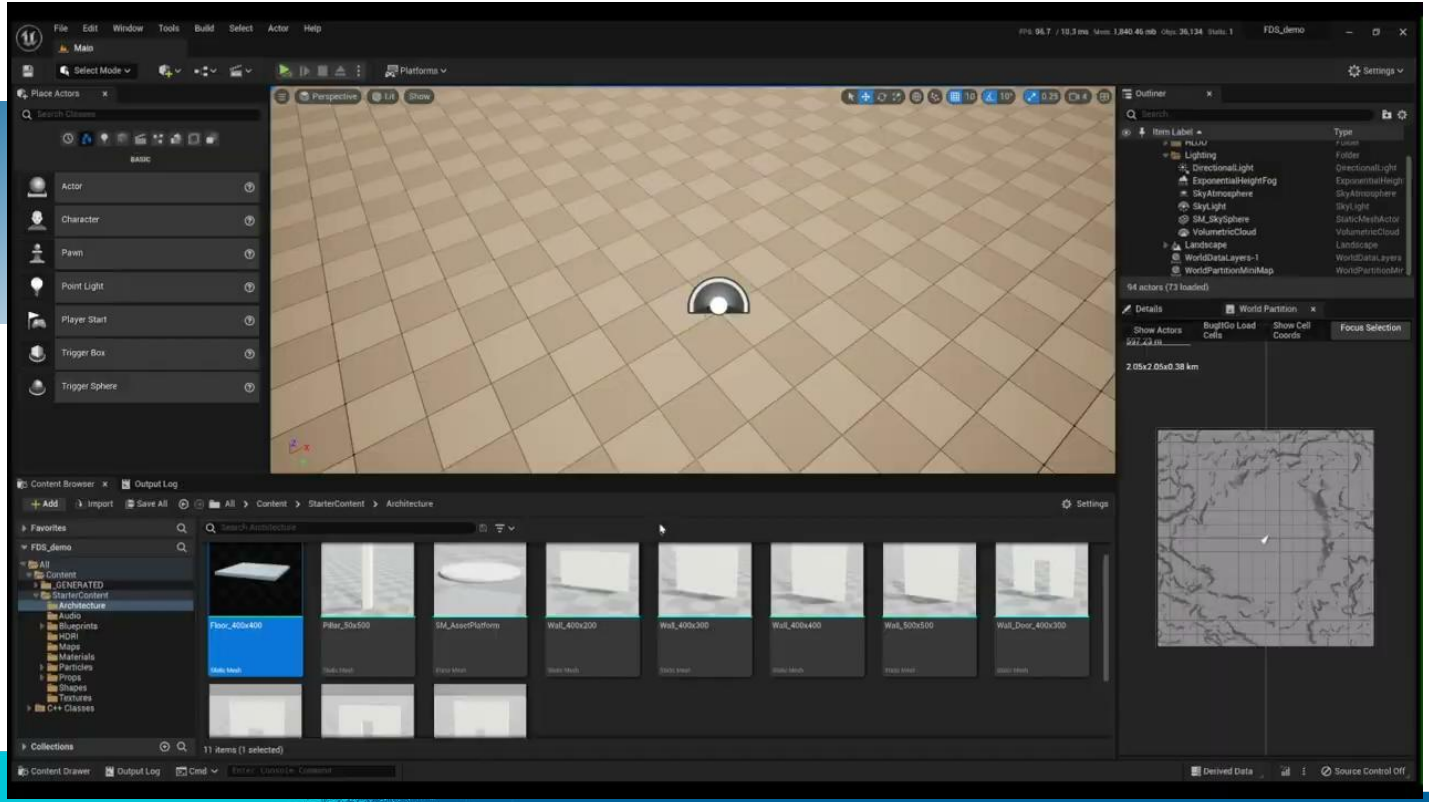
SDSC Summer Institute 2024

4.3a Conducting Scientific Data Visualization with VTK and Unreal Engine

Isaac Nealey

computer science and engineering @ UCSD

Data Visualization @ WIFIRE lab



The Fire Dynamics Simulator (FDS) is a computational model of fire-driven fluid flow. In this demonstration, an exchange format called glTF is used to transfer streamline geometry into Unreal Engine for real-time visualization (2023).

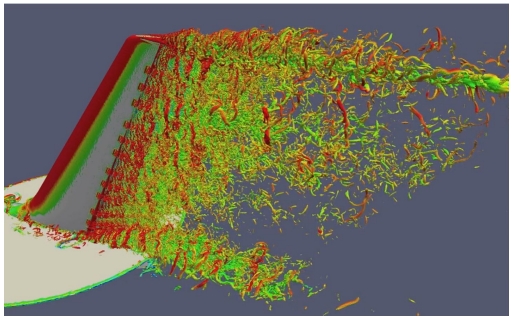
Immersive Forest, 2024

Immersive Forest (2023-present) serves as a geospatial sandbox for visualizing scientific data for wildland fire management purposes.

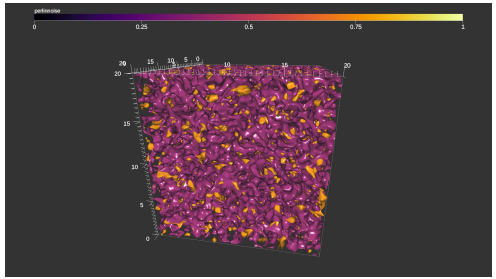
In this example, a collection of georeferenced LiDAR data is explored by a user's avatar

As big as it gets...

