ITER Workshop - AI and Visualizing large dataset
Princeton University Mader Hall Campus

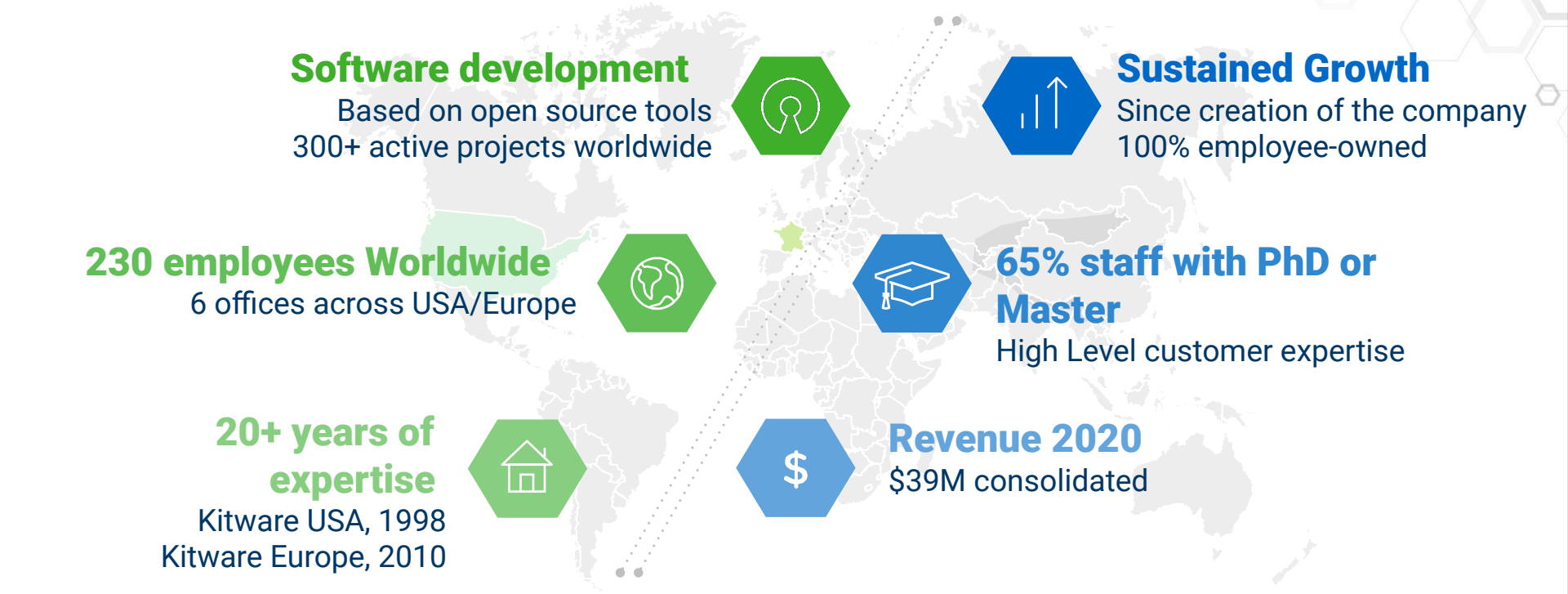
# **Build**, **Monitor** and **Run** a Digital Twin with ParaView

2024-06-12 - François Mazen

kitware

Contact : francois.mazen@kitware.com

# Kitware / Leader in AI & scientific open source solutions



## Software development

Based on open source tools
300+ active projects worldwide

## Sustained Growth

Since creation of the company
100% employee-owned

## 230 employees Worldwide

6 offices across USA/Europe

## 65% staff with PhD or Master

High Level customer expertise

## 20+ years of expertise

Kitware USA, 1998
Kitware Europe, 2010

## Revenue 2020

$39M consolidated

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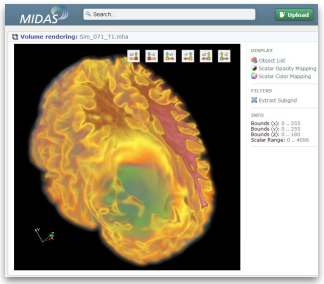
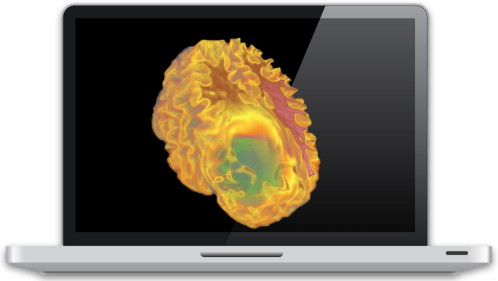
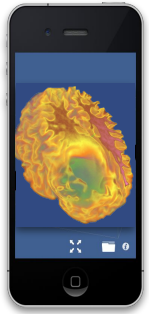
# Applications / Universal Platforms




Web



Desktop



Mobile

Cloud /HPC

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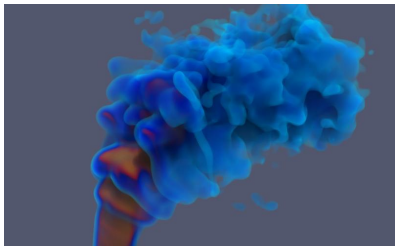
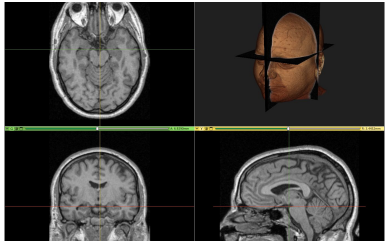
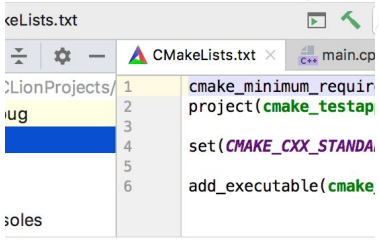
**Platforms**

3D Slicer
ParaView
KWIVER
mstk
VTK
Pulse Physiology Engine
CMake
Resonant
tomviz
ITK

# Areas of expertise / Built on open source








Computer Vision

Data and Analytics

Scientific Computing

Medical Computing

Software Solutions

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# Kitware / Services


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# Who Am I?

