SNOWVIEW AND FLOWVIEW - GEOGRAPHICAL PRESENTATION AND ANALYSIS OF INFORMATION IN BOTH TIME AND SPACE DOMAIN

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ABSTRACT

The SnowView-project was initiated in order to develop a decision support tool for hydropower companies. The goal was to improve production control and flood warnings by better monitoring of the actual snow situation. The participants in the project wanted a PC-based, user-friendly system for snow analysis, based on remote sensing techniques combined with the users own measurements and historical information. The project gathered experienced people with background from remote sensing, hydrology, software development and project management. Unlike earlier applications the system does not require skills in the use of complicated image processing or "heavy" GIS-systems.

Lessons learned and experience gained from the SnowView project has led to the development of the FlowView application. FlowView is tool that extends SnowView for unconstrained analysis of information in time and space domain. Time series and imagery can be used and combined. Aggregated knowledge and results can be presented and communicated to various user groups in an intuitive and understandable way. All is carried out in an easy to use geographical interface.

1 BACKGROUND

Scandinavia is the first deregulated electricity market in the world (with 50 % hydropower) and produces, trades and retails in an open market, which is recognised as one of the most volatile commodity market in the region. Competition and strong focus on core business have presented a host of new challenges and opportunities for the sector.

Ever-increasing quantities of information used to predict changes in the price of electricity help players act in the open market. Those who make the most out of this information will in the end show the best business performance.

Supported by the Norwegian Electricity Federation (EnFO) and the Norwegian Space Centre, Cap Gemini started the development of a satellite-based snow monitoring system called SnowView. By using a computer-based tool for viewing and analyzing satellite pictures and snow measurements, authorities and power companies are able to improve production planning and flood warnings.

Lessons learned and experience gained from the SnowView project has in turn led to the development of a new concept in which the application FlowView has been developed. FlowView were to extend SnowView by using not only snow information but any hydrological and meteorological data. The new hypothesis suggest a way to

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achieve more accurate price estimates and hydropower planning through improved analysis, presentation and communication of results.

Both the Norwegian Electricity Federation and some of the major players, including the Norwegian Water and Energy Administration (for the purpose of flood forecasting), have supported the FlowView project from its beginning and have been eager to see what could emerge from this new concept.

2   BUSINESS REQUIREMENTS

Due to deregulated trading, the utilization of information available is vital for competitiveness and the availability of accurate snow measurements is crucial. Real time understanding of the energy situation and forecasts for the future in the short (days), middle and long term (years) are important. When would the snow melt to water? How much water would it be? The seasonal weather differences and the existing volumes in water reservoirs determine price fluctuations. Knowledge gained at an early stage represents a competitive advantage.
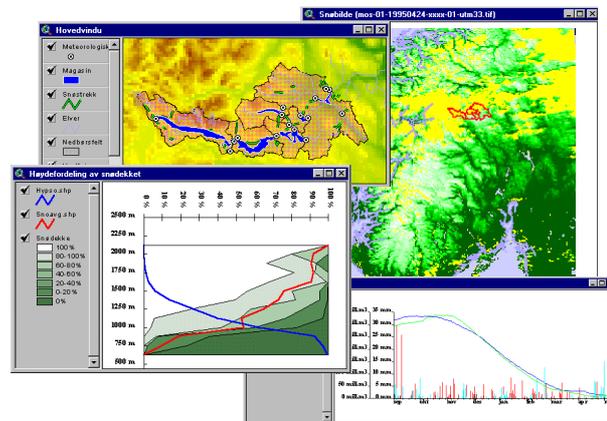

Figure 1, Graphs, maps and diagrams are used to visualize results in SnowView

Better use of existing information can reveal new insights. This is possible through access to databases and tools designed to analyse information in an unconstrained way.

Satellite systems also monitor competitors' snow-reservoirs in order to make better price prognosis. By introducing an easier to use and more cost-effective system, hydropower providers can compare current and historic data and generate reports based on accurate precipitation data.

