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1 **Continents of plastics: an estimate of the stock of microplastics in agricultural soils**

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7 ABSTRACT

8 While there are estimates of the stock of microplastics in the marine environment, there are
9 no estimates for soils. The main objective of this work is to estimate the total mass of
10 microplastics in global agricultural soils. Microplastic abundance data from 442 sampling
11 sites were collected from 43 articles. From these, the median of the abundance values, as
12 well as the abundance profile of microplastics in soils were calculated. Thus, 1.5 to 6.6 Mt of
13 microplastics would be present in soils on a global scale, i.e. one to two orders of magnitude
14 higher than the estimated ocean surface microplastic stock. However, many limitations exist
15 to accurately calculate these stocks. This work should therefore be considered as a first step
16 in addressing this question. In the long term, in order to better assess this stock, it seems
17 important to obtain more diversified data, e.g. better representing certain countries, or
18 certain land uses.

19 KEYWORDS

20 Microplastics, agricultural soils, stock evaluation, environmental contamination

21 1. Introduction

22 Microplastics (i.e. plastic particles smaller than 5 mm) were discovered in the early 1970s. In
23 1971, synthetic fibres were identified for the first time in water samples taken near the
24 English coast (Buchanan, 1971). In 1972, industrial pre-production granules between 0.25
25 and 0.5 mm were identified in the Sargasso Sea (Carpenter and Smith, 1972). The first maps
26 of the sea surface contamination by a few millimetres plastic were published in 1974 for the
27 Northwest Atlantic and Pacific Ocean (Colton et al., 1974; Wong et al., 1974). The term
28 "microplastic", used to describe this type of particle, appeared only in 2004 (Thompson et
29 al., 2004), and it was not until the 2010s that international research on microplastics was set
30 up and structured.

31 The assessment of microplastic stocks in the different environmental compartments remains
32 limited. The oceanic compartment (mainly the surface of the oceans) is probably the best
33 known of all, and various assessments of microplastic stocks have been proposed leading to
34 an overall assessment of a few hundred metric kilotons (Eriksen et al., 2014; Everaert et al.,
35 2018; Lebreton et al., 2019; van Sebille et al., 2015). Surprisingly, while soils could be among
36 the largest reservoirs of microplastic pollution in the world (Lofty et al., 2022), no stock
37 evaluation has been proposed to date.

38 In this context, our study proposes to contribute to the evaluation of the stock of
39 microplastic present in in the natural environment. The main objective was to propose the
40 quantification of the mass of microplastics present in agricultural soils. For this purpose,
41 microplastic abundance data for different soils were collected from the scientific literature.
42 A protocol was then developed to determine the median abundances, the evolution of the
43 abundances in the soil depth and finally the stock of microplastics. Thus, this work provides
44 the first picture of the stock (in mass) of microplastic in agricultural soils. It has also made it

45 possible to highlight the current limitations of the available data, as well as the need for
46 further development to refine this stock assessment.

47 2. Materials and methods

48 The data collection protocol for microplastics in soils was modified after the one developed
49 by Büks and Kaupenjohann (Büks and Kaupenjohann, 2020). To the 23 publications
50 previously identified by these authors, 20 new ones dealing with microplastics in agricultural
51 soils and covering a period from 2020 to July 2022 were added. Thus, the number of soil
52 samples considered in our study was 442. The data and metadata collected from the
53 publications in our study were less diversified than the collection protocol of Büks and
54 Kaupenjohann. It focused on median microplastic abundance (items.kg⁻¹ of dry soil),
55 sampling depth data and the geographical origin of the samples. It is important to note that
56 84% of the data used in this work comes from analyses of Chinese soil samples (Tab. 1).

