Minutes of the North Greenland Eemian Ice Drilling (NEEM) Steering Committee Meeting

Thursday, March 29

Minutes by Sune Olander Rasmussen, olander@gfy.ku.dk.

The background and visions of the NEEM project

by Dorthe Dahl-Jensen, Denmark. See also the pre-meeting material for further information about the background.

The aim of the previous deep drilling in Greenland, NorthGRIP, was to retrieve ice from the Eemian period. This objective was only met partly, as only the last 8 ka of the Eemian record was recovered. This came as a surprise, as the NorthGRIP drilling site had been chosen to ensure optimal possibilities for obtaining Eemian ice, the bedrock being flat and the accumulation being smaller than at the Summit (GRIP and GISP2) drill sites. We now know that ice is melting away from below due to higher than expected geothermal heat fluxes from the bedrock at the NorthGRIP site.

A Greenland record of the onset and end of the Eemian is important for the understanding of the dynamics of the glacial – interglacial climate dynamics, especially because the Northern hemisphere climate changes are more abrupt than the Southern hemisphere counterparts. We therefore want to have a record of the entire Eemian and measure as many parameters as possible to understand the dynamics of the climate.

A full Eemian record is also of paramount importance in the assessment of the stability of the Greenland Ice Sheet under warmer-than-present conditions.

It is not known whether Dansgaard/Oeschger-event occurred during the Illinois-/Saale glacial period (MIS 6). It is possible that enough of this question can be assessed using pre-Eemian ice from the NEEM core.

The idea of drilling again for a full Eemian record was conceived in Washington in 2004 , and the concept was further developed in Brussels in 2005 during an informal planning meeting. It is one of the IPICS goals, and is well integrated in the IPY framework.

In order to decide on the best drill site, radar profiling was used to detect the region where melting does not take place. An area of North-central-Greenland was identified. Unfortunately, the area is coinciding with the area of low accumulation in central North Greenland, which would be attractive because the layer thinning is less pronounced in this region. Flow modeling taking this information into account suggests that the Eemian ice has melted away in most places in North Greenland, and the NEEM site has been selected to obtain a location where the Eemian ice is located high above the bedrock and is rather thick. Models suggest that the Eemian is about 80 meter thick, located 2-300 meter above bedrock. Annual layer thicknesses are estimated to be 5 mm or more. In 2007,

radar profiles will be obtained to make sure that the conditions are indeed in accordance with our present knowledge.

The NEEM project is integrated in the IPY plans, and we have obtained endorsement letters that can be used for national applications.

The budget of the NEEM project

by J.P. Steffensen, Denmark

The project is structured in the same way as GRIP and NorthGRIP, that is, bringing as many scientists as possible to the field, and performing as much of the ice cores processing and analysis in the camp.

Significant changes

1. New drilling liquid. The Montreal protocol means that we will have to abandon the old drilling liquid. A new liquid based on coconut oil has been tested, but adds to the cost of the project.
2. We expect that most of the infrastructure must be removed after the project. This has implications for the choice of building styles etc.
3. New principles for the budgeting:
    a. Cost of travel costs to/from Greenland is covered by the participating projects
    b. Salary and per diem of scientific personnel is covered by the participating projects
    c. No scientific work outside Greenland is funded through the budget

The budget is based on the costs of the comparable NorthGRIP seasons (1996, 1997, 2000, and 2003), with additions for the 2007 traverse season. A total of 7350 man days of field work is anticipated. The main seasons 2008-2010 will be 90-100 days long.

See the pre-meeting material for a breakdown of the budget. The largest deviations from the NorthGRIP costs are caused by the more expensive drilling liquid, costs for updating the drill, a new *Pistenbully* track vehicle needed for camp logistics. Also, the plan is to use stationary fuel tanks, which are rather costly to acquire, but will save large amounts of flight time and cargo capacity (and a lot of hassle). The refueling is planned to take place using stationary tanks in the camp being filled up by approx. 4 annual LC-130 flights flying fuel in from Thule Air Base.

Which associated projects are funded over the NEEM budget will be negotiated.

To the question of whether operations out of Thule are planned, JPS told about experiences from previous projects: the logistical operation is easier and cheaper to operate in Kangerlussuaq, and cargo as well passenger transport to Thule Air Base is troublesome due to infrequent and heavily booked flights.

