Meeting report of the ad-hoc group for the modelling and assessment of contributions to climate change (MATCH)

31 May to 2 June,
Oslo, Norway

9 July 2007

Prepared by Niklas Höhne and Martina Jung

Contents

1 INTRODUCTION

As part of the negotiations on the Kyoto Protocol, the delegation of Brazil made a proposal, in May 1997, to set differentiated emissions reduction targets for Annex I Parties of the UNFCCC according to the impact of their historic emissions on temperature rise (UNFCCC document FCCC/AGBM/1997/MISC.1/Add.3).

After two expert meetings held under the auspices of the SBSTA (28 – 30 May 2001 in Bonn, Germany; 25 - 27 September 2002 in Bracknell, UK), the SBSTA agreed that the work should be continued by the scientific community. Subsequently, further expert meetings were held on the initiative of the governments of UK, Brazil and Germany.

In August 2003, the UK Department for the Environment (DEFRA) commissioned Ecofys to provide administrative, secretarial and scientific assistance as 'support unit' for the process until the end of 2005.

During the expert meeting held in Berlin on 8/9 September 2003, draft terms of reference and a draft work plan for a process until 2005 were discussed for the now called "Ad-hoc group for the modelling and assessment of contributions to climate change (MATCH)". Participants for a scientific coordination committee were selected, which guides and coordinates the process.

This document is the report of the meeting of MATCH held from 31 May to 2 June 2007 in Oslo, Norway. It was drafted by Niklas Höhne and Martina Jung, Ecofys, Germany [and reviewed by the participants of the meeting].

The agenda of the meeting (Annex A) consisted of three major parts, a discussion of authors and interested experts on paper # 3, the main workshop and a discussion of authors and interested experts on paper #4. All presentations held during the meeting are available on file exchange of the web site www.match-info.net. 20 participants attended the meeting (Annex B).

2 ISSUES DISCUSSED BY THE SCIENTIFIC COORDINATION COMMITTEE

The members of the scientific coordination committee (SCC) Jan Fuglestvedt, Joyce Penner, Jason Lowe, Michael Prather, Murari Lal, Guoquan Hu and Niklas Höhne met on 31 May and 1 June to discuss the agenda of the meeting, funding for developing country experts and the future process.

3 DISCUSSION ON PAPER #3

On the first day, authors of paper #3 "Contributions of individual countries' emissions to climate change and their uncertainty" met to discuss the progress. Helcio Blum presented the compilation of the results so far. Authors agreed on a new outline and task list, see C.

4 WORKSHOP

Joyce Penner opened the meeting as Co-Chair of the scientific coordination committee of the MATCH group. She expressed her thanks on behalf of the experts to CICERO for hosting this meeting.

Niklas Höhne welcomed the participants on behalf of Ecofys and introduced all participants to the history of MATCH. He presented the results obtained by MATCH so far, reported on the decision on the future of MATCH taken by SBSTA in May 2006 and proposed a time line for the future work of MATCH:

- May 2007: MATCH meeting to report progress
- 27-31 August 2007: Side event at UNFCCC meetings in Vienna
- 24-26 September 2007: MATCH Meeting to finalize work and to prepare report for UNFCCC (2 days writing papers, 1 day writing summary report)
- 31 October 2007: Submission of the final report to SBSTA
- December 2007: "In-session special side event" at SBSTA 27 to present the work to UNFCCC delegations
- 7 March 2008: Countries submit their views on the matter
- June 2008 or soon after: Official consideration by SBSTA 28

Niklas Höhne also mentioned that in 20 occasions, experts from developing countries were supported with travel and subsistence costs. There is additional money for additional 2-3 expert trips available in the fund provided through the UK, German and Norwegian governments.

4.1 STATUS AND DISCUSSION ON PAPER #2

Participants started with a presentation by Michael Prather on paper #2, as it includes some aspects which are the basis for the understanding of paper # 3. The paper is very close to being submitted.

