

ORTHOPHOTO AS A PART OF THE NATIONAL MAP PLAN OF NORWAY

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1. General

Orthophoto was introduced in Norway in the early 1970's. The optimistic estimates of needs for orthophoto at that time were never fulfilled and not more than 25-30% of the available capacity of 2 manually operated instruments were utilized.

The possible combination of using orthophoto in map revision, and having a supplementary product to the traditional map, presented an interesting aspect that became an important part of the Norwegian National Map Plan of 1979. Especially in connection with National Map series in scale 1:5000 and 1:10000.

Main points in the plan were:

- periodic aerial photography of Norway in photoscale 1:15000 and 1:40000. 10 years interval.
- establish a National Height Data Base - HDB in a 10-years period
- periodic orthophoto production parallel to the aerial photography
- periodic map revision of the National Map series in scale 1:5000 and 1:10000. In most areas by help of orthophoto.

Aerial photography as well as orthophoto and revised line-map gives an updated picture of the terrain. Dependant on the amount of details and land use each of them or combinations can serve as a sufficient tool for the map user to get the necessary updated information.

Today (1983) the Government has decided that periodic aerial photography and orthophoto production shall be carried out as stated in the 1979-plan. But only 25-30% of the 1:5000 and 1:10000 map-scale areas will be revised periodically.

The capacity of the two manual orthophoto instruments we had in the 1970-ies was not enough to meet the production specified in the plan. New techniques based on automatic projectors utilizing digital height data and the prospect of establishing a National Height Data Base (HDB) were evaluated. Orthophoto production-system as well as HDB were specified. During 1979-80, orthophoto projectors were evaluated and the choice fell on ORTHOCOMP Z-2 which were installed June 1981.

The ORTHOCOMP Z-2 is owned and operated in a cooperation of the five largest private map companies in Norway. The government, represented by the Ministry of Environment, has rendered a production guarantee.

2. Orthophoto production in Norway

The majority of orthophoto are produced in the scales 1:5000 and 1:10000 matching the National Map series of Norway. The orthophotos are compiled from aerial photographs in scale 1:15000 or 1:22000. The production in 1983 will cover approximately 2000 km². In addition some orthophotos in scale 1:500 and 1:1000 will be produced.

2.1 Height Data Base, HDB

The planimetric standard error specification to the map series in scales 1:5000 is +/- 2m. The orthophoto accuracy requirements are identical as orthophoto will be used in map revision. Through theoretical studies it has been found that orthophoto in Norwegian terrain produced from a 25m x 25m grid HDB with a height accuracy of +/- 3 - 3.5m will meet the planimetric accuracy requirements if the slit width is 5mm.

Based on this, heights for orthophoto and HDB are collected in one of the following ways.

- Digitizing contour lines from existing maps. Either continuously or as inter-sections between contour lines and 25m distant parallel profiles.
- Digitizing contour lines in stereoinstrument (autograph)
- Direct profiling in stereoinstrument with 25m parallel profiles in photoscale 1:30000 and greater.

These methods are work-intensive and the amount of data is great. Different tests and investigations are carried out to see if the accuracy-requirements to the heights could be reduced and the required orthophoto accuracy still be obtained.

To date no decision has been made to change established routines.
The digitized height data are filed by governmental mapping authorities.

2.2 Profiles and parameter data to the projector.

To prepare data for the ORTHOCOMP Z-2 Zeiss has made the software-package HIFI. HIFI is run on a HP 1000, a computer which is not in use by Norwegian map producers. In addition it is not possible on our configuration to scan on the ORTHOCOMP Z-2 and prepare data on the HIFI at the same time. As a consequence, we have prepared our own software, PROFGEN, on the Norwegian NORD 100 computer. PROFGEN prepares three datafiles, one with profiles, one with parameter data as passpoint coordinates, scales, focal length etc. and one with text for the map frame and crosses in the orthophoto-corners.

When the height data are contours the profiles are computed as intersections between the contour lines and the profiles. No interpolation methods are used.

The program issue warnings and locate errors if the height difference between points in the profiles is to big.

PROFGEN is now installed in 4 different companies. They prepare each the necessary data for the ORTHOCOMP Z-2 which is only used for scanning.

2.3 Scanning

The slits on our projector are 4,6,8 and 16 x 0.1mm.

Most orthophotos are made with the 6mm slit. Zeiss and others recommend 8mm slit-width. But the terrain in Norway is rough and change will not be done before we get the results of investigations carried out this autumn (1983).

