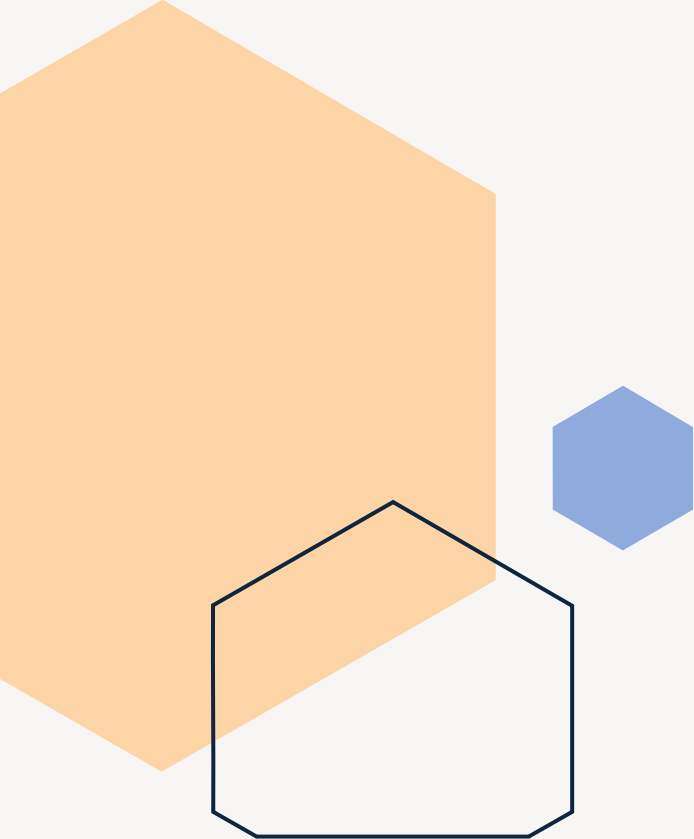


Engineering and Construction Surveying

ACBA4020



Module Overview



Aim

- To provide learners with the skills in linear surveys, levelling surveys, measured building surveys and construction projects.



Learning Outcomes

Upon the successful completion of this module, the student should be able to:

- demonstrate knowledge of the underlying concepts and basic principles of Surveying;
- present, and interpret data obtained through linear and levelling surveys to produce drawings and vertical differentiation.

Reference Systems

- In surveying, reference systems are used to define the position of points on the Earth's surface in both horizontal and vertical dimensions.



Reference Systems

- They ensure that survey data is consistent and aligned with global standards.



Reference Systems

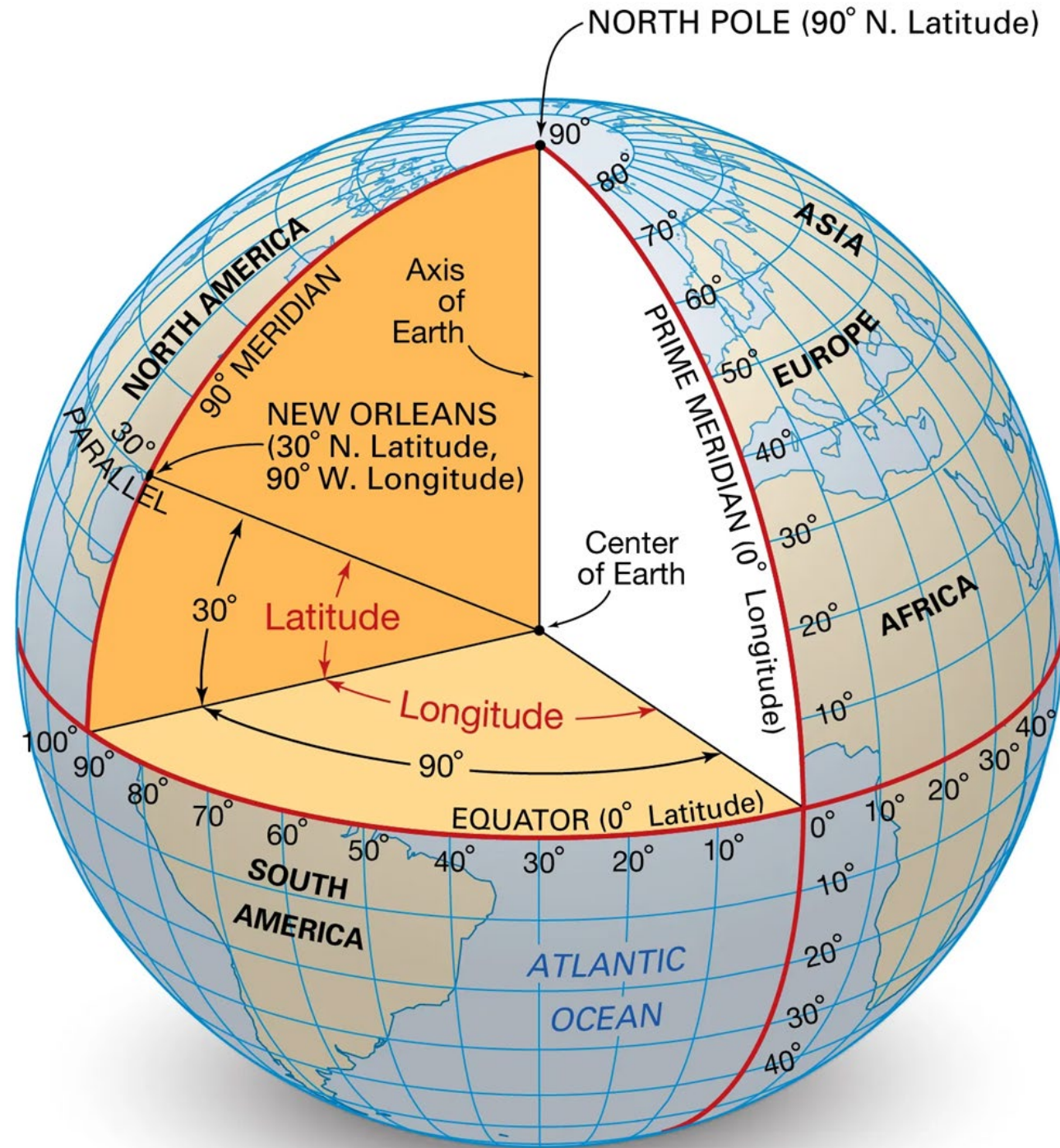
- These systems allow surveyors to specify the exact location of points with precision and accuracy.





Latitude and Longitude

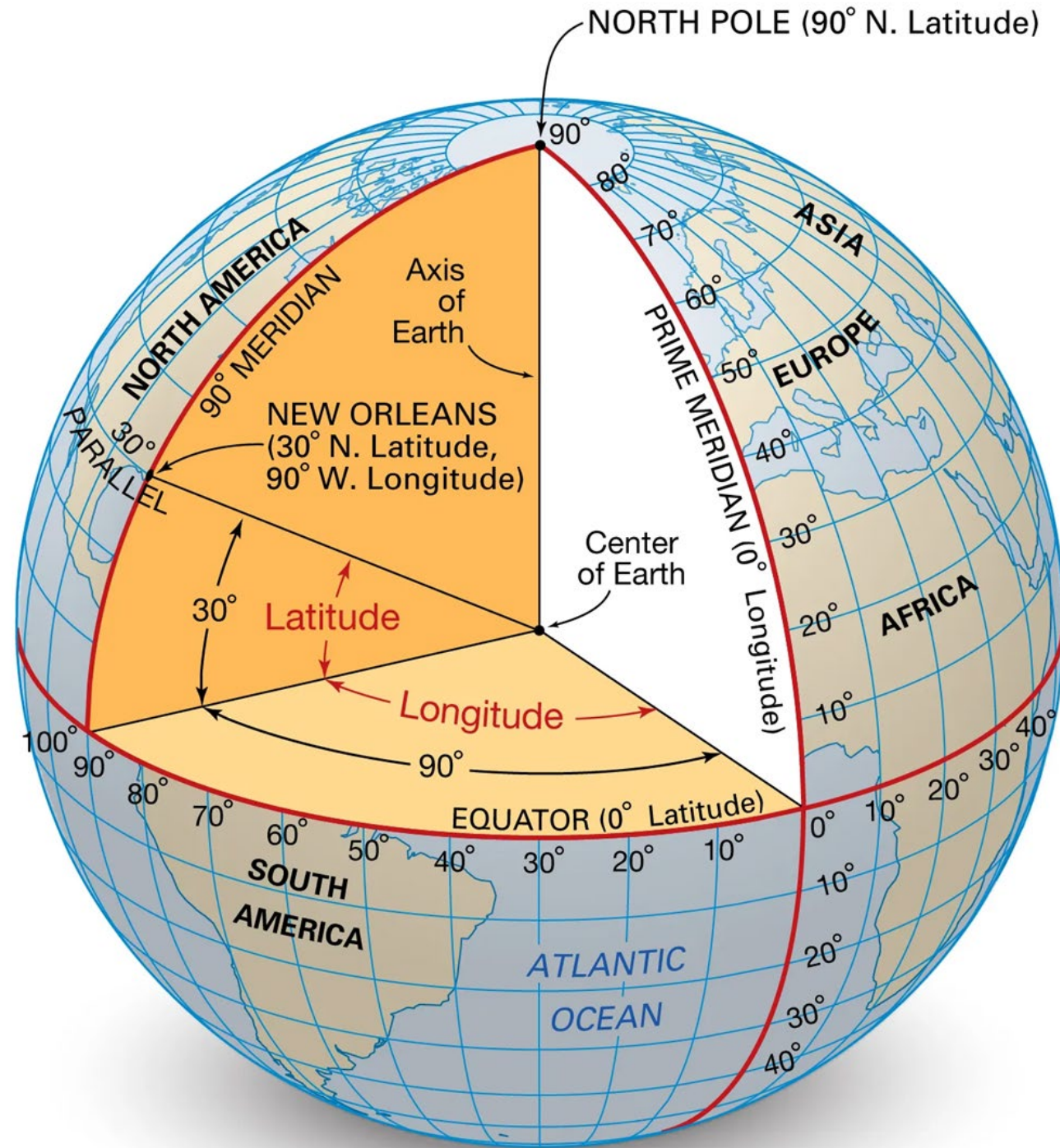
Latitude and Longitude form the most widely used global coordinate system for defining positions on earth.



Latitude and Longitude

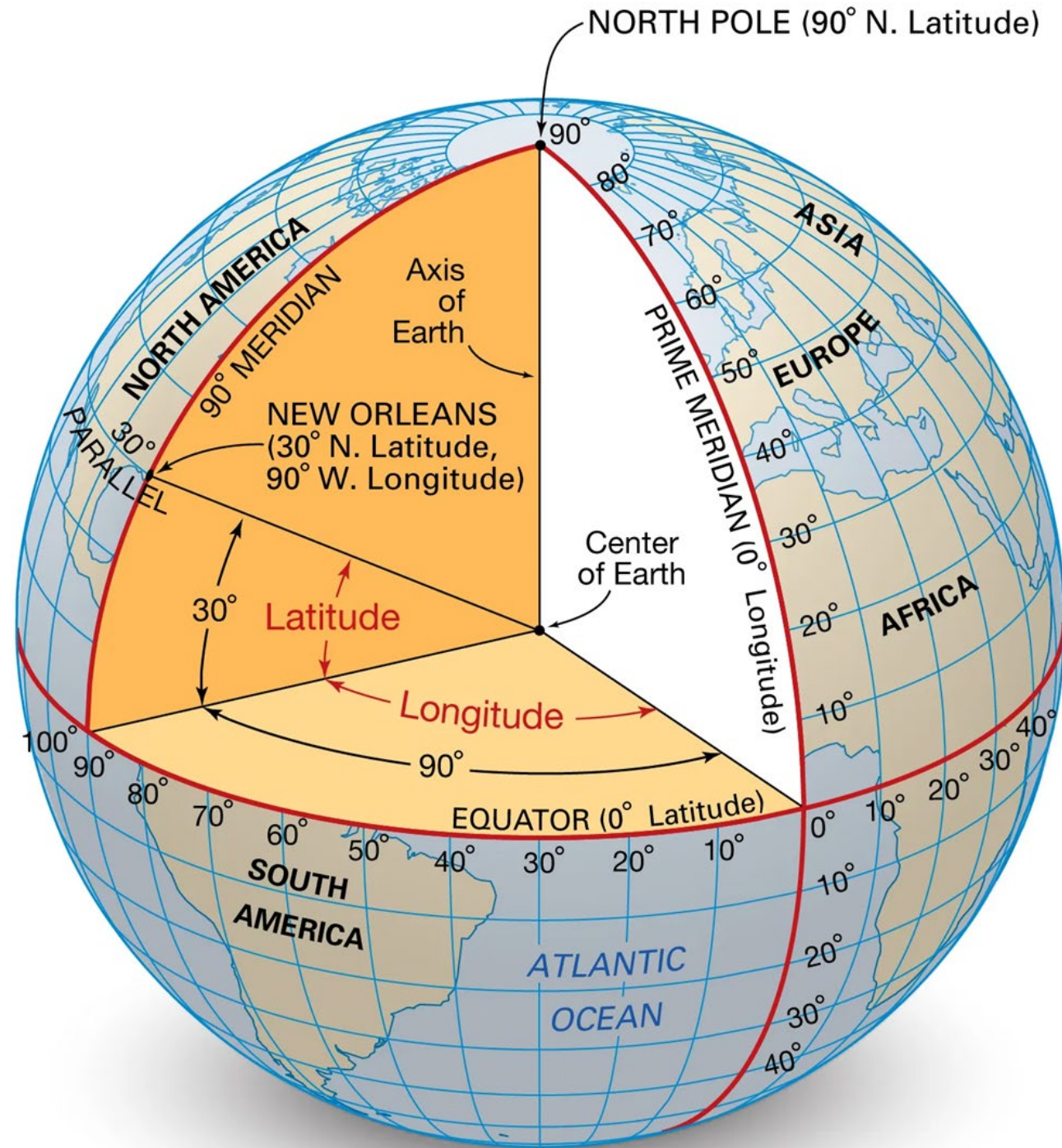
Latitude and Longitude form the most widely used global coordinate system for defining positions on earth.

