Cyclones and the Coriolis Force

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Abstract. The Coriolis force is generally considered to be an artifact of viewing moving objects from a rotating frame of reference. This article examines the extent to which the Coriolis force may in fact be real in relation to its role in determining the cyclonic behaviour in the atmosphere and the ocean currents, since these very real effects cannot be explained purely in terms of an artifact.

The Centrifugal Force

I. The centrifugal force is a radially outward force that occurs when an object possesses tangential velocity with respect to a reference point. It is real enough to invoke Archimedes' principle in a centrifuge. Since the centrifugal force is closely related to the Coriolis force, it is reasonable to enquire as to whether or not the Coriolis force might also be real, at least in certain circumstances.

The Foucault Pendulum

II. When an object that is stationary in the rest frame is viewed from a rotating frame of reference, it is seen to trace out a circular path. This is entirely an artifact of viewing the object from a rotating frame of reference.

On this basis, it is commonly assumed that the Coriolis force is a fictitious force, and that the twenty four hour period of precession of a Foucault pendulum centred at the North Pole is a consequence of the Coriolis force.

On the other hand, the cyclonic behaviour in the weather patterns and in the ocean currents is a real effect which can be viewed from space, in contrast to the artificial effect of the Foucault pendulum at the North Pole. We are therefore either obliged to look into other causes for the cyclonic behaviour in these natural phenomena, or to enquire into circumstances in which the Coriolis force might become real.

Possible Causes of Cyclonic Behaviour in the Oceans and in the Atmosphere

III. We might first of all consider that the cyclonic behaviour in the atmosphere and the oceans is caused by real aether vorticity surrounding the Earth, as a consequence of the Earth's diurnal rotation. Kepler's law of areal velocity however indicates that the large scale vorticity of the aether is very close to zero. Aether vorticity has largely been sponged off into the fine-grain electron-positron vortices that comprise the Earth's magnetic field.

The Earth's magnetic field becomes a possible candidate for explaining the cyclonic behaviour in the oceans and the atmosphere since the $\mathbf{F} = q\mathbf{v}X\mathbf{B}$ force is essentially a fine-grain Coriolis force which is definitely real. See section **VI** in 'The Coriolis Force in Maxwell's Equations' at,

http://www.wbabin.net/science/tombe4.pdf

Another factor which is often overlooked is the fact that a very real Coriolis force must be acting at atomic and molecular level between atoms and molecules. The evidence for this is all around us when we see the vortex patterns that occur in the air behind the wings of aircraft, and on the surface of disturbed water on the small scale, including the circular motion associated with surface water waves. See 'Turbulence, Vorticity, and the Coriolis Force' at,

http://www.wbabin.net/science/tombe30.pdf

It follows therefore that vorticity itself does not need the Earth's rotation to cause it. However, the Earth's rotation must in some way be involved in determining the cyclonic direction of the large scale vortex patterns in the atmosphere and the oceans.

So what about the large scale Coriolis force itself? Does it have to be totally an artifact? Might there be certain arrangements that would make the Coriolis force become real by analogy with the case of a centrifuge invoking Archimedes' principle?

Real Coriolis Force

IV. The Coriolis force, $2m\mathbf{v}X\boldsymbol{\omega}$, is derived as a tangential effect which occurs when an object has a linear velocity in conjunction with an angular velocity. So we must look at scenarios in which these two parameters are connected in some real physical manner and not just as a mathematical trick.

Clearly, when a missile takes off from the surface of the Earth, it will deviate from its path in the Earth's rest frame as a result of the Coriolis force. But this will be entirely an artificial effect. The missile itself will have lost all direct physical connection with the Earth's rotation, and so it will follow the path that it would have followed independently of the Earth's rotation.

There are however, other scenarios in which the linear velocity of the Coriolis force term is physically tied to the angular velocity.

In the Foucault pendulum, the swinging bob is anchored to a fulcrum that is co-rotating with the Earth, other than when the fulcrum is exactly at the poles. Hence, in this scenario, we might expect to detect a Coriolis force that is more than just fictitious. At the equator however, we don't expect to detect the Coriolis force anyway, and so we will not get any effect there. But as we move towards the poles, the Coriolis effect will increase.

This effect will only be real to the extent that the swinging bob's path is constrained by the diurnal motion of the fulcrum. So as we take the pendulum towards the poles, the Coriolis force becomes progressively stronger but progressively more artificial.

Then there is the case of the spinning gyroscope balanced on a pivot. The nutational angular velocity of the gyroscope and its circumferential velocity are totally physically connected and hence a real Coriolis force is induced which causes precession. See 'Gravitation and the Gyroscopic Force' at,

http://www.wbabin.net/science/tombe5.pdf

In the case of the atmosphere and the oceans, we are dealing with hydrodynamics. The atmosphere and the oceans co-rotate with the Earth. When an element of air or water begins to move, it does so relative to the larger body of the entrained atmosphere or the entrained ocean, and so it maintains a fixed physical relationship to the rotation of the Earth. As such we might expect real Coriolis effects to be induced in the atmosphere and oceans that can be viewed from outer space.

