

Interactive comment on “Adaptive Cartesian Meshes for Atmospheric Single-Column Models, a study using Basilisk 18-02-16” by J. Antoon van Hooft et al.

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Please see the Supplement to review the proposed changes to the manuscript

Please also note the supplement to this comment:

<https://www.geosci-model-dev-discuss.net/gmd-2018-21/gmd-2018-21-AC2-supplement.pdf>

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Adaptive Cartesian Meshes for Atmospheric Single-Column Models, a study using Basilisk 18-02-16

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Abstract. It is well known that the representation of certain atmospheric conditions in climate and weather models can still suffer from the limited grid resolution that is facilitated by modern-day computer systems. Herein we study a simple one-dimensional analogy to those models by using a Single-Column Model (SCM) description of the atmosphere. The model employs an adaptive Cartesian mesh that applies a high-resolution mesh only when and where it is required. The so-called adaptive-grid model is described and we report on our findings obtained for tests to evaluate the representation of the atmospheric boundary layer, based on the first two GABLS intercomparison cases. The analysis shows that the adaptive-grid algorithm is indeed able to dynamically coarsen and refine the numerical grid whilst maintaining an accurate solution. This is an interesting result as in reality, transitional dynamics (e.g. due to the diurnal cycle or due to changing synoptic conditions) are rule rather than exception.

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1 Introduction

Single-Column Models (SCMs) are often used as the building blocks for Global (or General) Circulation Models (GCMs). As such, many of the lessons learned from SCM development can be inherited by GCMs and hence the evaluations of SCMs receive considerable attention by the geoscientific model development community (see e.g. Neggers et al., 2012; Bosveld et al., 2014; Baas et al., 2017). In this work, we present a SCM that employs an adaptive Cartesian mesh that can drastically reduce the computational costs of such models, especially when pushing the model's resolution. The philosophy is inspired by recently obtained results on the evolution of atmospheric turbulence in a daytime boundary layer using three-dimensional (3D) adaptive grids. As promising results were obtained for turbulence-resolving techniques such as Direct Numerical Simulations and Large-eddy Simulation (LES), herein we explore whether similar advancements can be made with more practically oriented techniques for the numerical modelling of the atmosphere. As such, the present model uses Reynolds-averaged Navier-Stokes techniques to parameterize

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Fig. 1.

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