EGU24-1639, updated on 09 Feb 2025
https://doi.org/10.5194/egusphere-egu24-1639
EGU General Assembly 2024

Modelling the collision of streamers using the AMReX framework

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Streamers, precursors of the hot, long lightning leaders, are small filamentary discharges with high electric fields at their tips. Experiments of laboratory discharges have shown that streamers in their corona can approach each other and it has been suggested that such collisions enhance the electric field in-between beyond the thermal runaway electric field accelerating electrons to the runaway regime thus generating X-rays. Streamer collision also plays a role in the interaction of wind turbine blades with lightning when streamers locally incept from the surface of blades and attract the downward moving lightning leader. Despite the relevance of streamer collisions in the runaway process or their role in the interaction of lightning with wind turbine blades, there have only been a few numerical studies due to computational limitations. We have therefore developed a novel 3D fluid model for streamer propagation implemented in the AMREX framework. AMREX allows us to solve drift-diffusion and Poisson equation using parallelization and GPU support to accelerate the block structured adaptive mesh refinement. We will present details of the implementation as well as a parameter study on typical streamer parameters (electron density, electric field, tip width and velocity,...) during streamer collision in various ambient fields and for various initial electron densities. We will also study various geometries with different displacements of the initial electrons perpendicular to the ambient electric field. Finally, we will interpret our results with respect to the runaway process and wind turbine-lightning interaction.