Geophysical Research Abstracts
Vol. 21, EGU2019-6599, 2019
EGU General Assembly 2019

Shallow Water Equations by the Method of Characteristics with the Meshless Localized Radial Basis Function Collocation Method

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In this article, an accurate and efficient numerical model by combining the method of characteristics (MOC) and the meshless localized radial basis function collocation method (LRBFCM), is proposed to simulate the shallow water flow problems. The shallow water equations (SWEs) are classified into hyperbolic type partial differential equations (PDEs) system that easily bring on numerical unstable results for the case with discontinuous field values or shock waves. To solve this problem, the SWEs are derived into conservative eigensystem form, then the MOC is applied to capture the conservative variables change along the characteristic lines. Especially, the meshless LRBFCM is used to obtain the field values from the conservative variables, it can ease the complexity for interpolation procedure on characteristic Lagrangian points, decrease the requirement of computational nodes, and preserve the accuracy in transient problems. For the boundary disposal, a fractional time step skill with the characteristic velocity is considered to determine the boundary requirements. The computational nodes can be generated by the Cartesian distribution or by random node distribution, which reduce the difficulty of node generation to obtain efficient and accurate numerical analysis. Several numerical cases are simulated and discussed in the content for verifying the proposed model.