The Geometrical Approximation for the Rotating Shallow Water Equations

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The different geometrical approximations for the rotating shallow water equations are considered. The first approximation consists in transformation from the equations on the ellipsoid to the equations on the sphere. The second approach is to pass from the equations on the sphere to the equations of the tangent to the surface. For the first transformation a small eccentricity of the earth's parameters and also a small bounded function, which is a combination of eccentricity and the Lame coefficients, are used. For the second approximation a small parameter is the ratio of the spatial scale of these processes to the radius of the Earth. The approximate equations for all geometric approximations are obtained. The main requirement for constructing approximations consisted in the conservation of Hamiltonian structure. This goal was achieved in two ways. First, because the metric tensor of the surface determines the Hamiltonian structure of equations in it, so the first way was chosen as the approximate equations, the part of a complete system, which is associated with a corresponding expansion of the metric tensor. Second, it was observed that the Poisson bracket for the covariant components of the velocity is almost independent of the Lame coefficients, so the main dependence of the Lame coefficients is transferred to the Hamiltonian. And all the approximations are the expansion of this Hamiltonian. There were obtained equations in few orders of approximation. The zero order equations on the f-plane and the first order equations on beta-plane are well researched, but the main question for them is the domain of applicability of the transformations for the transformation from spherical geometry to a plane. Although the equations can be obtained of the same form, but the transformations to them may have different singularities and a different domain of reversibility.