57 Table 1. Origin of the samples used for calculation.

Area	Number of samples	References
Canada	4	(Crossman et al., 2020)
Chile	5	(Corradini et al., 2019)
China	372	(Cao et al., 2021; Chen et al., 2020; Ding et al., 2020; Feng et al., 2021; Haixin et al., 2022; Huang et al., 2020; Jiang et al., 2022; Lang et al., 2022; J. Li et al., 2022; Q. Li et al., 2021; S. Li et al., 2022; Li et al., 2020; Liu et al., 2018; Lv et al., 2019; Wang et al.,

		2021; Yang et al., 2021a, 2021b; Yu et al., 2021; Zhang and Liu, 2018; Zhang et al., 2018, 2020; Zhou et al., 2020)
Danemark	2	(Vollertsen and Hansen, 2017)
Germany	17	(Harms et al., 2021; Piehl et al., 2018; Tagg et al., 2022)
Korea	4	(Kim et al., 2021)
Iran	5	(Rezaei et al., 2019)
Mauritius	3	(Ragoobur et al., 2021)
Mexico	1	(Huerta Lwanga et al., 2017)
Netherlands	3	(van Schothorst et al., 2021)
Spain	20	(Beriot et al., 2021)
Sweden	3	(Ljung et al., 2018)
Tunisia	4	(Boughattas et al., 2021)

58

59 In most publications, microplastic abundance (items/mass of dry soil) in number was
60 expressed as an average of different sampled sites. As for Büks and Kaupenjohann, sites with
61 clear differences in geography, agricultural uses or properties were treated as separate
62 samples (Büks and Kaupenjohann, 2020). In the case where, for a set of sites, only the
63 average value of these sites is given in the article (text, tables and figures), the data were
64 obtained either via the supplements of the article or by requesting the data directly from the
65 authors. In the case where the authors did not respond to our requests, the average values
66 expressed in the publication were used.

67 The data were extracted from a scientific literature (eg. text, tables, figures, supplementary
68 materials) that used a wide variety of protocols (Büks and Kaupenjohann, 2020). For

69 example, studied microplastics could belong to different range of particle size ranges.
70 Nevertheless, for 98.8% of the samples studied, the upper size limit of the microplastics was
71 5mm. The lower size limit was more dependent on the analytical methods used to study the
72 chemical nature of the microplastics, i.e. for 86% of the samples studied, the lower size limit
73 of the microplastics was approximately equal to the analytical limit of the method. Since μ -
74 FTIR or μ -Raman spectropy tools were used in most of these studies, it was possible to
75 estimate this limit to a few tens of microns (Feng et al., 2021; Jiang et al., 2022; Wang et al.,
76 2021). Despite this relative homogeneity, the use of different particle size ranges in these
77 publications can lead to biases in the calculations. These biases, previously identified by Büks
78 and Kaupenjohann (Büks and Kaupenjohann, 2020), and their implications for our study will
79 be discussed.

80 The median microplastic abundance (C_s ; items.kg⁻¹ of dry soil) of the different sites was then
81 calculated, as well as the abundances corresponding to the 25% ($C_{S0.25}$) and 75% ($C_{S0.75}$)
82 quantiles. Since the average depth of the samples from different publications studied was
83 0.06 m, C_s , $C_{S0.25}$, $C_{S0.75}$ were considered as surface abundances.

84 The calculation of the abundance of particles per unit of volume (C_v ; items.m⁻³) required to
85 determine the evolution of the microplastic abundance according to the depth. This
86 information was available in 11 publications (Cao et al., 2021; Feng et al., 2021; Huang et al.,
87 2020; S. Li et al., 2022; Liu et al., 2018; Ragoobur et al., 2021; Tagg et al., 2022; van den Berg
88 et al., 2020; van Schothorst et al., 2021; Yu et al., 2021; Zhang et al., 2020). Because
89 microplastic surface abundances varied widely among publications, they were normalised
90 for each site to the abundance of the surface sample. Of the 20 sites identified, two behaved
91 very differently from the other 18 and were excluded from the analysis (Cao et al., 2021;

92 Zhang et al., 2020). The trend curve obtained allowed us to determine that between 0 and
93 0.2 m of depth no clear trend emerged. We therefore decided to consider the abundance of
94 microplastics between 0 and 0.2 m as constant. Below 0.2 m, the rate of microplastics
95 decreased and its evolution could be described approximately according to the following
96 equation:

$$97 \quad C_d = (-1.17d + 1.23)C_s \quad (1)$$

98 With, C_d the abundance in plastics (items.kg⁻¹) at a given depth (d , m). The depth used in the
99 calculations varied between 0 and 1 metre. The choice to limit the calculations to 1 metre
100 depth is explained by the too few data in the publications on the behaviour of microplastics
101 beyond this depth. The depth, d varied between 0 and 1 in increments Δd such that:

$$102 \quad \Delta d = \frac{1}{\rho_{soil}} \quad (2)$$

103 With ρ_{soil} , the density of the soil (1,300 kg.m⁻³) (FAO-Land and Water Division, 2006). The
104 abundance C_c (items.m⁻³) was then calculated by summing all the values of C_d .

