Titles of potential projects planned on Nordaustlandet, Svalbard during IPY 2007.

Overview, see details of the projects below.

Atmosphere focused studies
1.Spatial and temporal variability of snow properties on Vestfonna.
2.Monitoring of weather and climate characteristics: finding proxy data transfer functions.
3.Evaluate the changing inputs of atmospheric contaminants to surface snow, ice cores and lake sediments.
4.Estimating extent of anthropogenic radioactive fallout.
5.New particle formation in Arctic air and transport of heavy metals into the Arctic.

Biosphere focused studies
6. Spatial pattern and temporal dynamics of terrestrial ecosystems in relation to surface age and environmental change.
7.Biogeochemical cycling of carbon and mercury.
8.Nitrogen fixation in arctic desert vegetation and soil crusts.

Climatic and environmental direct and indirect archieves
9.Ice coring by Vestfonna Ice Cap: the last millennial of climatic variability over Svalbard at annual resolution.
10.Borehole thermometry in icecaps and permafrost: amplitude of warming during the last century.
11.Thermal interaction between glacier and permafrost areas under conditions of glacier retreat during the last centuries.
12.Holocene climate and environmental variability from lake and sea sediments and terrestrial periglacial landforms.

Geosphere focused studies
13.To monitor lithospheric response to glacial overburden utilizing InSAR techniques.
14. Tectonic evolution of the Barents Shelf.
15. Geological processes in the formation of the Arctic phosphogenic province

Ice Mass focused studies
16.Mass balance and mass dynamic evolution of the Nordaustlandet ice masses . 17.Glacial dynamics and flow of Vestfonna Ice Cap
18.A mechanical/hydrological investigation of Franklinbreen, as an analogue to mid-latitude Pleistocene ice streams.

Landscape focused studies
19.Quaternary landscape evolution of ice-free terrain on Nordostlandet, Svalbard.
20.To establish the long-term landscape evolution of Nordaustlandet. Oceanographic studies
21.Sea ice ecology and plankton dynamics.
22.Marine carbon sources and sinks near continental ice areas of the northern Atlantic.
Society focused studies
23.Arctic winds of the war: the strategic value of weather observations 1930-1950.
24.Natural harbours in the Arctic: sites of long-term historical and archeological significance.
25.The cultural meaning and significance of Arctic sites from an aboriginal and visitors' perspective.

Systems focused studies
26.Detecting current and predicting future glacier changes.

Potential projects planned on Nordaustlandet, Svalbard during IPY 2007.
Atmosphere focused studies

1. Spatial and temporal variability of snow properties on Vestfonna.

Contact person: Piotr Glowacki, Polish Academy of Science <glowacki@igf.edu.pl>/J. Moore Arctic Centre <jmoore@ulapland.fi>,

Science: Surveys of the spatial and temporal distribution of precipitation and accumulation over the ice cap are an important part of understanding the dynamics of ice masses, and of the climatological variability. Equally important is the surface sampling of chemical and physical signature of the precipitation in order to understand the signals present into ice core records to decipher signals stored therein. Automatic snow sensors will be installed to determine the temperature and snow accumulation evolution during the arctic winter. To understanding of the annual cycle of the annually active snow layer, from the surface down to about 5 m. This sensitive layer is the upper boundary zone of the glacier through which the glacier communicates with the atmosphere. A new snow climate model will be developed, and together with the glacier models wide set of tools will be available to investigate the influence of climate variations on Nordaustlandet glaciers. Information will be gathered from field surveys consisting of snow pits (2–5 m) for snow structure and properties, simple monitoring lines for surface melting and accumulation, surface truth lines for satellite remote sensing instruments, heat flux stations for air–snow heat exchange, radiation balance, and heat and light flux into the snow.

The snow pits provide the stratification, properties, metamorphic processes of the whole annually active snow layer, the pits will be sampled for chemical analyses. The monitoring lines consist of lines of survey stakes for monitoring the surface mass balance and ice flow (only on the glacier). Ground truth for satellite remote sensing products (which are sensitive to at most the upper 0.5 m of snow) is to be based on snow properties found on lines of shallow snow pits serving as calibration lines for the satellite instruments. Remote sensing data will be from Envisat and Cryosat (data flow not yet confirmed).

Air-snow heat and moisture fluxes will be examined from field data based on a portable snow station with the components of the radiation budget resolved. The system will have sensors also within the snow for the temperature and (upper part) transfer of sunlight. The key questions are the onset of melting, depth of the melting layer, and their connections to the temporal evolution of the albedo and transmissivity. We will also monitor water chemistry, as well as investigate and monitoring the isotopic composition of modern precipitation and open lake waters.

We will link the results from this study with others performed during IPY both in Svalbard and elsewhere by ensuring compatible methodology (Polarcat, POLAP etc). In particular we will work closely with measurements collected at Hornsund in southern Spitzbergen and at Ny Ålesund in Northern Spitzbergen.

Popular Summary Dry snow cover can reflect 90% of coming solar radiation back to the space and has a strong cooling influence to the climate. The chemical and physical properties of the surface snow cover influence its absorption, backscatter and emission properties that create the signals seen by satellites. Snow cover properties are used as an input data for numerical glacier and climate models.

Field requirements: Spring: Remote camp on Vestfonna, scoter/ATV transport, Refrigerated return of some samples (100 kg). Melt period based at hut spring-summer???

Time plan Spring 2007: field surveys. Spring-summer 2007 study of melting period?

2. **Monitoring of weather and climate characteristics on Nordaustlandet in order to find transfer functions between proxy data and meteorological parameters**.

Contact person: Regine Hock, Stockholm university**, <regine.hock@natgeo.su.se>,**

Science: The establishment of weather stations is of paramount importance for deciphering climatic change detected in the high-resolution palaeoarchives and for understanding the underlying processes of current glacier mass balances. We will install several automatic weather stations at Kinnvika and on the ice cap and perform radiosonde measurements. The data will be used to characterize the current meteorological conditions in the area and thus complement ongoing measurement programmes in Nya Ålesund and Hornsund. We will analyse seasonal and spatial variations in various meteorological variables,, and study the atmosphere-snow-ice exchange processes. The data will also serve as input for calibration of mass balance models (link to WP 16). We also intend to use the information of water isotopes to monitor changes in atmospheric circulation patterns. This is feasible because the isotopic composition of through flow-, and lake water in the Arctic, on for example Nordaustlandet, most likely represents the annual mean water isotoic signature of precipitation (as evaporation is negligible).
The main objectives are:

- to describe the current climate variability in time and space on Nordaustlandet
- to understand how the climate parameters on Nordaustlandet are linked to the climate of Svalbard and the general atmospheric circulation
- to find transfer functions for interpreting information from ice cores

Popular Summary

Weather stations will be operated on Nordaustlandet beside and on the ice cap in order to understand how meteorological conditions vary through the season and across Svalbard. Together with long time series from other weather stations on Svalbard, these data will help to derive information on past climate conditions as can be retrieved from ice cores or sediment cores. Current climate also determines the glacier mass balance and our data will contribute to an understanding of the link between climate and glaciers.