One element of the discussion was, whether the impact of the emissions of Annex IR countries in global average temperature should be displayed as an absolute number (in °C) or as a fraction of something to show the relative magnitude. As it is difficult to decide on the denominator (e.g. temperature increase since pre-industrial level, since 1990, without committed warming, contribution of all other countries' emissions) the decision was not to divide by anything, but show the absolute increase in the context of other temperature increases without calculating the fraction and to explain why a division is problematic.

4.2 STATUS AND DISCUSSION ON PAPER #3

Helcio Blum presented the status of the results on paper #3 "Contributions of individual countries' emissions to climate change and their uncertainty". Further comments were made and integrated in the outline and task list in Annex C.

4.3 STATUS AND DISCUSSION OF PAPER #4

Akinori Ito who was welcomed as a new member of the MATCH community, presented the first results of paper #4. His analysis offers some explanations for the huge differences existing in land use emissions estimates deriving from the different assumptions on land use activities and carbon pools considered by each data set. Detailed discussions were left to the scheduled discussion on the paper on the following day.

4.4 PRESENTATION OF PAPER ON INTERPRETING HISTORICAL RESPONSIBILITY

Benito Müller presented the efforts underway for a paper on interpreting the results of MATCH that he is preparing with Mathias Friman, Roda Verheyen and Niklas Höhne. All other MATCH participants are invited to participate and to comment on the paper. He made the distinction between "causal contribution" and "responsibility". MATCH so far considered the historical path of emissions originating from the territory of a country and assessed its contribution to temperature increase. But he argued that this is not necessarily what the country is "responsible" for. It could be less (emissions only as of the point in time where all should have known or emissions only above the level necessary to satisfy basic needs) or more (emission caused indirectly by consumption of good produced elsewhere or not having executed the duty to control emissions elsewhere).

The presentation was well received and MATCH participants looked forward to the final paper.

4.5 STOCKTAKING AND WRAP-UP

In the closing session Joyce Penner thanked the participants for their contributions and expressed her satisfaction with the progress on the outline and attribution of assignments for paper #3 during the workshop.

The group looked at the future timeline. It was noted that it would be beneficial to present the result of the MATCH work to a broader audience before October 2007. The opportunity to have a side event / workshop the Ad-hoc Working Group und the Kyoto Protocol and the dialogue on future action under the UNFCCC late August in Vienna was welcomed. It could include an introduction and then a presentation of paper #2 and #4 by Michael Prather and/or Akinori Ito as the background followed by a summary of paper #1 and #3 by Niklas Höhne.

The next meeting was agreed to be held 24-26 September in Cologne, possibly also Sunday. There were offers to host the next meeting in Japan, India and Norway. As many participants will be in the Netherlands for an international workshop the week before the next MATCH meeting, Cologne was chosen as the preferred location.

Decisions on who would present at the side event at the next COP in Indonesia December 2007 would be discussed once the dates are clear.

The group briefly talked about what it could contribute after the October report is finalised. Possible topics include "responsibility", uncertainty, LUCF, impacts, attributing regional climate change, sectors. It was also mentioned that MATCH could be more a quick consulting body to answer questions on the topic. The suggestion was made to ask donors what they are interested in, not loose the institutional capacity of this group.

Finally Joyce Penner thanked the participants for the successful meeting and participants thanked Jan Fuglestvedt for hosting and arranging this meeting.

5 DISCUSSION ON PAPER #4

On Saturday, the experts interested in the paper #4 on land use change and forestry discussed the paper. Participants expressed their satisfaction with the analysis and results obtained so far and thanked Akinori Ito for his effort to bring this paper forward. They discussed what should be the primary focus of the paper. One question intensively discussed was if – in comparing data sets - special attention should be given to data from UNFCCC reporting. After the more general discussion, experts worked on the outline of the paper and the distribution of tasks to individual experts. The paper outline resulting from this discussion is included in Annex D of this report.

