Supplementary Material

1 Regional livestock parameters

1.1 Livestock feed diet division

We divide the resource intakes into two types of feed : crop and grass according to the Global Livestock Environmental Assessment Model (FAO, 2018). The information are given by animal and by region and are defined as a percentage of total dry matter intake. Fig S1 shows the classification we use to divide grass from crop resources on the example of the dairy cattle diet. We consider that roughages such as fresh grass, hay and leaves are grass resources whereas legumes and silage, crop residues and grains come from cropland. We calculate the relative proportions of each by taking into account the sum of the two types of feed as the total. Concerning the small animals such as the pigs and the chicken, diet compositions are detailed by the farming type (backyard, industrial, broiler etc . . .) or by the animal category (dairy / meat small ruminants). The average of all the farming types and animal categories is calculated for each animal since such level of details is not considered in our approach.

Feed material	NA	RUS	WE	EE	NENA	ESEA	OCE	SA	LAC	SSA
percentage of total dry matter intake										
Roughages										
Fresh grass	13	22	26	22	16,8	17,1	61	4,6	31	29
Hay	16	22	20	23	43	21,1	5,1	23	30	45
Fodder beet	-	2,6	1,2	2,7	1,1	0,5	-	-	-	-
Legumes and silage	34	30	25	30	7	15,5	11	4,9	7,7	6,3
Crop residues	-	1,8	2,5	1,8	19,4	24,6	-	40	7,2	6
Sugarcane tops	-	-	-	-	0,5	1,1	-	2,6	3	-
Leaves	-	-	-	-	7,1	4	-	13	8,2	6,6
Agro-industrial by-products										
Bran	4,3	4,7	4,1	4,9	2,6	6,6	2,5	5,7	4,3	4,3
Oilseed meals	5,9	3,9	7,5	4	1	2,8	5	2	2	0,5
Wet distilleries grain	4,1	-	-	-	-	1	-	-	-	-
Grains	23	10	12	9,8	0,9	5	16	2,5	3,9	1,5
Molasses	-	-	-	-	0,6	0,7	-	1,2	2,5	0,6
Pulp	-	1,8	1,3	1,8	-	-	-	-	-	-

Figure S1. Default values used for the diet division for the dairy cattle example (adapted from FAO (2018)). The crop element is highlighted in magenta and the grass element in green. Regions: NA (North America), RUS (Russian Federation), WE (Western Europe), EE (Eastern Europe), NENA (Near East and North Africa), ESEA (East and Southeast Asia), OCE (Oceania), SA (South Asia), LAC (Latin America and the Caribbean) and SSA (Sub-Saharan Africa).

Table S1. Grass and crop proportions (d_{grass}, d_{crop}) that composed each animal diet for each region calculated according to the classification used in Fig S1. Regions: NA (North America), RUS (Russian Federation), WE (Western Europe), EE (Eastern Europe), NENA (Near East and North Africa), ESEA (East and Southeast Asia), OCE (Oceania), SA (South Asia), LAC (Latin America and the Caribbean) and SSA (Sub-Saharan Africa).

max width=1.2 center

	Region	*NA*	*RUS*	*WE*	*EE*	*NENA*	*ESEA*	*OCE*	*SA*	*LAC*	*SSA*
Dairy cattle	Grass	0.34	0.51	0.54	0.52	0.71	0.48	0.71	0.46	0.79	0.85
	Crop	0.66	0.49	0.46	0.48	0.29	0.52	0.29	0.54	0.21	0.15
Non dairy cattle	Grass	0.34	0.51	0.54	0.52	0.71	0.48	0.71	0.46	0.79	0.85
	Crop	0.66	0.49	0.46	0.48	0.29	0.52	0.29	0.54	0.21	0.15
Pig	Grass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Crop	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Chicken	Grass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Crop	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Small ruminant	Grass	0.78	0.73	0.69	0.73	0.59	0.39	0.86	0.45	0.78	0.78
	Crop	0.22	0.27	0.31	0.27	0.41	0.61	0.14	0.55	0.22	0.22

