

# RESCUER TRAINING PROGRAMME

## WORKSHOP 4

### Code development tools & high performance computing

#### General Information

Dates : 19<sup>th</sup> and 20<sup>th</sup> November 2025.

Format : online (link for participation : see calendar invitation).

#### Lecturers

- **Dr. Kyle MANDLI** – NSF National Center for Atmospheric Research, NSF-NCAR (USA).

Topic : high performance computing, architectures, programming, modeling.

- **Prof. Mario MORALES HERNANDEZ** – Associate Professor of Fluid Mechanics at the University of Zaragoza (Spain).

Topic : collaborative Software Development for PhD Students

#### Schedule

**Day 1** – Wednesday 19<sup>th</sup> of November 2025

**\*\*09:00 – 12:00\*\*** Session 1 - Prof. Mario Morales

**\*\*14:00 – 17:00\*\*** Session 2 - Dr. Kyle Mandli

**Day 2** – Thursday 20<sup>th</sup> of November 2025

**\*\*09:00 – 12:00\*\*** Session 1 - Prof. Mario Morales

**\*\*14:00 – 17:00\*\*** Session 2 - Dr. Kyle Mandli

## Outline of the lectures

### *Collaborative Software Development for PhD Students – Prof. Mario MORALES*

A one-day, hands-on workshop for PhD students that teaches practical, team-friendly workflows for research code. Through short demos and paired exercises, participants will practice using git and other common tools to collaborate safely, improve code quality, and adopt reproducible habits they can apply in their projects.

#### Lecture outline :

- What we will cover (high-level)
- Quick setup and tool checks (including git and an editor)
- Core version-control concepts with git (branches, remotes, simple workflows)
- Collaborative change proposals and review practices (PRs and feedback)
- Principles for resolving conflicts and recovering from common mistakes
- Lightweight documentation habits for research code and reproducibility
- Basic testing practices and how to make tests useful for research work
- Simple automation to catch issues early (pre-commit / CI concepts)
- Hands-on, paired exercises to practice collaboration skills on a small project
- Guidance for common lab scenarios and practical troubleshooting

### *High performance computing, architectures, programming, modeling – Dr. Kyle MANDLI*

A one-day, hands-on workshop for PhD students to learn about computer architecture in the context of computational science and engineering.

Git repository : [https://github.com/mandli/RESCUER\\_workshop](https://github.com/mandli/RESCUER_workshop).

#### Lecture outline:

- Introduce/review concepts from HPC related architectures and modeling
  - o Basic operations: FLOPs, memory access, computational intensity
  - o Memory: layout, types of memory, buses, caches
  - o Classification: Flynn's taxonomy, Moore's law, Amdahl's law
  - o Threads vs. Processes
  - o Task vs. Data parallelism
  - o Partitioning and load balancing
  - o Scalability
  - o Machine architecture
  - o Models of machine architecture and bottlenecks -> especially new joined architectures
- Programming models
  - o Memory access
  - o Streams
  - o Optimization of memory access
  - o Asynchronous communication
  - o Memory management
  - o GPU models
  - o Basics of GPU task parallelism.