Where lies the horizontal scientist?

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Comment on Professor Ronald F. Abler's speech.

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Professor Abler, dear colleagues, dear friends.

It is indeed a great pleasure to be here at the opening of the Geography Department's new premises in Kumpula. Knowing that the good old sofa is still to be found somewhere at the department and seeing the numerous familiar faces in the audience makes one feel at home. I have to admit, however, that there is one aspect to be longed for: the revolving doors of Porthania. Would it still be possible to negotiate with the architect about reconsidering this small detail?

It is an equal pleasure and honour to have the opportunity to comment on Professor Ron Abler's presentation on *Geography among the sciences*. It is, however, also a grand challenge. Anyone would find himself in a rather exciting position commenting on such a thorough and knowledgeable presentation.

Professor Abler did very well indeed in covering the whole discipline. Therefore, it is best not to try to re-invent geography here. Instead, I shall give a snapshot of a narrow slice of the neighbouring, newly emerging fields of science which Professor Abler referred to as the grand challenges, namely Earth System Science, and its close relative, Global Change Science.

In this presentation, I shall briefly try to formulate the relationship between these disciplines and geography, as we know it.

Environmental scientists often make the headlines nowadays as global environmental problems, such as climate change or land degradation, are tackled. The complexity and interconnections of various environmental problems have set whole new requirements for the research community. Politicians and decision-makers in general currently harass scientists with the most convoluted queries about, say, whether there are indeed any harmful changes in nature, what causes these changes, and how we should mitigate or adapt to these dilemmas.

Questions arise, such as whether our energy sector should invest in nuclear energy or natural gas, whether we should protect old growth forests or concentrate on increasing biodiversity in commercial forests, how to allocate aid to developing countries, or how to balance urbanisation, increasing poverty and inequality on a regional and global scale, just to give a few examples. Suddenly, environmental sciences are all very policy relevant.

A beautiful example of an increasing demand for scientific expertise in policy is climate change. I suppose we all clearly remember the international meeting on emission reductions in Bonn in July. The participants encountered severe problems and disagreement about carbon sinks and forest accounting, with perhaps less emphasis on true emission reductions. The Intergovernmental Panel on Climate Change, the IPCC, had slightly earlier published its third assessment report on climate change. We remember how the US president, George W. Bush, questioned the scientific merit of the "Summary for policymakers" (IPCC 2001) and established a small group of experts within the National Science Foundation to review the report. The outcome of the review was that the IPCC report was scientifically valid, but this finding did not stop President Bush from withdrawing from the Kyoto protocol. Global environmental problems have indeed taken science onto a completely new level of policy relevance. However, let us move back to geography now.