- François Mazen

- Director Scientific Visualization at Kitware Europe, France
- Career in Numerical Simulation (Ansys, Siemens PLM)

- Free Software Enthousiast
- Debian Developer and Maintainer

Ansys

SIEMENS

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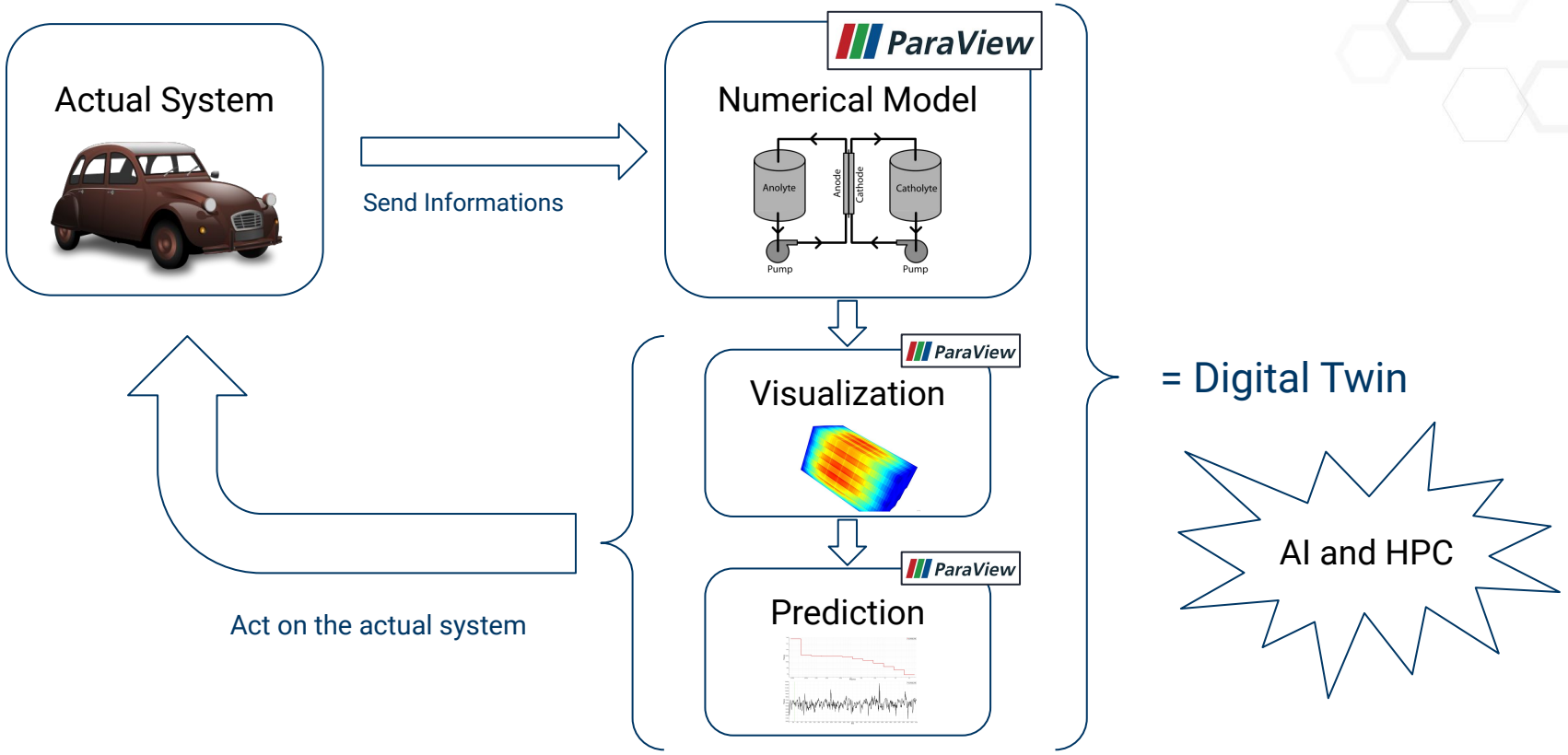
Actual System
Send Informations
ParaView
Numerical Model
Anolyte
Anode
Cathode
Catholyte
Pump
Pump
ParaView
Visualization
ParaView
Prediction
Act on the actual system
= Digital Twin
AI and HPC