105 The conversion of C_c to a concentration in mass was carried out using the curves proposed
106 by Büks and Kaupenjohann (Büks and Kaupenjohann, 2020). For this purpose, two cases
107 were dissociated: microplastics from sewage activities and microplastics from plastic films
108 (Büks and Kaupenjohann, 2020). Thus:

$$109 \quad C_{sewage} = \frac{C_c}{938.86} \quad (3)$$

$$110 \quad C_{mulching} = \frac{C_c}{175.86} \quad (4)$$

111 Where C_{sewage} was the mass concentration (g.m⁻³) of a soil with sewage sludge and
112 wastewater applications, and $C_{mulching}$ was the mass concentration of a soil covered by a

113 plastic cover (e.g. plastic mulch, greenhouse). It is important to note that these two sources
114 constitute two of the top three sources of microplastics for agricultural soils (Brandes et al.,
115 2021). The last of the three sources, the use of compost as a soil amendment, will not be
116 addressed in this work due to lack of data. Furthermore, the association of sewage sludge
117 and wastewater, which are very different sources of contamination, is undoubtedly open to
118 criticism, but the lack of data does not allow at this stage to treat them in a differentiated
119 way.

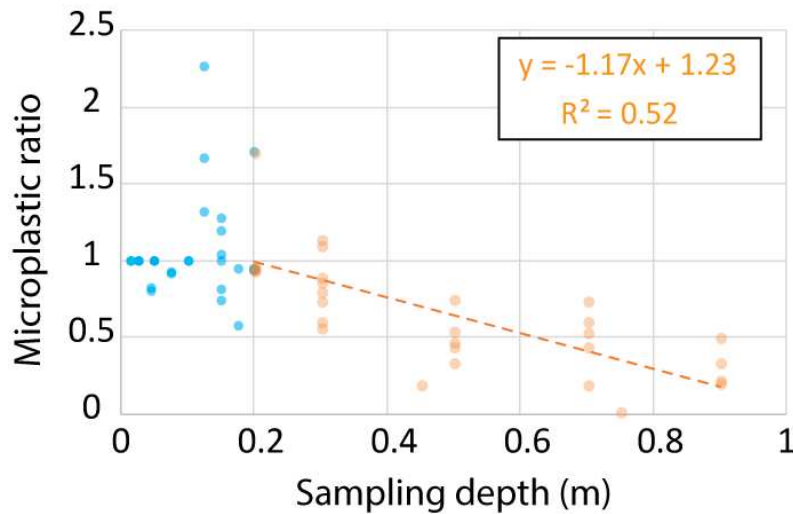
120 The value of irrigated land area in the world was used as a proxy to calculate the total stock
121 of microplastics in soil from sewage, and more particularly from wastewater use. This area
122 was $2.44 \cdot 10^{12} \text{ m}^2$ according to the combined FAO data (average of the period 2000-2019),
123 including approximately $6.0 \cdot 10^{11} \text{ m}^2$ for China (FAO, 2021; Zhu et al., 2013). These data
124 allowed us to work on the scale of a country. The surface of soils covered by plastic mulch or
125 plastic tunnels was $2.18 \cdot 10^{11} \text{ m}^2$, of which $2.04 \cdot 10^{11} \text{ m}^2$ for China (Espí et al., 2006; Gao et al.,
126 2019). Apart from the case of China, these data did not allow us to work on a geographical
127 scale lower than that of the continent. To the extent that a soil can be both irrigated and
128 covered with plastic, these two areas probably overlap in part, and it was not possible to
129 determine the overlap rate here. The most conservative approach, consisting of considering
130 that any surface with a plastic cover was also irrigated, was therefore chosen. For this type
131 of surface, $C_{mulching}$ was used for stock calculations. For the irrigated areas, the area under
132 plastic cover was subtracted from that of the irrigated areas and C_{sewage} was used for
133 calculations.