We are not able to utilize the maximum scanning speed of 50mm/sec and at the same time get the best photographic quality. This can be due to our choice of film or that we use 6 x 0.1mm instead of the standard 6 x 0.2mm slit. We use mostly 30 or 40mm/sec.

To make 1 orthophoto the operator needs on the average 1 hour to complete the whole process. The orthophoto is then produced from 1/3 - 1/2 of the photograph.

2.4 Reproduction

In contradiction to maps, everybody seems to have an opinion about the quality of an orthophoto. In addition the requirements are different dependant of the use.

The quality on the other hand is dependant on serveral factors such as:

- weather of photography
- time of photography
- exposure
- film
- chemicals etc.

As a result reclamation on orthophotos is higher than on maps.

In Norway no education on academic level in photography and reproduction is offered. It is therefore difficult to get people with the necessary skill to obtain the best quality from existing negatives, and to specify in advance the process giving the best result, and to indicate which result existing negatives will give.

Different investigations have been carried out to reduce the reproduction problems as different tones between adjoining orthophotos, negatives with light and dark areas, too much contrast, too hard copies etc..The following investigations have been carried out:

- Aerial photography - Recommended period of the day and season. The weather conditions and short photoseason in Norway makes this difficult.
- Diapositive - Equipment for electronic contrast-adjustment is purchased.
- Film and chemicals - Different film and chemical combinations are tested - recommendations are given.
- Exposure - The relation between exposure and scanning speed are specified for recommended films.
- Final Orthophoto - The final product is either a positive screened or continuous film or a paper copy. Different screenes and materials have been tested.
- Prints - Most clients make their own prints from a positive film. Different day light films have been tested on continuous and screened positive film.

2.5 Stereomates

To get the best result using orthophoto in map revision as well as in soil-, vegetation- and geological interpretation and in classification, a stereomate is needed. When the accuracy requirements are high, as in map revision, special instruments are necessary and a Rost Stereograph is purchased for test production.

We have, so far, produced less stereomates than expected. The reason is probably the relative high price compared to the price on orthophoto. A stereomate is as timeconsuming to produce as an orthophoto, that is approx 1 hour in the ORTHOCOMP. Usually you need 2 stereomates to each orthophoto. In addition all stereomate data must be prepared on the HP 1000 in the ORTHOCOMP Z-2 equipment. This because the software, including HIFI, is not available on our regular main frame. This causes a break in the scanning work as scanning and HIFI-processing can not be done at the same time on our configuration.

As a consequence making one set of stereomates is approximately 3 times more time-consuming than to make one orthophoto.

3. The project - orthophoto, quality and use

As a consequence of the installment of the new orthophoto projector and the increased amount of orthophoto to be produced, a new project on orthophoto has been started in Norway. The aim of this project is to specify procedures for orthophoto production, to optimize production methods and select areas for the use of orthophoto. The project is called - "Orthophoto, quality and use". Project cost is approx NOK 1.8 mill (US\$ 250.000), project period 1982-84.

Main activities in the project are:

- Accuracy tests with different photoscales, different HDB accuracies and different slit-widths.
- Test of reproduction processes and materials
- Orthophoto with stereomate as an inventory tool in forestry, land classification, property boundaries and geology
- Quality in interpretation on orthophotos compared with traditional aerial photographs
- Evaluation of results and development of a system for optimum use of orthophoto in different fields.

The Rost Stereograph mentioned earlier is purchased for this project.

4. Use of orthophoto

The only field where orthophoto is used systematically is in forestry. Other users are so far doing testproductions, and are using orthophoto as a service for supplementary information.

In forestry orthophoto is used in planning, for classification and evaluation, in data collection and in mapping:

The other fields where orthophoto is being tested are:

- Map revision with and without stereomate
- Thematic mapping as soils, vegetations and geology
- Planning of living and recreation areas

Tests on road planning have not been successfull.

Orthophoto has in addition been used with success as a cheap and fast substitute for maps in areas which will be the last to get coverage of National Maps in scale 1:5000 or 1:10000.

5. The user reaction on orthophoto

Many of the potential users of orthophoto in Norway have been negative and restrained in taking it in use. The reasons are many, some of the most usual comments are:

- It is too expensive as long as we also have to produce the HDB
- The photographic quality of orthophotos is bad compared to the aerial photograph
- Prints of the orthophoto with good quality are expensive

- Day-light film quality is not good enough
- To draw new plans on the orthophoto is difficult.

