

# **National Report of Denmark 1995-1998**

## **IUGG General Assembly Birmingham, UK**

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This report to the International Association of Geodesy, within the International Union of Geodesy and Geophysics, covers the scientific activities in Denmark during the 4-year period at the following institutions:

National Survey and Cadastre, Department of Geodesy (KMS)

University of Copenhagen, Department of Geophysics (UOC).

The geodetic activities are to a large extent carried out as a cooperation between the two mentioned institutions. Further a number of the projects are carried out within the framework of the Nordic Geodetic Commission, which facilitates the geodetic work going on in Iceland, Norway, Sweden, Finland and Denmark.

### **Geodetic networks**

KMS has participated in the establishment of the European Vertical GPS Reference Network carrying out GPS observations at five tide gauge stations - four in Denmark and one in the Faroe Islands.

New geodetic networks based on ETRS89 has been introduced in Denmark and the Faroe Islands.

The third order precise levelling network in Denmark is completed and a new vertical datum has been introduced. Furthermore all observations have been introduced in the Unified European Levelling Network 1995 (UELN-95)

## **Satellite positioning**

Three permanent GPS reference stations are established in Denmark providing observations to a number of services aiming at an improvement of the GPS code observations.

In Greenland two permanent GPS reference stations are in operation - one in Thule (Pittufik) in cooperation with Jet Propulsion Laboratory, USA and one in Scoresbysund (Ittoqqortoormiut). The permanent station in Thule collects data from GPS and GLONAS.

## **Gravimetry**

The gravity surveys in Greenland covering the ice free part of Greenland have been completed resulting in an average spacing between gravity points of approx. 20 km.

New gravity projects have been initiated by developing methods for airborne gravity observations through the Airborne Geoid Mapping System for Coastal Oceanography (AGMASCO). AGMASCO is a cooperation between Germany, Portugal, Norway and Denmark. Surveys with the system for airborne gravity observations has been performed in the Polar Sea North and East of Greenland.

## **Altimetry**

A number of investigations using altimeter observations from the ERS, GEOSAT and Topex-Poseidon satellites have been performed. This includes

- global gravity field determinations
- global ocean tide models
- mean sea level changes
- combinations with other remote sensing data (temperature and ocean colour).

Further, a digital terrain model for Greenland using all available data such as altimetry, radar observations from aircrafts and photogrammetry has been established.

## **Geoid determinations**

The work with the Nordic geoid has been continued and a new version was established during 1996. This version includes new data especially from eastern-european countries, as well as new data from joint Nordic marine gravimetry projects in the Baltic and the North Sea.

A number of investigations on geoid determinations and inversion problems has been performed related to the North Sea and the North Atlantic area.

## Ice sheet monitoring

Several sites at the Greenland ice sheet have been monitored by GPS, airborne laser altimetry and SAR interferometry in order to assess height changes and intercomparison of methods. The ice sheet measurements have been carried out in cooperation with University of Copenhagen and the Danish Center for Remote Sensing.

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## Selected Publications:

### 1996:

Andersen, O. Ba.: *Using Inversion for Ocean tide Mapping*. In: Inverse Methods: Interdisciplinary elements of methodology, computation, and applications, B.H. Jacobsen et al. (eds.), Lecture Notes in Earth Sciences, 63, Springer Verlag, Berlin, 239-246, 1996.

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Andersen, O. Ba., and P. Knudsen: *Multi-satellite ocean tide modelling. How can we improve KI?* Presented TIDAL SCIENCE 1996, London, October, 1996.

Andersen, O.Ba., P.Knudsen, and C.C.Tscherning: *Investigation of methods for global gravity field recovery from dense ERS-1 geodetic mission altimetry*. In: Global Gravity Field and its temporal variations. (Rapp, Cazenave & Nerem, Ed.), IAG Symposia no. 116, pp. 218 - 226, Springer Verlag, 1996.

Andersen, O.Ba., T. Knudsen, P. Knudsen: *Global Analysis Of The Seasonal Cycle from ATSR Sea Surface Temperature Data and Topex/Poseidon Altimetry* Presented, EGS XXI General Assembly, Den Haag, May 1996.

Andersen, O. B., and R. Forsberg: *Danish precision gravity reference network*. Kort & Matrikelstyrelsen, Skrifter 4. rk, bd. 4 (Publications of the National Survey and Cadastre, Publications 4. series, vol. 4), 1996.

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- Forsberg, R. and J.M. Brozena: *Airborne geoid measurements in the Arctic ocean*. Proc. International Symposium on Gravity, Geoid and Marine Geodesy, Tokyo, Sept. 1996.
- Forsberg R., K. Hehl, L. Bastos, A. Giskehaug, U. Meyer: *Development of an airborne geoid mapping system for coastal oceanograph (AGMASCO)*. Proc. International Symposium on Gravity, Geoid and Marine Geodesy, Sept. 1996, Tokyo, 1996.
- Forsberg, R., D. Solheim and J. Kaminskis: *Geoid of the Nordic and Baltic area from gravimetry and satellite altimetry*. Proc. International Symposium on Gravity, Geoid and Marine Geodesy, Sept. 1996, Tokyo, 1996.
- Jiang, Z., C.Poitevin and C.C.Tscherning: *Nouvelles Solutions pour le geoide gravimetrique Belgique-Luxembourg*. Rapp. Geode no.22, ENSG/LAREG/IGN, St. Mande, France, 1996.
- Jiang, Z., C. Poitevin and C.C.Tscherning: *Adjustment combine du geoide en prenant differentes realisations par les pays voisins*. Rapp. Geode no. 23, ENSG/LAREG/IGN, St. Mande, France, 1996.
- Knudsen, P. and O. B. Andersen: *Ocean bottom topography from ERS-1 altimeter data*. Earth Observation Quarterly (EOQ), 51, ESRIN, 16-18, 1996.
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