On grid generation for numerical schemes of atmospheric models

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Simulation of large-scale atmospheric and ocean processes, such as weather phenomena, regional and global circulations, and climate dynamics, imply the formulation of the corresponding mathematical models in spherical geometry. The properties of numerical schemes, used to find approximate solutions of atmospheric models, are defined, at certain degree, by the choice of the computational grids. Discretizations based on uniform grids in natural spherical coordinates suffer from highly non-uniform physical resolution, especially in polar regions. On the other hand, general homeomorphic mappings of spherical domains, which can provide quite uniform physical resolution, are not usually applied due to the complex form of the governing equations in such general coordinates. One of the widespread approaches to circumvent this problem is the application of conformal mappings from a sphere onto a plane, which preserve a simpler form of the governing equations and assure local isotropy and smoothness of the variation of physical mesh size on the computational grid. In this study the problem of generation of the conformal mappings with the most possible uniformity is considered. A construction of conformal mappings with the minimum distortion for spherical domains of different extension and form is analyzed, and the obtained results for the practical computational grids are compared with the theoretical evaluations.