Determination of Points on the Surfaces

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ABSTRACT

In order to determine the position of a point on the surface, the height of the points is determined as a result of leveling. First of all, you need to know the initial mark. During the observations, a zero point was obtained in relation to the dry part of the sea level, i.e., the shores, in order to know the point state of the earth's surface. The distance from the level surface passing through the point to the level surface, which is assumed to be the beginning of the count, is the altitude. Determining the position of a point on the surface, that is, measuring it above sea level, takes a long time. Each state has its own zero point and accepts a certain sea level.

Keywords: International altitude systems, absolute and relative heights, geodetic points, markings, sea level, surface, altitude system, Kronstadt futstock, National Geodetic Vertical Datum, copper plate, sea level system, determining the surface elevations, leveling, distance measurement

Mean sea level (MSL, often shortened to sea level) is an average surface level of one or more among Earth's coastal bodies of water from which heights such as elevation may be measured. The global MSL is a type of vertical datum – a standardized geodetic datum – that is used, for example, as a chart datum in cartography and marine navigation, or, in aviation, as the standard sea level at which atmospheric pressure is measured to calibrate altitude and, consequently, aircraft flight levels. A common and relatively straightforward mean sea-level standard is instead the midpoint between a mean low and mean high tide at a particular location.

Sea levels can be affected by many factors and are known to have varied greatly over geological time scales. However, 20th century and current millennium sea level rise is presumed to be caused by climate change and careful measurement of variations in MSL can offer insights into ongoing climate change.

The term above sea level generally refers to above mean sea level (AMSL). The term APSL means Above Present Sea Level, comparing sea levels in the past with the level today.

Earth's radius at sea level is 6378.137 km (3963.191 mi) at the equator. It is 6,356.752 km (3,949.903 mi) at the poles and 6,371.001 km (3,958.756 mi) on average.

In order to determine the position of a point on the surface, the height of the points is determined as a result of leveling. In this case, first of all, it was necessary to know the initial mark. During the observations, the determination of the point height is taken in relation to the dry part of the sea level (coast).

The distance from the level surface passing through the point to the level surface, which is assumed to be the beginning of the count, is the altitude. Knowing the relative height of one point from one point and the height of one of the points, you can find the height of another point.

Determining the position of a point on the surface, that is, measuring it above sea level, takes a long time. Each state has its own zero point and accepts a certain sea level. Let's take a brief look at which countries use the elevation system and what leveling work they have done.

North America uses the ***North American altitude system***. This altitude system is used in the United States, Canada, and Mexico. It has its own confirmed history 4 times. The NAVD 88 was established in 1991 by the minimum-constraint adjustment of geodetic leveling observations in Canada, the United States, and Mexico. It held fixed the height of the primary tidal bench mark, referenced to the International Great Lakes Datum of 1985 local mean sea level height value, at Rimouski, Quebec, Canada. Additional tidal bench mark elevations were not used due to the demonstrated variations in sea surface topography, i.e., the fact that mean sea level is not the same equipotential surface at all tidal bench marks. The NAVD 88 replaced the National Geodetic Vertical Datum of 1929 (NGVD 29), previously known as the Sea Level Datum of 1929. The system was finalized as the North American Vertical Datum of 1988 (NAVD88).

The UK uses the ***UK altitude system***. The count began in 1915-1921 from where it was considered the average level of the port of Nyulin. Located at the end of one of the UK's busiest fishing ports, you'll find the unassuming Newlyn Tidal Observatory – the home of mean sea level for mainland Great Britain. Sea level was measured using averages of readings taken using a device known as a tide gauge. Used in ports and harbours worldwide, tide gauges record the heights of the rising and falling tides. 100 years ago, on 30 April 1921, sea level recording here by OS was concluded after six years of measurement. Within these six years, the Newlyn tide gauge took hourly readings. Conducting and recording these measurements over a set period of time enabled a mean sea level “datum point” to be established, and every height measurement in the country has been determined based on the work of this machine. The resulting height datum is known as Ordnance Datum Newlyn (ODN) and marks height zero on maps in Britain.

The Germany Main Height Network (Datum: Deutsches Haupthoehennetz 2016 “DHHN2016”) is a precise leveling network of measured height differences to establish a uniform height reference system in Germany. It goes back to a resolution of the plenum of the AdV at the 116th meeting in Bonn in 2005, which provides for the renewal of the DHHN in the period 2006 – 2011 and which entrusts the spatial reference working group with further detailed planning.