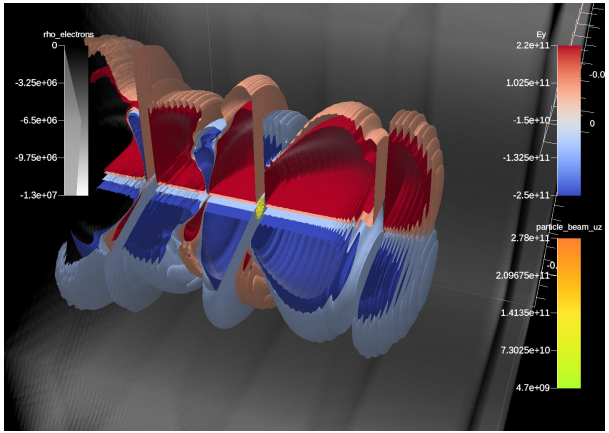
UC San Diego



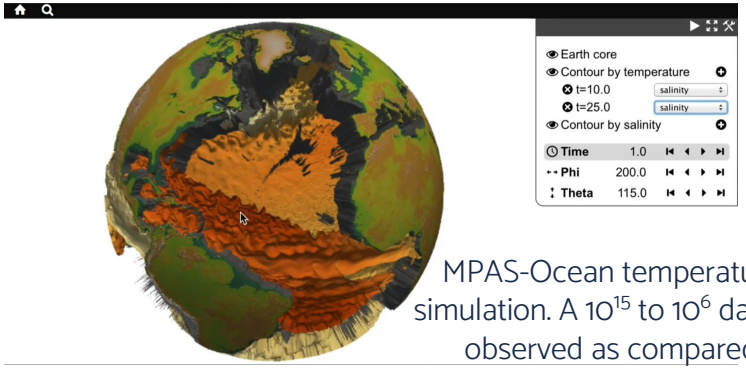
PHASTA + ParaView Catalyst:
In Situ CFD Analysis at 256K MPI processes on IBM Blue Jean



VTK-m rendering of 79.5 trillion cell synthetic data set using 74,088 GPUs on Frontier. This image was rendered in 0.3 seconds.

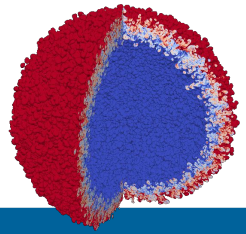


WarpX: modeling of advanced particle accelerators. A 4.6 billion element simulation ran across 4416 GPUs on 552 nodes on the Frontier supercomputer

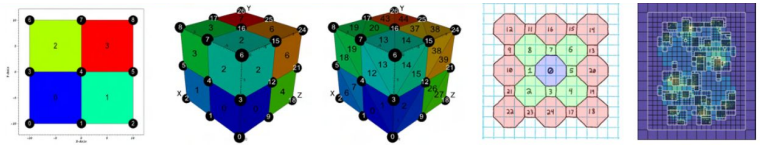


MPAS-Ocean temperature and salinity simulation. A 10^{15} to 10^{6} data reduction was observed as compared to *post hoc*

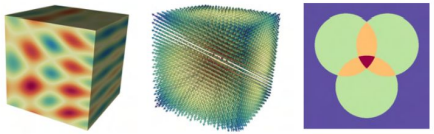
The 97.8 billion element simulation ran across 16,384 GPUs on 4,096 Sierra nodes at LLNL to guide development of sub-grid models to capture instability effects



The fundamental Task..

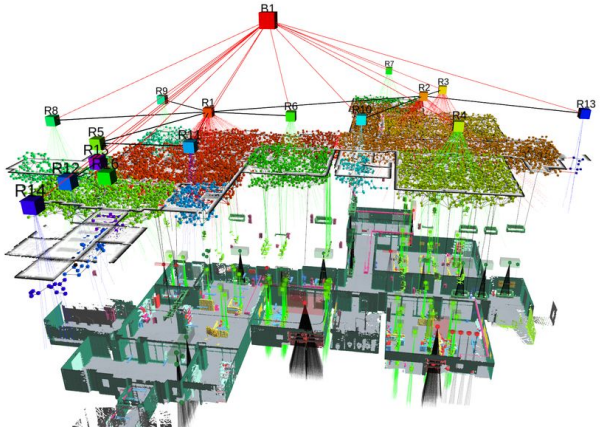


Topologies: 1D/2D/3D - Uniform, Rectilinear, Structured, Unstructured, Polygonal, Polyhedral, AMR



Fields: Scalar, Vector, Multi-material

Numerical simulation, Answering research questions



Representing the results in an interpretable manner

Paraview Tutorial

Tutorial:

https://docs.alcf.anl.gov/polaris/visualization/paraview-tutorial/

Dataset:

https://web.cels.anl.gov/projects/alcf_vis_internal/MISC/BLOODFLOW_TUTORIAL_DATA.tar.gz

Unreal Tutorial

Cesium Quickstart:
https://cesium.com/learn/unreal/unreal-quickstart/