

Overview of MS' LULUCF GHG inventories ("under the Convention"), and common problems identified during the EU QA/QC

**Viorel Blujdea,
Giacomo Grassi**

European Commission - Joint Research Centre,
Institute for Environment and Sustainability
Climate Change Unit - Ispra (VA), Italy

- *GHG inventory* is a requirement under Art 4 and 12 of the convention
- Principles of GHG inventory:
 - Transparency
 - Consistency
 - Comparability
 - Completeness
 - Accuracy
- Furthermore ... GHG NI is the foundation for the partial accounting of LULUCF activities over the Kyoto Protocol!



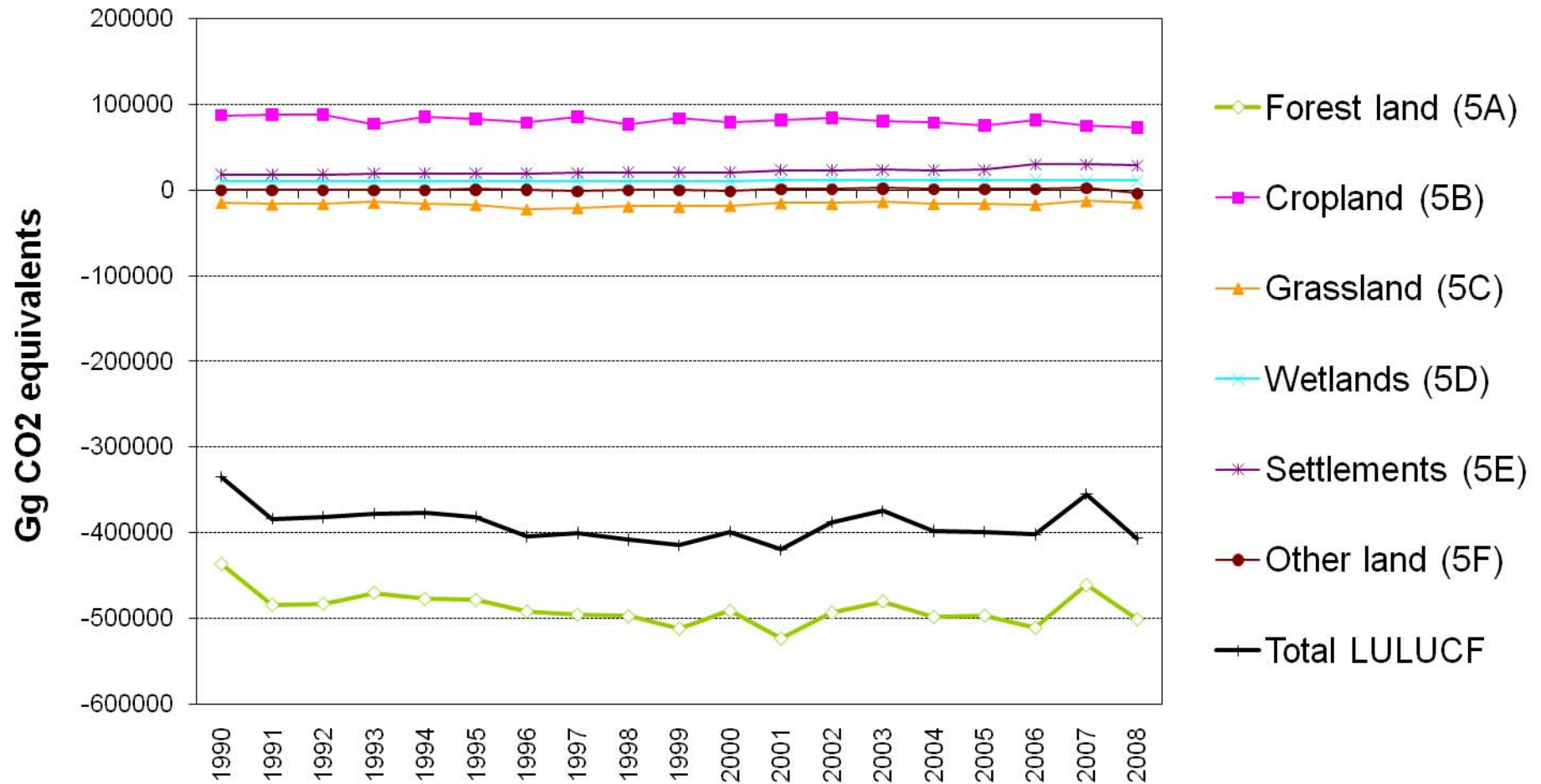


www.eea.europa.eu

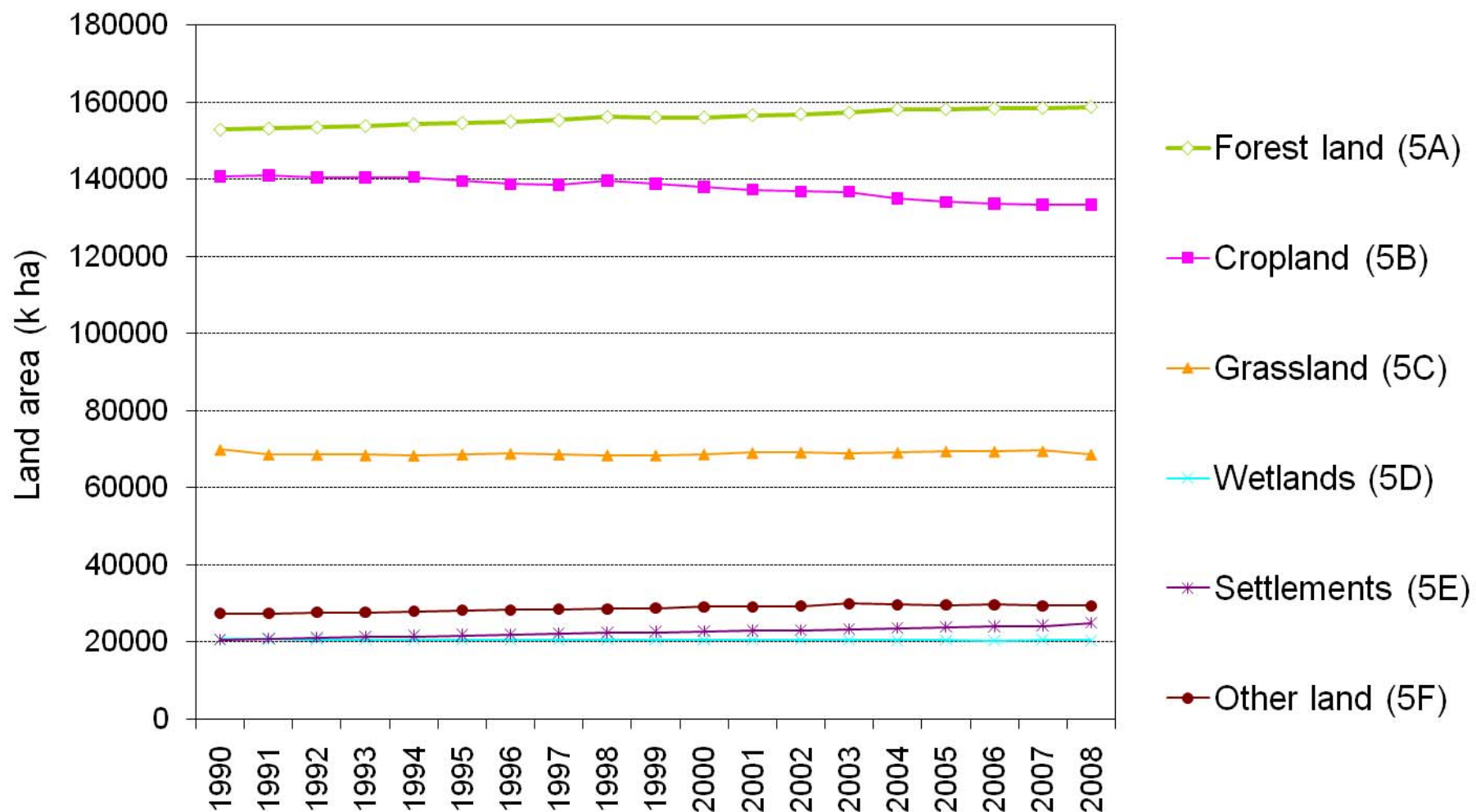
EU GHG inventory, compilation based on MS submissions (for EU 15) comprises:

- Annual estimates, trend, recalculations
- Definitions of LUs and 5A related C pools
- Approaches and Methodological information (datasets, methods)
- IEFs values and ranges
- Information on QA/QC, verification, uncertainty, recalculations

