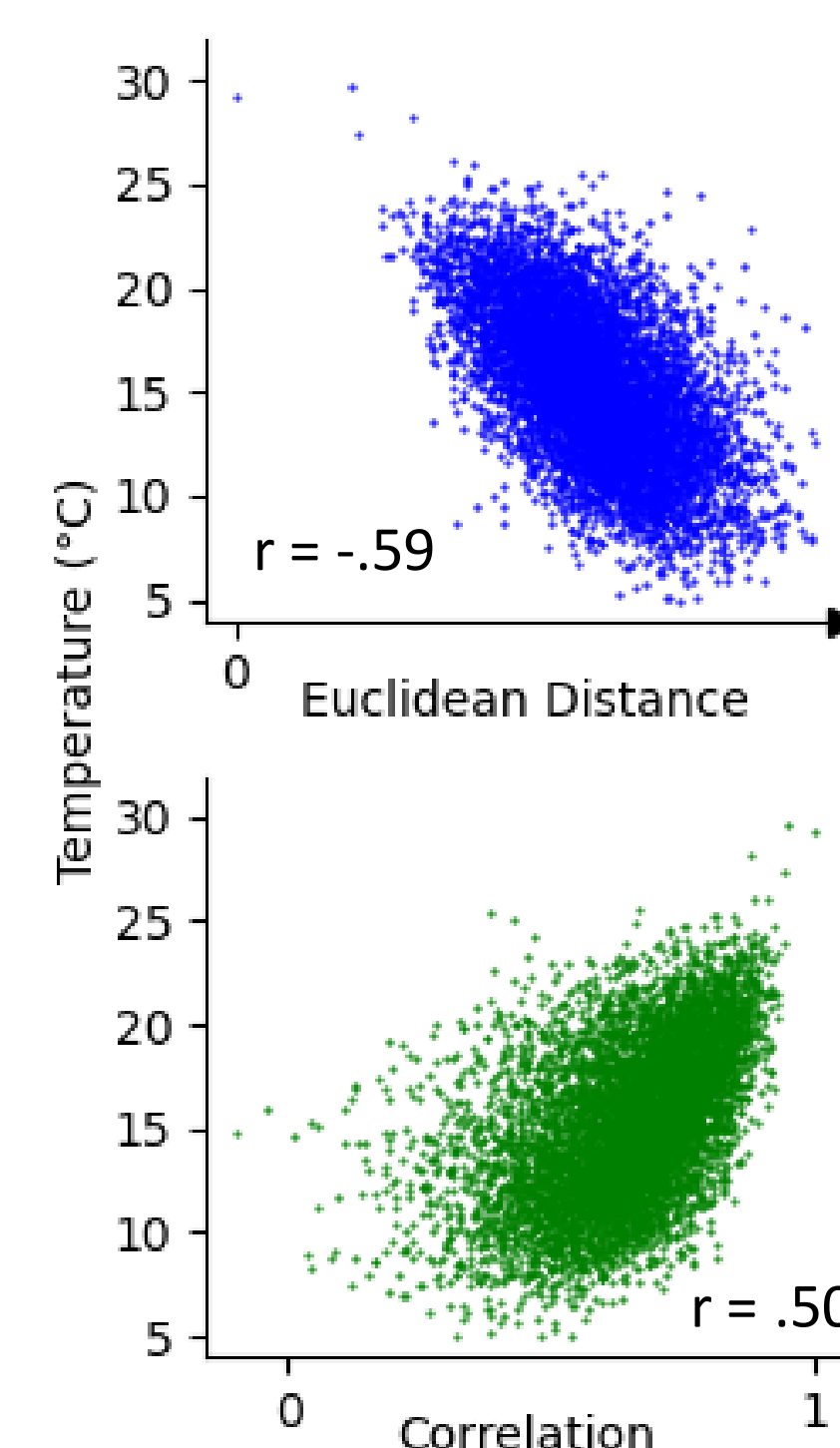


SLP or Z500?
We correlate the possible analogue anomaly fields with the hazard timeseries. Here, we find higher correlation using Z500.



Analogue domain chosen as region with highest correlation.

Euclidean distance or spatial correlation?
Analogues are identified from anomaly fields (removing the spatial mean across the analogue domain for each day individually).

