NORDISKA KOMMISSIONEN FÖR GEODESI
HEIGHT DETERMINATION WORKING GROUP
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# Working group for Height Determination

Minutes from the meeting in Akranes, June 19, 2001.

*Participants:*

*Denmark*

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| *Casper Jepsen* | *Kort-og Matrikelstyrelsen* |
| *Klaus Schmidt* | *Kort-og Matrikelstyrelsen* |

*Finland*

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| *Jaakko Mäkinen* | *Geodeettinen Laitos* |
| *Veikko Saaranen* | *Geodeettinen Laitos* |
| *Mikko Takalo* | *Geodeettinen Laitos* |

*Norway*

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| *John Sundsby* | *Statens Kartverk* |
| *Olav Vestøl* | *Statens Kartverk* |

*Sweden*

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| *Jean-Marie Becker* | *Lantmäteriverket* |
| *Per-Ola Eriksson* | *Lantmäteriverket* |
| *Mikael Lilje* | *Lantmäteriverket* |
| *Stig-Göran Mårtensson* | *Högskolan i Gävle* |

*Iceland*

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| *Thorarinn Sigurdsson* | *Landmælingar Islands* |
| *Markus Rennen* | *Landmælingar Islands* |
| *Gavin Adcock* | *Landmælingar Islands* |

*Chairman:* *Jean-Marie Becker*
*Secretaries:* *Per-Ola Eriksson and Mikael Lilje*

**Opening of the meeting.**

The chairman welcomed all the participants to the meeting which started at 8.15 am. Thorarinn thanked for the participation of the Nordic Height Determination Group at the seminar on Height determination that was held in Akranes the day before to help the Icelandic colleagues in the preparation for their new height network.

**Approval of the agenda**

The proposed agenda was accepted.

**National reports**:
***Denmark* (Casper Jepsen)**
KMS are working intensively to recalculate the local height systems so that they are connected to DVR90. This will go on until the end of 2001.

Denmark has been using Zeiss DiNi11 since 1999 in motorised levelling and the results are good. One team levels about 20-30 km each day with high accuracy (appr. 1.2 mm/vkm). Denmark has two more teams and one is entirely working with MTL and the third can use both techniques. In 2000, Denmark measured 4250 km single run in total (2020 km ML and 2230 km MTL).

Denmark has offered to be the Nordic Computer Centre for the adjustment of the Nordic Height Network. This was later discussed during meeting, see below.

The connection between Denmark and Sweden was levelled and report was given later on at this meeting.

***Finland* (Veikko Saaranen)**
The report included the activities during 1999 and 2000. In 1999, 402 km was levelled in Torne valley area. The mean error was 0.36 mm/vkm .In 2000 the levelling continued in western Lapland and two lines from 1999 was relevelled due to large misclosure in the loop from 1999That loop was also devided in order to detect any error, and the misclosure decreased from −64 mm in the old loop to −26 and −10 mm in the two new loops. The new tide gauge in Vaasa was also levelled during 2000. In total 361 km double run was levelled during 2000.

***Norway* (Olav Vestøl)**
Norway levelled 501 km double run in total during 2000, including the production that was done by the Swedish team. This was also according to the plan. 431 km should be levelled in 2001 according to the plan, but only 328 km will be performed. In addition to that control levelling was performed for 13 tide gauges, and 19 points from Stamnett/landsnett were connected.

Norway reported that they have stopped all gravity measurements due to financial reasons.

***Sweden* (Per-Ola Eriksson)**
Sweden did not level any new lines during 2000 but concentrated on remeasuring the loops that have high misclosures. The resulta are promising and Sweden will continue this work during 2001.

The total production of this remeasurement was 1 700 km double run, with a relevelling of 6.6%. In addition to that 190 km double run was carried out in the Norwegian network

The connection between Denmark and Sweden was levelled and report was given later on at this meeting.

Per-Ola also mentioned that there was a 750 km loop completed in 2000, going through the Northern parts of Sweden, Norway and Finland and that the misclosure of this loop was only 35 mm.

The remeasurements will contiue this year with a planned volume of 1 200 km double run. The two lines remaining in the network will also be measured this year.

