

23.8.2006	NORDISKA KOMMISSIONEN FÖR GEODESI Nordic Geodetic Commission Height Determination Working Group Chairman Mikko Takalo Finnish Geodetic Institute P.O.Box 15 FIN-02431 Masala, Finland	
-----------	--	--

## Minutes (Memorandum) of the NKG SWG Workshop 20-21.10.2003 in Hønefoss

### Present

Denmark: Casper Jespen  
Karsten Ensager

Estonia: Andres Rüdja  
Tarmo Kall  
Harli Jürgenson

Finland: Jaakko Mäkinen (Chairman of SWG)  
Mikko Takalo (Chairman of WGH)  
Veikko Saaranen

Norway: Olav Vestøl

Sweden: Per-Anders Olsson  
Per-Ola Eriksson  
Runar Svensson  
Mikael Lilje

### 1. Opening of the workshop

Jaakko Mäkinen welcomed the participants and opened the workshop.  
Mikael Lilje was as chairman and Mikko Takalo as secretary of the workshop.

### 2. Approval the agenda

Mikael proposed that items “Network adjustment” and “National and other schedule goals” should be treated on Tuesday. The lunch was moved to start at 12 o’clock.  
The agenda was agreed with the proposed changes.

### 3. Report from the EUREF-TWG meeting in Toledo (Jaakko Mäkinen)

Jaakko gave his report from TWG meeting and presentation of Position paper there. He told, that the paper was contently received in meeting. Jaakko had emphasized that land uplift modelling of the Nordic Block must be taken into account also in UELN adjustments. The outcome was that the NKG will be done the post glacial rebound (PGR) modelling around the Baltic and ask permissions to use data from UELN data centre from Holland, Germany, Lithuania, Latvia and Estonia. Jaakko told that the transfer of data is simple in practise and he had got already the permission from Holland, Poland and Baltic countries and discussed with Ihde to get also from Germany. Wolfgang Augath had proposed that NKG send the data corrected with landuplift to the

23.8.2006	NORDISKA KOMMISSIONEN FÖR GEODESI Nordic Geodetic Commission Height Determination Working Group Chairman Mikko Takalo Finnish Geodetic Institute P.O.Box 15 FIN-02431 Masala, Finland	
-----------	--	--

UENL data centre and they can do the adjustment. Jaakko did not like the idea, because we know better the landuplift modelling and the adjustment problems of the Nordic Block. Therefore the UENL data centre needs the landuplift corrected data from different countries.

Eric Gubler had told that Euro Geographics have adopted to the EVRF2000 GIS standards the European Geodetic Standards. TWG proposed a close co-operation between Scandinavian colleagues and TWG and ask to send all relevant levelling data also to BKG data centre.

#### 4. National Reports

##### 4.1 Denmark

Casper Jespen told that until now a half of municipalities has decided to take the new Danish height system DVR90 in to use and believed that almost all will come in the 1<sup>st</sup> January 2005 when the change of system occur.

Denmark has installed three new permanent GPS stations close to the mareographs (ESEAS-project).

They have planned to establish a 4D-point network, where GPS points are near to the first order levelling points. GPS points will be measured with session over many days.

Klaus has examined the Öresund loop but the work is not yet ready. Karsten believed that it will be completed soon. He proposed that only the best measurements in Helsingör will be taken into account.

Adjustment programs are working now in data computer.

##### 4.2 Estonia

Andres expressed that the National levelling of Estonia started this Autumn. Digital levelling system Zeiss DiNi12 will be used. The maximum sight distance is 40 m and the minimum reading height is 70 cm. Air temperatures and temperatures at rods are automatically observed.

According to the plan the levelling will be completed in 2008. The total length of the network is 2800 km and the mean distance between benchmarks is 2.5 km.

Harli presented the examination dealing with the difference between height systems of Finland (N60) and Estonia (Baltic Height System year 1977). The difference between the systems is approximately 1 cm.

##### 4.3 Finland

Veikko told that he is now creating a new levelling database including measurements and bench marks. The X-position program will be used to analyse data in database and same program will also be used to adjust the loop around the Baltic Sea.

Jaakko presented results of GPS/geoid campaign and of mareograph recording applying a new oceanographic model over the Gulf of Finland between Finland and Estonia. Conclusion was that the mareograph method gave the height difference  $-3 \pm 2$  cm and the GPS levelling  $-5 \pm 4$  cm. Then Jaakko showed a table of closing errors around the Baltic Sea computing in different ways. The new height system of Finland may be ready in 2006.