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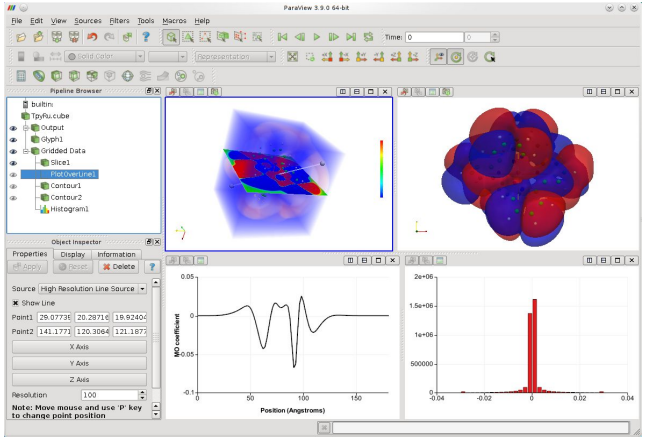
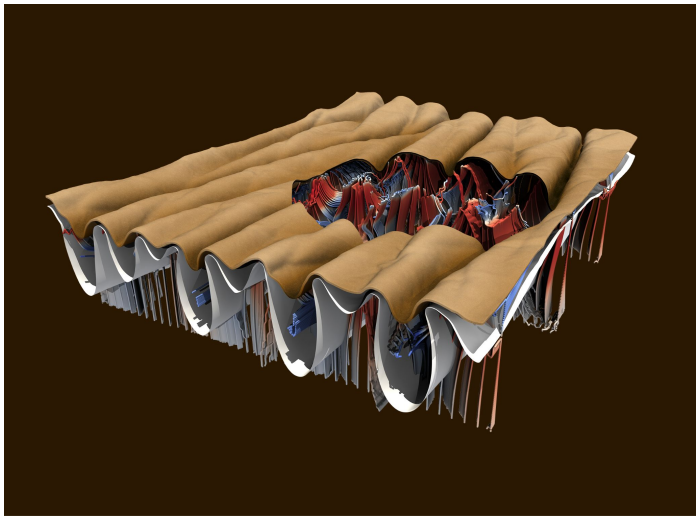
# ParaView / High-Performance Post-Processing (2002)

- **Open-source, multi-platform, data analysis and visualization application**
- **Analysis of extremely large datasets using distributed memory computing resources**



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# ParaView Community

- **Open Source Software (BSD license)**
- **Run on most of Top500 HPC**
- **300000+ download yearly from Kitware servers**
  - More users via other unknown download channel (Linux packaging, Enterprise distribution…)
- **157k commits made by 339 contributors since 2000**
- **1.6M lines of code**



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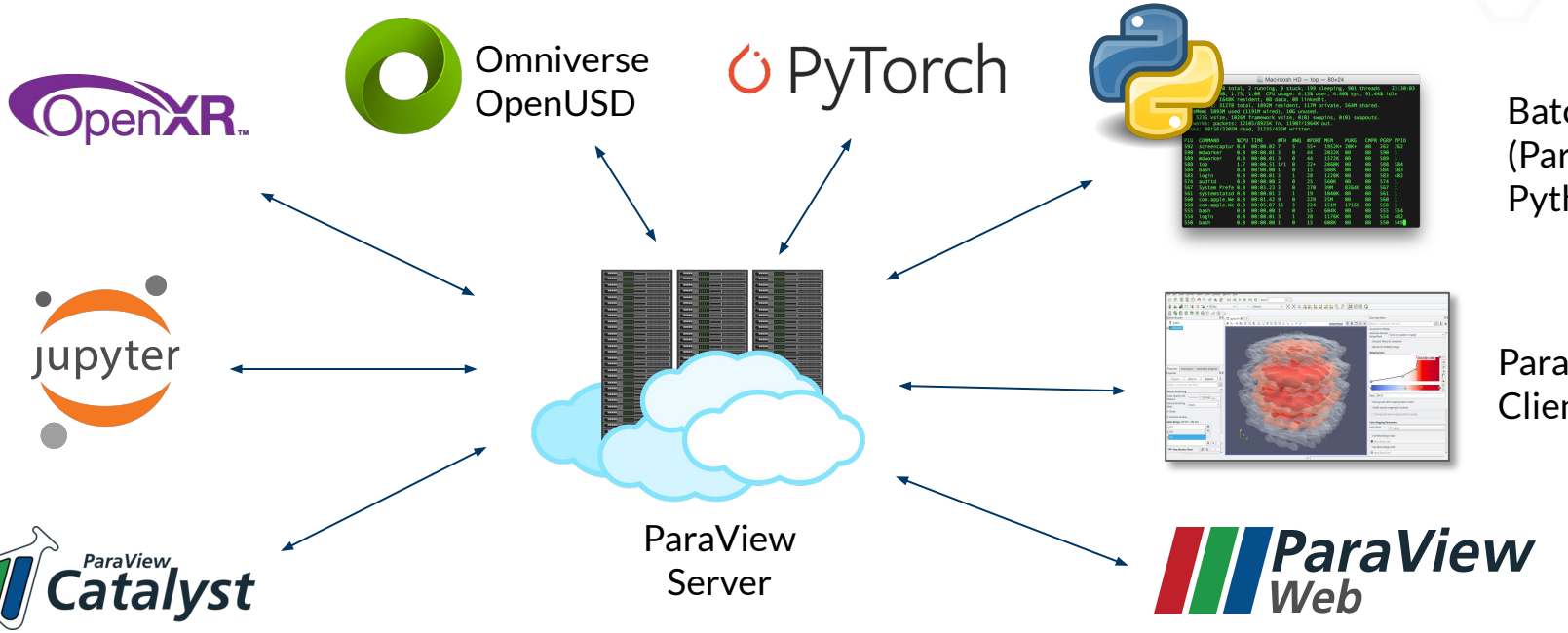
# ParaView Ecosystem



# ParaView / Nvidia

- **On-Demand rendering**
  - Omniverse ParaView Connector
- **3D Volumetric visualization**
  - ParaView plugin for Index
- **Ray-tracing**
  - OptiX integration with ParaView

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# ParaView / Intel

- **Distributed Rendering on CPUs**
  - The Open, Scalable, and Portable Ray Tracing Engine (OSPRay)
- **Code parallelization**
  - Threading Building Blocks (TBB)
- **Intel GPU support**