A heavy task for this year is the project of "cleaning" the levelling database in order to prepare for a final calculation of the entire network. Investigations about possible systematic errors, inventory of adjustment programmes and test calculations are other matters included in this project that runs to the end of this year.

***Iceland* (Thorarinn Sigurdsson)**
Iceland levelled 260 km using foot levelling and Zeiss DiNi11 during 2000. They are planning a new height network, which was the reason for having the group meeting in Iceland.

**Öresund-bridge measurements 2000**
Casper and Per-Ola reported from the levellings that took place in April 2000 across the Öresund link in order to connect the Danish and Swedish height networks. One Swedish ML team and one Danish ML team levelled the link several times. The Danish team levelled the whole connection two times and the Swedish team measured it three times. The Swedish ML team also levelled the West Bridge a forth time. One of the Danish measurements on the East bridge and one of the Swedish measurements on the West bridge were some divergent, but not enough to be rejected.

In order to confirm the levellings across the High bridge that was considered to be the hardest part of the connection, Denmark also had two levellings across the High bridge using MTL. The results from those measurements corresponded very well with the results from the levellings. The height difference is +21281.793 mm going from Kastrup to Lernacken. The standard deviation is 2.35 mm, which is a considerable good result. A loop Kastrup-Helsingör-Helsingborg-Malmö will be calculated as soon as the Swedish measurements South of Helsingborg has been cleaned. That will give a comparison to former connections between Helsingör and Helsingborg. Casper and Per-Ola has written a report about the measurements and it was distributed to all present at the meeting.

**Nordic Height Block**
The major part of the meeting was discussions concerning the proposed adjustment of the Nordic Height Block.

The chairman presented his proposed plan for the Nordic Height Block, see Appendix 1. This was sent to the Height Determination Group the 31st of May, 2001.

The chairman pointed out that the Presidium at their meeting in Copenhagen in February had discussed the plan. Denmark had earlier made an offer to become the Nordic Computer Centre (NCC) and, according to the chairman, the Presidium accepted the offer. This was also confirmed by Denmark but it was however a surprise for Finland who had the information that no such decision had been made during the meeting. Unfortunately, there had not been any minutes distributed from the Presidium meeting in February, which would have cleared the question. A draft of the minutes concerning this item was presented to the Swedish group two days before leaving for Iceland. That draft was read to the Height Determination Group, but it did not clear the question.

Finally, we all agreed to the offer from Denmark and KMS to become the NCC. KMS also pointed out that we all should have access to all data through telnet at any time.

However, the Nordic Height Determination Group **urges** the Presidium to distribute the minutes much faster in the future and especiely before working group meetings if items discussed during the Presidium meeting also are on the table at the working group meetings.

The different countries discussed the proposed plan and how we should get started. Norway pointed out that it would be good if the final result could be a joint height datum for Norway, Sweden and Finland. Sweden made it clear that we are only interested in that if the final result is better than making a national height datum. For Sweden it is also most important to be able to release the new height system as soon as possible, since there are strong demands from the local users, who have already been waiting far too long for the new system.

We all agreed though that we need to start quickly since there is a lot to do. Sweden made the suggestion that the specification on what data that should be included and in what format should be specified at the latest the 1st of January, 2002 and this was accepted.

There was a discussion on how to organise the work, especially if there should be one, two or three groups running. There will probably be the same people working even if the work is divided into several working groups. We agreed on to try to start with:

- Working Group on Height Network.
- Working Group on Land Uplift.