ANNEX A: AGENDA

MATCH
Modelling and assessment of contributions to climate change

AGENDA
AD HOC GROUP FOR THE MODELLING AND ASSESSMENT OF CONTRIBUTIONS OF CLIMATE CHANGE (MATCH)
31 MAY TO 2 JUNE, OSLO, NORWAY
CIERO CENTER FOR INTERNATIONAL CLIMATE AND ENVIRONMENTAL RESERACH - OSLO
GAUSTADALLÉEN 21, OSLO, NORWAY

Thursday, 31 May 2007 **For authors of paper # 3 and interested experts only**

9.30 - 11.00	Chair: Niklas Höhne	Discussion on the status of the modelling of paper #3 and interpretation of the results	1.5h
11:00	Coffee Break		30'
11:30 - 13:00	Chair: Niklas Höhne	(Continued)	1.5h
13:00	Lunch		1h
14:00 – 16.00	Chair: Niklas Höhne	(Continued)	2 h
16:00	End		
19:00	Dinner *		

Friday, 1 June 2007 **For all experts**

9.00 – 9.30	Chair: Joyce Penner	- Welcome - Review of timelines (SBSTA), tasks, goals of MATCH, review of long-term work plan, update on UNFCCC meetings (Niklas Höhne)	0.5h
9.30- 11.00	Chair: Joyce Penner	- Presentation of the modelling of paper #3: "Contributions to climate change by country with uncertainty" (Niklas Höhne and Helcio Blum) - Discussion	1.5h
11:00	Coffee Break		30'
11.30- 13.00	Chair: Jan Fuglestvedt	- Presentation of the status of paper #4: "Land use change and forestry" (Akinori Ito) - Discussion	1.5h
13.00	Lunch		1h
14.00 - 14.45	Chair: Jan Fuglestvedt	- Presentation of a paper interpreting the results of historical responsibility (Benito Müller) - Discussion	0.75h
14:45 – 15.30	Chair: Joyce Penner	- Lessons learned from paper #2 (Jason Lowe/Michael Prather) - Discussion	0.75h
15:30	Coffee Break		30'
16:00 – 17.30	Chair: Joyce Penner	- Stocktaking - Work plan - Decision on next meeting - Distribution of tasks	1.5h
17:30	End		
19:00	Dinner		

Saturday, 2 June 2007 **For authors of paper # 4 and interested experts only**

9.00 - 11.00	Chair: Michael Prather / Akinori Ito	Discussion on status and way forward for paper #4 on LUCF.	2h
11:00	Coffee Break		30'
11:30 - 13:00	Chair: Michael Prather / Akinori Ito	(Continued)	2h
13:00	Lunch		1h

ANNEX B: PARTICIPANTS OF THE MEETING

Ana Claudia Nioac de Salles	Federal University of Rio de Janeiro, COPPE/UFRJ, Brazil
Akinori Ito	Frontier Research Center for Global Change, Japan
Atsushi Kurosawa	The Institute of Applied Energy, Tokyo, JAPAN
Ben Matthews	Université catholique de Louvain, Louvain la Neuve, BELGIUM
Benito Müller	University of Oxford
Christiano Pires de Campos	Petrobras, Brazil
Helcio Blum	Federal University of Rio de Janeiro, COPPE/UFRJ, Brazil
Luiz Pinguelli Rosa	Federal University of Rio de Janeiro, COPPE/UFRJ, Brazil
Malte Meinshausen	Potsdam Institut für Klimaforschung, Germany
Maria Silvia Muylaert de Araujo	Federal University of Rio de Janeiro, COPPE/UFRJ, Brazil
Martina Jung	Ecofys Germany
Mathias Friman	Centre for Climate Science and Policy Research, LiU, SWEDEN
Ragnhild Bieltvedt Skeie	CICERO, Centre for Climate Research, Norway
Scientific coordination committee	
Michael Prather	University of California at Irvine, USA
Jan Fuglestvedt	CICERO Centre for Climate Research, Norway
Jason Lowe	Met Office Hadley Centre for Climate Prediction and Research, UK
Joyce Penner	University of Michigan, USA
Murari Lal	Climate, Energy and Sustainable Development Analysis Centre, India
Guoquan Hu	National Climate Center, China Meteorological Administration, China
Niklas Höhne	Ecofys Germany