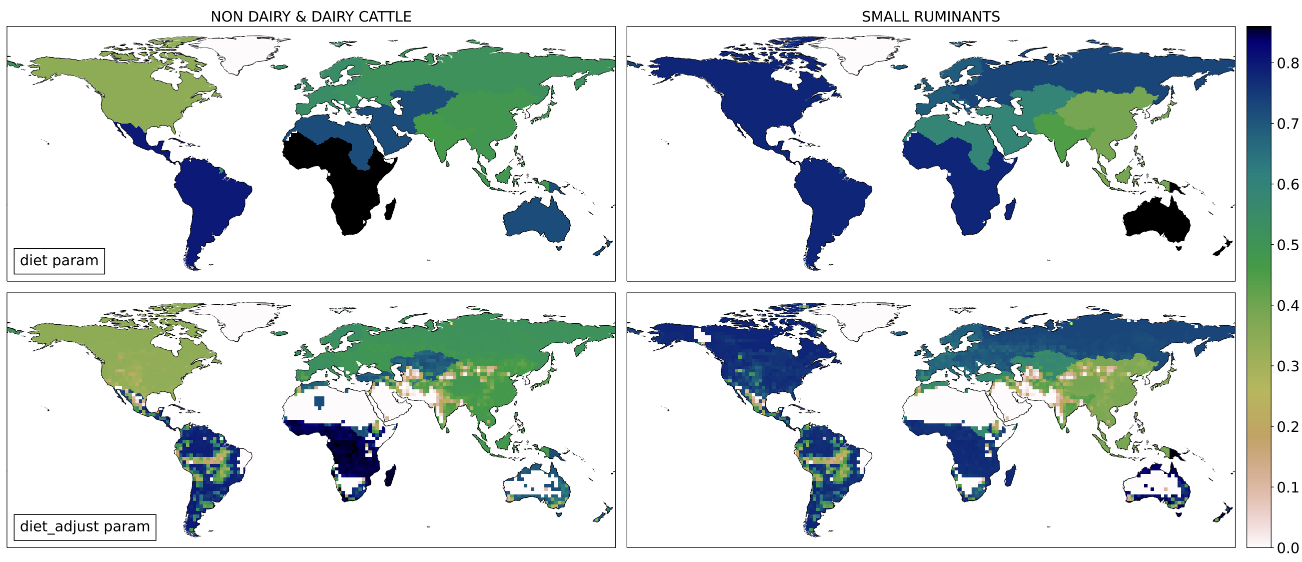

Figure S2. Maps of the d_{grass} before (first row) and after adjustment ($d_{grass,adjusted}$ in second row) parameters for the non dairy and dairy cattle (first column) and the small ruminant (second column).

1.2 Livestock manure type division

We consider that manure is handled as two types : liquid and solid manure. This division depends on the region and on the livestock type (FAO, 2018). We group what is called 'drylot', 'pasture,range, paddock' and 'solid storage' into the solid type. In addition, in the case of chicken systems, the 'chicken manure with litter' is also seen as solid manure. Liquid manure type accounts for the 'liquid slurry' and the 'uncovered anaerobic lagoon'. Fig S3 describes the classification used to divide the proportions of each manure types (here is the example for dairy cattle livestock category).

Manure management system	NA	RUS	WE	EE	NENA	ESEA	OCE	SA	LAC	SSA
Share										
Burned for fuel	-	-	-	-	4	2	-	20	-	7
Daily spread	10	-	1	2	-	-	1	-	-	-
Drylot	-	-	-	-	39	29	-	54	42	35
Uncovered anaerobic lagoon	27	-	-	-	-	-	5	-	-	-
Liquid slurry	26	-	42	10	-	3	-	-	-	-
Pasture, range, paddock	12	23	27	17	46	30	94	24	54	40
Solid storage	25	77	30	71	11	36	-	2	4	18

Figure S3. Default values used for the manure type division for the dairy cattle example (adapted from FAO (2018)). The solid manure type is highlighted in orange and the liquid manure type in yellow. Regions: NA (North America), RUS (Russian Federation), WE (Western Europe), EE (Eastern Europe), NENA (Near East and North Africa), ESEA (East and Southeast Asia), OCE (Oceania), SA (South Asia), LAC (Latin America and the Caribbean) and SSA (Sub-Saharan Africa).