The first precision leveling took place in 1868 and was continuously improved. These go back to a decision of the Second Degree Measurement Conference in 1867 to carry out geometric precision levels instead of trigonometric main levels . The measurements, also known as original leveling, were continued in northern Germany (as part of the Prussian new admission), Alsace-Lorraine and Hohenzollern until 1894 and expanded into a total height network. Heights of this loop leveling (mean final error ± 2.04 mm / km), which refer to the normal height point 1879, are given as Height above sea level (heights above sea level in the old system).

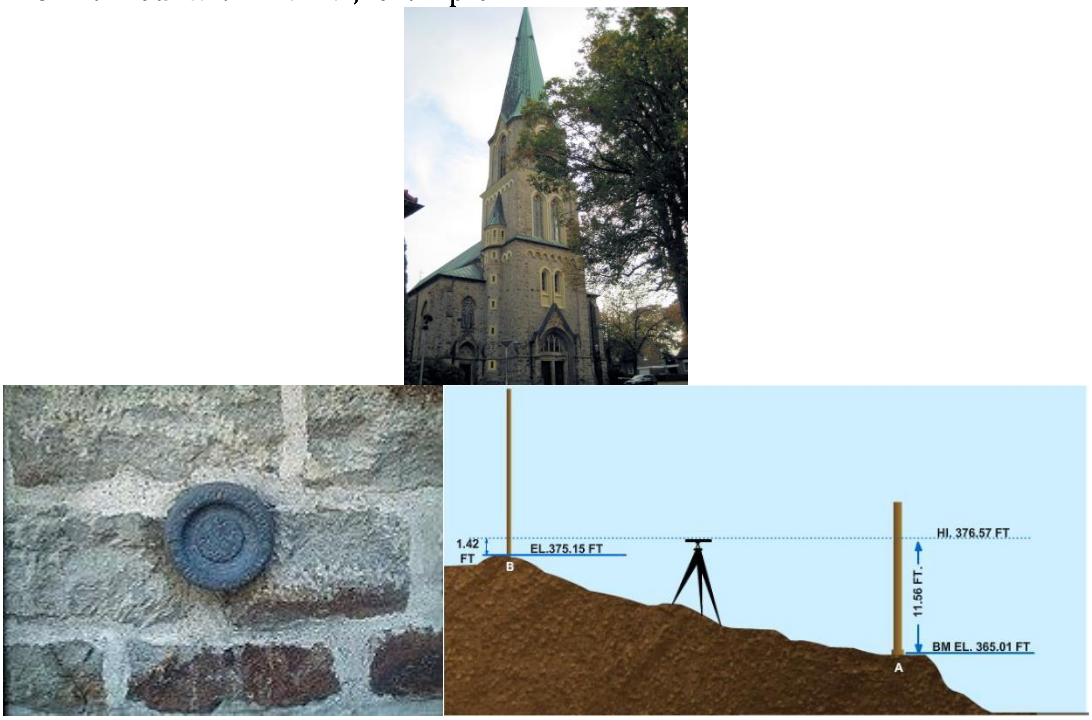
Before the demolition of the Berlin observatory in 1912, five underground fixtures (UF) (special design for height fixed point) in Hoppegarten near Muncheberg (40 km from the city center of Berlin, 24 km from today's city limits) replaced the normal height point 1879 , without to change the reference horizon. In addition to these five UFs, two more simple UFs north and south were added to the three middle UFs at a distance of 100 to 300 meters.

They are intended to serve as additional safeguards in the event that the UF on the road is at risk. Thus, the normal high point in 1912 as a point group consists of a total of eleven underground determinations.

Since no gravity measurements were carried out for the leveling, the heights were corrected with the normal gravity . The heights above sea level obtained in this way in the new system were normal orthometric heights . This height system is now called DHHN12. The status number of the system is 100.

DHHN92 was the elevation system that was valid in Germany until it was replaced by DHHN2016 in June 2017. Corresponding height information is marked with "NHN", example: "500 m above sea level. NHN". The differences to the previous systems are a few millimeters in the lowlands and just under 20 cm in the Alps.

