National report to CGSIC IISC 9th European meeting in Monaco 30 November-1 December 2000

REPORT FROM NORWAY

1. National Activities

a. Time/frequency activities

Nothing to report

b. Survey/geodesy/GIS activities

The Norwegian Mapping Authority (Statens kartverk) is running a multipurpose national reference system for satellite-based accurate positioning and navigation called SATREF. Ten reference and monitor stations (with geodetic GPS-receivers) are connected to a control centre (with central integrity monitoring and alarm system) for real time transmission of raw GPS and DGPS data. The standard sampling rate is 1 second. Raw GPS and DGPS data are then distributed via magnetic tape, diskette, e-mail, ftp, modem, etc., for post mission use. DGPS data are also transmitted in real time via FM radio network (see differential service below) and to other distributors (public and private). In addition to the 10 SATREF stations there are 4 other permanent GPS stations.

The Geomatics Group at the University College of Gjovik has established a permanent GPS/GLONASS reference station to support land surveying activities in the local area. The reference station is equipped with a dual frequency combined GPS/GLONASS receiver and choke ring antenna, and is at this time supporting static surveying applications. The reference station, known as "Station GJOV", is now automatically providing observational data to the International GLONASS Service Pilot Project (IGLOS-PP) which has been recently launched by the IGS.

The new Norwegian geodetic base net, in geodetic EUREF89, consists of 113 primary 1st order stations and 817 primary 2nd order stations. Observation campaigns were completed in 1994, 1995 and 1996 for the primary 1st order network, with being made over periods of three days, 24 hours a day. The positions were computed by means of the GIPSY program and precise ephemerides. Final coordinates were computed for all 113 stations in ETRF89 using the method recommended by the EUREF commision.
The primary 2nd order stations are situated along roads between the primary 1st order stations at a density of 14 to 25 km. Observation times were 4 hours for each vector. Strong connections were made to primary 1st order stations. The whole primary 2nd order network was completed in 1997, and official coordinates in geodetic datum EUREF89 were published in May 1997. The adjusted positions show a RMS. of approximately 3-7 mm.

The Norwegian Hydrographic Service (a division in Statens kartverk) uses a local differential GPS system (50km range) on all their vessels operating along the Norwegian coast. This consists of a total of 8 units, of which 3 are reference stations. In addition 3 receivers are used for geodetic purposes.

c. Navigation activities

Approximately 4000 users of the national maritime differential GPS service**.**

d. Civil aviation use of GPS

In accordance with ICAO requirements the coordinates for all 54 Norwegian airports and all navigation installations were changed to WGS-84 by the first of January 1998.

GPS Time is used for synchronising all electronic systems used by Air Traffic Control at most Norwegian airports and at the Area Control Centres. This includes for instance communication, surveillance and information systems.

GPS-receivers are used as reference for calibration of the ground based aeronautical radionavigation systems.

DGPS SCAT-1 landing systems (RTCA/DO-217) for precision approach are planned for about 10 Norwegian regional airports. The first approach will be commissioned January 2001. The SCAT-1 approaches also include GPS operations in the terminal areas (TMA). All aircraft operating these airports will be equipped with SCAT-1 (currently approximately 30 aircraft).

Procedures for GPS non-precision approaches will be successively published and used at all the Norwegian regional airports, beginning in 2000.

B-RNAV – which allows use of GPS in combination with VOR/DME- has been mandatory in Norwegian airspace since April 1998.

ADS (automatic dependant surveillance) with GPS and communication via Inmarsat is implemented at 3 Area Control Centres and became mandatory from January 1999 for all the helicopters operating in the oil-fields in the North Sea (currently between 30- 40 helicopters).

Helicopters operating in the oil-fields in the North Sea use GPS for en-route navigation in the Ocean Areas.

2. Differential Services

Ref Station	Operator	Distribution	Charges	Users
12 stations along coastline	Norwegian National Coastal Administration	Maritime radio beacon	None	Maritime users
SATREF (se 1b) (10 ref.stations)	Norwegian Mapping Authority	1. FM/RDS (nation-wide)	1. Free of charge	primarily land-users (survey/GIS, locating, navigation), secondary for maritime users
		2. For post-processing	1. No cost for science.	Geodesy/IGS
			2. Minor charge for commercial	Geodesy,survey, GIS

3 ref.stations in Norway (part of global system)	Fugro Seastar AS	1. Inmarsat High Power Spot Beam	Commercial	Offshore, maritime
4 ref. stations in Norway (part of global system)	Racal Survey	1. Inmarsat A	Commercial	Offshore
3 ref. stations in Norway (part of global system)	Oceonics	1. Inmarsat A 2. Norsat	Commercial	Offshore, marine
Eurofix(2 ref. stations in Norway Part of regional European system)	NELS/CAO	Loran-C	None	Maritime-,land- and offshore
1 station GJOV	University College of Gjovik	UHF and GSM	Not determined	Land surveying, GIS Local area- 30 km

3. Development Activities

a. Land use

The Norwegian Public Roads Administration (NPRA) is currently using GPS and DGPS for accurate positioning of equipment and vehicles for data collection at road construction sites and for maintenance. NPRA, Norwegian Mapping Authority and a number of transport companies co-operate in a large scale pilot project that employs the new Norwegian digital road database in applications including vehicle positioning and navigation. Fleet management systems with GPS positioning for transport companies, agencies, ambulances and taxi-companies are in commercial operation.

