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Interactive comment on "Inverse modelling of national and European CH_4 emissions using the atmospheric zoom model TM5" *by* P. Bergamaschi et al.

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Revision of German bottom-up CH_4 inventories reported to UNFCCC

In our paper we have presented inverse modelling based estimates of national CH_4 emissions for various European countries for the year 2001. We have compared these estimates with the values reported to UNFCCC (EEA, 2003). While the EU-15 totals agree relatively well (within 10–30%), the inverse modelling results yielded up to 50–90% higher emissions for Germany, France and UK.

In the framework of the annual reporting of national GHG emissions to UNFCCC it is good practice to recalculate historic emissions in order to account for improvements or

changes of methodologies. The recent recalculation of Germany resulted in a considerable revision of reported CH_4 emissions (EEA, 2004), with an increase of $\sim$70% for the whole time series 1990–2001. For year 2001 this update amounts to an increase of 1.64 Tg CH_4/yr (68.5%) compared to the CH_4 emission reported in (EEA, 2003) (Table 1).

A major reason for the German update of CH_4 emissions are updated values for CH_4 emissions from manure management, which have increased from 0.21 to 1.31 Tg CH_4/yr (Table 2). This change is mainly due to the increase of applied CH_4 conversion factors from liquid manure management systems (increase from 10% to 39%), the consideration of the frequency distribution of manure management systems by district instead of fixed emission factors for each animal type, and due to the incorporation of smaller Bundeslaender (Bremen, Hamburg, Berlin), which in previous reports had not been included (UBA, 2004).

As illustrated in Table 1, the update of the German inventory leads to a virtually perfect agreement with the inverse modelling based value.

Also some other EU member states have performed recalculations (e.g. Portugal $-$24%), but with an overall relatively small effect on absolute total CH_4 emissions. The recalculation of German emissions, however, leads to a significant increase also of total EU-15 emissions (+8.0%; +1.26 Tg CH_4/yr). This new EU-15 total (16.96 Tg/yr) is now in even better agreement with our top-down-estimate (4–21%, assuming natural sources in the range of 3.9–1.0 Tg/yr).

Despite the very favorable agreement of our inverse modelling based estimate and the new UNFCCC value for the total emissions of Germany, we note that there are still some discrepancies regarding the emissions per source categories (see Table 2). While our bottom-up inventory assumes relative low CH_4 emissions from manure management (0.26 Tg/yr) it suggests much higher emissions in particular for landfill sites (1.1 Tg/ yr, compared to 0.50 Tg/yr, EEA, 2003, and 0.62 Tg/yr, EEA, 2004). Note that

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the inverse modelling as set up in our study does not further optimize the partitioning of source categories, but is optimizing the total emissions within one region and one month, which is equivalent of scaling all source categories equally (within this region and month).

The revision shows that total uncertainties of CH_4 bottom-up inventories may be larger than currently assumed (member states report very different uncertainties, ranging from only 1.8% (Sweden) to 48.3% (Austria); several member states (e.g. Germany, France) do not give any uncertainty estimate). Furthermore, it underlines that independent verification by top-down techniques is important.

References

EEA, Annual European Community greenhouse gas inventory 1990–2001 and inventory report 2003, European Environment Agency, Copenhagen, 2003.

EEA, Annual European Community greenhouse gas inventory 1990–2002 and inventory report 2004, European Environment Agency, Copenhagen, 2004.

UBA, Deutsches Treibhausgasinventar 1990–2002 – Nationaler Inventarbericht 2004 – Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen, pp. 398, Umweltbundesamt, Berlin, 2004.

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Table 1: Comparison of a priori and a posteriori CH_4 emission estimates from our study with official values reported to UNFCCC (EEA, 2003; EEA, 2004). Values are given in Tg CH_4/yr. (Update of Table 1 in our paper for EU-15 emissions.)

	UNFCCC		a priori used in this study			a posteriori		
	[EEA, 2003]	[EEA, 2004]	anthrop.	natural	total	avg S1-S7	range	anthr.
EU-15								
Germany	2.40	4.04	3.62	0.26	3.88±0.64	4.20	(3.90...4.87)	3.95
Italy	1.73	1.68	2.06	−0.04	2.02±0.40	2.14	(2.10...2.17)	2.18
France	3.08	3.01	2.68	−0.11	2.56±0.42	4.38	(3.86...4.71)	4.50
BENELUX	1.49	1.42	1.31	0.15	1.47±0.23	1.58	(1.35...1.67)	1.43
Austria	0.43	0.36	0.33	−0.01	0.32±0.05	0.30	(0.28...0.30)	0.31
Spain	1.92	1.92	1.91	−0.06	1.84±0.32	1.99	(1.96...2.04)	2.06
Portugal	0.51	0.39	0.39	−0.02	0.37±0.08	0.38	(0.38...0.39)	0.40
United Kingdom	2.20	2.19	3.39	−0.04	3.35±0.82	4.15	(3.91...4.39)	4.19
Ireland	0.60	0.60	0.66	−0.01	0.64±0.12	0.36	(0.26...0.75)	0.38
Greece	0.53	0.53	0.42	−0.01	0.40±0.07	0.40	(0.39...0.40)	0.41
Sweden	0.28	0.28	0.22	0.85	1.08±0.44	0.93	(0.86...0.99)	
Finland	0.26	0.26	0.24	2.98	3.23±1.36	0.36	(−0.27...1.30)	
Denmark	0.27	0.28	0.34	−0.01	0.34±0.06	0.33	(0.30...0.34)	0.33
Total EU-15	15.69	16.96	17.59	3.92	21.51±1.92	21.52	(21.05...22.03)	17.60

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Table 2: German CH_4 emissions per category. Values are given in Gg CH_4/yr.

	[EEA, 2003]	[EEA, 2004]	this study a priori	a posteriori
fossil fuel combustion	57	59	0	
coal	279	453	640	
oil and gas	353	357	401	
industrial processes	0	0	0	
enteric fermentation	998	1276	1129	
manure management	212	1309	262	
agricultural soils	0	−30	0	
biomass burning	0	0	68	
waste	498	617	1123	
total anthropogenic	2397	4039	3624	
wetlands			321	
wild animals			8	
soils			−73	
total natural			256	
total emissions			3879	4200 (3900...4870)

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