MAE *Seminar* SERIES

THURSDAY, FEBRUARY 14

3:30 PM

114 HOCHSTETTER

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3D VIRTUAL REALITY FOR MODERN CONCEPTUALIZATION OF DIGITAL INFORMATION

ABSTRACT

The influx of digital data, unprecedented high-performance computing (HPC) resources, and advances in visualization algorithms are driving a paradigm shift in how scientists work with information. The coupling of three-dimensional (3D) data visualization with HPC can render physical meaning to numerical problems, enabling the user to grasp the model as if it were a tangible physical construct. Here I show examples of this process and demonstrate how the increase in computational power has enabled a new avenue of geodynamics research of natural subduction zones on Earth. Virtual voyages through the Earth's interior are presented that provide a snapshot into the four-dimensional evolution of plate tectonics, captured by the modern state of slab structure. Examining the modern subduction system in an interactive 3D framework provides an improved conceptualization of the morphology of the Earth's subducted plates. This approach facilitates a paradigm shift from a two-dimensional to 3D framework for interpreting the subduction process, with results presented from high-resolution, geographically referenced, fluid dynamics simulations with a complex model design representative of the natural plate boundaries. The 3D models contain over 100 million mesh nodes, over 500 million unknowns, have a local resolution of 2.5 km, and cost 15,000 - 20,000 compute hours per time-step. Flow regions with large strain-rates emerge resulting in low viscosity regions to due to the non-linear weakening of the strain-rate dependent rheology in the Earth's upper mantle. The 3D non-linear mantle flow produced is a departure from the paradigm of 2D corner flow. For facilitating scientific reproducibility in the era of HPC and big data, university sponsored streaming and storage sites, such as institutional repositories may provide a critical link in moving this new technology forward and redefining approaches to scientific research.

BIO SKETCH

Margarete Jadamec received her B.S. in Geology and Geophysics from the University of Connecticut, a M.S. from the University of Alaska, Fairbanks, and a PhD in Geodynamics from the University of California, Davis (2009). She was a Postdoctoral Research Fellow in the School of Mathematical Sciences and School Geosciences at Monash University in Australia, where she co-founded 3DALIVE, a collaborative 3D data visualization facility. She was awarded a National Science Foundation Postdoctoral Fellowship at Brown University where she designed seismically 3D models of subduction. She was an Assistant Professor in the Department of Earth and Atmospheric Sciences at the University of Houston (2014-2017), and recently joined the faculty at the University at Buffalo as Assistant Professor (2017-present), with a joint appointment between the Department of Geology and the Computational and Data-Enabled Science and Engineering program. Margarete's research uses high performance computing and 3D immersive visualization to study nonlinear processes in plate tectonics and mantle convection. She was awarded both Best Science Paper and Best Conference Paper at XSEDE12. Through her expertise she was invited to a Think Tank at the Australian Academy of Sciences (2010), a National Strategic Computing Initiative Workshop through the Obama administration (2016), and had her work recently highlighted on a joint NIH-DOE-NSF report on ExaScale computing (2017).

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