This system is based on the geographic coordinate system that uses angles measured from the Earth's centre.



Latitude – Measuring North & South

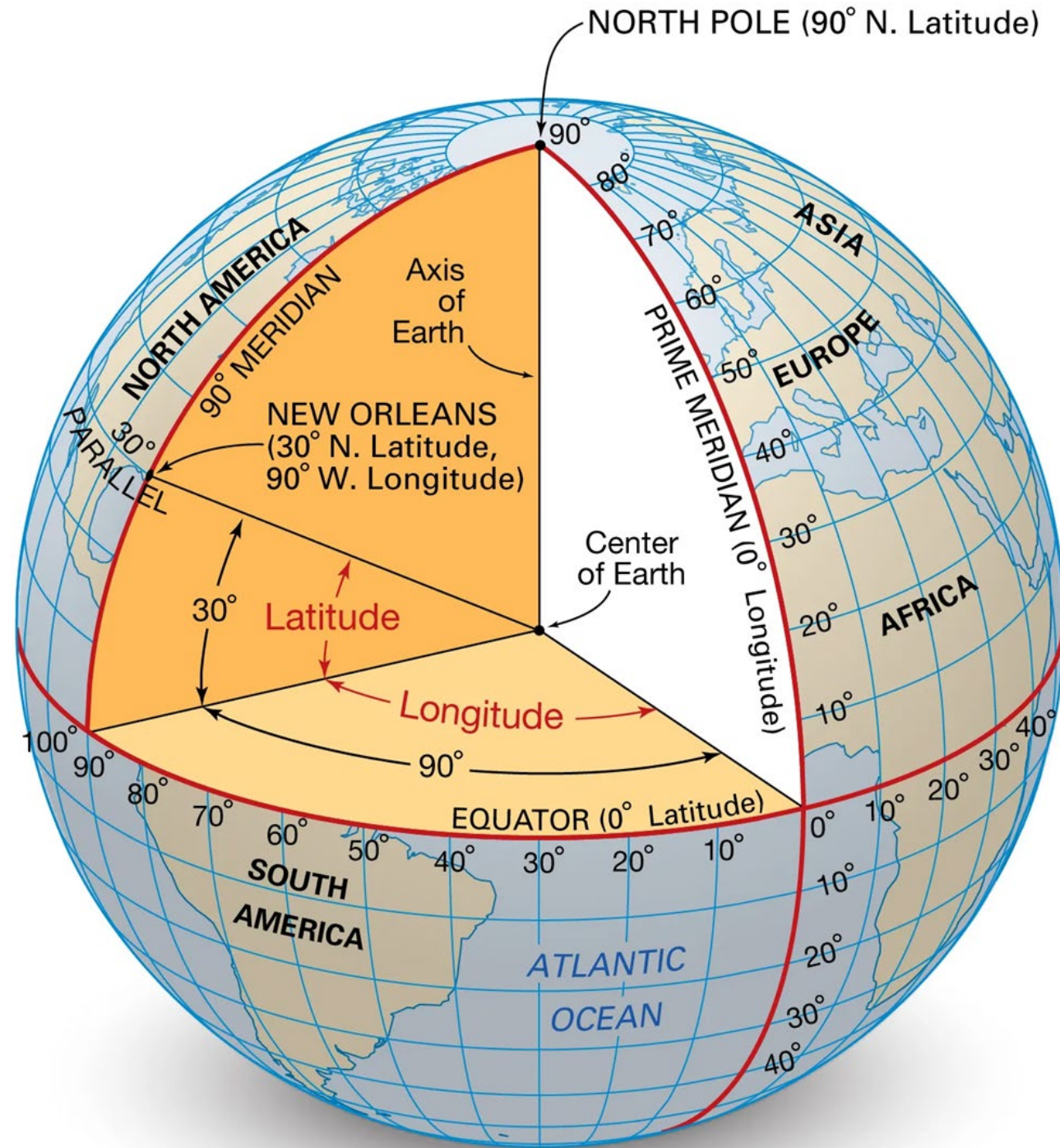
Latitude measures the North-South position relative to the Equator (0°)



Latitude – Measuring North & South

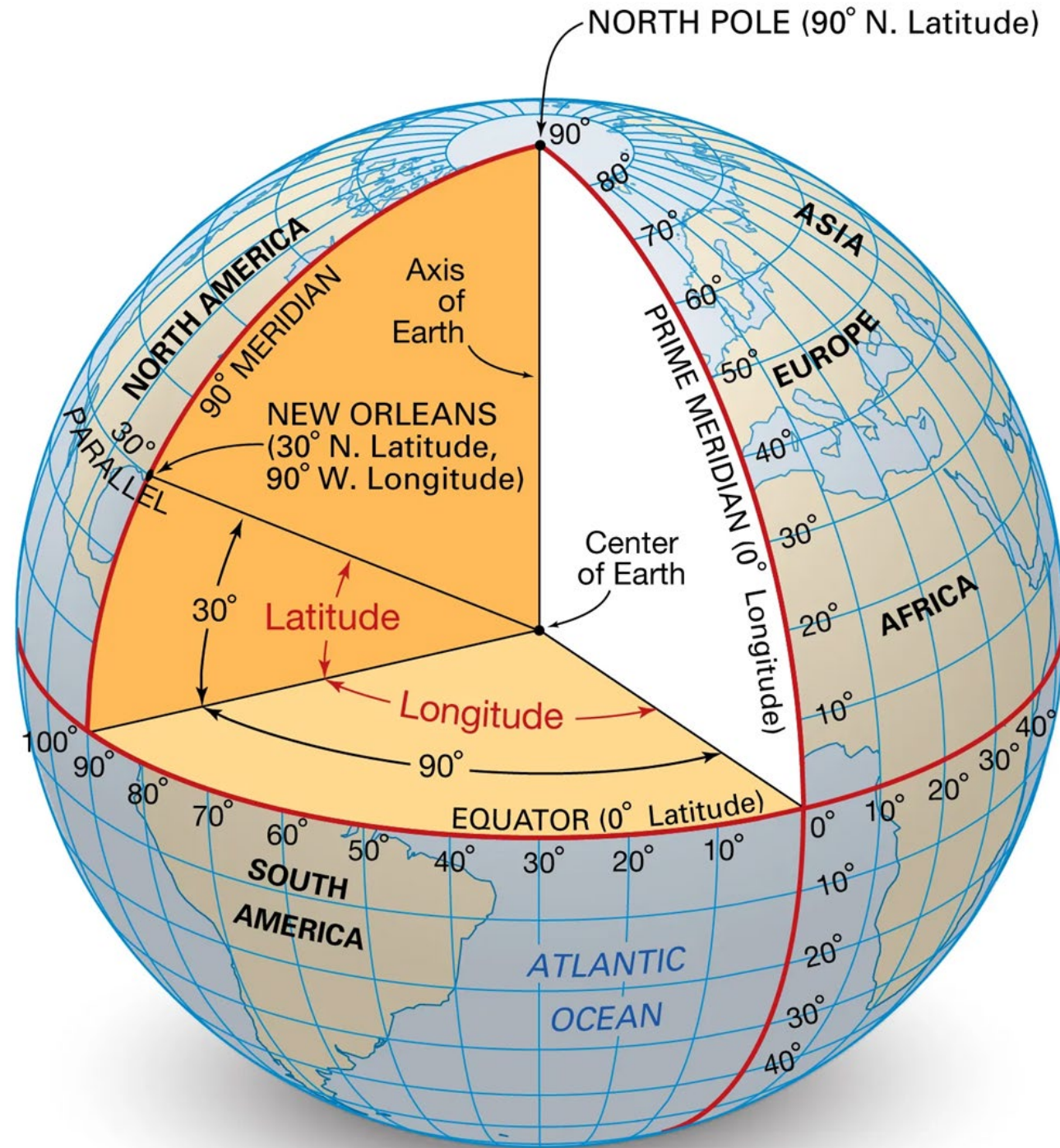
Latitude measures the North-South position relative to the Equator (0°)

The values range from **$+90^\circ$** at the North Pole to **-90°** at the South Pole.



Longitude – Measuring East & West

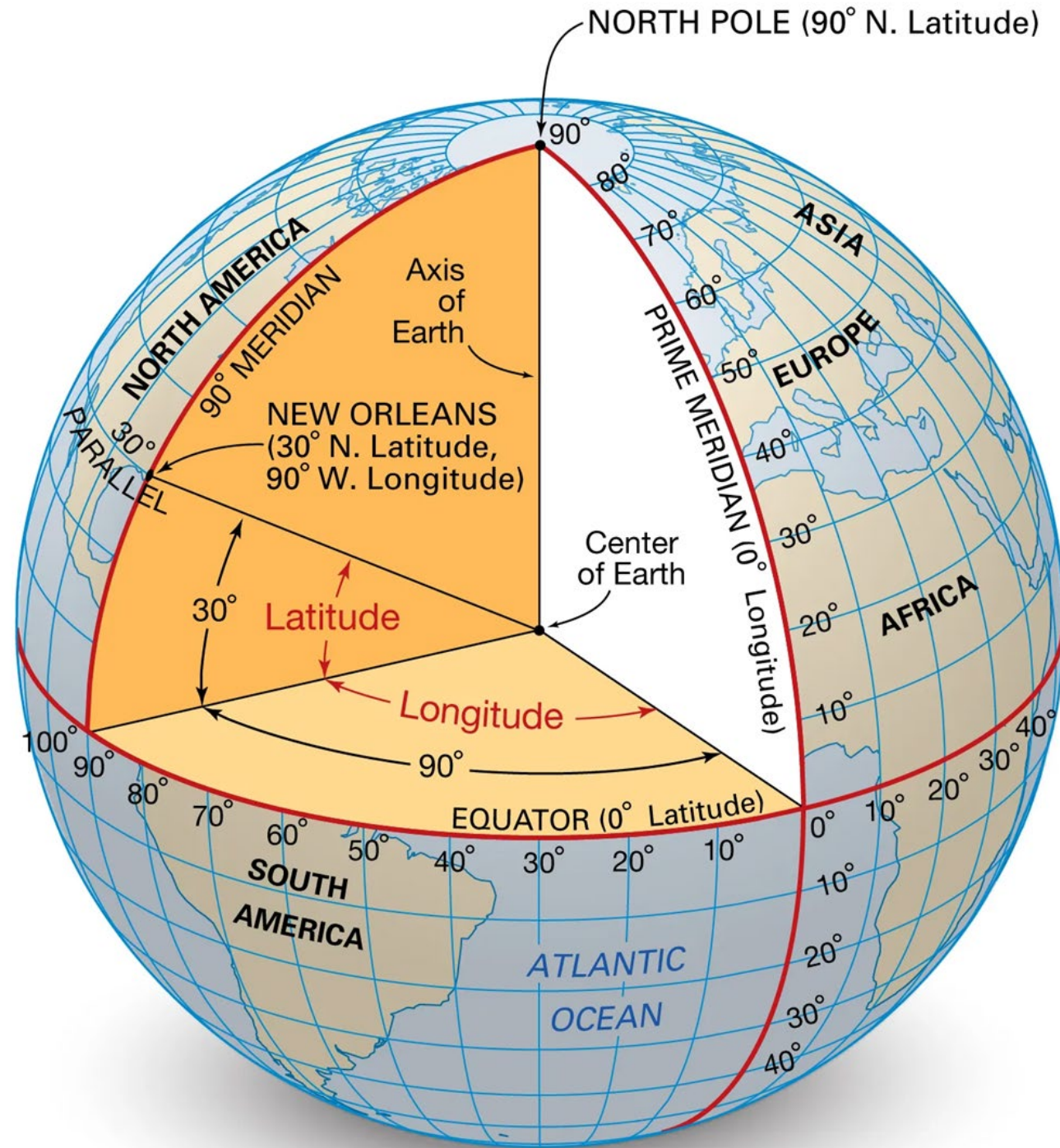
Longitude measures the east-west position from the Prime Meridian (0°) in Greenwich, UK.



Longitude – Measuring East & West

Longitude measures the east-west position from the Prime Meridian (0°) in Greenwich, UK.

The values range from **$+180^\circ$** east to **-180°** west.

