46.2: Examples

For example, suppose we're on the surface of the Earth, in the northern hemisphere, and hit a golf ball due south with velocity v. Since the Earth rotates to the east, the Earth's angular velocity vector $\mathbf{\Omega}$ is along the Earth's axis, northward out of the north pole. Then by Eq. 46.1.8, there will be a westward Coriolis force acting on the golf ball, equal in magnitude to

$$F_c = 2m\Omega v \sin\varphi \tag{46.2.1}$$

where φ is the latitude and m is the mass of the golf ball. This will cause the ball to slice the right. The effect is very slight, though. For example, given the rotation rate of the Earth $\Omega = 7.2921 \times 10^{-5}\,\mathrm{rad/s}$, the mass of the golf ball $m = 45\ \mathrm{g}$, a typical ball speed $v = 50\ \mathrm{m/s}$, and a latitude of $\varphi = 39^\circ$, the Coriolis force only amounts to $F_c = 206.5\mu\mathrm{N}$, or about 0.05% of the weight of the golf ball.

The Coriolis force is zero at the equator, and greater at higher latitudes. In the southern hemisphere, the Coriolis force will cause a slight hook of the ball to the left, rather than the slice it will experience in the northern hemisphere.

Weather

By Eq. 46.1.8, we can see that in the northern hemisphere, air currents moving northward are deflected to the east; eastward currents are deflected to the south; southward currents are deflected to the west; and westward currents are deflected to the north. If a low-pressure area forms in the atmosphere, then the pressure gradients will cause the air currents to flow toward the center of the area; but because of the Coriolis deflections, the result will be that the air currents will flow counter-clockwise, creating an air pattern called a cyclone around the low-pressure area. Similarly, in the southern hemisphere, cyclones will be air currents rotating clockwise.

Hurricanes, tornados, water spouts, and whirlpools all rotate counterclockwise in the northern hemisphere due to the Coriolis force (and clockwise in the southern hemisphere).