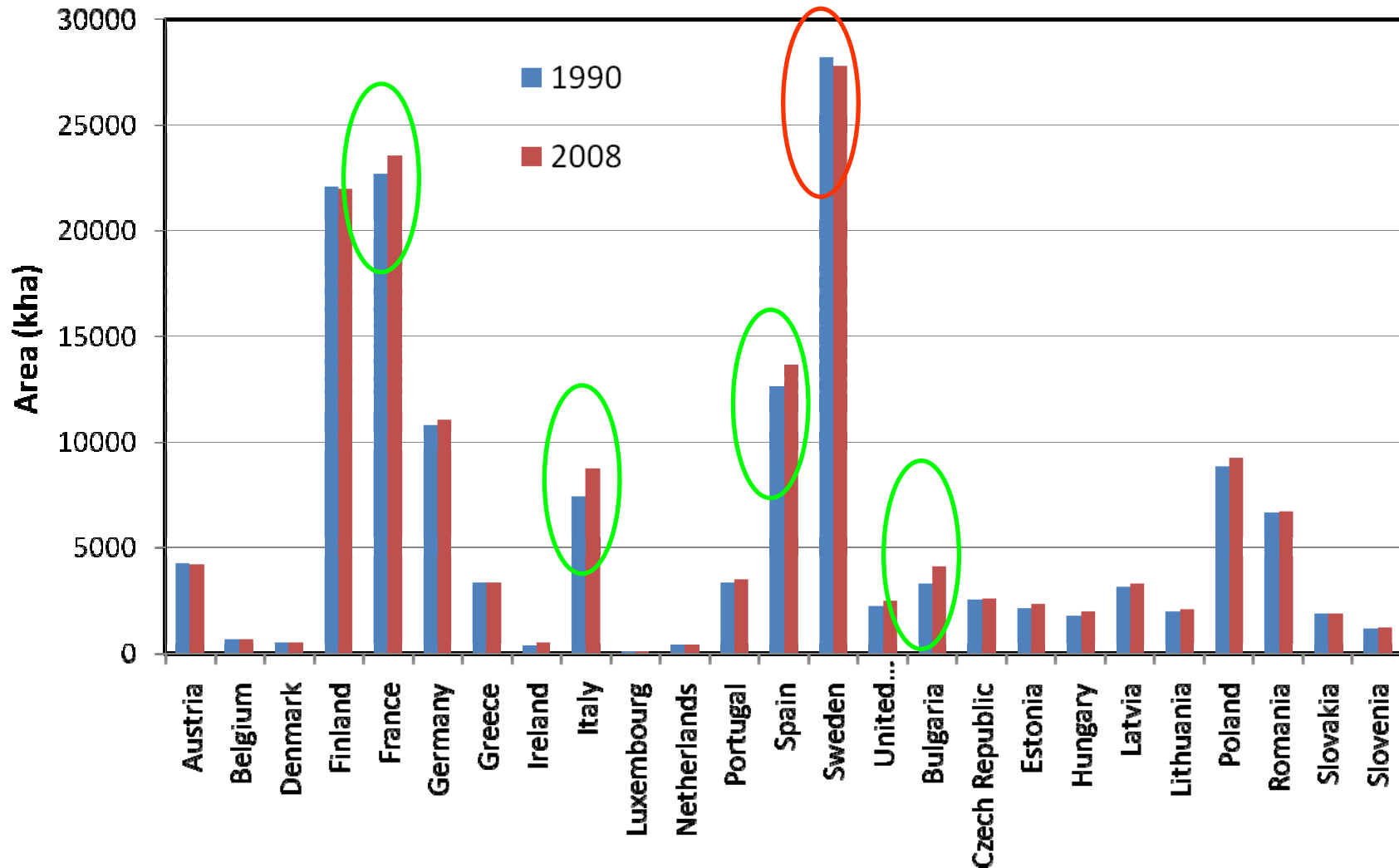
EU-27: trend in emissions/removals of land use categories



