Box 1: The GAIM Earth System Questions

In 2001, in response to the evolving science, structure and results of the IGBP, GAIM developed a new set of overarching questions as a challenge to the scientific community concerned with global change. These questions are not limited in scope to those that can be answered by individual research projects, programmes, or even communities. Rather, they are meant to help define the overall context of global change science regardless of our present ability to address the issues articulated therein. In many cases it will be necessary to develop a dialogue with communities far beyond IGBP and the ESSP.

Analytic Questions:

1. What are the vital organs of the ecosphere in view of operation and evolution?
2. What are the major dynamical patterns, teleconnections and feedback loops in the planetary machinery?
3. What are the critical elements (thresholds, bottlenecks, switches) in the Earth System?
4. What are the characteristic regimes and time-scales of natural planetary variability?
5. What are the anthropogenic disturbance regimes and teleperturbations that matter at the Earth System level?
6. Which are the vital ecosphere organs and critical planetary elements that can actually be transformed by human action?
7. Which are the most vulnerable regions under global change?
8. How are abrupt and extreme events processed through nature-society interactions?

Operational Questions:

9. What are the principles for constructing “macroscopes”, i.e., representations of the Earth System that aggregate away the details while retaining all systems-order items?
10. What levels of complexity and resolution have to be achieved in Earth System modelling?
11. Is it possible to describe the Earth System as a composition of weakly coupled organs and regions, and to reconstruct the planetary machinery from these parts?
12. What might be the most effective global strategy for generating, processing and integrating relevant Earth System data sets?
13. What are the best techniques for analysing and possibly predicting irregular events?
14. What are the most appropriate methodologies for integrating natural-science and social-science knowledge?

Normative Questions:

15. What are the general criteria and principles for distinguishing non-sustainable and sustainable futures?
16. What is the carrying capacity of the Earth?
17. What are the accessible but intolerable domains in the co-evolution space of nature and humanity?
18. What kind of nature do modern societies want?
19. What are the equity principles that should govern global environmental management?

Strategic Questions:

20. What is the optimal mix of adaptation and mitigation measures to respond to global change?
21. What is the optimal decomposition of the planetary surface into nature reserves and managed areas?
22. What are the options and caveats for technological fixes like geoengineering and genetic modification?
23. What is the structure of an effective and efficient system of global environment & development institutions?

For some questions, GAIM is already in a position to begin to address the issues involved. In other cases, close collaboration will be necessary with IGBP projects, and with WCRP, IHDP, DIVERSITAS and others. There are additional questions whose answers will depend not on scientific research, but rather on social or philosophical considerations.