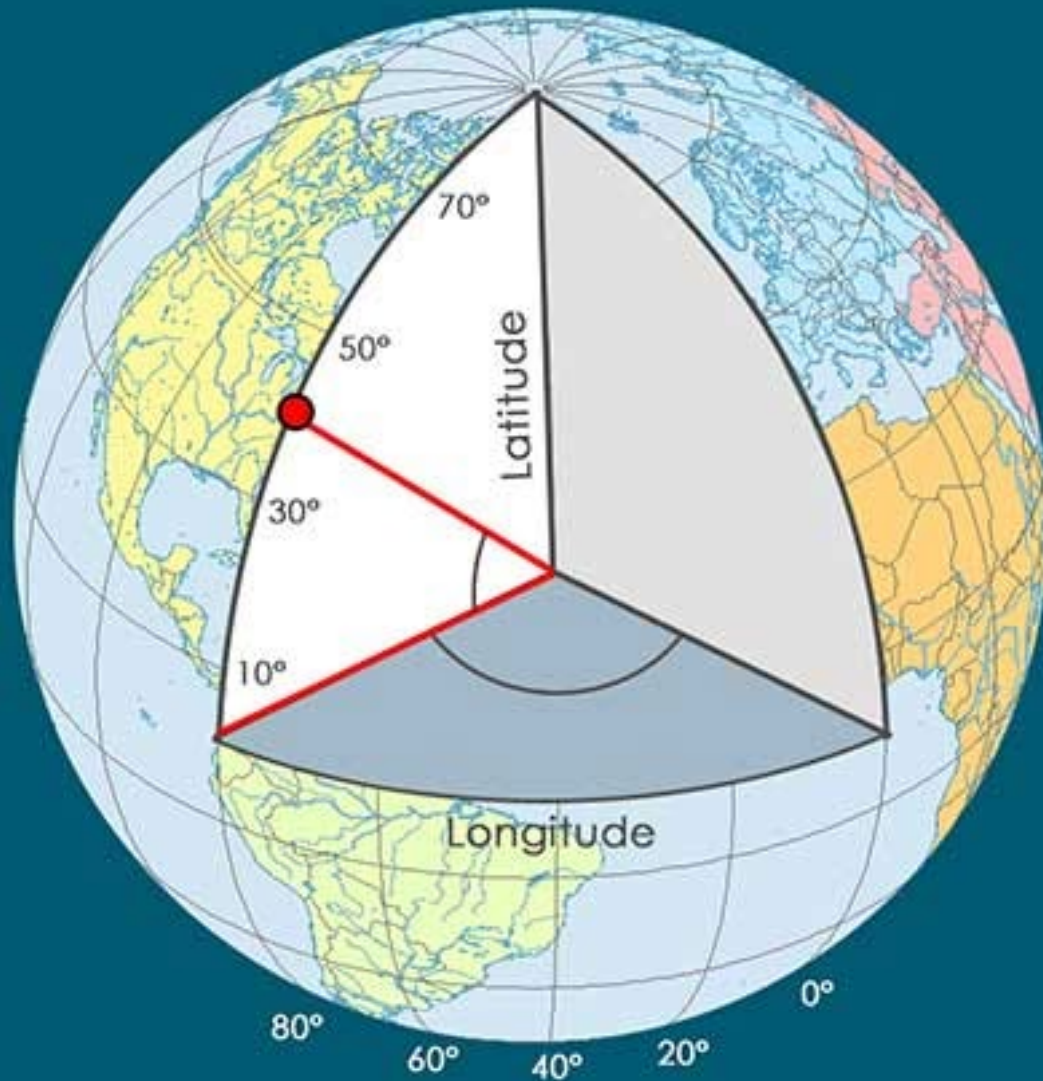


Coordinates in Action: Swansea





Latitude	Longitude
51°30'N	0°08'W
38°54'N	77°02'W
39°55'N	116°23'E
1°29'N	103°44'E
35°18'S	149°07'E
34°36'S	58°23'W



DECIMAL DEGREES

VS

**DEGREES / MINUTES /
SECONDS**

Decimal Degrees vs Degrees/Minutes/Seconds

One way to write spherical coordinates (latitudes and longitudes) is using degrees-minutes-seconds (DMS).

An angle written using:

Degrees ($^{\circ}$) Minutes ($'$) Seconds ($''$)

Where:

$1^{\circ} = 60$ minutes

$1' = 60$ seconds

$1'' = 3600$ seconds

Decimal Degrees vs Degrees/Minutes/Seconds

$52^{\circ}12'30''$

Meaning:

52 whole degrees

12/60 of a degree

30/3600 of a degree

Decimal Degrees vs Degrees/Minutes/Seconds

But you can also express geographic coordinates in decimal degrees. It's just another way to represent that same location in a different format.

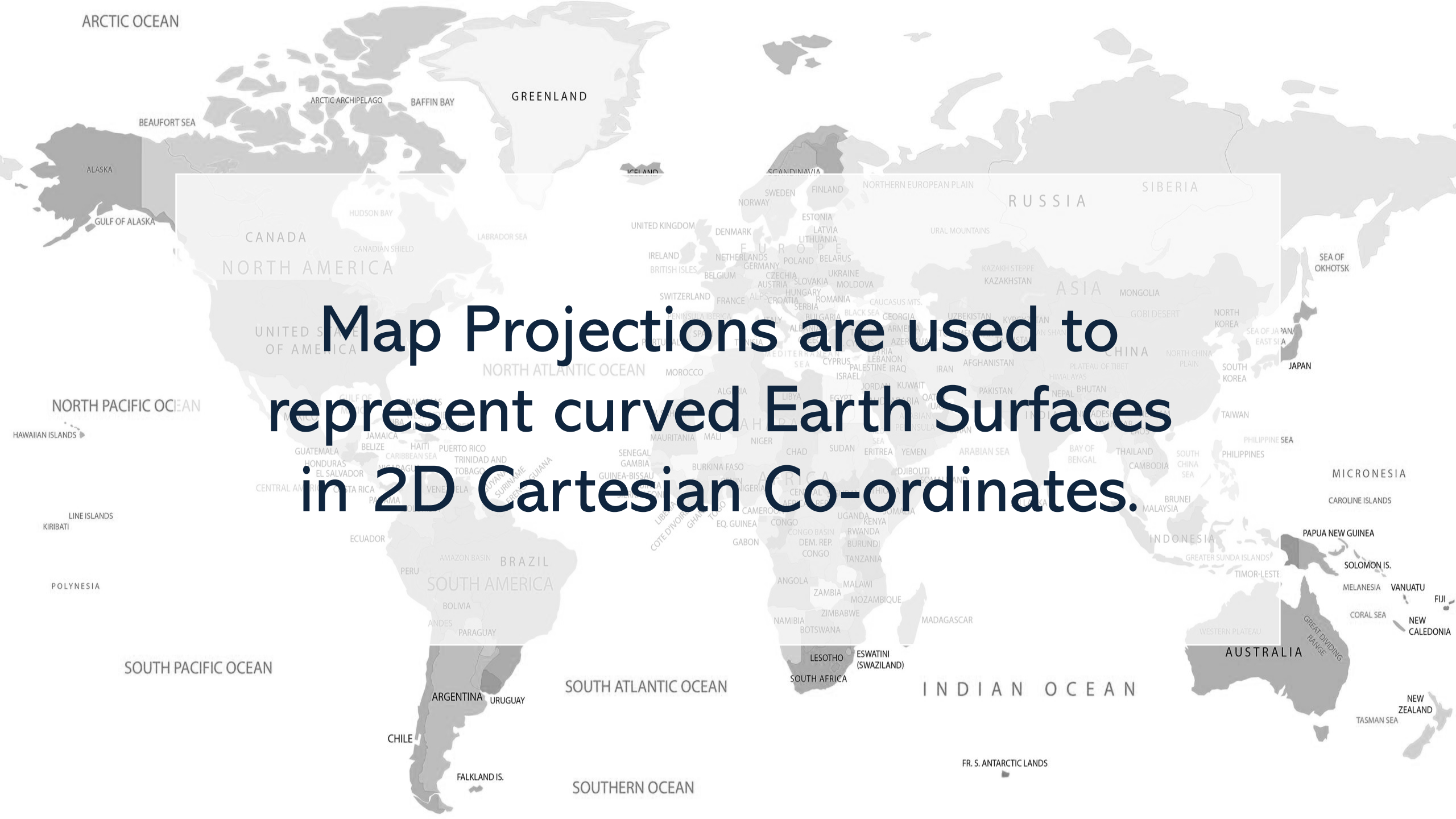
52.20833°

Meaning:

52 degrees

0.20833 of a degree





Map Projections are used to
represent curved Earth Surfaces
in 2D Cartesian Co-ordinates.

Maps are notoriously difficult to make as cartographers need to unfold our **spherical** Earth onto a **flat** surface.

