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VOLIMPACT

Improving volcanic ash transport modelling through coupling with a plume rise model

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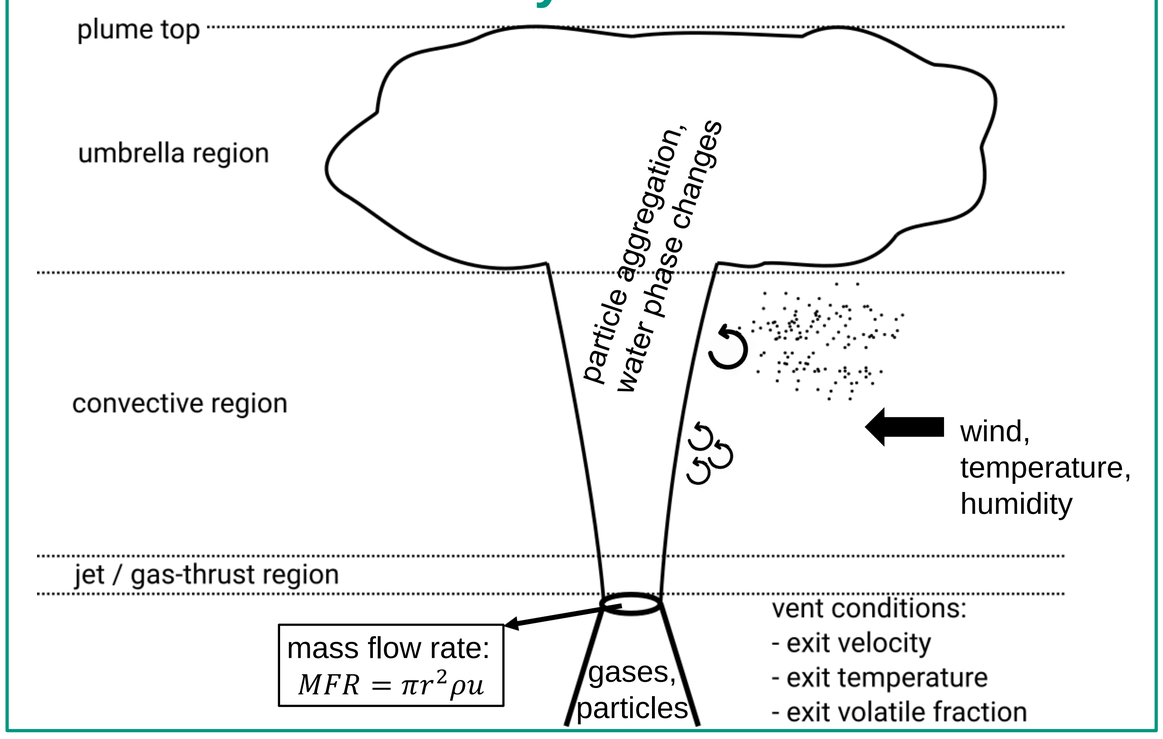
1. Motivation

- The amount and the injection profiles of very fine volcanic ash is a crucial input for forecast models
- In most models: rather simple parametrizations based on the plume height, e.g. Mastin et al. (2009), and fixed value for very fine ash → can lead to errors in the prediction of ash transport in the atmosphere
- **Objectives: ICON-ART coupled with 1-D plume model FPLUME**

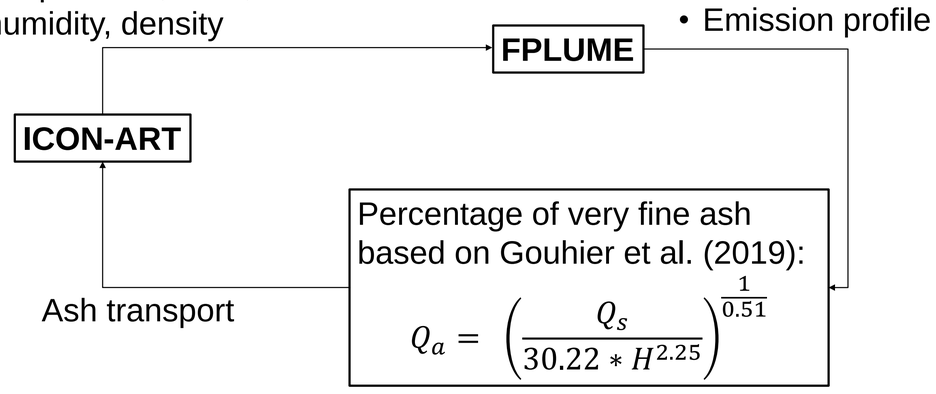
2. Volcanic Plume Dynamics



3. Coupled Model Framework

Vertical profiles:
temperature, wind, humidity, density

- MFR
- Emission profile



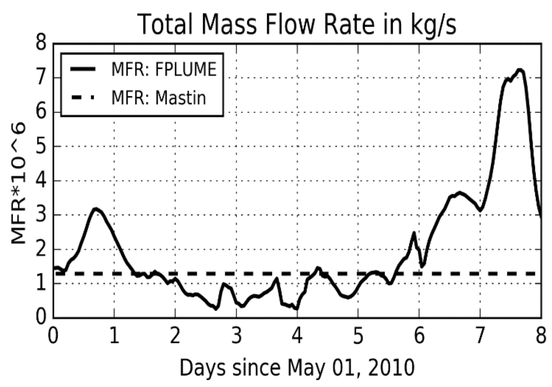
Two options in FPLUME:

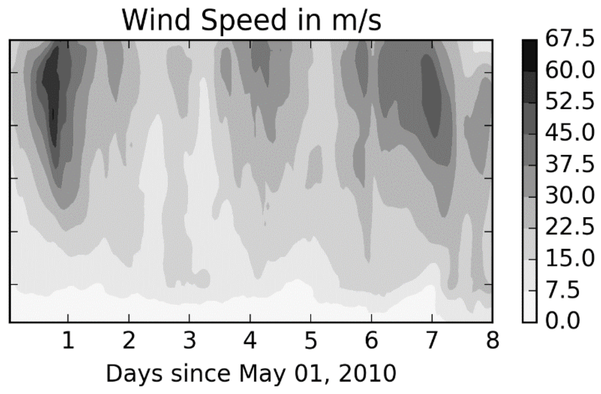
1. Solve for plume height in case MFR is given
2. Solve for MFR in case plume height is given

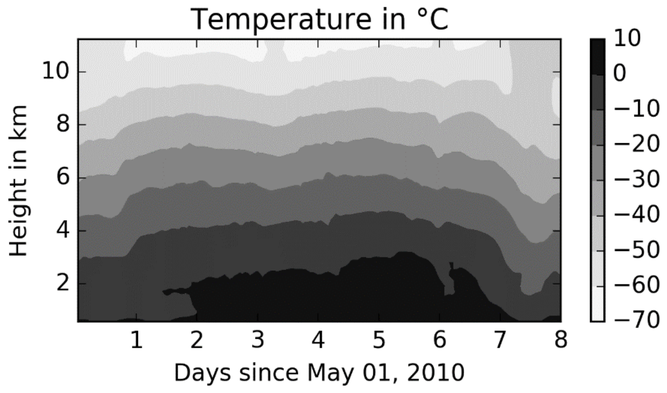
4. Test Case: Eyjafjallajökull eruption 2010

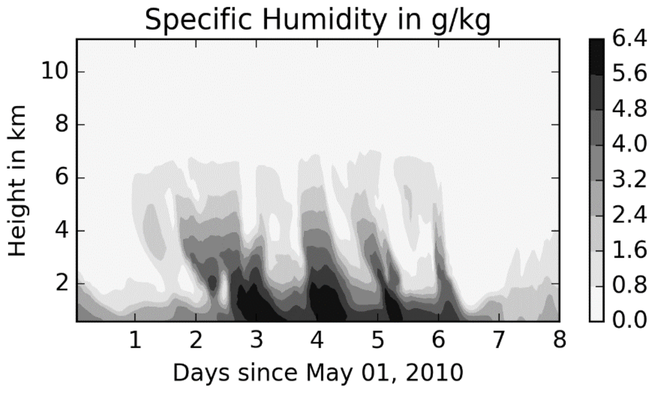
- Fixed plume height: 9km → solve for MFR
- Exit velocity: 120m/s
- Exit volatile fraction: 5%
- Exit temperature: 950°C

5.1. Mass Flow Rate (fixed height of 9km)



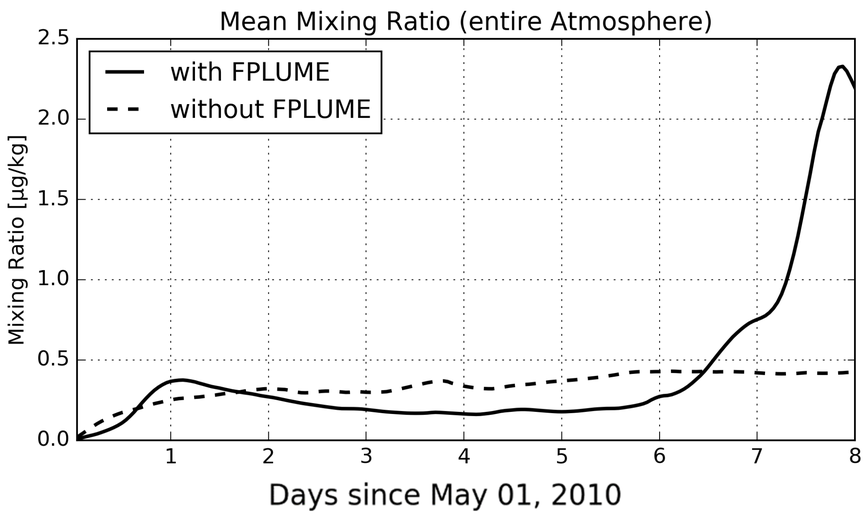






5.2. Volcanic ash transport

With FPLUME: calculation of very fine ash emission based on FPLUME and Gouhier et al. (2019)
Without FPLUME: MFR from Mastin for 9 km; very fine ash fraction of 5%; emission profile from Rieger et al. (2015)



6. Outlook

- Study in-plume chemistry with ICON-ART and LEM physics
  → initial fate of volcanic emissions reaching the upper troposphere and stratosphere
- Limited Area Mode (2.5 km) and 3 Nests to reach from a global resolution of 40 km to 0.3 km at location of eruption
- Simulation of past major volcanic eruptions and sensitivity analysis

References

- Folch et al. (2016), *FPLUME-1.0: An integral volcanic plume model accounting for ash aggregation*
- Gouhier et al. (2019), *Low efficiency of large volcanic eruptions in transporting very fine ash into the atmosphere*
- Mastin et al . (2009), *A multidiscplinary effort to assign realistic source parameters to models of volcanic ash-cloud transport and dispersion during eruptions*
- Rieger et al. (2015), *ICON–ART 1.0 – a new online-coupled model system from the global to regional scale*

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