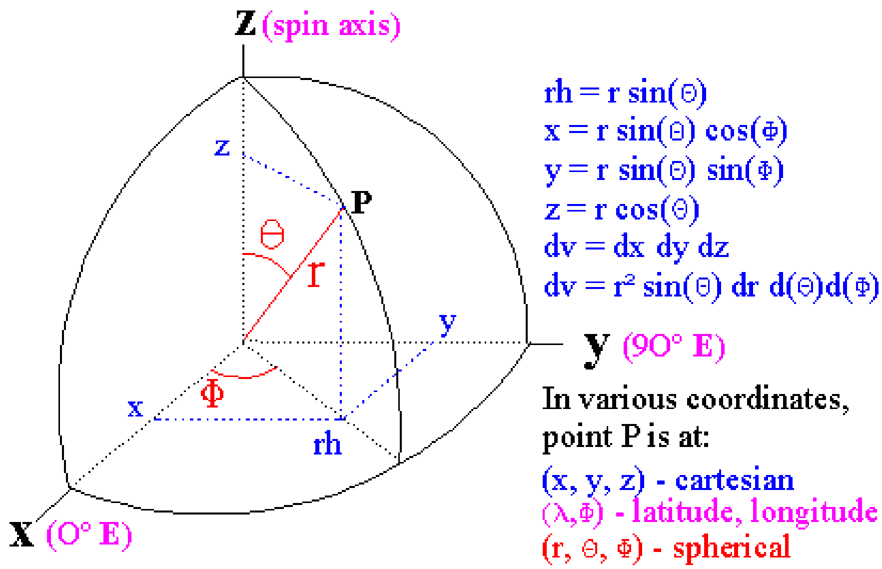
Vector **dot products** provide one way to find the distance between two points on a sphere.

Consider each of two points on a sphere as vectors defined by longitude, latitude, and radius(Φ,λ, r). The Cartesian coordinates of those points are x, y, z in the standard right-hand coordinate system. In the plane of the equator, x and y point towards 0° and 90°E longitude respectively; z is aligned with the spin axis.



The **dot product** is defined as a scalar product:

$$\vec{A} \bullet \vec{B} = |\vec{A}||\vec{B}|\cos(\delta)$$

where δ (delta) is the angle between the two vectors. Thus, to find the great circle angular distance between two vectors:

$$\delta = \cos^{-1}\left(\frac{\vec{A} \bullet \vec{B}}{|\vec{A}||\vec{B}|}\right)$$

So, how do we evaluate this expression? By definition:

$$\delta = \cos^{-1}\left(\frac{A_x B_x + A_y B_y + A_z B_z}{|\vec{A}||\vec{B}|}\right)$$

If we consider the vectors to be unit vectors, here the unit would be Earth's radius, then:

$$\delta = \cos^{-1}\left(A_x B_x + A_y B_y + A_z B_z\right).$$

Thus, find the x, y, and z coordinates of (Φ,λ, r) and evaluate the above expression. As an example, find the distance between Missoula and Rabaul, Papua New Guinea:

What is the great circle distance from Missoula to Rabaul, Papua New Guinea?		
Missoula: (ϕ,λ) = (246°E, 46°N)	Rabaul: (ϕ,λ) = (152°E, 4°S)	**The products**
A_x = -.283	B_x = -.881	A_xB_x = 0.249
A_y = -.635	B_y = 0.468	A_yB_y = -.297
A_z = 0.719	B_z = -.070	A_zB_z = -.050
		SUM = -.098

$$\delta_{MSO-RAB} = \cos^{-1}\left(A_xB_x + A_yB_y + A_zB_z\right)$$

$$\delta_{MSO-RAB} = \cos^{-1}\left(-.098\right)$$

$$\delta_{MSO-RAB} = 95.6^\circ$$

$$95.6^\circ * \frac{2*\pi*6,371km}{360^\circ} = 10,630km,$$

(if Earth was spherical)