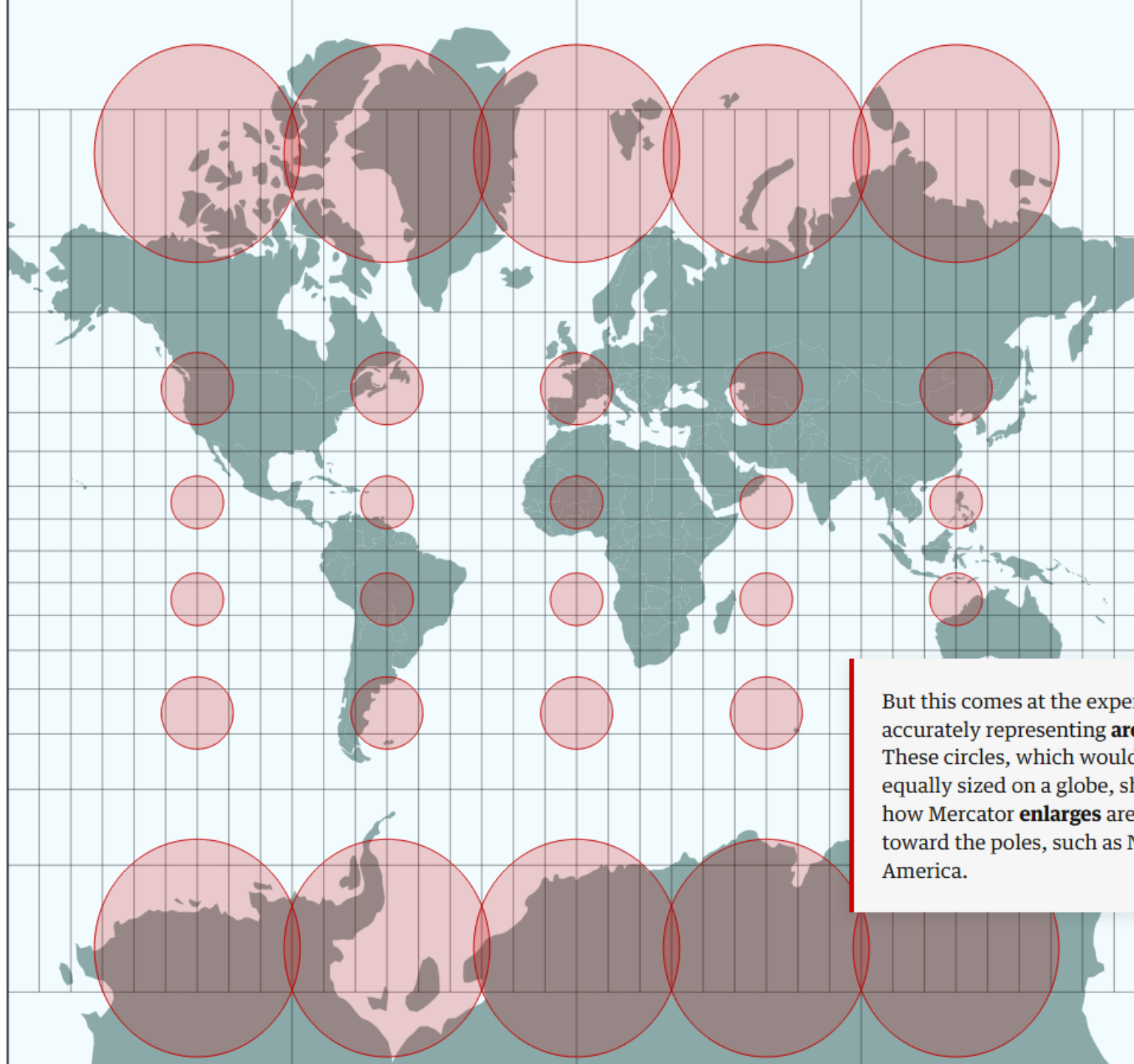




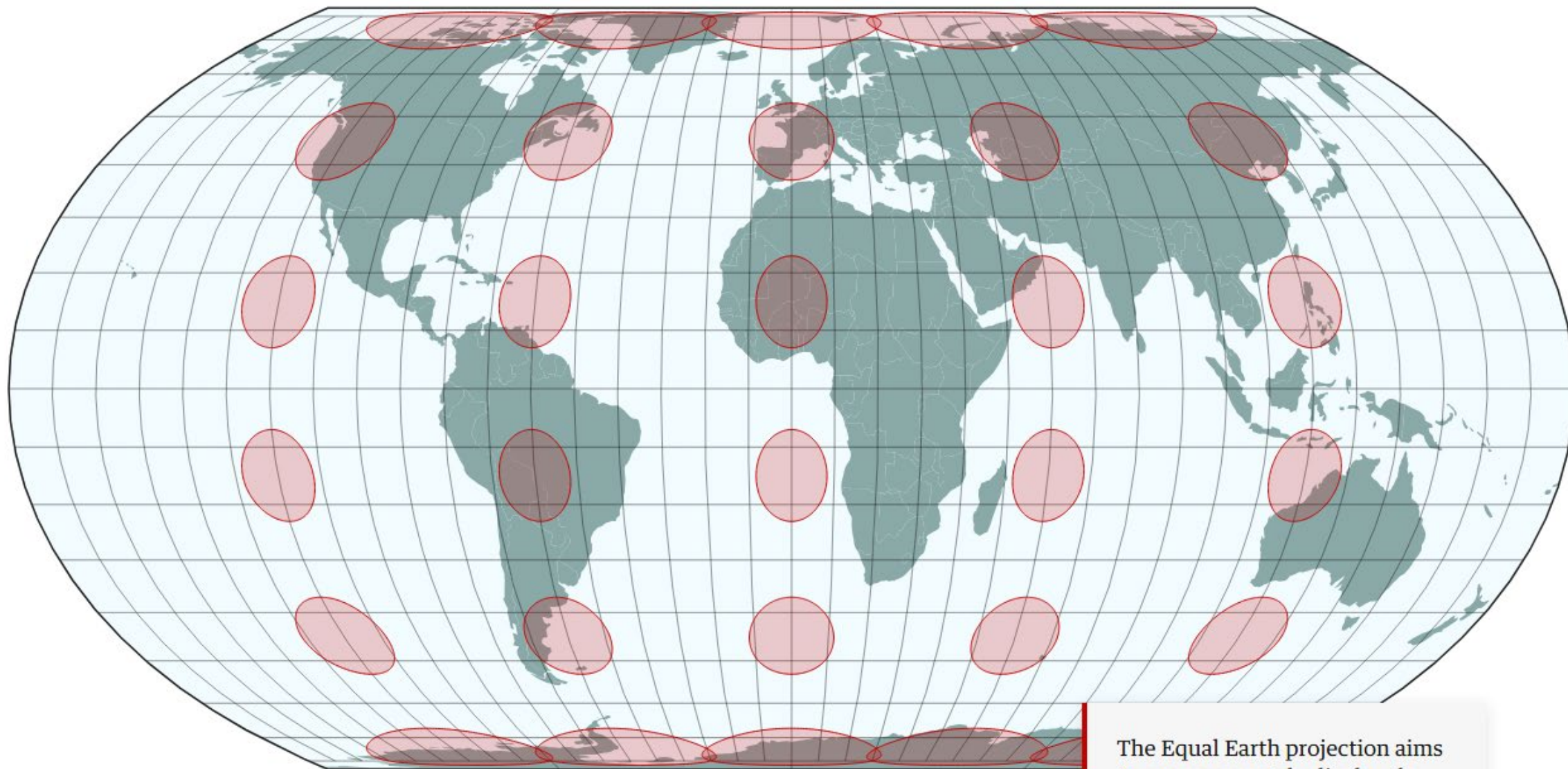
To get around this problem, cartographers use mathematical **projections**. But these can **distort** shape, area, distance, direction.



The 1569 Mercator projection was developed to help navigators, as **each straight line matches a compass bearing.**

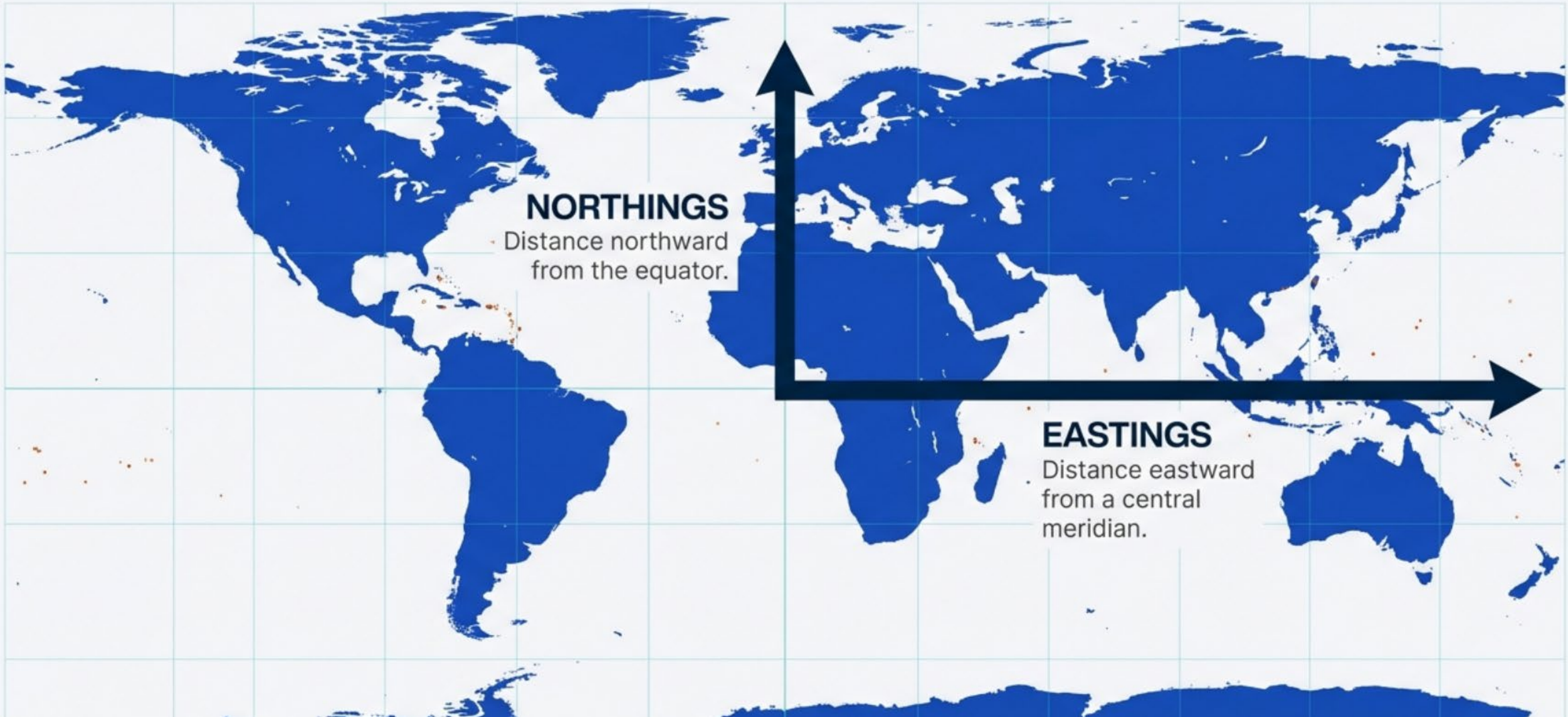


But this comes at the expense of accurately representing **area**. These circles, which would look equally sized on a globe, show how Mercator **enlarges** areas toward the poles, such as North America.



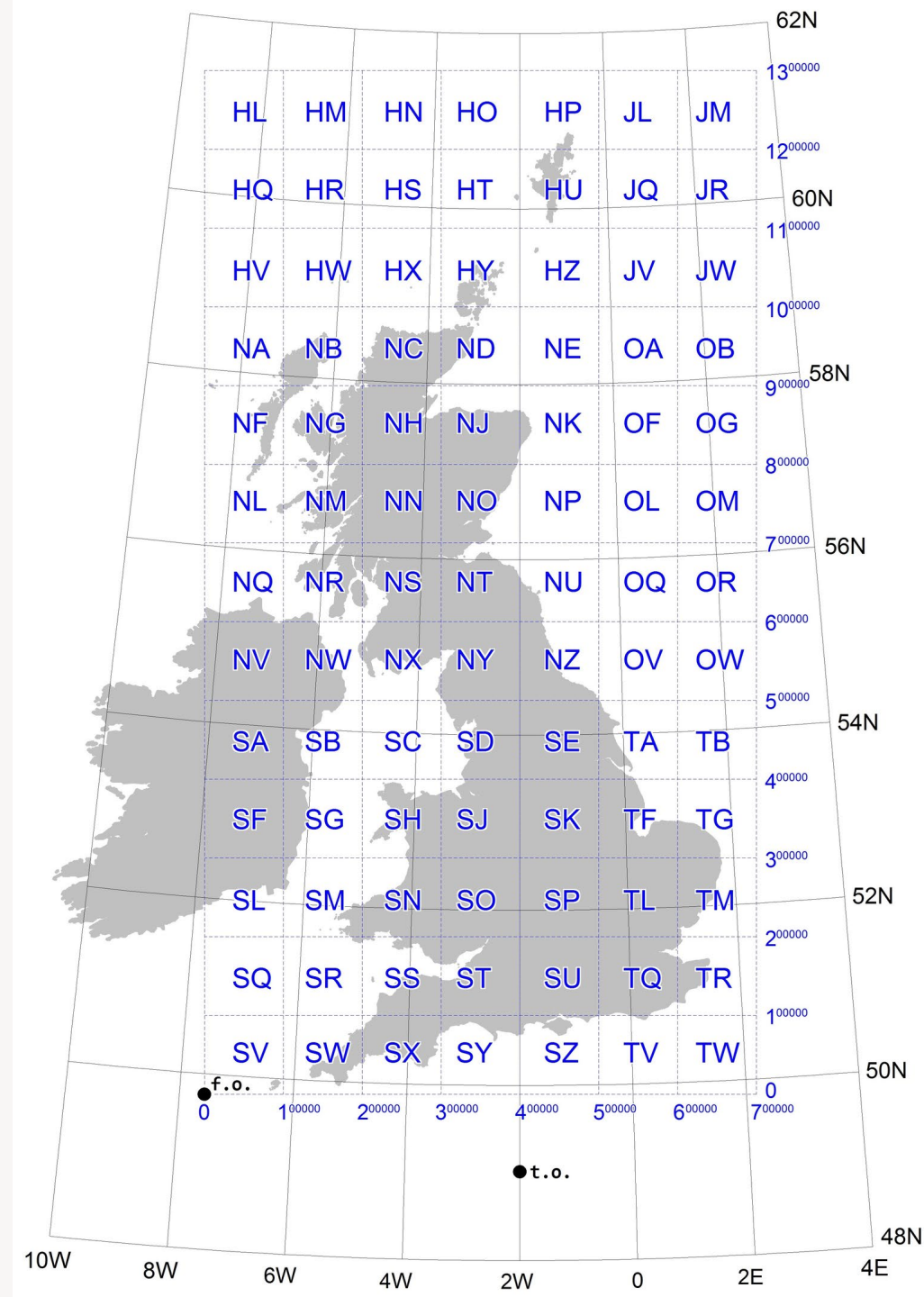
The Equal Earth projection aims to more accurately display the **relative size** of Africa, Asia and Latin America.

Eastings and Northings



Local Coordinate System

- The National Grid is a local projection system used in the UK for land surveys.
- It uses eastings and northings but is based on a transverse Mercator projection tailored to fit the UK's geography.



Local Coordinate System

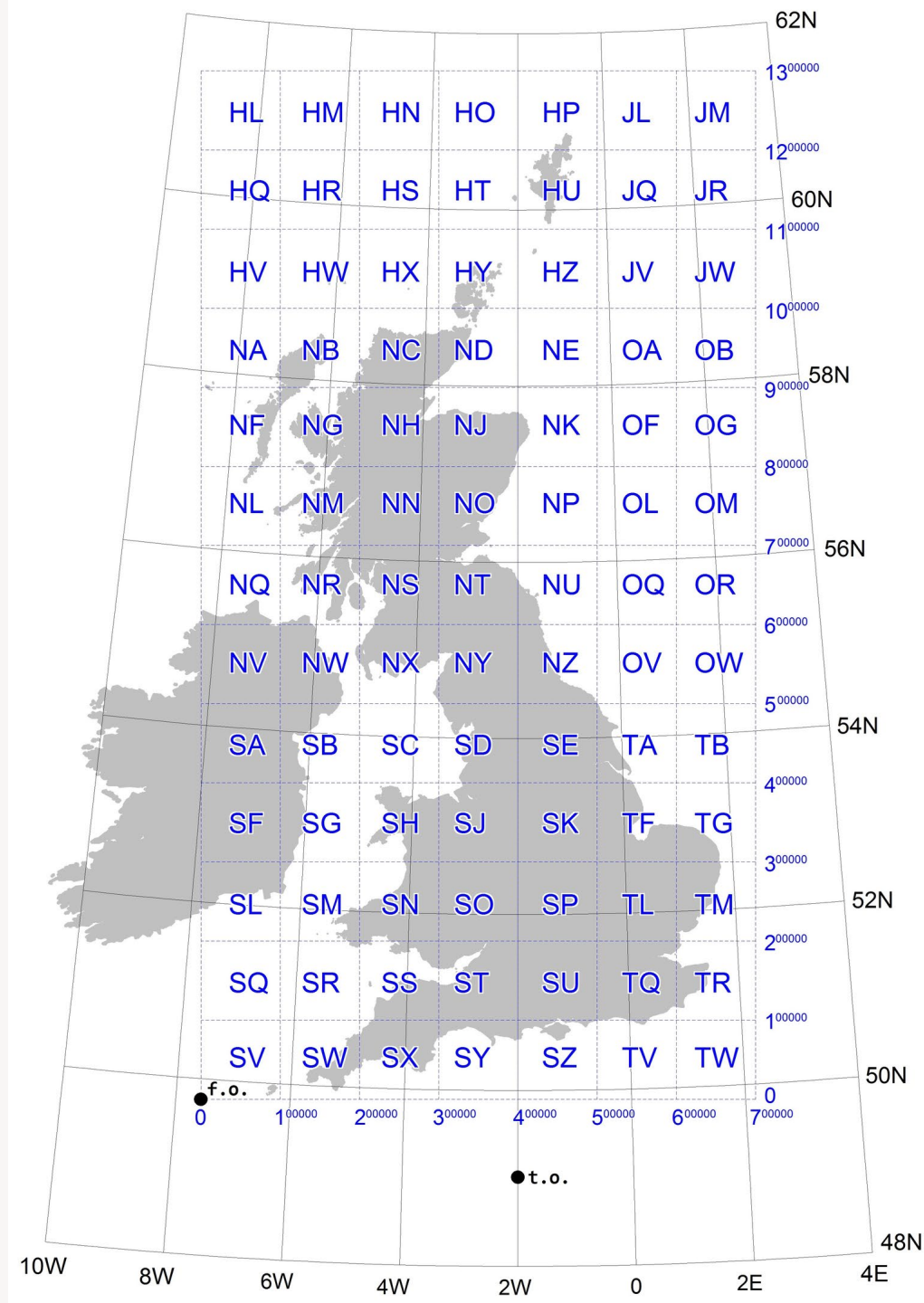
- The first letter identifies a 500km square.

