Improving emission estimates of ingredients used in home and personal care products for use in EU risk assessments

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INTRODUCTION

• Realistic estimation of chemical emissions are critical for predicting accurate environmental concentrations for use in regulatory assessments

• REACh Guidance introduces the concept of Environmental Release Categories (ERCs) for estimating emissions from production, manufacturing and use life cycle phases

• Default values include estimates of the amount used in a 200 × 200 km EU hypothetical region ($F_{prodregion}$) with a population of 20 million and the amount directed to a local STP ($F_{mainsource}$) that serves 10,000 people

• The fraction of EU tonnage (C_{load}) directed to an average STP in the hypothetical region is a function of $F_{prodregion}$ and $F_{mainsource}$:

$$C_{load}\ \ (kg\ d^{-1}) = \left(\frac{Tonnage \times 1000}{T_{emission}\ (d)}\right) \times \mathbf{F_{prodregion}} \times \mathbf{F_{mainsource}}$$

- Current defaults for wide dispersive use of home and personal care products have little provenance and include:
  1. $F_{prodregion}$ = 0.1 (10% of the total EU27 product usage used in region)
  2. $F_{mainsource}$ = 0.002 (i.e. the local STP receives four times the average amount used in region)
- The objectives of this research were:
  1. Couple up-to-date population distributions with market research data on product consumption to estimate product usage in EU hypothetical region
  2. Provide realistic worst-case estimates for a range of home and personal care products for use in exposure modelling under REACh

MATERIALS & METHODS

• EEA, Norwegian and Swiss gridded population datasets were aggregated to form a 5 km resolution population density grid for the EU27+3 (EU27, Croatia, Norway and Switzerland) - Figure 1

• Sales volume data were obtained for 25 different product types in 9 main product categories for the EU27+3 countries (data from Euromonitor)

• Product usage in an individual country were assumed to be constant and per capita usage/consumption (PCC) estimates derived (Table 1)

• The 5 km gridded population dataset for the EU27+3 (Figure 2) was coupled with PCC estimates for each country to obtain an amount used per 5 × 5 km region

• Two assessments were performed to identify product usage within hypothetical regions (200 × 200 km) across the EU27+3
  - an inter-country analysis that did not consider Member State boundaries (i.e. regions that contained two or more countries)
  - an intra-country analysis where the assessment was restricted to within individual Member State boundaries

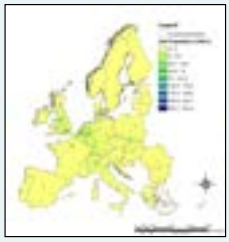

Figure 1: Illustration of the spatial distribution of population in the EU27+3 within each five km grid square.

Table 1: Product usage data reported for nine main HPC product categories in 2008 for the EU27+3 (mL capita^{-1} year^{-1})

Category	EU27+3 Per Capita Usage (mL capita^{-1} year^{-1})	
	mean	maximum
Laundry	8837	16714 (Italy)
Surface care	1749	4113 (Portugal)
Toilet care	474	1337 (Luxembourg)
Dish wash	2240	5048 (Italy)
Hair care	1013	1744 (Norway)
Oral care	350	740 (UK)
Deodorant	229	828 (UK)
Body care	1256	2589 (Spain)
Bleach	1485	9363 (Spain)

• For both assessments, the hypothetical region was moved over the EU27+3 in 5 km increments and the distribution of usage determined (176,753 hypothetical regions for inter-country analysis)

• Hypothetical regions with less than 50% landmass were excluded from the final analysis. Countries smaller than the hypothetical region were weighted to achieve hypothetical region size.

RESULTS & DISCUSSION

• Population distributions across hypothetical regions (200 × 200 km) are shown in Figure 2

• The hypothetical region with highest population (25.9 million) is a transboundary region that encompasses Germany (Dusseldorf), Netherlands (Eindhoven and Maastricht) and Belgium (Liege)

• Hypothetical regions with a population of 20 million people is equivalent to the 99.5th percentile

• EU27+3 average PCC is typically less than a factor of three lower than the maximum country PCC (Table 1)

• Countries (top 10) with highest intra-country regional usage of laundry, hair care and deodorant are given in Figure 3a-c (bar charts), and are dominated by Western EU countries

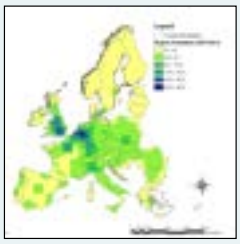

Figure 2: Illustration of the spatial distribution of population in the EU27+3 within each 200 km grid square.

•The inter-country analysis identified two primary regions in EU27+3 with maximum use of home and personal care products (the UK and the transboundary region)

• The distributions of laundry, hair care and deodorant product usage in all EU inter-country hypothetical regions are given in Figure 3a-c (line graphs)

• Examples of the spatial patterns of product usage for the inter-country analysis are given in Figure 3d-f

• EU regions containing 20 million people (99.5th percentile) have product usage ranging from 3.6 to 9.0% (Table 2)

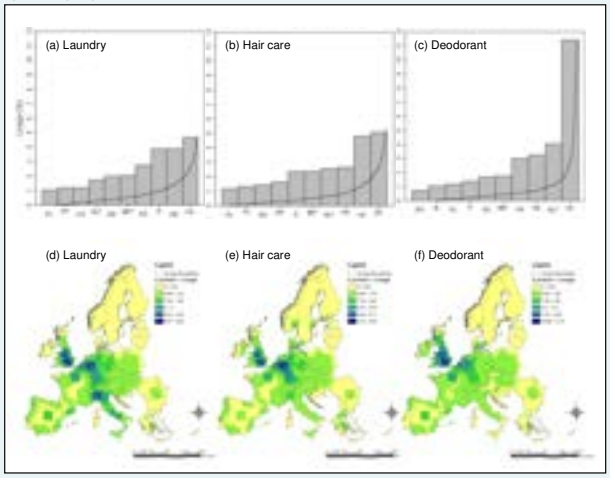

Figure 3: Plot of the maximum EU product usage (%) in each 200 x 200 km hypothetical region (line graphs and spatial distributions) as well as maximum hypothetical region usage in the top ten countries (bar charts) for (a, d) laundry care (b, e) hair care (c, f) deodorant.

CONCLUSIONS

• For home care products the weighted average for $F_{prodregion}$ is 0.0402 (4.02%)

• For personal care products the weighted average for $F_{prodregion}$ is 0.0529 (5.29%)

• Values have now been adopted by EU Trade Associations (Colipa and AISE) for use in refined exposure assessments under REACh

Table 2: Estimating "worst-case" usage statistics for exposure estimates under REACh for ingredients used in home and personal care products

Product type	Average PCC (mL/cap/yr)	$F_{prodregion}$ (99.5^{th} Lite)	% Home care PCC	% Personal care PCC	Weighted Contribution
Laundry Care	8837	0.0385	59.77	-	0.0230
Surface Care	1749	0.0362	11.83	-	0.0043
Toilet Care	474	0.0492	3.21	-	0.0016
Dish Washing	2240	0.0410	15.15	-	0.0062
Bleach	1485	0.0511	10.04	-	0.0051
Weighted average for home care products ($F_{prodregion}$)					**0.0402**
Hair Care	1013	0.0464	-	35.57	0.0165
Oral Care	350	0.0597	-	12.29	0.0073
Deodorant	229	0.0904	-	8.04	0.0073
Body Care	1256	0.0494	-	44.10	0.0218
Weighted average for personal care products ($F_{prodregion}$)					**0.0529**