LUCC DATA NEEDS FOR INTEGRATED ASSESSMENT MODELS OF CLIMATE CHANGE

Hans-Martin Füssel and Ferenc L. Toth
Potsdam Institute for Climate Impact Research, Dept. Integrated Systems Analysis, Germany

Land-use and land-cover change (LUCC) and global climate change (GCC) are among the most important examples of global environmental change. Many LUCC processes like deforestation, afforestation, soil disturbances and changing agricultural practices contribute to GCC by emitting/absorbing greenhouse gases (GHG) or changing surface albedo. Tropical deforestation alone accounts for about 25% of global anthropogenic CO_2 emissions (cf. figure 1), and the share of LUCC processes for other GHGs is even higher. Also, impacts of GCC drive LUCC by processes like inundation due to sea-level rise, changing biomes, and thawing permafrost soils while mitigation measures include afforestation and the use of biomass energy. Moreover, LUCC and GCC have a number of demographic, socio-economic, political and cultural driving forces in common.

This situation calls for the integration of LUCC processes into Integrated Assessment Models of Climate Change (IAM-CC). There have already been some efforts in this direction, aiming, i.a., at the establishment of more realistic scenarios for non-industrial GHG emissions, and at assessing the relevance of feedback loops between LUCC processes on the one hand and GCC impacts and/or mitigation measures on the other.

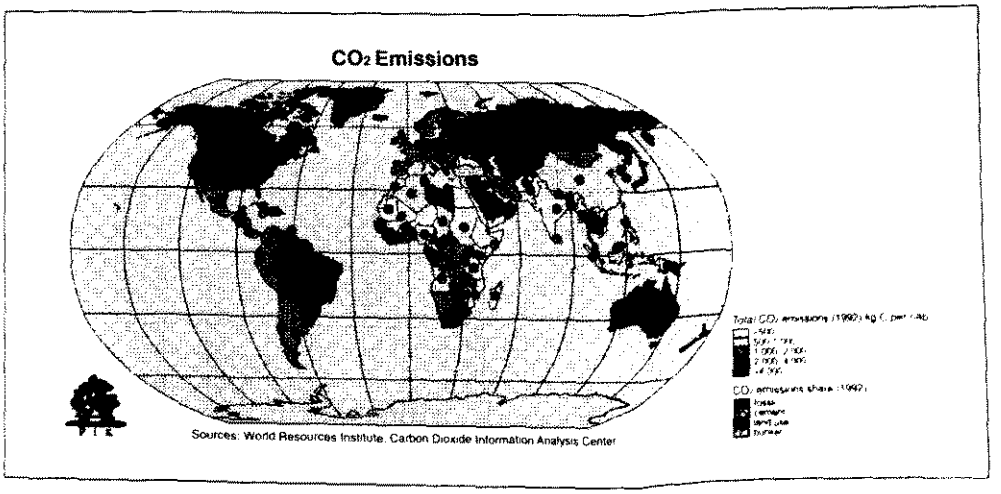

Figure 1

Although the coupling between LUCC models and other modules of IAMs-CC is still in a very early stage, some important insights into the interaction of GCC and LUCC have already been gained. An improved representation of LUCC processes in IAMs-CC certainly requires a refined set of LUC categories, and more precisely elaborated land allocation rules. Yet these efforts are often severely restricted by the lack of adequate data even on the current extent of LUCC. The most recent IPCC report still states a range of 0.6-2.6 Gt C for the global CO_2 emissions from tropical deforestation, and the uncertainty is even higher for data on a national level and for non-CO_2 GHGs.

It is important to improve our knowledge on this subject, both for obvious scientific reasons and for political and legal reasons, in particular with respect to GHG emission reductions and the enhancement of sinks as requested by the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Fortunately, the increasing availability of remote sensing data from satellite systems like the Advanced Very High Resolution Radiometer (AVHRR) as well as progress in the field of computerized Geographical Information Systems (GIS) and data storage systems provide the opportunity to improve this situation considerably in the next few years. Many international programs, like LUCC, IGBP, GEMS, WISE, and SOTER already address this issue.

From the viewpoint of an IA modeller, the most important aspects concerning LUCC data as input to IAMs-CC are as follows. LUC classifications and databases need to be related to sinks and fluxes of GHGs and possibly to surface albedo. Datasets must have global coverage, and they should be globally comparable, consistent and of uniform quality, to the highest degree achievable. For high-level, functional data (e.g. based on net primary productivity) the spatial resolution can be rather coarse (about 100 km grid size) whereas for physiognomic data (e.g. land-cover classes) a much finer resolution is required. The provision of nationally aggregated parameters would be very helpful for meeting data demands related to the implementation of the UNFCCC. The Intergovernmental Panel on Climate Change (IPCC) suggests an update frequency of 3-5 years for data on non-industrial GHG emissions.

From the considerations above, the following specific needs for LUC data can be derived: a globally standardized, hierarchically classified, geo-referenced database depicting land use and land cover, which is updated at regular intervals; soil carbon and biomass carbon inventories that are compatible with the LUC classifications; a database for typical one-time GHG emissions connected with major LUCC processes (as an intermediate step); and a database on GHG fluxes for different categories and intensities of agricultural land use.