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Modifications in the German LULUCF-Inventory 2012 compared to previous years

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Submission 2011 - Review

„Good news”

Germany hasn't got a saturday letter !



Germany changed essentially parts of its
LULUCF-reporting system for the 2012
submission !



Modifications

- **Implementation of a new system for the identification and designation of land and land use**
- **Implementation of a transition time for all land use categories**
- **Modification of the reporting system on mineral soils**
- **Implementation of new country specific emission factors for mineral soils and biomass**

LULUCF-mapping – Developing a consistent Land Use Matrix

Why?

- temporal and spatial inconsistency
- inconsistent mapping methods between forest (5.A) and LULUC (5.B – 5.F)
- inconsistent mapping methods between LULUCF and KP-LULUCF

Needs!

The new approach shall

- lead to a temporal and spatial consistent, comprehensive and complete land use matrix (LUM)
- be implementable in given time and with given resources
- have the potential to combine different data sets
- account for the differences in quality of the used data sets
- account for the spatial and quality development of the used data sets
- allow the verification of mapped changes between different data sets
- allow own inquiries
- allow the reconstruction and the verification of a LUM for 1990

LULUCF-mapping – Developing a consistent Land Use Matrix

Solution!

A sampling based information system

Why?

- Integration of different sample based data sets
- Point detection of LU and LUC, not areas
- Verification of unsure and unlike LU and LUC by a (simple) sampling approach (point control).
- Quantification of different error sources

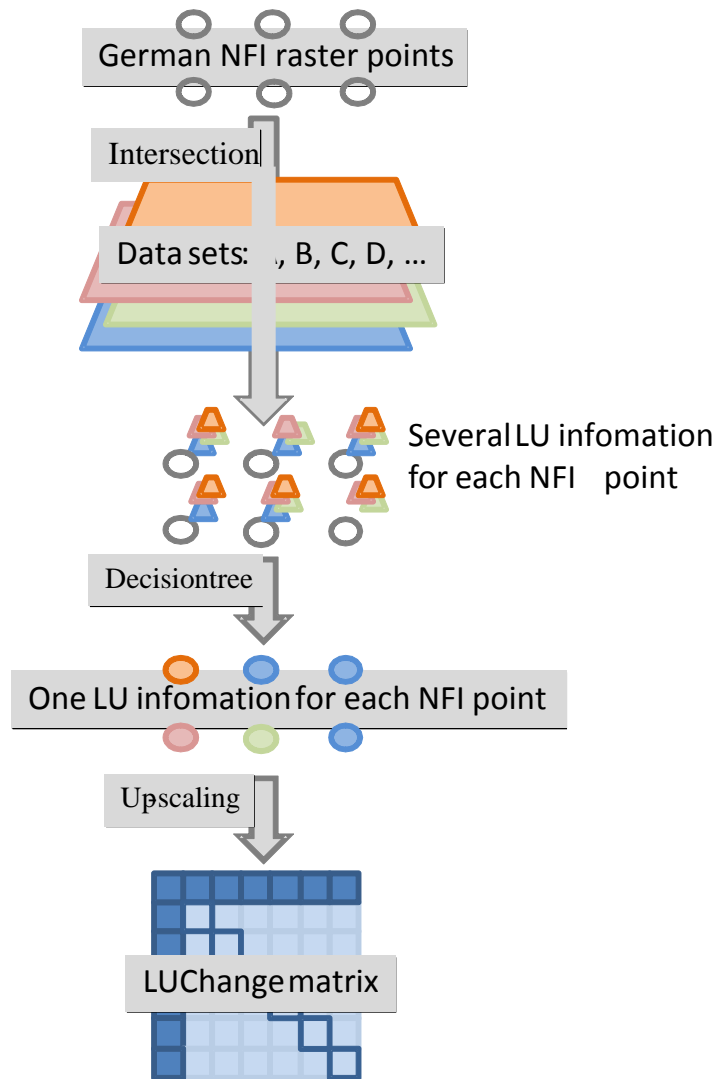
System Change

from previously used wall to wall (respectively hybrid) - approach

to a

raster point approach

The Raster Point Approach



➤ Sensitivity analysis



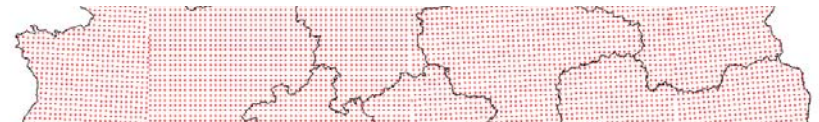
➤ NFI – data sets (1987, 2002)