Field requirements

Use of Kinnvika station and temporary camps on the ice cap for installation and operation of automatic weather stations

Time plan

2007 installation of weather stations, operation of all stations for 1 year and of the station at Kinnvika base for several years

3. **Evaluate the changing inputs of atmospheric contaminants to surface snow, ice cores and lake sediments**.

Contact person:: Pirkko Kortelainen, SYKE), <Pirkko.Kortelainen@ymparisto.fi>.

Science:
Previous work on Svalbard snow and ice cores suggests highly variable geographic and temporal inputs of organic contaminants (carbon, mercury) from net atmospheric deposition by long range transportation from densely populated areas. As atmospheric circulation patterns change, sources and fates of these contaminants will also change. It is important to increase our understanding of contaminant input history, in addition to knowing present inputs. New ice cores from Vestfonna, Nordaustlandet, the coldest region of Svalbard, will provide details of the contaminant history from that region. This will also help to identify the local contaminant effects of human activities in other regions of Svalbard. Results of ongoing research in the Yukon River basin of Alaska USA and northwest Canada suggest that climate warming is having a substantial effect on dissolved organic carbon (DOC) cycling in permafrost dominated basins. As the permafrost melts, frozen organic carbon becomes bioavailable. We hypothesizes that this is occurring in other permafrost dominated basins across the north. Biotic and abiotic factors controlling carbon cycling in a cold and dry arctic environment will be studied by analysing CO2 and CH4 over/undersaturation, and δ13C and δ14C of carbon species in a range of aquatic settings. We have a possibility to use new systems for a continuous monitoring of CO2 concentration. The applicability of this system in harsh conditions will be tested as a part of this project. In the presence of pollutants such as mercury, micro-organisms survive by using mechanisms of detoxifying harmful compounds. Mercury is an example of the several pollutants that may affect the arctic environment, and links with the carbon cycle makes it particularly interesting as an object of study. Freshly deposited ionic mercury is likely to be bioavailable, but very little is known about the presence and potential activity of microbes involved in mercury transformation at high latitudes. The distribution of total and methyl mercury in snowpack, water and sediment will be determined, and mercury methylation rates will be analysed.

Popular Summary
In the presence of pollutants such as mercury, micro-organisms survive by using mechanisms of detoxifying harmful compounds. Mercury is an example of the several pollutants that may affect the arctic environment, and links with the carbon cycle makes it particularly interesting as an object of study. Subglacial microbial populations are able to oxidize and ferment organic carbon, producing CO2 and CH4 which may be dissolved in meltwaters, or stored beneath ice sheets and then be released to the atmosphere following deglaciation.

Field requirements
Sampling in summer from melt water and lake sediments.

Time plan
Preparing and testing the analytical methods 2006-2007
Field surveys and sampling at Svalbard 2007-2008
Analyses, laboratory experiments and data analyses 2007-2009

4. **Estimating extent of anthropogenic radioactive fallout**.

Contact person: Ala Aldahan, Uppsala university <ala.aldahan@geo.uu.se>

Science: As a semi-isolated landmass in the Arctic Basin, Nordaustlandet represents a uniquely sensitive region for the evaluation of anthropogenic input and sources of radioactive and other pollutants in the atmosphere of the Arctic. Such anthropogenic signals are also well preserved in the ice-sheet of the region which is located at lower altitude than that of Greenland and thus can be strongly affected by regionally moisture and wind tracks of north Europe and the Arctic Ocean. The ice-sheet will be sampled through several cores for this and other research objectives. In the research activities linked to this project, the focus will be on evaluation of anthropogenic loading to the Nordaustlandet as well as using the anthropogenic signal to bracket and support chronology of the ice cores. Such data are indispensable for the comprehensive past evaluation of environmental changes in the Arctic and for establishing reasonable prognoses about the trends of future developments.

Popular Summary: Radioactive contaminants are spread through atmosphere due to antropogenic activity. As a consequence of the wash-out through precipitation processes, the atmospheric signals are deposited in snowfields. In the retrieval of ice cores these signals can be reconstructed.

Field requirements: This project is mainly laborattive, and does not have a strong field component. The main interest is the deliverance of ice core material from which samples can be attained for laborative purposes.

Time plan: The analyses can processed as soon the ice cores, and other records have been sampled.

5. **New particle formation in Arctic air and transport of heavy metals into the Arctic**.

Contact person: Dr. Jussi Paatero, Finnish meteorological Institute<Jussi.Paatero@fmi.fi>.

Science

Aerosol particles affect climate directly by scattering and absorbing solar radiation and indirectly by modifying the formation, properties and lifetimes of clouds. Atmospheric particles form by two different production mechanisms. In primary production particles are formed by mechanical processes like sea spray or particles from volcano eruptions. These particles affect both directly and indirectly to climate. In secondary production particles are formed by nucleation and consequent growth of condensable gases. When these particles have grown large enough (50 -100 nm in diameter) they can act as cloud condensation nuclei and thus affect the properties of clouds (indirect effect). Secondary particle production can lead to orders of magnitude change in concentration of cloud condensation nuclei and is thus an important factor affecting the climate. New particle formation events have been observed almost all over the world. Trajectory analyses of events observed in Finnish Lapland have revealed that all these observed events occurred in clean air masses from Arctic Ocean and/or northern Atlantic. No events were observed in the continental air masses. The formation mechanism and the vapours involved in the nucleation and growth processes are not yet known.