Status and expectations from all participating nations

Dorthe Dahl-Jensen, Denmark

22 MDKK has been granted for the period 2007-11. Overhead 20% has to be subtracted, but negotiations are under way to deal with this.

Denmark will provide the drill and coordinate the logistics. It is suggested to employ Lars Berg Larsen for the project, and additional support is given by our technical and administrative staff.

Funding for a centre of Excellence, Centre for Ice and Climate, has been granted. The centre will start April 2007 with a duration of 5 (possible 10) years. The centre will provide an attractive shell for the Danish scientific work and for organizing meetings and workshops related to NEEM planning and science.

Jim White, USA

NSF has funded the air support and fuel for the NEEM project, approx. 1.3 MUSD for 2007-2009. The Kansas radar project has been funded under the IPY activities, but is the only science project funded so far.
A science proposal will be submitted, focusing on gas measurements, stable isotopes of ice, and the climate of the last 2ky. Decision some time during 2008 is anticipated.

Frank Pattyn, Belgium

Funding has been granted, and 60 k€ is available for the NEEM project.
The main scientific interests are studies of basal ice and local (high-order) ice flow modeling with the purpose of dating and obtaining back-trajectories.

Roderik van der Wal, Netherlands

3 groups are involved in the Netherlands with the following interests:

- Sources and sinks of greenhouse gases.
- Stable isotopes and differential fractionation.
- Improve understanding of isotope diffusion in the snow pack.
- ^{14}C measurements from ice cores.

- Trace elements, ICPMS measurements.
- Meteorology, improving understanding of ice core records.
- Large-scale ice sheet modeling focusing on assessing the stability of the GIS.

Funding: 200 k€ (80/80/40 in 2007/8/9) for NEEM logistics. Most of the above projects are not funded yet.

1-2 Technicians + 1-2 PhD students are likely to participate in the field work.

Valérie Masson-Delmotte, France

4 institutions are interested in participating in NEEM:

- LSCE focuses on water isotopes and climate and stable isotopes modeling.
- LGGE focuses on drilling technology, measurements of gas, dust, chemistry and physical properties.
- Institut Polaire Paul Emile Victor (Brest) is mainly into the logistics.
- LEGOS, CNRM and CERFACS (Toulouse) has interests in validation of altimetry. Other interests are climate modeling and inverse modeling for dating.

Funding: 30 k€ + 30 k€ 2006/7. Application for 40 k€/year 2007-2010 will be submitted. The French contribution thus possibly adds up to 190 k€, in line with the French NorthGRIP contribution. In addition comes an in-kind contribution with drilling equipment and personnel.

A temperature logger and shallow core drilling technology is available for NEEM use.

Model data based on re-analysis data are available for estimation of current-day conditions.

Jocelyne Bourgeois, Canada

An IPY/NEEM proposal has been submitted and the project has been approved. The funding details are not final yet, but about 1 MDKK is anticipated, most of it for the 2008/9 seasons. About half is meant for logistics.

Participation in field work is anticipated.

Main scientific topics are measurements of toxic trace metals and pollen analysis. The latter requires large sample sizes, but experiments with using drilling chips will be made.

Hubertus Fischer, Germany

Drilling: contributing with expertise and equipment, 1-2 experienced drillers.

Science:

- Physical and Di-electric properties (DEP, Line-scanner, maybe also grain size scanner, microstructure mapping, fabrics).
- Dust (continuous and discrete), size and elemental composition.
- Methane isotopes.
- IC chemistry.
- Isotopes on both oxygen and hydrogen on the same sample, but with low resolution.
- ^{3}He of extraterrestrial dust
- Accompanying studies: 3D modeling, high-res airborne radar survey, upsteam surface studies, firn and snow studies (microtomography)

Will participate in traverse 2007: one scientist to do shallow drilling and one to operate AWI surface-based radar measurements.

Funding: vehicles and sledges (worth 100 k€), in 2008-2011 a 30 k€/y contribution is anticipated, hopefully more in 2009-2010.

Kumiko Goto-Azuma, Japan

No funding confirmed yet. There is only one annual application round (next one in November 2007, decision by April 2008). Initial funding may be obtained from NIPR budget and related projects. The aim is to raise 1.4–2.3 MDKK.