➤ Forest inventory study (2008)

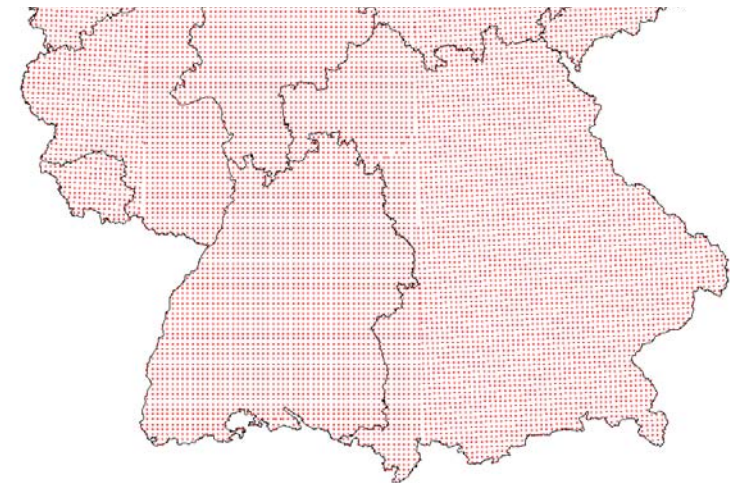
➤ Basic digital landscape model of Germany (2000,2005,2008,2010)

➤ Corine Land Cover (1990, 2000, 2006)

➤ GSE-data sets for the new Bundesländer (1990, 2002, 2006)



➤ Decision Modell (compare presentation V. Mues)



LULUCF-mapping – Land Use Matrix

Land use matrix [kha] of Germany for the year 2010, based on the raster point approach and calculated for a transition time of 20 years (yellow: remaining category)

Germany: Land-Use Matrix 2010 [area in kha] Raster Point Approach (20 a transition time)								
Initial\Final	Forest Land	Cropland	Grassland	Grassland _{woody}	Wetlands	Waters	Settlements	Other Land
Forest Land	10.584,98	46,15	50,66	43,83	1,89	5,79	33,34	0,00
Cropland	121,48	13.567,21	0,00	113,16	1,70	29,38	564,34	0,00
Grassland	104,99	422,41	5.374,81	44,40	8,21	15,18	112,82	0,00
Grassland _{woody}	56,57	57,47	68,22	373,82	0,80	4,30	19,60	0,00
Wetlands	14,76	2,50	8,50	0,30	53,45	1,19	8,87	0,00
Waters	1,10	1,40	9,49	0,70	0,30	508,25	2,73	0,00
Settlements	46,48	104,68	136,08	28,83	0,00	23,07	2.936,16	0,00
Other Land	3,48	1,00	14,04	2,49	0,40	0,20	3,29	38,37
Σ Land Use Category	10.933,84	14.202,82	5.661,81	607,54	66,75	587,36	3.681,16	38,37
Σ Germany	35.779,63							

LULUCF-mapping – Uncertainties

Land use matrix of Germany for the year 2010: Uncertainties [half of the 95-% CI in %]

Germany: Land-Use Matrix 2010 Uncertainties [half of 95%-CI] Raster Point Approach								
Initial\Final	Forest Land	Cropland	Grassland	Grassland _{woody}	Wetlands	Waters	Settlements	Other Land
Forest Land	1,34	8,02	13,58	15,27	72,48	44,31	18,75	0
Cropland	8,02	0,54	0,00	9,47	60,22	21,09	5,49	0
Grassland	9,66	5,59	1,76	14,76	33,95	27,45	11,10	0
Grassland _{woody}	12,37	14,63	13,23	5,81	109,99	55,85	28,08	0
Wetlands	31,88	69,05	42,04	146,88	20,89	76,95	49,19	0
Waters	62,75	69,00	32,04	80,46	146,69	6,19	83,66	0
Settlements	17,79	11,39	9,76	20,94	0,00	29,98	2,82	0
Other Land	53,65	73,58	31,55	65,46	110,49	139,34	110,49	23,93
Sampling error _{total}	0,60 %							