A	B	C	D	E
F	G	H	J	K
L	M	N	O	P
Q	R	S	T	U
V	W	X	Y	Z

A yellow map of the United Kingdom is overlaid on the grid, specifically covering the 'N' and 'S' squares. The map is positioned such that it spans across the vertical boundary between the 'N' and 'S' squares, with the majority of the landmass falling within the 'S' square.

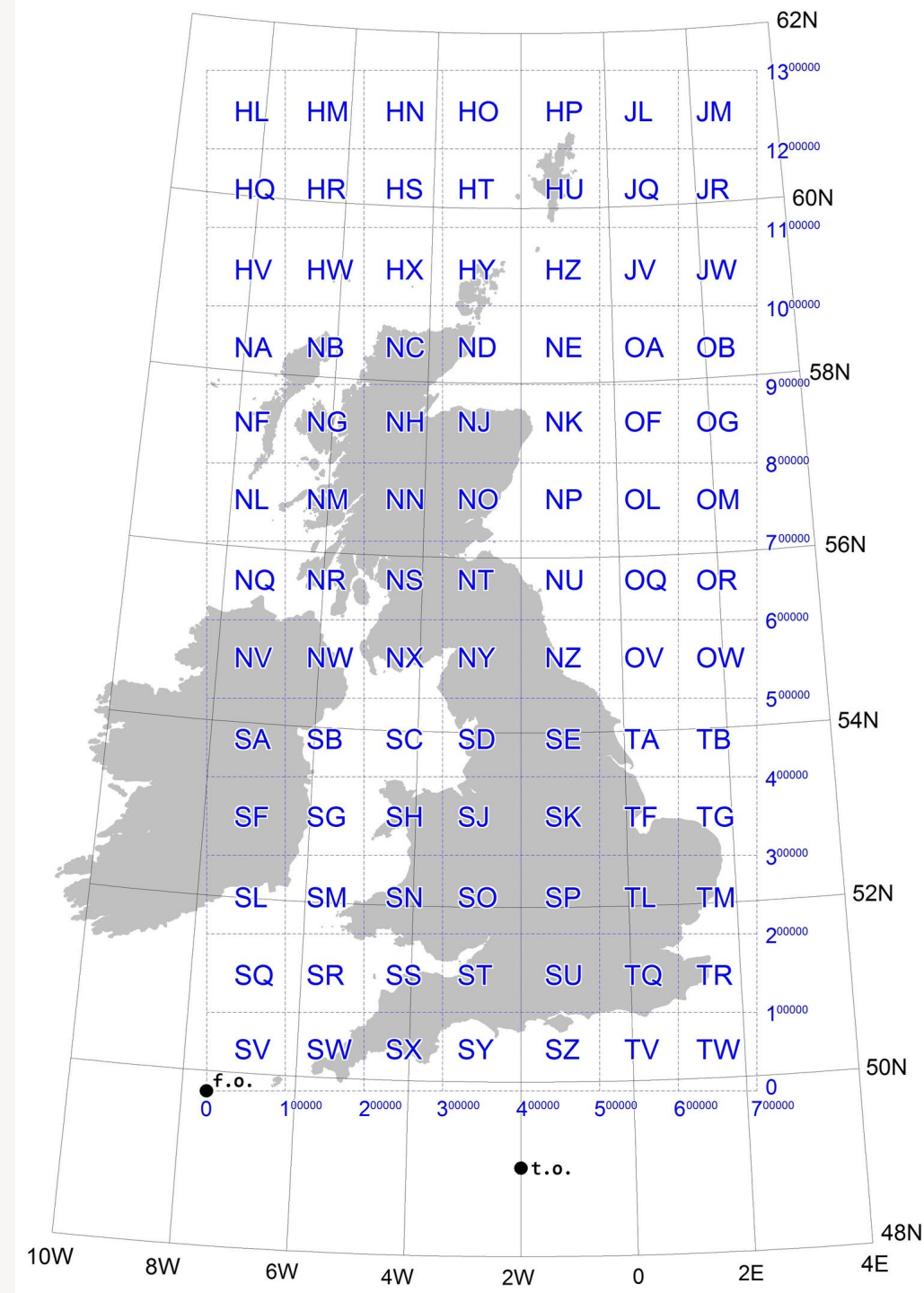
Local Coordinate System

- The first letter identifies a 500km square.
- Each 500km square is then divided into twenty-five 100km squares, and these squares are then labelled using the same pattern of letters.



Local Coordinate System

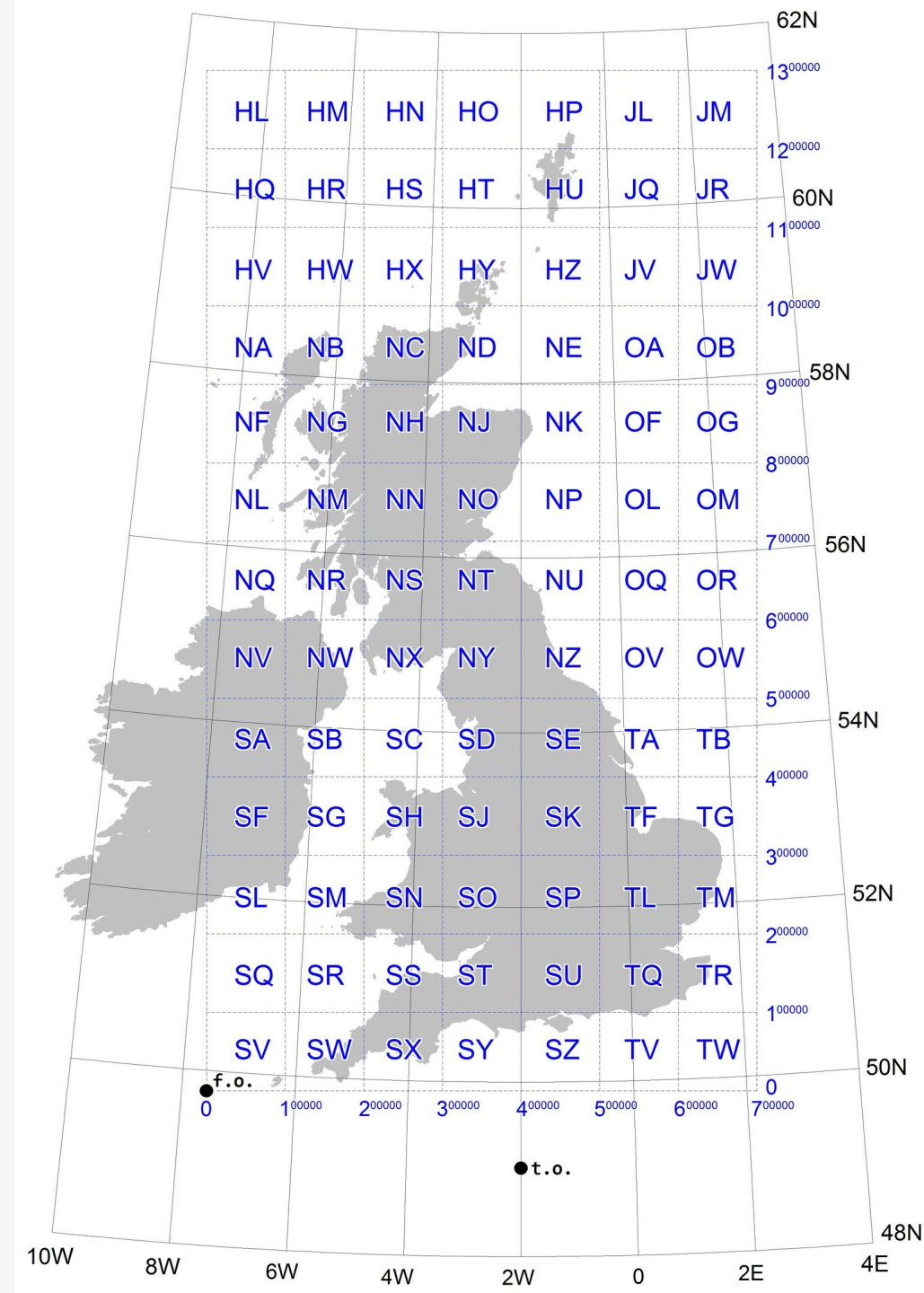
- The digits identify a location within a 100km square.
 - 2 digits: the Easting and Northing are each in units of 10km;
 - 4 digits: the Easting and Northing are each in units of 1km;
 - 6 digits: the Easting and Northing are each in units of 100m;
 - 8 digits: the Easting and Northing are each in units of 10m;
 - 10 digits: the Easting and Northing are each in units of 1m.





Convert Grid Reference to Eastings and Northings

1. Remove the two letters at the beginning of the reference.
2. Split the reference into it's East and North components.
3. Work out the numerical reference for the two letters.
4. Add the appropriate 100km reference to the rest of the reference.



Elevation

- Elevation refers to the vertical distance of a point above or below a reference level, typically mean sea level (MSL).



Elevation

- Heights above sea level are positive, while measurements below sea level are negative