EU-27: trend in area of land use categories

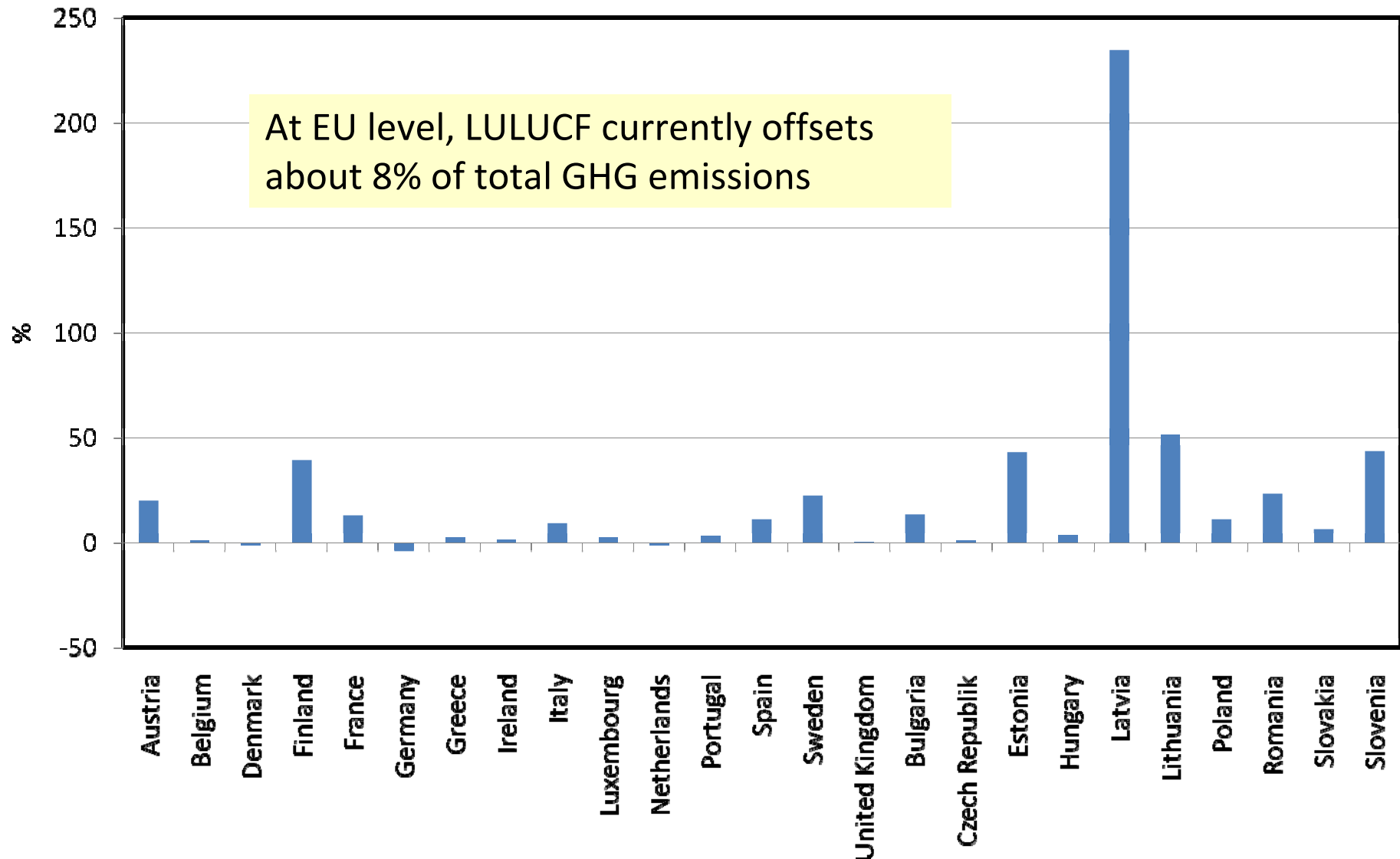


Forest land area by MS (5A)



At EU level: 153000 kha in 1990, 158500 kha in 2008 (+3,6 %)

MS: % contribution of LULUCF to total GHG emissions in 2008



Key categories in GHG inventory of EU 15 :

- **5A1** Forest Land remaining Forest Land: CO₂
- **5A2** Land converted to Forest Land: CO₂
- **5B1** Cropland remaining Cropland: CO₂
- **5B2** Land converted to Cropland: CO₂
- **5C1** Grassland remaining Grassland: CO₂
- **5C2** Land converted to Grassland: CO₂
- **5E2** Land converted to Settlements: CO₂

Land category	Contribution emission/removal to total LULUCF (all absolute)
5A	80%
5B	11%
5C	2%
5E2	4%

- **Definitions of land use**
 - LU definitions are still missing (few)
 - Explanation on managed, un-managed lands
 - “Other land” issue (EU: 24 mil. ha)
- **Transparency in NIRs:**
 - Explications on land dynamics (i.e. recalculations)
 - Land hierarchy and how is implemented (in “conflicting” LU, ...)
 - Uncertainty or accuracy checks on LU data
- **Accuracy**
 - Land use matrix and consistency of time series (i.e. incomplete, land estimation in intermediary, non-measured years,)
 - Not reported subcategories
 - Simple errors
- **Consistency**
 - In itself, with other official data (i.e. national area)
 - With other processes (ex: Eurostat, FAOStat, etc)
 - Transition period
- **Completeness ... unequal weight of reporting effort over the lands sub/categories (less on 5D, 5E, ...)**

Completeness of reporting – land use categories

	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5.A.1. F-F	5.A.2. L-F	5.B.1. C-C	5.B.2. L-C	5.C.1. G-G	5.C.2. L-G	5.D.1. W-W	5.D.2. L-W	5.E.1. S-S	5.E.2. L-S	5.F.1. O-O	5.F.2. L-O
Austria	R	R	R	E	E	R		E		E		E
Belgium	R	R	E	E	E	R		R		E		E
Denmark	E	R	E	R	E	E	E	R		E		
Finland	R	R	E	E	E	R		E				
France	R	R	E	E	E	R		E		E		E
Germany	R	R	E	E	E	E	E	E	E	E		E
Greece	R	R	R	E	E	E		E		E		E
Ireland	R	R	R	E	E	R	E	E		E		
Italy	R	R	R		R	R				E		
Luxemb.	R	R	E	E		E		E		E		E
Netherl.	R	R		E	E	E		E		E		E
Portugal	R	R	R	E		R		E	E	E		E
Spain	R	R	R			R				E		
Sweden	R	R	E	E	E	R	E		R	E		
UK		R	E	E	E	R				E		
Bulgaria	R	R	R	E	E	R		E		E		E
Czech Rep.	R	R	E	E	E	R		E		E		
Estonia	R		E		E	R	R	E				
Hungary	R	R	E	E	E	R						R
Latvia	R	R	E		E		E	E				
Lithuania	R	R					E	E		E		E
Poland	R	R	E		E	R	E	E	R			
Romania	R											
Slovakia	R	R	E			R						E
Slovenia	R	R	E	E	E	E						

