Dynamically Consistent Shallow-Atmosphere Equations with a Complete Coriolis force[1] MARINE TORT, THOMAS DUBOS, Laboratoire Meteorologique Dynamique, FRANCOIS BOUCHUT, Laboratoire d'Analyse et de Mathematiques Appliquees, VLADIMIR ZEITLIN, Laboratoire Meteorologique Dynamique — Atmospheric and oceanic motion are usually modelled within the shallow-fluid approximation, which simplifies the 3D spherical geometry. For dynamical consistency, i.e. to ensure conservation laws for potential vorticity, energy and angular momentum, the horizontal component of the Coriolis force is neglected. Here new equation sets combining consistently a simplified shallow-fluid geometry with a complete Coriolis force are presented. The derivation invokes Hamilton's principle of least action with an approximate Lagrangian capturing the small increase with height of the solid-body entrainment velocity due to planetary rotation. A three-dimensional compressible model and a one-layer shallow-water model are obtained. The latter extends previous work done on the f-plane and β-plane. Preliminary numerical results confirm the accuracy of the 3D model within the range of parameters for which the equations are relevant. These new models could be useful to incorporate a full Coriolis force into existing numerical models and to disentangle the effects of the shallow-atmosphere approximation from those of the traditional approximation.

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