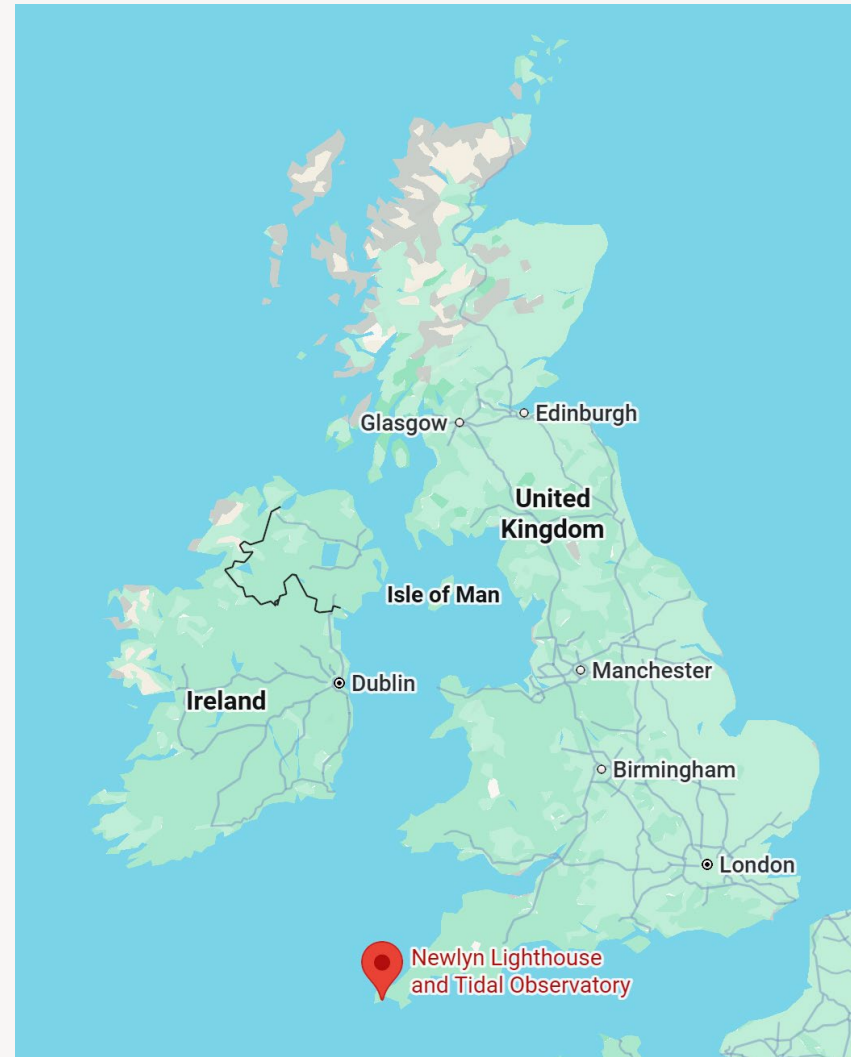




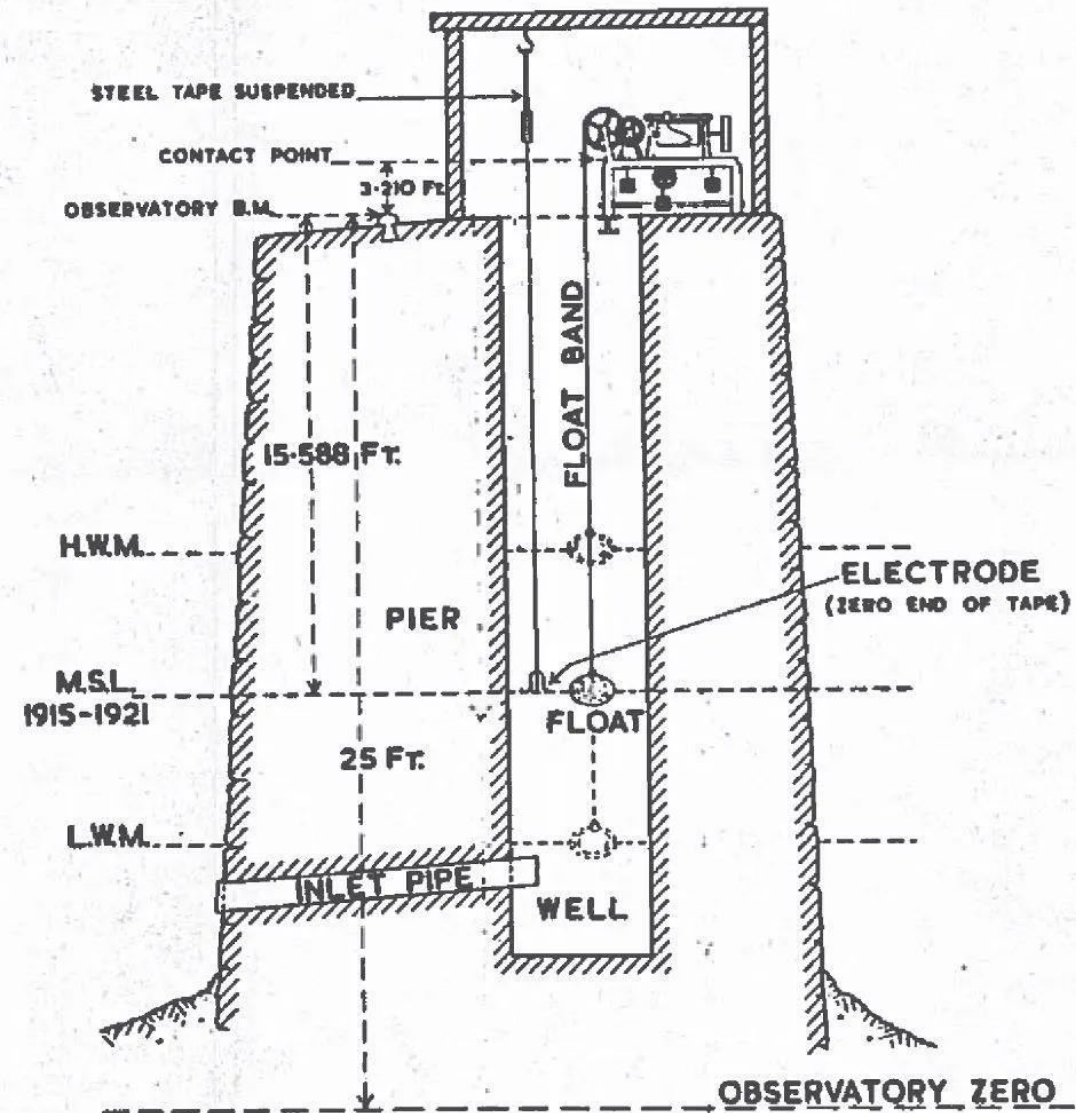
Elevation



Elevation



TIDAL OBSERVATORY (NEWLYN)

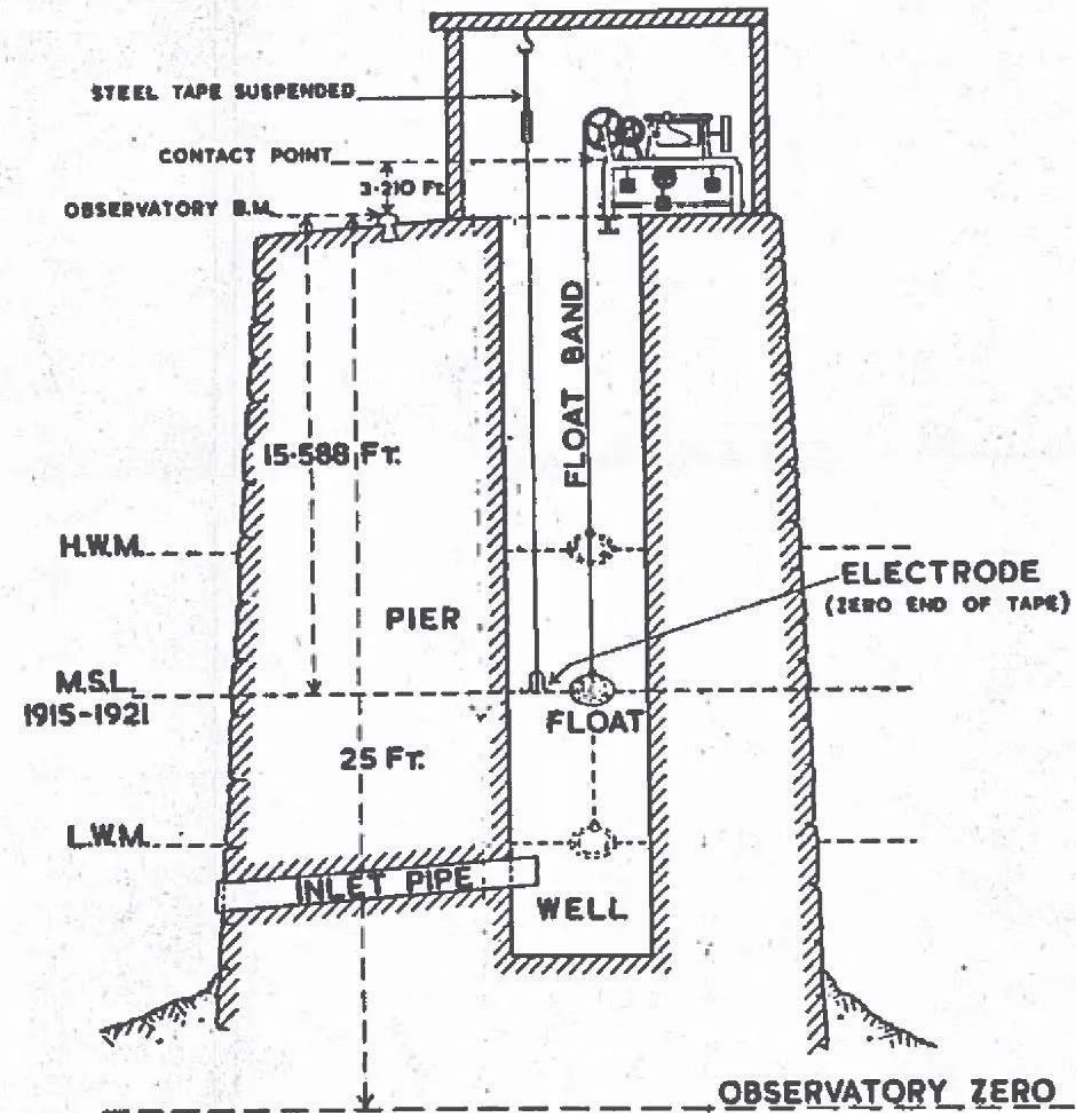


Elevation

On 30 April 1921, sea level recording here by OS was concluded after six years.

Within these six years, the Newlyn tide gauge took hourly readings.

TIDAL OBSERVATORY (NEWLYN)

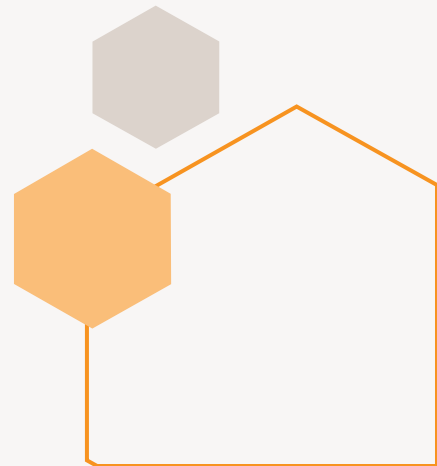


Elevation

The resulting height datum is known as Ordnance Datum and marks height zero on maps in Britain.

Elevation

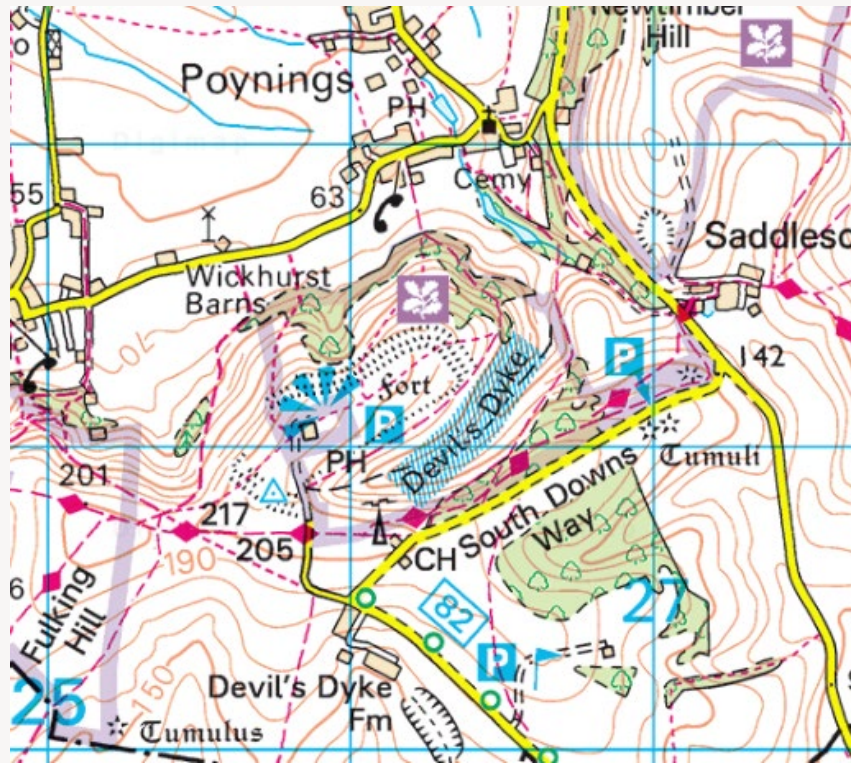
On Ordnance Survey maps there are 3 methods of showing height.