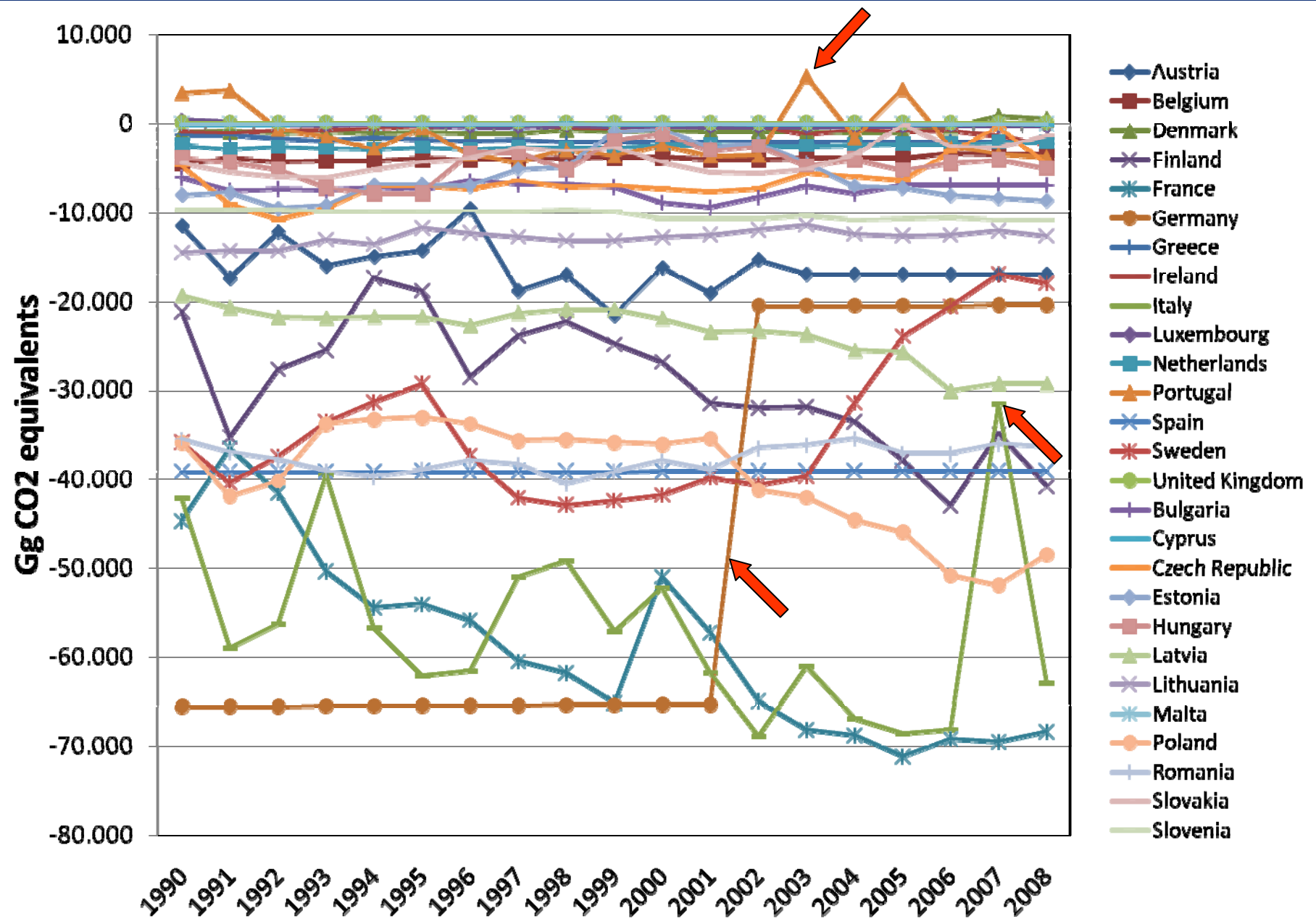
R= removal E = Emission In red categories newly reported in 2010

- Unequal weight of reporting effort over the lands sub/categories (less on 5D, 5E, ...)
- C pools: need of definitions and additional description helps (with quantitative parameters)
- Explicit time series data on disturbances in the NIR text
- Recalculations (explanation needed in NIR)
- Errors (i.e. measurement units)
- Completeness (DOM, SOM)