In connection with installing its reference station, the University College of Gjovik has established some 50 well surveyed points in forest and built up areas in order to test the performance of RTK measurements under varying conditions of season, weather and satellite geometry. All points are within about 1500 metres of the reference station. As resources become available, it is planned to establish further test ranges at greater distances from the reference station in order to acquire direct experience of accuracy fall-off, as well as to test the use of radio repeaters and mobile telephones for distributing RTK data. These same test ranges will be suitable for testing the performance of code differential systems intended for GIS data capture, again using either UHF radio or mobile telephones as distribution medium.

b. Maritime use

Current development activity is mainly concerned with updating the local integrity monitor sub-system.

The Norwegian National Coastal Administration is planning for frequency changes in March/April 2001 in accordance with the new IALA co-ordinated Frequency Plan for the European Maritime Area.

Nortwest European Loran-C System (NELS) by the Coordinating Agency Office (CAO) has for a while been sending out differential GPS-corrections from the following Loran-C stations: Boe and Vaerlandet (Norway), Sylt (Germany), and in the near future also from Lessay (France).

Preparations for a program for verifying the quality of the service have just started, and measurements with new-developed Loran-C/Eurofix receivers are expected to be operational in the shift between October and November this year.

d. Space use

Norway participates in the European Space Agency's (ESA) project, Artes element 9, through the Norwegian Space Centre. The Artes 9 project includes EGNOS (equal to FAA's WAAS in US), GNSS1 and GNSS2.

e. Military use

- Integration of P(Y)-code receivers in navigation systems
- A local area P(Y)- code DGPS has been developed
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f. Time/frequency use

None

g. Survey/geodesy/GIS

The Norwegian Mapping Authority (NMA) has been participating in the development of EGNOS system test bed and is now operationally responsible for computing GIC/WAD corrections.

NMA is now improving the SATREF concept in order to provide the users with a GPS based navigation service with a few decimetre accuracy level.

4. Industrial Aspects

A Norwegian company, Seatex, has developed/produced the system for distribution of DGPS-corrections via FM/RDS-network. Norwegian Mapping Authority is working for an international standard/agreement for distribution of DGPS-corrections via FM/RDS which is system independent.

Industry Support. The surveying community in Norway has in recent months been troubled by the various changes in ownership and importing agencies concerning satellite based surveying equipments. These changes have resulted in uncertainty amongst users concerning in-country sources of technical support from manufacturers. It is also unfortunate to note that certain main equipment manufacturers are all but unrepresented in-country with the consequence that local authority and local private practice surveyors find themselves unable to obtain advice and support in their own language.

Education. Practical land surveying and GIS education at college and university level to support industry at large has made every effort to keep up with the development of satellite surveying technologies despite the considerable financial involved in acquiring modern equipments. At the same time, terrestrial surveying systems are also essential due to the mountainous and forest terrain. It has however been necessary to drastically reduce the amount of time devoted to terrestrial techniques in order to remain within the time frames available for surveying and GIS education. Nevertheless, student courses are now directed very much with satellite systems in view, and awareness of current and proposed future systems is high.

5. National Policy activities and decisions

The Norwegian guidelines for civil radionavigation are still not approved.

The Chief of Defence Norway Master Navigation Plan has been effective for military use since 1992. Norwegian government authorities (Ministry of Transport, Ministry of Fisheries) take part in the group initiated by a European Commission on possible future European GNSS. The Ministry of Fisheries also participates in the Advisory Group for an European Radionavigation plan.

Norway, represented by the Ministry of Fisheries, assisted by Norwegian Space Centre, has observer status in the EU Steering Committee for Galileo.

6. National Responsible Authorities

The Ministry of Fisheries is responsible for the co-ordination of civil aids to navigation. The ministry is also responsible for installing and operating maritime aids to navigation

Use	Responsible Authority
Land (navigation)	Ministry of Transport and Communication
Maritime navigation	Norwegian National Coastal Administration
Aviation	Ministry of Transport and Communication (Civil Aviation Administration)
Space	National Space Centre
Military	Ministry of Defence
Time/frequency	Time: Norwegian Mapping Authority Frequency: Norwegian telecommunication company, Telenor
Survey/geodesy/GIS	Norwegian Mapping Authority
Industrial affairs	Ministry of Industry
National Co-ordination	Ministry of Fisheries

7. Relevant Conferences/Seminars/Exhibitions held within nation

EUREF2000-symposium
arranged in Tromso, Norway, 22 - 24 June
More than 100 participants from 32 European countries.

Nordic Commission of Geodesy's Autumn School,
in Fevik, Norway, 28 August - 2 September
arranged by Statens kartverk

COST Action 716 Workshop
arranged in Oslo 10-12 July

IGS Network Workshop 2000
arranged in Oslo 12-14 July

8. National Points of Contact

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