##### 4.4 Norway

Olav has compared EVRF2000 and NN1954 heights. Result depends on which kind of heights you are using, the normal heights or the orthometric heights. European system EVRF2000 is app. 7 cm

23.8.2006	NORDISKA KOMMISSIONEN FÖR GEODESI Nordic Geodetic Commission Height Determination Working Group Chairman Mikko Takalo Finnish Geodetic Institute P.O.Box 15 FIN-02431 Masala, Finland	
-----------	--	--

below NN1954 in Tregde. EVRF2000 and NN1954 have zero levels that correspond to MSL within approximately the same accuracy.

Olav expressed some words of the budget reduction in Statens Kartverk. There is a proposal from the directors of Statens Kartverk and the Geodesy Department to close down all activity concerning vertical and horizontal network and the Ny-Ålesund station.

Olav told also that they have planed to present a new levelling network in 2005 or 2006.

#### 4.5 Sweden

Runar told of his study dealing with the land uplift model derived from three national levellings in Sweden. There are some problems in the middle Sweden in the loop close to the Norwegian border. According to his study the land uplift maximum is to the south from that of the Martin Ekman's model. A short discussion of adjustment methods used by Runar was talked through. Runar had used the land uplift differences vs. Karsten's proposal to determine heights directly from different levellings.

#### 5. Comparisons between different land uplift models

Jaakko presented results of his comparison work between land uplift models of Ekman, Lambeck, the Bifrost, Olav's model, in which values are derived using collocation method, the Finnref, in which values are given by the Finnish permanent GPS stations and the model computed from three precise levellings in Finland.

#### 6. National and other schedule goals and constraints

##### Epoch and type of height

Sweden proposed that instead of epoch 2000, they may possible want to select 1999.5 and asked for the opinion from other countries on such a selection. The reason was that 2000 could cause confusions later when users want to use a shortened form RH00 instead of RH2000 since the RH00 is already in use in Sweden. There was no contradiction to that. Norway is not going to use orthometric heights instead of normal heights even that Austrian and Schwitserland have recommended to use the orthometric heights as well fitting for hilly countries.

#### 7. Open discussion of Land uplift model

Olav: Ekman's model is good in Sweden, but not as good in neighbour countries done to lack of data. Uncertainty is in mm. The Ekman's model has tie to Norwegian mareographs.

Karsten: Proposal to compute the networks of Norway, Sweden and Finland together should be difficult due to different epochs. With collocation we get also the land uplift, but much work is needed.

Mikael: Can we apply the Ekman's model in Baltic Countries? Jaakko knew that Tarmo Kall has studied the possibilities and the answer is why not, but there are some systematic effects in mareograph data. That should be studied.

Jaakko: To the data of the Baltic Countries have not been applied the Ekman's model. Therefor the Lambeck model completed with the Bifrost model fits well on the Baltic area. Short discussion of the Bifrost model and problems of the network in Sweden was talked through.

23.8.2006	NORDISKA KOMMISSIONEN FÖR GEODESI Nordic Geodetic Commission Height Determination Working Group Chairman Mikko Takalo Finnish Geodetic Institute P.O.Box 15 FIN-02431 Masala, Finland	
-----------	--	--

Karsten: If the time interval between levellings is very short, the land uplift values can strongly be influenced by noise.

Harli: Is the land uplift linear?

Jaakko: In Finland three national levellings gave sometimes changes in land uplift values, but they are more like influenced by different closing errors of loops than the time variable land uplift values.

Runar: There is in the middle Sweden a levelling line running to Norway, which has been very problematic. There is 400 m height difference in the distance of 50 km and the line has been measured three times resulting the maximum difference of 200 ppm. On the same area in Norway, on the other side of border near Røros, is a line with three unfitted measurements. The land uplift values of tide gauges in Sweden are linear, but in Baltic exist some mareographs with non-linear time series.

Karsten: The linear land uplift model is the best, but levellings with errors give more uncertain land uplift than mareographs. Expectation value of land uplift is linear. The reasons for non-linearity must be studied and cleared up.

Mikael: Proposal is that we use the Ekman's model in Nordic countries and the Bifrost one in Baltic countries.

Jaakko: In the Northern Finland the land uplift values given by the Ekman's model are a guess. In the middle part of Sweden there can be found quite clear tilt between the Bifrost values and the mareographs ones.

Karsten: How big are the errors using the Ekman's model – some mm perhaps, but who can control them and how? The Baltic ring gives anyway a good start and a connection to the Amsterdam peil.