Main science goals:

- Physical properties
- Gases: CH_4, N_2O and isotopes
- Ion chemistry and dust, especially across Dansgaard/Oeschger-events
- Biology
- Water-soluble particles
- Other: $\delta^{18}O$ and δD, tephras, trace metals, climate and ice sheets models, astronomy

Logistical contributions: drillers and other experienced field work personnel, and equipment.

Margareta Hansson, Sweden

Scientific interests:

- Radionuclides ^{10}Be and ^{14}C in the Holocene and across selected events.
- Tephras, especially in the Eemian
- Ion and stable sulphur isotopes. Eemian record, comparison with other Greenland cores, biochemical cycling of sulphur.

Science funding is not a large problem, but logistical support is difficult due to lack of funding sources. 400 kDKK has been applied for from Swedish Science Foundation / IPY-related projects.

The aim is to reach the NorthGRIP funding level, approx. 2MDKK.

Jakob Schwander, Switzerland

Scientific interests (and equipment):

- Firn gas sampling (pumping station available)
- Holocene climate variations, correlation with NAO (full operational CFA setup)
- Isotopes of air, $\delta^{15}N$ and $\delta^{40}Ar$, and isotopes and concentrations of CH_4 and N_2O on selected intervals. For methane, especially for the Eemian section.

Funding target 50 – 80 k€/y in the period 2008-2011. Decision is likely early 2008.

Personnel: CFA (2/season), Firn air (2), drillers (?), mechanic (1), electronic engineer (1).

Ren Jiawen, China

This is the first Chinese participation in a Greenland project. One aim is to prepare for the Dome A deep drilling in Antarctica. NEEM results will be compared to Dome A and Tibetan Plateau data.

Funding will be applied for from Chinese Academy of Sciences and Ministry of Science and Technology. Indication of funding level: at least 100 kUSD.

Main interests:

- Drilling operation.
- Ion chemistry of snow and ice samples (IC).
- Analysis of trace elements (ICPMS).

Sunming Hong, South Korea

Funding within the IPY framework: 30 kUSD/y from 2008-2011 for logistics is granted, maybe increased depending on the subjects to be included (e.g. microbiology)

Scientific interests:

- Trace metal analysis and comparison with GRIP, both from deep core and shallow cores.
- High-resolution Pb and Sr isotope measurements to trace the provenance of dust.
- Persistent Organic Pollutants (POPs) in recent ice and snow.
- Microbiology in ancient ice

Training of personnel by participation in the drilling operation is also an interest.

Árný Sveinbjörnsdóttir, Iceland

Scientific interests:

- Stable isotopes of the ice
- Crystals and fabrics
- Tephra and volcanic signals

Icelandic technical and logistical staff has participated in the GRIP and NorthGRIP projects, and this is likely to continue for NEEM.

The funding situation is unclear, but the science foundation has indicated a support level comparable to the Icelandic contribution to GRIP and NorthGRIP. Additional funding from IPY-sources will be approached.

Regine Rötlisberger, U.K.

The main interest is from the British Antarctic Survey, with emphasis on chemistry records, especially related to sea ice proxies, The Eemian record, and relative phasing across Dansgaard/Oeschger-events and North-South phasing (Berkener Island)

Contributions:

- Development of new MSA detection method, possibly including chloride.
- Experienced scientists, engineers, and drilling staff for field work.

- DEP and stable isotopes if wanted.

Funding: Logistic support from NERC: 60 k€ is granted, possibly increased to 120 k€. Research grant with some funding for logistics is due for decision December 2007.

There are other groups in the UK with NEEM interests: Bill Sturges, Jemma Wadham, Siwan Davies, Peter Sammonds.

Friday, March 30

Minutes by Anders Svensson (as@gfy.ku.dk) and Inger K. Seierstad (inger@gfy.ku.dk), Denmark.

Organization of the NEEM project

Chaired by Dorthe Dahl-Jensen, Denmark.

