

**EC BIOCLIM and BioMoSA Projects
Joint Final Seminar
Luxembourg, 27 and 28 November 2003**

SESSION 6: CONCLUSIONS

Summary of General Discussion

Chairperson: U Kautsky (SKB), independent participant, assisted by:

H von Maravic (EC Representative)

D Texier (ANDRA), BIOCLIM Project Co-ordinator

G Pröhl (GSF), BioMoSA Project Co-ordinator

G Smith (Enviros) and S Mobbs (NRPB), Day 1 and Day 2 Chairpersons.

Opening comments

U Kautsky thanked the EC for providing the venue for the Joint Final Seminar and all the seminar presenters for their interesting presentations. As someone who had not been involved with either of the projects, he felt that a lot of interesting information had been presented and he was sure that everyone agreed. He had not realised that the BIOCLIM project had dealt in such depth with modelling future climate over such long timescales. In particular, the coupling of atmospheric, ocean and ice sheet climate models had given a fascinating insight into the possible development of the climate over the next 200,000 years. It had been interesting to note that all the climate scenarios considered had pointed to a prolonged interglacial period without any ice sheet development, i.e. the delay of the next period of glaciation for a considerable period due to the influence of elevated concentrations of carbon dioxide in the atmosphere. This topic is of particular interest to Sweden and other northern European countries that have to take glacial-interglacial cycling into consideration in long-term radiological assessments. There was a lot of information on a number of climate issues that people could take back to their organisations. The BioMoSA exercise of comparing results for site-specific and generic models for different types of present day biosphere systems had also been useful. A lot of data had been presented so it would be important to have access to the final documentation for both projects and he hoped that the EC would make the various project reports easily and quickly available.

U Kautsky then opened the discussion to all participants at the meeting.

Discussion relating to the consequences of a prolonged interglacial climate

A Ikonen (POSIVA) commented that the long-term consequences of greenhouse gas warming needs to be considered in Finland. However, to date, assessment calculations only consider activity concentrations/fluxes from the geosphere to the biosphere rather than radiation doses to humans.

M Thorne (M Thorne & Associates) noted that processes such as land uplift (due to rebound following ice sheet melting), eustatic sea level rise and thermal expansion of water with ice melt are important for Scandinavia. The latter two processes could give sea level rises that could counter land uplift.

D Paillard (LSCE) stated that there is a lot of uncertainty about the overall consequence of eustatic sea-level rise relative to land uplift as the Greenland Ice Sheet melts – particularly how fast the latter will melt and what the consequences will be. The output from some models suggest a sea level rise due to thermal expansion and melting of the Greenland and West Antarctic ice sheets of 7 metres or more in just a few hundred years whereas others estimate that it will take thousands of years to produce such a change.

U Kautsky emphasised that the prospect of an extended greenhouse gas warmed interglacial period and its consequences could pose problems even over shorter time frames for nuclear power plants located on the coast.

F van Dorp (NAGRA) said that sediment transport either before or after glaciation is an important process because the turnover of materials can be large. To date, most models have not captured this.

M Thorne was of the opinion that one must consider both the style and tempo of erosion. For example, changes in both the overall characteristics of river channels and the rates of evolution of channels of a particular overall character. In the UK, for the Drigg programme, the concept of a conceptual landscape model has been developed and work had now moved on to quantify the landscape model. Geomorphologists can describe the style of landscape evolution but it is less easy to compute this in a mechanistic model. He posed the question of whether we need process based models or whether it is sufficient to talk in terms of narratives of landscape change. He suggested that for modelling purposes it is easier to consider the overall movement of mass without necessarily addressing in detail the processes of movement – with this concept it is possible to develop phenomenological models.

U Kautsky asked if we don't have a glaciation for 100,000 years or more, what landscape evolution processes should we consider in the assessment models. Continental drift perhaps? Or weathering impacts on rocks?

P Degan (UK Nirex Ltd) asked what would be the next step beyond the transition climate interaction matrices and time charts presented. It is important to think about soils and water bodies. We need to think of how the various transition processes affect radionuclide migration and accumulation. We should use the interaction matrices to think laterally and find out what is important and what has the greatest consequences for radionuclide migration and accumulation and hence human exposure.

M Thorne said that he could only answer this for British context. He felt that it was necessary to ask questions about how to characterise young and old landscapes. In the North of England, the superficial deposits were laid down about 18 thousand years (ka) Before Present (BP) whereas in the South East they were laid down about 400 ka BP. Comparisons of the degree of erosion of these deposits, indicates that much of the incision occurs in the first 10 to 20 ka after a glacial episode. However, this leaves outstanding the question of how soils would evolve under a future extended period of warm conditions, with associated irrigation, as there is no analogue for this in the palaeo-environmental record.

E Mouche (LSCE) said that the important aspects of landscape evolution are due to climate change. For example, changes to river networks have real impacts on the flow network of near-surface hydrology. Erosion may have impact on the outlets of

the system, e.g. regional flow. Maybe the next study should concentrate on climate impacts on the geosphere-biosphere interface rather than the biosphere only. Perhaps there could be a BIOCLIM phase II to study climate change effects on the geosphere. There is a need to study real sites. In France there is an underground rock laboratory for carrying out investigations and observations. It is not possible to understand impacts of processes if one is only considering a generic site.

M Thorne strongly agreed. A real site is what we need to know about, but actually the site area may be too small to give the answers to the effects of large-scale, long-term processes. Early in the 1990s some work was done on selected sites in Britain, but they did not give all the answers. Information is required on various spatial scales.

E Mouche asked whether it only the UK and France that are interested in near-surface hydrology.

