Temperature and mixing in different climate regimes

Four specific scientific issues were identified, all of which should be viewed within the context of climate change, the primary impact of which will be on physical lake dynamics. This is important because physical lake dynamics is the ultimate internal driver of most lake processes. Because climate change will affect different climatic regimes (with their various lake types) differently, a positive effort needs to be made to expand GLEON in the direction of the under-represented tropics.

1) Climate forcing
Because of the initially limited duration of the time-series that can be expected to arise from GLEON, the long-term effects of climate change on lake ecosystems cannot be investigated directly. However, within a few years, in a range of different lake types and in a variety of climate regimes, it should be possible to study the effects of interannual variations in meteorological driving variables on physical lake dynamics, resulting in increased understanding of the mechanisms by which lakes in different climate regimes are driven by weather (i.e., small-scale meteorology) and climate (i.e., spatially coherent large-scale meteorology). This is a prerequisite to understanding the likely impact of climate change on lake ecosystems. Thus, for instance, the physical responses of lakes to unusually warm winters or summers that may occur during the first few years of GLEON can be compared and contrasted in great temporal detail with the lakes' responses to "normal" or colder winters or summers. The occurrence of extremely warm periods corresponding to the average conditions that are predicted by RCMs to occur, say, at the end of the current century cannot of course be guaranteed during the first few years of the project, but the likelihood of these occurring will increase with time.

2) Ice-on and ice-off
In high-latitude and high-altitude lakes, ice cover - and especially the timing of ice-off - is the most important physical determinant of lake ecology, governing, for instance, internal nutrient recycling and the timing of the spring algal bloom. As a result of climate change, there is already a detectable long-term global tendency for ice-on to occur later, and ice-off to occur earlier. Intensive measuring under ice, and especially during ice-on and ice-off, again coupled with high-resolution meteorological measurements, would allow the physical processes governing ice phenology to be studied in detail.

3) Internal nutrient recycling
The high-resolution GLEON measurements can be employed to plan field campaigns - at much lower resolution - to study the internal recycling of nutrients in a range of different lakes. These field campaigns would be triggered by knowledge of the timing of large-scale vertical mixing obtained on-line from the GLEON sites, and would complement the high-resolution measurements.

4) Phytoplankton diversity
The high-resolution GLEON measurements would allow us to investigate the influence of short-term mixing processes on phytoplankton diversity; i.e., to determine whether short-term physical variability results in a higher degree of phytoplankton diversity than that predicted by the competitive exclusion theory (Hutchinson's "paradox of the plankton"). This study should involve a whole spectrum of lakes from northern ice-covered lakes through temperate lakes to sub-tropical and tropical lakes, thus making use of GLEON's global dimension.