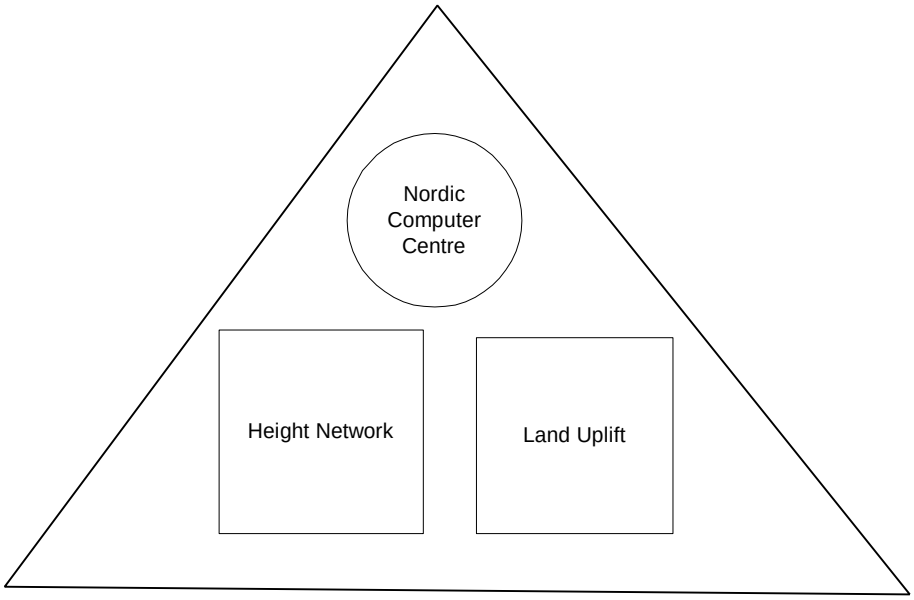


Figure 1. Sketch of the proposed working groups and the Nordic Computer Centre.

The first task that these working groups will handle is the specification on data and data format. Here it will be important to make sure that the data included is sufficient for any type of investigations within these projects in the future e.g. the access to all three precise national levellings in digital format.

The meeting decided to go with the proposal from the chairman to appoint maximum two names from each country. These should work within the two proposed groups. We need to discuss the goals and priorities within the different working groups and items and suggestions should be given to the chairman. All this should be done at the latest the 1st of July, 2001, preferably by mail.

In the mail to the chairman, suggestions for responsible persons for each groups should be made.

***Agreed action 1:*** *At the most two names from each country should be appointed to the chairman at the latest the 1st of July, 2001. These persons are to work in the working groups on the adjustment and calculation of land uplift for the Nordic levelling networks. To start with the group should discuss what data should be sent to the NCC and in which format. Suggestions and priorities within the working items should be sent to the chairman at the latest the 1st of July, 2001. Also, suggestions of responsible persons to the working groups should be given to the chairman.*

***Agreed action 2.*** *The proposed working groups are to meet at earliest possible occasion in the autumn 2001 to start the specification of data work as well as outline the work for the nearest future. Place and time will be decided by the*

*Height Determination Group chair together with the members of the working groups.*

***Agreed action 3:*** *The specification of data format should be finished by the 1st of January, 2002.*

**Next meeting**

There is a need of co-ordination, consultation and discussion in the work with the Nordic Height Block. Therefore there is a need to meet with certain intervals in the beginning of the work. A first meeting should be held in the beginning of the autumn 2001 and it will also be neccessary to meet during the spring, 2002 (see agreed actions 2 and 3 above) since the NKG Congress is not until the autumn.

The chairman mentioned that Michel Kasser, IGN, France had offered the NKG Working group to have their next meeting in Paris. The meeting should be in March 2002 The delegates were requested to think about the offer and send in their comments to the chairman at earliest possibility.

**Closing of the meeting**

The chairman thanked each and everyone for a good working group meeting and closed the meeting at 12.15. The chairman especially thanked the host country (Iceland) for the superb preparations for the working group meeting, seminar and technical tour. Their hospitality was also greatly accepeted.

Thorarinn also thanked the NKG working group for having the seminar and meeting in Akranes and thanked for the offer to participate in the meetings of the group in the future.

**APPENDIX 1 PLAN FOR THE NORDIC HEIGHT BLOCK**

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NKG Presidium Meeting in Copenhagen at KMS - February 8, 2001

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# Plan for the Nordic Height Block

By
BECKER Jean-Marie - Chairman
NKG Working Group for Height determinations

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1. **Actual situation concerning the activities for the establishment of a new precise height networks in the Nordic countries:**