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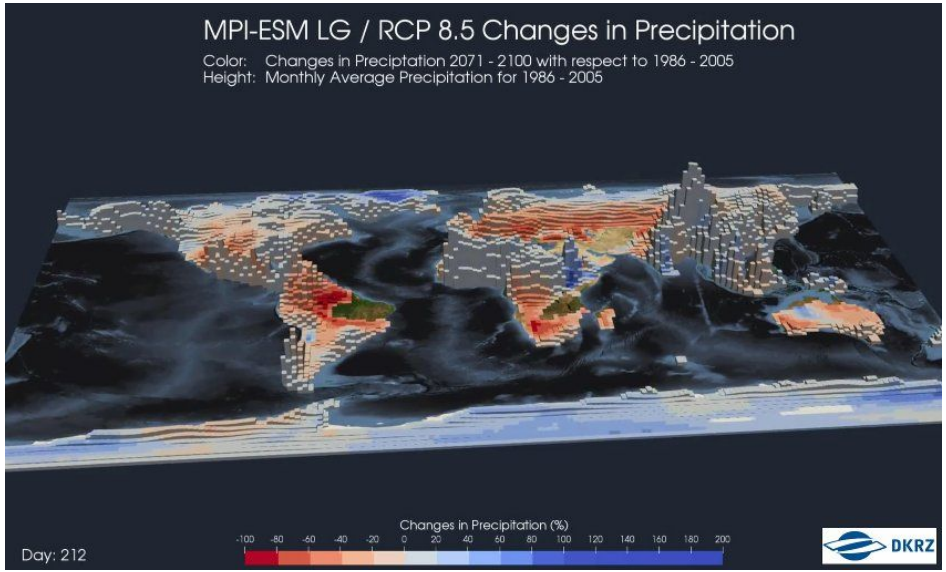
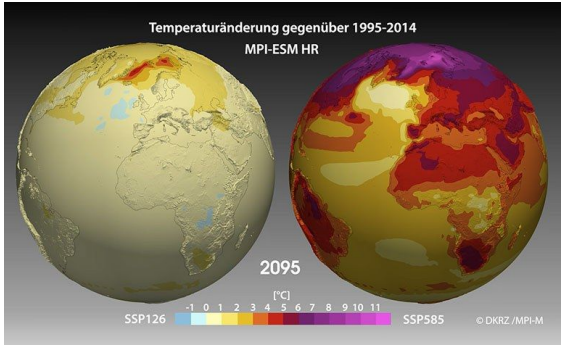
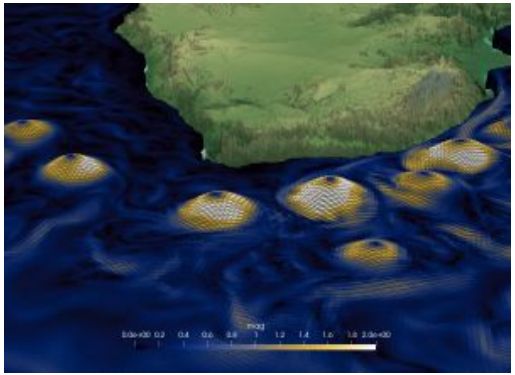
# ParaView Use Cases: Climate Simulation (DKRZ)




IPCC Report



https://www.dkrz.de/de/kommunikation/klimasimulationen

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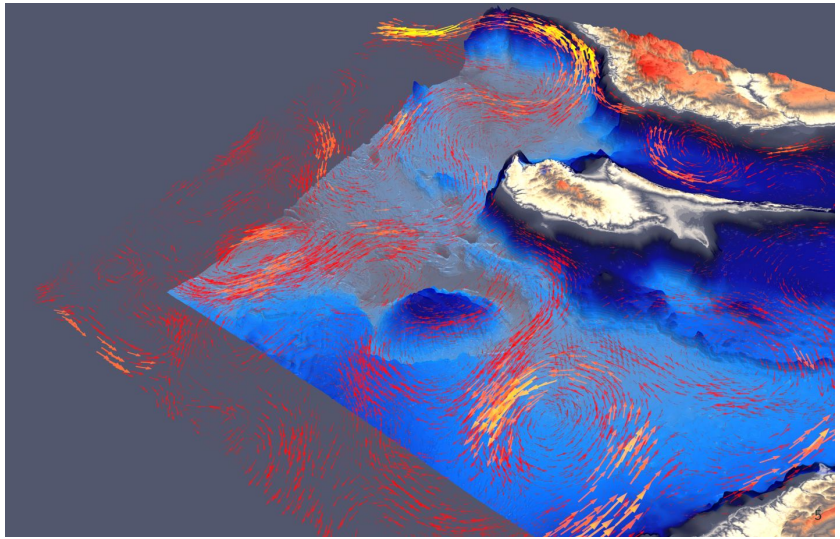
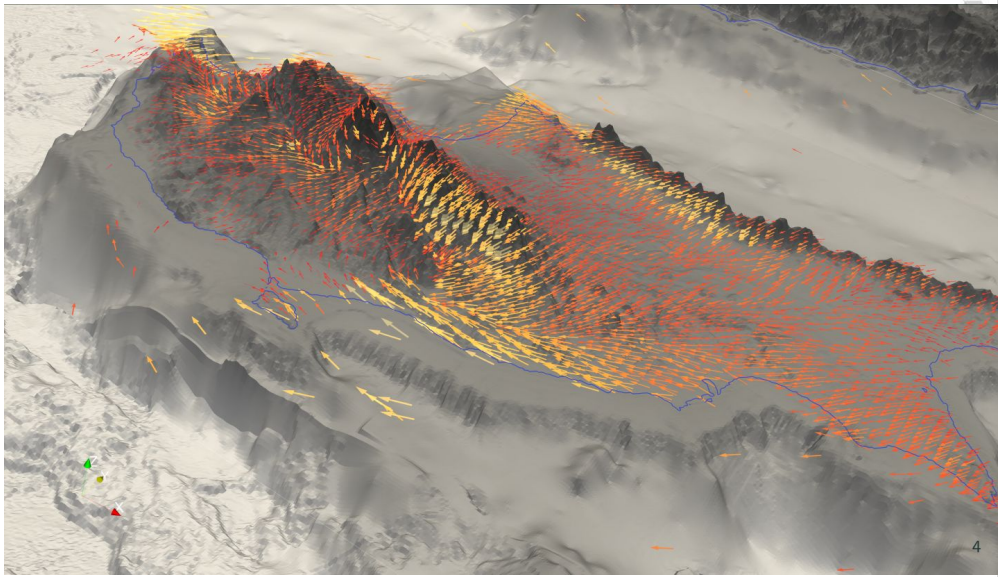
# ParaView Use Cases: Weather Forecast (The Cyprus Institute)