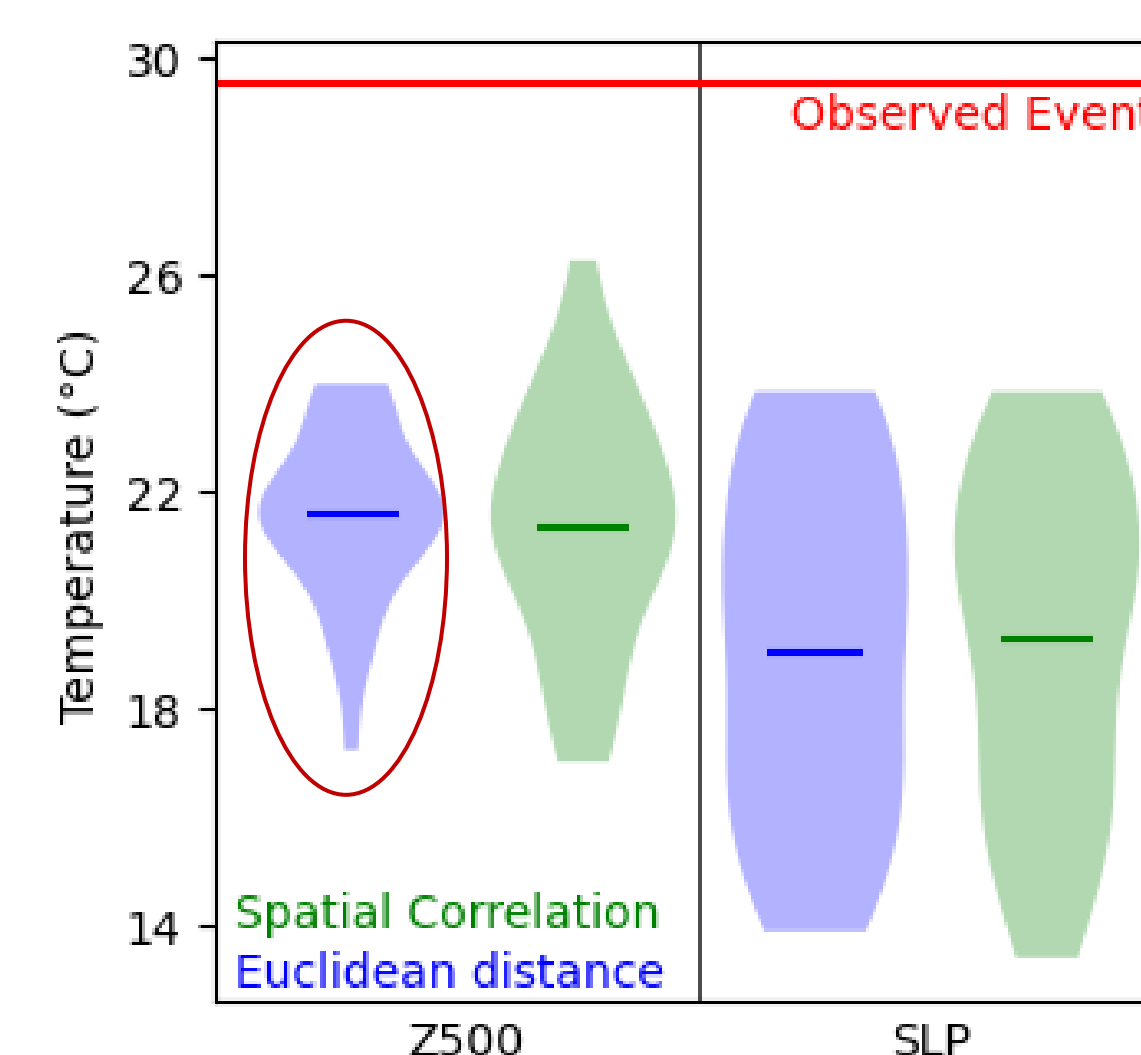


We use Euclidean distance, as it shows stronger relationship with the event.

