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Towards Canopy parameterization for Multiscale Finite Element Method

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Canopies represent sub-grid scale features in earth system models and interact as such with the large-scale processes resolved numerically. The canopy is implemented with a viscosity approach, resembling a roughness parameterization. However, the idea is that high viscosity is applied locally to an obstacle area whereas free spaces are assigned low viscosity. In a first step, we test this approach on a micro-scale, using an advection-diffusion equation to solve for tracer transport around obstacles. Available wind tunnel data are used for validation of a standard finite element implementation. In a second step, this approach is combined with a multi-scale finite element approach, such that a large-scale simulation can be coupled to the micro-scale representation of a canopy. Comparison of high-resolution standard finite element and low-resolution multi-scale finite element methods will allow for quantitative error analysis. This approach has the potential to lead to better parameterizations of subgrid-scale processes in large-scale simulations.