Steering Committee, Field leaders, Science Consortia

Dorthe Dahl-Jensen (Denmark) suggested a structure of the NEEM Steering Committee (SC) similar to that of NGRIP and EPICA:

- The committee has one representative from each nation
- Meetings are held 1-2 times a year (2007-2011). SC approves field programs (not always all representatives are needed)
- The SC is the highest level in all matters
- Consortia are formed under SC – see later
- Field organization structure is under SC
- Sample request are granted by SC – written sample request are submitted to the chairman who distributes to all SC members
- Budgets are accepted by SC
- SC is led by a chairman
- SC meetings are in general open to all participating nations

This structure was agreed upon and DDJ was elected as chair of SC.

DDJ suggested a minimum threshold of 1% contribution to funding of NEEM in order to allow voting in SC, but allowing all participating nations to participate in the SC meetings. Thomas Stocker (Switzerland) suggested a different organization with an associated membership for less-contributing non-SC participating countries. Jim White (US) suggested yet a different structure: all nations are members of SC, but only an executive committee makes decisions. It was agreed upon that the influence and the science output of the participating countries has to reflect the financial and logistic contributions.

The following structure was suggested for the management of NEEM field seasons:

- During field seasons a Field Leader (FL) and a Field Operation Manager (FOM) will be assigned by the Logistic Center (approved by SC)
- FOM will be responsible for the operational center in Kangerlussuaq
- The FOM writes weekly situation reports on science, drilling and field activities
- FL will be responsible for the field camp

At the NEEM camp:

- The field leader is the 'captain of the ship'
- In camp the FL organizes the logistical group (cook, diesel mechanic, helpers etc.)
- FL writes daily reports and there should be a web log like at NGRIP

The drilling is organized as follows:

- A drilling consortium assigns a drill leader at all time in the camp
- Important drill decisions are discussed in a drill group in camp chaired by the drill leader and including the FL
- The drill consortium – (worst case SC) - is consulted by the drill group when needed.

Science work in camp is organized as follows:

- The scientific team is organized with a leader (an exception may be the 2008 field season where only a small science team is needed)
- A cutting/working plan is produced by consortia and approved by SC before field seasons

The scientific work is organized in Consortia covering different fields:

- SC forms the consortia
- Each consortium has a chairman
- The consortia are working groups under the SC
- The consortia are expected to produce science plans and year to year detailed plans for the scientific programs
- Publication plans are presented by the consortia to SC

Jim White (US) commented that publication conflicts in between consortia have been an issue at other projects. TS warned about introducing too many unnecessary rules and suggested there should be a few key papers presenting basic profiles. DDJ commented that NEEM is an IPY project and we do need a data policy. We should try to have a structure that works better than for NGRIP and EPICA. JW commented that we need to give credit to heavily contribution nations. There is a need for having conferences where scientists across the consortia can meet and discuss science. Need funding.

Logistic plans for the NEEM project 2007-2011

Chaired by J.P. Steffensen, Denmark.

Layout of field seasons

Jørgen Peder Steffensen (DK) presented a short outline of the logistical components of the five comming NEEM seasons:

Season 2007

Borehole logging at NGRIP.

Traverse from NGRIP to NEEM with AWI traverse train along ice divide.

Radar sounding, shallow ice coring and GPS strain net survey during the traverse.

At NEEM, setting up garage, skiway and radar grid mapping.

Transporting heavy equipment from NGRIP to NEEM.

A team of 10 will participate (5 DK, 2 US, 1 FR, 1 G, 1 IS)

Containers by ship to Kangerlussuaq with camp construction material for 2008 season.

Season 2008

Construction of ice drilling camp which includes main building, weatherports, workshops, drilling trench and science trench.

Drilling pilot hole to 100 m, hole casing, setting up deep drill infrastructure and drilling to 400m depth.

Ice core logging and limited processing.

Containers by ship to Kangerlussuaq with camp construction material and equipment for late 2008 season

Season 2009

Full time deep drilling and full processing to 1600 m depth.

Season 2010

Full time deep drilling and full processing to warm ice (2450m) or bedrock (2560m).

Season 2011

Finish deep drilling. Borehole logging. Sampling of basal material.

Additional shallow ice coring and limited processing.

Last associated programs, dismantling of camp and pull out.

Jim White asked if it would be possible to obtain two Eemian ice core sections. E.g. by applying a drilling technique similar to that applied at Vostok.