https://www.kitware.com/scientific-visualization-of-weather-research-and-forecasting-model-output-in-paraview/

Terrain following wind field

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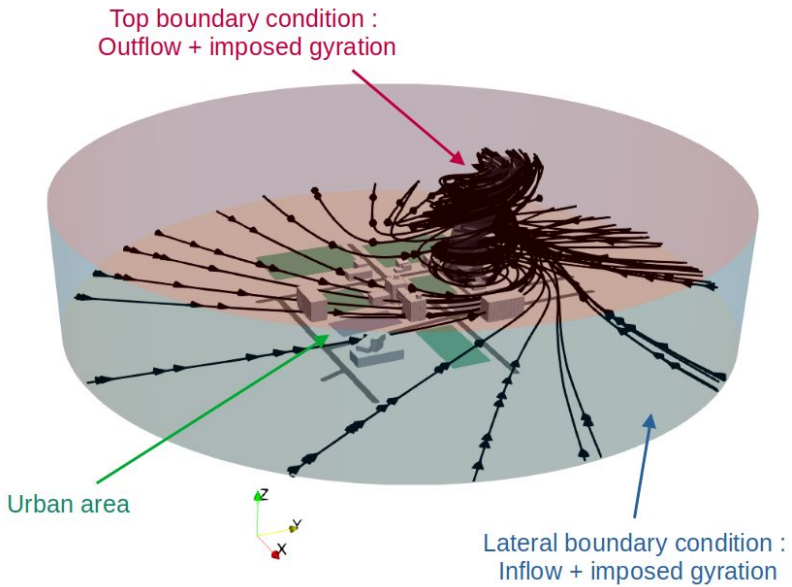
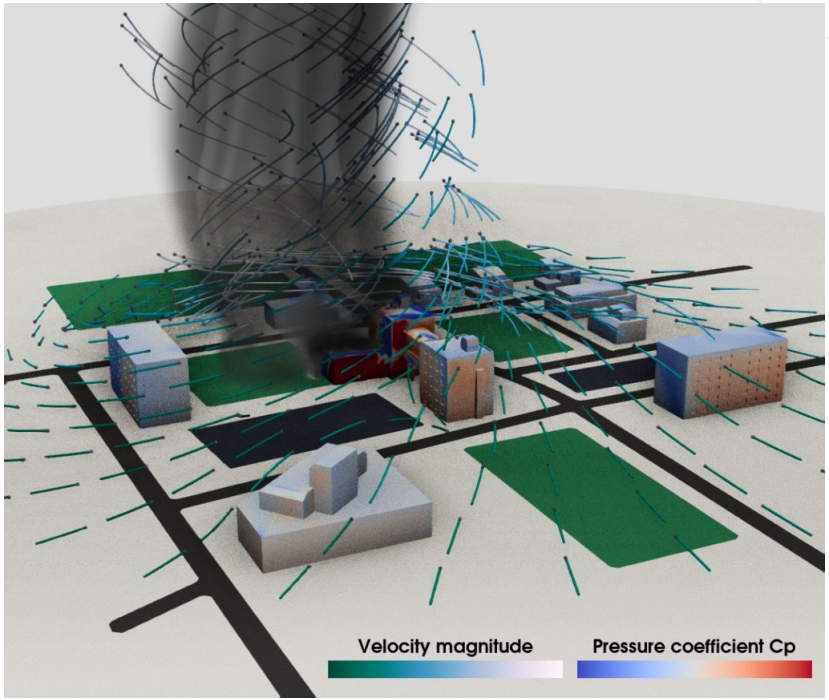
# ParaView Use Cases: impact of tornado wind on buildings (NemosFlow)

