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Introduction to Numerical Modeling of the Atmosphere JOSEPH WILKINS, BENJAMIN MACCALL, University of louisville physics and astronomy department — A set of governing partial differential equations (PDE) derived from fundamental physical principles can describe the behavior of a fluid, but due to non-linearity they cannot be analytically solved. Instead, they must be approximated. This work is a survey of well established finite-difference methods applied to two sets of equations– the linear advection equation (LAE) and the linearized shallow-water equations (LSWE). Finite difference schemes replace the partial derivatives of a variable with the differences between discrete points in space and time. The resulting equations only approximate the original PDE leading to unwanted behavior, such as computational instability, damping, dispersion, and unphysical solutions. The following numerical schemes were applied to both the LAE and the LSWE: forward-in-time-and-space, Euler, backward, leapfrog, Lax-Wendroff. While there are many types of numerical schemes used for solving PDE, the schemes we employed show the necessity of weighing the characteristics of a particular scheme against the physical behavior being simulated and the resources available for computation.

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