Camp structures and buildings

Simon Sheldon (DK) presented the layout of the NEEM camp structure. The camp will consist of:

- Covered drill trench & science trench.
- Geodesic main dome.

- A separate geodesic dome for the camp generator.
- Weather ports.
- Frame & fabric domes.
- Flagged Ski-way for LC-130's, Twin Otters, Dorniers

There will be normal working & sleeping facilities for 27 persons, provisions for 54.

The drill trench will be 30m x 5m timber covered and contain all deep drilling operations,

operators cabin (DML style), ice core logging, drill repair & servicing cabin, and trench to surface elevator (DML style).

DDJ asked how the logging temperature can be kept sufficiently low. SS answered that inblown air will be cooled in the firn and the temperature will be low. Christine Hvidberg (DK) suggested having the logging table more separated from the drilling.

The science trench will be 40m x 4.5m timber covered and containing ice core storage, core processing facilities and have a firn cooled cooling system

We need to find a solution for the floor in drill and science trenches in order to avoid slippery conditions.

Sepp Kipfstuhl (G) commented that we need an extension of the science trench with a small heated cabin for physical properties measurements.

The Main Dome will be a geodesic dome, 11m diameter, metal frame, insulated, containing camp HQ & communication centre, medical treatment facilities, computer friendly work area, cooking facilities, eating, drinking, social, & relaxing areas, sleeping quarters for 5 persons (maximum 10) and showers, wash basins, water flushing toilets + urinates & cleaning facilities.

The generator Dome will be a geodesic dome, approx. 6m diameter, metal frame, insulated providing the camp electrical supply, circa 110KVA at 2,600m altitude, Main Dome heating supply, and camp fresh water supply from snow smelter. The dome can be dragged to cargo line for over-wintering and lifted every year. It has an external fuel tank.

Skiway

The skiway is made according to full Hercules LC-130's specifications:

- Bamboo poles with fabric flags & Aluminum radar reflecting foil
- 12,000 ft x 300 ft ski-way
- 2,000 ft x 450 ft loading apron
- 12,000 ft approach & Lead-out markers

Orientation of the camp and skiway will be decided based on data from the installed weather station.

Communication

Simon Sheldon (DK) explained how the camp communications will be based on 4 independent systems, each duplicated:

- Broad band data connection via satellite.

- Satellite phones
- Short wave radio for inter-Greenland communication
- VHF for local aircraft communication

World wide communication will be available through Inmarsat BGAN phones and Iridium phones. Web, e-mail, & Telex will use Inmarsat BGAN Data 256 Kbps, Inmarsat C Telex and Iridium Data 2.4Kbps. We will be able to send and receive e-mails, but transfer of large files will be limited as it is too expensive.

Local Greenland communication will be possible via short wave Radio (Greenland coverage), VHF (local & aircraft communication), and 433MHz Handsets (camp use).

There will be a wired 100 Mbit/s camp data network working in Main Dome and in the trenches and a wireless surface network.

NEEM Medical Unit at Gentofte University Hospital

Lars Berg Larsen (DK) introduced a new medical clearance test for NEEM that will be set up at Gentofte University Hospital Denmark (for altitude and not-over-wintering work). The test will be valid for two years. All participants going to NEEM need a medical clearing. Antarctic clearances will be valid for NEEM. Participants need to give their medical history and take a medical test. The test should be finished 3 weeks prior to travel to NEEM. DK participant will do the test at Gentofte Hospital, whereas participants from other countries should send the medical form to NEEM Medical Unit. A confidential copy will be brought to the field by the Medical doctor. There will be a guideline for visitors, DV's and VIP's. The new clearance will be tested in 2007 and run in routine from 2008.

Thule will be our main emergency hub. At the moment we don't know if it is possible to drive down. Medical evacuation from NEEM camp is possible with Twin-Otter at a cost of ~300 kDKK.

All participants are recommended to take a first-aid course. It was suggested to arrange a first-aid course along with the next meeting.

Drilling plans for the NEEM project 2007-2011

Chaired by Sigfus Johnsen, Denmark.

Drilling consortium

Sigfus Johnsen (DK) presented the newly established NEEM drilling group (consortium). Members of the group are Sigfús J. Johnsen (chair), Steffen Bo Hansen (mechanic design etc.), Simon Sheldon (electronics, liquid, trenches), J. P. Steffensen (drilling liquid), Jakob Schwander (Bern), and Frank Wilhelms (AWI).

