

# ADVANCED WEATHER DATA MORPHING FOR FUTURE CLIMATE-BASED BUILDING SIMULATION

Project by: Sophie Hamann  
Supervisors: Dr. Renato Rocha Souza, Angelos Chronis  
In cooperation with Infrared City GmbH

A Modular Python Tool Utilizing Enhanced Morphing Algorithms for EPW File Generation

## 1 The Climate Adaptation Challenge

- Extreme weather events and unpredictable temperature patterns threaten urban environments
- Traditional weather files fail to capture evolving climate conditions
- There is a critical gap between design assumptions and real-world conditions buildings must withstand

## 2 Existing Tools: Gaps & Constraints

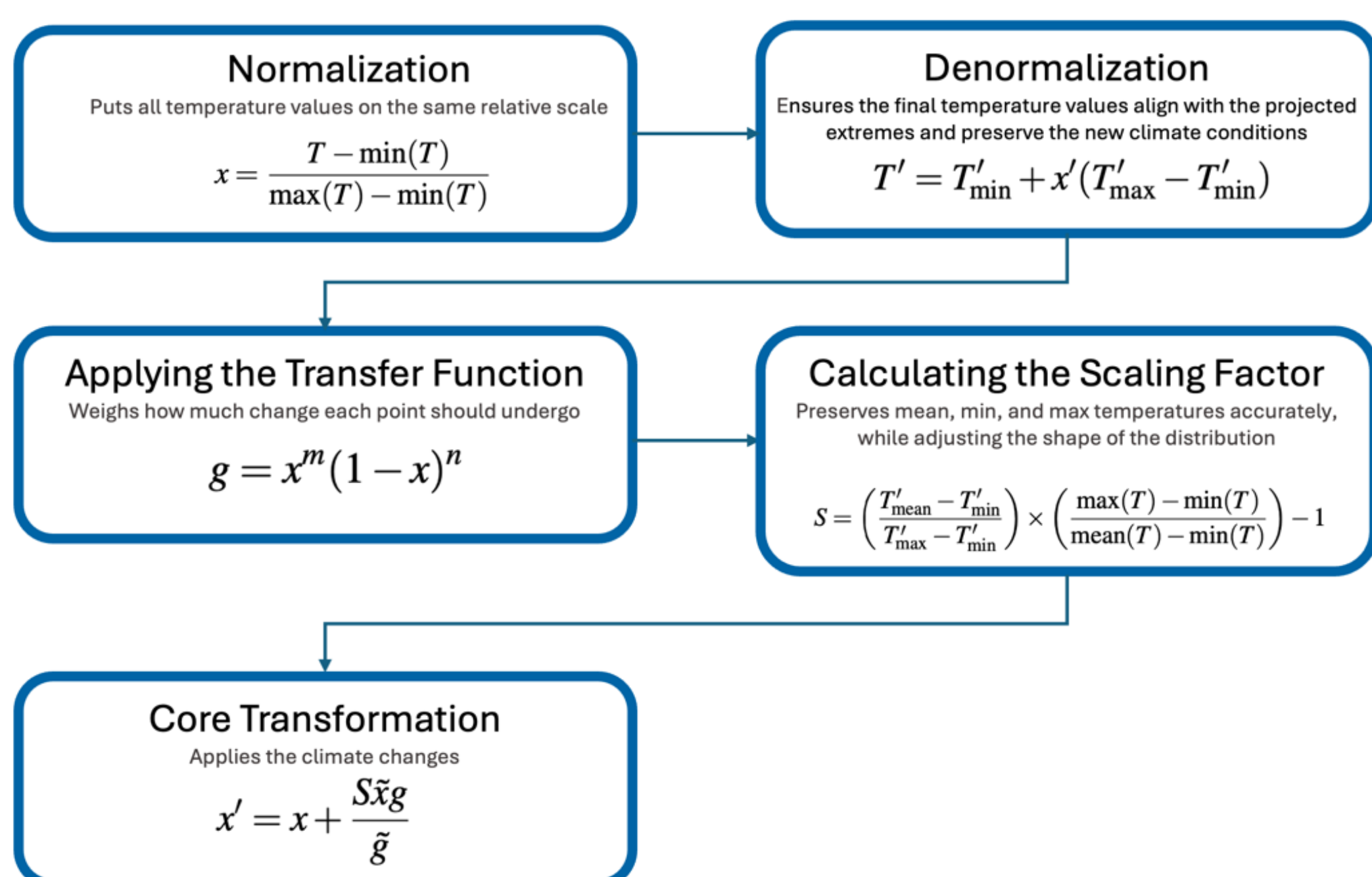
- Existing tools (CCWorldWeatherGen, WeatherShift, FutureWeatherGenerator) use outdated climate data or not up-to-date Morphing Algorithms
- Still operate with RCPs instead of newer SSP scenarios from the IPCC AR6
- Limited transparency in methodologies
- High costs create barriers to climate-informed design