Excluding mercury the airborne heavy metals are attached to aerosol articles. In the Arctic air they originate from various sources in Europe, Russia, East Asia, and North America. These pollutants subsequently lead to the contamination of the vulnerable Arctic ecosystems.. Especially in Russia there are two important areas polluting the Arctic, namely Norilsk and Kola peninsula. A wide variety of industrial activities, like ferrous and non-ferrous smelters or peat-fired power plants, have operated in these regions for decades. Heavy metal emissions to the atmosphere are much higher for the non-ferrous mining, smelting, roasting and processing industry than for the ferrous industry. After World War II the need for minerals and natural resources expedited the rapid expansion of these facilities until the 1990's when the Soviet Union collapsed. Among the heavy metals present in the Arctic are lead, cadmium and mercury. Even though the emissions of lead have decreased owing to the use of unleaded fuel in cars there still exists various sources. Records of cadmium concentration show varying trends but the accumulation of cadmium in the food chain have possibly caused some health effects to sea birds. Mercury concentrations in the Arctic food chains are in some cases so high that adverse health effects have been observed among indigenous people consuming a lot of local food products, e.g. seal meat and fish. The high volatility and complex chemistry of mercury increase its atmospheric transport to the high Arctic.

Main objectives of this study are

- to find out mechanism of new particle formation in Arctic air masses and which vapours take part in to the formation and growth processes
- to assess the climatic effects of the newly formed particles
- to find out the source areas of airborne heavy metals in the high Arctic which would help to aim the emission reduction actions efficiently
- to provide input data on heavy metals to ecotoxicological effects research
- to support the work of the Arctic Monitoring and Assessment Programme (AMAP).

Popular Summary

In this work package fine particles in the Arctic air are studied because the particles and/or the heavy metals they contain have effects on the climate and the Arctic ecosystems.

Field requirements

- Food, accommodation and safety equipment to two scientists during the field campaigns in spring and summer 2007
- A generator and its fuel to provide electric power for the instruments

- A snow mobile and an all-terrain vehicle to carry the instruments to the measurement site

Time plan

Preparing, building and testing the instrumentation 2006-2007
Measurements at Lapland 2004-2009
Measurements at Spitzbergen in spring and summer 2007
Data analyses 2007-2009

Biospherically focused studies

6. Spatial pattern and temporal dynamics of terrestrial ecosystems in relation to surface age and environmental change.

Contact person: Bruce Forbes, Arctic Centre. <Bruce.Forbes@ulapland.fi>

Science:

High arctic vegetation communities and ecosystems are potentially highly sensitive to climatic change (the low heat sum during the thaw period being dramatically affected by modest changes in air/surface temperature, and several key species being at or near the geographical limits of their distribution). They are similarly sensitive to human impacts, such as low-level surface disturbance and nutrient additions. These may either increase or decrease productivity depending on the type and severity of the impact. In several scenarios of environmental change some of these ecosystem types literally have nowhere left to go (even if they were able to shift, *en bloc*, in phase with climate change). At the same time, anthropogenic communities serve as anomalies within the larger relatively undisturbed landscapes. Examples in the High Arctic include archaeological sites enriched by human activity with changes in vegetation and soils that can persist for millennia. For these reasons, as well as for their intrinsic value, high Arctic ecosystems merit investigation. As sensitive indicators of change (through, for example, shifts in population structure/demography, soil nutrients) these systems are also potentially very valuable. The record of recent (late Holocene and 20th century) change preserved in patterns of plant cover and soil organic matter beneath vegetation mats is a largely unexplored palaeoenvironmental archive as well as an indicator of recent ecosystem dynamics. This study programme is linked to 1 as a consequence of the climatic information therein, but also to pollen and chemical records from the ice cores. Kinnvika is one of the few areas in the Arctic where a good archive of historical photographs exists allowing comparative studies on ecology to be undertaken.

Popular Summary

Detailed sampling of vegetation/soil units can be used to derive a chronosequence of environmental change. Responses to climate change may be studied in relatively undisturbed communities. It is also possible to understand direct anthropogenic influences by investigating the biological legacy of the International Geophysical Year 1957-58.

Field requirements

- Food, accommodation for four scientists for one month during summer 2007.
- Access to refrigeration and drying facilities for storing and drying samples.

Time plan

Vegetation and soils would be best sampled during the warmest month, July 2007. Laboratory processing of samples and data analyses would take place 2007-2009

7. **Biogeochemical cycling of carbon, mercury and nitrogen**.

Contact person: vacant

Science: This project will investigate biogeochemical functions of cold-adapted microbial populations in carbon and mercury cycling, such as factors controlling carbon cycling. The distribution of total and methyl-mercury in snow-pack water and sediment will also be studied. The question is whether the combination of long distance atmospheric pollution, coupled to that released from the archive in glacier ice in places of negative mass balance, is ecologically relevant or not. In this way, lakes and streams that are alternately glacially and non-glacially fed,will be measured in the same region to find the reservoir effect.

Popular Summary

Field requirements

Time plan

8. **Nitrogen fixation in arctic desert vegetation and soil crusts**.

Contact person: Matthias Zielke, University of Tromsø, Norway. <matthias.zielke@ib.uit.no>

Science: Beside harsh climatic conditions, deficiency of nutrients is a limiting factor for plant growth in high arctic terrestrial environments. Biological fixation of nitrogen may contribute substancial amounts of this nutrient to the ecosystem. The proposed project will investigate the role nitrogen-fixing microorganisms in the nitrogen cycle and how environmental factors such as precipitation, solar radiation and temperature affect this process. The information is needed in order to understand how climate change may have a direct or indirect influence on terrestrial primary production in reagrd to the nitrogen cycle, which in turn may affect higher trophic levels of these ecosystems.

Popular Summary: The aim of this study is to understand how alteration of enviromental factors caused by climate change affect primary production in high arctic desert soils and the possible consequences for higher trophic levels.

Field requirements:
- Food, accommodation for two scientists for two weeks during summer 2007.
- Access to refrigeration and drying facilities for storing and drying samples.

Time plan:
Sampling of vegetation, soil and rock material and simple measurements will be conducted during July 2007. Detailed and advanced analyses will be done at laboratory in Tromsø in 2007 and 2008.

Climatic and environmental direct and indirect archives

9. **Ice coring on Vestfonna Ice Cap**

Contact person: Elisabeth Isaksson, Norwegian Polar Institute <elli@npolar.no>.