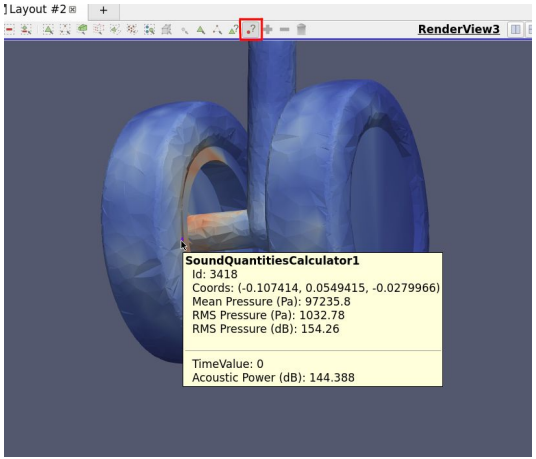


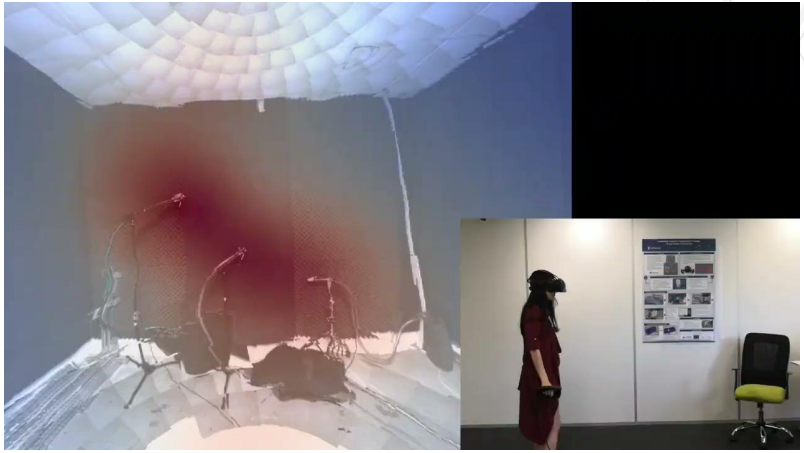




https://www.kitware.com/cfd-post-processing-with-paraview-a-practical-case-in-wind-engineering-impact-of-tornado-wind-on-buildings/

# CALM-AA: Tooling for Aeroacoustic Studies

convergence of digital simulation approaches and experimental tests during work on the reduction of aeroacoustic noise



Acoustic Data Visualization using VR in ParaView

https://www.kitware.com/explore-large-acoustic-data-with-the-digital-signal-processing-plugin-in-paraview/

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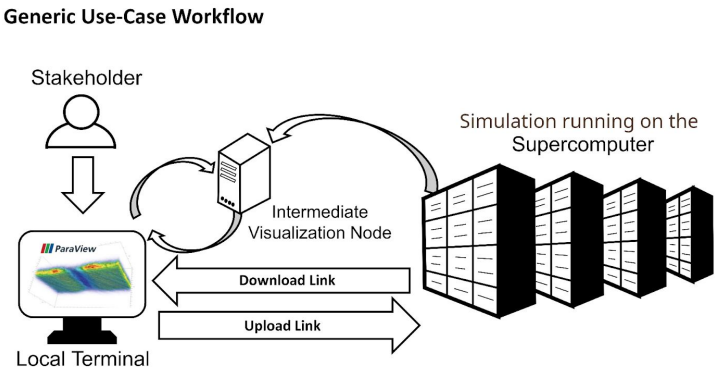
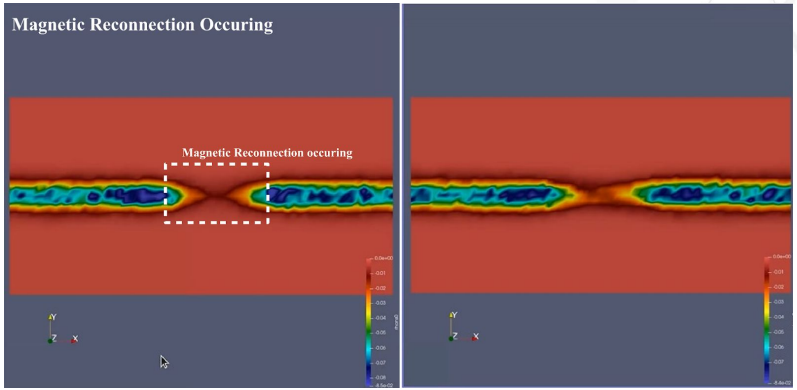
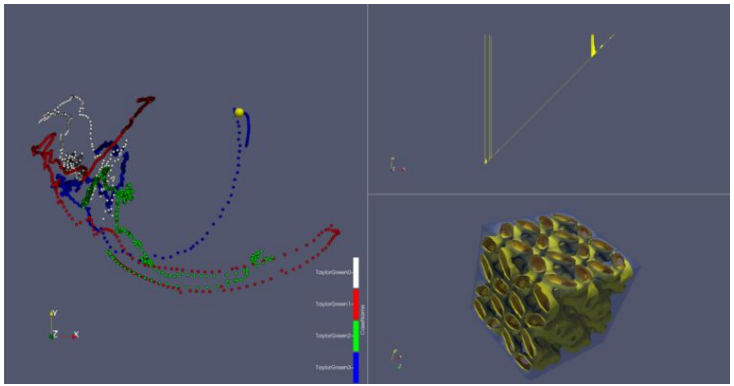
# VESTEC: Visual Exploration and Sampling Toolkit for Extreme Computing

Urgent decision making using ensemble simulation and *in-situ* analysis with ParaView Catalyst