Confirm Choices

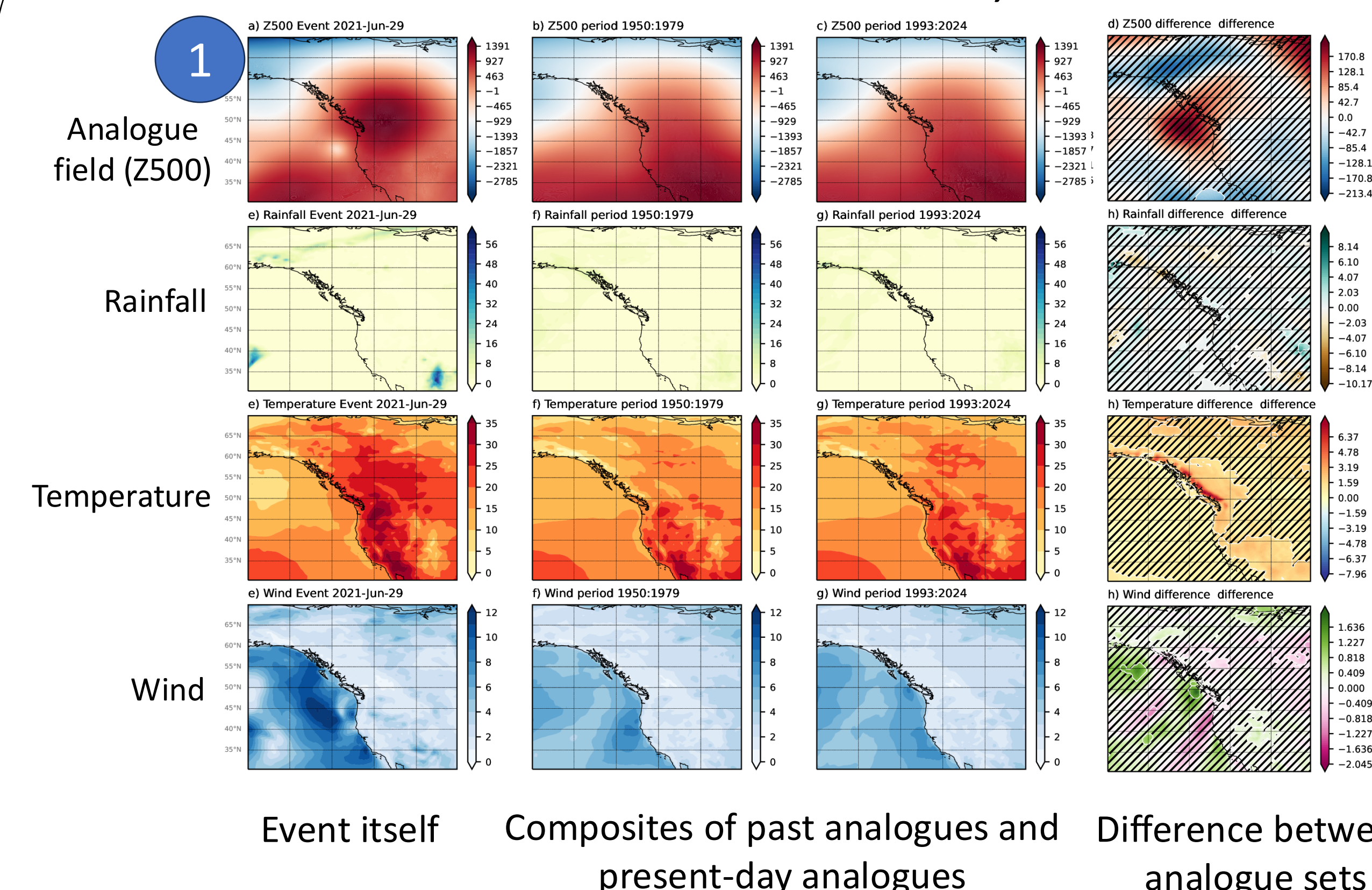
We identify top 30 analogue days and assess the temperatures.

This confirms the selected analogue method give highest temperatures.