Positive arguments for orthophoto as:

- orthophoto can be produced fast
- it gives the possibility to interpretate directly in true scale
- it makes map revision simpler and increases the quality
- it is a revised map alone
- it increases the amount of information
- it is cheaper than a map
etc.

are difficult to get the potential user to accept.

Lacking knowledge about how orthophoto is produced and that established working procedures has to be changed, can also be the reason.

6. Final comments

Orthophoto is, in spite of some resistance, becoming an important map-product in Norway. More and more people finds it useful and the stream line of production is increasing.

We will, in 1983, produce 3 times as much orthophotos as in 1982 and in 1985 we will probably have problems with the capacity.

Today there are two bottle necks in the process, digitizing of height data and reproduction. Digitizing is on its way to be more effective. An increased productivity on the reproduction part seems not to be so close.

But, everything taken into consideration, it appears that we are in the process where orthophoto in short time will be as common as line maps.

SUMMARY

The Ministry of Environment presented the Norwegian National Map Plan in 1979. Orthophoto was an important part of the plan. It was considered a 10 years cyclus of orthophotocoverage for approx 200 000 km² in the scales 1:5000 and 1:10000.

To realize this the orthophoto production has to be based on modern techniques and the choice fell on the ORTHOCOMP Z-2 from Zeiss Oberkochen.

This presentation describes the techniques used in Norway and the fields where orthophoto and orthophotomaps are used. The establishing of a national height data base and how orthophoto will be used in map revision, forestry and area planning is emphasized.

ZUSAMMENFASSUNG

ORTHOPHOTOS ALS TEIL DES NORWEGISCHEN NATIONALKARTENPLANS

Im Jahre 1979 legte das Umweltministerium den Nationalkartenplan vor. Orthophotos waren ein wichtiger Bestandteil dieses Plans. Für die Orthophotoerfassung von ca. 200 000 km² im Maßstab 1:5000 und 1:10000 wurde ein Zeitraum von 10 Jahren veranschlagt.

Um dies zu erreichen, mußten moderne Verfahren für die Orthophotoherstellung gewählt werden; der Zuschlag fiel auf den Orthocomp Z-2 von Zeiss Oberkochen.

Der Artikel beschreibt die in Norwegen benutzten Methoden und die Bereiche, in denen Orthophotos und Orthophotokarten verwendet werden. Die Betonung liegt auf dem Aufbau einer Nationalen Höhendatenbank und auf der Verwendung von Orthophotos für die Kartenfortführung, im Forstwesen und in der Flurplanung.

RESUME

L'ORTHOPHOTOGRAPHIE APPLIQUEE AU PROGRAMME DE CARTE NATIONALE DE LA NORVEGE

Le Ministère de l'Environnement présenta en 1979 la Carte Nationale de la Norvège. Une grande partie de cette carte a été réalisée par orthophotographie. Il a été prévu d'exécuter cette couverture photographique à l'échelle de 1:5000 et 1:10000 dans un cycle de 10 ans. La surface à couvrir est de 200 000 km² environ.

Pour réaliser cette performance il a fallu mettre en oeuvre des techniques modernes et le choix se fixa sur l'Orthocomp Z-2 de la maison Zeiss Oberkochen.

L'exposé décrit les techniques utilisées en Norvège et les domaines d'application de l'orthophotographie et des orthophotocartes, l'établissement d'une base de données altimétriques nationale et la manière dont est utilisée l'orthophotogra-

phie pour la révision des cartes, pour les Services des Eaux et Forêts et pour les plans d'aménagement du territoire.

RESUMEN

LAS ORTOFOTOS COMO PARTE DEL PROGRAMA NACIONAL DE MAPAS DE NORUEGA

En 1979, el Ministerio del Medio Ambiente presentó el Programa Nacional de Mapas de Noruega. Una parte importante de este programa está representada por ortofotos. Se estimó que para cubrir con ortofotos a escalas 1:5000 y 1:10000 una extensión de unos 200 000 km² se tardaría 10 años.

Para conseguir este objetivo, era necesario recurrir a modernos métodos de producción de ortofotoplanos y la decisión se ha tomado en favor del Orthocomp Z-2 de la casa Zeiss, Oberkochen/Alemania Occ.

En la conferencia se exponen los métodos aplicados en Noruega y aquellos sectores en los cuales se utilizan ortofotoplanos. Se ha atribuido especial importancia a la creación de un banco nacional de datos altimétricos y a la manera de servirse de las ortofotos para la actualización de mapas, en silvicultura y para fines de planificación.

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