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Adaptive volcanic modeling using Discontinuous Galerkin Methods

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Advances in num. modelling of volcanic hazards
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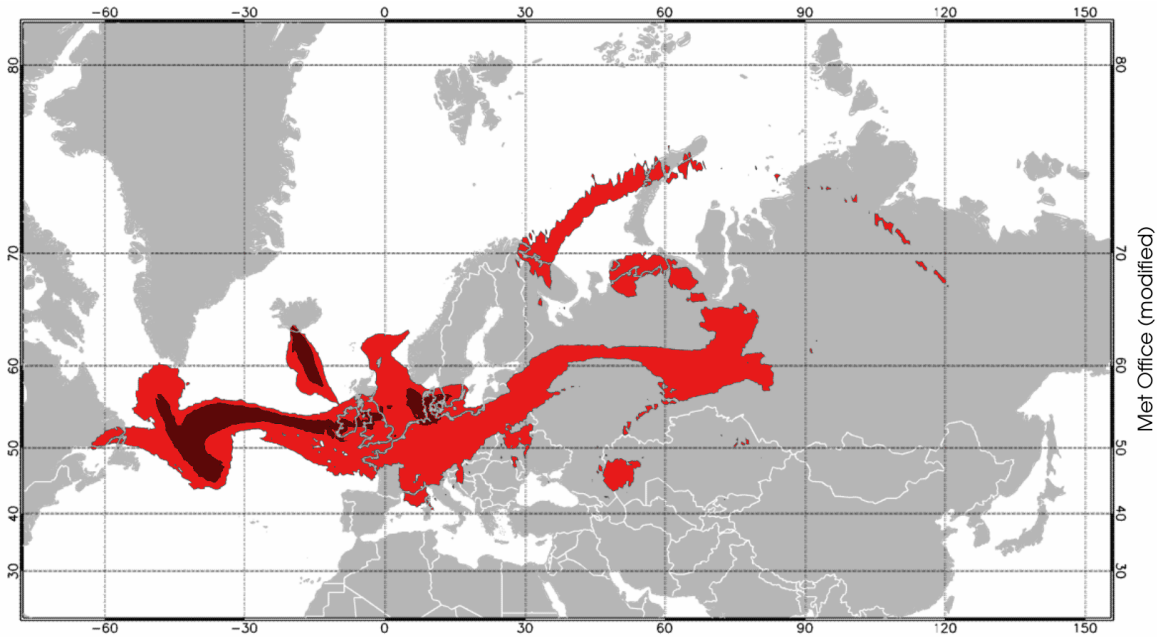
Motivation

