

## OVERVIEW

Understanding geodetic systems, datums and reference surfaces can be very complex but in very simple terms, the primary aim is to precisely represent the Earth on maps and to locate places. Datums are used in geodesy, navigation, and surveying by cartographers and satellite navigation systems to translate positions indicated on maps (paper or digital) to their real position on Earth.

## GEODESY

Geodesy (also known as geodetics) is the science of accurately measuring and understanding three of Earth's fundamental properties—its geometric shape, its orientation in space, and its gravitational field—and how they change over time.

## GEOID

While we often think of the earth as a sphere, our planet is actually very bumpy and irregular. So what is the true shape of the earth? The geoid is a surface on which all earth's gravitational forces are equal. It is an imaginary surface which coincides with mean sea level (imagining there was no land), where the effects of non-gravitational forces, such as tides, currents and meteorological effects, are removed. However, there are local gravitational anomalies to this simplistic concept, due to land mass, noticed particularly in mountainous areas, and these can distort the shape of the geoid locally.

The geoid is of fundamental importance in determining positions on the earth's surface as most measurements are made with reference to this surface. For instance, heights are referred to mean sea level (which is effectively the geoid). Furthermore, satellite systems operate within an environment directly influenced by gravity. The geoid is not a simple mathematical surface, but deviates by up to 100m from an ellipsoid, largely due to variations in gravity around the globe.

## ELLIPSOID

Because the ellipsoid is a good approximation to the shape of the geoid, and it is simple to define mathematically, it is used to provide a figure of the earth on which positions may be given in terms of latitude, longitude and height above the ellipsoidal surface.

A reference ellipsoid can be described by its semi-major axis (equatorial radius) and flattening. The 1980 Geodetic Reference System (GRS 80) is the basis for geodetic positioning by the Global Positioning System (GPS) and is widespread use outside the geodetic community.

However, the shape of the geoid varies around the globe and therefore different sized ellipsoids are used for different regions. For example, an ellipsoid which provides a good fit for the whole globe is not necessarily the most suitable for North America, and neither would be the most appropriate for Ireland.

### Key fact

All data acquired by the INFOMAR program use either the [ITRF](#) or more commonly the [ETRS89](#) reference systems. More information about Irish reference systems can be found [here](#).

## Horizontal and Vertical Datums

A geodetic datum is a coordinate system with a reference surface (such as sea level) that provides known locations. In many way datums act as starting points like, for example, when you give someone directions.

Surveyors use datums to create starting or reference points for floodplain maps, property boundaries or other work requiring accurate coordinates. Hydrographers use datum and accurate GPS systems to measure the three-dimensional positions of the survey vessel and all the various sensors.

Horizontal datums measure positions in latitude and longitude on the surface of the Earth. Vertical data are used to measure land elevations and water depths either above or below a nationally defined reference surface (e.g. mean sea level). Geodetic vertical datums are generally used to express land elevations. However, water level datums are slightly different and are used to reference bathymetric soundings to nautical charts. In hydrography this is commonly known as the Chart datum and it defines the level of water that charted depths displayed on a nautical chart are measured from. A chart datum is generally a tidal datum derived from some phase of the tide.

If you want to know more about datums please use the following resources:

- [Geodetic and vertical datum](#)
- [Datums and reference ellipsoids](#)
- [Chart datum](#)
- A short video explaining chart datum can be found [here](#)

### Key facts

All hydrographic data acquired by the INFOMAR program are referenced to:

- Malin Head Ordnance Datum - the fundamental reference point for all surveying work in Ireland.
- Geoid or Mean Sea-Level (MSL) - average global sea-surface level.
- Lowest Astronomical Tide (LAT) - lowest water levels predicted to occur under average meteorological conditions.

Many national seabed mapping agencies, including INFOMAR use the Lowest Astronomical Tide to define chart datum.

More information about Irish Grid reference systems can be found [here](#).