The surveying administrations of the 16 federal states of Germany decided in 1993 (after the reunification of Germany) to introduce a uniform height reference system for the old and new federal states, the DHHN92. With connection leveling and gravity measurements between the existing height networks DHHN85 (old federal states) and SNN76 (new federal states), the necessary foundations for the merger to form a network were laid from 1990 to 1992.



Pic. 1: Leveling point at the New St. Alexander Church in Wallenhorst

The final working heights in the DHHN92 were calculated as normal heights according to Molodenski's theory by dividing the geopotential heights available at points by the individually calculated normal gravity value. The normal gravity formula of the GRS80 and point coordinates in the ETRS89 were used. Heights in DHHN92 therefore refer to the quasigeoid that was calculated with the parameters of the GRS80 and that runs through the zero point of the former Amsterdam level. With this, the DHHN92 was determined at the same reference level as the pan-European leveling networks.

In conclusion, it can be said about the German altitude system, the German altitude system has been used in Germany since 1992. The count began with the Church of St. Alexander in Vallenhorst.

Italy uses the altitude system in Italy and nearby European countries. The count starts from the Euro Asian lithosphere plate. The Eurasian plate is a lithosphere plate that covers much of the Eurasian continent. The western part of the Eurasian plate extends into the middle Atlantic ridge and occupies part of Iceland. To the north of the Eurasian plate lies a huge peak bounded by the Heckel ridge, crossing the passive continental boundary of the Arctic Ocean. To the south of the Eurasian plate there is a huge collision zone: the Tethys is a set of mountains formed as a result of the closure of the ocean and the collision with the Indian plate.

Amsterdam Ordnance Datum *or* ***Normaal Amsterdams Peil (NAP)*** is a vertical datum in use in large parts of Western Europe. Originally created for use in the Netherlands, its height was used by Prussia in 1879 for defining Normalnull, and in 1955 by other European countries. In the 1990s, it was used as the reference level for the United European leveling Network (UELN) which in turn led to the European Vertical Reference System (EVRS).

Mayor Johannes Hudde of Amsterdam in a way came up with the idea after he expanded the sea dike after a flood in Amsterdam in 1675. Of course a dike should be storm-resistant to protect a city against flooding, and in this case a margin of "9 feet and 5 inches" (2.67 m - margin is defined in Amsterdam feet) was deemed enough to cope with rising water. So he measured the water level of the adjacent sea arm. It was compared it with the water level in the canals within the city itself. He found that the water level at an average summer flood in the sea arm (when the water level reaches its maximum, not counting storms) was about the same as the level on the other side of the sea-dike, plus the margin of 9 feet and 5 inches. The relatively constant water level in the canals of Amsterdam, called Amsterdams Peil ("Amsterdam level", AP), equaled the level at summer flood at sea in the sea-inlet, which changes throughout the year. AP was carried over to other areas in the Netherlands in 1860, to replace locally used levels. In this operation, an error was introduced which was corrected (normalized) between 1885 and 1894, resulting in the Normaal Amsterdams Peil.

Pic. 2: NAP level in Amsterdam City Hall

Originally the zero level of NAP was the average summer flood water level in the just north of the center of Amsterdam (which was at the time, in 1684, the main shipping area, then still connected with the open sea). Currently it is physically realized by a brass benchmark on a 22-meter pile below the Dam square in Amsterdam. The brass benchmark in the Amsterdam Stopera (combined city hall and opera house), which is a tourist attraction, is no longer used as a reference point.

The Amsterdam Elevation System was adopted in the Netherlands in 1879. This altitude system is the basis for the German altitude system. The Amsterdam zero points is one of the deepest in Western Europe. The zero point starts at 9 feet 5 inches above sea level in the center of Amsterdam.

The ***Turkish altitude system*** was adopted in Turkey and the counting started from 1936-1971 from the average level of the Mediterranean Sea. Leveling works have been carried out in the Antaly region.

