Optimization-based Tracer Transport on the Sphere

Kara Peterson Pavel Bochev
Computational Mathematics

Denis Ridzal
Optimization and Uncertainty Quantification

Sandia National Laboratories*
P.O. Box 5800 MS-1318
Albuquerque, NM 87185 USA

We present a new conservative and bounds-preserving optimization-based transport algorithm for passive tracers on the the cubed sphere grid. The method is based on an incremental remap approach with an optimization-based remap step at the core. The optimization variables are average tracer concentrations in a cell and the objective is to minimize the discrepancy between these variables and high-order target tracer concentrations while satisfying constraints that include local bounds and total tracer conservation. This formulation results in a robust and efficient algorithm for tracer transport that provably preserves linear relationships between tracers. The capabilities of the method will be illustrated in computational studies using several standard two-dimensional test problems on the sphere.

*Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Company, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94-AL85000.