Valérie Masson-Delmotte (F) commented that Grenoble may be interested in participating in the drilling group.

More drillers will be needed in the field. Possible candidates from: CPH, LGGE, BAS, Japan, USA, Iceland…

The main task for the drilling group is building of a new drill for 2008.

Drill liquid

Simon Sheldon (DK) presented the thoughts behind selection of drilling liquids for NEEM. Finding a suitable liquid for deep ice coring is not so easy. Factors to be considered are: ice core quality, compatibility with ice and water, health issues, general environmental considerations, toxicity, temperatures at the drill site, impact on drill performance, drill design, working environment, logistics of transport and overall costs. The choice of drilling liquid depends on trade-offs.

Past drill liquids include n-Butyl acetate (used at Dome F, GISP II). This liquid has many favorable properties, but is hazardous material class 3, UN 1123 - transportation and it has both health and environmental issues.

Other widely used drill liquid have been Exxol D-30, D-40, D-60 mixed with HCFC-141b (used at NorthGRIP, EPICA DML, EPICA Dome C). This liquid mixture cannot be applied any more because HCFC-141b is now un-available

A new drilling liquid is ESTISOL 240 (coconut oil extract) mixed with Coasol. This liquid is non-polar, non-hazardous, no explosive risk, 'healthy', low environmental impact, BUT is twice the price of D-40/HCFC-141b and it has higher viscosity, especially at low temperatures!

ESTISOL 240 was field tested as a drilling liquid at Flade Isblink, Greenland 2006 with a 4" diameter ice core drilled using the Hans Tausen electro-mechanical drill to a depth of 423.30m (260m of this core using the new liquid). The ice core quality was 'good', no problems encountered cleaning and processing the ice core, the mixture has a slippery feel with no discernable odour, and the liquid is very slippery when spilt on the smooth wooden flooring. The Hans Tausen drill descents at speeds of 0.95m/s at drill liquid temperatures of -16 deg. C. By increasing the borehole diameter by 4mm (to 134mm) a 36% descent speed increase was achieved (1.28m/s). Further improvements can be achieved by adding a dead weight, reducing the pressure chamber diameter, or reducing the pressure chamber length.

Hubertus Fischer (G) asked if sample contamination is a problem with this liquid and if samples from the Flade Isblink ice core could be distributed for testing this.

Deep drill

Steffen Bo Hansen (DK) presented the plans for the new drill that will be made for NEEM. The existing drill from NGRIP and EDML is worn out, so a new drill has to be made. The higher viscosity drill liquid has to be taken into account. The new drill will be based on the Hans Tausen drill, but it will be a modified version with larger cutters to obtain a wider hole. The high-precision drill tube will be brought commercially. A similar drill without the pump system but with a booster has worked very well at Dome F under colder conditions and with a different drilling liquid. Installation of a booster for the new drill may be a good idea.

Electronics

Simon Sheldon (DK) went through the present (NGRIP/EDML) and the future electronics for the drill and the winch control system. As compared to the existing system the new system will have drilling control improvements, new software displaying relevant drilling parameters, integrated drill, cable load sensors, depth sensors and winch control, automatic safety features & alerts within software, large indicator displays for drill trench personnel, and a stock of replacement parts, kits & systems.

Detailed science plans for the 2007 season

Chaired by Dorthe Dahl-Jensen, Denmark.

Logging of the NGRIP borehole

DDJ explained that the Danish logger will be brought to NGRIP and the bore hole will be logged for temperature, pressure, diameter, inclination and azimuth. The bore hole inclination is now of particular interest because the hole is getting close to 10 years old. We don't know exactly the accessibility of the hole for the moment.

Valérie Masson-Delmotte (F) mentioned that Grenoble may also be interested in logging the bore hole.

Radar programs (presentations from CReSIS, AWI)

1. Kansas University, CReSIS.

Prasad Gogineni (Kansas) presented the CReSIS program. The goals of the NEEM part of the program are to provide radar data to select the optimal drilling site, to test new sensors and techniques, and to give field experience and opportunity for students.

