Summary Session 1

Chair: Christian Reick
Notes: Tobias Ceglarek

General discussion:
The general discussion in this session concentrated on the following points:

- What is already landuse, as compared to still being natural landcover? Background for this question is the observation that certain landuse practices do not fall under the FAO-definition of croplands (e.g. wood harvest in natural forests, slash&burn practices, cropping with fallow times beyond 5 years, etc.). Another related problem is the identification of pastures: the FAO definition considers grasslands as pastures only, if they are fenced. This excludes e.g. nomadic herding. Especially for preindustrial times these non-FAO landuse types may contribute substantially to the overall landuse. For recent times it has been proposed in the discussion to derive the extent of pastures from live stock data.
- The curves on the development on blue water shown by Dieter indicate that the general increase of water withdrawal slowed down after 1960. Dieter pointed out that after 1960 agricultural practices were significantly intensified. This process of intensification is not represented in LPJmL. It was proposed to apply the “fertilization ansatz” developed in Kassel, to overcome this problem.
- A final topic concerned the question of sowing and harvesting dates. Jörg indicates that CESR has developed a deterministic model for deriving these dates.

Presentation by Julia Pongratz, MPI for Meteorology, Hamburg:
"The Millennium Land Use and Land Cover Reconstruction"
Preindustrial times are quite interesting for climate research, because at that time climate is less perturbed by mankind. This does not mean unperturbed: The most prominent human disturbance before industrial revolution arose from landuse. To study its influence on climate, Julia Pongratz reconstructed the extent of croplands, pastures and natural vegetation for the last 1200 years (800-1992, 0.5 degree resolution, yearly, fractional area). For the last 300 years, back to 1700, there exist the SAGE and HYDE reconstructions of landuse. In a first step these datasets have been combined with respect to the extent of pastures, and slightly improved with respect to croplands in some regions known to be problematic (West Africa, Sibiria, Australia and New Zealand). Based on the landuse pattern for the year 1700, maps for earlier times are derived, by assuming constant landuse per capita, i.e. by using population data to scale agricultural activity back in time until 800AD, except for regions where this method must fail (e.g. the Americas before Columbus). These maps for croplands and pastures were then combined with a map of potential natural vegetation. In addition, the maps have been equipped with an uncertainty range for each pixel, by accounting for uncertainties in population data and considering possible effects of agrotechnical improvements. – The data set will soon be available from the CERA-database (cera-www.dkrz.de).

Presentation by Carsten Lemmen, GKSS, Geesthacht:
"Modelling of anthropogenic landuse in prehistorical times"
Even further back led the presentation of Carsten Lemmen. He showed results from simulations with his Global Land Use and Technological Evolution Simulator (GLUES). This model has been developed to test hypotheses on the neolithic transition from hunter-gatherer to agro-pastoral cultures, in particular to analyze the influence of climate on the development of human societies. The model is unique as it combines population growth, economic and cultural development, and changes in environmental conditions. Starting from a small, globally homogeneous population at 12000BP and a worldwide distribution of natural resources (introduced as a map of Net Primary

Productivity), the model roughly reproduces the timing and spreading of humankind starting from the 5 ancient centers of human development (fertile crest, north and south China, Andes, Mesoamerica). In a next step the methane emissions from rice cultivation will be derived from the model. Background for this activity is the Ruddiman hypothesis, that man has started changing climate already 10000 years ago --- one argument in this discussion is the development of the atmospheric methane content, known from ice cores. Another intention going along with the development of GLUES is to foster discussions between anthropologists, archeologists and climate researchers. The network HECCAN (Human Ecodynamics and Climate Change AdaptatioN), founded recently, will be a platform for such discussions. .

Presentation by Dieter Gerten, PIK, Potsdam:
"Hydrological data uses and needs for the LPJmL-model"
Dieter Gerten presented results from the application of the ”Lund-Potsdam-Jena model with managed land” (LPJmL). He showed computations for “green” and “blue” water, i.e. water actively put onto the fields for irrigation (blue water), as compared to natural watering of crops by precipitation (green water). With this model he identified regions/times of sustainable/nonsustainable water use. Overall, even today with our highly industrialized agro-economy, still 80-90% of crop water supply stems directly from precipitation. Dieter pointed out that studies on sustainable use of water suffer very much from insufficient data availability, in particular there is need for (improved) global data sets and/or models on:

- irrigated areas
- distribution of water reservoirs
- reservoir management
- flow velocities
- groundwater resources
- household and industrial water withdrawal

Summary WBGU Discussion

The discussion was motivated by the question whether GINKGO as a scientific network could contribute to WBGU’s next report, which is focusing on biofuels and their socio-environmental impacts including land use issues.

PIK and CESR have been contacted by WBGU before, while other GINKGO groups present at the meeting are currently not involved.