ANNEX C: PAPER #3

MATCH paper#3: Contributions of individual countries' emissions to climate change and their uncertainty
1 June 2007

Responsibilities and timeline

Lead author: Niklas Höhne, Helcio Blum, Ian, Ben, Jan
Authors:
Interested: Ben, Chris, Atsushi, Gouquan, Jan, Ragnhild, Ana Claudia, Jason, Malte, Niklas, Norichika, Mathias

Task	Responsible	Deadline	Action taken
Preparation of emission dataset: Future emissions, LUCF ($MtCO_2$), check Mongolia, Australia, Taiwan, cement	Niklas Höhne, Helcio Blum	15 June 2007	**Open**
Check models, provide model description	All modelers	15 June 2007	**Open**
Model runs	Helcio, Ben, Jan, Niklas, Guoquan, Atsushi (Ian, Jason, Natasha)	15 July 2007	**Open**
Compilation of data	Niklas Höhne, Helcio Blum	1 August 2007	**Open**
Writing of the paper	Special issues written by those that are doing the calculations Lead: Niklas, Ian, Ben, Jan	First draft 1 September 2007	**Open**
Submit paper	Niklas	31 October	**Open**

1 INTRODUCTION

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2 METHODOLOGIES

2.1 MODELING SETUP

Each modelling group is using the same historical emission data set but their own simple climate model to calculate contributions to climate change and related uncertainties. The alternative settings are presented in Table 1.
Criteria for selection of these options.

Table 1. Alternative settings used by the modelling groups

Contribution	• Relative (the countries emissions (high low or best value) divided by the sum over the attributed best emission values for all countries. Estimates of single gases and sectors are also divided by sum of all attributed gases and sectors and no other forcings) • Absolute
Indicators	• Cumulative GWP weighted emissions (fixed Kyoto GWPs, calculated only by one group) • Temperature increase at end year • Temperature increase at 2100
Start dates	• 1750 • 1900 • 1950 • 1990
Enddate (Ben/Jan)	• 2005 • 2020 • 2050
Sectors and gases	• All sectors and gases excluding LUCF • All sectors and gases including LUCF • CO_2 only • CH_4 only • N_2O only
Emissions	• Lower bound • Best estimate • Upper bound
Sources (192+3)	• All separate individual countries • All globally aggregated sectors (Ben/Jan)

2.2 EMISSION DATASET AND EMISSION UNCERTAINTIES

All modelling groups use the same emission dataset. It includes 192 countries for three sectors: energy and industry (CO_2, CH_4, N_2O), agriculture/waste (non-CO_2) and land use change and forestry (CO_2) from1750 to 2100.

We first collected historical emission estimates by country, by gas and by sector from the following sources and ordered them in the following hierarchy:

1. National submissions to the UNFCCC as collected by the UNFCCC secretariat and published in the GHG emission database available at their

web site. For Annex I countries the latest available year is usually 2004. Most non-Annex I countries report only or until 1994 (UNFCCC 2005)

2. CO_2 emissions from fuel combustion as published by the International Energy Agency. The latest available year is 2004 (IEA 2006).
3. Emissions from CH_4 and N_2O as estimated by the US Environmental Protection Agency. Latest available year is 2005 (USEPA 2006)
4. CO_2 emissions from fuel combustion and cement production as published by Marland et al. 2003 as retrieved in 2006. It includes emissions from 90 countries from earliest 1750 (only OECD countries) or 1900 to 2003.
5. Emissions from Land-use change as published by Houghton in the WRI climate indicator analysis tool (Houghton 2003)
6. Emissions from Land-use change as published by IVIG (…)
7. Regional past data: Edgar/Hyde available for all sectors, 17 regions from 1890 to 1990 Klein Goldewijk and Battjes 1995.
8. Regional future regional emission data: MNP/RIVM IMAGE 2.2 implementation of the SRES scenarios (IMAGE team 2001), available for all gases and sectors from 1970 to 2100

The datasets vary in their completeness and sectoral split. We first defined which of the sectors provided in the datasets correspond to the three sectors. Note that CO_2 emissions from the IEA do not include process emissions from cement production. Hence, if IEA data is chosen, process emissions from cement production are not included.

