

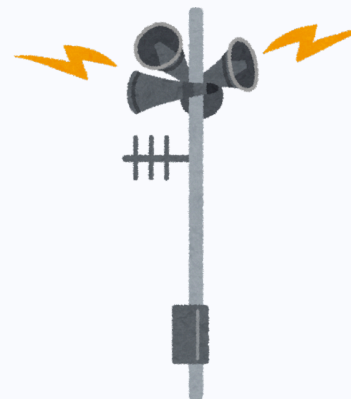
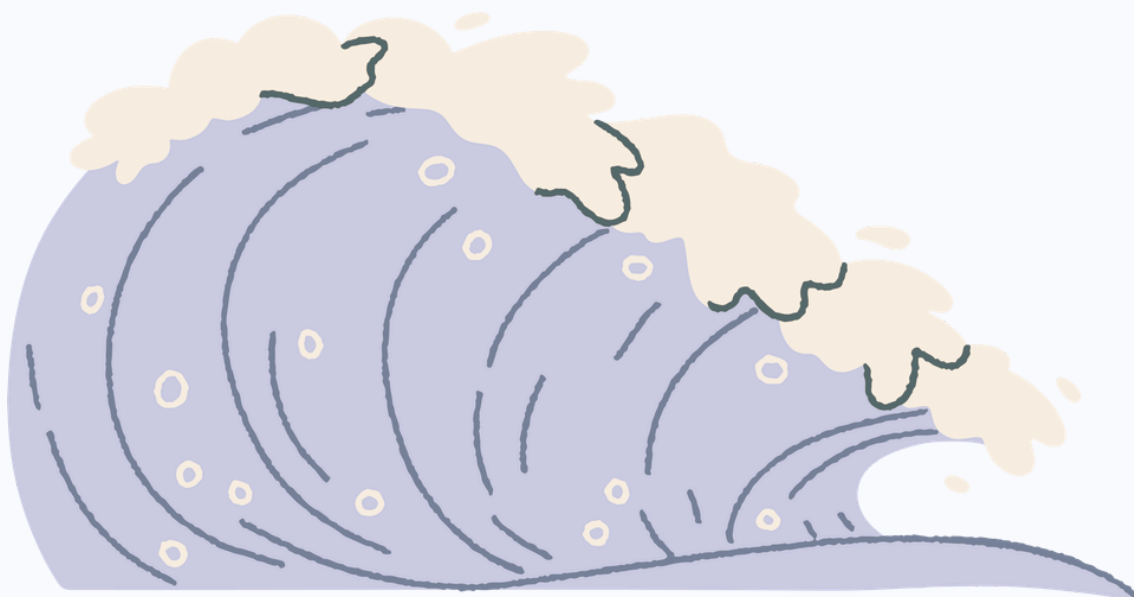
DIGITAL TWINS FOR TSUNAMI EARLY WARNING IN THE CASCADIA SUBDUCTION ZONE AND THE JAPAN TRENCH

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Dr. Stefan Henneking is a Research Scientist at the Oden Institute for Computational Engineering and Sciences at The University of Texas at Austin. His research focuses on high-performance computing, scalable algorithms, and Bayesian inverse methods for complex scientific applications, including acoustic sensing, fiber optic modeling, earthquake monitoring, and tsunami early warning. He is a recipient of the 2025 ACM Gordon Bell Prize.

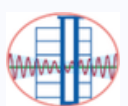
- Date: Friday, October 2, 2026
- Venue: NCREE 13F
- Agenda:
 - 9:30 AM – 10:00 AM | Registration & Welcome Coffee
 - 10:00 AM – 11:00 AM | Keynote Lecture



ABSTRACT:



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Following the devastating 2011 magnitude 9.0 Tōhoku megathrust earthquake, Japan installed large-scale offshore sensor networks, including S-Net, a network of 150 seafloor stations deployed in the area of the Japan Trench. Each station is equipped with seismometers and pressure gauges. In the event of an earthquake, these seafloor sensors provide real-time data that can be used for tsunami early warning. We present a full-scale Bayesian inversion-based digital twin for the Japan Trench that shows how S-Net sensor data can be assimilated in real time to perform tsunami inference with high-fidelity, physics-based models. Using near-field observations of acoustic pressures and ground velocities, the digital twin infers over two billion parameters that describe the spatiotemporal seafloor motion during the earthquake, and forecasts tsunami wave heights at target locations, along with their uncertainties. The digital twin is tested with synthetic data generated by dynamic rupture models of the 2011 Tōhoku earthquake, demonstrating that accurate tsunami forecasts for complex earthquake ruptures can be obtained in a matter of seconds. Finally, we show that a sensor network of similar size to S-Net, if deployed in the Cascadia Subduction Zone, would provide sufficient data to enable accurate real-time tsunami early warning in the Pacific Northwest for Cascadia megathrust earthquakes. Our Cascadia digital twin is tested with hypothetical earthquake scenarios, both partial and margin-wide ruptures, that are generated with large-scale, fully-coupled dynamic rupture simulations.

