REMARKS OF THE CORIOLIS EFFECT IN METEOROLOGY

Equatorial bulge

At the equator the Earth's surface is about 20 kilometers further away from the Earth's geometric center than at the poles. Compared to the total Earth radius of 6400 kilometer that looks like a very small difference indeed, you may be tempted to think the bulge is negligable.

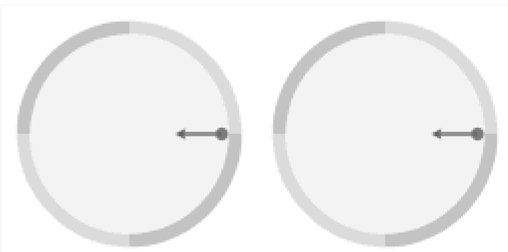
In the diagram the angle between the red and the blue arrow is exaggerated for clarity; in the case of the actual Earth that angle, at 45 degrees latitude, is about a tenth of a degree. That downward slope of 0.1 degree provides the required inward force.

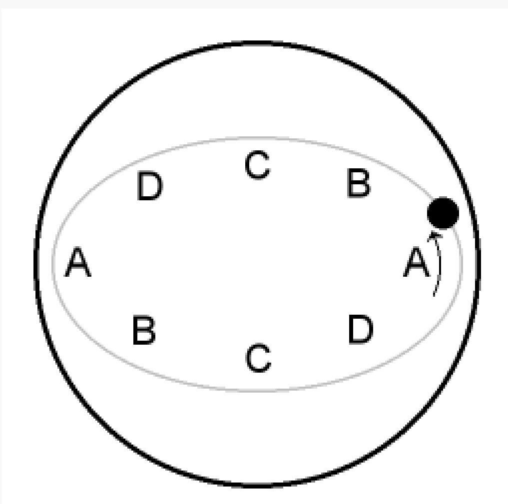
At a rate of one revolution per day, how much inward force is required to circumnavigate the Earth's axis? For the latitude of 45 degrees the calculation gives that for an object with a mass of 1 kilogram a force of 1.7 gram-force is required. The ratio is 1:580. So whatever measure of weight you use, divide it by 580 and you have the required inward force.
(In case you decide to check the number I present here: the required inward force I gave is the component parallel to the local surface, as depicted in the diagram.)

I weigh about 80 kilogram (176 american pounds), and for me the required force is about 140 gram-force. If you have some weighing utensil at hand, feel how strong you have to push to exert 140 gram-force.

Cause of the turning

The cause of the turning is different in each direction, but the common factor is that in every direction it's an interplay between the inward force and the inertia of the circumnavigating object.





An overview:

A When the moving object is at the parts of the trajectory labeled **A** it is circumnavigating *slower* than the parabolic dish itself. Circumnavigating slower there is a surplus of inward force, and subsequently the object is pulled closer to the central axis.

C When the moving object is at the parts of the trajectory labeled **C** it is circumnavigating *faster* than the parabolic dish itself. Now there is *not enough* inward force, and subsequently the object recedes from the central axis again.

B During the parts of the trajectory labeled **B** the object is giving in to the inward pull, gaining velocity in the process.

D During the parts of the trajectory labeled **D** the object is moving against the pull of the inward force, and accordingly the object is losing velocity.

Explanation with motion in a straight line?

Here I discuss whether the turning that is so typical of the rotation-of-Earth-effect can also be explained with an example that is based on motion in a straight line. To do that I will discuss two cases, one with motion over a parabolic dish, and one with motion over a level surface. I will invoke the following as crucial criterium: the rotation-of-Earth-effect that is at play in the atmosphere is the same for all directions of motion.

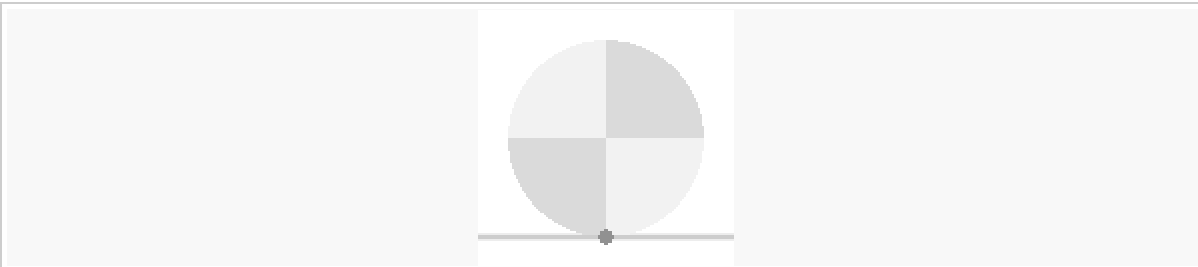
Parabolic ice-rink

Imagine you are on a parabolic ice-rink. (That would require a very large platform. Actually, in France there is a scientific center that has a 13 meter diameter rotating tank. When that rotating water mass is in an equilibrium state you can try to freeze it, which would result in a parabolic ice-rink.)

Imagine you are on that ice-rink, co-rotating with it (and the ice-rink is rotating with the same angular velocity as when it was manufactured). You give an ice-hockey puck a push so that goes forward. That is: you push it so that it still circumnavigates the central axis, but faster than the rink itself. The puck will then start to recede from the central axis.
Then give an ice-hockey puck a push in rearward direction: now it circumnavigates slower than the rink itself, and the puck will start to *slump down* towards the center.

Flat disk

Now for the same experiment conducted on the surface of a rotating flat disk. The animation below illustrates such a setup. You see several pucks being launched at the same time, all moving along the same straight line, but with different velocities.



The pucks that move in forward direction move away from the central axis. Ok, that is somewhat the same as in the parabolic dish case.

How about the puck that is moving in rearward direction? The rearward moving pucks are *receding* from the central axis of rotation too! They recede because they are moving along a straight line that is tangent to the circular platform. Hence on a flat disk it doesn't matter whether the pucks are moving forward or rearward, either way they are receding from the central axis of rotation.

The answer to the question is *No*: in Meteorology the deflection of the motion with respect to the rotating system cannot be explained with a example that is based on motion in a straight line.

Source : http://www.cleonis.nl/physics/phys256/coriolis_in_meteorology.php