Cyclones

V. Cyclones spiral counter-clockwise in the Northern hemisphere. The effect is uniform all the way around the cyclone. The Coriolis force on the large scale due to the Earth's rotation should however only operate for north-south currents. This is a point which is strongly disputed by some sources on the grounds that the mathematical expression for the Coriolis force doesn't explicitly specify a direction. The derivation of this expression does however specify it as a tangential effect induced by a radial motion, and anybody looking at a rotating turntable and considering a tangential motion beginning at a point on the table will see that the deflection will always be radially

outwards. If this deflection were coming from the Coriolis force, then we would expect that if the deflection were to be outwards on a westerly motion, that it would then have to be inwards on an easterly motion. Such an inverse relationship does not occur with tangential motion.

At any rate, if the Coriolis force acts as a real effect on north-south currents, then that should be sufficient to determine the cyclonic direction of large scale vortex phenomena in the atmosphere and oceans. After that, there are other stronger fine-grain Coriolis forces on the atomic and molecular scale which will come into play and dominate the situation.

The Earth's Magnetic Field

VI. The cause of the Earth's magnetic field remains somewhat of a mystery. The fact that the Earth's magnetic axis is so closely aligned with the Earth's rotational axis tends to point with reasonable certainty to the Earth's rotation as being the ultimate cause. The 'Barnett Effect' [1] must almost certainly contribute towards the Earth's magnetic field. The special case of Saturn in which the magnetic axis, the rotational axis, and the ring axis are all totally aligned leaves this matter in not much doubt.

But we also have the contradictory evidence of the slight difference in alignment between the Earth's rotational axis and the Earth's magnetic axis, and the fact that the magnetic axis precesses with the Earth's diurnal rotation. This leaves us to conclude that an additional ferromagnetic source for the Earth's magnetic field must be embedded inside the Earth. This ferromagnetic alignment must in turn be ultimately related to the Earth's rotation as well as to the sum of all the rotational, orbital and precessional motions going on in the solar system.

Rotational Motion

VII. The Earth's magnetic field is a solenoidal alignment of aether vortices within a sea of rotating electron-positron dipoles that we will refer to as 'The Electric Sea'. The phenomenon of stellar aberration combined with the 1887

Michelson-Morley experiment tells us that the electric sea is entrained with the Earth in its translational motion around the Sun.

However, the 1925 Michelson-Gale experiment gives us a slight indication that the electric sea may not be partaking in the rotation of the Earth. This idea is further backed up by the fact that bar magnets do not invoke the q**v**X**B** force when they are rotating. A rotating magnet only ever invokes the electromagnetic $\partial\mathbf{A}/\partial t$ force, where **A** is the magnetic vector potential which is related to aether field momentum. **A** and the magnetic flux density **B** are related to each other by the vorticity equation curl **A** = **B**.

If the electric sea is not partaking in the Earth's rotation, then as was stated earlier, the aligned sea of aether vortices which constitutes the magnetic field could contribute towards the Coriolis force in the ocean currents and the weather patterns.

Maxwell's Vortex Sea

VIII. In his 1861 paper entitled 'On Physical Lines of Force',

http://vacuum-physics.com/Maxwell/maxwell_oplf.pdf

Maxwell modeled the magnetic field hydrodynamically using a sea of tiny fine-grain aether vortices. At equation (5) in part 1, he obtained a Coriolis force expression with which he used to derive Ampère's Circuital Law at equation (9). The reciprocal of this Coriolis force expression in which the cause and effect have been reversed appears at equation (77) and is nowadays known as the Lorentz force, although Maxwell clearly only intended it to be used for electromagnetic induction. Nowadays however, the **v**X**B** effect is never overtly advertised in electromagnetic induction and yet on the other hand it is used to account for the force on a current carrying wire.

Maxwell did not use the **v**X**B** force to account for the force on a current carrying wire. Instead he used fine-grain centrifugal force. It is likely that the use of **v**X**B** for the force on a current carrying wire is an approximation which only becomes accurate in the ideal scenario in which the test wire has got no magnetic field of its own. In normal circumstances, the **v**X**B** force can not possibly account for the transfer of energy between potential and

kinetic that is associated with magnetic force, and so Maxwell's now disused fine-grain centrifugal and Coulomb force explanations for magnetic force are more likely to be the correct explanations.

At any rate, the **v**X**B** force is clearly a Coriolis ingredient in electromagnetic induction. See section **VI** of 'The Coriolis Force in Maxwell's Equations' at,

http://www.wbabin.net/science/tombe4.pdf

Conclusion

IX. The cyclonic behaviour in the atmosphere and in the ocean currents cannot be caused by a purely fictitious force, since we can view these effects from outer space. Hence we must consider that the Coriolis force can be a real force that is acting on three levels. It can act directly on the large scale due to the Earth's rotation. It can act on the atomic and molecular scale between atoms and molecules, and it can act on the electric sea scale in the form of the electromagnetic **F** = q**v**X**B** force arising out of motion through a sea of tiny solenoidally aligned vortices.

The fact that all atomic and molecular matter has got an inbuilt negative electric charge has already been dealt with in 'Gravity Reversal and Atomic Bonding'. See,

http://www.wbabin.net/science/tombe6.pdf

References

[1] Barnett S. J., *"Magnetization by Rotation"* Physical Review 6/4 (1915) 239 - 270