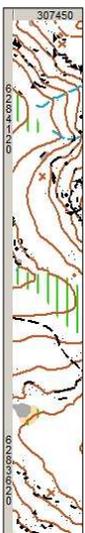


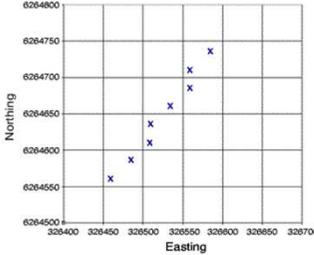
# What are Real World Map Coordinates?

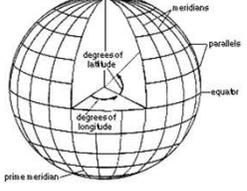
(Why are they so long?)

Why are there 3 norths?



## What are Coordinate Systems?





**Planar coordinates** (left) locate a point in relationship to an origin. (Also called: projected, UTM, MGA, ...)

**Global Coordinates** (right)

**Latitude:** the angle between the point and the equator along a meridian.

**Longitude:** the angle between the meridian of the point and the central meridian (through Greenwich).



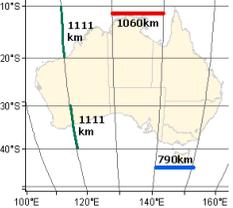
### Global (geographic) coordinates

Global coordinates accurately represent a location on the earth's surface.

They are traditionally expressed as degrees, minutes and seconds. There are 60" in 1' and 60" 1°.

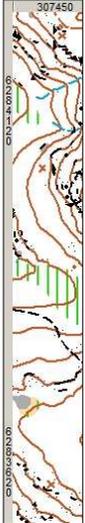
Sydney Opera House is approx. 33° 53' 30" (south) and 151° 12' 45" (east)

#### Drawbacks of using a global coordinate system



At the equator, 1° is equivalent to 1110km (1' is approx. 2km)

At the poles 1° longitude is 0km!



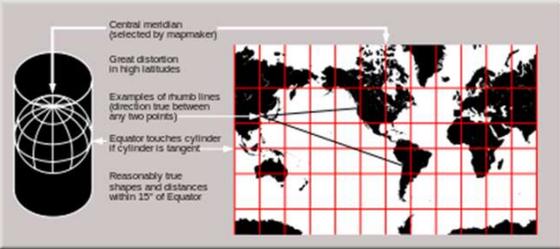
### Projected Coordinate Systems

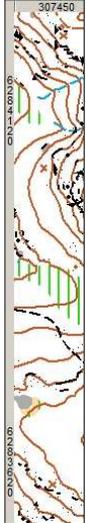
There are many mathematical formulae to project the Earth's surface onto a plane.

Any representation of the Earth's surface in 2-D ALWAYS distorts shape, area, distance, or direction.

#### Common Projections

Mercator      Transverse Mercator      Albers Equal Area  
 Lambert Conformal Conic      Universal Transverse Mercator





### Universal Transverse Mercator

The system is devised to minimise distortion over small areas.

In an east-west direction, the globe is divided into 60 zones.

In an north-south direction, the globe is divided into 20 "strips".

Sydney is in zone ???  
Canberra is in zone ???

UTM coordinates are based on these zones and are expressed in metres.

The x (easting) has 6 digits and y (northing) has 7 digits.

The coordinates of Sports House are: 321537, 6252855  
(But these coordinates will also be found in other zones!)

### The Geocentric Datum of Australia

Map Grid of Australia (MGA) coordinates are based on a UTM coordinate system.

On 1 Jan 2000 the earth moved in Australia...

MGA (Map Grid of Australia)

- used since 2000
- based on the Geodetic Datum of Australia

AMG (Australian Map Grid)

- used since 1966
- based on the Australian Geodetic Datum

(MCG)

Using UTM coordinates:  
the change in an easting is about 100m  
the change in a northing is about 200m

### Norths: True, Magnetic and Grid

A mapper needs to know the difference between them in degrees  
My favourite website is (was) GeoScience Australia:  
<http://www.ga.gov.au/oracle/geomag/agrfform.jsp>

Updated: 13 June 2013

#### Australian Geomagnetic Reference Field Values

If the chosen location is outside the coloured area in the adjacent image then a global magnetic field model will be used for the calculations.

If location coordinates are unknown, try the place name search. The WGS84 datum is used for location coordinates.

► **Geographic Latitude:** degrees: [-24] minutes: [00] seconds: [00]  
(Enter negative value for south of equator)

► **Geographic Longitude:** degrees: [135] minutes: [00] seconds: [00]  
(Enter positive value for east of Greenwich)

► **Altitude (km):** [0]  
(Enter 0 if unsure of altitude)

► **Select a year, month and day:** Year: [2010] Month: [January] Day: [1]  
(Models not available prior to 1985.0 or after 2015.0)

### Norths: cont'd

- The angle between magnetic and true north is called the "magnetic declination" (or "magnetic variation")
- It differs with location and changes over time
- It is positive when the compass points east of true north
- The angle is ~ 12.5° in Sydney, and ~11.8 ° in Lithgow

• Grid North is the direction of the central meridian of a map

• The difference from true north is greatest at the zone edges

• The angle is called the "grid convergence"

• Wikipedia says:  
"The difference between grid north and true north is very small and (...) can almost always be ignored."

- The angle is ~ -1° in Sydney, and ~ -1.6 ° in Lithgow
- The angle is ~ +1.1° in Orange