Eyjafjallajökull eruption 2010

Predicted ash cloud over the northern hemisphere

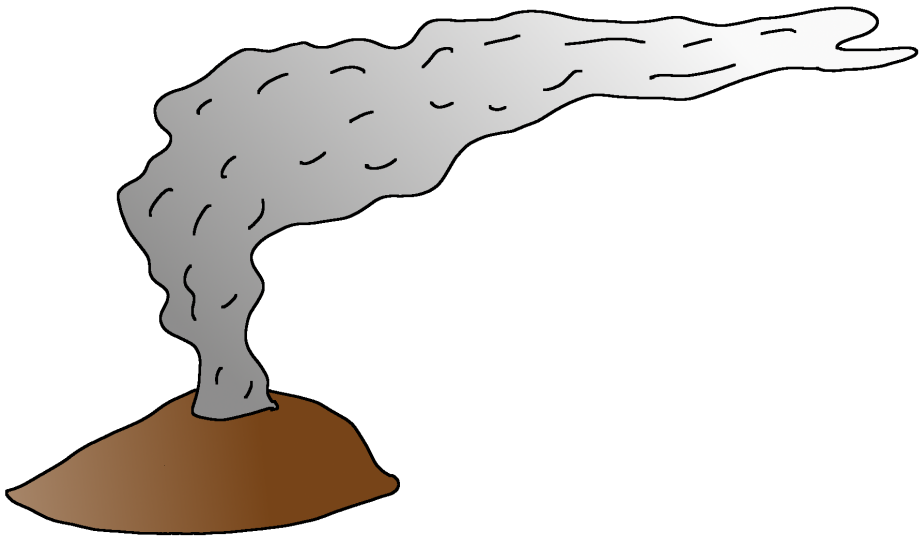
April 20th, 00:00 UTC



Motivation

Volcanic plume

Mass flux $\propto$ height$^{1/4}$



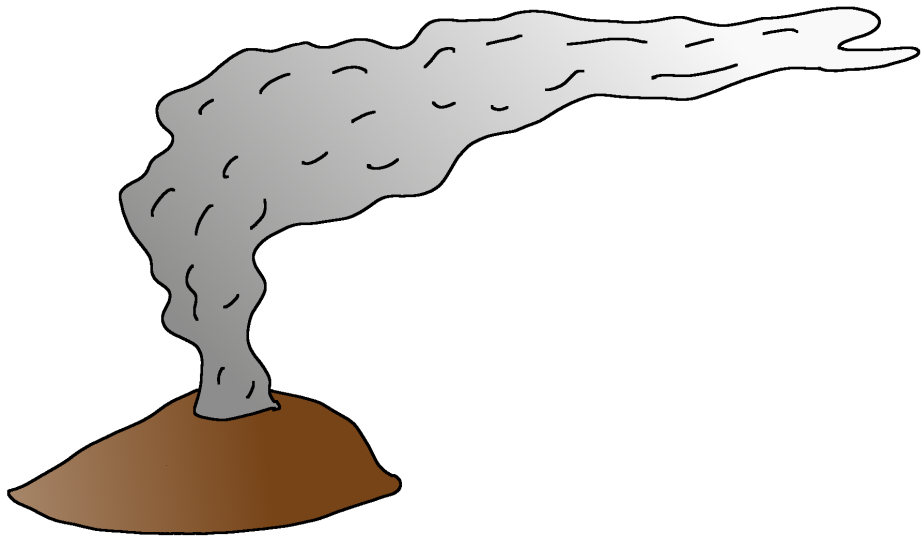
Motivation

Volcanic plume

Mass flux $\propto$ height$^{1/4}$

Issues for plume models:

- resolution
- shock modeling



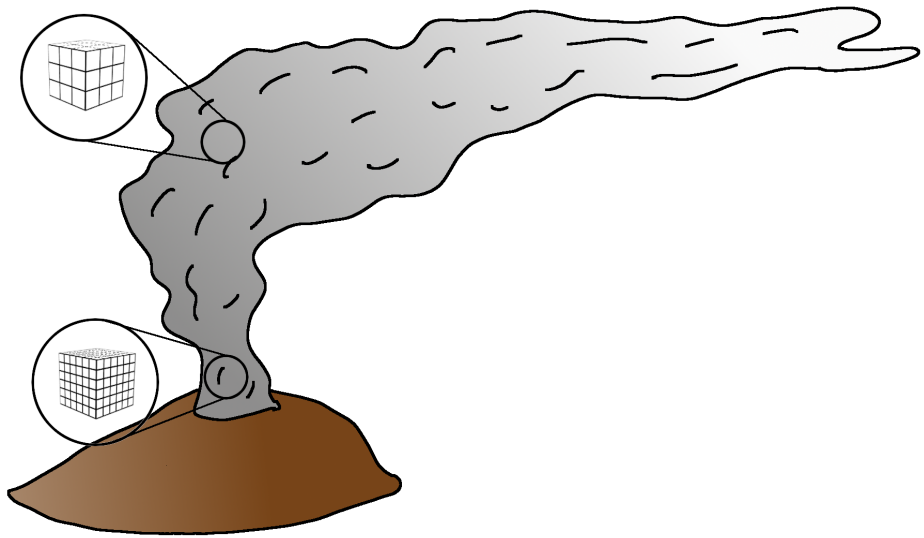
Motivation

Volcanic plume

Mass flux $\propto$ height$^{1/4}$

Issues for plume models:

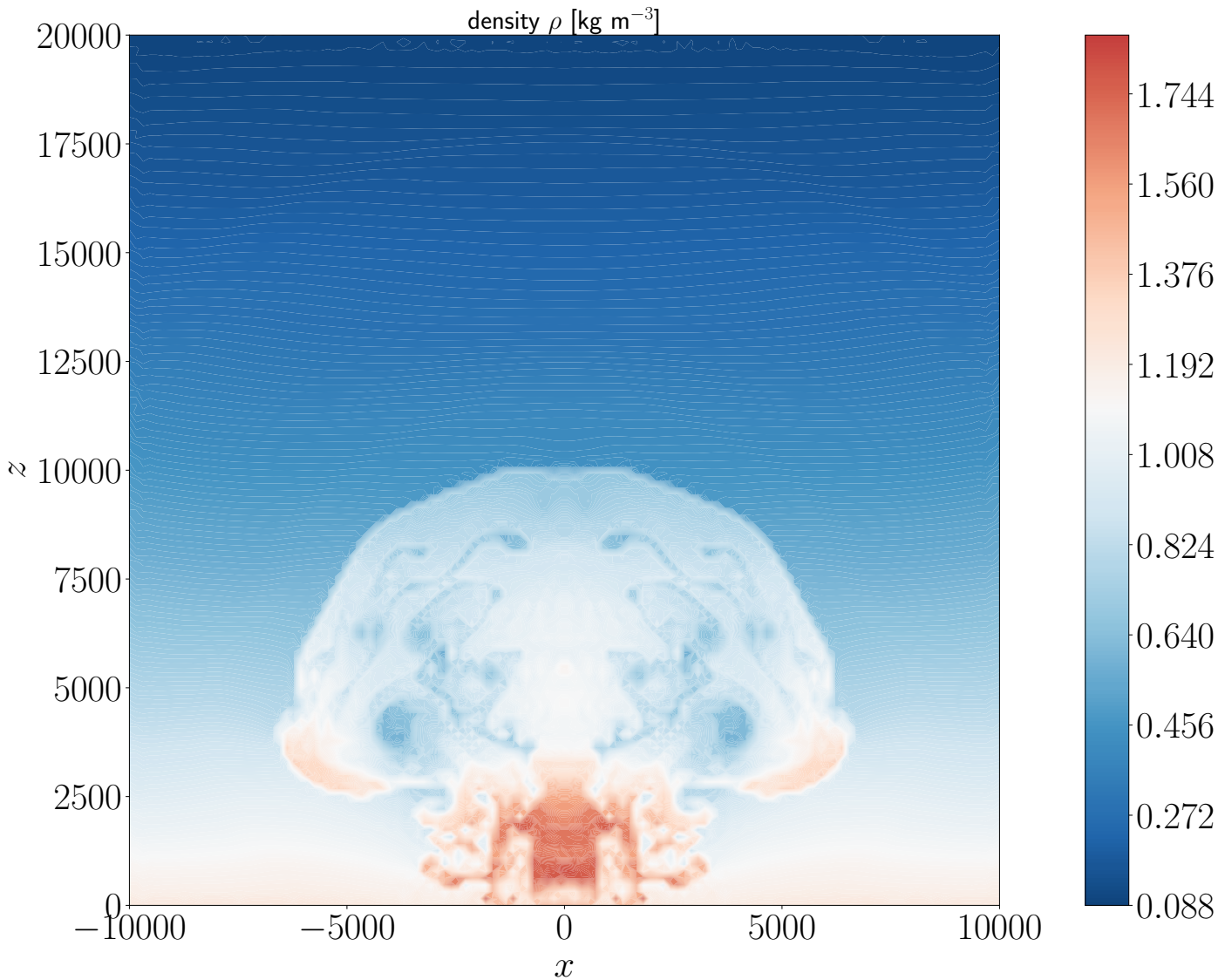
- resolution
  $\rightarrow$ **A**daptive **M**esh **R**efinement
- shock modeling
  $\rightarrow$ correct numerics



Checklist

- Gas dynamics: Euler equations
- Numerical method: Discontinuous Galerkin Method
- Include ash phase
- AMR

Current results



Questions?