Science:
Ice cores from the glaciers outside the main ice fields of Antarctica and Greenland have not received much attention, partly because of surface melting during the summer season, which could alter the original ice core record. Many of the scientists in the group of potentially interested participants has participated in other projects successfully drilling ice core from several of the major ice caps on Svalbard. Previous work has shown that despite the high degree of summer melting it is possible to retrieve annually resolved climate records. The overall picture from the available climate records from Svalbard suggest warmer temperatures about 1000 years ago and a cooling trend from about 1500 AD to the end of the 1800s, followed by a warming thereafter. However, the spatial variations of these changes are not fully known. Previous ice cores from Soviet and Japanese expeditions have shown a potential to extract high-resolution climate records from Vestfonna. The 500 m thick ice cap has the potential to preserve at least two millennia of climatic information. In this project we plan to drill an ice core at the summit of this ice cap. The main goal of the project is to investigate the present and the recent past climate and the input of long-range contaminants.

Popular Summary:
Ice core records from polar ice sheets and ice caps have provided valuable records of both climate and pollution. In favourable cases these can be obtained with seasonal resolution. The ice cap of Vestfonna contains some of the deepest ice in Svalbard and therefore has the potential to contain old ice at a high resolution.

Field requirements:
The ice coring site will be located at the summit of the ice cap. It will require a field camp with about 5-6 people with sleeping and kitchen tents. A fuel and equipment depot has to be prepared the season before the drilling. Helicopter or preferably Twin Otter transport will be necessary to take people in and out from the site. Based on previous work on Nordaustlandet the estimated load is 4 tons to the camp and 8 tons back, depending on the depth of the ice core.

Time plan:
The main ice core drilling will take place during the spring of 2007- preferably April to early May. The time in the field depends on the drill depth, but we estimate that at least one month is required in order to drill a 200 m deep core with the available drill equipment.
It would be necessary to perform some radar work the season before the drilling operation.

10. **Borehole paleothermometry:**

Contact person: Roderick van de Wal, Utrecht University <r.s.w.vandewal@phys.uu.nl>

Science: Very few temperature records are available from the Arctic Basin that span longer than 50 years. We can extract temperature trends as well as estimates of the geothermal heat flux using inverse heat-flow modelling temperature records in boreholes within ice caps, or within the soil/permafrost over a time span of 1 to 2 centuries. Regional pattterns of past climate change can be derived from these studies. The method is most sensitive to changes in the recent past, so the climate change at the end of the Little Ice Age can be captured. In addition we can provide insight in the temporal changes in the bottom layers in the ice as well as changes in the permafrost thickness in near future. These are important for the ice dynamics and hence for the response of the ice sheet to climate change. Modelling effort should include estimates of the temporal changes in refreezing as these strongly influence the results. This can be estimated from melt-layer in the ice cores.

Popular Summary

This workpackage aims to reconstruct temperatures over the last 1-2 centuries and provides estimates of changes in bottom temperatures of ice fields in near future.

Field requirements

Modelling efforts are constraint best by boreholes in the ice which penetrate to a depth close to the bottom and need to be drilled in a central part of the ice sheet.

Time plan

Initial measurements can be done in a day after the drilling operation is finished, but the intention is also to leave a thermistorstring in the borehole which needs to be revisited each year after installation in order to monitor the trends over recent time spans.

11. **Studying of the thermal interaction between glacier and permafrost areas under conditions of glacier retreat during the last centuries**.

Contact person: Jacek Jania, University of Silesia. <jjania@us.edu.pl>

Science: The planed studies will seek to answer the question: how react temperatures of permanently frozen grounds and thickness of the active layer in Svalbard to climate changes during the last one hundred years. In this context one of major unsolved problem concerns the relation between the thermal structure of land based polythermal glaciers and permafrost features in the marginal zone close to their snouts. Svalbard glaciers are retreating. Permafrost features in the newly exposed ice-free areas are not properly studied yet, but one may suggest the increase of permanently frozen ground thickness within a larger marginal zone. In general, thickening of the active layer due to climate warming has been observed in Svalbard recently. Therefore, the transition zone between the ground near the glacier snout and glacier itself will be the focus of studies using different methods. Comparison of results from SW Spitsbergen (area of traditional research activity of Polish expeditions since the 3rd International Geophysical Year) with the Vestfonna outlet glaciers in Nordaustlandet could give data on gradient in dynamics of permafrost changes between climate with significant maritime influences of the Hornsund region and more continental one in the Kinnvika area.

The group of interested scientists has a good experience in the study of mountain permafrost areas with geophysical measurements. The team can perform electroresistivity sounding profiling which can detect the permafrost dynamic changes up to several hundred meters depth. Ground penetrating radar (GPR) and precise GPS surveys will also be applied to both the marginal zone and frontal part of glacier snouts. It is also planned to install strings of thermistors into ground and ice collecting a record over at least one year. The research will provide a complementary insight in the glacier termini – permafrost relationship in the changing climate, and can be applicable in other places of the Arctic.

Detailed mapping of studied areas is planned using high resolution remote sensing data from different time slices (e.g. aerial photos, Terra/ASTER images). Superimposed results could record of recession rates of glaciers. Data derived from old maps will be use as well. The recent record has to be used as a topographic base (DTM) for analysis of a pattern of physical features of frozen ground and thermal structure of snouts of glaciers. Planned studies correspond to topics of WP1, WP16, WP17 and WP26. Results might be also useful for studies of changes of components of terrestrial ecosystems.

Popular Summary

The increase in air and ground temperatures over the last century as a result of changing climate will impact permafrost. These studies aim to better understanding the evolution of the permafrost active layer thickness and ground temperatures, and hence their sensitivity to future climate chnage. Special attention will be paid measuring the intensity of permafrost change on newly exposed ice-free areas close to snouts of retreating glaciers. The thermal structure of the frozen ground and that of land based glaciers will be compared with similar field studies in the SW Spitsbergen.

Field requirements

Base camp for preparation instruments and equipment for field campaigns. Field equipment (tents, communication facilities, navigation GPS, gun, etc.). Zodiac boat for local transport by sea. Instruments: Terrameter (for electric resistivity profiling), GPR, precise GPS receivers, strings of thermistors with loggers, solar panels, bateries, etc. Access to meteorological data from AWSs located close to studied areas.

Time plan

Analysis of remote sensing data and old maps. Acquisition of all published and archive data on climate and ground temperatures since 3rd IGY. Preparation of most actual topographic map (and DTM) of studied areas in 2006.

Field campaign in late summer 2007 (3-4 persons): implementation of thermistors and selected reference locations. First stage of geophysical profiling.

