

*National Report  
Denmark*

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## **Status of EUREF in Denmark**

The basic network called REFDK has been described in the 1999 report.

It is decided to make the network more dense to a 10 km 3-dim. network over all of Denmark. The densification is planned to be fulfilled in the years 2000-2003. The first 120 points in this network are surveyed in 2001 covering whole Zealand. In 2002 the points are expanded to cover half of Denmark.

## **Introduction of new map projections in Denmark**

Last year, a general hearing were send out from National Survey and Cadastre (KMS), asking about the opinion in changing the used map projections in Denmark to a common European coordinate system and new map projections connected to ETRS89 (in Denmark known as EUREF89) instead of the old used projections UTM/ED50 and System 1934.

In the hearing KMS wanted the opinion about introduction of two different map projections in the EUREF89 datum, to be used in parallel. A standard UTM projection and three Transversal Mapping (TM) map projections called Kp2000 for use in Denmark. The Kp2000 map projections are defined especially to fulfil the needs for a map projection with a distance correction not more than +/- 5 cm/km. The Central meridian and the false easting are elected so that the projection is traceable from the easting coordinate and a weak knowledge of location.

Zones	Central Meridian	Scale	False Easting	E Values
Jutland and Funen	9.5E	0.99995	200 km	100 - 300 km
Zealand	12.0E	0.99995	500 km	400 - 600 km
Bornholm	15.0E	1.00000	900 km	850 - 950 km
UTM32/EUREF89	9.0E	0.99960	500 km	400 - 750 km

The new map projections should be introduced as new standards in Denmark in first hand in co-existence with the old map projections.

The response from the different organizations was, that it seems natural to introduce UTM/EUREF89, but some of the hearing organizations, especial from the GIS part of the society, and also from the chartered surveyors would prefer that only the UTM/EUREF89 map projection were used.

This first hearing was therefore followed up this spring by another hearing. In this hearing KMS recommends, that the UTM/EUREF89 should be user as a **primary map projection** for storing, manipulating and exchange of data. KMS recommends, that Kp2000 if needed, should be used as a secondary projection, for surveying purposes mostly inside the organisations.

The answer to the second hearing is not yet in house, but KMS can foresee problems in the recommendations especially with the local municipalities, who has the larges numbers of data to transform and also are potential user of both map projections.

UTM/Euref89 will be implemented in the National Topographic- and Cadastral mapping. In the beginning of 2003 all data in KMS will be transformed to and restored in this projection.

Hopeful the technical maps will in the long run be changed to EUREF89, but the state (KMS) cannot force the single municipality to change.

It has facilitated the introduction of the new map projections that the whole KMS transformation system is now available on the KMS homepage **free of charge** ([www.kms.dk](http://www.kms.dk)).

### **Height system**

The new Danish height system DVR90 (Danish Vertical Reference) is the outcome of the third precise levelling (1986-1992) and the Danish sea level observations during the past century. The new heights, referring to the reference year 1990, are Helmert heights above the Danish mean sea level in 1990. The heights are adjusted in units of GPU with astronomical correction applied to the observations (giving non tidal heights).

### **Introduction of DVR90**

A new height system is only fully useful for the society if it is brought into play. Therefore another part of the hearing already mentioned in connection with introduction of new map projections was to introduce DVR90 as official height system from 2003. The plan is that all benchmarks should become heights in DVR90 in the coming years through an adjustment of all new(er) observations. Some benchmarks will become new heights in DVR90 through a transformation from the old height system. In the years 2001 to 2003 the new height system will co-exist with the old systems (3 in use in different parts of Denmark), but from 2003 old systems will only be used as historical information.

The main problem in introducing a new height system is not to give new heights to the benchmarks. The main problem is the derived height data; - first of all the heights used in the sewer systems, and in road planning. A lot of efforts is therefore put into problems in how to change the heights in all the databases, and secure, that all analogue heights are labelled with information about which system the height is referring to.

The answer to the hearing was that the plans for introduction of DVR90 was accepted everywhere. All benchmark with new height information (about 40.000 points) are therefore recalculated in DVR90, a recalculation that will be finished in autumn 2001. The rest of the benchmarks (about 30.000) will be transformed to the new height datum in this year.

## **Permanent GPS stations in Denmark**

The 3 permanent stations in operation in Denmark have been included in the EUREF network.

A homepage containing phase data from the permanent stations in Denmark, as well as in Norway and Sweden are under preparation, and will probably be finished inside few months.

Plans are made to establish up to 7 more permanent GPS stations in Denmark. Included in this number are 3 permanent reference stations driven by The Danish Lighthouse organization. These new points will be the backbone for all measurements in Denmark. Together, with repeated measurements to parts of the new established 10 km 3-dim. network, the network will take over repeated precise levelling in Denmark.

## **Private RTK initiative in Denmark**

In the beginning of 2001 two private companies has established private RTK services in Denmark on a commercial basis. The first company has on a cooperative basis gathered approx. 60 GPS “second order permanent” stations established by different private firms. From this network (Distances between stations about 40 – 50 km) a traditional RTK service with radio or cellular phones are available.

A private surveyor company in Denmark has established 26 “second order permanent” GPS stations covering almost whole Denmark. Spacing between stations is about 70 km. The Terrasat technique, with Virtual reference stations is used. The service is only accessible through cellular phones. The RTK service has now been in use for 2 month.

## **Geodetic activities in Greenland**

Four primary stations along with four permanent stations in Greenland form the backbone for an ongoing densification to 20 major towns and settlements in Greenland.

In 2000 has 59 towns and settlements been surveyed in cooperation with the Greenland authority. This improves the basic network, so a readjustment of the Greenland datum GR96 is needed.

All observation made from 1920 in the geodetic network extended with GPS measured 3-dim vectors is being adjusted in the UTM zone 22 ETRF96 including ellipsoidal heights and mean sea level heights. A total of 4020 stations are being coordinated on the west coast. It is expected that 40% of all stations will have an accuracy better than 12 cm and 80% an accuracy better than 25 cm and in remote areas an accuracy poorer than 25 cm.

In the coming years the GPS measurements will be extended to more parts of the network.

The permanent GPS station in Greenland Thule is giving data every second to the global IGS network and in the IGEX network, the station in Kellyville is in the global IGS network.

On the East coast Kulusuk is operated by the University of Colorado and has no facilities for data transfer on a regular basis. Scoresbysund is operated by KMS. Data from this station is available.

## **References**

Klaus Schmidt: The Danish Height System DVR90, National Survey and Cadastre – Denmark 2000.  
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