Table S2. Liquid and solid proportions (x_{liq} and x_{sol}) that composed the manure of each animal for each region calculated according the classification given in Fig S3. Regions: NA (North America), RUS (Russian Federation), WE (Western Europe), EE (Eastern Europe), NENA (Near East and North Africa), ESEA (East and Southeast Asia), OCE (Oceania), SA (South Asia), LAC (Latin America and the Caribbean) and SSA (Sub-Saharan Africa).

max width=1.2 center

	Region	*NA*	*RUS*	*WE*	*EE*	*NENA*	*ESEA*	*OCE*	*SA*	*LAC*	*SSA*
Dairy cattle	Solid	0.41	1.0	0.58	0.90	1.0	0.97	0.95	1.0	1.0	1.0
	Liquid	0.59	0.0	0.42	0.10	0.0	0.03	0.05	0.0	0.0	0.0
Non dairy cattle	Solid	0.99	1.00	0.77	0.35	1.00	1.00	1.00	1.00	1.00	1.00
	Liquid	0.01	0.00	0.23	0.65	0.00	0.00	0.00	0.00	0.00	0.00
Pig	Solid	0.30	0.70	0.47	0.62	0.60	0.25	0.25	0.59	0.57	0.80
	Liquid	0.70	0.30	0.53	0.38	0.40	0.75	0.75	0.41	0.43	0.20
Chicken	Solid	0.9	1.0	1.0	1.0	0.82	0.75	1.0	1.0	0.8	1.0
	Liquid	0.1	0.0	0.0	0.0	0.18	0.25	0.0	0.0	0.2	0.0
Small ruminant	Solid	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Liquid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

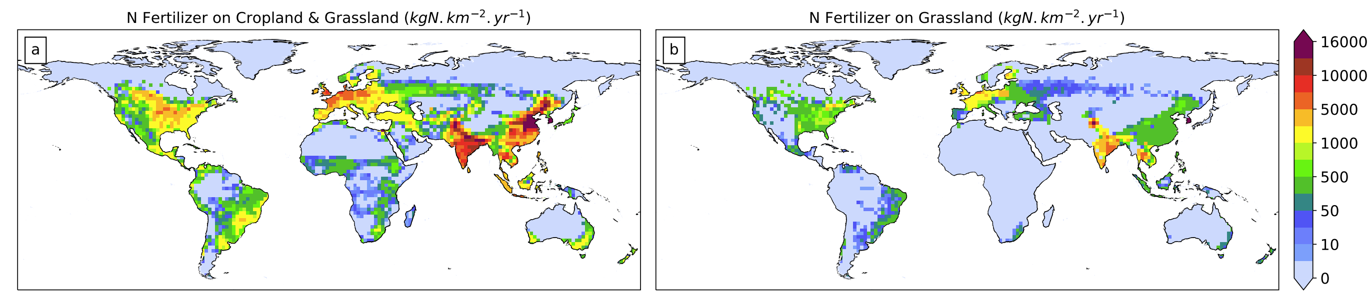

Figure S5. Fertilizer application $\mathrm{kgNkm^{-2}yr^{-1}}$) on the total cultivated land (a) and on grassland (b) used in ORCHIDEE for 2010.