Field campaign in late summer 2008 (2-3 persons) repetition of geophysical profiling across reference points. In both cases transport of people and equipment to the Kinnvika station by ship and local transport by Zodiac type motor boat. Analysis of collected data and preparation of publication 2008-2009.

12. **To study the Holocene climate and environmental variability utilizing sediment cores from lake and sea basins and terrestrial periglacial landforms.**

Contact person: Hanne Christiansen, UNIS. < Hanne.Christiansen@unis.no>

Science: While the ice core record can provide ca. two millennia of climate information, we also need to get information of changes over longer time scales, that place 1, 3 and 6 into the longer time perspective. The aim of this project is to cover signals of rapid climate changes i.e. the YD/Holocene boundary, the 8.2 kyrs event and The Little Ice Age. This is relevant not only to decipher the long-time trends, but also to understand the landscape evolution in 6 and to back-up the measurements of the isostatic rebound in 7. In order to answer the question of exact leads and lags between the glacial and terrestrial records we need to reconstruct high-precision chronologies with decadal to centennial time-resolution of the terrestrial archives using macrofossil analysis and radiocarbon wiggle match dating.

Popular Summary

Field requirements

Time plan

Lithospherically focused studies

13. **To monitor lithospheric response to glacial overburden utilizing InSAR techniques**.

Contact person: Gerhard Bax, Uppsala university <gerhard.bax@geo.uu.se>

Science: Signs of marine shorelines below the present sea level have been observed by Karlén during previous visits on western Nordaustlandet and there is still a debate over the rate of isostatic uplift of Nordaustlandet, which casts light upon the question of how large the Pleistocene ice sheets were over the Svalbard Archipelago. Ongoing vertical crustal movement will be measured from time series of Radar images with InSAR technology and the observed shore lines will be mapped and investigated in the field. Also, we intend to add information of the geological properties that are determinant of the lithospheric reactions on the variability in ice loads.

Popular Summary: Isostatic rebound and the resulting uplift of land masses with displacement of shore lines is a well known phenomena along the Baltic sea. Along the shore line of western Nordaustlandet the opposite phenomena (sea level rise) was observed and the results from a further investigation will give us more knowledge about the history of glaciations in this part of the Arctic.

Field requirements: **Summer 2007**: Kinnvika as a basic camp during the field season. Small boats/Zodiacs for local transportation and investigation in shallow parts of the bay. Possibility to mount equipment for depth sounding (echo) or sonar. Tent camps at selected locations in SW Nordaustlandet

Time plan: Spring 2007 – Remote sensing image preparation prior to field work. Autumn 2007 and 2008 - Interpretation of GPS measurement, field observations and results from image processing. Compilation of material for presentation at the International Geological Congress, Olso, Norway in August 2008 and later publication.

14. **Tectonic Evolution of the Barents Shelf (TEBS).**

Contact person: David Gee, Uppsala university <david.gee@geo.uu.se>

Background. Nearly a decade of support for bedrock research on Nordaustlandet and Ny Friesland from the Swedish Polar Research Committee in the 1990's provided the foundation for a complete reinterpretation of the Svalbard Caledonides and their relationship to mid Palaeozoic Orogeny in Scandinavia and East Greenland. The Barents Shelf has been inferred to be founded on the axial zone of the Caledonides (not a Precambrian craton as previously inferred), a conclusion that is of importance not only for the understanding of Palaeozoic orogeny, but also the development of successor basins and their hydrocarbon resources. The new hypothesis is critically dependent on evidence from eastern Nordaustlandet and relationships to Franz Josef Land and further east, to Novaya Zemlya, where studies are on-going (expeditions 2004-5).

IPY studies 2007

Research. The work in 2007 will test new interpretations of Barents Shelf tectonics and correlation with the Eastern Greenland Caledonides. It will focus on Nordaustlandet and islands further to the east and involve studies of stratigraphy, structure, petrology, isotope age (particularly sediment provenance) and palaeomagnetism. Analyses of potential field and seismic data across the shelf, from Nordaustlandet to Franz Josef Land and Novaya Zemlya, will better define the boundary (sutures) between the Laurentian Caledonides of Svalbard and the Baltica–related eastern flank of the orogen. Establishing the structure and tectonic evolution of the Eurasian shelf-margin is essential for testing alternative hypotheses for origin of the Arctic Basin.

Fieldwork will involve targets on Botniahalvøya, Planethalvøya, innermost Duvefjorden and Storøya and neighbouring islands. It may be necessary to return to Kvitøya. Remote sensing techniques, as developed further east in the high Arctic on Severnaya Zemlya and Novaya Zemlya, will provide the foundation for the fieldwork and promote the subsequent analysis of data.

Field requirements – standard equipment for camping and HSE, transport (preferably helicopters)

Time plan 6-8 weeks (July – August) to be coordinated with activities of other group.

15. **Geological processes in the formation of the Arctic phosphogenic province**

Contact person: Krzysztof P. Krajewski, Polish Academy of Sciences, Warsaw, Poland
<kpkraj@twarda.pan.pl>

Science: Sedimentary basins surrounding the Arctic Ocean focused deposition of phosphatic, organic carbon-rich facies during the Triassic, which resulted in the formation of a widespread phosphogenic province stretching from Alaska through the Arctic Canada and the Barents shelf to East Siberia. The poor understanding of the origin and scale of this Arctic phosphogenic province impedes a proper evaluation of its role in the global phosphorus cycle during the Phanerozoic history of Earth. This research activity will be carried out in an attempt to recognize oceanic, tectonic, biological, and geochemical processes that led to allocation of the phosphorus overload at margins of the paleo-Arctic basins after the biological crisis associated with the Paleozoic/Mesozoic boundary. In order to evaluate these processes good examples of the Triassic sequence in the Arctic need to be studied in detail, with special emphasis placed on the nature of the phosphorus and organic carbon association in different paleoenvironmental settings of the basins. The Triassic sequence in Svalbard, which is a part of depositional system of the NW Barents shelf, represents the best known geologically setting of the phosphogenic province. The Triassic phosphogenic facies in Spitsbergen have focused scientific attention during the last ten years, and those ones occurring in Edgeøya and Barentsøya are currently being elaborated. The Kinnvika project will provide logistic support for studying the Triassic sedimentary sequence in SW Nordaustlandet, which contains the northernmost located phosphogenic facies in the Arctic. Compilation of the results from Nordaustlandet with the existing data will allow us to develop a model of the formation of the Svalbard's part of the phosphogenic province and to provide first estimate of its phosphorus reservoir.