The lack of globally consistent biofuel scenarios e.g. as output of GTAP or other models was identified as a general deficiency hampering global and regional biofuel impact studies.

Thus, PIK will provide a global study, mainly based on the simulations of Tim Erbrecht, which are addressing the potential to grow 2nd generation biofuels to as input for the Fischer-Tropsch conversion (BTL). 3 crops are distinguished in this study (Miscanthus, a temperate poplar type PFT, a tropical Eucalyptus type PFT.

CESR is focusing on 1st generation energy crops such as sugarcane, maize (for bioethanol) and Pongamia/Jatropha (for biodiesel). The study will be conducted for 3 of the globally most important biofuel producers and consumers Brazil, EU and India. The study will be guided by political targets set in the respective regions/countries and assess the environmental impacts of fulfilling the biofuel targets to various degrees.

The discussion revealed that it is unclear, which type of guardrails (a concept often used by WBGU) are relevant (or favoured by WBGU) for this type of study. PIK is applying strict area constraints (e.g.: do not use current agric. areas for biofuels), while other constraints such as minimum requirements for food production could also be used.

Other important issues such as biofuel related emissions of CO2 or N2O cannot be addressed by the groups present at the workshop, given that only a few months until February 2008 are left (and no funds are provided) before the studies/statements have to be presented.

It was suggested that PIK and CESR should coordinate their activities, but that the remaining time is too short to coordinate a joint GINKGO activity.

Summary Session 2

Chair: Hermann Lotze-Campen
Notes: Jennifer Koch

GINKGO Session at IHPD Meeting in New Delhi 2008

The next IHDP Open Meeting will be on 16 -19 October 2008 in New Delhi, India. Deadline for session proposals is 30 November 2007. It was proposed that land-use related people from the GINGKO network, together with some other European colleagues, submit a proposal for a session with a focus e.g. on bio-energy, or other GINKGO-related topics. Details to be discussed at the next general GINKGO meeting in Hamburg Nov. 2007.

Presentation by Hermann Lotze-Campen (originally Tim Erbrecht), PIK Potsdam:

Preliminary results from introducing biofuels in LPJmL

Unfortunately, Tim could not attend the workshop, due to railway strikes. Hermann Lotze-Campen could only provide a few comments on Tim's work. Three bio-energy crops for the second generation of biofuels have been implemented in LPJmL and validated (Miscantus, Poplar, Eucalyptus). Two first scenarios for land allocation have been calculated, an unrestricted scenario with high concentration in grid cells with highest yield potential, and a restricted scenario with more local production. Arable land for food production and biodiversity hotspot areas has been taken out, such that bio-energy production will not compromise these. Area demand for biofuels is very low in the unrestricted scenario.

Presentation by Jörg Priess, CESR Kassel:

Global wood demands derived from the MEA scenarios

The topic of the talk was the derivation of forest-related scenario inputs for LandSHIFT. Forestry is still underrepresented in most scenarios and models. One forest trade model with global coverage and 14 product categories is the Global Forest Product Model (GFPM, Joseph Buongiorno, University of Wisconsin together with FAO, 2003). GFPM forest categories fit well to LPJ plant functional types, and the model can be used for projections up to 100 years. It was discussed, however, that such a partial-equilibrium model might have structural limitations for long-term projections and might need recalibration. Two MEA scenarios were used as a background, Techno Garden (TG) and Order from Strength (OS). The quantification of the storylines was done together with the Buongiorno group. Important inputs for GFPM are demography, GDP per capita, trade barriers and waste paper recovery. With regard to global trade in wood products, Asia is the main exporter, and OECD countries are the main importers. Total production of roundwood is higher in OS (2.8 bil. m^3) than in TG (2.1 bil. m^3), due to higher population growth and lower use efficiency. The results on global demand and trade from GFPM are fed into LandSHIFT, which contains a global database on forest management types and distributes country-results into grid cells. Currently

there are two management types, sustainable vs. unsustainable. The goal is to distinguish "Clear cut" from "Selective cutting". A country-specific database on timber harvesting methods has been established, but has still to be implemented into the LandShift framework.

Presentation by Tobias Ceglarek, CESR Kassel:

Developing an age structure for woody PFT in LPJ

The goal of this work is to create a link between LPJmL (C-version) and LandSHIFT. Forest yields from LPJmL should be used in LandSHIFT. Therefore, a forestry module with age structures has to be implemented in LPJ. As a start, woody plant functional types (PFTs) with constant parameters have been chosen. The current goal is to stay as close as possible to the validated LPJ structure, describing mortality, establishment and C-cycles. The age structure has been introduced as an "add-on" distribution, based on average PFTs. Four different age structures have been tested: equal distribution, summing-up, linear increase and a combination of different mortality factors. Moreover, a maximum age for the PFT has been introduced. An open question is, how the quality of the age structure can be assessed, e.g. through foliage projective cover or number of individuals per age class. For a cohort model the global information base would be insufficient.

