MOTIVATION
Modern web visualization frameworks scale poorly for huge datasets. Aggregate visualization limits the number of data points to be rendered, but bin recomputation becomes the bottleneck.

WebGPU provides an API for GPGPU in web browsers via compute shaders. This offers a significant improvement in performance through parallelization.

OUR GOAL
Showcase the potential of WebGPU for aggregate visualization.

Enable users to filter and aggregate millions of data points in realtime to explore temperature changes around the world.

Render aggregated data as hexagonal bins superimposed on a world map.

CLIMATE CHANGE EXPLORER

BEHIND THE SCENES

Pre-Processing - Offline Step
Compression of ~10M temperature entries at 5,165 different locations (Berkeley Earth Local Temperature Dataset).

Aggregation - WebGPU Compute Pipeline
Average temperatures per location depending on specified time range.

Binning - WebGPU Compute Pipeline
Calculate average temperature per bin. Neighborhood search utilizing a k-d tree.

Min-Max - WebGPU Compute Pipeline
Evaluate the minimum and maximum grid values for the color scale. Parallel reduction leads to GPU peak performance.

RESULTS
We can maintain interactive frame rates with millions of data points. WebGPU’s compute and rendering pipelines can significantly increase the performance of client-side aggregate visualization compared to state-of-the-art solutions.