Popular Summary. Millions of tonnes of mineral phosphorus are concentrated in one horizon of sedimentary rock that extends throughout the Arctic. The nature of this unique geological reservoir needs to be revealed.

Field requirements. **Summer 2007**: Kinnvika as a basic camp during the filed season. Support from ice strengthened research vessel. Small boats/Zodiacs for local transportation. Tent camps at selected locations in SW Nordaustlandet.

Time plan. **Summer 2007**: Field research in SW Nordaustlandet. **Fall 2007- 2008**: Laboratory analysis, elaboration and publication of results.

Ice Masses focused studies

16. **Mass balance and mass dynamic evolution of the Nordaustlandet ice masses.** ..

Contact person: PI: Jon Ove Hagen, Oslo University. <j.o.m.hagen@geo.uio.no>

Motivation: Nordaustlandet is by 90% covered of ice. This comprises two major ice caps, Vestfonna and Austfonna and several smaller glaciated catchments. Austfonna is the largest individual ice cap in the Svalbard archipelago, ca. 8200 km2, more than 20% of all ice in Svalbard, and is one of the largest ice caps in the European Arctic outside the Greenland ice sheet. It is also one of the target study glaciers for the IPY proposal GLACIODYN **(**The dynamic response of Arctic glaciers to global warming). The IASC-MAGICS program have stressed the importance to monitor mass-balance of Artic ice masses, since the contribution to global sea level changes in the coming hundred years most likely will be larger from the glaciers and ice caps than from the Ice Sheets. The current mass balance of the ice caps on Nordaustlandet is not known. We want to specifically study the surface mass balance, changes in geometry and dynamics of the Ice Caps. These studies will give current surface mass balance and input to mass balance modeling of future response. A part of the group has started investigations on Austfonna as a calibration project for the new satellite CryoSat. The work will combine field investigations (ground-based and airborne), remote sensing and modeling.

Popular Summary: The ice caps Vestfonna and Austfonna are among the largest ice caps in the Arctic outside the Greenland Ice Sheet. The Arctic glaciers and ice caps have a rapid response times to climate change and are believed to contribute more to sea level rise over the next hundred years than Greenland and Antarctica. It is therefore important to understand the current and future volume changes (mass balance) on these ice caps.

Field requirements: The main part of the field investigations will be carried out by snowmobiles. The work on Austfonna must be done out from field camps, just outside the ice cap or at the summit. Transport out in spring requires helicopter. Teams of minimum four persons are necessary both for efficient work and security. It is required to have winter equipment for this number of persons for field campaigns of up to four weeks. Field equipment depots should be established during the summer before the first field work starts. Communication must be done by Satellite telephone for all contact outside Nordaustlandet. The field instruments must include surveying equipment (GPS-receivers), Ground penetrating radar with different frequency antennas, shallow ice core drill, AWS-Automatic Weather Stations, snow shaft equipment, ablation/accumulation stakes with drill.

Time plan: The bulk of the field investigations should be done in April/May just before the ablation season starts in order to be able to move easily around on the ice caps by snowmobiles. This will be the main field season, but additional, shorter, work can be done at the end of the summer season. It should be planned for a minimum of three years investigations, 2007-2009.

17. **Glacial dynamics and flow of Vestfonna Ice Cap.**

Contact person: Peter Jansson, Stockholm university <peter.jansson@natgeo.su.se>

Science: We propose to use ground penetrating radar (GPR) and differential GPS, and InSAR to study the hydrology and internal structure and the dynamics of the Vestfonna Ice Cap. This will shed light on mechanisms of glacial dynamics and flow, and provide data for studies on responses of Arctic glaciers and ice caps to past (such as the termination of the Little Ice Age) and future changing climates. Comparison of glacier survey data undertaken by the original 1957 expedition with our results will also be both scientifically valuable and provide historical continuity. Another aim is to study the sensitivity of flow regimes of Arctic glaciers to climate change using a variety of models such as SICOPOLIS and flow line models with varying input climatologies. Polar glaciers have generally temperatures below the freezing point. Global warming in the Arctic will via percolating water heat up the ice, and make the ice flow faster, and increase the wastage by this positive feedback regime. We will study this process in detail on Scandinavian glaciers with similar regime, and apply our results to the Vestfonna Ice Cap.

Popular Summary

Field requirements

Time plan

18. **To perform a mechanical/hydrological investigation of Franklinbreen, as an analogue to mid-latitude Pleistocene ice streams.**

Contact person: Veijo Pohjola, Uppsala university <veijo.pohjola@geo.uu.se>

Science: during the last decade the scientific community has made considerable progress in understanding the dynamics of ice sheets, and ice streams. Ice streams are features that transport most of the mass in ice sheets, and are the dominant entities that alter the subglacial terrain. The ice streams studied today are more or less confined to the polar ice sheets. To understand the ice dynamics of the more temperate palaeo-ice sheets of the mid-latitudes we need to study objects in similar settings. The Vestfonna Ice Cap can be argued to be a down-scaled analogue of the mid-latitude ice sheets of the Pleistocene, and the large outlet glacier / ice stream Franklinbreen is a good analogue for the Pleistocene ice streams. Special focus will be on the mechanics of the ice stream and the coupling with water pathways and deformation of subglacial sediments. We will utilize remote sensing techniques such as optical, SAR and InSAR data for velocity mapping and for surface hydrology investigations.

Popular Summary. The large scale scouring on the landscapes that during the last ice age was beneath ice sheets was mostly performed by warm based ice streams. The warm base of the ice streams giving melting point of the ice and little friction to the bed produced a corridor where large units of volume ice eroded the landscape beneath the ice streams, while the non ice stream part of the ice sheet likely where cold based, and by being frozen to the ground, minimal erosion was accomplished. In this Work Package we intend to study the glacial dynamics of an ice stream at Vestfonna that is similar to the ice streams of the ice age in order to find the glacial mechanisms controlling ice streaming in ice sheets that are thermally more similar to the mid latitude ice sheets of the ice age, than the cold polar ice sheets.

Field requirements: Snowmobiles, sleds and camping gear, GPS (dual frequency? As many receivers as possible), ice radar (detailed bed topography, and study of water pockets in the ice to find the ice viscosity, and subglacial water content), hot water drill, inclinometry?, borehole video, gear for measuring passive seismics, some helicopter hours to access heavily crevassed areas, and ground proofing of the remote sensing part of the project.