Appendix: DGM - Discontinuous Galerkin Method

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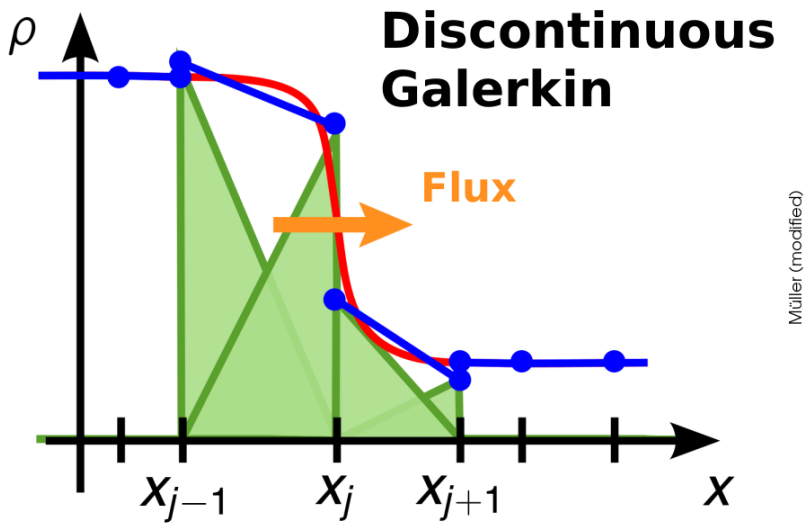
Quick outline:

- start with a weak formulation (Galerkin Method)
- use (piecewise continuous) polynomials as test functions
- coupling with neighboring elements through flux



Results regarding stabilization for the Euler equations has been submitted.

Appendix: Adaptive Mesh Refinement

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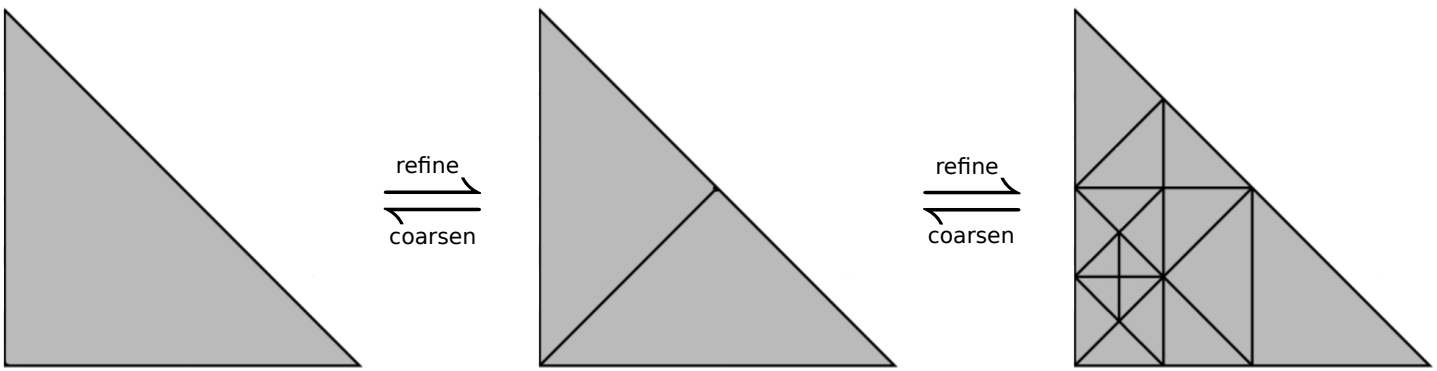
Grid is adapted according to error estimator/indicator:

small error $\Rightarrow$ grid is coarsened

large error $\Rightarrow$ grid is refined

Reason: saving CPU time while maintaining high resolution

AMR library: AMATOS (h-adaptivity)



Appendix: Warm air bubble with AMR