The radar measurement programs will consist of surface-based measurements (2007 field season: 120-300 MHz, 2008 and 2009 field seasons: 150, 450 and 750 MHz, fine spatial and temporal resolution) and airborne measurements (2007 and 2008 field seasons: 150 and 450 MHz).

Claude M. Laird (Kansas) presented the CReSIS goals for NEEM 2007: Mapping of near-surface layers, deep internal layers, ice thickness and basal conditions along the ice divide flow line from NGRIP to NEEM and in NEEM vicinity. Also to characterize deep layers and bedrock at NEEM to assure integrity and minimally disturbed nature of ice prior to drill placement.

2. AWI: Traverse NGRIP – NEEM with German commercial system

Daniel Steinhage (AWI) presented the AWI geophysical measurements for the 2007 traverse NGRIP – NEEM. There will be 500 MHz GPR (upper 20 m) and 100 MHz GPR (upper 100 m) using kinematic GPS. GPS reference stations during traverse will be situated at Kangerlussuaq, at NGRIP (collected with 2nd traverse), and at shallow drill sites for profiles perpendicular to the ice divide. The measurements need one Skidoo, one sledge and two persons. It will be possible to make profiles perpendicular to the ice divide at shallow drill locations.

PG noted that there may be interferences between the radar systems. Systems should be kept at a distance, which is logistically manageable.

DDJ asked if one or two persons are needed to operate the German radar system, because only one person was assigned in the manning plan presented earlier.

Shallow ice cores, pits and GPS-markers on traverse NGRIP to NEEM

Three shallow ice cores will be drilled on the ice divide equally spaced within 200 km distance upstream from NEEM. The cores will reach back to 1783 AD (Laki) about 60-70 m depth. The science plan will include density

profile, d18O, d17O, dD (55 cm, 5 cm (possibly 2.5 cm)) and 3D tomography. Chemistry may not be necessary. DEP/ECM is necessary for radar work. Thomas Stocker mentioned that there may be an interest in CFA measurements for the calibration line of the last 40 kyr. It was suggested to do the core processing at AWI, Bremerhaven.

Within two weeks it has to be decided if core should be 3 or 4 inch. The German DEP setup works on 4 inch cores, but the 3 inch shallow drill is much easier to handle in the field for the traverse.

Stakes will be positioned around NEEM site for GPS strain net measurement

Science plan for NEEM

Chaired by Dorthe Dahl-Jensen, Denmark.

Consortia

It was decided to form10 NEEM consortia. 1-2 persons per consortium were appointed as being responsible for forming the consortia. The consortia and the names of the appointed persons are listed below:

- Stable isotopes of ice (Valérie Masson-Delmotte, Sigfús Johnsen)
- Gas incl. gas isotopes (Jim White, Thomas Blunier)
- Aerosols (dust, chemistry, cosmogenic nucleides) (Anders Svensson, Margareta Hansson)
- Dating incl. Δage + tephra (Jørgen Peder Steffensen, Jakob Schwander)
- Physical properties (Sepp Kipfstuhl, Gäel Durand)
- Biology (Joselyne Bourgeous, Eske Willerslev)
- Basal properties (Jean-Louis Tison)
- Borehole data (Dorthe Dahl-Jensen, Gary Clow)
- Drilling (Sigfús Johnsen, Frank Wilhelm)
- Geophysical survey + remote sensing (Prasad Gogineni, Daniel Steinhage)

It was agreed that modeling should not form a consortium itself, but modeling work should rather be involved in relevant consortia from the list above.

The appointed persons are responsible for addressing the scientific tasks of each consortium. They should write a short document on this, which is to be presented at the first consortium meeting. The consortia meetings will be held the day before the next SC meeting in Copenhagen in November 2007. Chairs for each consortium are to be elected at these meetings.

The national representatives are responsible for gathering a list of names of persons who would like to join the different consortia. The national representatives should send the lists of names to the appointed persons for each consortium by **July 1st**.

Funding of science (EEC, FP7 …)

There is a need to find sources for funding NEEM science. No concrete plans were derived at the meeting and it was agreed that all nations should proceed on this in the coming months. It was suggested to look for funding both in Europe and in the US.