Time plan: Insertion of velocity markers spring 06, and first measurement. Re-measurement of markers spring 07 together with radar work. Ice drilling work may best be scheduled to summer 07 due to availability of water for drilling. Inclinometry and borehole video may take place after the drilling is complete. Groundproofing should be done both spring and summer, due to different surface conditions.

Landscape focused studies

19. **Quaternary landscape evolution of ice-free terrain on Nordostlandet, Svalbard.**

Contact person: Olafur Ingjolfsson, University of Iceland < oi@hi.is>

Science: The record of Quaternary environmental change of ice-free terrain on Nordaustlandet is established in relation to glacial reconstructions. Glacial advance and retreat histories, as well as sea level change, will be mapped and dated using radiocarbon, *in-situ* produced terrestrial cosmogenic nuclides and OSL. In order to correlate terrestrial glacial reconstructions and glaciological records with marine records of glaciation a focus will be put on the investigation of the marine reservoir effect along the coast of Nordaustlandet. Sea surface temperature variations during the Late Holocene are not consistent in marine cores, which could be caused by different marine reservoir effects in specific parts of the North Atlantic and is not well known around Svalbard. Post-glacial slope processes will be assessed, supported by monitoring of active-layer conditions and processes in relation to climate change. A special target is to study glacial cycles in the Gothia-halvøya. We also plan to monitor present day geomorphological processes as consequences to global change as a part of the global SEDIFLUX project. The details of the timing of glaciation and deglaciation, especially, are valuable complementary information to project 20.

Popular Summary

Field requirements

Time plan

20. **To establish the long-term landscape evolution of Nordaustlandet**.

Contact person: Arjen Stroeven, Stockholm university <arjen.stroeven@natgeo.su.se>

Science: Using geomorphological mapping techniques from aerial photographs and satellite images, as well as field studies including terrestrial cosmogenic nuclide (TCN) techniques, we will deduce the long-term landscape evolution with focus on the non-glacial landscape in this high-Arctic setting. Weathering studies using SEM and XRD will support with independent data on the landscape history. We suspect that glacial erosion has been highly variable but predictable in space, and highly variable in time. This study can serve as the backbone for other landscape change studies targeting the modern and future situation. Are current processes effective in shaping the landscape, or are they merely providing a finish of a landscape of different origin?
During a field study we will target to verify/determine the thickness (and, where applicable, TCN date its maximum extent) of glaciers that formerly covered Nordaustlandet during maximum of glaciation. Thus, we will be able to answer the timely question whether ice-free parts existed during maximum of glaciation or if Nordaustlandet was completely inundated by an ice sheet. To do so, we will (a) collect erratic boulders to constrain the timing of deglaciation, (b) sample glacially-abraded/plucked bedrock samples to constrain amounts of erosion, knowing time of deglaciation from (a), and (c) sample bedrock of non-glacial landscapes to determine complex exposure-burial (by ice) histories using multiple TCN's. As this study focuses on the maximum of glacial expansion, and glacial erosion patterns, it strongly complements studies of ice sheet advance/retreat patterns proposed in project 19.

Popular Summary

Field requirements

Time plan

Oceanographic studies

21. **Sea ice ecology and plankton dynamics: Dynamics of plankton communities, and secondary production in sea ice and at sea ice edge in Svalbard and Greenland area in late summer**

Contact person: Juha Flinkman (Finnish Institute of Marine Research, P.O. Box 33, FIN-00931 Helsinki, Finland. e-mail flinkman@fimr.fi)

Science: The study will be performed during and in close connection to the Finnish IPY expedition to Svalbard area in 2007. We will conduct marine (pelagial and sea ice) biological studies in the area. Our objectives are to

1) study the presence of a unique sea ice biota and communities of pelagic plankton near ice edge in the high Arctic
2) study the structure (i.e. species composition and abundance) and dynamics of, and interactions between these communities, with a particular emphasis on energy transfer from lower to higher trophic levels (unicellular algae, zooplankton, fish) in sea ice and the pelagic food web
3) use modern advanced and proven technologies to rapidly find, assess and sample the pycnoclines, frontal areas and other discontinuity layers that have significance to marine biology in these large sea areas
4) finally, enhance the overall understanding of the functioning of high Arctic marine food webs in the pelagic, with specific implications on management by means of sustainable ecosystem approach.

Popular summary: The aim of the studies is to improve the general understanding of the nature and ecology of, and dynamic interactions between sea ice biota and the marine pelagic communities in the high Arctic. Our results will also serve in ecological and economical decision making regarding biological marine resources, in particular fishery, in the area.

Field requirements: R/V Aranda or other research vessel maneuverable in variable ice conditions, and with suitable fittings to advanced laboratory facilities and sampling gear (CPR, UTOW). Ample time at ice stations to sample sea ice.

Time plan: mainly during the Finnish expedition in summer 2007, possible continuation in 2008

22. **Marine carbon sources and sinks near continental ice areas of the northern Atlantic.**

Contact person: Matti Perttilä/ Kimmo Kahma, FIMR<Kimmo.Kahma@fimr.fi>

Science: The scientific community have not yet understood the marine carbon flux. We intend to fill the gap in knowledge of the size and direction of the carbon flux on the continental shelves in the polar areas of the Atlantic.

Popular Summary

Field requirements

Time plan

Society focused studies

General motivation: Polar research as part of 19th century geography included most of the non-laboratory natural sciences, as well as human and cultural studies. Its ambition was to spearhead the Western colonial intrusion into the Polar Regions and it was often instrumental as a token of territorial interest. Some of todays problems in the Polar Regions are outcomes of this process and a lack of awareness and historical knowledge about it.

Polar science and humanities have today evolved into a post-colonial approach and given this development they have a lot to offer in understanding the modern problems and opportunities in Western and human interaction with the polar environment. The society focused studies in this IPY expression of intent will undertake interdisciplinary co-operation in researching the international history of Svalbard with a field focus at Nordaustlandet. It will emphasise the interplay and continuity of both co-operation across national, ethnic and cultural boundaries, and on the other hand competition over natural resources and military conflict.