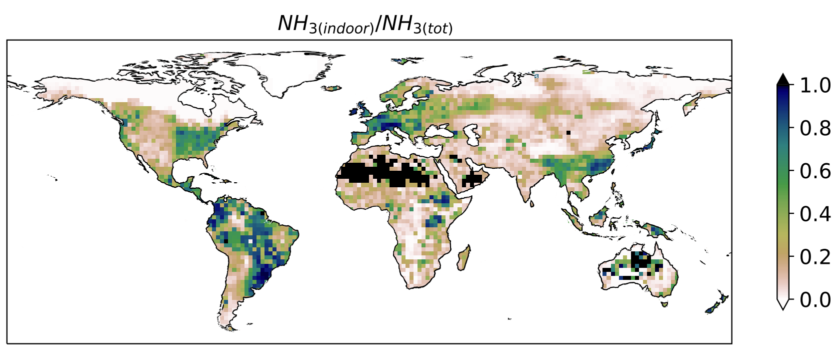

Figure S6. Indoor emissions contribution in the total emissions (in %) computed by ORCHIDEE.

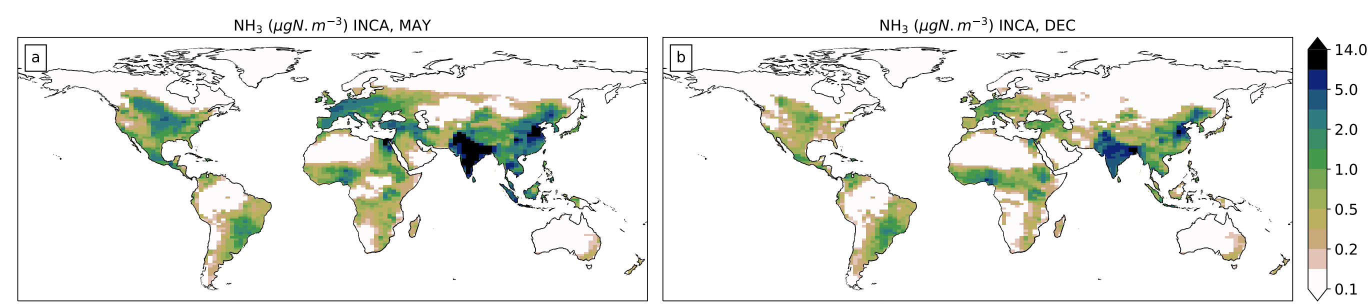

Figure S7. Simulated global distribution of NH_3 for 2005–2015 with LMDZ-INCA ($\mathrm{\mu gNm^{-3}}$). The distribution in May is shown in (a) and the December one is in (b).

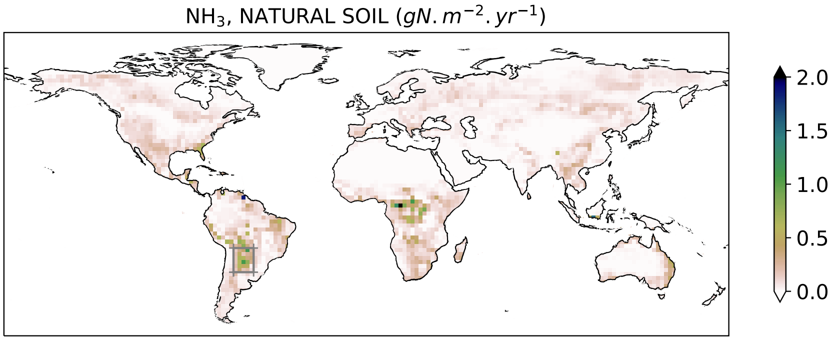

Figure S8. Simulated ammonia emissions ($\mathrm{gNm^{-2}yr^{-1}}$) from natural sources computed by CAMEO (2005–2015)

