Geophysical Research Abstracts
Vol. 20, EGU2018-4644, 2018
EGU General Assembly 2018

Effective subgrid-scale parameterization for one-dimensional shallow water dynamics using stochastic mode reduction

Matthias Zacharuk (1), Stamen Dolaptchiev (1), Ilya Timofeyev (2), and Ulrich Achatz (1)

(1) Goethe Universität Frankfurt am Main, Institut für Atmosphäre und Umwelt IAU, Frankfurt am Main, Germany (zacharuk@iau.uni-frankfurt.de), (2) Department of Mathematics, University of Houston, Houston Texas, USA

The processes acting in the atmosphere take place on a wide range of different scales in space and time.
It is impossible to resolve all these scales in atmospheric models, therefore, a parameterization of unresolved scales is necessary.
In this study we examine the problem of unresolved subgrid-scale (SGS) processes. As a simple model of the atmosphere a one-dimensional shallow water model with a finite difference discretization is considered as reference. For a model on a lower spatial resolution an SGS parameterization is derived with the stochastic mode reduction procedure (Majda, Timofeyev, Vanden-Eijnden 2001, A mathematical framework for stochastic climate models. Commun. Pure Appl. Math., 54:891–974). This method relies on the separation of the reference model variables into slow and fast variables. Therefore, local spatial averages are interpreted as slow variables and deviations from these averages as fast variables.
This allows the derivation of a local stochastic SGS parameterization from the reference model eq., which is able to improve the spectrum of the low order model significantly for high wave numbers.
The performance of the so derived SGS parameterization is compared to purely empirical closures and outperforms them.
In extension the scale aware SGS parameterization can be applied to different resolutions of the low order model without additional effort and outperforms empirical closures too.