The common notion of the remote Arctic Islands to be peaceful oasis during larger mainland conflicts is to be contested. The waters and the land of Nordaustlandet bear proof of many conflicts in form of wrecks and wasted buildings that can be traced back to at least the 18th century. These remains stress the fact that these remote areas had a valuable strategic and economic importance for the nations of yesterday. One example illustrating this fact is that the major hostile action done by the German battlecruiser Tirpitz was to steam up to Longyerbyen with its destroyer escadre to set fire to the Spitsbergen coalmines, and to shut down the allied weather services there in September 1943. From this facts todays activities make a fond for activities and strategies we may foresee for a future Arctic, where predicted pack-ice withdrawal open new prospects in these water

23. **Arctic winds of the war: the globalisation of meterological research and the strategic value of weather observations 1930-1950.**

Contact person: Urban Wråkberg, The Swedish Programme for Social Science Research in the Polar Regions <urban@spkp.se>

Motivation: During WW2 Svalbard was a scene of conflict between allied and axis meteorological services. Svalbard is situated on the boundary between extratropical and polar air- and water masses, which makes this area as an important for synoptic studies, and predictions of weather, being of utmost importance for the air, naval and amphibious warfare in the Atlantic sector during WW2. Special attention on Svalbard was the information to convoys bound to Murmansk, and to the wolf-packs trying to hunt them down.

The aim of the project is to study the globalisation of the field networks of 20th-century meteorology with a focus on its disruption and modification in times of war. This address the important general questions of how the democratic ethos of science and the intellectual and practical requirement of an open international flow of information can be overtaken by political concerns and science transformed into a tool of empire and war. Studies will address the social processes through whish polar experts on both sides of the conflict were spotted within the armies throughout the war and commissioned to meteorological service in the Arctic.

Through field work on various locations on Nordaustlandet the project will evaluate archaeological remains to reconstruct the organisation of the wartime clandestine meteorological station, including the successful innovative developments in automatic weather observation. In their lack of immediate technological successors these represent an historical case that challenge the idea that technological developments during wars in one way or the other often benefit posterity. We will also aim for a compilation of the meteorological efforts in the period before, and after WW2 to understand the scientific achievements in this area.

Popular Summary

Field requirements

Time plan

24. **Natural harbours in the Arctic: sites of long-term historical and archaeological significance.**

Contact person: Urban Wråkberg, The Swedish Programme for Social Science Research in the Polar Regions <urban@spkp.se>

Motivation: The history of Svalbard is clearly connected to economical, colonial and scientific interests, but also to less often acknowledged, and seldom studied, orthodox religious interests (18th century)and early environmental concern (late 19th century). The archival documentation of the older of these initiatives is meagre as far as is know at present . Therefore, in order to understand these activities there is a need to focus on the archaeological artefacts and traces in the landscape left in the area, both on land and on the sea bottom. We plan to search for marine artefacts in the shallow Murchinson Bay, which has never been studied for such finds -- nor any other site in Svalbard -- and may well be rich in potential findings. To special attention is the remains of a larger naval battle that took place between Dutch and French forces in the mid 18th century in Sorgfjorden, once again pointing to the importance of the area for yeasterday's nations. For the marine studies we will utilize side-scan sonars, and professional scuba-diving crews for documentation of the artefacts. Areas to investigate are: Sorgfjorden, Murchinson Bay, Kinnvika, Ryssøya and Waldenøya.

Popular Summary

Field requirements

Time plan

25. **The cultural meaning and significance of Arctic sites from an aboriginal and visitors' perspective: place names, scientific and literary narratives defining sites, regions and/or cultures in the polar regions.**

Contact person: Urban Wråkberg, The Swedish Programme for Social Science Research in the Polar Regions <urban@spkp.se>

Motivation: the names given to places bring information of the cultural perspective within the frame of the exploration and usage of the particular place. In the outposts of the society the different histories are well kept since different cultural influence have been preserved in a higher degree than in areas with higher social and political pressure. For the field based part of the project we plan to visit areas in Kinnvika, Murchinson Bay, and the survey-points from the Russo-Swedish Arc of the Meridian Expeditions to Spitsbergen 1898-1902.

Systems focused studies

26 Detecting current and predicting future glacier changes.

Contact person: John Moore, Arctic Centre <john.moore@ulapland.fi>.

Science: This project serves to integrate the present day measurement of ice cap condition and climate sensitivity with the record of the past provided by the ice core and of the deeper past from the land and marine geological record. It is intended to calibrate glacier models to current conditions and compute the sensitivity of the ice cap to climate change. The ultimate goal is to predict mass and geometry changes for the coming 100 years based on climate scenarios from global or regional climate models. Since climate model results tend to differ considerably on a local scale we intend to use a suite of model predictions for driving the glacier model and investigate the sensitivity of the ice cap to a range of possible future climate change scenarios. Svalbard glaciers are representative of many glaciers in the Arctic, and the glaciers and large ice caps are currently in a period of retreat, causing a rise in world sea level. The project will be closely linked with the methodology used in the GLACIODYN IPY project, which plans similar work on Austfonna, and we shall also endevour to make best joint use of logistics and scientists. We propose to use glacier dynamics results from projects 16, the long term record of ice variability from project 18 and the ice core results from project 9 to give records of the mass variations of the ice cap, which can be utilized in ice flow models to reconstruct the dynamical state, and the past geometry of the Vestfonna ice cap. Mathematical models of varying complexity will be used: including three dimensional thermodynamic models for large-scale ice sheet simulations. Solving the full thermo-mechanical flow problem enables to study the transition from glacier to (glacial period) ice shelf, and thus to have the marine component included. The simplest models will be flow line model, which can be tuned easily with Monte Carlo methods to match key geophysical observables such as the dip angle of radar isochrones. This gives flow constraints over perhaps the last millennia. Longer terms variability is addressed by the ice sheet models driven by climate forcing parameters, and tuned using the ice flow and accumulation patterns established by field surveys, the flow line model and broad-scale geological mapping. The models connect the observed stratigraphic events and glacier flow information to glacier mass balance and climate. The glacier model gives scenarios of the glaciation and deglaciation cycles, in terms of mass balance changes and glacier flow.

Popular Summary Climate change over the coming decades is expected to most noticeable in the Arctic. We will evaluate past responses of the glaciers to climate change over the past 120 000 years and model their future response. Many of the glaciers there are likely to be quite sensitive to warmer and possibly wetter climates, and may react relatively quickly, changing world sea level, and creating local changes in landscape, environment and climate.

Field requirements: Spring 2007 survey and ice core data. Repeat surveying. Remote sensing data. Data should be available from other projects ?

Time plan