

Summary of outcomes of IPICS II meeting, Brussels, 16-19 October 2005.

The IPICS II meeting in Brussels was organised under the auspices of the European Polar Consortium, as a follow-up to the IPICS I meeting that was held in Virginia, USA (organised by the US NSF), in 2004. The aims of the meeting are laid out in the introduction that was provided to all participants, but essentially were to extend the collaborative framework of IPICS by: (1) confirming the choice of science projects from IPICS I; (2) exploring the engineering (drilling), logistic, and collaborative implications of pursuing those projects; (3) starting discussions with funding agencies and colleagues to implement the projects; (4) setting IPICS on a firmer basis to pursue its aims.

The initial planning for the meeting was carried out by a small committee consisting of Paul Egerton (EPC), Yves Frenot (IPEV), Heinz Miller (AWI), Gerard Jugie (IPEV), Dominique Raynaud (LGGE), and Eric Wolff (BAS), in consultation with Julie Palais (NSF) and Jane Dionne (NSF). This group was supported by Catherine Schall (EPC). This group appointed Ed Brook and Eric Wolff as conference chairs, and they organised the final programme for the meeting, while all the logistic and administrative details were handled by EPC.

The meeting was attended by 46 people from 17 different ice coring nations. Both drillers and scientists were present, as well as representatives from some major funding agencies. One representative each from the Scientific Committee on Antarctic Research (SCAR) and the IGBP Past Global Changes (PAGES) project also attended. Attendees are listed in the attached appendix. In advance of the meeting, brief updates on national ice core activities were submitted and included in the conference papers, along with the version of the science white papers that was then current.

This document will summarise briefly the main points made during the meeting, and the conclusions and actions from it. Detailed points about individual science projects will not be described here but will be included in the final versions of the white papers, or in science plans that will follow later. It is expected that various other documents will accompany this summary in a final complete meeting report: list of attendees, programme of the meeting, finalised white papers, national ice core activity updates.

Introductory sessions

The initial discussions at the meeting: introduced the participants; explained the role of the EPC and of NSF; presented briefly the outcomes of the IPICS I meeting; and summarised the 4 white papers that had emerged from IPICS I. The opening talk by Dorthe Dahl-Jensen and the discussion that followed emphasised some of the scientific issues, but also the arguments we would have to use to persuade funding agencies and governments that they need more ice core science. Of particular relevance here was the extent to which documents such as the IPCC reports rely on findings from ice cores.

Initial discussions about the two “array” white papers began the process of defining the scope of each of them, so that the later discussions could concentrate on other

issues. However, I will fold the summary of those discussions into the general considerations of the white papers.

The entire second day of the meeting was devoted to discussing the 4 science white papers. The respective discussion leaders were asked to devise an agenda that would include the following elements: reiteration/refinement of the science goal; site selection (where relevant); drilling issues; logistic needs; level of international collaboration needed and assessment of which nations are interested; next steps needed. In general the outcomes of these discussions are already worked into the finalised white papers that were made available in December 2005, and here I outline only the widest conclusions. The names in parentheses are the discussion leaders for each paper.

Oldest ice core (Wolff, Azuma, Severinghaus)

The overriding aim is certainly to take us into the period where 40 kyr cycles predominate. While 1.2 Myr would be valuable, 1.5 Myr would be even better (this is now reflected in the white paper). The meeting reinforced the consensus that it would be better to drill two cores, to ensure both success and replication.

The most pressing issue is that likely sites are in poorly surveyed areas of East Antarctica, so the first task would be to arrange additional survey. The various ground traverses along ice divides that come under the umbrella of the IPY project TASTE-IDEA (2007-2010) would serve as a skeleton of valuable data. If all of them happen they would link all the existing deep core sites with both Dome A and some coastal regions. A detailed aircraft survey would also be essential, and various proposed options for this were aired, including use of long-range aircraft, of small aircraft and unmanned UAVs. All of them have some logistic problems, and IPICS would need to encourage one or more of them to happen. The required survey work will certainly provide information towards other (non ice core) science goals as well. IPICS will need to organise the interpretation, synthesis and modelling effort that will lead to site selection.

