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The modelling of the atmospheric gravity correction using a new analytical integration approach

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To model the gravitation effect of the Earth's atmosphere we apply a commonly used methodology of subdividing the surface integration domain into zones and compartments defined in a frame of the polar spherical coordinates. The germane effect calculations are based on the newly derived analytical expression for the gravitational effect of truncated spherical shell with density varying in the radial direction. The adopted atmospheric density distribution is based on the atmospheric model USSA76 (United States Standard Atmosphere 1976) which is closely approximated by a polynomial function. While adopting the spherical approximation of the geoid surface, we use various digital elevation models to describe the geometry of the lower bound of atmospheric masses when computing their gravitational effect. Among those models, the 5×5 arc-min global elevation data from the ETOPO5 are used either everywhere when calculating the effect globally in a 1×1 arc-deg grid of calculation points, or in the distant zone when working at more detailed scales. In detailed calculations we use more detailed digital elevation models within the near zone, down to 20×20 m meshes where available. In this article we also analyze and discuss the calculated effects and make comparisons with the results of previous studies over various regions with different calculation parameters.