For each country, gas and the sectors Energy & industry and Waste & Agriculture, the algorithm completes the following steps:

1. For all data sets, missing years in-between available years within a data set are linearly interpolated and the growth rate is calculated for each year step.
2. The data source is selected, which is highest in hierarchy and for which emission data are available. All available data points are chosen as the basis for absolute emissions.
3. Still missing years are filled by applying the growth rates from the highest data set in the hierarchy for which a growth rate is available.
4. Uncertainty bounds (upper and lower limit) are calculated based on fixed factors per dataset and sector as provided in Table 2. The values are based on simple assumptions, including IPCC inventory guidelines as default, information provided in paper #2, increasing backwards in time. The values are also informed by Oliver/Marland who compared the CDIAC and EDGAR datasets.

As future emissions are only available on a regional basis and not country-by-country, we are applying regional growth rates to country level emission estimates. Mention two other methods: Van Vuuren and IIASA Grubler and discuss.

For the land use change and forestry, we used a different approach. The use of growth rates is not possible here as the estimates can be negative (removals). Hence we used the simple approach of taking two datasets that for the global total represent the two extremes: Houghton 2003 (high) and IVIG (low). Both datasets were extended to 2100 using SRES scenarios (Add description of the method from submitted text). For each country the "best estimate" is the average between the two datasets, the upper limit is the maximum of both, the lower limit the minimum. Refer to paper #4 which will have better estimates.

Table 2. Uncertainty factors per dataset (roughly 16th and 84th percentile, one sigma)

	Edgar/Hyde	CDIAC	USEPA	IEA	UNFCCC	IMAGE SRES scenarios
	7	4	3	2	1	8
	1890-1990	1750 – 2003	1990 - 2000	1970 – 2004	1990 – 2004	1970 - 2100
	Region	Country	Country	Country	Country	Region
Energy and industry CO_2	1.3	1.15		1.1	1.05	1.15
Energy and industry CH_4 /N_2O	2		1.75		1.5	2
Agriculture/Waste $_{CH4}$	2		1.5		1.35	2
Agriculture/Waste N_2O	6		5		4	6
Land use change and forestry	Use "LUCF JCM IVIGB" and "LUCF JCM HC": Upper limit: Max of both Best estimate: Average of both Lower limit: Min of both					

Plot picture on decreasing and increasing uncertainty.
Review table by Oliver, Rypdal
Mention what this means for changing geographical borders.
Compare to paper #2 uncertainties.

2.3 CLIMATE MODELS

For the calculation of the regional contribution to climate indicators, i.e. concentrations, radiative forcing, temperature change, different climate models are used, which are briefly described below and summarised in Table 3.

Table 3. Specifications of the ACCC models (default) and alternatives of models used

Model	Carbon cycle ($_{CO2}$)	Atmospheric chemistry (non-CO_2)	Sulphate aerosols	Radiative forcing	Temperature and sea level rise	Attribution method
ACCC (default)	IRF (Bern)	fixed lifetimes	Hadley	IPCC-TAR	IRFs (Hadley)	
ECOFYS-ACCC						Normalised marginal
IVIG-ACCC						
IAE	-	-	-	-	-	Normalised marginal
CMA						
CICERO-SCM	Non-linear	IPCC-TAR	IPCC-TAR	ACCC	EBC/UDO model	Normalised marginal
UCL-JCM	Bern non-linear	IPCC-TAR	IPCC-TAR	ACCC	UDEB[v]	

* Same methodology used as in the ACCC model; [i] For the alternative calculations in section 3.3.2; [v] The Upwelling-Diffusion Energy-Balance (UDEB) climate model of Raper et al. 2001.