Associated programs for NEEM

Chaired by Margareta Hansson, Sweden

Seismic station

Trine Dahl-Jensen, from GEUS (Geological Survey of Denmark and Greenland), Denmark, gave a presentation of the GLATIS program that has 28 (NEEM included) seismic stations in Greenland, of which 4 are permanent stations.

The GLATIS program would like to place a seismometer at NEEM from 2007 and onwards. The instrument should be placed 2 m below the surface in a pit, or better in a quiet spot in e.g. the science trench. GLATIS will appreciate help from camp regarding installation etc. Satellite connection is a help for checking the status of the instrument. The instrument runs with solar panels.

Meteorology, automatic weather station (AWS)

Konrad Steffen (PARCA, USA) who has already set up an AWS at NEEM should be contacted. The Netherlands are also interested in setting up an AWS.

Firn gas

Jakob Schwander (Switzerland) informed that the Swiss group can collect firn gas samples for people who are interested. Approximately 150 samples can be sampled during one season. July 2008 was suggested as a possible sampling period, as the shallow drill most likely will be free to use. 2011 is also an option. JS have had a request from some scientists to get firn-air samples.

Detailed temperature profiles in shallow holes

Dorthe Dahl-Jensen (Denmark) said that Gary Clow (USGS, USA) might be interested.

Shallow ice cores

Shallow ice cores should be drilled for

- firn chemistry back to 40 yrs (and beyond) to make reanalysis, i.e. to compare with meteorological data
- all sorts of parameters which consume a lot of ice

Stationary radar

Hugh Corr (BAS, United Kingdom) is interested.

JPL Philbert probe, optical logging

Testing equipment

New drill equipment etc. can be tested at the NEEM site.

IPY data policy for NEEM

Chaired by Dorthe Dahl-Jensen, Denmark

DDJ stressed that there is an open data policy for all IPY projects. She suggested that NEEM should have a homepage where preprints, published papers, data or contact details for getting data should be made available. Internal discussions, drafts of papers, meeting announcements, minutes etc. can be posted on a log-in part for NEEM-members only. The first version of the NEEM homepage will be launched soon.

DDJ advocated that we should agree on whom to write a certain paper and also agree upon a time limit. If a paper is not being published as promised we should follow up on this internally, as others might wait for the data. Thomas Stocker (Switzerland) said that it might be difficult to put a strict time limit on when to publish data. Prasad Gogineni (USA) will check what kind of rules NSF has regarding deadlines for publishing measured data. Similar rules might be relevant for the NEEM community. PG suggested that a one page white-paper on a data policy that should be written and circulated in the NEEM group and everybody in the SC agrees upon. DDJ will write the white paper.

Jørgen Peder Steffensen (Denmark) encouraged modelers to try to model the Eemian climate curve (The NEEM-challenge).

IPY education and outreach for NEEM

Chaired by Dorthe Dahl-Jensen, Denmark

Prasad Gogineni (USA) gave a presentation of the American ideas for education and outreach. It is the goal to inform and educate the general public and policymakers on the importance of

- climate change
- ice sheets
- sea level rise

This will be done in interaction with the public, science community, graduate education, policymakers, UG education and K-12 (kindergarten).

Dorthe Dahl-Jensen encouraged everybody in NEEM to do an effort regarding the education and outreach obligations of the IPY program. This should be done at a national level as well at an international level in NEEM. A homepage is important for outreach. We should have VIP visits in camp and invite policymakers (important for funding and for putting focus on climate change). In the spirit of IPY we could open the camp for something completely else, e.g. artists to make ice sculptures (for their own money). This will be in line with the outreach goal and it will create publicity and inspiration. Thomas Stocker (Switzerland) suggested that we put attention on sea-level rise and its effect on indigenous people in Greenland and also nature issues (vegetation, fauna and flora). Dorthe Dahl-Jensen said that Greenlandic students will have high priority to go to camp. There exist an agreement between USA and Denmark that may give financial support for such visitors in camp. Katrine Krogh Andersen (Denmark) suggested that we give talks in Greenland about our research, preferentially not during summer time, and also in Nuuk. Regarding the webpage we should upload not only scientific publications, but also popular science publications.

The first NEEM SC meeting closes by announcing the next meeting, which will be held in Copenhagen in mid November 2007.