Maps

Did your PPL theory include descriptions of different chart projections and their properties? The answer is probably either no, or yes but I've forgotten most of it! And since you've read this far in Flyabout, you can read another couple of pages if you're interested.

Lines

Firstly, a bit about the important lines. A great circle is any circle you get if you cut the earth in half. The equator is a great circle, and any meridian of longitude is half of a great circle. The most useful thing about them is the shortest distance between two points is along a great circle. Radio waves travel that way, and long-distance flights go pretty close, flying a series of secants (go on, look it up!) to the great circle. Every turn on a great circle route is towards the equator. If you're using GPS or ground-based radio aids, you're flying great circle tracks.

A rhumb line is useful too, because it cuts all the meridians at the same angle, which means it's a constant track. That's easy for navigation, and it works fine for flying from Northam to Leeuwin Estate for lunch, but a rhumb line track from Johannesburg to Sydney is about 500 nm longer than the great circle route. All parallels of latitude cut the meridians at 90°, so they are rhumb lines.

The rhumb line between any two points is closer to the equator than the great circle track.

Projections

The age-old problem of map-making will never change. You can't project a section of a sphere (the earth) onto a flat surface without some distortion. The cartographer's challenge is to make a map that minimises the distortions but is still useful for navigation. The basic idea is to project the earth's surface onto a 3-D shape that can be cut and flattened into a 2-D shape. Two such shapes are a cylinder and a cone.

Mercator projections

The best-known cylindrical projection is the Mercator. This one's made by putting an imaginary light bulb inside the imaginary earth and projecting the earth's surface onto the cylinder, which you then cut and lay flat. See Figure 1. A Mercator projection has a line of tangency, meaning the line where the cone and cylinder touch. For the basic Mercator map of the world, like the one that was stuck on the wall of your Grade 4 classroom, the tangent line is the equator.

On a Mercator the parallels of latitude are parallel, which is accurate, but the meridians are also parallel and don't converge at the poles, which of course is not a correct representation of the earth's surface. That's why on a Mercator map of the world, Antarctica looks about eight times the size of Australia when it's actually about twice the size.

So the stated scale on a Mercator is accurate at the tangent line, but it's more distorted the further you get from that, which makes it a pretty useless map for showing large areas.

Because the meridians on a Mercator are parallel, a rhumb line track is a straight line, and a great circle track is concave to the equator.

The difference between a rhumb line and a great circle track is very clear over long distances. If you go to http://gc.kls2.com/ and type in Joburg to Sydney (JNB-SYD) you'll see the route plotted on a Mercator projection, looking like a big loop that goes miles and miles south of both Sydney and

Joburg. The way to see that it's the shortest route is to get a globe of the world, put a bit of string between the two cities and pull it tight. That's the great circle route.

So a Mercator is only useful for small areas. But there's no rule that says the tangent line has to be the equator. If you tilt the imaginary cylinder you can put the tangent line anywhere you want. The result is a transverse Mercator projection, such as a VTC or an AvPlan or OzRunways display. Since a VTC only covers a degree or two of latitude, the distortions are minimal. So when you draw a straight line on a VTC, you're drawing a rhumb line, and you can steer whatever heading you work out for that track. It's not a great circle, so it's not the shortest distance, but over a short distance the differences are small enough to not matter.

Conic projections

A conic projection is made by projecting the earth onto a cone whose apex is at the pole. A basic conic projection has the cone touching the sphere on one parallel of latitude, which is called the standard parallel. The Lambert Conformal projection is accurate over a bigger area than a VTC because it uses two standard parallels, with the cone being inside the sphere in between the standard parallels. See Figure 2. The WAC and VNC are made from this projection. A Lambert chart will always have the details of the standard parallels. They're normally 1/6 of the way from the top and the bottom. For instance, on the Albany WAC they are 32° and 34°40'.

"Conformal" means the angles are correctly represented. So unlike on a Mercator, on a Lambert Conformal chart the meridians converge to the nearer pole, which is what they do on the real earth. If you look at the Albany WAC and measure the distance between two meridians at the top of the chart, it's about 51 nm. At the bottom it's about 49 nm. And since the angle between a parallel and meridian is 90°, and since that's shown correctly on a conformal chart, the parallels have to curve towards the equator. If you put a ruler along a parallel on a WAC, you see that clearly.

On a Lambert Conformal a great circle track is straight, and a rhumb line (such as a parallel) curves towards the equator. So when you draw a track, you're drawing a great circle, and the track will be different at each end because the meridians are not parallel.

Thankfully, as mentioned above, over a short distance a great circle and a rhumb line track are so close together that the difference in angles and distance is negligible.

But even if you don't remember and can't really be bothered with conic projections and rhumb lines and great circles, at least make sure your maps are up to date!

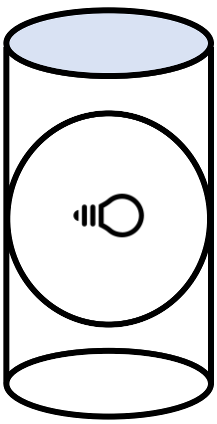

Figure 1

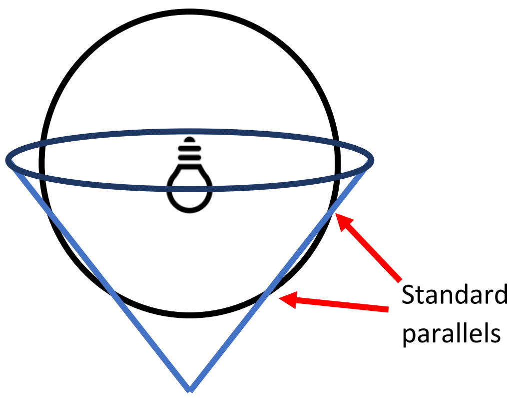

Figure 2