space weather event using the iPIC3D simulator



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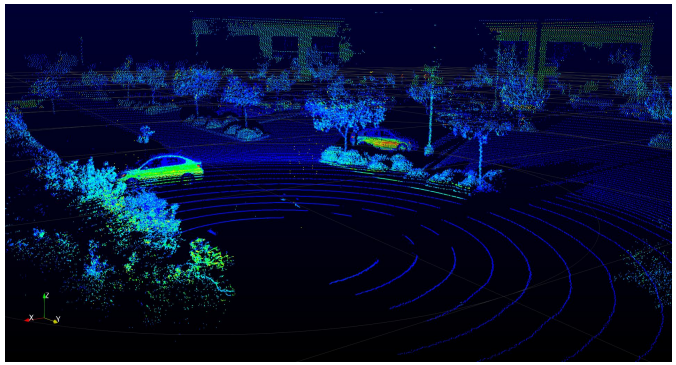
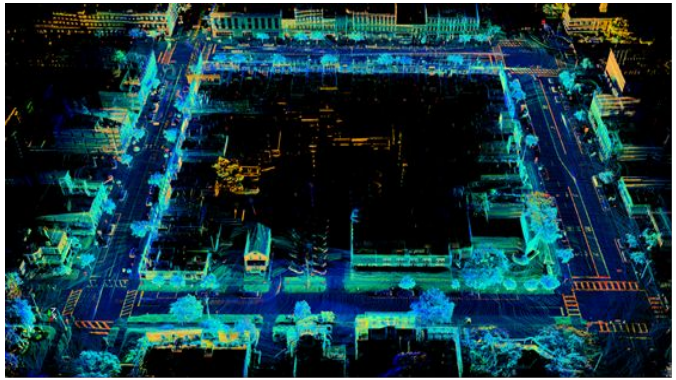
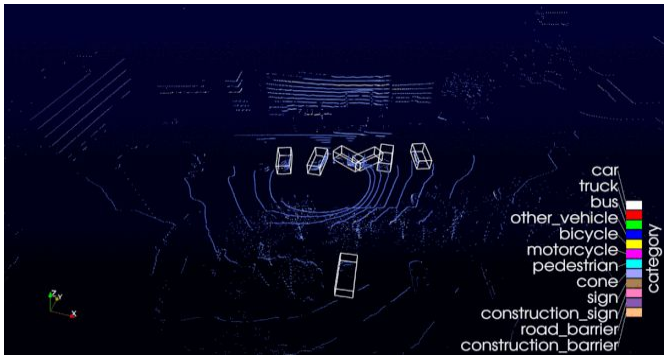
https://www.kitware.com/urgent-decision-making-using-ensemble-simulation-and-in-situ-analysis-with-paraview-catalyst/

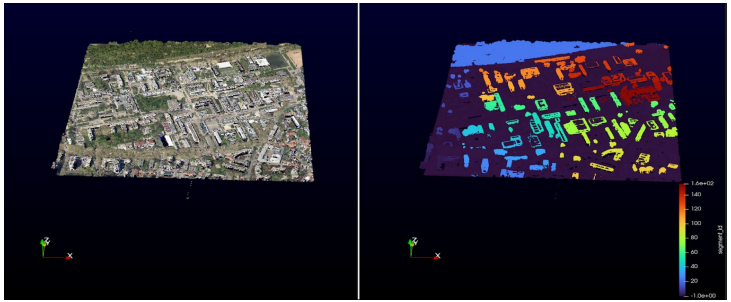
# LidarView A Visualization and Analytics Toolkit





## Deep Learning with Lidar Data



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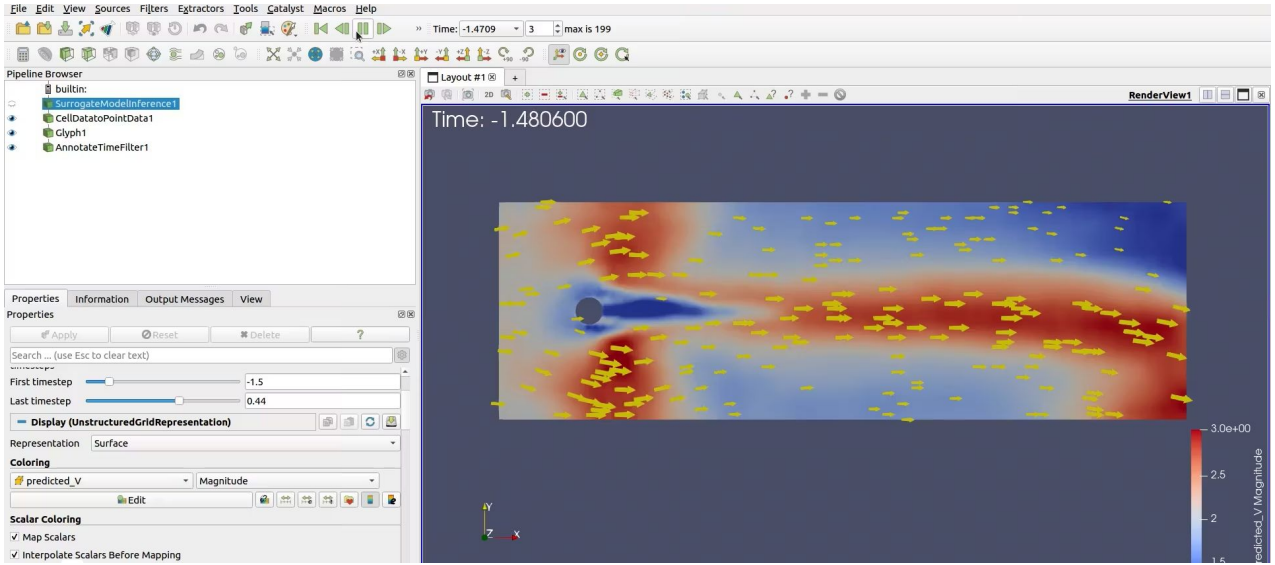
# AI + HPC = ParaView?

