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Editorial

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KEY WORDS: low numerical diffusion; nonoscillatory advection; convection; high-resolution schemes; conservative interpolation; DNS; LES; MILES; VLES; implicit turbulence modelling; incompressible flow solvers; compressible flow solvers; mesh adaptivity; mesh refinement; error estimation; stratified rotating flows; atmospheric simulations; ocean modelling; general circulation modelling; geophysical fluid dynamics; modified equation analysis; sign preservation; conservative remapping; wave braking; wave–wave and wave–mean-flow interaction; semi-Lagrangian advection; reversible and irreversible energy flux; sand dunes; saltation; sand avalanches; boundary-layer sand-dune coupling; continuous mapping; shock capturing; flux-corrective transport; limiters and monotonicity; hurricane simulation; flow past complex terrain.

This special issue of the *International Journal for Numerical Methods in Fluids* is devoted to recent developments and applications of high resolution methods based on MPDATA—Multidimensional Positive Definite Advection Transport Algorithm. Proposed in the early 1980s MPDATA has gained recognition for its robustness and accuracy in several fields of computational physics with a large portfolio of successful applications documented for geophysical flows on scales from micro to planetary. While, traditionally, developments of MPDATA have been pursued on Cartesian-type structured grids, using mappings for geometry representation, recent generalizations for unstructured meshes expand MPDATA's applicability to engineering problems involving complex geometries.

The opening paper by Piotr K. Smolarkiewicz serves as an introduction providing a comprehensive overview of the underlying concepts of MPDATA, principles of implementation to complete fluid models and guidance to the literature. The remaining collection of papers reports on progress in the theory of the MPDATA approach, related topics of implicit turbulence modelling, nonoscillatory forward-in-time fluid solvers, and MPDATA based mesh adaptive methods. Theoretical developments are illustrated with idealised tests of cross-disciplinary relevance, and with challenging calculations in areas of weather and climate modelling, gravity-wave dynamics, sediment transport past evolutionary beds, and aerodynamics.

Since an accurate solution of the advection (convection) equation is at heart of many numerical schemes for fluid flow, this special issue may interest researches less aware of MPDATA's unique concept, properties and performance. To assist these readers we provide an extended list of key words as guidance to MPDATA-based research.

The papers published in this issue include the material presented during the XIII Conference on Finite Elements for Flow Problems at Swansea UK (4–6 April 2005). The presentations were given at two invited sessions entitled *MPDATA Methods for Fluids*. I would like to thank the authors for the effort in preparing their contributions and help in organising the sessions. Thanks are also due to Professor Nigel Weatherill and Frea Thorne for their editorial effort.