Communicating Climate Science Through Virtual Reality Environments

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Introduction

Site-specific research often requires travel to distant or inaccessible field sites, which means only a limited number of non-researchers (such as students) can experience fieldwork environments firsthand. Photos and video from field sites can convey valuable information, but lack a feeling of discovery and limit student interactivity.

Virtual reality (VR) environments enable students to experience field sites and interact with data in a dynamic and non-linear way. VR allows students a range of hand and head motions that translate into the visual, audio, and haptic feedback they receive, thus offering them a level of decision-making and self-determination that is unavailable through photos, video, and text material alone. Studies have shown that exposure to VR environments stimulates similar psychological and physiological responses to those experiences in reality (Lamb and Etopio, 2019.) VR can also convey data invisible to the naked eye, enabling advanced interaction with research findings.

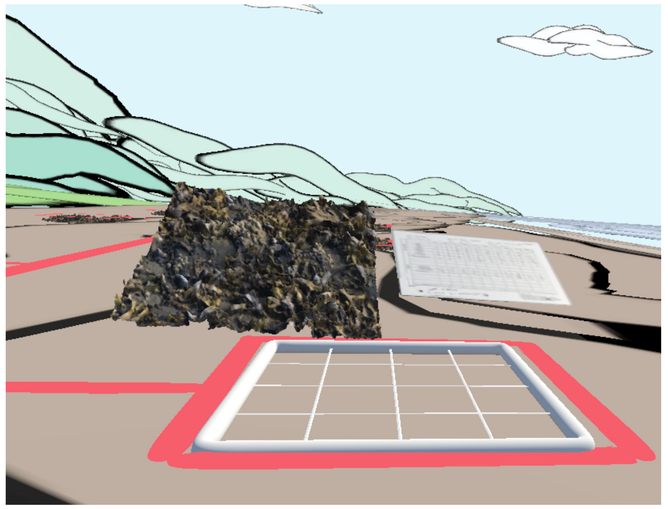

Fig. 1: VR simulation by Cassidy Phillips featuring a 3D model of a quadrat section and corresponding notes. Image by Naomi Hutchquist/Alaska EPSCoR.

Fig. 2: Technician Sydney King takes notes on a quadrat in the Cowee Creek estuary outside of Juneau, Alaska, July 4, 2019. Photo by Tom Moran/Alaska EPSCoR.

VR simulations create a viable alternative to traditional educational materials.

Materials in Development

Our team has produced a digital model of our software development room, "Dev Space," to dynamically display information and data from Alaska NSF EPSCoR's current research project, "Fire & Ice." The virtual space contains a growing array of 360-degree photos, models, and simulations. The immersive and interactive nature of these environments, experienced through headsets like the HTC Vive, gives them an advantage over many existing educational tools. Virtual environments encourage active and playful participation in learning by giving the user control of the learning process. Such environments give students the opportunity to learn by making mistakes without real-world consequences (Lannen et al, 2002.) By enabling each user to customize their experience using hand, head, and body movements, information is presented in a more engaging and provocative way.

Our first immersive environment represents the intertidal zone of a Southeast Alaska beach. Fire and Ice Coastal Margins researchers are studying the density and diversity of marine life in these zones through *quadrat sampling* - recording details of plant and animal life and physical conditions within 1/2 x 1/2 meter squares, gathered along a 50-meter transect. This environment represents such an intertidal zone through a hand-drawn background, containing a hyperrealistic model of an actual quadrat and a corresponding data sheet. The quadrat was photographed *in situ* and converted into a digital model using photogrammetry software. Viewers can manipulate the quadrat to examine it in closer detail and from any angle, and compare their observations with those of an Alaska EPSCoR scientist. This has the potential to be useful both for general educational purposes and for researcher training.

The second simulation is a three-dimensional model of Alaska overlaid with a two-dimensional animation indicating the path of wildfires and smoke across the state during a period of intense wildfire activity in August 2019. The VR environment facilitates a better understanding of how landscape features impact the trajectory of wildfire smoke, while offering a visceral representation of the characteristics of an Alaska fire season. With further refinement, such an application has the potential to help educate audiences about wildfire characteristics and enable enhanced examination of the interactions between fire, landscape, and smoke patterns.

Fig. 3: A smokejumper plane delivers personnel to the Bearnose Hill Fire near the village of Chalkyitsik, Alaska, July 21, 2019. Photo by Ed Sanford/Alaska Interagency Incident Management Team.

Conclusion

VR environments like these enable individuals and groups to experience site-specific aspects of EPSCoR Fire and Ice locations in an a controlled environment. Simulations like these could aid in the communication of interactive materials and processes, while providing students with a novel, playful, and memorable experience. VR simulations offer a safe, accessible space for individuals who learn best through body movements to explore new spaces and develop unique ideas. In situations where information is largely audiovisual, and where objects are best viewed in a three-dimensional space, such simulations offer a viable supplement or alternative to field training and location-based learning.

Acknowledgments

We would like to thank Faye Gallant, Pips Veazey, Shannon Watson, Chris Waigl, Santosh Panda, Sydney King, Brenda Konar, Courtney Breest, Laura Conner, Megan McGinty, Anne Beaudreau, LeeAnn Munk, Uma Bhatt, Todd Brinkman, Martin Steuffer, and all participating researchers, faculty, staff, and students of the Alaska NSF EPSCoR Fire & Ice project.

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