Jaakko proposed that we use the Lambeck model, which fitting well to the Bifrost model, because it is an improved version of the Ekman's model. The Lambeck model must be digitised. Then Jaakko presented a map illustrating comparison between the Ekman's tide gauge model and the Lambeck model.

Runar expressed that in Sweden the land uplift from the 2. and 3. levelling vs. the Ekman's model includes many problems but the corresponding from the 1. and 3. one, not.

**Agreed action:**

23.8.2006	NORDISKA KOMMISSIONEN FÖR GEODESI Nordic Geodetic Commission Height Determination Working Group Chairman Mikko Takalo Finnish Geodetic Institute P.O.Box 15 FIN-02431 Masala, Finland	
-----------	--	--

The Lambeck model will be used in the adjustment of the networks around the Baltic Sea. Finland and Sweden will digitize the Lambeck model and the work must be ready at the 1<sup>st</sup> of December 2003.

Jaakko announced that one week intensive work should be enough to study different models in order to create a good land uplift model and he was optimistic to have time for that before his departure to Antarctic.

## 8. Discussion of the preliminary adjustment of the Nordic levelling Block

In order to joint the Nordic Block to EURF2000 we have to apply data from UELN database. The UELN data is not epoch reduced and the programs do not apply land uplift models. We have to do a nodal point adjustment of the Nordic countries together with data from Baltic countries, Poland, Germany and Holland. We have got already a promise from EUREF to use data from UELN database if we get permission from each corresponding countries. It should be good idea that we transferred our Nordic nodal point data to a special database, which could be in KMS. Finland and Denmark announced to be interested to do the preliminary adjustment.

The following practical steps must be taken to perform the adjustment:

Contacts to Holland, Germany, Poland, Lithuanian, Latvia and Estonia shall be taken to get permission to use their UELN-data. Jaakko will send email or phone.

In order to get specification of data format, Jaakko will take contact to the UELN data centre.

Finland and Sweden digitalize the Lambeck model. This stage must be ready at the 1<sup>st</sup> of December. Bo-Gunnar has written a short description of digitize work for the Martin Ekman's model. To digitalize a map we have to take account the maximum land uplift values, the map projection, the common points and use the same format as used in the Ekman's model.

Consolidation at the common bench marks along the border between Sweden and Norway, Sweden and Finland, Finland and Norway must be done. Per-Ola, Olav, Veikko, Jaakko and Mikko are responsible for the work.

Data specification of the UELN-data shall be sent by email to Sweden, Norway and Denmark immediately since Jaakko has received it from UELN.

Jaakko will also ask the UELN data centre to sent data of each country from UELN database since we have received the permission, soon to Sweden, Norway and Finland.

Finland, Norway and Sweden control data and arrange it and sent their data to Denmark as soon as they have got the data specification.

Denmark creates the second database for this data. Casper will be responsibility.

Adjustment of the net around the Baltic Sea in epoch 2000, applying normal heights for nodal points will be done by Denmark and Finland.

23.8.2006	NORDISKA KOMMISSIONEN FÖR GEODESI Nordic Geodetic Commission Height Determination Working Group Chairman Mikko Takalo Finnish Geodetic Institute P.O.Box 15 FIN-02431 Masala, Finland	
-----------	--	--

Results shall be compared at the WGH meeting at the end of March 2004.

Documentation of the adjustment will be done by WGH/SWG- Nordic levelling Block.

**9. Response to the Presidium of the NKG  
item 2.**

Mikael presented the previous version of the draft of the form for routines to distribute data from NDC at KMS. Short discussion brought some proposals which Mikael promised to take into account and send later a correct version to the members.

**10. Ajour at height net in France**

Francois L'Écu from IGN presented how the updating of the height network has been planned to perform in France. Updating includes networks of levelling with three classes and the rules how to use GPS and trigonometric levelling in updating work and which points shall be updated. They are going to maintain 100 000 bench marks in France.

**11. Björn Engen: Problems in Norway**

Björn gave a closer information of the budget problems in Norway and the consequences of them to the Staten Kartverk, especially on the sector of height determination.

Björn asked WGH send a letter to the Environment Ministry of Norway and try in scientific manner to explain what kind of drawbacks the reduce of Norwegian activities in height determination can cause in Nordic countries..

**12. Next meeting**

The next meeting of WGH will be held at the last week of March 2004 in Tallinna. Mikko and Andres will appoint the closer datum and inform then the members.

**13. Closing the SWG meeting**

Jaakko and Mikael thanked the participants of the workshop for fruitful discussions and constructive decisions to contribute the progress the adjustment of the Nordic levelling Block.