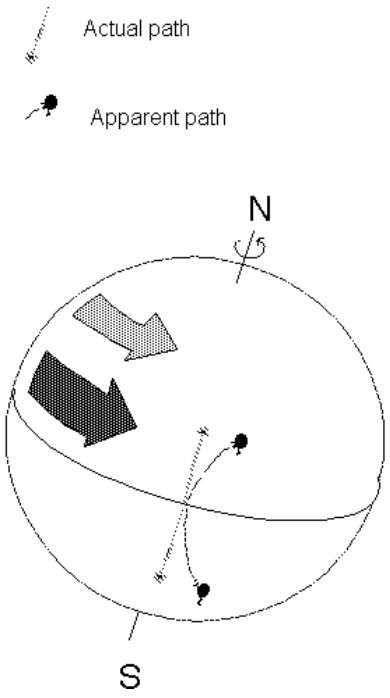
Polar vortex mystery unraveled



One of the most pressing problems for environmental scientists recently has been the rapid erosion of the ozone layer near the North Pole. These scientists have shown a strong connection between the depletion of the ozone layer and the "polar vortex" but have so far failed to communicate the concept clearly to the public.

Fortunately, the Polar Vortex is not as intimidating as it sounds.

In order to understand how the Polar Vortex is formed, we need only to understand two basic concepts: Newton's first law, and the shape of the earth.

Newton's first law

From his famous three laws, we need only the first: "Objects tend to remain at a constant velocity." More simply, if an object is moving in a certain direction it will continue to move at that same speed and direction unless acted upon by another force. In our case, it is our atmosphere that is moving and resisting a change in velocity.

The shape of the earth

Although most people realize that the earth is rotating, very few realize that the actual rotation speed depends on how far you are from the equator.

Since the earth is the thickest at the equator, an object will travel around a very big circle in one day. In contrast, where the earth is not nearly as thick (closer to either pole, for example), an object travels around a much smaller circle in one day. Because of the difference in circle lengths, objects near the equator go much further in one day – so are traveling much faster.

How the Polar Vortex is formed

How do these two facts combine to form the Polar Vortex?

To start, imagine a parcel of atmosphere traveling around the equator. As it is heated, it heads to a cooler spot: such as the North or South Pole. Because of Newton's first law, it will travel to the pole at a constant velocity.

Second, imagine being on the ground and watching this parcel of atmosphere pass above you. Because of the shape of the earth (as mentioned above), unless you are on the equator you will be rotating around the earth's axis slower than the parcel is. Remember – it is still rotating around the earth at the speed of the equator. Since you are rotating around the earth's axis slower than the parcel of air is, the parcel will appear to be moving sideways as well.
The difference in speed increases as the observer nears either pole -- so our parcel appears to move sideways faster the closer we get to either pole.

The combined effect of many, many parcels of atmosphere behaving like this causes a whirlpool-like wind-current that is tightest at either pole. The tightest part of this whirlpool, centered at either pole, is also known as the "Polar Vortex".