The establishment of vertical reference system in Turkey, that is, Turkish National Vertical Control Network (TNVCN) started with the adjustment of the observations at Antalya tide-gauge station between 1936 and 1971. In March 2012, Turkey National Geodesy commission held an official meeting at Zonguldak Bulent Ecevit University. In the final declaration of the meeting, the problems with the leveling-based vertical control approach which is currently used in the country and the realization of the vertical datum in Turkey were discussed. The definition of geoid model which is more resistant to geodynamic activity, local crustal uplift or subsidence as well as the deterioration of the benchmarks are specified as the main topics of the realization of the new vertical datum

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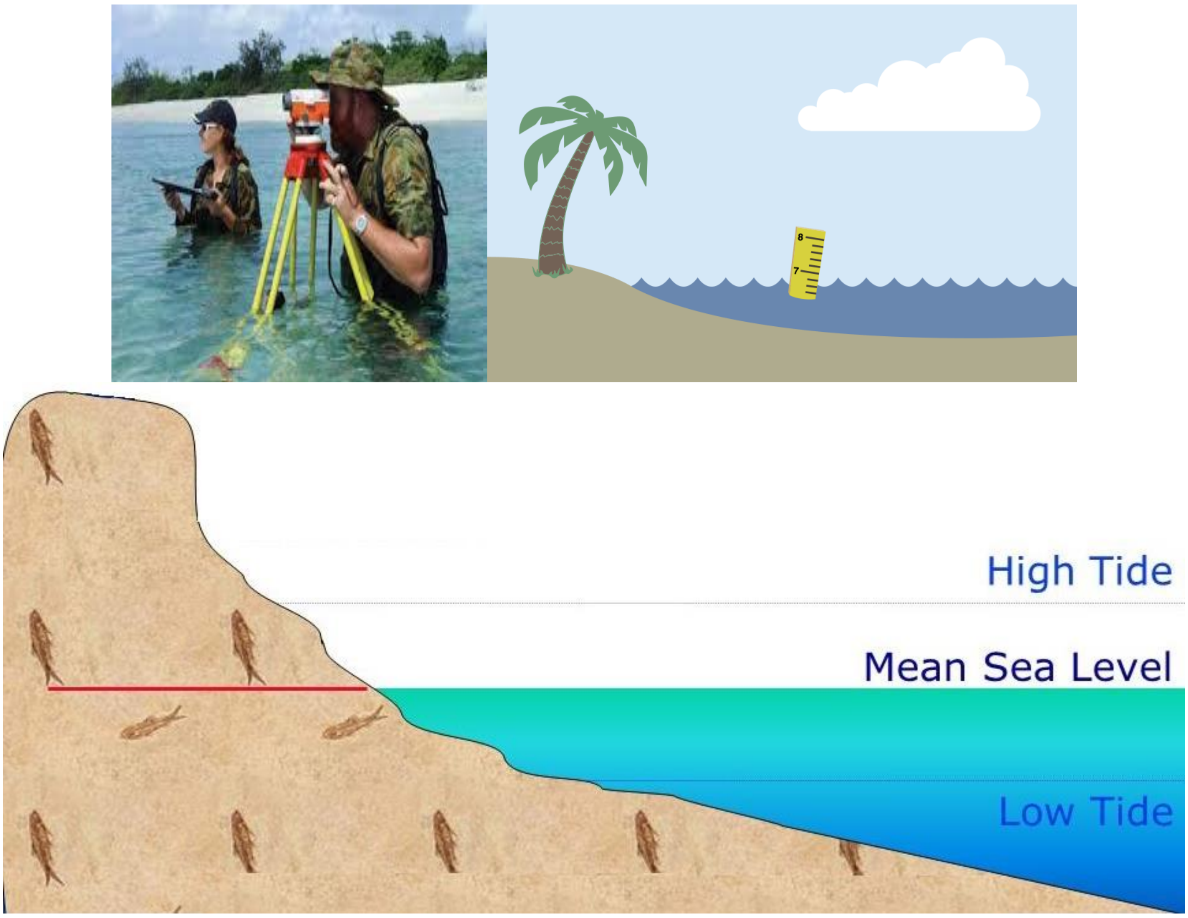

