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Continuous Plug Flow and Discrete Particle Phase Coupling Using Triangular Parcels

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Abstract : Various processes are modelled using a discrete phase, where particles are seeded from a source. Such particles can represent liquid water droplets, which are affecting the continuous phase by exchanging thermal energy, momentum, species etc. Discrete phases are typically modelled using parcel, which represents a collection of particles, which share properties such as temperature, velocity etc. When coupling the phases, the exchange rates are integrated over the cell, in which the parcel is located. This can cause spikes and fluctuating exchange rates. This paper presents an alternative method of coupling a discrete and a continuous plug flow phase. This is done using triangular parcels, which span between nodes following the dynamics of single droplets. Thus, the triangular parcels are propagated using the corner nodes. At each time step, the exchange rates are spatially integrated over the surface of the triangular parcels, which yields a smooth continuous exchange rate to the continuous phase. The results shows that the method is more stable, converges slightly faster and yields smooth exchange rates compared with the steam tube approach. However, the computational requirements are about five times greater, so the applicability of the alternative method should be limited to processes, where the exchange rates are important. The overall balances of the exchanged properties did not change significantly using the new approach.

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