ADAPTEX

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MOTIVATION

Current resolution limit for global large scale simulations are around $1 - 5$ km. Doubling the resolution results in a deterioration in runtime, memory, and disk space by a factor of 8-16.
The goals are:

- Increase the scalability of current and future CFD applications
- Improve the modeled spatial resolution and the accuracy, and increase the resource efficiency

ADAPTIVE MESH REFINEMENT

To increase the scalability of current and future CFD frameworks, we build an open source software framework for exascale-capable flow.
We use adaptive mesh refinement (AMR) which leads to the following benefits:

- Increase resolution only where required
- Dynamically change mesh with time
- Reduces required DOFs significantly
- Allows higher resolution with same or reduced runtime

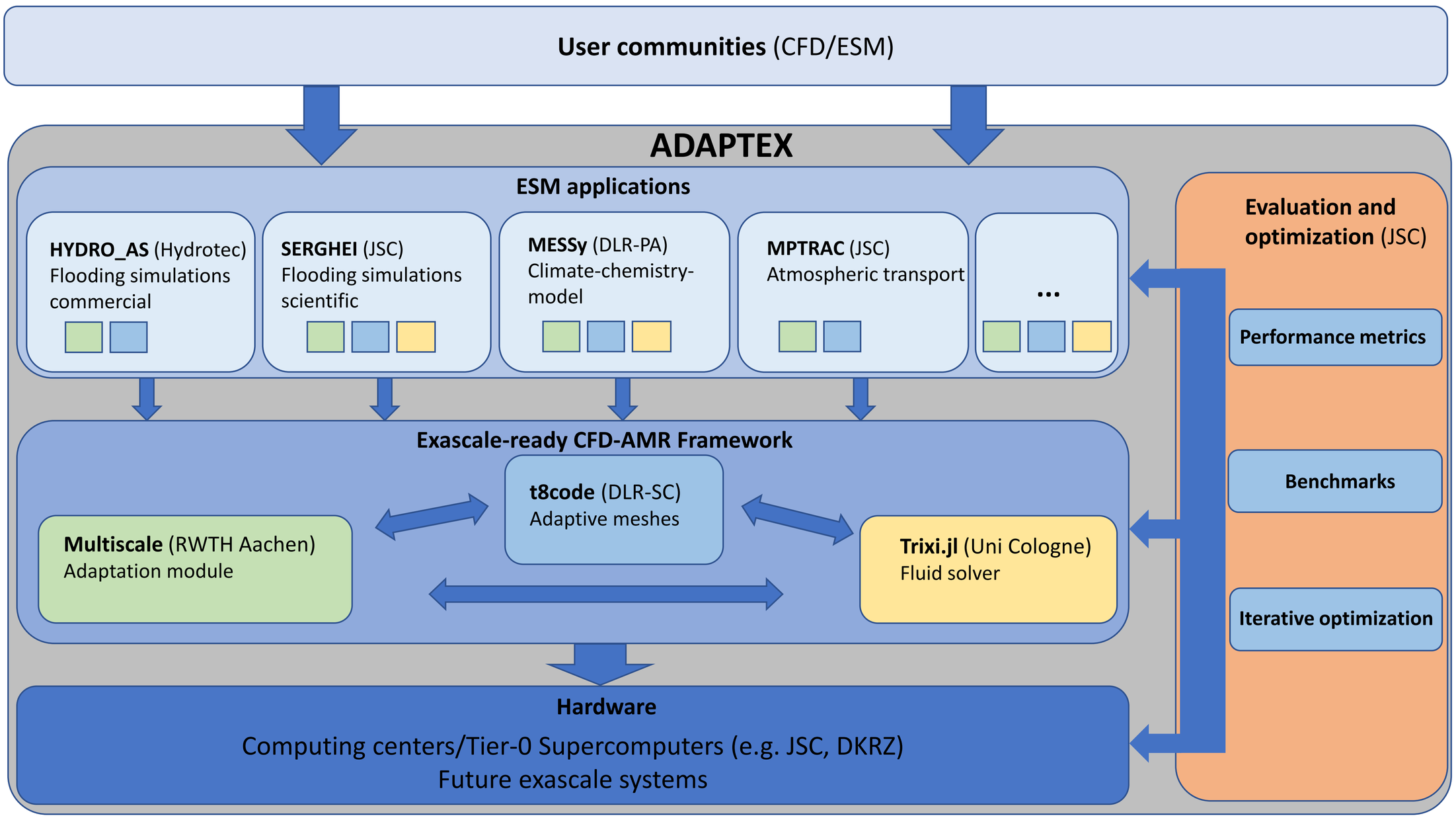

Figure: Software components and their dependencies, and connection to data centers and user communities. The dots symbolize the possibility to further integrate applications.

EXASCALE-READY CFD-AMR FRAMEWORK

- Individually specialized HPC software libraries are merged:
  - Discontinuous Galerkin solver framework (Trixi.jl)
  - Adaptive mesh refinement software (t8code)
  - Multiresolution-based grid adaptation method (Multiwave)
- Software libraries are expanded to heterogeneous computer architectures of the exascale performance class.

ESM APPLICATIONS

The developed technologies will be implemented directly

- in a commercial flood simulation code (HYDRO-AS),
- a shallow water simulation tool for overland flow (SERGHEI-SWE),
- in global climate-chemistry simulations (MESSy), and
- atmospheric Lagrangian transport simulations (MPTRAC).

CHALLENGES

- Coupling of Trixi.jl, t8code and the adaptation module
- Proper interface design
- C, C++, Fortran, Julia
- Extension of multiscale methods and Trixi.jl to prisms
- AMR and GPUs

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Scalable Adaptive Mesh Refinement