Press Release from the Danish Center for Earth System Science:

Carbon Sequestration: a boon or a burden?

Carbon sequestration is being promoted as a major tool for avoiding global warming. For example, the European Union plans to invest billions of euros within the next ten years to develop carbon capture and storage (CCS) whereby CO_2 will be extracted at power plants and other combustion sites and stored underground. Large scale use of CCS could help to avoid extreme global warming in the near future that would otherwise result from high levels of atmospheric CO_2, as will occur unless fossil fuel emissions are reduced significantly. However it is not clear how effective different types of sequestration are in the long run, owing to leakage of stored CO_2 back out to the atmosphere. Nor is it clear what would be the long-term consequences for the Earth system of such leakage. In a paper published on-line on June 27 in the scientific journal **Nature Geoscience**, Professor Gary Shaffer, leader of the research team at the Danish Center for Earth System Science (DCESS), casts light upon these important issues.

Professor Shaffer made long projections with the DCESS Earth System Model (www.dcess.dk) for a number of sequestration/leakage scenarios. He found that leakage of sequestered CO_2 may bring about large atmosphere warming, large sea level rise and oxygen depletion, acidification and elevated CO_2 concentrations in the ocean. Storage of CO_2 in the deep ocean is a poor choice since this creates grave problems for deep sea life and since CO_2 stored this way returns to the atmosphere relatively quickly, bringing back the global warming. Geological storage may be more effective in delaying the return of the warming but only if a CO_2 leakage of 1 % or less per thousand years can be obtained for an underground stored reservoir on land or beneath the ocean floor. Alternatively, long term leakage from the ocean or geological reservoirs could be actively countered by re-sequestration to stabilize climate at some desired level. But it would be hard to gauge the global leakage rate to be matched by re-sequestration. Furthermore, re-sequestration would have to be carried out over many thousands of years, a burden for future society in line with that of long term management of nuclear waste.

Professor Shaffer notes that “CCS has many potential advantages over other forms of climate geoengineering. It makes good sense to modify the Earth’s radiation balance by putting carbon back in where it came from rather than to mess around with short-lived aerosols. Atmospheric CO_2 is long-lived and evenly-distributed globally making it possible to manage it in a long-term, controlled way with less chance for unpleasant climate surprises. However, potential short and long-term problems with leakage from underground storage should not be taken lightly. Carbon in light form will seek its way out of the ground or seabed. The present situation in the Gulf of Mexico is a poignant reminder of that fact.”

Professor Shaffer concludes that “The dangers of carbon sequestration are real and the development of CCS should not be used as a way of justifying continued high fossil fuel emissions. On the contrary, we should greatly limit CO_2 emissions in our time to reduce

the need for massive carbon sequestration and thus reduce unwanted consequences and burdens over many future generations from the leakage of sequestered CO_2."

Contact information:
Gary Shaffer, Danish Center for Earth System Science (e-mail: gs@dcess.dk).
Professor Shaffer is also at the Department of Geophysics, University of Concepcion, Chile (e-mail: gshaffer@dgeo.udec.cl) and the Niels Bohr Institute, University of Copenhagen (e-mail: gs@nbi.ku.dk).