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Visualizing Tsunami Threats to Coastal Communities with Immersive Technologies

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Abstract. Immersive technologies could help prepare coastal communities by simulating and visualizing threats posed by natural disasters and a changing climate. We have been developing a tool to help the coastal community of Port Alberni (Canada) to prepare for a tsunami. The long-term goals of the project are to help communicate, plan, and eventually coordinate the response to a tsunami.

Keywords: Tsunami · Emergency management · Disaster planning · Virtual reality · Augmented reality · Immersive technology

1 Background

Immersive virtual environments (IVEs) are increasingly being leveraged for disaster preparedness and response training [1]. Virtual reality enables accessible representations of complex scenarios that could affect communities; while augmented reality provides a means to overlay critical information on the real world environment for effective planning and decision making. Virtual reality has been effectively used to simulate sea level rise related to climate scenarios [2] and flooding [3]. These can be persuasive approaches for communicating and training communities [4]

We have been developing an IVE to help the coastal community of Port Alberni in British Columbia, Canada, prepare for a tsunami. The town is considered highly vulnerable as the Alberni Inlet would funnel and concentrate waves produced by offshore seismic activity and amplify their impact on the community. A tsunami in 1964 caused widespread physical damage and an earlier event in 1700 was even more devastating.

1.1 Goals

- Communicate the threat to the community, using immersive technologies and the sense of presence to make that threat personally relevant
- Help stakeholders plan for a disaster using the latest in earth observation data, layered with sensor data
- Provide support via a virtual emergency operations (EOC) center during the disaster.

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Fig. 1. Virtual representation of Port Alberni for tsunami preparedness

1.2 Approach

Our initial priority is to develop an IVE for tsunami education and planning for community members and students; the IVE will eventually be expanded to develop a virtual EOC for emergency managers.

The virtual model was developed by combining digital elevation models of the region with relevant geospatial layers to capture social vulnerability, critical infrastructure, transportation networks, and response assets. These layers were combined into a virtual representation of region to enable users to envision the impact of tsunamis of varying magnitudes.

The system layers disaster assets with simulations informed by earth observations and sensor data. This architecture bridges virtual benefits with real world observations, and positions the tool to be used for visually interpreting complex data and models. The sea level simulation was developed in collaboration with Ocean Networks Canada, their offshore sensor network measurements are used to extend the spatiotemporal range of tsunami detection. Immersive visualizations can help facilitate the interpretation and communication of these complex measurements and models to stakeholders

Virtual representations of the community, wired to observation data, and mapped to disaster response assets could eventually power a virtual EOC, allowing emergency managers to virtually position assets and personnel, reroute traffic, issue alerts, and coordinate the overall response. Critically, access to these capabilities via commodity headsets and devices, coupled with satellite communications, could distributed and enhance the flexibility and resilience of the emergency response.

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