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3 MODEL ANALYSIS

Bargraphs: 10 big an 10 interesting countries (excluding countries < .5% of global emissions? Subdivide bars for gases or sectors?
Default start date 1900

3.1 COMMON CASE

Helcio/Niklas
Show countries for which model uncertainty is large
-> all models can do the same
Default case?
All modellers check that climate sensitivity is 3°C
All modellers check how CH_4 is treated.
All modellers provide concentrations, RF and dT in 2005 from sum of best estimate emissions for all countries 1750 to 2005 (no other forcings)
Compare GWP weighted cumulative emissions over models. Should be the same.
Check whether data were imported on Mt of Gas – yes! MtCH4, MtN2O, but error in LUCF
Check whether Mongolia is OK?
Check whether Australia is OK?

3.2 MODEL UNCERTAINTY VERSUS EMISSION UNCERTAINTY

Helcio/Niklas
Show countries for which emission uncertainty is large
-> Model uncertainty is low compared to emission uncertainty. Therefore in the following sections show only results from one model with the emission uncertainty as error bars
Check whether early CO_2 is treated differently.
Include variance of model and emission error

In the following sections show relative for individual countries and the sum over all absolute (as in paper #1)

3.3 INDICATORS

Show difference between Cumulative GWP weighted emissions, Temperature increase at end year and Temperature increase at 2100
Mention countries, where this makes a large difference and why.
Mention set of choices where this is most relevant (long time horizons dT is discounting, medium both are the same, short time horizon dT is discounting)
Histogram plot dT vs. GWP weighted cumulative Ben
20 most interesting countries

3.4 START DATES

Show difference and mention the countries, where this makes the largest difference and why (depends on the path)
Scatter plot Helcio/Niklas
20 most interesting countries

Show timesslices enddates from 1900 to 2005

3.5 LUCF

Show difference and mention the countries, where this makes the largest difference and why (large deforestation countries Brazil, Indonesia, Malaysia. Discuss also the increasing uncertainty)
Scatter plot Helcio/Niklas
20 most interesting countries

3.6 PER CAPITA

Refer to standard use of per capita indices and Jan's work
Low priority
Ana will provide a proposal how to show it
Histogramm

3.7 EXTRA ANALYSIS

Future responsibilities: Using enddates and evaluation dates in the future.
Ben / Jan
Stacked plot where 100% is the sum of all countries. with individual/regional Non-Annex I countries on the top and Annex I countries at the bottom (all gases all sectors, AIB)
Bargraphs for 4 regions for 2000, 2010, 2020, 2030, 2040 with emission uncertainty

Sectors: Use sectors instead of nations in the calculations of future responsibilties. Jan, Ranghild, possibly with Transport

4 DISCUSSION

If needed here. Depends on section 3. But may be necessary to have an overview discussion.

5 CONCLUSIONS

Niklas, Ian, Ben, Jan
Journal: ESP or GEC

REFERENCES

ANNEX D: PAPER #4

Paper on historical emissions from land use change (MATCH Paper #4)

The purpose of this paper is to compare available estimates of historical and current emissions from LULUCF and identify the reasons for the differences in estimates obtained (see Table 1a and 1b for a list of sources). Biogeochemical models include the effect of CO_2 and climate, so an additional simulation was performed to estimate the marginal effect of cropland establishment and abandonment as in McGuire et al [2001] (Sc2). In a first step, we identify potential factors responsible for the differences in estimates of LULUCF emissions:

a) Land use/activities considered
b) Carbon pools considered

These factors (characteristics and assumptions of datasets and models) will then be analysed and compared in a systematic manner. The most important (and difficult task) will be to reconcile the different classifications used in the different dataset. Section 2 to 5, will include an in-depth analysis of 4-5 countries or regions (Countries: US, China, Brazil, Indonesia, (Canada, Russia, EU-15, Australia). Additionally, we have to show the global values (before, after case study?).

Outline of the paper:

1. **Introduction (Joyce)**
2. **Data sets available (Akinori, Chris)**

(expand table 1 a and b), heritage of the datasets in table 1a should be clearly stated. Table 1a. Data sources on land-use change area data obtained in 1990s.