Additional source of uncertainties: Number of validated grid points

	1990	2000	2005	2008	2010
Validated grid points[%]	55,07	96,08	98,70	98,95	98,97

LULUCF-mapping – Outlook

Summary

- We created a temporal/spatial consistent land use matrix by means of a sampling based information system using quite different data sources
- The approach is elaborately and very complex in merging different data sets
- An efficient (country specific fitted) decision model is needed
- Reconstruction of a LUM and the cross-validation of results is possible

Planned and ongoing improvements

- Inclusion of additional data sources (CIR-data; thematic maps)
- cross-validation of preferably all raster points

Reporting System Mineral Soils - Modifications

Why?

- asymmetric system
- no transition time
- inaccuracy of the used carbon response functions (crf)
- high uncertainties concerning the initial soil carbon stocks
- missing CRF 's (e.g. soils in settlements)

Solution

Simple switch system with mean area weighted soil carbon stocks due to land use and soil properties

Switch System LULUCF – Mineral Soils Data Base



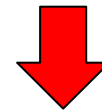
Soil map 1:1.000.000
(BÜK 1000, BGR 1997)

Forest Land:

- Preliminary results of the German forest soil inventory

Non Forest Land:

- Hybrid system: Combination of the data sets of the soil map of Germany and the results of the nationwide study to carbon contents of topsoils in Germany (BGR 2007) (additional information of 14.000 profiles)
- Intersection of the soil map (BÜK 1000) and the land use map (ATKIS-data)



area weighted soil carbon stocks for each land use category due to soil properties and climate

Mean area weighted carbon stocks [Mg ha⁻¹] in mineral soils of Germany and emission factors for C-stock change [Mg ha⁻¹ a⁻¹] due to land-use change (implied transition time of 20 years; yellow fields: reported cases in previous submissions)

Mean Carbon Stocks in Mineral Soils of Germany (Range)								
	Forest Land	Cropland	Grassland	Grassland _{woody}	Wetlands	Waters	Settlements	Other Land
C [Mg ha⁻¹]	62,03 (37 – 93)	60,03 (40 – 90)	77,43 (42 – 138)	73,18 (42 – 134)	74,00 (42 – 113)	0	58,67 (32 – 109)	55,60 (31 – 107)
Mean Carbon Stock Change [Mg C ha ⁻¹ a ⁻¹] for a transition time of 20 years								
Initial\Final	Forest Land	Cropland	Grassland	Grassland _{woody}	Wetlands	Waters	Settlements	Other Land
Forest Land		-0,100	0,770	0,558	0,598	0	-0,168	-0,321
Cropland	0,100		0,870	0,658	0,699	0	-0,068	-0,221
Grassland	-0,770	-0,870		-0,213	-0,172	0	-0,938	-1,091
Grassland _{woody}	-0,558	-0,658	0,213		0,041	0	-0,725	-0,879
Wetlands	-0,598	-0,699	0,172	-0,041		0	-0,766	-0,920
Waters	0	0	0	0	0		0	0
Settlements	0,168	0,068	0,938	0,725	0,766	0		-0,154
Other Land	0,321	0,221	1,091	0,879	0,920	0	0,154	