It is likely that the drilling will encounter warm ice, and this issue will have to be solved. Additionally, a new drilling fluid that is acceptable from a regulatory view, and that will work at very cold temperatures, will be needed.

For this very major project, the next step will be to develop a science plan, to ensure that the necessary survey takes place so that site selection can be done, and to create an implementation plan that solves the related issues of who is involved, and developing the international framework for sharing the costs, the logistic burden, the science effort and the science output.

Greenland last interglacial / NEEM (Dahl-Jensen, White)

The context for this project is that the NGRIP project reached into the last interglacial but not through it. It should be possible to find a site where basal melt has not played a prominent role. The new core would have multiple scientific targets but with completion of the last interglacial as a critical requirement.

The Copenhagen group has already gone a long way in planning this project, and has enough survey material that they have almost identified a favoured site, likely to be in NW Greenland. At least 11 nations had already expressed an interest in taking part (and more did so at the meeting). Drilling should in principle pose no new issues compared to previous Greenland sites. Copenhagen already has some well-trying and tested ways of carrying out the logistics, and previous projects such as NGRIP provide a model that works for the international collaboration. Copenhagen was hoping to ship material in 2006 and start in 2007 (but this has since slipped a year, because funding is not in place).

Because this project is well-advanced (and aiming at IPY) the next step is to set up a Steering Committee and probably consortia for the science issues. Dorthe Dahl-Jensen is leading on this. Documents already being produced by the Copenhagen group should be adequate, and an additional IPICS science plan for this project is not needed.

30K/40K array (Fischer/Brook/Mulvaney)

The aim of this project will be to generate data needed to understand processes occurring during rapid climate changes, deglaciation and sea-level change, and for testing against models. It was agreed that, in order to encompass some of the more recent Dansgaard-Oeschger events, the aim should be 40 kyr, although cores that could not reach this age were not ruled out if they were the best possible in a region. High resolution data, and good tools for synchronisation, were important.

A map/list of sites was generated at the meeting and included in the white paper. This project provides an umbrella for several ongoing projects, but we also identified some regions where new sites need to be found. In this project there must definitely be two phases: the core collection and the synthesis of the different records to get the science story. IPICS must ensure that the mechanism for the latter is in place.

The individual drillings in this project are likely to be done by a small group of nations over a small number of seasons (as for example at Berkner Island and Talos Dome). There was general agreement that they need to be done lightweight: Twin Otter or helicopter/ship, rather than C130, and this poses some issues of drill development (or at least of sharing best practice).

The next step is to write a fuller science plan to identify more carefully the science goals and needs and to delineate desirable components of the array. This project will need to set up a system of having regular meetings at which data from the different sites can be synthesised.

2K array (Steig, McConnell, Masson-Delmotte)

The context here is that the instrumental record in the polar regions and other snow-covered regions is very short; efforts such as ITASE and PARCA have done a good job of obtaining data covering one or two centuries; but if we want to contribute to the major efforts in climate reconstruction such as IPCC, then we need a coordinated effort to obtain 2000 year records. A possible strategy for each "climatic regime" is to drill a number of 50 year records for comparison with the instrumental record, a

few 200 year cores at annual resolution to establish the variability, and a single 2000 year (multi-annual) core to contribute to the longer time series. Cores should contribute to aspects such as atmospheric composition, volcanic, solar and aerosol forcing as well as climate. This array should include non-polar regions where suitable sites exist.

Sites for this array could generally be drilled by a single nation, but the array must be designed, and IPICS should recommend a minimum (but not prohibitively onerous) set of measurements. There are drilling issues because many of the cores will need to be a few hundred metres, so the availability of lightweight drills capable of reaching these depths relatively quickly will be important.

The next step for this project is again a science plan that lays out more clearly where new sites are needed to give a framework for individual nations to target. In this project IPICS will have a crucial role in making sure that the resources are found for synthesis so that not just for a set of holes and datasets are produced.

