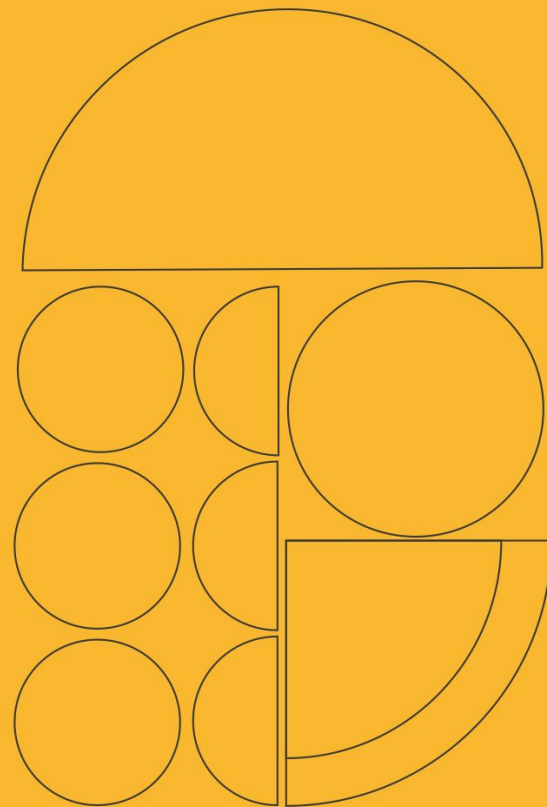


FALL3D status

ChEESE WP2 meeting - 28 March 2023

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General description

Contacts:

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- Technical contact: L. Mingari (provisional)

Summary:

FALL3D is an open-source off-line Eulerian model for atmospheric passive transport and deposition of multiple atmospheric species, including volcanic ash and volcanic gases, mineral dust, and radionuclides. FALL3D code is available through public GitLab repositories and Zenodo (DOI: 10.5281/zenodo.6343786)

Features:

- MPI/OpenACC in Fortran 2008
- Ensemble runs using a hierarchy of MPI communicators
- Parallel I/O in NetCDF-4
- Level 2 code: able to perform full capability runs or capacity workloads on current petascale machines and good scalability (>90% efficiency) in about 100 nodes

Repositories:

- Main code: <https://gitlab.com/fall3d-suite/fall3d>
- GPU code: <https://gitlab.com/fall3d-suite/fall3d-gpu>
- Mini-app: Repository available soon at <https://gitlab.com/fall3d-suite>
- Documentation: <https://fall3d-suite.gitlab.io/fall3d/>
- Zenodo: <https://doi.org/10.5281/zenodo.6343786>



Current FALL3D Performance

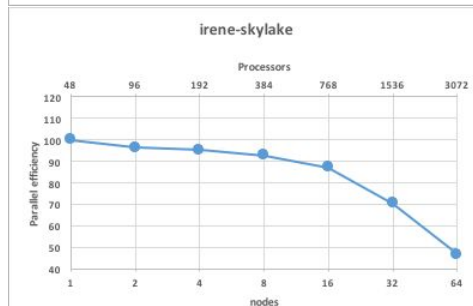
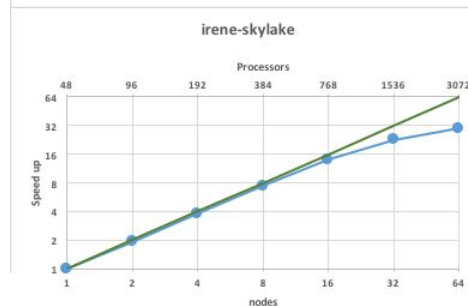
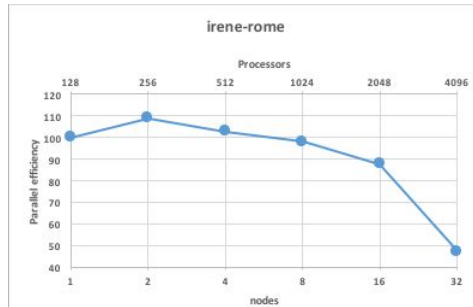
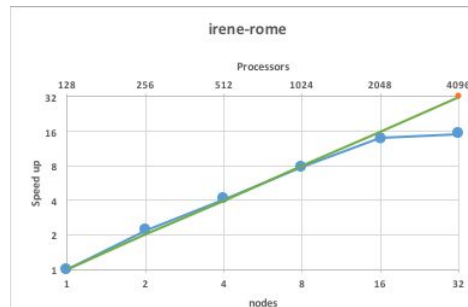
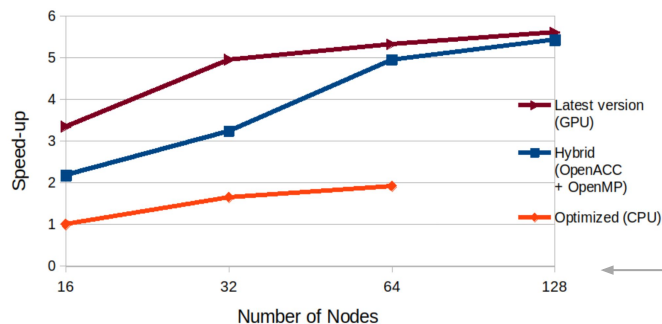
CPU version tests:

- Strong scalability (time to solution) analysis on irene-rome and irene-skylake partitions
- Parallel efficiencies are substantially better at irene-rome, with >90% up to 2048 processors (16 nodes)
- At the irene-skylake partition, parallel efficiencies already drop to ~70% with only 1036 processors (32 nodes)

GPU version tests:

- FALL3D performance and scalability was evaluated on Marconi100 @Cineca
- Totally ported and optimized the main kernel
- Regular scaling: should be improved

FALL3D Performance Results



CPU strong scalability analysis (time to solution). Top: speed-up and parallel efficiency at irene-rome (128 AMD processors per node). Bottom: same for irene-skylake (48 skylake processors per node).

GPU strong scaling comparison amongst three different versions of full FALL3D. Executed on two different platforms MN4@BSC and M100@Cineca

Code Releases and Mini-apps

CPU code:

- Latest: version 8.2.1 (<https://gitlab.com/fall3d-suite/fall3d>)
- MPI
- Mini-app: available (in the repository <https://gitlab.com/fall3d-suite> soon)
- Quality assessment and awarding: This software has received a **gold badge** according to the Software Quality Baseline criteria defined by the EOSC-Synergy project

GPU code:

- Latest: version 8.2.0 (<https://gitlab.com/fall3d-suite/fall3d-gpu>)
- MPI+OpenACC
- Mini-app: available (in the repository <https://gitlab.com/fall3d-suite> soon)
- Quality assessment: to be done soon



Future work

WP2 & WP3:

- Code audit with GPU version
- Improve GPU scalability
- Co-design with mini-app
- Intra-node communication efficiency
- Overall parallel IO efficiency
- CI/CD selected Euro HPC systems

WP5:

- Implement a mass-consistent meteorological downscaling
- Nested domains for multiscale simulations
- Containerization using Docker/udocker/Singularity
- Workflow manager and orchestrator (WIP)
- FALL3D will be used in two Simulation Cases and a Pilot Demonstrator:
 - SC5.1: The European tephra hazard map at a resolution of less than 10 km for European scale and 2 km at regional scale
 - SC5.2: Volcanic gas dispersal at local scale: a reanalysis of the 2021 La Palma case at 1-2 km resolution making use of different observations available for tuning and verifying the model performance
 - PD5: Ensemble-based volcanic dispersal at multiple scales