Name	Study	Resolution	Period
LUC1	Houghton & Hackler	Country	1980/2000
LUC2	Christiano et al	Country	1700/2002
LUC3	Kato et al., based on R&F	T42 based on 0.5°	1900/2000
LUC4	Hurtt et al., based on Klein Goldewijk and FAOSTAT	1°× 1°	1700/2000
LUC5	Hurtt et al., based on R&F and LUC3a	1°× 1°	1700/2000
LUC6	Wang et al., Linear	0.5°× 0.5°	1850/2100
LUC7	Wang et al., Rule-based	0.5°× 0.5°	1850/2100

Table 1b. Data sources on LULUCF emissions obtained in 1990s.

Name	Study	Resolution	Period	Land use data
EMI1	Houghton	Country	1980/2000	Houghton & Hackler
EMI2	UNFCCC	Country	1990s	National inventory
EMI3	Olivier and Berdowski	Country	1990&1995	FAO
EMI4	Hurtt et al	Country	1700/2000	National statistics
EMI5	Christiano et al	Country	1700/2002	Klein Goldewijk & FAO
EMI6	Kato et al	T42 (2.8°× 2.8°)	1900/1999	Ramakutty & Foley
EMI7	Jain and Yang	0.5°× 0.5°	1990s	Ramakutty & Foley

3. Land use (change) area (Akinori, Chris)

Identification of the largest differences in the emissions from land use/activities (a) considered in each land-use dataset. The authors of the datasets provided areas and fluxes categorized by the land-use activities below in their dataset.

Table 2 and b: Land-use change areas and terrestrial carbon fluxes for each land-use activity considered in the different land-use datasets. Further, these data of areas and fluxes at finer spatial resolutions (i.g., region, UNFCCC data submission (Annex-I, Non-Annex-I, non-report), country, biome type, and grid scale) will be examined.

Table 2a. Global sum of land-use change areas (100 km^2 yr^{-1}) in 1990.

Type of land use	LUC1	LUC2	LUC3	LUC4	LUC5	LUC6, 7
Primary to crop	1366	557	634	41	402	570
Secondary to crop				1345	2789	
Pasture to crop	N.A		N.A	8	16	N.A
Shifting cultivation	409			5000	6000	
Clearing primary for pastures	473	975	N.A	251	173	N.A
Clearing secondary for pastures				909	969	
Clearing grasslands for pastures	1047			2675	2886	
Logging	478			1104	917	
Fuelwood	110			58, 686	122, 769	
Agriculture abandonment	61	275	886	1643	3244	741
Pasture abandonment		425	N.A	3746	3993	N.A
Crop to pasture	N.A			21	74	
Primary harvest on non-forests				1161	1046	
Secondary harvest on non-forests				1471	1660	
Wildfires	236			N.A	N.A	
Woody invasion into grasslands						
Woody thickening						
Soils (land degradation)	142					

4. Carbon pools (Akinori, Chris)

Identification of the largest differences in the carbon pool changes (b) considered in each land-use dataset. Authors of the emission datasets provided carbon pools and fluxes categorized by the carbon pools considered by the land-use emission data sets.

Table 3: Carbon pools and fluxes for each pool considered in the different land-use datasets. This example shows the global sum of terrestrial carbon fluxes (TgC yr^{-1}) in 1990. Further, these data of pools and fluxes at finer spatial resolutions (i.g., region, country, biome type, and grid scale) will be examined.

Table 3b. Global sum of carbon pools (PgC) in 1990.

Carbon pools	EMI1	EMI5	EMI6	EMI7
Ground vegetation	517	688	23	89
Non woody tree parts (leaf)				42
Non woody tree parts (root)			117	
Woody tree parts			570	675
Decomposable non-woody material	15		95	7.1
Resistant material (woody debris)				468
Burning associated with LUC	22		0.1	0.3
Biofuel (wood products)				
paper products (wood products)			0.9	1.2
long- lived products (wood products)			0.6	1.2
elemental carbon (wood products)			N.A	0.6
Microbial biomass	854	1478	1415	34
Humus organic matter				1313
Wild fires		N.A	N.A	N.A
Lime application	N.A			
Total amounts	1408	2166	2221	2631

Notes: Carbon pools for the UNFCCC data are not available. On the country studies, we will try to obtain these from the individual countries.

