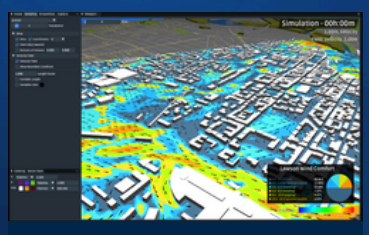
HiDALGO2 CENTRE OF EXCELLENCE

HPC & BIG DATA TECHNOLOGIES FOR GLOBAL CHALLENGES

VISION & MISSION

- HiDALGO2 envisions a future where Advanced Simulation, High-Performance Computing and Artificial Intelligence drive data-led innovation to address complex societal challenges
- HiDALGO2 is developing cutting-edge simulation tools and models as well as fostering collaboration to enable data-informed decision-making in real-time across diverse sectors like energy, urban planning and disaster preparedness.

USE CASES & PROGRESS



URBAN AIR PROJECT

HPC-computation of the air in the urban areas for air quality, wind comfort, and urban planning by 1 meter resolution. Open source (e.g. OpenStreetMap) and sensor data for inputs, web-based user interface for EuroHPC-execution and visualization.

- Scalable CFD solutions with OpenFOAM and RedSim on EuroHPC machines.
- Real-time digital twin for urban wind comfort and air quality.
- RedSim: HPC-code for CFD for compressible fluids on unstructured mesh, optimized for CPU (vectorized with AVX512 for x86_x64, blend masks, atomics) and native OpenMPI + CUDA.

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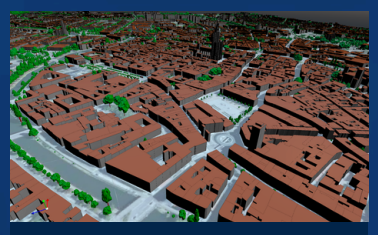

URBAN BUILDINGS

Ktirio Urban Building is an advanced HPC-based simulation code that models both energy performance and indoor air quality, enabling accurate evaluations of urban buildings' heat, CO_2, and NOx emissions.

- Modern C++ Code: Built on the Feel++ open-source platform for robust HPC simulations.
- Multi-Platform Deployment: Runs on EuroHPC systems, with automated benchmarking/deployment (feelpp.benchmarking and CI/CD).
- KtirioGUI: Data-preparation tool integrating OpenStreetMap, OpenMeteo, and others to generate high-fidelity urban meshes (including vegetation for solar shading).
- Data Management: Employs Girder and CKAN for centralized, updated, and shared data.
- Urban Energy Simulations: Provides city-wide energy analyses with automated, comprehensive web-based reporting.

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RENEWABLE ENERGY SOURCES

RES is a HPC-based simulation code that forecasts energy production from renewable sources such as wind farms and solar panels. The solutions are accustomed to urban and rural areas.

- Based on MPI Fortran WRF and EULAG models
- AI-driven energy production forecast
- Uncertainty quantification and sensitivity analysis with mUQSA toolkit
- Using orchestration portal with the HPC environment to facilitate simulation setup and job execution.

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WILDFIRES

HPC high-resolution simulation of wildfire atmosphere interactions and smoke dispersion in forest and urban areas. Immersive 3D visualization with Unreal Engine visualizer.

- Two different scenarios for fire spread and smoke dispersion: Wildfires and Wildland-Urban Interface.
- Wildfires simulation with WRF-Sfire deployed in multiple JU-HPC machines.
- Special attention is paid to the interactions between the atmosphere and the wildfire: wind, energy, water vapor and smoke.
- Wildland-Urban simulation with OpenFOAM and fireFOAM on JU-HPC machines.
- Vegetation representation at different scales to suit simulation requirements.

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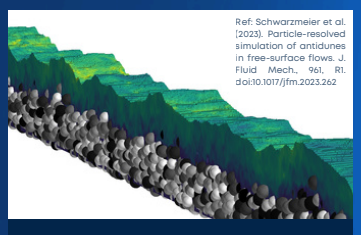

MATERIAL TRANSPORT IN WATER

The scalar transport simulations provide insights into temperature distribution in particle-laden flows in the study of aquatic ecosystems and large river bodies.

- Our in-house CFD solver employs the lattice Boltzmann method for highly scalable fluid-solid-particle interaction processes on off-HPC clusters, with support for GPU architectures.
- Additionally, we utilize existing datasets from various sources to model and improve predictions of flow dynamics and material transport in water.

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FURTHER TOOLS

- MathSO and QCG, workflow orchestrator engines which manage the execution of jobs within the EuroHPC systems
- Visualization tools like VISTLE-COVISE which allows for interactive and immersive visualization environments for collective analysis of simulation results and UEAV for the compilation of photorealistic VR experiences
- mUQSA, a Web-based platform developed to support Uncertainty Quantification and Sensitivity Analysis of computational models

Scan for more

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EuroHPC Joint Undertaking

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