National ice core activities

Each nation (or in the case of Europe, group of nations) briefly presented its plans, including funded projects, unfunded proposals, and possible contributions to the white paper projects. Much of the material is already covered in the national update reports and will not be repeated here. Most countries expressed their interest in one or more of the white paper projects and their inputs will be taken into account in developing these further.

International organisations

PAGES outlined the scope of its activities and facilities. PAGES can be particularly effective for communication with the palaeoclimate community. Of particular relevance for IPICS, PAGES offered to host an initial IPICS website, and it will produce a special issue of the PAGES newsletter devoted to ice cores (editor Hubertus Fischer) which will include an IPICS article.

SCAR outlined its new structure and activities. Parts of IPICS map closely onto projects such as AGCS and ACE, and ice drilling is also related to SALE (sub-glacial lakes). SCAR will discuss a formal relationship with IPICS in the near future.

Drilling report (Fitzpatrick, Schwander, others)

An Expert Group on Ice Drilling Technology (under IPICS and SCAR) was proposed at, and formed after, the IPICS I meeting, and reported back to IPICS II on its activities, and on what it sees as the issues IPICS must consider if it wants to pursue the science white paper projects. Many of the issues discussed at the meeting will be summarised in a white paper still under construction by the drilling group, and this section will outline only the main issues.

Some progress has been made in identifying alternative drilling fluids, but for inland Antarctic ice further work will be needed. Other issues discussed include how to handle brittle ice, experience and progress in drilling warm ice, replicate and sideways

coring, and considerations in deciding the diameter for cores. While large diameters are desirable for some purposes, smaller diameter holes may be adequate and appropriate for some of the array projects. Rapid access drilling may also be a useful tool for site selection activities.

Some more general issues that concern the drilling teams are access to testing facilities (for example, annual test/training activities in Greenland would be desirable), and the importance of continuity when projects finish, so that knowledge and expertise are retained and shared. This is an issue that IPICS might want to pursue if it wants to retain the expertise to drill the cores planned in the white papers. A continuing close relationship between the drilling and science teams will be essential, so that the drillers can produce what the science requires, and the science asks only for what is feasible! The Expert Group hopes to hold an International Drill Technology Workshop (tentatively September 2006 in West Virginia).

Integration, funding, logistics (Egerton, Miller, Raynaud)

This session discussed different models for international collaboration with a view to seeing how we could achieve the ambitious science projects within limited budgets.

Various attempts were made to put the projects onto a timeline. The two arrays would be ongoing, with different nations and groups of nations contributing sites at intervals, and could mainly be continued as background activities (although an individual 40k site is a substantial activity). The Greenland deep drilling should coincide with the pre-site survey for the Antarctic deep drilling, with the actual deep drilling following much later (after 2011), so there is no fundamental clash of the major projects.

As well as national funding, there may be some additional opportunities through IPY and in Europe through EU Framework Programme (FP) 7 and (for deep Antarctic ice) FP8. However, some additional multinational structure will be required for most of the proposed projects to coordinate the inputs and outputs. A large number of models used in other projects were compared and discussed (NGRIP, EPICA, WAIS, ITASE, ANDRILL, IODP...). No particular conclusion was reached on the model to use; it was felt that models such as EPICA and NGRIP have been very successful, but might not provide the full solution for every case.

In fact, each of the 4 science white papers was very different in scale and style, and might call for different solutions. The two array projects require common coordination (deciding sites, and synthesising data into more than the individual cores), but not necessarily common funding, although sharing of expertise or equipment would certainly accelerate the projects. The deep Greenland project is already advanced, and a funding model similar to that of NGRIP is already being assumed. The deep Antarctic core, involving probably a larger and more diverse group of nations and agencies than previous projects would need a new model. Developing this should be a task for IPICS in the next year or so.

Other science issues

Some additional issues were considered and discussed. These included interpretation of proxies, atmospheric chemistry and meteorological support, development of

common timescales, data centres, and statistical treatment of ice core data. These are all areas where IPICS should be ready to play a role but do not require specific IPICS initiatives at this point. A presentation about ice core biology pointed out the links between the mainly climate and ice issues in the white papers and biological studies, with possible synergies.

