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Commentary

Comment on "A modified leapfrog scheme for shallow water equations" by Wen-Yih Sun and Oliver M.T. Sun

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ABSTRACT

A recent paper published in this journal considers the numerical integration of the shallow-water equations using the leapfrog time-stepping scheme [Sun Wen-Yih, Sun Oliver MT. A modified leapfrog scheme for shallow water equations. Comput Fluids 2011;52:69–72]. The authors of that paper propose using the time-averaged height in the numerical calculation of the pressure-gradient force, instead of the instantaneous height at the middle time step. The authors show that this modification doubles the maximum Courant number (and hence the maximum time step) at which the integrations are stable, doubling the computational efficiency. Unfortunately, the pressure-averaging technique proposed by the authors is not original. It was devised and published by Shuman [5] and has been widely used in the atmosphere and ocean modelling community for over 40 years.

1. Introduction

Sun and Sun [7] consider the numerical integration of the shallow-water equations using the leapfrog time-stepping scheme. The authors of that paper propose using the time-averaged height in the numerical calculation of the pressure-gradient force, instead of the instantaneous height at the middle time step. The authors show that this modification doubles the maximum Courant number (and hence the maximum time step) at which the integrations are stable, doubling the computational efficiency.

Unfortunately, the pressure-averaging technique proposed by Sun and Sun [7] is not original. It was devised and published 40 years earlier by Shuman [5] and is now known as the "Shuman pressure gradient averaging technique". Its stability and accuracy properties have been studied in a variety of contexts (e.g. [4]). A generalization of the technique, in which the three pressure gradient terms involved in the time average are allowed to have adjustable weights, has been studied by Brown and Campana [2]. The Shuman technique has been used widely for over 40 years in many different models of the atmosphere (e.g. [1,3]) and ocean (e.g. [6]).

2. Conclusions

Authors of papers are reminded of the basic need to conduct a thorough literature search before starting new research projects, and certainly before submitting papers for publication. Even the most perfunctory of searches would have revealed the above 40-year catalogue of previous work. Reviewers of papers submitted for publication are reminded of the same. The ultimate responsibility for conducting the due diligence must rest with the authors, however.

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