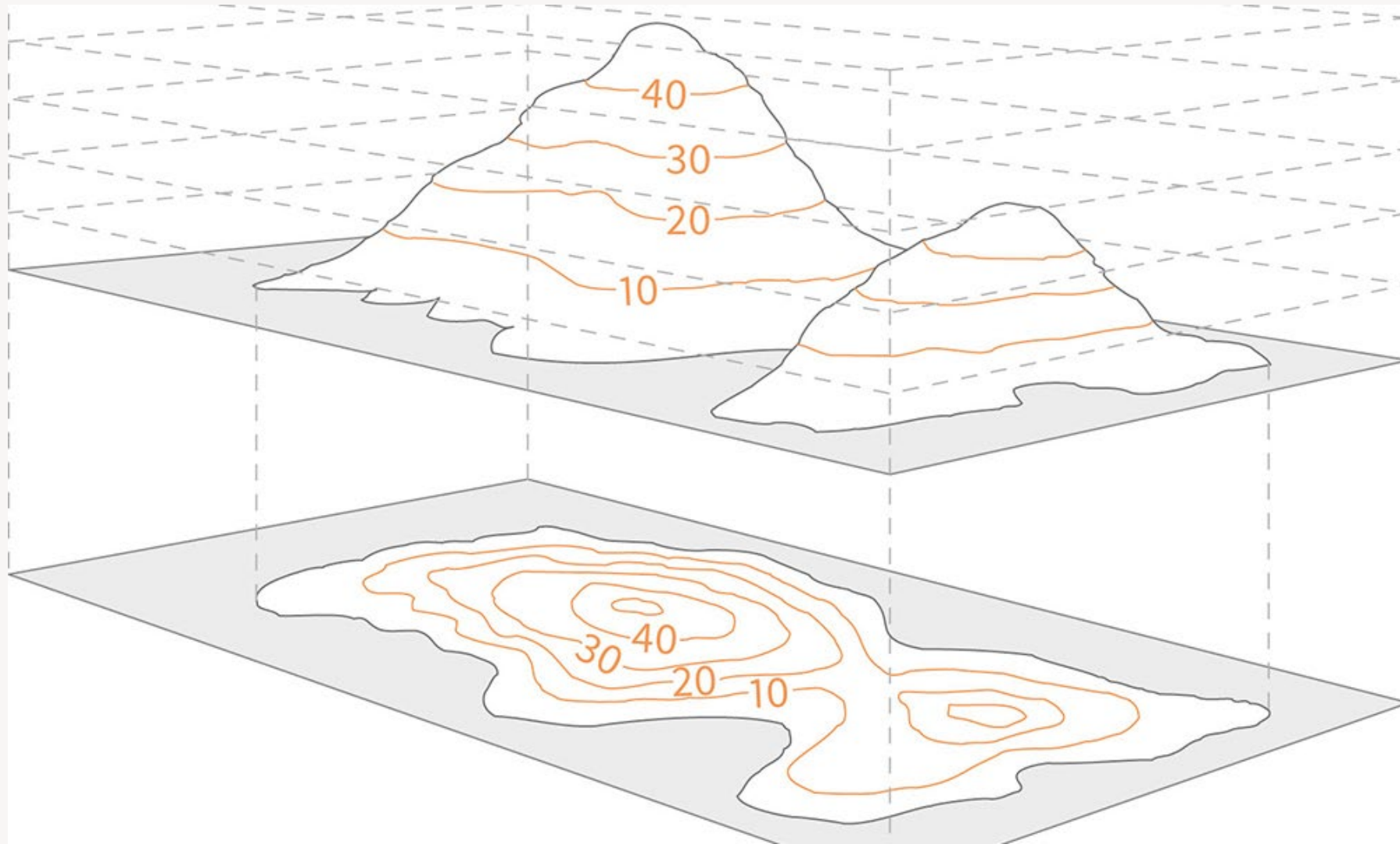


Contours

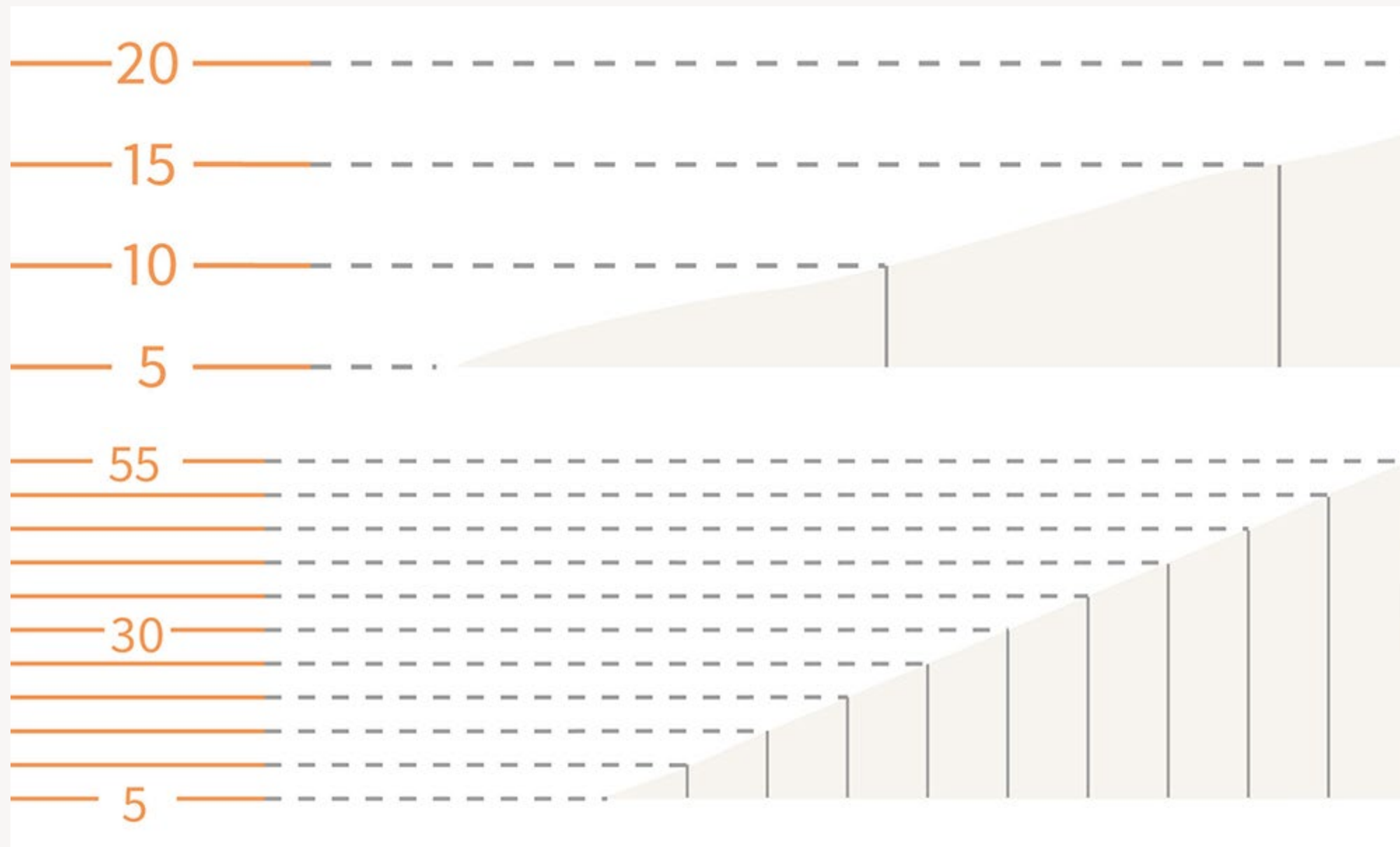
A contour line is a line joining all points of equal height.



Contours



Contours

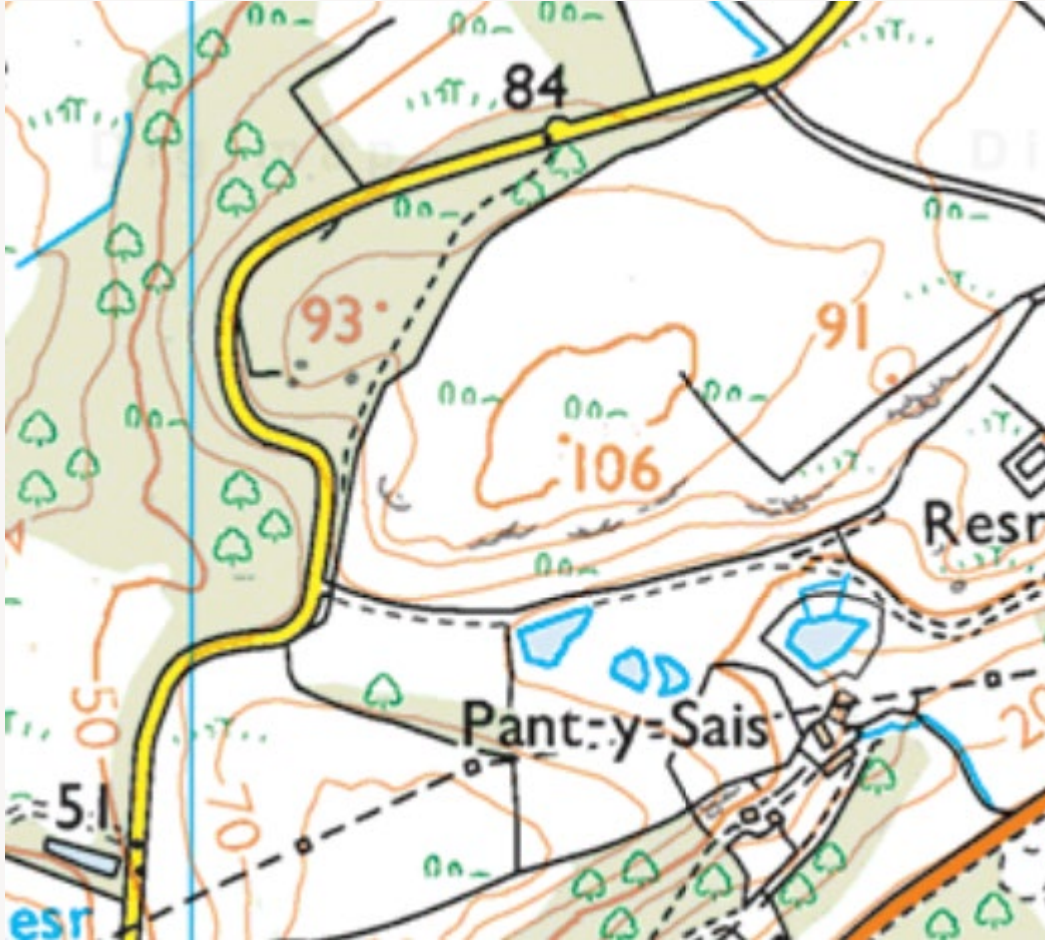




Spot Heights

A spot level is simply a level print on the map.





Spot Heights

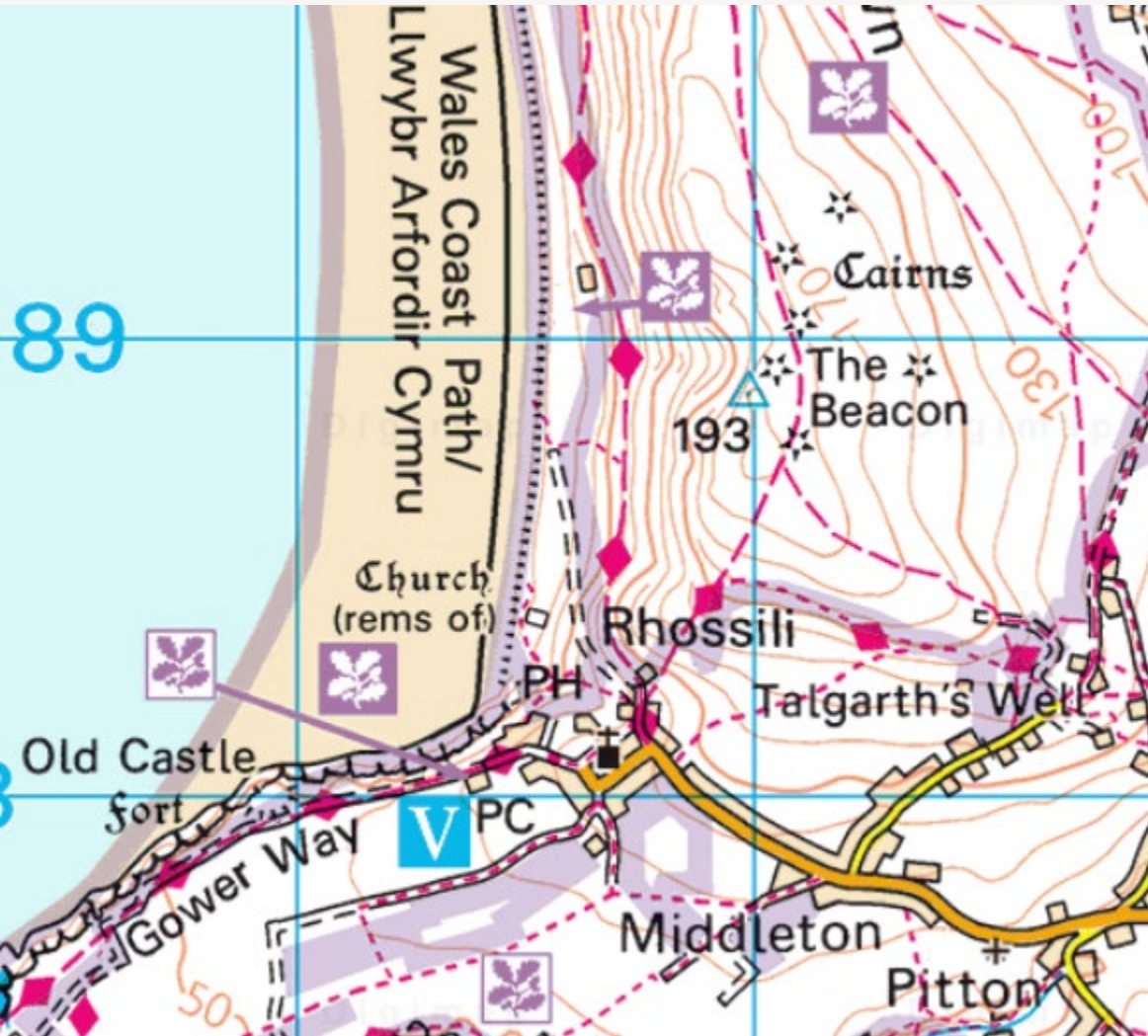
Ground Survey Height vs
Air Survey Height



Triangulation Points

Provide stable, precise points for surveyors to create accurate maps by measuring angles between them