134 3. Results and discussion

135 3.1. Distribution of microplastics in the soil depth

136 The synthesis of the previous work showed that the distribution of microplastic abundance
137 in soil was not monotonic (Fig. 1). No clear trend seemed to emerge in the first 20
138 centimetres as some publications showed a decrease in the abundance in this depth range
139 (Yu et al., 2021), while others showed rather an increase (Huang et al., 2020; Ragoobur et al.,
140 2021). These different types of behaviour had sometimes been highlighted in the same study
141 (S. Li et al., 2022). This pattern may be related to the tilling of the soil by agricultural
142 activities which, by mixing the surface layer, tends to randomly distribute the abundance of
143 microplastics (Piehl et al., 2018; Rillig et al., 2017). In some publications, however, an
144 increase in abundance relative to the surface was demonstrated within this surface layer
145 (Huang et al., 2020; Ragoobur et al., 2021; van Schothorst et al., 2021). Several hypotheses
146 had been proposed to explain this pattern such as retention of microplastics by plant roots
147 or variations in soil compaction (H. Li et al., 2021; O'Connor et al., 2019; Z. Ren et al., 2021).
148 Between 0.2 and 1 m depth, a clearer trend showed a relatively regular decrease in
149 microplastic abundance (S. Li et al., 2022; Tagg et al., 2022), even if more complex
150 behaviours had sometimes been demonstrated (Cao et al., 2021; Huang et al., 2020). This
151 pattern could correspond to a migration phenomenon of microplastics under the action of
152 both abiotic and biotic factors, without direct anthropic actions. From the point of view of
153 abiotic transport, water could play an important role. Seasonal cycles alternating dry and
154 wet periods, by modifying the soil structure, could have an important control of the
155 penetration capacity of microplastics in soils (O'Connor et al., 2019). Experimentally, the
156 greater the number of cycles, the greater the penetration of microplastics into the soil
157 (O'Connor et al., 2019). In China, this phenomenon could result in a ground penetration
158 speed of about 5.24 m per century (O'Connor et al., 2019). However, this migration capacity
159 is probably modulated by many physical (e.g. pore size, pore connectivity, soil aggregation)

160 and chemical (e.g. presence of fulvic acid, humic acid, iron oxides) factors within the soil
161 (Hou et al., 2020; O'Connor et al., 2019; Z. Ren et al., 2021; Wu et al., 2020; Yan et al., 2020).



162
163 Fig. 1. Microplastic abundance ratio (expressed in relation to the topmost sample) as a
164 function of average sampling depth (m). Between 0 and 0.2 m (blue dots), no trend was
165 apparent and a constant microplastic rate was approximated for this depth range. Between
166 0.2 and 1 m (orange dots), a decreasing pattern was highlighted.

167 3.2. Global stock of microplastics in soils

168 The median abundance of microplastics (C_s) of the 442 sites analysed was 1,245 items.kg⁻¹,
169 and the $C_{s0.25}$ and $C_{s0.75}$ values were 532 and 2,263 items.kg⁻¹ respectively (Tab. 2). For sites
170 subject to contamination using wastewater for irrigation, the concentration (C_{sewage}) could
171 therefore be between 456 and 1,938 mg.m⁻³, with a median value of 1,066 mg.m⁻³. For sites
172 subject to contamination via plastic mulching activities, $C_{mulching}$ was higher and ranged from
173 2,432 to 10,347 mg.m⁻³, with a median value of 5,692 mg.m⁻³.

174 Table. 2. Summary table of number and mass concentrations and stocks of plastic according
175 to the source considered.