Final session: Structures and actions from the meeting

It was agreed that IPICS should organise itself as a formal and continuing independent body, with a Steering Committee. After much discussion about whether the steering body should consist mainly of practitioners, or of agencies with practitioners advising them, it was decided that, at this stage of development, the SC should be practitioners (scientists and drillers). Engaging with agencies would be one of the SC's tasks, and when project plans became more concrete, the structure could be reconsidered.

It was agreed that the SC should include:

- 1 person from each nation taking part (including Norway who were unable to attend). (New nations may join IPICS, and can join the SC if they can show they are, or plan to be, carrying out IPICS activities.)
- Additional people representing each white paper (including, we have confirmed subsequently, the drilling group), with the main task of developing the projects.

Ed Brook and Eric Wolff were asked to chair the SC, which would have about 25 members (full list should be available in associated part of full meeting report, and on the IPICS web site when completed). It would do most of its business by email. At this point we decided not to instigate any kind of formal MoUs between nations. Rather we need to develop the science plans and then engage the national agencies and find out what kind of agreements they need.

IPICS should liaise with international agencies, and we tasked people to work with SCAR (Robert Mulvaney), PAGES (Jerome Chappellaz), and IASC (Dorthe Dahl-Jensen). Heinz Miller will arrange that COMNAP discusses IPICS at its meeting in Hobart in June.

The 4 white papers will be (have been) completed, along with one from the drilling group, and a glossy folder will be prepared to present them in (should be ready mid-March 2006). Once completed, all SC members should make sure they reach appropriate agencies. They were also distributed at AGU and will be distributed at EGU (Vienna, April 2006). The main task of the SC in the next year will be to develop, where appropriate, science plans for the projects (to be adopted when IPICS next meets). The main responsibility for this task will fall on the SC members from the white paper groups; however the writing teams should be organic, including whoever can assist, and including the drilling group in each case. Each science plan should, as a minimum include: Introductory material; a description of the project; a rationale for site selection; a description of drilling and logistics needs and a schedule; preliminary funding plan; a discussion of related issues (age scales, proxy interpretation, data treatment, etc.); and a summary of what next steps are needed.

Finally, we discussed the next IPICS full meeting. China kindly offered to host it in Shanghai. The alternative would be to attach it to another meeting. The SC will consider the time and place, recognising that it may not be necessary to hold it in 12 months' time, but might be delayed until 2007.

Acknowledgment

The chairs of the IPICS II meeting, Ed Brook and Eric Wolff, would like to thank Paul Egerton and Catherine Schall of EPC for all their work to organise the meeting so efficiently, the U.S. NSF for supporting the attendance of US scientists, and the EPC for supporting the attendance of European and several non-European attendees.

Summary action list from IPICS 2 meeting

Action	Who?	Status at 1st March 2006	When by?
Set up SC	Brook	Done	January 2006
Finalise science white papers	Various	Done	November 2005
Finalise drilling white paper	Fitzpatrick		
Produce glossy folder for white papers	Wolff	With printers	Actual: March 2006
Distribute white papers/glossy cover to agencies etc	All SC	Awaiting glossy covers	
Meeting report/action list	Wolff	This document	Actual: Feb 2006
Full meeting report to EPC	Egerton		
Summary meeting report to Eos	Brook	Published	November 2005
IPICS report for PAGES newsletter	Brook/Wolff	In Press	January 2006
Present IPICS at AGU Fall 2005	Brook	Oral presentation given	December 2005
Present IPICS at EGU April 2006	Wolff	Poster presentation scheduled	April 2006
Set up IPICS web page with PAGES	Fischer/Kull	Under discussion	
Present IPICS at SCAR, Hobart, June 2006	Mulvaney	Added to agenda	June 2006
Represent IPICS to COMNAP	Miller		June 2006
Represent IPICS to IASC	Dahl-Jensen		
Produce science plans	Various		May 15 th 2006 (likely to slip)
Schedule next full IPICS meeting	Wolff, Brook, Li, SC		mid-2006 for meeting 2007