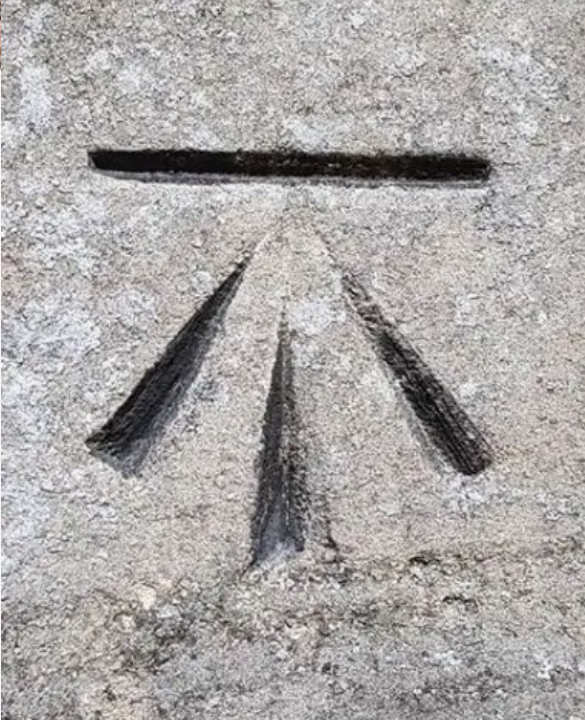
Triangulation Points

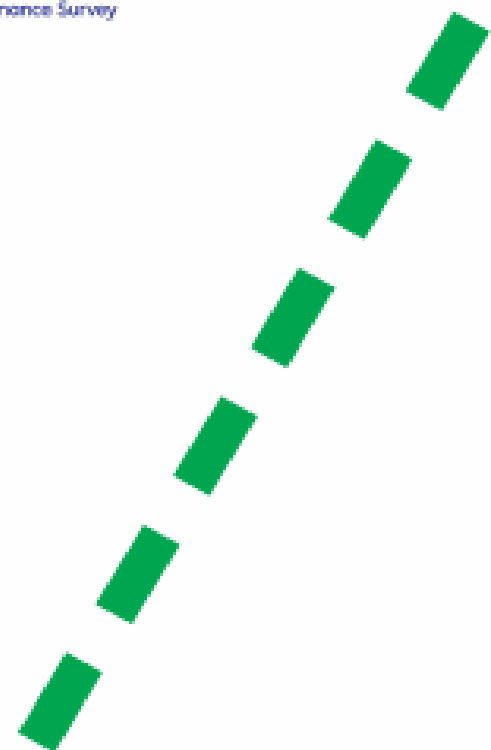
Provide stable, precise points for surveyors to create accurate maps by measuring angles between them

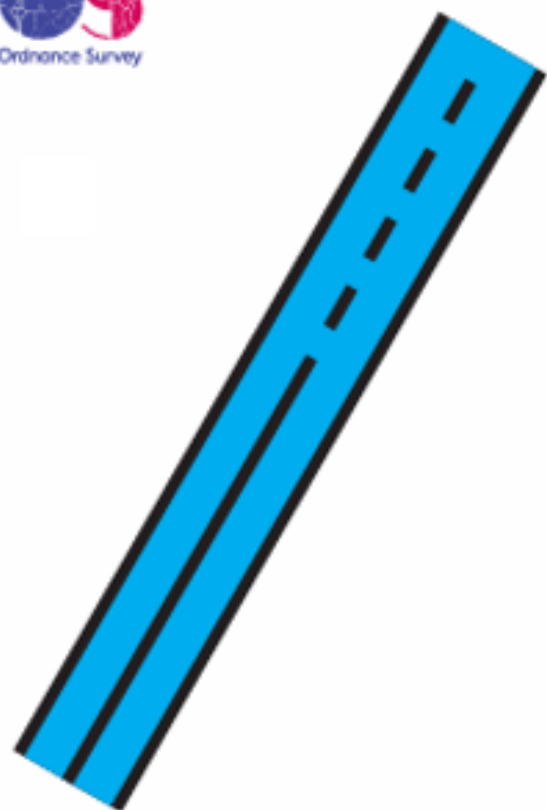


OS Benchmarks

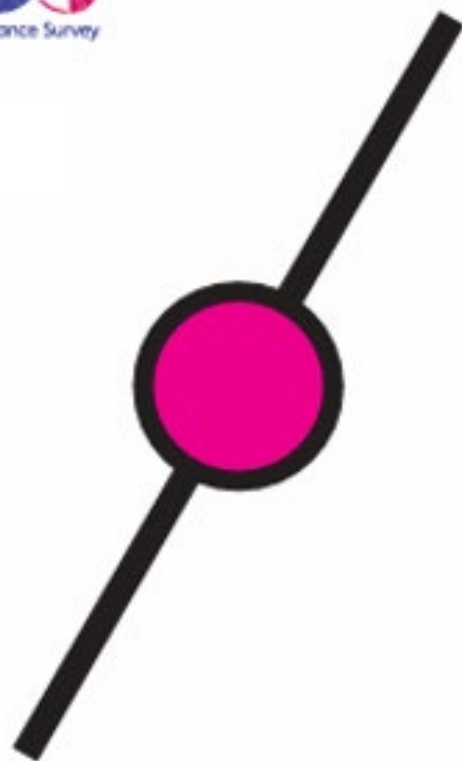
An OS benchmark is a fixed point with a known elevation above a reference level (usually mean sea level).







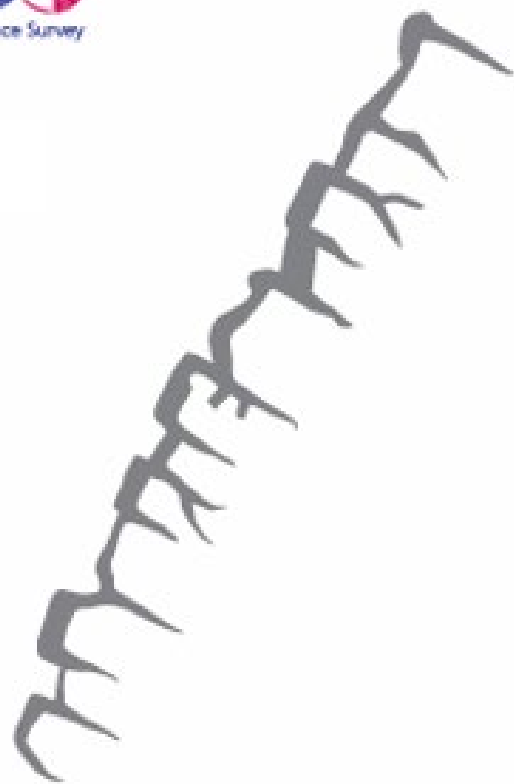




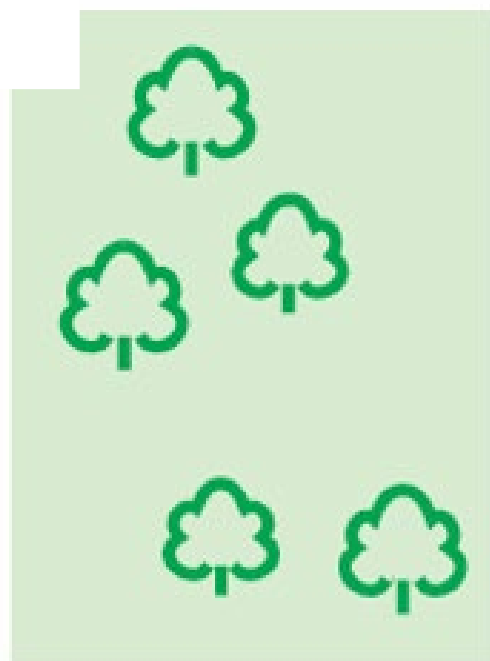


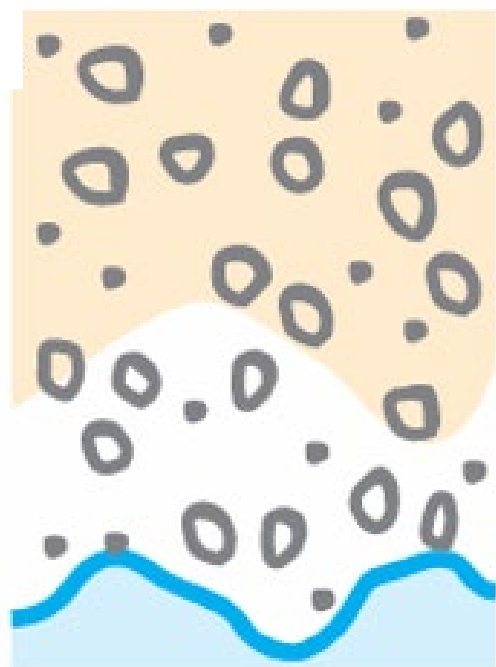


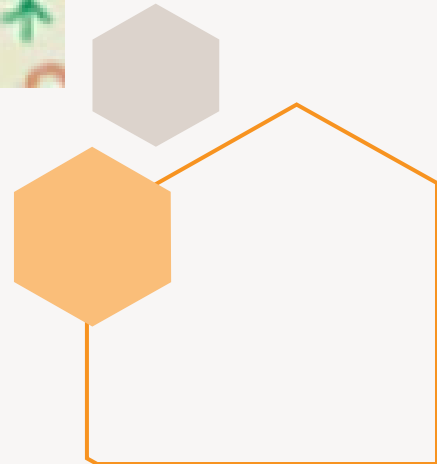
Ordnance Survey



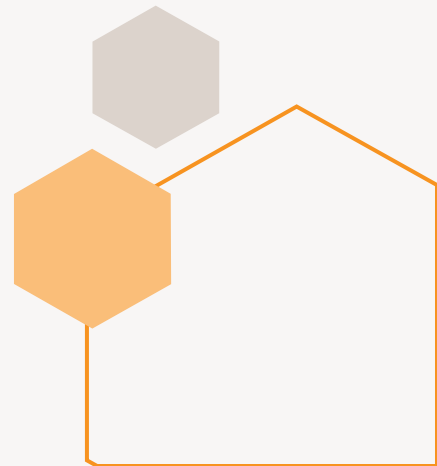






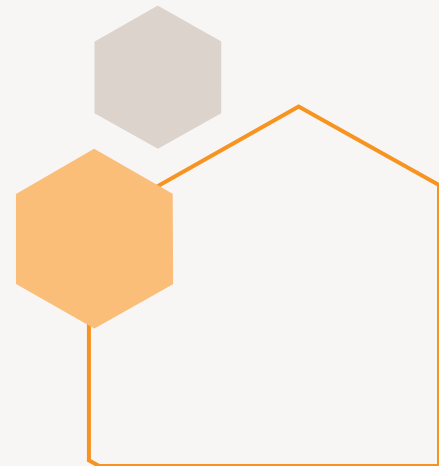


Understanding Plans



Understanding Plans

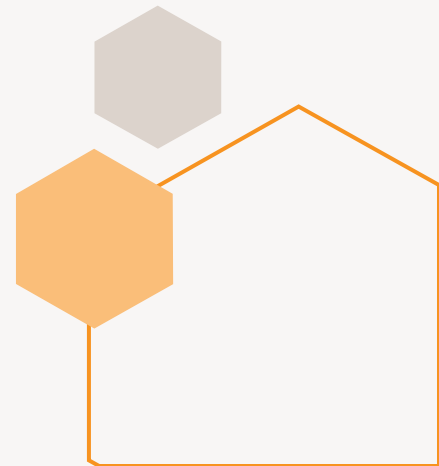
Item	Symbol	Alternatives
Fence		
Tree		
Gate		
Embankment/ Cutting		
Hedge		
Spot height	x 25.79 BM	+25.79 示
Gully, manhole		
Paving		
Grass		
Steps, ramp		





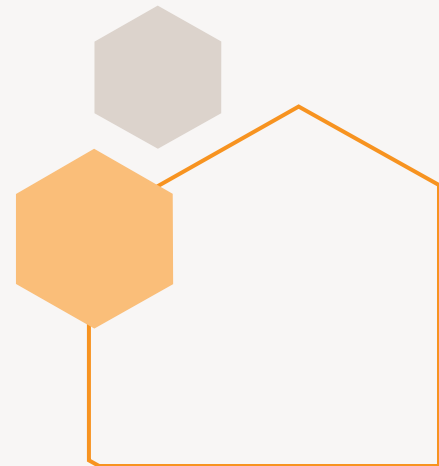
Understanding Scale

- Scale usually refers to the adjustment of size, which is either the reduction or magnification of real-life objects while maintaining their proportions.
- When a drawing is described as 'to scale,' it means that each element in that drawing is in the same proportion, related to the real or proposed thing – it is smaller or indeed larger by a particular percentage.
- If something is 'drawn to scale' we expect that it has been drawn, or printed, to a common scale that is used as standard in the construction industry



Understanding Scale

- Scales are expressed in ratios. In the real world, one metre is equal to one metre. This is considered a 1:1 scale. A drawing at a scale of 1:10 means that the object is 10 times smaller than in real life scale, 1:1. You could also say, 1 unit in the drawing is equal to 10 units in real life.
- As the numbers in the scale get bigger, i.e. 1:50 – 1:200, the elements in the drawing get smaller. This is because in a drawing at 1:50 there is 1 unit for every 50 units in real life. A drawing of 1:200 is representing 200 units for every one unit – and therefore is showing the elements smaller than the 1:50 drawing.



Understanding Scale

- The scale bar is a key component of scale drawings as it helps provide an understanding of distances depicted on the drawing.



SCALE BAR 1:500



SCALE BAR 1:250