Pic. 3: Leveling from the zero point of the average sea level

The problems in leveling-based vertical control approach have led the country to find an alternative approach to vertical control. In this aspect, geoid based vertical datum approach is under consideration as an alternative way. Thus, the Realization of Turkish National Control Network Project has been initiated by the General Command of Mapping. The aim of the project is to obtain a 1-2 cm-accuracy geoid model that will be the new vertical datum of Turkey by using terrestrial and airborne gravity data which were obtained during the realization Project. The maximum accuracy of the regional geoid models achieved in Turkey is 8.7 cm. According to the Large-Scale Map and Map Information Production Regulation of Turkey, though, the accuracy should be at least 5 cm, which means that the result of the accuracy of the latest geoid model in Turkey is not satisfactory. Until reaching the aimed accuracy (1-2 cm accuracy regional geoid model), the local GPS/leveling surface models will be used as a geodetic infrastructure in Turkey. There is an increasing trend of geoid models in the world, and many countries determine them as their vertical datum. An example of this is the GRAV-D (Re-definition of the American Vertical Datum) project of the United States. From this aspect, having a local geoid model which can meet the accuracy demands in Turkey is very important. This study aims to specify the historical perspective of Turkish vertical control approaches, their current situation and current developments.

Kronstadt futstock (copper plate), which defines the average level of the Baltic Sea in Russia, is taken as the absolute height in the Commonwealth of Independent States (CIS).

Kronstadt (from German Krone - "crown" and Stadt - "city") is a port city in Russia, located on the island of Kotlin. It is the only settlement (city) of the Kronstadt district of the federal city of St. Petersburg and its intracity municipality.

The Baltic altitude system has been used in Russia since 1977. Height Kronstadt futstock starts from scratch on a copper board. The Kronstadt futstock is a futstock for measuring the height of the Baltic Sea, which was built over the Blue Sea Bridge. Kronstadt was determined as a result of leveling the absolute height of the territories of the Russian Federation from zero. Kronstadt futstock is given in centimeters.

Pic. 4: Kronstadt futstock

The Russian futstock was organized by Peter I. The first futstock appeared in St. Petersburg in 1703. In 1840, Mikhail Frantsevich Reyneke made an offer. The leveling results were measured in 15 years and completed in 1880. The Kronstadt futstock is a futstock for measuring altitude above the level of the Baltic Sea, which is a bridge pier of the Blue Sea and a revolving canal in Kronstadt.

As mentioned above, we have said that each state has used the existing sea level in its territory as a zero point. We all know that the Aral Sea is located in Uzbekistan. However, we cannot use the zero point of this sea to determine the surface elevations, because as a result of the drying up of the Aral Sea in recent years, the ecological environment and natural balance have been disturbed and the climate has been changing negatively. As a result of the release of sand, salt and dust from these areas into the air and into the environment, serious damage is being done to the population, flora and fauna of the Aral Sea region. In areas where agricultural crops, orchards and vineyards are planted, secondary salinization is increasing, negatively affecting productivity. The Aral Sea Desert, which covers more than 5.5 million hectares, has replaced the dried sea.

In his Address to the Oliy Majlis, the President expressed serious concern over the deteriorating environmental situation in the region and the world, and stressed the need to continue efforts to mitigate the effects of the Aral Sea environmental tragedy.

He said: "In this regard, we will intensify practical work within the framework of the Multilateral Trust Fund for Human Security in the Aral Sea Region, established in cooperation with the United Nations", it was emphasized

Pic. 5: The tragic fate of the Aral Sea

Indeed, the drying up of the Aral Sea has become a center of environmental disaster not only in our region but also globally. Therefore, both at the 75th session of the UN General Assembly and at the 72nd session in 2017, our esteemed President put this issue on the agenda.

At that time, for the first time in history, at the UN rostrum, the President showed the map of the sea to the whole world community and sadly revealed how deep and complex the problem was.

Pic. 6: Proposals of President Sh.M.Mirziyoev at the UN General Assembly on the Aral Sea issue.

Last year, the head of state proposed to adopt a special resolution of the United Nations General Assembly declaring the Aral Sea region a zone of ecological innovation and technology, and to celebrate the date of approval of this important document as the International Day for the Protection and Restoration of Ecological Systems.

As we have noted, as a result of the drying up of the Aral Sea, the Baltic Sea, ie the zero of the Kronstadt futstock copper plate, is used as the sea level system to determine the surface elevations of our region.

References:

1. Resolution of the cabinet of ministers of the republic of Uzbekistan.
2. No.132 of February 15, 2019
3. Resolution of the cabinet of ministers of the republic of Uzbekistan.
4. No.1031 of December 24, 2019.
5. www.geodesy.com.