5. Carbon fluxes (Akinori, Chris)

Table 2b and 3b in one section for the year 1990 or available year in 1990s. This is not what I have done, but will do it.

Table 2b. Global sum of carbon fluxes (TgC yr^{-1}) in 1990.

Type of land use	EMI1	EMI2	EMI3	EMI4	EMI5	EMI6	EMI7
Primary to crop	619	(592)	514	N.A	Data 1	416	896
Secondary to crop							
Shifting cultivation	256				N.A		
Clearing primary for pastures	590				Data 2	N.A	N.A
Clearing secondary for pastures							
Clearing grasslands for pastures	1		N.A				
Logging	258	(-610)			N.A		
Fuelwood	86						
Agriculture abandonment	-85	(-108)			Data3	-1797	-384
Pasture abandonment					Data4	N.A	N.A
Pasture to crop	N.A	(-4)			N.A		
Crop to pasture							
Primary harvest on non-forests							
Secondary harvest on non-forests							
Wildfires	-121						
Woody invasion into grasslands							
Woody thickening						-965	-808
Soils (land degradation)	12	(10)				N.A	N.A
Total amounts	1615	(-120)	514		505	-2346	-296
Harvested wood products				1320			

Table 3b. Global sum of carbon fluxes (TgC yr^{-1}) in 1990.

Carbon pools	EMI1	EMI2	EMI3	EMI5	EMI6	EMI7
Ground vegetation	-2294	(-116)	N.A	242	-519	-315
Non woody tree parts (leaf)						-64
Non woody tree parts (root)					-632	
Woody tree parts					-880	-253
Decomposable non-woody material	1721				-65	118
Resistant material (woody debris)						140
Burning associated with LUC	1992		514		-24	0
Biofuel (wood products)			N.A			
paper products (wood products)					25	42
long- lived products (wood products)					9	5.8
elemental carbon (wood products)					N.A	-1.2
Microbial biomass	226	(-4)		263	-49	12
Humus organic matter						-34
Wild fires				N.A	N.A	N.A
Lime application	N.A					
Total amounts	1644	(-120)	514	505	-2135	-349

Notes: For EMI2 (UNFCCC), the individual countries do not list all this detail. Thus, the data listed here are from:

Carbon flux in category from (Annex I-R + some non-Annex I) * global UNFCCC flux / total (Annex I-R + some non-Annex I) flux

Main results: fluxes and why they are different

Which are the most interesting countries? One task section 3, 4 and 5: comparing countries.

6. Time history (Tina)

- Inhomogeneity (i.e. what pools are available and which are not) (summary in table), what is missing, what should be added per dataset to try to construct a time history
- Compare to paper #2 and #3

7. Global scaling for 1990s (Joyce, Michael)

- Develop estimates for global emissions for the 1990's (Akinori)

I can not say 1990s at this point, because some data are available for only 1990, but will try.

- Put the global numbers into perspective of AR4 numbers and paper #2

Country teams

Task: analyse UNFCCC reporting by country; obtain estimates for changes in land area for each country (either from the total land areas and its changes by year or if the country reports changes); and search additional information on carbon pools, follow case-studies through 3-5:

Brazil: Chris
USA: Akinori

Canada: Akinori
China: Akinori
Indonesia: Chris
Russia: Olga Krankina?

Future work:

1. Time history data (country-level, maybe global), from 1. and 2. we would know what it would need to do 3. (can we achieve this in MATCH timeframe?)
   Thinking about the algorithm of how to ‘correct’ the data for certain countries
   etc. (question if this is realistic)

Open questions:

1. Reason for huge sink in emissions from EMI6. This may be related to huge sink in vegetation and huge emission in litter and pool from EMI1.

Timeline:

By 15 June	First screen of data and decision of country team, reaffirmation by all parties of the outline and timeline
15 July	Distribution of all work in process (problems with deadlines?)
By 20 August	Preliminary drafts of sections 2-6
31 August	Preliminary draft of section 1 and 7
By 24 September	Full draft of paper #4