## 3 Meeting the Need: An Advanced Morphing Solution

- A Modular Python Based Tool with object-oriented design and transparent methodology
- State-of-the-Art Bounded Weighted Morphing Algorithm (Eames et al. 2023)
- Shared Socioeconomic Pathway Scenarios from the 6th Assessment Report of the Intergovernmental Panel on Climate Change instead of Representative Concentration Pathway Scenarios
- Up-To-Date Global Climate Model Ensembles and Historic Data
- Incorporation of statistical percentiles for uncertainty analysis

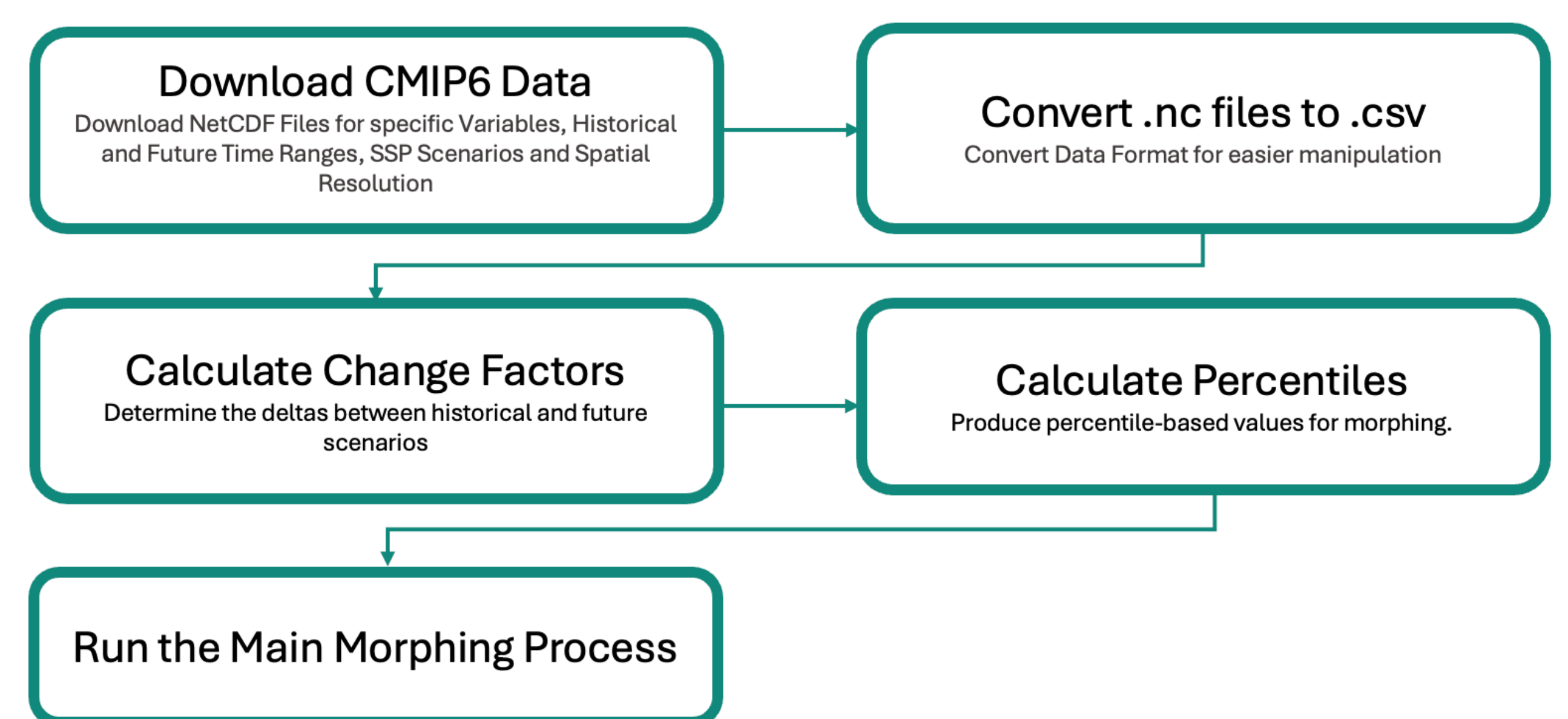
## 4 Morphing Methodology

Morphing combines historical weather data with climate model projections to generate future weather files by adjusting baseline variables through mathematical transformations. The process applies shifts to mean values and stretches to variance while preserving physical relationships between climate variables. Down Below you can find the Bounded Temperature Weighted Stretch Algorithm for Dry Bulb Temperature as an example.