	Abundance (Items.kg ⁻¹)		Concentration (mg.m ⁻³)	Area (m ²)	Total mass (Mt)
Sewage	Cs _{0.75}	2,263	1,938	2.22 10 ¹²	4.31
	Cs	1,245	1,066		2.37
	Cs _{0.25}	532	456		1.01
Plastic mulching	Cs _{0.75}	2,263	10,347	2.18 10 ¹¹	2.26
	Cs	1,245	5,692		1.24
	Cs _{0.25}	532	2,432		0.53
Total (Sewage and plastic mulching)	Cs _{0.75}	2,263	-	2.44 10 ¹²	6.56
	Cs	1,245	-		3.61
	Cs _{0.25}	532	-		1.54

176 On a global scale, soil contamination by plastics represented a total mass that could be
177 between 1.0 Mt and 4.3 Mt for inputs from wastewater and between 0.5 and 2.3 Mt for
178 those related to plastic mulching. The total stock, considering both types of inputs, was
179 estimated to be between 1.5 and 6.6 Mt of microplastics, with a median value of 3.6 Mt.
180 There is no other estimate of the global mass of microplastics in soils with which to compare
181 these results. In the context of the aquatic environment, for which the state of knowledge is
182 more advanced, several estimates have been proposed for microplastics floating on the
183 ocean surface (Tabl. 3). The comparison of these estimates with the one proposed for soil
184 shows that the mass of microplastics in agricultural soils could be one to two orders of
185 magnitude higher than of the ocean surface. Moreover, the mass of microplastics in soils
186 could be greater than the total mass of all plastics (micro, meso and macroplastics) on the
187 ocean surface (0.9 to 2.5 Mt) (Lebreton et al., 2019). This result underlines the importance
188 that research on microplastics in soil should have. In fact, while the research on

189 microplastics in the marine environment now seems well established, research on
 190 microplastics in the soil compartment is more discreet, especially outside China. This
 191 observation is all the more worrying as microplastic contamination is not neutral for soils
 192 since they are likely to impact their structure, as well as the living beings that depend on
 193 them (Guo et al., 2020; Mbachu et al., 2021; Wang et al., 2020). Furthermore, from a human
 194 perspective, the contamination of agricultural soils by microplastics endangers our food
 195 production (Ng et al., 2018; Rillig et al., 2019). Maintaining a good quality of agricultural soils
 196 represents a crucial issue for our societies. Finally, although significant, the mass of
 197 microplastics calculated for agricultural soils may only represent about 0.07% of the 4,900
 198 Mt of plastics thrown away between 1950 and 2015 (Geyer et al., 2017). It can be concluded
 199 that out of this mass, a relatively small fraction of our plastics could end up as diffuse
 200 microplastic pollution of agricultural soils. The other fraction, concentrated and buried in
 201 landfills, could represent hot spots of plastic pollution in soils and whose stock has yet to be
 202 assessed.

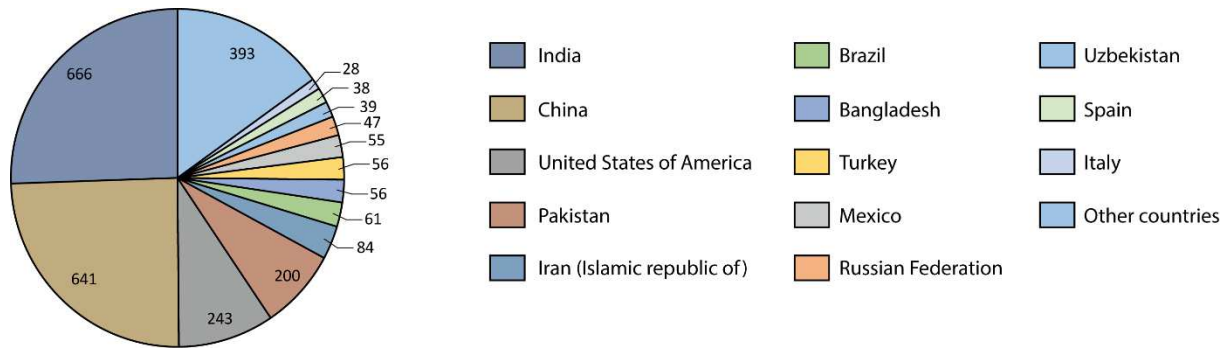
203 Table. 3. Estimated mass of microplastics on the ocean surface based on scientific literature.