P Degnan stated that such a topic should be of interest to many countries because there are important questions for the geosphere-biosphere interface that haven't been studied.

F Recreo (CIEMAT) said that Spain is also be interested in near-surface hydrological processes. We need to develop an integrated picture of the whole system – from the engineered barriers to the biosphere.

D Texier announced that there would be a 2 day workshop on the geosphere-biosphere interface at ANDRA in mid-December under auspices of the Bioprotect project. Maybe it would be possible to develop an expression of interest on the topic of integrated system evolution for the EC 6th framework programme.

U Kautsky suggested that perhaps we don't need to worry about climate change in assessments if an interglacial episode will continue for 100,000 to 200,000 years. Rather, we need to understand the dynamics and processes at the geosphere-biosphere interface.

P Degnan felt that we need some information on how climate acts on the system. Perhaps information could be obtained from a site in Canada that experiences non-continuous permafrost. The site could provide interesting information on the interrelationship between climate and geosphere-biosphere interface processes.

E Mouche stated that what is needed from the climate models is not year on year data but rather the overall impact of climate.

F van Dorp said that we need to continue international cooperation to obtain the information required from both generic cases and specific cases. Climate is one of the most important aspects for shaping surface environment. Geosphere processes are also important.

D Paillard stated that climate is a dangerous word! He asked what was meant by climate in this context, what time periods – day, month, year; what components of climate - temperature, precipitation, ice volume?

U Kautsky considered that it is those components of climate that affect the site and its safety.

R Little (Quintessa) noted that other factors than climate drive environmental change. He picked up on the previous mention of the development of landscape narratives. He suggested that when the BIOCLIM results are presented it would be necessary to show how the methodology that has been developed can be applied to other mechanisms causing environmental change. BIOCLIM has built on the IAEA BIOMASS Reference Biosphere to develop narratives. It will be necessary to show how you could take the landscape narratives further and what would be the impacts on results of using the methodology. He noted that SKB has done work using snapshot

approach by taking different geosphere-biosphere interfaces but for each, constant conditions were assumed. He mentioned work he had done on behalf of SSI on developing a model that includes dynamic processes involved in land uplift and that provides a time sequence of what happens. This is a practical illustration of the application of a mathematical model to the concept of change.

P Degan commented that the isostatic uplift raised by R Little was a secondary process that is actually a result of climate change. Perhaps we need to consider more fully what processes and changes are possible and what are likely. There are very few mechanisms that are not related to climate change (e.g. volcanism).

M Thorne said that we have learnt a broad lesson of an approach to dynamic modelling by developing the methodology in BIOCLIM. But we should also be aware of the *quantitative* geomorphological literature that there is available in some journals and relating to some components of selected environments.

U Kautsky felt that we can always do better. But do we actually need to? We just need to be able to justify the approach we use.

U Kautsky would like the answer to the question: For a given site, what do I need to know? We don't necessarily need to know everything.

P Degan stated that nevertheless one needs to convince the public that you know sufficient.

F van Dorp said that the approach previously was often to take a conservative viewpoint. But now there is more pressure to reduce conservatism. However, we should be aware that the more realistic we go the more detail of actual processes we need. We need to take a balanced approach to what is required for a landscape evolution model.

Use of project results and availability of documentation

R Yearsley (Environment Agency) stated that he was encouraged that the IAEA BIOMASS Reference Biosphere methodology has been used robustly in both projects. This gives assurance that the methodology is workable and useful. Also, in BIOCLIM, two different climate models were used and although the results were not identical we do see similar output so this can give us some confidence in the suggested general trends of climate evolution. Although he noted that it is still possible that both models are wrong, this is less likely than if one model only had been used. It is useful for regulators and others to see that different models are used as this does give greater confidence in the results if they are similar.

R Little said that he is interested in applying outputs from the projects. Consequently, he considered it is vitally important not just to have the summary reports from both projects but also to have all the background material. The BioMoSA datasets would be useful to everyone so he made a strong plea that the input information and data should not be lost. The data used in the models would form an excellent database. As a start, he asked if the pdf files of the presentations could be made available so that immediate conclusions and results can be disseminated.

D Texier (ANDRA) stated that the reason for holding a Joint Final Seminar, the detailed programme, abstracts and actual presentations, and a summary of the final discussion session will be provided on the BIOCLIM website (managed by ANDRA) as soon as presenters send their material. It is hoped that both BIOCLIM and BioMoSA presentations will be uploaded.

U Kautsky considered that the most useful way to help ensure that the information is used by others is to publish the project results in journal articles that can be properly referenced.

H von Maravic (EC) stated that the EC policy for publication of project material has changed. For projects under the 5th Framework Programme it is the responsibility of the project coordinators to make the information available. It might be possible to make a case for a 50-60 page technical report to be published under EC report covers as a EUR report. He will ask if this is possible. Otherwise, short abstracts can be made available via the CORDIS web site.

D Texier stated that all the BIOCLIM reports will be available on the ANDRA website. It is hoped that all the supporting data can be made publicly available too. M Thorne raised the possibility of publishing some of the BioMoSA and BIOCLIM material in an internationally renowned journal. It may be possible to issue a single special issue of journal, although this is less likely if the journal editorial board knows we have plans for technical publication of the project documents.

A Lee (BNFL) said that he preferred to get the documentation now rather than wait for journal publications.

U Kautsky asked whether the mistakes made during the project would be documented because these would be useful for learning for future projects.

H von Maravic said that the discussions showed how important it was to bring the two projects together at the end. He asked participants to think about what more should be done both in performance assessment and in climate change contexts. The EC is open to ideas and expressions of interest can be brought to the 6th Framework programme. He thanked everyone for a very useful and stimulating seminar.