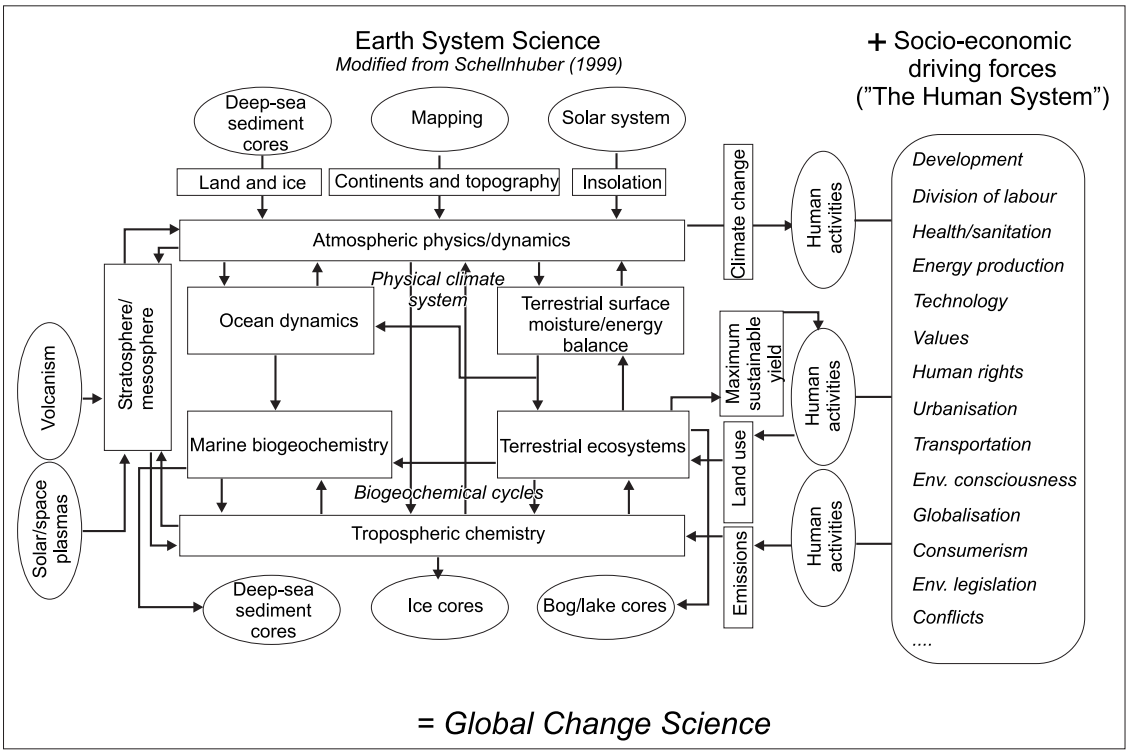

Fig. 1. The proposed scientific approach, "the global change science", consists of the (physical) earth system science (e.g., Schellnhuber 1999) and the socio-economic (human) system plus their interaction. The scope therefore reminds that of traditional geography, but the vast spatial dimension calls for multidisciplinary collaboration.

The complexity of Mother Earth has opened the eyes of many scientists to realise that a narrow, traditional, discipline-oriented approach will not suffice. Among other researchers, Dr. Hans-Joachim Schellnhuber, a renowned physicist who has lately been appointed as the director of the multidisciplinary Tyndall Centre for climate research in the UK, has suggested Earth System Science (ESS) as an aid in solving global environmental problems (Schellnhuber 1999).

The diagram (Fig. 1, the right hand panel excluded) presents the Earth as a simplified, conceptual model, which is referred to as the Earth System. As geographers we are naturally familiar with this flow model of the Earth. It includes various ecosystems, oceans and biogeochemical cycles. However, something is lacking: the human factor. In the Earth System Science approach, the human dimension has been reduced to the three ellipsoids on the right. It does not look too comprehensive as an approach to a geographer, does it? But let me come back to this ESS issue slightly later.

Similarly, Dr. John Lawton, a biochemist and the head of the Natural Environment Research Council in the UK, stated in the Editorial of *Science* in June (see the insert on page 184), that Earth System Science is the ultimate solution to environmental problems (Lawton 2001). It studies not only the main components of the planet Earth, such as the atmosphere, the oceans etc., but also their interactions – a revolutionary approach. Professor Abler critically commented on this "not-so-revolutionary" view in the AAG Newsletter later in the summer from the geographer's point of view (Abler 2001).

Indeed, let us go back to the Schellnhuber diagram for a second and revise it somewhat by adding some socio-economical aspects and humanities (cf. Fig 1, right hand panel included). Now we have a more complete model of the planet Earth, as we geographers know it. The Earth system appears now more realistic with topics such as development, technology, urbanisation and transportation included. It is, however, also much

less readily predictable! Suddenly we have to deal with democratic elections, revolutions, black Tuesdays on the stock market, even wars. The world is not only stirred – it is shaken.

I may not be the first one, but I call this approach *global change science*. It is probably enlightening to stress here that global change is *not a synonym for climate change*, as is so often mistakenly considered to be, even in scientific contributions. Global change is much more than climate. It covers all spheres, both natural and human systems. However, why call it global change? What's wrong with good old geography?

Very simply, geography cannot do this all by itself. Very few of us geographers do atmospheric modelling, calculate the national price tag for Kyoto emission reductions, or investigate the juridical matters with regard to the biodiversity convention and the rights of aboriginal tribes in the Amazon region. Geographers use the results for regional syntheses, but they do not necessarily undertake the primary work. There is still a clear, justified need for specialists, and we know it.

I shall try to conceptualise global change methodology in a simple diagram (Fig. 2), showing the various research fields needed to implement the approach.

First, we need traditional (what I call) "vertical scientists" (physicists, chemists, geologists, economists, lawyers etc) to dig deep into their own fields of speciality and feed facts into the database.