Estimated mass of microplastics on the ocean surface (kt)	References
250	(Eriksen et al., 2014)
93 to 236	(van Sebille et al., 2015)
490	(Everaert et al., 2018)
290 to 800	(Lebreton et al., 2019)

204

205 3.3. Microplastic stocks by state or geographic region

206 The countries practising the most irrigation with wastewater are probably also among the
207 most exposed to microplastic contamination. This is mainly true in Asia where irrigation is
208 highly developed. This could result in a stock of more than 660 kt of microplastics in the soils
209 of India and about 640 kt for those of China ($C_{sewage} = 1,066 \text{ mg.m}^{-3}$) (Fig. 2). Other countries
210 of the Asian continent could also be greatly affected, like Bangladesh (56 kt) or Uzbekistan
211 (39 kt). Some North and South American countries could also be very exposed, such as the
212 United States of America (250 kt), Brazil (61 kt) and Mexico (55 kt). In the Middle East,
213 countries such as Pakistan, Iran, or Turkey could be potentially impacted by this
214 contamination with respectively 200 kt, 84 kt and 56 kt. Finally, in Europe, the countries
215 around the Mediterranean Sea such as Spain and Italy could be the most impacted with
216 respectively 38 kt and 28 kt. Because of its immense territory, the stock of microplastics in
217 Russian soils could also be significant (47 kt). The lack of assessment of microplastic stocks in
218 soils limits the validation of our estimations. In 2021, Brandes and colleagues sought to
219 model the input of microplastics into German agricultural soils (Brandes et al., 2021). They
220 estimated the stock of microplastics in Germany to be about 58 kt, of which about 45 kt
221 came from sewage sludge. For this country, our calculations give a stock lower by an order of
222 magnitude (3.8 kt). This difference could be explained by the median value of the
223 microplastic abundance, which is highly influenced by the large amount of data from China,
224 leading to a potential lack of representativeness. Consequently, if the actual abundance of
225 microplastics into German soils is much higher than in China, the total stock of microplastics
226 in German soils may have been underestimated.



227

228 Fig. 2. Distribution of microplastic stocks (kt) from crop irrigation with wastewater.

229 Regarding plastic mulch, the huge area cultivated in China (18 Mha) means that potentially
 230 93% of the stock of microplastics from this type of source could be found in Chinese soils (i.e.
 231 1.16 Mt, if we consider $C_{mulching} = 5,692 \text{ mg}\cdot\text{m}^{-3}$). Therefore, the rest of Asia and the Pacific
 232 would represent no more than 3% (36 kt) of the stock, Europe 1.7% (20.7 kt), the Middle
 233 East 1.3% (7.5 kt), the Americas 0.6% (7.5 kt) and Africa less than 0.04% (0.5 kt). In 2021, Ren
 234 and colleagues developed a model to estimate the stock of microplastics from plastic
 235 mulching practices in Chinese soils and estimated it to be about 4.9 to 10 Mt (S.-Y. Ren et al.,
 236 2021). The value obtained in our work was therefore lower, but of the same order of
 237 magnitude as the value proposed in the study of Ren and colleagues. As can be seen here,
 238 China could be one of the most exposed countries to plastic pollution and, considering the
 239 potential overlap of irrigated and plastic mulched areas, might have accumulated a
 240 microplastic stock of about $1.6 \pm 0.3 \text{ Mt}$.

241 3.4. Limitations to the assessment of the microplastic stock in the soil compartment.

242 How robust were the data and calculation used in our study? A similar problematic was
 243 already raised by Büks and Kaupenjohann in 2020, in an article in which they reported
 244 various limitations to the use of available data (Büks and Kaupenjohann, 2020). One of the
 245 main limitations identified stems from the heterogeneity of protocols used to study