# Surrogate Model Inference in ParaView




https://player.vimeo.com/video/681359142?h=256ce5d59f&dnt=1&app_id=122963

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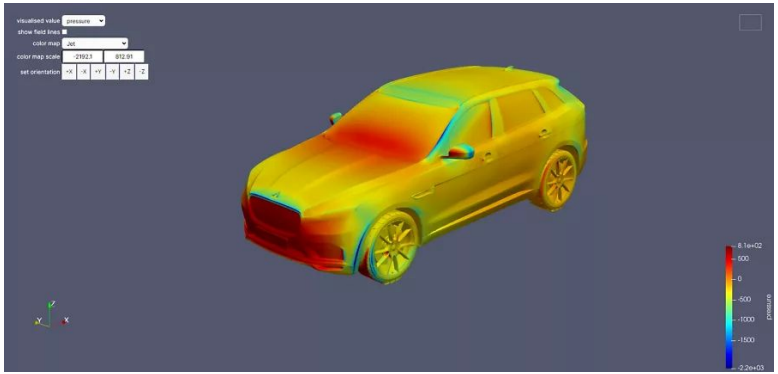
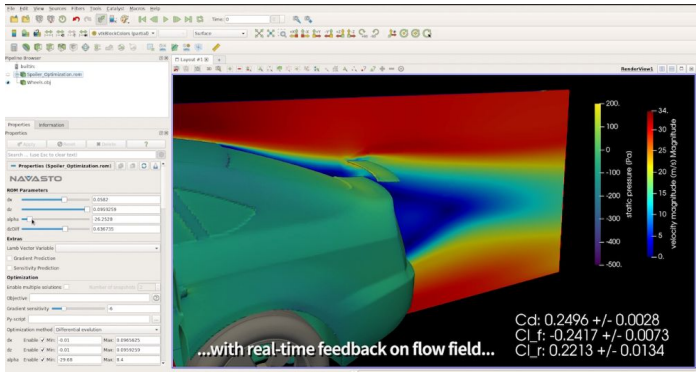
# AI in ParaView

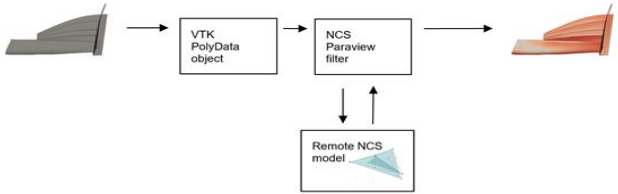
Ansys SIMAI




NAVASTO




NEURAL CONCEPT

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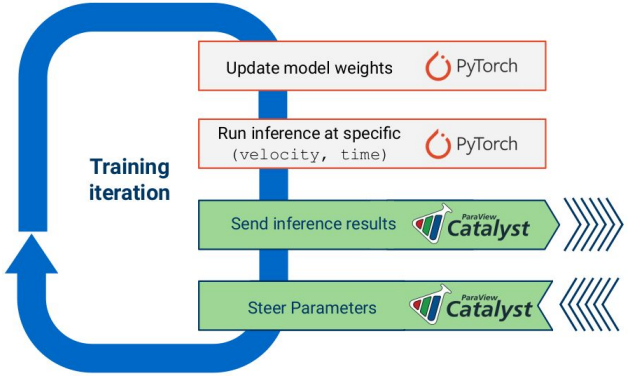
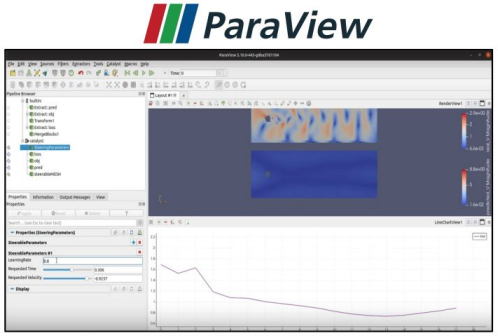
# Surrogate Model Training Monitoring with ParaView

- Live visualization
- Steering to interact with the training




Inference result and loss graph shown in real time

A. Ribes, F. Mazen, L. Meyer. In Situ Monitoring and Steering Deep Learning Training from Numerical Simulations in ParaView-Catalyst. Talk at In Situ Infrastructures for Enabling Extreme-Scale Analysis and Visualization (ISAV'22), November 13, 2022, Dallas, TX, USA.

F. Mazen, A. Schieb, A. Ribes, L. Meyer. Visualize, Monitor and Control the Training Process of a Deep Surrogate Model in ParaView. ISC HPC 2022 Project Poster Session. Hamburg, Germany. May-June 2022.

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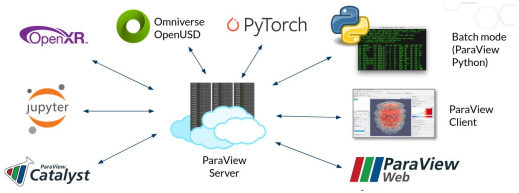
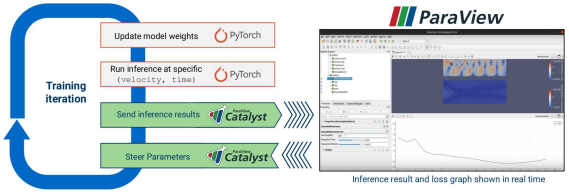
# Digital Twin / Scientific Visualization

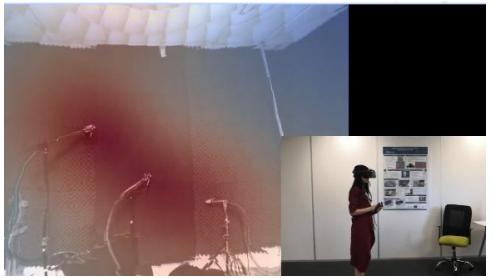
## Build




## Monitor




## Run



# ParaView

## Take Part in the ParaView User Day Europe!

### Lyon, France - September 26th, 2024

- Inspiring keynotes
- Lightning talks by users
- Kitware one-to-one hands-on sessions
- Demo space
- ParaView dinner (optional)

**Join the experience and present!**

We understand the value of your expertise, if you want to share with the community, we welcome you to submit a presentation title and summary to present during the event.

kitware cea TotalEnergies

**More Info:** https://www.kitware.eu/paraview-user-day-europe-2024/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