Luo, Zhendong; **Gao, Junqiang**

The numerical simulations based on the NND finite difference scheme for shallow water wave equations including sediment concentration. (English) Zbl 1423.76316

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Summary: In this study, a numerical model based on the non-oscillatory and non-free parameter dissipation (NND) finite difference scheme for shallow water wave equations including sediment concentration is established in order to simulate the phenomena for dam-break flow and the development of alluvial plain in an estuary. Some numerical experiments show that the numerical model is feasible and efficient for simulating the phenomena for dam-break flow and the development of alluvial plain in an estuary.

MSC:

76M20 Finite difference methods applied to problems in fluid mechanics
65M06 Finite difference methods for initial value and initial-boundary value problems involving PDEs
65M15 Error bounds for initial value and initial-boundary value problems involving PDEs
76D99 Incompressible viscous fluids
86A05 Hydrology, hydrography, oceanography

Keywords:

non-oscillatory and non-free parameter dissipation (NND) finite difference scheme; shallow water wave equations including sediment concentration; numerical simulation

Full Text: DOI

References:

[1] de Saint-Venant, A. J.C., Théorie du mouvement non permanent des eaux, avec application aux crues des rivîres et à l'introduction des marées dans leur lit, C. R. Acad. Sci. Paris, 73, 147-154, (1871) · Zbl 03.0482.04

[2] Giovangigli, V.; Tran, B., Mathematical analysis of a Saint-Venant model with variable temperature, Math. Models Methods Appl. Sci., 20, 8, 1251-1297, (2010) · Zbl 1204.35134

[3] Anatasiou, K.; Chan, C. T., Solution of the 2d shallow water equations using the finite volume method on unstructures triangular meshes, Internat. J. Numer. Methods Fluids, 24, 1225-1245, (1997) · Zbl 0886.76064

[4] Bermudez, A.; Vazquez, M. E., Upwind methods for hyperbolic conservation laws with source terms, Comput. Fluids, 23, 1049-1071, (1994) · Zbl 0816.76052

[5] Cai, Y.; Navon, I. M., Parallel block preconditioning techniques for the numerical simulation of the shallow water flow using finite element methods, J. Comput. Phys., 122, 39-50, (1995) · Zbl 0840.76031

[6] Chen, X.; Navon, I. M., Optimal control of a finite-element limited-area shallow-water equations model, Stud. Inf. Control, 18, 1, 41-62, (2009)

[7] Liang, A. J.; Hsu, T. W., Least-squares finite-element method for shallow-water equations with source terms, Acta Mech. Sin., 25, 597-610, (2009) · Zbl 1269.76071

[8] Lu, C. N.; Qiu, J. X., Simulations of shallow water equations with finite difference Lax-Wendroff weighted essentially non-oscillatory schemes, J. Sci. Comput., 47, 3, 281-302, (2011) · Zbl 1358.76017

[9] Navon, I. M., Finite-element simulation of the shallow-water equations model on a limited area domain, Appl. Math. Model., 3, 1, 337-348, (1979) · Zbl 0438.76017

[10] Qiu, J. X.; Shu, C. W., Finite difference WENO schemes with Lax-Wendroff-type time discretizations, SIAM J. Sci. Comput., 24, 2185-2198, (2003) · Zbl 1034.65073

[11] Rogers, B. D.; Borthwick, A. G.L.; Taylor, P. H., Mathematical balancing of flux gradient and source terms prior to using roe's approximate Riemann solver, J. Comput. Phys., 192, 422-451, (2003) · Zbl 1047.76539

[12] Vukovic, S.; Sopta, L., ENO and WENO schemes with the exact conservation property for one dimensional shallow water equations, J. Comput. Phys., 179, 593-621, (2002) · Zbl 1130.76389

[13] Wang, B., An explicit multi-conservation finite-difference scheme for shallow-water-wave equation, J. Comput. Math., 26, 3, 404-409, (2008) · Zbl 1174.76014