2.1   Market Analysis and Prestudy

In 1996 the Norwegian Space Center and Cap Gemini cooperated in a market analysis study as a first step in defining the needs for user applications based on earth observation. The utility sector represented by hydropower producers was among the most interested potential users for such systems. A prestudy was launched soon after to define the requirements of a snow monitoring system based on satellite images. The user specifications of a possible future system were shown in a prototype developed in two parts: An image processing system which transformed "raw" satellite images into snowmaps and a presentation system based on a GIS-platform. The latter was very easy to use, but the IP-system required some expertise.

3   MAIN PROJECT/SOLUTION

Three parties - Cap Gemini, the Norwegian Space Center, and the Norwegian Electricity Federation co-financed the *SnowView* system. The PC-based system, has a user-friendly MS Windows interface and employs a Geographic Information System (GIS). Downloaded images are the basis for "snow maps" that are sent via the Internet from the satellite ground station (Tromsø Satellite Station, TSS in Tromsø) to the GIS system. TSS produces the snowmaps in a specialized application. In this way the need for expertise are centralized and the end-users are able to visualize the classified snowmaps "at the click of a button".

The system allows users to:

- Transfer pre-processed satellite pictures daily via an Internet-based service
- Enter precipitation data for specific geographical regions, enabling power companies to develop their own information databases
- View meteorological prognoses as graphs or maps
- View snow measurements (current, historic and prognoses) as maps and diagrams
- Compare current and historic snow measurements
- Generate reports with "management summaries"
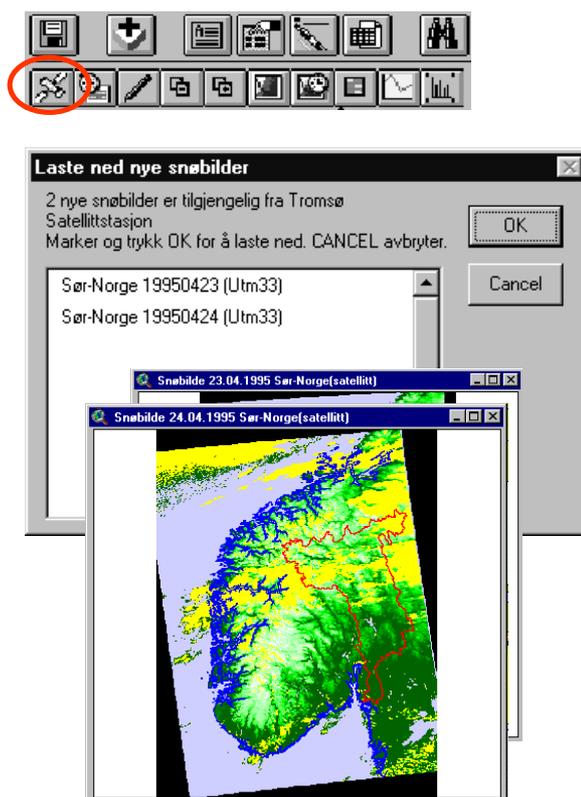- Export information to spreadsheets and presentation systems

Figure 2, Snowmaps in SnowView are received in a user-friendly way: You "click" on the "get snowmap – button", select the snowmaps you want in the dialogue-box and the snowmaps are opened.

The prototype was available in five weeks. The operational system was made in five months including two user installations. The PC-based application uses a standard GIS-platform and a standard database system.

Experience from the SnowView project resulted in a new project, FlowView. The concept behind FlowView is to allow unconstrained analysis of information giving users the possibility to combine different hydrological and meteorological sources of data using basis operations. As for SnowView, FlowView is also a PC-based system employing a user-friendly MS Windows interface and a Geographic Information System (GIS). Presentations are displayed in maps and analysis can be performed easily in both the space and time domains. Information can be integrated from different sources and is accessible through simple but powerful ways of structuring data in the system.