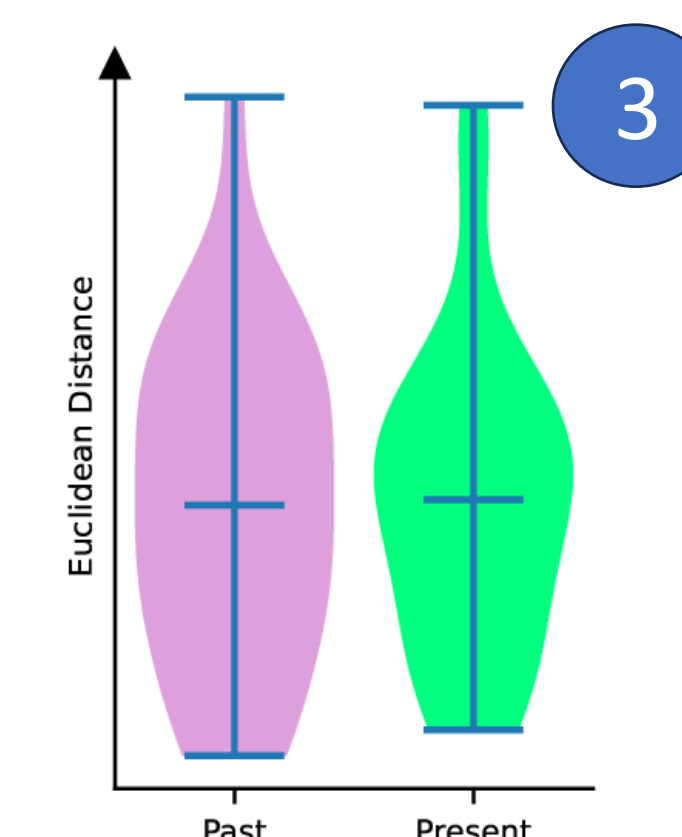
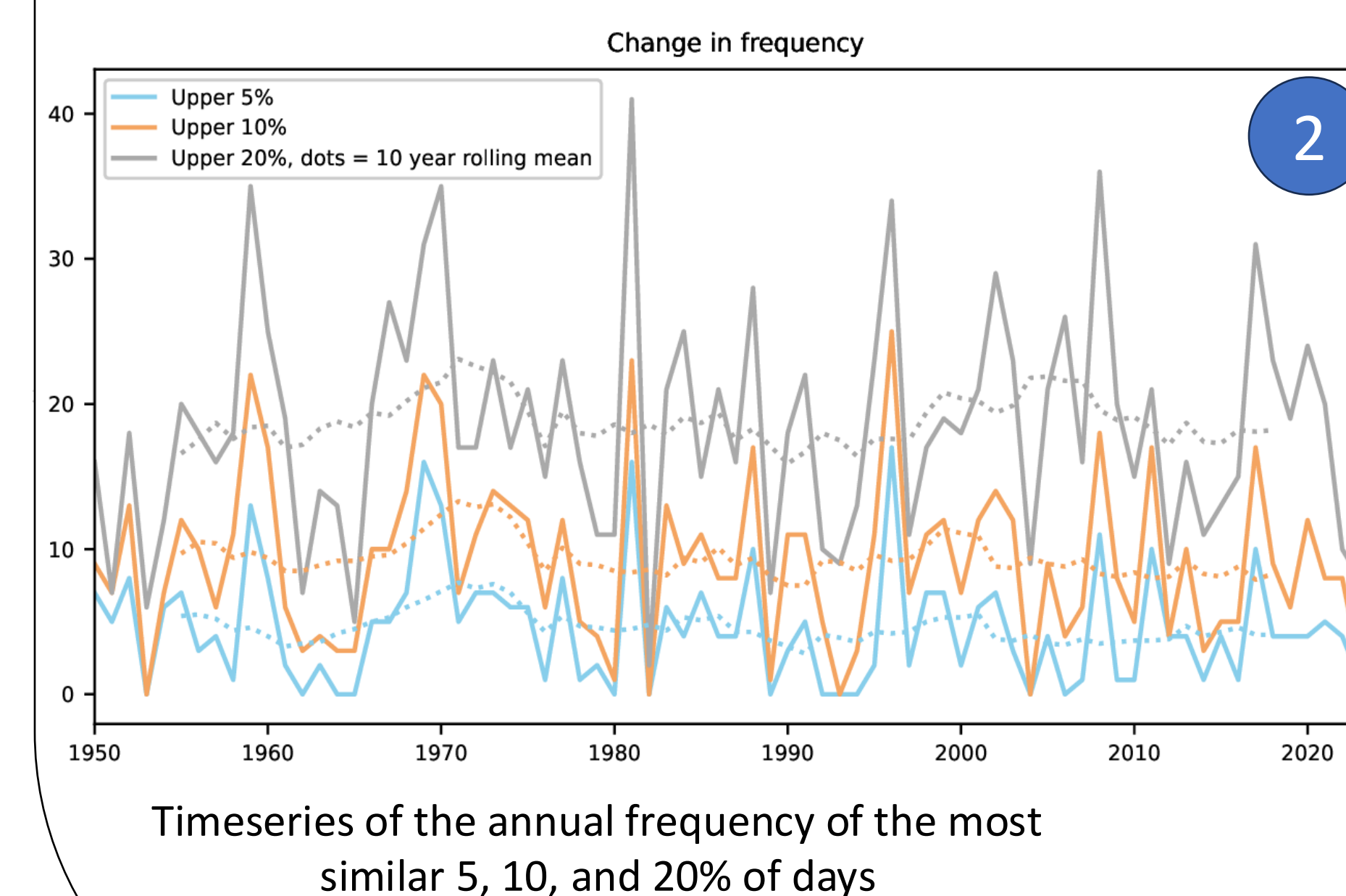
Tool Outputs:

Western North America heatwave, 29th June 2021



Analogues can show us how dynamically similar events differ between time periods.

- 1 We see an **increase in intensity** in similar systems, though the difference is not statistically significant. Dynamically similar events are becoming **hotter** (as expected due to thermodynamical changes).
- 2 There is no significant trend in frequency, though we see **multidecadal variability**.
- 3 There is no shift in similarity – analogues are of comparable quality in both time periods.



Analogue Similarity: Comparing the Euclidean distances of the analogue sets – smaller values are more similar to the event

References

1. Thompson et al., 2024. Atmospheric Science Letters
2. Philip et al., 2022. Earth System Dynamics