- Denmark: The measurements, computation and evaluation are achieved and published see: "KMS Publications4. Volume 8 – The Danish height system DVR90 by Klaus Schmidt, 2000".
  Ongoing densification over most of the country and some also GPS measurements on Nodal points.
- Finland: Measurements and relevelling for error detection continues as planned and will be achieved during 2003. All data are prepared for final calculation immediately after.
- Iceland: Is planning for future activities to establish a new height network
- Norway: Measurement activities are decreasing, in best case they will have achieved during 2005 at least a reduced volume (Björn Engen, Gävle, 18 January 2001). Some preparations for the final calculation and adjustment have been made concerning the use of selected old measurement data (1900-2000).
- Sweden: All field measurements will be achieved 2001. Relevelling for error detection continue to 2003 (this includes also densification of the gravity network). A special project for the preparation for the final adjustment has been established (PO Eriksson leader) to detect all errors, to clean the data including which remeasurements are needed. All this preparation work (project) has to be done during 2001. Until 2003 the preparation will also include the test and evaluation of adjustment software. From 2003 the final adjustment of the Swedish Network is achievable and the Swedish data can be included in a common Nordic Block Adjustment.

*NOTE: The NKG Height WG organise a Seminar about height determination questions the 16-19th June 2001 in Arkanes/Iceland in connection with the annual meeting.*

2. **Proposals concerning the activities for the common Nordic Block Adjustment:**
   - Achievement of all national field activities including revelling as soon as possible (from 2001 to 2003 and for Norway 2005)
   - Cleaning of all data: detection and elimination of errors in respective country
   - Preparation of final data to be included in the National Network adjustment
   - **Adjustment of the National Networks from 2003 to 2005 (except Denmark allready made)**
   - Evaluation of the results – Detection of non-acceptable local weaknesses (to low accuracy)
   - Complementary national activities (relevelling, etc) to eliminate (minimise) eventual non-desirable residual errors.

- Preparation of national data to be included in the common adjustment of the Nordic Block in accordance with the **common accepted instructions**. (This is a very important point that needs to be discussed deeply)
- Deliverance to the **Nordic Database** at the **Nordic Computer Centre (NCC)**
- **Adjustment of the Nordic Block at the Nordic Computer Centre (2005):** Two steps: first Nodal points adjustment and after that all points adjustment
- Evaluation of the results (2006)
- Additional actions to eliminate eventual weaknesses: densifications, GPS checks, etc.
- **Final Heights for the whole Nordic Block (2006- 2007)**

**3. Other activities affecting the Nordic Block Adjustment:**

- Designation of the **Nordic Computer Centre (NCC)** : Responsible for the common Nordic Block Adjustment, including the capture of national data and distribution of results (**before 2003**)
- Densification of the national **gravity network** to give enough gravity support to the height network in accordance with the variations of the gravity field: mountainous areas especially (Sweden especially before 2003)
- Establishment of a **Combined GPS and Levelling Nordic Network (CGPS/LNN)** consisting of points common for levelling (nodal points) and GPS measurements. This for two reasons: firstly to detect eventual (systematic) errors in levelling lines, secondly to establish and assure a good and regular connection/relationship between geoid and ellipsoid. This network has to be homogene over the whole Nordic Block with a density to be decided (as example 100 km x 100km) (to be planned **as soon as possible** and executed thereafter, before 2006)
- **Connection to the European Network (**after request or 2005?) **(**Note: Denmark has already delivered the third precise levelling to the IAG subcommission EUREF)

**4. Landuplift in the Nordic Block and eventual extension to the countries around the Baltic Sea**

- Creation of a **WG responsible for the landuplift** problematic in the Nordic Countries and who takes care of all related questions: data capture, calculation, evaluation, etc
- Preparation and transfer of the data from **previous precise levelling** (1st and 2nd) first into the national database and later to the common **Nordic Database** in accordance to given and accepted instructions. This is for the common calculation of the **landuplift in Scandinavia**.
  Note: This old data can also be very helpful in the research of possible explanations of suspect discrepancies (systematic errors, settlement, landuplift?)(**before 2003, Norway before 2005**)
- Connections to the mareographs/**tide-gages** around Scandinavia (both by levelling and GPS) (important item).
- **Contact with the other countries around the Baltic Sea** for discussions about integration of their networks into a common adjustment and for the calculation of the landuplift around the Baltic Sea (**as soon as possible** – before 2003)