Experiencing Climate Change through dataphysicalization

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Fig. 1

This paper outlines our approach to visualizing water stress in relation to population density. While most water stress mappings focus on tempo-spatial context, our project maps the water stress of selected capitals within the context of global population density to explore the interaction between both dimensions. By removing cartographic borderlines, an abstract space of mountain ranges shows the world as a spatial accumulation of humans facing changing environmental conditions. We describe the development process of the artifact and how physical layers were created.

CCS Concepts: • **Human-centered computing** → **Information visualization**.

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1 INTRODUCTION

Climate change is a pressing issue that requires innovative ways of communicating its complexity to a wider audience. Water stress is a major threat posed by climate change that can have profound impacts on human populations around the world[6, 11, 14, 15]. Traditional maps and visualizations offer only a limited view of the problem as they cannot encode all the necessary data dimensions. To overcome this limitation, we propose three dimensional approach to

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provide a more engaging experience for viewers.Recent work has explored interactive three-dimensional stereoscopic displays[1, 5, 13, 16–18] and physical data presentation techniques [2, 3, 9] to represent data in physical forms, such as 3D models or tangible interfaces. These approaches can potentially enhance user engagement and understanding of the data [8, 10] and provide a more intuitive representation of the complex relationships between climate variables and geographic locations. Our approach visualizes water stress in a geospatial context in relation to population density, focusing on selected capitals within the global population density. By removing cartographic borderlines, we create an abstract space of mountain ranges that shows the world as a spatial accumulation of humans facing changing environmental conditions. We also describe the development process of the artifact on our project website. The underlying data, all production files, and impressions from the installation can be accessed on the project website.[1]

2 THE DESIGN PROCESS

This project maps the water stress of selected capitals within the context of global population density. Water stress is encoded in red, semitransparent epoxy discs representing four dimensions: latitude, longitude, population, and projected water stress. The installation uses a wooden elevation map [12] shaped with a CNC cutter based on demographic data to show the world's population density[4]. The map's surface is coated with high-pigmented color to reflect the water-stress epoxy discs accurately. By removing cartographic borderlines, an abstract space of mountain ranges remains, showing the world as a spatial accumulation of humans confronting changing environmental conditions.

2.1 The physical dimension

NASA population data was used to create the population-density mountains for the installation. A heat map was generated from the data and used to create a 3D model in Houdini, where the visualization was converted into points, moved in the normal direction, sliced, and extruded to their appropriate thickness. Fusion 360 software was used to reorganize the model for CNC cutting, and the individual parts were assembled into the landscape. An overhead projection of the geodata mapping was used to position the layers accurately, and all parts were glued together with wood glue.

2.2 Mapping Water Stress

Water stress data was used from the Aqueduct framework[7] to create 3D models of cylinders, where the height represents stress level and the radius reflects affected population. Material studies were conducted to determine suitable pigment and epoxy mixing ratios for accurate color projection. Cylinders were 3D printed in PLA and used to make silicone molds for casting. Layers were coated with highly pigmented lacquer and sanded before surface treatment. The lighting system, designed in Autodesk Fusion 360, was 3D printed and included a mounting system for the cylinders and power LEDs.

3 RESULTS AND DISCUSSION

This project visualizes water stress's impact on capital cities by combining a wooden elevation map of population density with red epoxy discs representing water stress. The installation is interactive, with the disc's radius representing the population and height representing projected water stress. The team plans to expand the experience with spatial audio cues and user interactions, and a formal study will examine user understanding of the data.

[1] https://certainuncertainty.de/project/

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