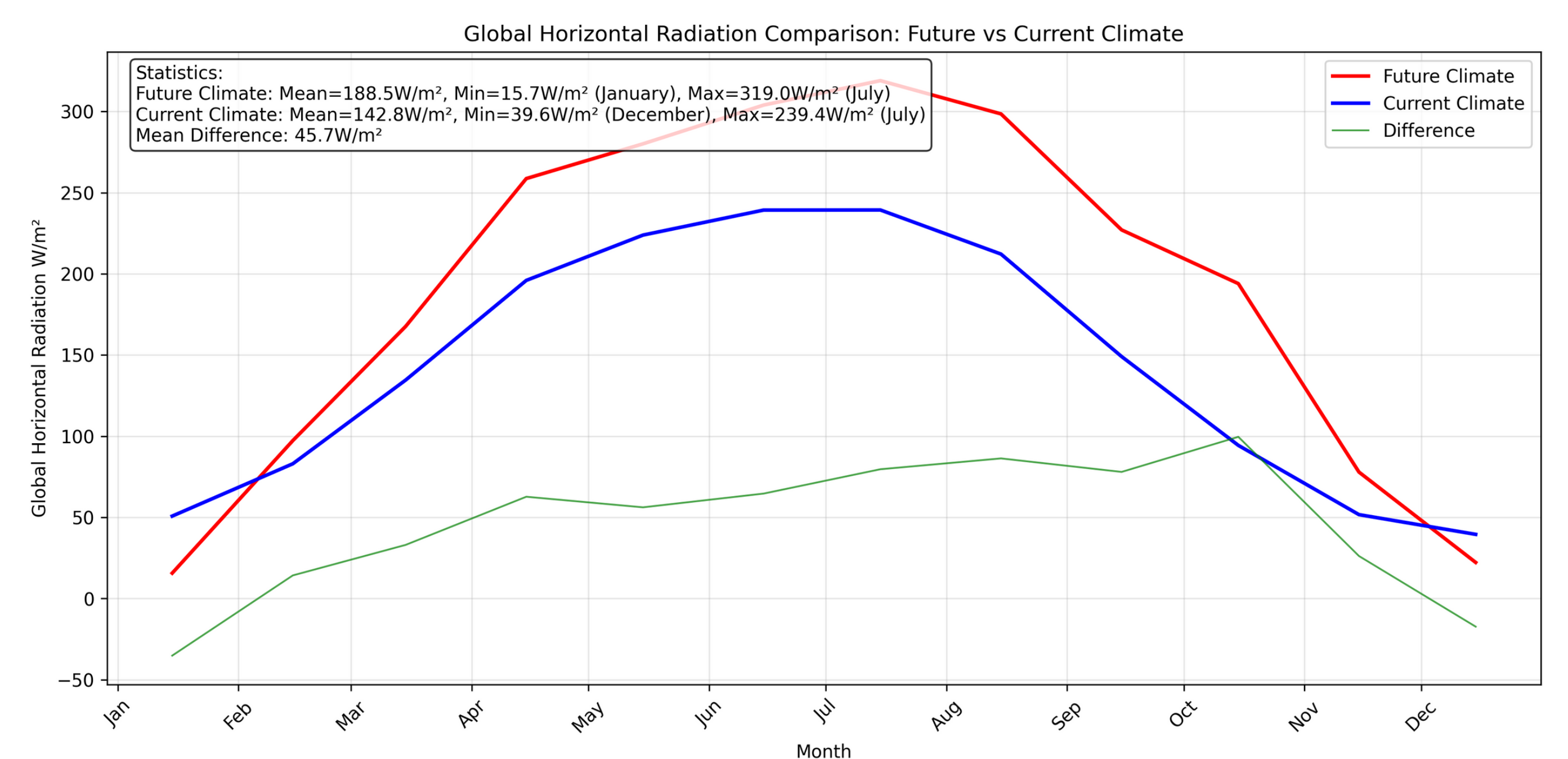
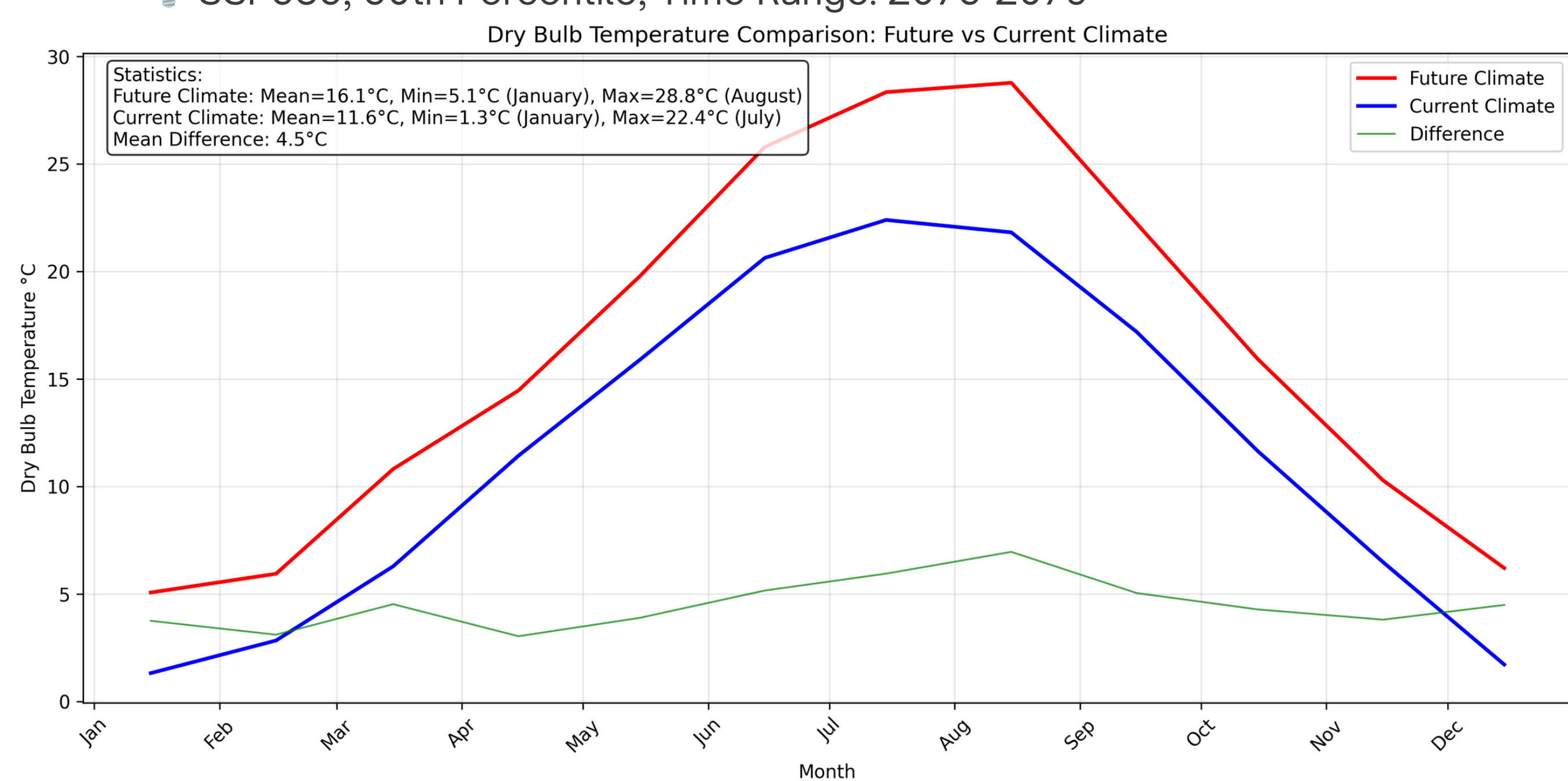
## 5 Morphing Tool Architecture

Before the Main Morphing can begin, the data needs to be processed. As soon as this is done, the user can select city, time range, SSP scenario as well as percentiles to morph the respective .epw file.