The system allows users to:

- Geographically display information in both points and images
- Organise all data as time series modelled as layers of point collections or images

- Display all information with free colour setting in proportion to values at one instant of time

- Carry out analysis by a "calculator" operating on points and images in time and space domain

- Convert values in point collections to images that fill in information between point values, and to combine images in the "calculator"
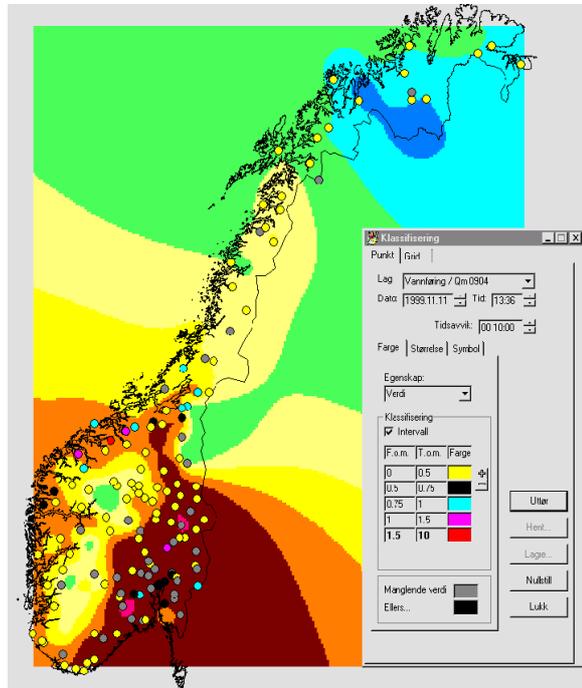

Figure 3, Classification of information in FlowView

4   SYSTEM DESIGN

4.1   SnowView

SnowView is based upon ESRI's ArcView 3.0. The user interface of SnowView is implemented as an ArcView project, and the script language Avenue is used to activate other modules.

4.2   FlowView

FlowView is developed in Microsoft Visual Basic supported by the tools Map Objects by ESRI and Surfer by Golden Software. FlowView is designed in a way that allows the application to:

- Be user friendly, fast and easy to operate

- Provide uncomplicated access to all relevant information

- Give presentations that are intuitive and straightforward to understand

- Ensure that analysis and presentations are executed in an unconstrained way

- Provide trouble-free integration into different environment of systems and databases

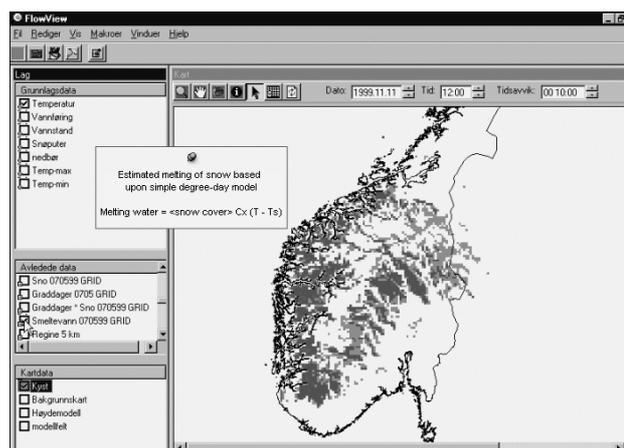- Have a component based IT-architecture

Figure 4, Example of a FlowView calculation. The map shows a forecast of melting water due to melting of snow.

5 THE BENEFITS

5.1 SnowView

The benefits gained from SnowView are:

- Improved snow-volume accuracy, which gives enhanced water-feed simulations.
- Better calculations of water run-off from the snow, gives improved early flood warnings and more effective production planning.
- Competitors have a clearer presentation of the snow-situation in the market.

5.2 FlowView

The main benefits of FlowView as reported by authority, are:

- A new way to aggregate detailed point information to area based knowledge
- Likely to uncover new competitive knowledge in the existing information
- Are now able to carry out analysis on an aggregated level
- Improved communication of results through aggregated analysis and presentations
Replaces "magic" home made solutions