[14] Wang, J. S.; Liu, R. X., The composite finite volume method on unstructured meshes for 2D shallow water equations, Internat. J. Numer. Methods Fluids, 37, 933-949, (2001) · Zbl 1055.76532

[15] Xing, Y.; Shu, C. W., High order finite difference WENO schemes with the exact conservation property for the shallow water equations, J. Comput. Phys., 208, 206-227, (2005) · Zbl 1114.76340

[16] Xing, Y.; Shu, C. W., High order well-balanced finite volume WENO schemes and discontinuous Galerkin methods for a class of hyperbolic systems with source terms, J. Comput. Phys., 214, 567-598, (2006) · Zbl 1089.65091

[17] Xing, Y.; Zhang, X.; Shu, C. W., Positivity-preserving high order well-balanced discontinuous Galerkin methods for the shallow water equations, Adv. Water Resour., 33, 1476-1493, (2010)

[18] Yoon, S. B.; Lim, C. H.; Choi, L., Dispersion-correction finite difference model for simulation of transoceanic tsunamis, Terr. Atmos. Ocean. Sci., 18, 1, 31-53, (2007)

[19] Yuan, M.; Song, S. H., A nonoscillatory finite volume method for 2D shallow water equations on two-dimensional unstructured meshes, J. Numer. Methods Comput. Appl., 29, 1, 49-55, (2008) · Zbl 1174.76341

[20] Zhou, J. G.; Causon, D. M.; Mingham, C. G.; Ingram, D. M., The surface gradient method for the treatment of source terms in the shallow-water equations, J. Comput. Phys., 168, 1-25, (2001) · Zbl 1074.86500

[21] Wang, J. S.; Ni, H. G.; He, Y. S., Finite-difference TVD scheme for computation of dam-break problems, J. Hydraul. Eng., 126, 4, 253-262, (2000)

[22] Vosoughifar, H. R.; Dolatshah, A.; Shokouhi, S. K.S., Discretization of multidimensional mathematical equations of dam break phenomena using a novel approach of finite volume method, J. Appl. Math., 2013, 1-12, (2013) · Zbl 1266.65150

[23] Zeng, Q. C., Silt sedimentation and relevant engineering problem-an example of natural cybernetics, (Proceedings of the Third International Congress on Industrial and Applied Mathematics, ICIAM95 held in Hamburg, (1995), Akademie Verlag), 463-487 · Zbl 0849.76091

[24] Zhu, J.; Zeng, Q. C.; Guo, D. J.; Liu, Z., Optimal control problems related to the navigation channel engineering, Sci. China E, 40, 1, 82-88, (1997) · Zbl 0883.49027

[25] Luo, Z. D.; Zhu, J.; Zeng, Q. C.; Xie, Z. H., Mixed finite element methods for shallow water equations including current and silt sedimentation (I): the time continuous case, Appl. Math. Mech., 25, 1, 80-92, (2004) · Zbl 1141.76424

[26] Luo, Z. D.; Zhu, J.; Zeng, Q. C.; Xie, Z. H., Mixed finite element methods for shallow water equations including current and silt sedimentation (II): the discrete-case alone characteristics, Appl. Math. Mech., 25, 2, 186-201, (2004) · Zbl 1145.76404

[27] Li, G. S.; Wang, H. L.; Liao, H. P., Simulation on seasonal transport variations and mechanisms of suspended sediment discharged from the yellow river to the bohai sea, J. Geogr. Sci., 20, 6, 923-937, (2010)

[28] Zhang, H. X., A non-oscillatory and non-free parameter dissipation difference scheme, Acta Aerodyn. Sin., 6, 2, 143-165, (1988)

[29] Chung, T., Computational fluid dynamics, (2002), Cambridge University Press Cambridge · Zbl 1037.76001

[30] Liu, R. X.; Shu, C. W., Several new methods for computational fluid mechanics (in Chinese), (2003), Science Press Beijing