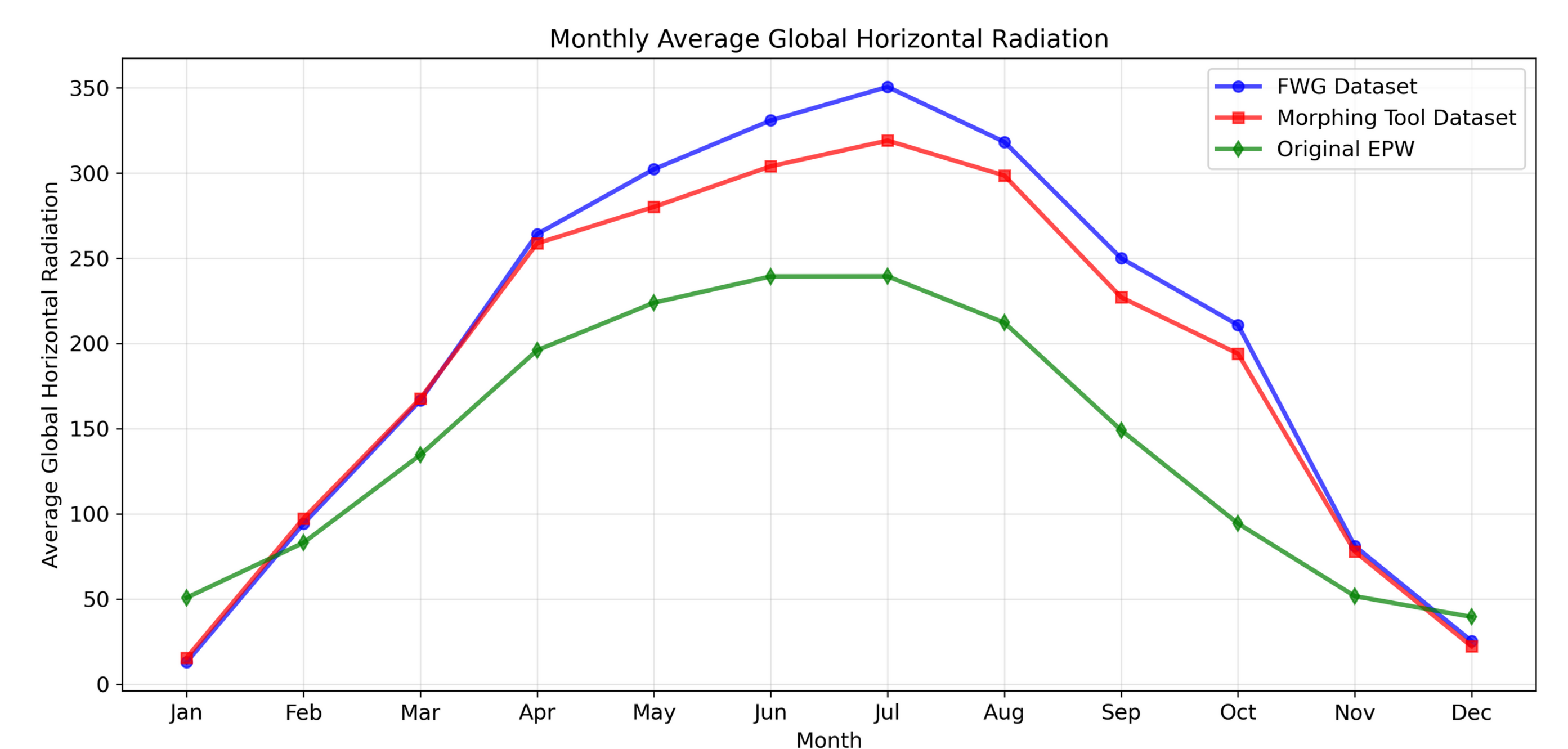
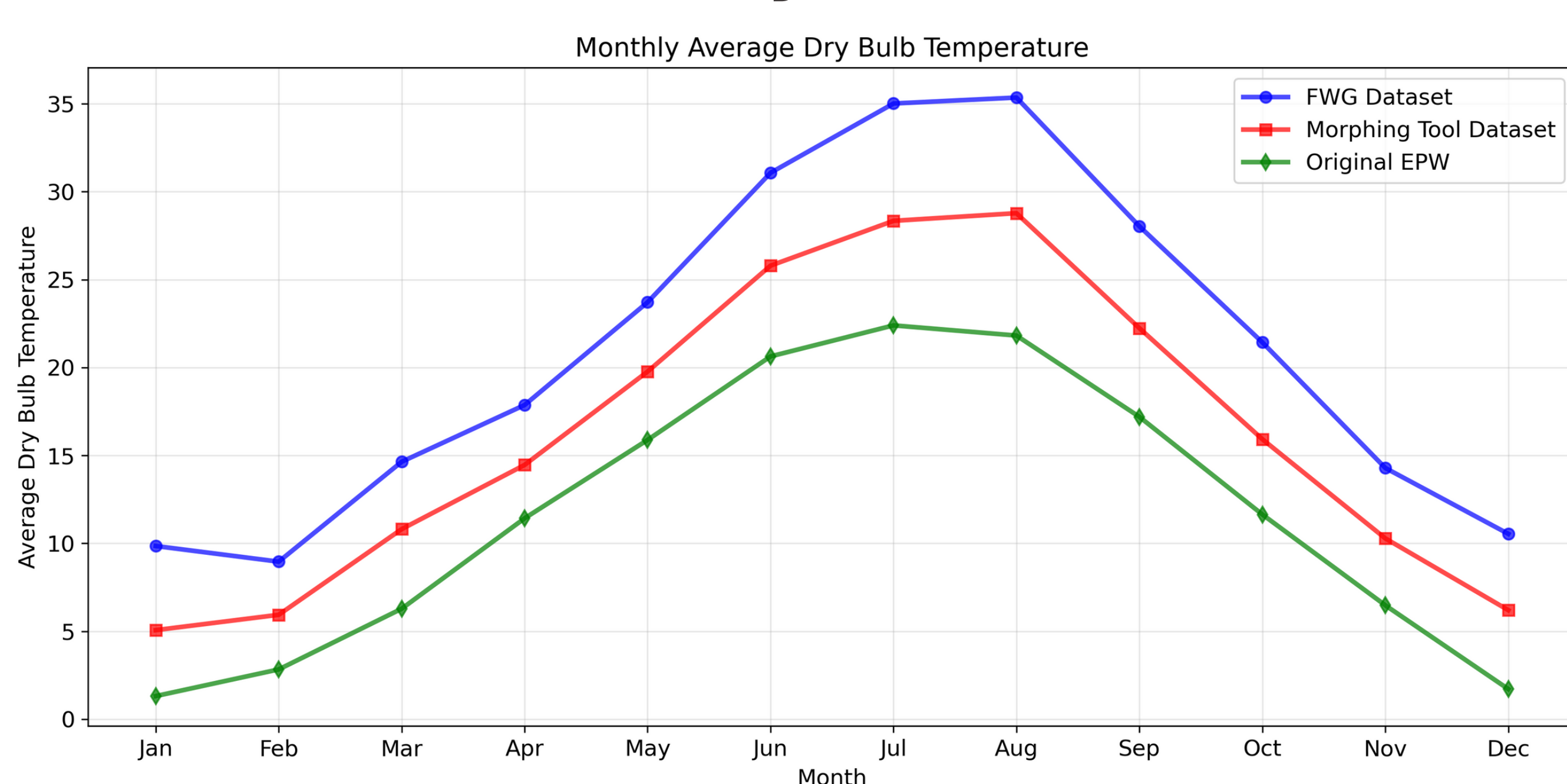


## 6 Case Study Results - Future Climate Scenarios for Vienna

SSP585, 50th Percentile, Time Range: 2075-2079



## 7 Validation Study



## 8 Added Value

- Enhanced Climate Adaptation
- Methodological Innovation
- Validation Insights
- Decision Support