



## MAP DATUM: WHAT IS IT AND HOW DOES IT AFFECT ME?

Some people are unaware of the concept of map datum and how it may affect their navigation. Others have heard of it but aren't sure what it is. Hopefully this tutorial will clear things up slightly. There are 3 main issues here:

*What is an ellipsoid?*

*What is a datum?*

*What datum is used on SA maps?*

Before we start, a quick note: The concept of datum has two components: a reference ellipsoid and a local reference point. A datum is basically an admission of not being perfect. It's a theoretical model of how people *think* earth looks.

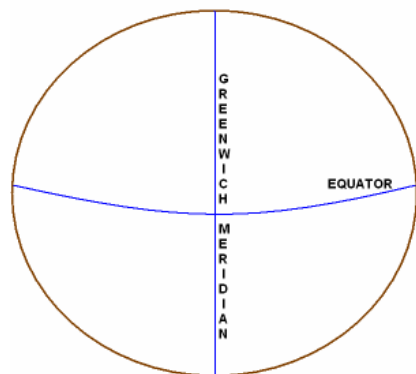
### WHAT IS AN ELLIPSOID?

Think of it this way: Before the age of satellite no-one really *knew* for a fact what exact shape and dimensions earth had, so the cartographers and surveyors of the time had to try to work out the shape and dimensions of earth mathematically. An analogy would be to take a large beach ball (several tens of metres in diameter) that isn't exactly round, place your nose right against the beach ball and then try to calculate or measure the dimensions. Obviously there's considerable potential for error.

Since earth isn't a sphere but an ellipsoid (it's slightly flattened at the poles) it has two diameters - a major diameter (at the equator) and a minor diameter (at the poles). These diameters were calculated mathematically by the cartographers of the time, the combination of the two being referred to as the 'ellipsoid'. This was such a difficult task that no two cartographers could agree. Some of them didn't even agree with themselves (eg: Clarke\_1866 and Clarke\_1880). Also, local variations in the shape of the earth would sometimes skew their calculations and although this would give them a reference ellipsoid that was less accurate for the shape of planet earth overall, it would give them an ellipsoid that worked better for their part of the world.



### WHAT IS A DATUM?



Once the cartographers or surveyors had determined an ellipsoid they then had to go about getting the latitude/longitude system referenced to it. What they would do is measure (as best they could) the geographic position of a fixed object within their area of survey (often an astronomical observatory - they tend not to move too much). This measurement and calculation was difficult and required a great deal of precision. The point of origin for this measurement is the intersection of the Equator (or 0°N) and the Greenwich Meridian (or 0°E), a spot in the middle of the Atlantic ocean which was sometimes several thousands of kilometres away from where they were. Once they had calculated the latitude and longitude of this object

they would fix their latitude and longitude system to be based on the location of their chosen object. This combination of ellipsoid and local reference point is known as the **map datum**.

**datum.** Everything else that was mapped in that area was surveyed in relation to that point of origin.

Basically what they were saying is: "Hey, I think I've got it right, but just in case someone finds out later that I'm wrong and needs adjust the surveyed positions of things, here's the reference point and earth-shape from which I worked so that fixing it isn't impossible".

### **WHAT DATUM IS USED ON SOUTH AFRICAN MAPS?**

In RSA we used to use mainly the CAPE datum, which was the Clarke\_1880 ellipsoid referenced to one of the astronomical observatories in the Cape area.

With the advent of satellite, measurements of planet earth's shape became more accurate and a new ellipsoid was calculated - WGS\_84 (World Geodetic Survey, 1984). Since they might STILL have it wrong (or, at least, future cartographers and surveyors might be able to do it more accurately), they've stuck with the datum concept of an ellipsoid and reference point. The reference point for the South African implementation is the Hartbeeshoek Radio-Astronomy Observatory near Pretoria and this datum is known as Hartbeeshoek\_94. Basically this is just a local implementation of WGS\_84, and most GPS's come out of the box with WGS\_84 as their default datum.

### ***So, is there a difference between CAPE DATUM and HARTBEESHOEK\_94?***

Yes, there is.

For most people this isn't a relevant problem as the worst-case error is about 300m for South Africa, with the average about 180m and people can normally see objects further than that. But...for fine navigation this is a problem. Being 300m out in the mountains when hiking in mist can be the difference between trying to descend a hanging valley (and getting into life-threatening trouble) and finding the pass that you need to get you down.

### ***How do you tell what datum the map you're using is based on?***

Not always easy. However, most of the new (revised and updated) SA Surveyor General maps will have a WGS\_84 logo (an earth globe) in blue somewhere on the border. The older maps will, at the bottom, say: 'CLARKE\_1880'. The older KZN Wildlife Drakensberg maps were all CAPE datum (although they didn't say so) but there was talk of issuing them in HARTBEESHOEK\_94 datum or WGS\_84 datum, which might happen from edition 4 onwards, so edition 3 and less can be assumed to be CAPE datum.

In general, when in doubt set your GPS to WGS\_84/HARTBEESHOEK\_94, except for SA maps made before about 1998, which would probably use CAPE datum as their default.

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For further information contact the:

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Any of the MDT accredited training providers listed on the MDT website.

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Errors, corrections or suggestions for improvements for this training sheet may be forwarded to:



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