Second, we need futures researchers: scientists investigating potential, largely unpredictable futures with various scenario approaches. This is an autonomous field of research in its own right.

Third, someone has to build the enormously complex models to run the scenarios. We need modellers to do the trick.

Finally, in the middle of the diagram (cf. Fig. 2), "lies" the horizontal scientist – we may wish to call him a geographer – who understands interactions, spatial and regional entities, and both natural and anthropogenic processes, to aid in putting together the model of Mother Earth, or a part of it. This whole entity is global change science. It is more than what can be accomplished by geographers on their own, but it will be difficult to complete without one.

What is surprising, and annoying as well, I guess, is the fact that geographers seem not to have been able to sufficiently show their abilities. It is as if the whole discipline of integration had been invented only now, when our fellows among the vertical scientists have realised that integration is the magic word in better understanding our environment. Let me give an example from Finland. The Finnish Global Change Research Programme, FIGARE, is funded by the Academy of Finland and consists of nearly 40 projects from all over Finland. To my knowledge, there is only one geographer among the 120 researchers. Hardly any geographer sent in an application three years ago when the global change research programme was established.

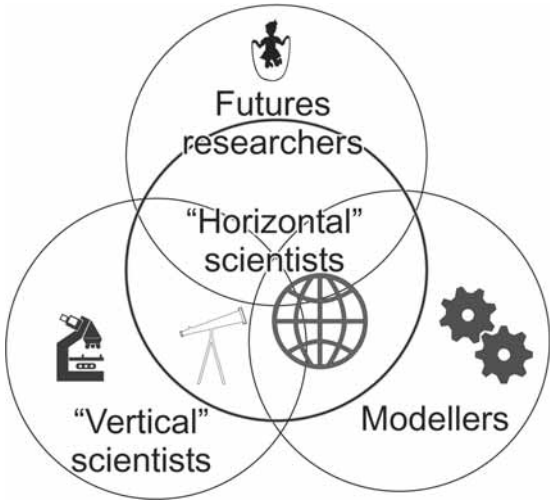

Fig. 2. A conceptual 'global change science' approach showing the four fields of research required for the completion of the system.

Why don't geographers get excited of a topic, which should by definition be their slice of bread? I believe that there is a paradox here. The strength of geography lies in its unified approach, its ability to bridge the natural sciences and humanities into purposeful and practical applications. However, these very same qualities may dilute the scope and aims in the contemporary world. It is difficult to be a specialised generalist. Perhaps we geographers are not very good in marketing our expertise and ourselves. Perhaps we should stop jealously protecting our own discipline and look confidently for collaboration, proud of the strengths of geographical approach, to offer ourselves as linkages between vertical scientists. Nobody will do this for us. Whether or not geography will be among the big-S sciences in the future, as professor Abler expressed it, is up to you and me.

I would like to end here by thanking Professor Abler for his thought-provoking presentation, and wishing the Geography Department a successful future. The new, once again unified premises of Kumpula will certainly serve for geography's benefit.

I would also like to invite geographers to collaborate and integrate forces, not only within your own department, but also with colleagues working elsewhere in Finland and abroad.

Viribus unitis.

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Prof. John Lawton, *Science* Editorial, 15 June 2001 (partially)

One of the great scientific challenges of the 21st century is to forecast the future of the planet Earth. As human activities push atmospheric carbon dioxide and methane concentrations far beyond anything seen for nearly half a million years (prompting the strongest statement yet from the Intergovernmental Panel on Climate Change that human activities are warming the world), we find ourselves, literally in uncharted territory, performing an uncontrolled experiment with planet Earth that is terrifying in its scale and complexity.

Wrestling to understand these challenges is the young, still emerging, discipline of Earth System Science (ESS).

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ESS takes the main components of planet Earth – the atmosphere, oceans, freshwater, rocks, soils and biosphere – and seeks to understand major patterns and processes in their dynamics. To do this, we need to study not only the processes that go within each component, but also interactions *between* these components. It is the need to study and understand these between-component interactions that defines ESS as a discipline in its own right.

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It is hard to imagine a more important discipline than Earth System Science. We urgently need to overhaul our thinking and rejig our institutions to allow this crucial new science to flourish.