Problems regarding the age structure occurred with the 30-year cycle in LPJ results due to CRUE climate inputs on inter-annual variability. It should be checked, for which processes this cycle is needed, e.g. fire events and C-cycle. Experience at PIK shows that some of the artefacts may only occur in a small number of cells.

Presentation by Joseph Alcamo, CESR Kassel:

Current status of the discussion on NEW IPCC Scenarios

New IPCC scenarios are to be developed over the next years. A background document has been drafted in Nordwijk, involving three "communities": IAM (Integrated Assessment Modelling), ESM (Earth System Modelling ("Climate modeling")), IAV (Impact, Adaptation, Vulnerability, later changed to VIMA: Vulnerability, Impacts, Mitigation, Adaptation). Four BCP (Benchmark concentration pathways) have been defined related to total radiative forcing in W/sqm: 8.5 (~25 GtC), 6, 4.5, 2.5 (or 3). There will be no separate IPCC scenario report, as "IPCC should only facilitate new scenarios".

Three phases are planned:

Phase (1): IAM provides emissions pathways for all GHG, aerosols, black soot until June 2008. ESM will provide climate scenarios until June 2009. Land use (LU) is an important issue, but should in the first phase be calculated in IAM for consistency only. No immediate action is required from VIMA/Land use community. Information requests may come from IAM/ESM communities. Preliminary results from simple climate models to be used by LU/VIMA community.

Phase (2): VIMA/LU community downscales ESM results and impacts and provides feedback to IAM/ESM about constraints/limitations, possibly in an iterative process (but not clear yet). The goal is to move away from sequential analysis IAM – ESM – VIMA. Finally, this should result in consistent/unique scenarios for IPCC AR5.

Phase (3): Synthesis. Data collection centers should be created also for emissions and impacts. Harmonisation of approaches is needed. Community of climate impact researchers worldwide has to be better organized, e.g. through informal meetings, IPCC WG2, CIESIN, or a US group around Cynthia Rosenzweig.

Summary Session 3

Chair: Jörg Priess
Notes: Christian Schweitzer

General discussion:
In this session the general discussion focused on the still unresolved problem how to validate large scale/global studies. In addition to the absence of independent global land cover/land use data sets, the inconsistency of different spatial data sets was seen as a serious problem. Partial validation at least for Europe may be possible in the near future, as soon as a land cover data set of the University of Wageningen for the year 1960 will be available.
As a second issue, the problem of large scale simulations of water quality, especially salinisation was discussed. The discussants agreed that an approach would be needed, but that the data availability in this sector is still very poor and incomplete.

Presentation by Hermann Lotze-Campen, PIK Potsdam
The current status of the MagPie model:
MagPie is a global land-use model deviding the world into 10 ecoregions with a 3 degree spatial resolution (~ 2200 grid cells), based on output of the LPJmL model. Under the assumption of constant agricultural areas, MagPie's allocation algorithm minimizes production costs (constraints: water, area, caloric intake).
While most other approaches use technological change as an input, MagPie estimates rates of tech change, which are necessary to produce enough food for the world's population. Feedbacks from MagPie to LPJ are not yet implemented.

Presentation of the current status of the LandShift model by Rüdiger Schaldach
Landshift is a modeling approach, developed mainly to study large scale i.e. continental – global land-use dynamics. The spatial scales implemented in the global version are the country level, an intermediate 0.5 degree level and 5 arc minutes pixels (9 x 9 km; > 2 Mio grid cells). Land allocation is driven by exogenous commodity demands (e.g. from the IMPACT model) and are allocated based on a multi-criteria suitability analysis and a MOLA-algorithm (Multi Objective Land Allocation) i.e. heuristics to resolve land allocation conflicts. So far, LandShift has been used in a biofuel study for India, and within the GEO4 process for land- and water use dynamics in Africa.

Presentation by Martina Weiss, CESR Kassel:
Green and blue water fluxes in Africa, simulated with Watergap 2.0 and Landshift
The coupling between Landshift and Watergap 2.0 (soft coupling) enables the assessment of green (= evapo-transpiration) and blue (runoff and irrigation) water fluxes. The total amounts of green water fluxes vary strongly and are extremely scenario-dependent. Validation of the the estimates is possible for the year 2000. Model comparisons with estimates e.g. of the IMAGE team revealed that Landshift/Watergap 2.0 estimates were clearly below IMAGE estimates.

Presentation by Jennifer Koch, CESR Kassel:
Stocking capacities of grasslands in the Jordan river basin, simulated with Landshift
Based on land-use maps and current stocking densities, different livestock scenarios were presented, assuming livestock densities within and above the carrying capacity of the grasslands. Large differences in land-use and degradation regimes were observed for different assumed land-use strategies. The preliminary degradation function will be replaced by an empirically based function, being made available by GLOWA Jordan-project partners in the coming weeks.