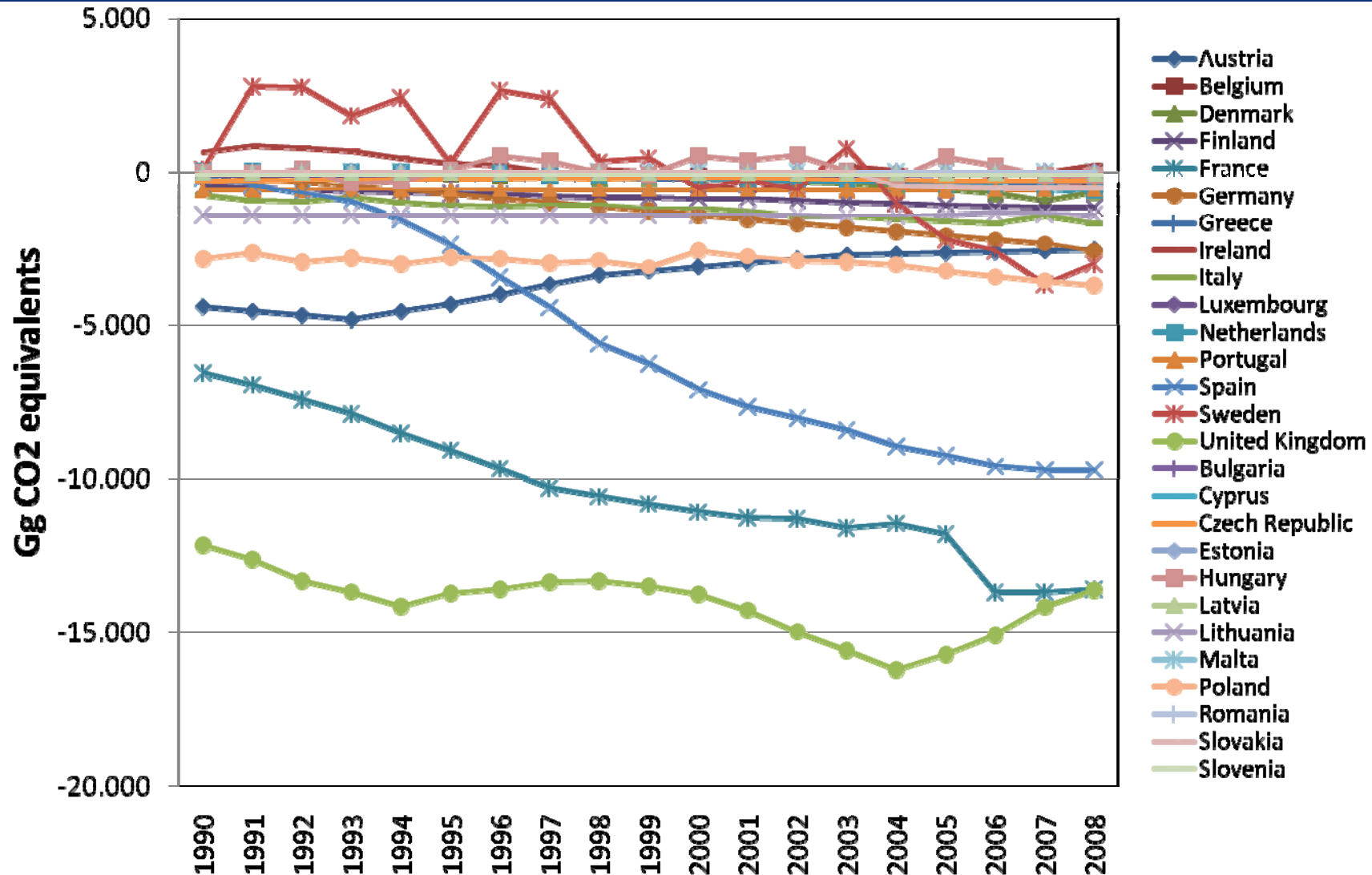
Completeness of reporting – C pools

	Reporting category																							
	Forest land								Cropland								Grassland							
	5.A.1. F-F				5.A.2. L-L				5.B.1. C-C				5.B.2. L-C				5.C.1. G-G				5.C.2. L-G			
	B	Dom	Soil min	Soil org	B	Dom	Soil min	Soil org	B	Dom	Soil min	Soil org	B	Dom	Soil min	Soil org	B	Dom	Soil min	Soil org	B	Dom	Soil min	Soil org
Austria	R	R			R		R		E		R		R		E				E		E		R	
Belgium	R	R	R		R		R				E		E		E				E		E		R	
Denmark	E	R			R	R			E		R	E	R	E	E		E			E	E			E
Finland	R		R	E	R		R	E	R		R	E	R		E	E			E	E	R		R	E
France	R	E	R										E	E	E						E	E	R	
Germany	R	R		E	R	R	R	E	R		R	E	E		E	E				E	E		R	E
Greece	R				R				R		R	E	E								E			
Ireland	R	R			R	R	E	E			R				E					E	R		R	E
Italy	R	R	R						R	R	R	E	R			E	E	R	R					
Luxemb	R				R		R		E				E	E	E						E	E	R	
Netherl	R	R			R								E	E						E				E
Portugal	R	E	R		R	E	R		R	E	E		E	E	E						E	E	R	
Spain	R				R				R														R	
Sweden	R	R	R	E	R	R	E	E	R	R	E	E	R	E	E	E	R	E	E	E	R	E	R	E
United Kingdom	R	R	R	R	R	R	R	R	R		E	E	E		E		R		R	E	R		R	
Bulgaria	R								E		R		E								E		R	
Czech Republic	R				R		R		R		R		E		E				R		E		R	
Estonia	R			E					E			E								E			R	
Hungary	R				R				E		R		R		E				E		E		R	
Latvia	R			E	R							E								E				
Lithuania	R	R	R	E	R	R	R																	
Poland	R		R		R		R		R		E	E								E			R	
Romania	R																							
Slovakia	R						R																R	
Slovenia	R	R			R	R	R		R		E	E	E		E					E	E		R	

Trends of sink in *Forest remaining forest* (MS)