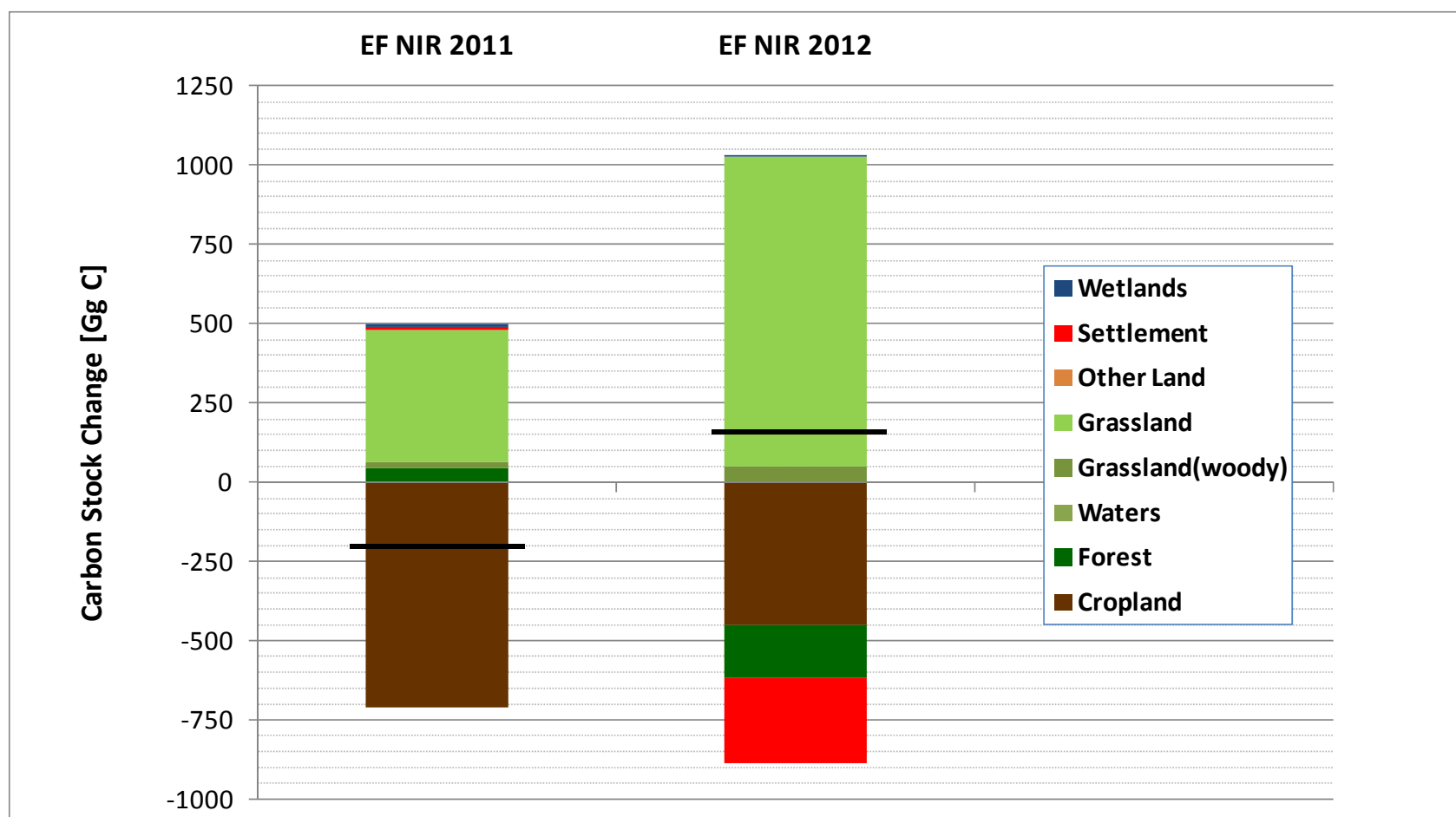
– source / + sink

Mineral Soils

Implied emission factors for carbon stock change reporting on mineral soils of Germany due to land-use change compared to other European countries [Mg ha⁻¹]

Implied Emission Factors (IEF) Mineral soils	Land converted to				
	Forestland	Cropland	Grassland	Wetlands	Settlements
	Mg C ha ⁻¹				
Austria	1,35	-1,06	0,216	-3,738	-0,472
Belgium	0,8	-1,83	1,442	0,869	0,000
Czech Republic	0,16	-0,35	0,482	NA,NO	NA,NO
Denmark	-0,16	0,18	-0,124	0,500	NA,NO
France	0,06	-0,84	0,634	NO	-0,100
Netherlands	NE	NE	NE	NE	NE
Poland	1,98	NA,NO,NE	NO,NE	NA,NO	-1,481
Sweden		-0,36	0,399	NA	-1,631
Switzerland	NO	-0,21	0,634	0,439	-1,102
Great Britain and Northern Ireland	0,14	-0,60	0,491	IE,NO	-1,273
Germany 2009		-0,63	0,753	0,015	-2,515
Germany 2010	-0,26	-0,64	0,754	0,013	-2,553

Mineral Soils



Influence of the new reporting system on carbon stock changes in mineral soils [Gg]:

Activity data: land use change area NIR 2011; Emission factors: NIR 2011, NIR 2012

Improvements

- Implementation of the final results of the German Forest Soil Inventory
- Implementation of the results of the “German Agricultural Soil Inventory” (in progress)

LULUCF-Reporting on Biomass - Modifications

Why ?

