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Downburst outflow with cooling source[1] YANGYUE ZHANG, RUIFENG HU, Lanzhou University, XIAOJING ZHENG, Xidian Univesity — A downburst outflow can trigger thunderstorms or sandstorms. This work describes theories and direct numerical simulations that focus on the front velocity of gravity current produced by a downburst outflow with cooling source. A global theory based on the mass, momentum and energy conservations suggests that the front velocity and height are governed by the center height and longitudinal radius of the cooling source, while much less affected by the vertical radius.We also present a modified shallow-water theory allowing the longitudinal variation of depth-averaged temperature, which demonstrates that the longitudinal temperature gradient can also be a driving mechanism. Similarity solutions in conjunction with dimensional analysis predict various scaling laws during the inertial and viscous phases. In the inertial phase, cooling source can prevent the gravity current from slowing down, resulting in a steady propagating front. During the viscous phase, the decaying trend of front velocity is $t^{-1/5}$, that is much gentler than $t^{-4/5}$ in lock-exchange flows. Two-dimensional direction numerical simulations are conducted to justify the theoretical models, and good agreements with the theories are found.

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