Trends of sink in *Land converted to forest* in all MS



Scale issue: e.g. rate of conversion to forest is about 78 kha/yr in IT and 6 kha/yr in UK

1) Land use changes: Contribution of land use changes in 2008 for EU-15, in terms of area (columns a-b) and GHG emissions (columns c-d)

Land converted to	a) land area (kha)	b) % of area of the corresponding category ¹	Net c) emissions (+) and removals (-) (Gg CO ₂ equivalent)	d) % of net emissions of the corresponding category ^{1,2}
Forest land	7227	6	-50430	15
Cropland	10948	12	44136	70
Grassland	11599	22	-26062	184
Wetlands	758	4	2892	59
Settlements	4072	21	25759	92
Other Land	2281	10	-4185	100
<i>Total land use changes</i>	36887	11	-7889	32

153000 Gg CO₂ summing the absolute values, corresponding to 32% of total LULUCF emissions

5A2 transitions: 1 year by DE, IT and 100 years by UK (justified by literature)

2) Estimation and Reporting **annual change in C pools: Dead Organic Matter (DOM)** = Lt (litter) + DW (dead wood)

MS/Annex I Party	Datasource, methods	Comments
AT	NFI	Only standing DW in 5A1
BE	NFI	LT neutral
BG	ICP Forests	LT included with SOM (no DW?)
DK	NFI	
FI	NFI, Model	
FR	NFI	Lt neutral
DE	NFI	Lt neutral
IT	NFI	Default (DW), LT: linearly regressed against ABG
NL	NFI, Soil datasets	
SE	NFI, Model	Includes research project results for organic soils
UK	Model	
SV	NFI	Data available only for 2007
CZ,ES,GR,HU,IE,LV,LT,LUX,PL,PT		DOM neutral
EST, RO, SK	na	na
Other Annex I countries	Models	Iceland: DOM, SOM neutral

3) Estimation and reporting **annual change in C pools**: soil organic matter (SOM) in mineral and organic soils

MS/Annex I Party	Datasource, methods (for both 5A1,5A2)
AT	Soil Information System, literature, expert guess/ reference C stocks
BE	Research projects/ reference C stocks
BG	ICP Forest/ time C stock change
DK	NFI soil datasets, soil monitoring / model
FI	NFI/ Model
ES,FR,PL	NFI, reference C stocks (IPCC default: PL)
IT	NFI, regression on ABG
SWE	NFI , model & research project for Organic Soils
UK	Carbon accounting model
BE,CZ, DE,GR,IE,EST,LV,LT,LUX,NL,PT, ES	Mineral soils: SOM neutral (for 5A1)
EST,LT, PL	IPCC default data : Organic soils
HU,SK,RO,SLV	na
Other annex I	database, re-sampling / models

4) Organic soils: Across all land uses, 98% of organic soils area are in “remaining” land categories, the rest of 2 % of land is under various conversions

Land category	Area (kHa)	Overall average IES (range) (MgC/ha)	Emissions (Gg)
5A1	12087	-0.42	5033
5A2	497	0.01	- 6
5B1	2031	-4.97 (-1 /LV:-11/ DE)	10095
5B2	55	-5.59	309
5C1	1582	-3.15 (+0.25/DK: - 13/UK	4978
5C2	34	-1.61	55

But

.... Consistency of AD between Table 5B and Table 4 Ds11

... time in consistent series ...

.... definitions and descriptions by quantitative parameters for organic soils and peat lands are largely missing in the NIRs

5) Features of QA/QC procedures by MS

Most of MS: Tier 1

Tier 2 – implementation in-depth category-specific procedures for key categories, for example:

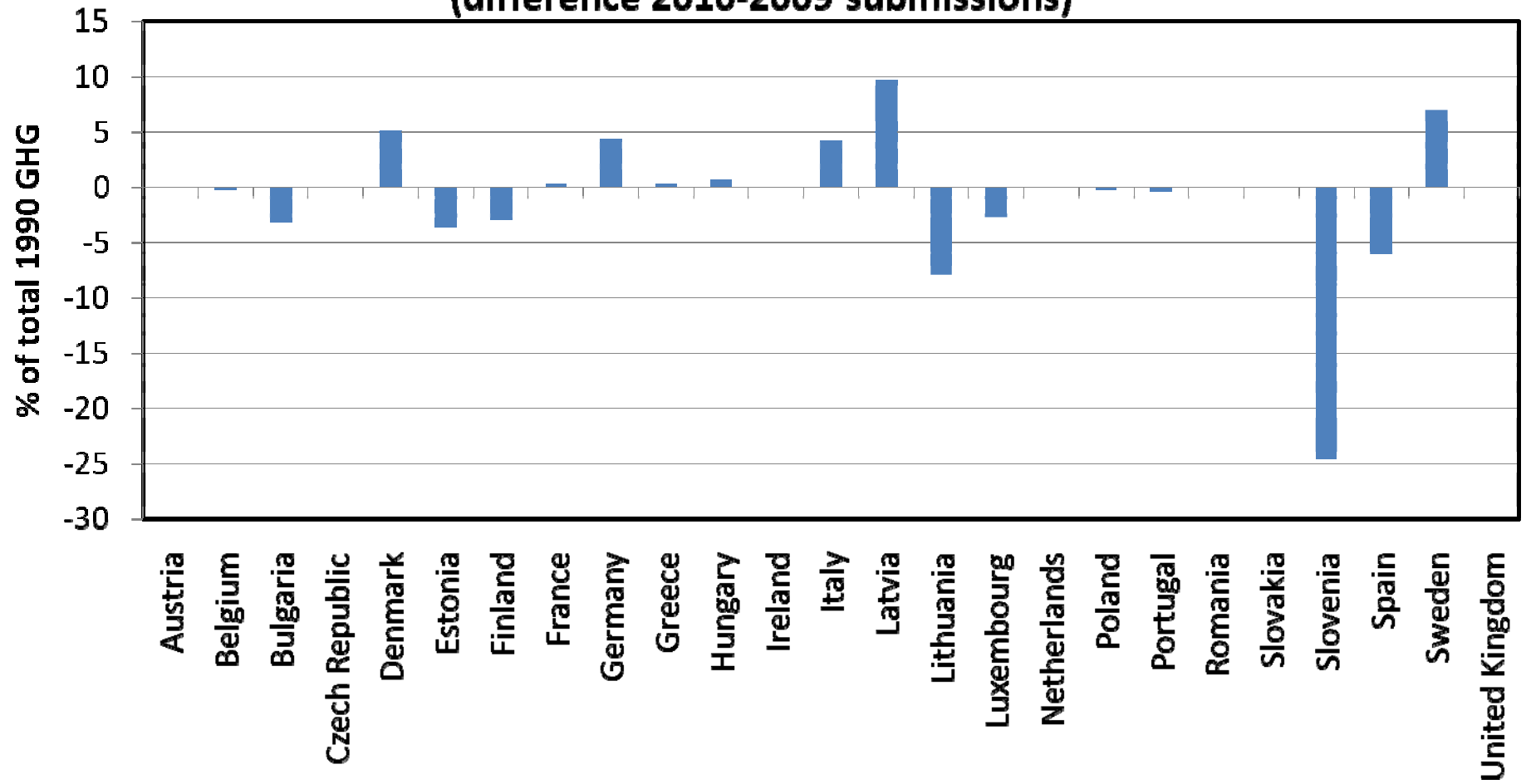
- soil pool in Finland
- re-sampling of previous soil inventory and experiments to detect the effect of cultivation on CO₂, CH₄ and N₂O fluxes and on soil carbon stocks, in UK
- land data, in Austria

Often loose description of QAQC procedures in NIR (especially for new MS)

- 6) **Verification issues** - independent producing of partial or total estimates of emissions/removal
- In general, verification is mixed with QA/QC (internal control procedure vs. audit vs. independent estimation)
 - Verification approaches on C stocks and stocks change (for ex):
 - soil by Denmark, Sweden (also CH) (measured dynamic of SOM vs. modelled)
 - all pools (by Germany)
 - soil and litter (Italy) by comparing results of a regional soil inventory with GHG inventory method (regression on stand parametric)
 - network for monitoring of drained organic soils (Finland)
 - atmospheric emission inventories at local scale (Italy)
 - trend confirmation by default method (growth minus drain) (Sweden)

7) Recalculations

**Recalculation for the year 2007 in “forest remaining forest”
(difference 2010-2009 submissions)**



Uncertainties at EU-15 level

Tier 1

Land use sub category	E/R in 2008 (Gg CO ₂ eq)	Category uncertainty for EU (%)	Uncertainty introduced into the trend of total LULUCF	Uncertain amount for each land subcategory GHG (GgCO ₂ eq)
FL-FL	-280702	29%	18.9%	± 81 644
L-FL	-49779	25%	3.4%	± 12 446
CL-CL	19184	110%	6.8%	± 21 042
L-CL	41433	32%	3.3%	± 13 294
GL-GL	11923	89%	3.8%	± 10 598
L-GL	-25984	41%	3.8%	± 10 558
Total	-251002	35%		± 87 868

How accurate is it ?

...accurate for reported pools/sources

Tier 2

Parameter	Changes in C stock (Gg CO ₂)					
	Biomass Gain	Biomass Loss	DOM	SOM Mineral	SOM Organic	Aggregated pools
5A1 – Forestland remaining Forestland						
EU 15 aggregated uncertainty (%)	15%	17%	69%	66%	48%	37%
5A2 – Conversions to Forestland						
EU 15 aggregated uncertainty (%)	16%	25%	30%	57%	551%	30%

- Data not fully comparable among MS (different definitions of forest, LUC,...) - further harmonization desirable, but difficult
- KP reporting pressure for DOM, SOM, need scientific effort
- High uncertainties (30-40%) characterize the LULUCF sector - improvement possible, but don't expect much
- Little efforts on verification
- Recalculations important: more “stable” numbers may be expected - but yr-to-yr changes will remain !!!

Thanks!