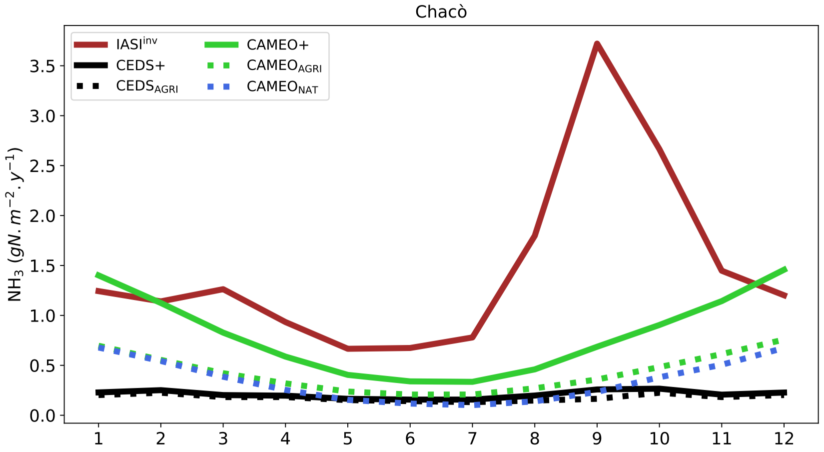

Figure S9. Monthly $\mathrm{NH_3}$ emissions ($\mathrm{gNm^{-2}yr^{-1}}$) averaged over the Chacò region. CAMEO emissions accounting for natural and agricultural emissions aggregated with other sources is represented by the solid green line while agricultural emissions by the dotted green line and natural emissions by the dotted blue line. The agricultural sector of CEDS alone and aggregated with other sources are represented by lines in black dotted and solid lines respectively and the IASI-derived product is in red for 2011-2015 period (other sources include biomass burning from van der Werf et al. (2010) and industrial and waste sectors from CEDS). The Chacò region is situated in Latin America and is located on the map of the natural emissions.

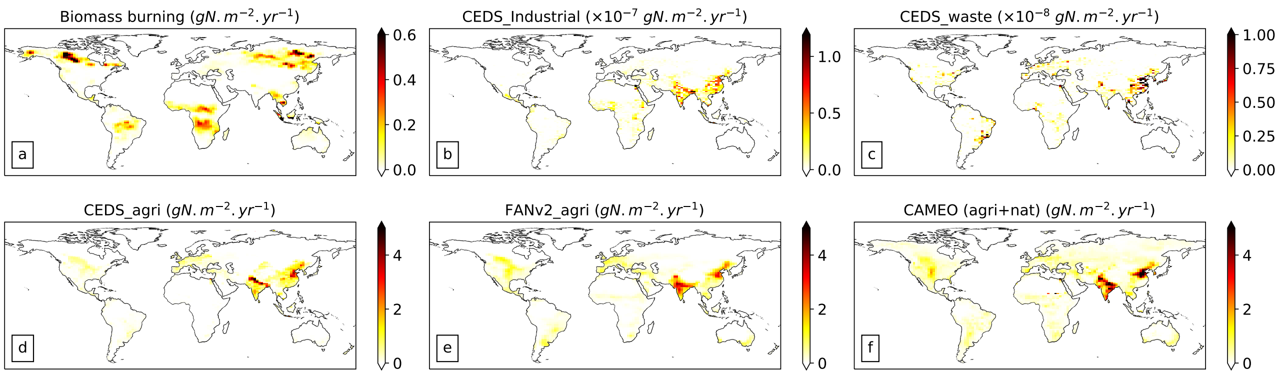

Figure S10. Annual standard deviations of NH_3 emissions from different sources ($gNm^{-2}yr^{-1}$) : biomass burning (a), industrial sector from CEDS (b), waste activity from CEDS (c), agricultural sector from CEDS (d), agricultural activities from FANv2 (e), agricultural and natural sources from CAMEO (f). Please note that emissions from (b) and (c) have been multiplied respectively by 10^7 and 10^8.

References

FAO: Global Livestock Environmental Assessment Model. Version 2. Data Reference Year: 2010. Food and Agriculture Organization of the United Nations., p. 121, 2018.

van der Werf, G. R., Randerson, J. T., Giglio, L., Collatz, G. J., Mu, M., Kasibhatla, P. S., Morton, D. C., DeFries, R. S., Jin, Y., and van Leeuwen, T. T.: Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009), Atmospheric Chemistry and Physics, 10, 11 707–11 735, https://doi.org/10.5194/acp-10-11707-2010, 2010.