246 microplastics (e.g. soil sample collection, extraction, characterisation, size range of particles
247 studied). This disparity, and the lack of intercomparability tests between the different
248 methodologies, probably result in biases in the microplastic abundances used to calculate
249 the global stock. It is important to note that certain steps in the extraction and
250 characterisation of microplastics are known to potentially lead to over- or under-estimations
251 of microplastic abundance. For example, since the abundance of microplastics varies with
252 depth, and at the same time the height and depth of soil samples vary from publication to
253 publication, it is likely that the final abundance depends in part on the authors' sampling
254 choices (Büks and Kaupenjohann, 2020). In this case, Büks and Kaupenjohann consider that
255 this methodological bias is likely to lead to an overestimation of the final microplastic
256 abundance (Büks and Kaupenjohann, 2020). On the contrary, the steps of extraction or
257 characterisation of the polymer chemistry seem rather likely to lead to an underestimation
258 of the microplastic abundance (Büks and Kaupenjohann, 2020). According to these previous
259 conclusions, the relationship between microplastic mass and particle number was limited
260 both by the amount of data available to establish the right-hand equations and by the
261 diversity of the microplastic sources studied. Moreover, the general tendency observed in
262 the scientific literature of the last two years seems to be to no longer propose the
263 abundance results in the form of two different units. The results are nowadays most often
264 expressed in a number of microplastics per unit of dry soil mass.

265 Beyond the limitations identified by Büks and Kaupenjohann (Büks and Kaupenjohann,
266 2020), others, specific to our study, must also be pointed out. First, there is uncertainty
267 about the values of irrigated surface areas, as well as those cultivated under plastic cover. In
268 particular, the surface area of agricultural soil cultivated under plastic cover is increasing
269 very rapidly in China, so the area used in this publication may have been underestimated

270 (Zhu et al., 2013). The analysis of satellite images combined with the use of GIS tools (i.e.
271 Geographic Information System) would certainly allow a better calculation of the agricultural
272 soil surfaces exposed to plastic pollution (Brandes et al., 2021; Zhu et al., 2014). This could
273 also allow for a better assessment of soil surfaces affected by other sources of microplastics
274 (e.g. microplastic rainfall, transport activities, organic fertiliser applications such as
275 biowaste). In the end, the likely underestimation of continental surfaces exposed to plastic
276 pollution may have led to an underestimation of the global stock of microplastics in soils in
277 this study. The second important limitation is that the global stock was calculated from data
278 mainly coming from Chinese soils. This necessarily raises the question of the
279 representativeness of these data. Consequently, it is not unreasonable to think that the
280 acquisition of data from other regions of the world, or representative of more diverse
281 agricultural practices, is likely to result in a C_s diverging from that obtained here. In the case
282 of surfaces affected by irrigation, different factors, such as the accessibility of plastic
283 materials (eg. clothing made of synthetic fibres, plastic packaging), the type of agricultural
284 practice, or even wastewater management practices, probably modulate the extent of
285 contamination. Finally, it would be relevant to integrate more diverse sources of
286 microplastics into the calculations. This would require, among other things, having the
287 necessary data to perform the conversion step from abundance in number to concentration.
288 However, this kind of research is scarce, and generally, only concerns soils exposed to
289 mulching or sewage.

290 4. Conclusion

291 Research on plastic pollution in soils has started more recently than on the ocean surface
292 and, unlike the latter, no attempt to assess the stock has yet been made. However, this

293 information is important because it could help focus attention on an environmental matrix
294 for which the extent of microplastic contamination remains poorly understood. Based on the
295 methodology previously developed by Büks and Kaupenjohann (Büks and Kaupenjohann,
296 2020), our study collected data on microplastic abundances in soils from the scientific
297 literature. These data allowed us to estimate that the global median stock of microplastics in
298 soils could be of the order of 3.6 Mt, which is one to two orders of magnitude higher than
299 what has been estimated for microplastic stocks at the ocean surface. However, this result
300 must be tempered as there are many limitations to the knowledge acquired on microplastics
301 in the soil compartment. This work is therefore a very preliminary attempt to assess the
302 global stock of microplastics and must be viewed with some caution, particularly in view of
303 the various limitations identified. Nevertheless, this work has the merit of setting a
304 milestone, and of highlighting the research that needs to be carried out to improve this
305 assessment. Notably, it seems urgent to better assess the state of soil contamination outside
306 China, and to understand better the state of pollution of soils subjected to different sources
307 of microplastics.

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