where ω is the angular valocity of the earth's rotation.

The formulas for changing from one coordinate system to another have the form

$$x = x_1 \cos \omega t - y_1 \sin \omega t,$$
$$y = x_1 \sin \omega t + y_1 \cos \omega t, \qquad (20)$$
$$z = z_1,$$

$$x_1 = x \cos \omega t + y \sin \omega t,$$
$$y_1 = -x \sin \omega t + y \sin \omega t, \qquad (20a)$$
$$z_1 = z.$$

If we convert from equations (1) to a rotary spherical system of coordinates (r, φ, λ), where r is the radius vector, φ is latitude and λ is longitude, we get, as is known,

$$\frac{dv_r}{dt} = -\frac{1}{\rho}\frac{\partial p}{\partial r} + 2\omega v_\lambda \cos\varphi + \frac{v_\varphi^2 + v_\lambda^2}{r} - \frac{\partial}{\partial r}\left(\Phi - \frac{\omega^2 r^2}{2}\cos^2\varphi\right), \qquad (21)$$
$$\frac{dv_\varphi}{dt} = -\frac{1}{\rho r}\frac{\partial p}{\partial \varphi} - 2\omega v_\lambda \sin\varphi - 2\frac{v_r v_\varphi}{r} - \frac{v_\lambda^2}{r}\operatorname{tg}\varphi - \frac{1}{r}\frac{\partial}{\partial \varphi}\left(\Phi - \frac{\omega^2 r^2}{2}\cos^2\varphi\right),$$
$$\frac{dv_\lambda}{dt} = -\frac{1}{\rho r\cos\varphi}\frac{\partial p}{\partial \lambda} - 2\omega v_r \cos\varphi + 2\omega v_\varphi \sin\varphi - 2\frac{v_r v_\lambda}{r} - 2\frac{v_\lambda v_\varphi}{2}\operatorname{tg}\varphi - \frac{1}{r\cos\varphi}\frac{\partial}{\partial\lambda}\left(\Phi - \frac{\omega^2 r^2}{2}\cos^2\varphi\right).$$

The formulas for the transition from an immobile system of coordinates to a rotary spherical system have the form

$$x = r\cos\varphi\cos(\lambda - \omega t),$$
$$y = -r\cos\varphi\sin(\lambda - \omega t), \qquad (22)$$
$$z = r\sin\varphi.$$

Using (3) and (5) let us find the formulas for the transition from a rotary Cartesian coordinate system to a rotary spherical system:

$$x_1 = r\cos\varphi\cos\lambda,$$
$$y_1 = -r\cos\varphi\sin\lambda, \qquad (23)$$
$$z_1 = r\sin\varphi.$$

Relationships (23) make it possible to convert from system (19) to system (21) and vice versa. Let us note that the relationships

$$u_1 = v_r\cos\varphi\cos\lambda - v_\varphi\sin\varphi\cos\lambda - v_\lambda\sin\lambda,$$
$$v_1 = -v_r\cos\varphi\sin\lambda - v_\varphi\sin\varphi\sin\lambda - v_\lambda\cos\lambda,$$
$$w_1 = v_r\sin\varphi + v_\varphi\cos\varphi, \qquad (24)$$
$$v_r = u_1\cos\varphi\cos\lambda - v_1\cos\varphi\sin\lambda + w_1\sin\varphi,$$
$$v_\varphi = -u_1\sin\varphi\cos\lambda + v_1\sin\varphi\sin\lambda + w_1\cos\varphi, \qquad (24a)$$
$$v_\lambda = -{}_1 u\sin\lambda - v_1\cos\lambda.$$

occur between the velocities in these two systems. Thus we will assume that we are given a system of differential equations (21) in a spherical coordinate system. Using formulas (20a) and (24a) let us convert it to system (19) in rectangular coordinates.