- too much emission factors (15 factor combinations for 439 regions)
- emission factor for wood (Default 63 Mg/ha) is too high
- no partitioning between above and below ground biomass
- missing country specific EF for hedgerows, groves, streetside vegetation, shrubs
- different biomass calculation methods for cropland and grassland in sectors 4 and 5
- adaption to the new reporting system

Solution

No system change but calculation of only one mean country specific biomass carbon stock for each land use category

Biomass – Emission Factors

Calculation of area weighted mean biomass carbon stocks for

1. **Cropland/Grassland_{non woody}**: Derivation of an area and yield weighted mean carbon stock for non woody above- and belowground cropland and grassland biomass, based on annual statistics of yield and area of cultivable land for 65 arable crops and grass
2. **Groves, hedgerows, woods**: Calculation of new country specific carbon stocks on the basis of the results of a research project (PÖPKEN 2011)
3. **Orchards, vineyards and Christmas tree plantations**: Calculation of new country specific carbon stocks on the basis of the results of a research project (PÖPKEN 2011)
4. **Forest**: Country specific carbon stocks for afforestation and deforestation on the basis of the results of the National Forest Inventory

➔ **Calculation of one mean biomass carbon stock for each land use category by weighted combination of these carbon stocks (1. – 4.)**

Mean carbon stocks [Mg ha⁻¹] in biomass of Germany and emission factors for carbon stock change [Mg ha⁻¹ a⁻¹] due to land-use and land-use change (NIR 2012)

Mean Biomass Carbon Stocks in Germany (Range)								
	Forest Land ¹⁾	Cropland	Grassland	Grassland _{woody}	Wetlands	Waters	Settlements	Other Land
C [Mg ha⁻¹]	32,63 (21 – 44)	7,07 (6 - 8)	6,69 (5 – 8)	46,70 (7 – 154)	20,02 (9 – 51)	0	13,35 (5 – 36)	0
Mean Carbon Stock Change [Mg C ha ⁻¹ a ⁻¹]								
Initial\Final	Forest Land ²⁾	Cropland	Grassland	Grassland _{woody}	Wetlands	Waters	Settlements	Other Land
Forest Land		-25,6	-25,9	14,1	-12,6	-32,6	-19,3	-32,6
Cropland	3,8		-0,4	39,6	13,0	-7,1	6,3	-7,1
Grassland	3,8	0,4		40,0	13,3	-6,7	6,7	-6,7
Grassland _{woody}	1,8	-39,6	-40,0		-26,7	-46,7	-33,4	-46,7
Wetlands	3,1	-13,0	-13,3	26,7		-20,0	-6,7	-20,0
Waters	4,1	7,1	6,7	46,7	20,0		13,3	0
Settlements	3,5	-6,3	-6,7	33,4	6,7	-13,3		-13,3
Other Land	4,1	7,1	6,7	46,7	20,0	0	13,3	

¹⁾ carbon stock deforestation

²⁾ annual carbon stock change for 20 years

– source / + sink

Biomass

Implied emission factors for carbon stock change reporting on biomass due to land-use change compared to other European countries [Mg ha⁻¹]

Implied Emission Factors (IEF) Biomass	Land converted to				
	Forestland	Cropland	Grassland	Wetlands	Settlements
	Mg C ha ⁻¹				
Austria	0,97	0,042	-0,703	-0,407	0,225
Belgium	2,3	-0,091	-0,205	-0,790	-0,159
Czech Republic	0,84	-0,091	-0,008	-0,458	-0,395
Denmark	0,99	-0,069	-0,130	0,185	-0,214
France	0,77	-0,169	-0,112	-0,338	-0,470
Netherlands	1,70	-0,705	-7,253	-5,133	-5,084
Poland	0,85	NA,NO,NE	NO,NE	-0,002	IE,NA
Sweden		-0,362	0,397	NA	0,012
Switzerland	0,10	-0,076	-0,935	-4,116	-0,404
Great Britain and Northern Ireland	0,52	-0,008	0,000	IE,NO	0,000
Germany 2009		-0,047	0,644	-0,476	0,194
Germany 2010	0,43	-0,058	0,659	-0,465	0,210

The End!?

We are curious about your comments and suggestions!

Thank you very much!