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## **Gaps and overlaps between sustainability science and the environmental humanities**

Julien Blanco, Clémence Moreau, Stéphanie M. Carrière, Elodie Fache, Miriam Cué Rio, François Calatayud, Jean-Christophe Castella, Pierre-Yves Le Meur, Emilie Coudel, Dominique Hervé, et al.

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1 **Title Page**

2  
3 **Title:** Gaps and overlaps between sustainability science and the environmental humanities

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24 **Abstract**

25 Given the wicked environmental and sustainability challenges we face today, the need for a cross-  
26 disciplinary, science–society approach is increasingly undisputed. Yet is the development of the  
27 distinct research fields of sustainability science (SustSci) and the environmental humanities (EnvHum)  
28 another example of academic silos? In this study, we conducted a comprehensive science mapping of  
29 the literature to explore the overlap or compartmentalization of these fields. Standardized search  
30 strings submitted in the Web of Science allowed us to gather a total of 2076 publications, including  
31 1678 for SustSci and 398 for EnvHum, from which we explored the social, intellectual and conceptual  
32 structures of the two fields. The results indicated that SustSci and EnvHum are nourished by distinct  
33 research communities (distinct authors and journals) and rely on different epistemological legacies. In  
34 addition, results showed that the two research fields focus on similar challenges (e.g., climate change  
35 and biodiversity decline) but with contrasting approaches. SustSci combines natural and social  
36 sciences to address sustainability as a systemic problem, while EnvHum combines social sciences and  
37 the humanities, approaching it as a power and values issue. Nonetheless, a comprehensive analysis  
38 suggested that they also share key aims: bridging the nature–culture divide, transforming socio-  
39 political relationships, and taking into account values, affects and imaginaries. In light of these results,  
40 we finally discuss the opportunities and challenges for mutual enrichment between SustSci and  
41 EnvHum around these three shared goals, which might foster a strengthened response to the crises we  
42 face.

43

44 **Keywords:**

45 Anthropocene; Interdisciplinary approaches; Human-nature relationships; Quantitative review;  
46 Science mapping; Science-society interface.

47

48

## 49 **Introduction**

50 To prevent us from crossing planetary boundaries, do we first need to traverse academic ones? For  
51 several decades now, scientists and humanities scholars are arguing for the necessity of this in order to  
52 address complex environmental and sustainability problems. One disciplinary silo it is thought to be  
53 important to dismantle is between the so-called natural and social sciences (Machlis 1992), as  
54 environmental and sustainability issues are intrinsically social-ecological – neither purely biophysical  
55 nor purely social. Another concerns the divide between science and society, which is increasingly  
56 acknowledged as critical to bridge to address wicked environmental and sustainability issues that have  
57 a plethora of causes and plausible solutions (Funtowicz and Ravetz 1991).

58 Several research fields illustrate the academic community’s efforts to embrace a more inter- and  
59 transdisciplinary approach. For instance, ecological economics integrates ecological and economic  
60 sciences to address challenges related to human well-being, sustainability and justice. Ethnobiology  
61 merges social and cultural anthropology and various environmental sciences to study the dynamic  
62 relationships between people and their environments. Environmental history combines multiple  
63 disciplines to explore the changing relationships between humans and their environments over time.  
64 Environmental psychology examines the psychological processes involved in the relations between  
65 people and their physical surroundings. Such inter- and transdisciplinary research fields are today very  
66 diverse, and structured through a diversity of scientific journals and academic programs around the  
67 world. They all share a common ambition: to foster dialogue between their core disciplines and other  
68 disciplines (and sometimes, other forms of knowledge and ways of knowing) to better understand and  
69 analyse environmental and sustainability issues.

70 More recently, two labels and research fields have gained momentum within the academic community,  
71 fostering an inter- and transdisciplinary shift more significantly than previous efforts: sustainability  
72 science (SustSci) and the environmental humanities (EnvHum). SustSci, which can be tracked back to  
73 2001, aims to unite scholars interested in “the dynamic interactions between nature and society”  
74 (Kates et al. 2001, p. 8059). It encompasses a vast array of research on social-ecological systems,  
75 ecosystem services, resilience, and more (Clark and Harley 2020), but not necessarily embrace all  
76 research on sustainability issues. Indeed, the first hallmark of SustSci is to be both about and for  
77 sustainability: it is a problem-driven and solution-oriented science explicitly aimed at promoting  
78 sustainable development. The second hallmark is its interdisciplinary – or at least ‘interdisciplinary-  
79 ready’ – approach and its goal of strengthening the connections between science and policy (Clark and  
80 Dickson 2003; Spangenberg 2011). EnvHum, on the other hand, has arisen from the “growing  
81 willingness to engage with the environment from within the humanities and social sciences” (Rose et  
82 al. 2012, p. 1). The aims of EnvHum are (i) to enrich environmental research with a broader  
83 conceptualization of the historical, social, cultural, political and ethical dimensions (among others) of  
84 environmental issues, while (ii) challenging the ‘human exceptionalism’ that has prevailed in the social

85 sciences and the humanities (Rose et al. 2012). Like SustSci, EnvHum is not anchored in one or a few  
86 disciplines but embraces a vast range of disciplines from the social sciences – i.e. disciplines that use  
87 scientific methods to study human behaviours and societies such as sociology, psychology, economics,  
88 political science, and anthropology – and the humanities – which explore human culture, thought, and  
89 expression through a more interpretative and analytical lens, including disciplines such as literature,  
90 philosophy, history, arts, and religious studies.

91 Arising around the same time, both SustSci and EnvHum have been structured through research  
92 programs, dedicated journals, undergraduate and postgraduate training programs and conferences  
93 worldwide (Nye et al. 2013; Clark and Harley 2020). Unlike the other interdisciplinary research fields  
94 mentioned earlier, the two emerging fields are not centred around a core discipline but rather advocate  
95 for taking a broader interdisciplinary approach. From this perspective, they are sometimes seen as  
96 efforts to connect scattered research fields interested in environmental and sustainability issues, which  
97 would ultimately become “sub-fields” of SustSci and/or EnvHum (Clark and Dickson 2003; Rose et  
98 al. 2012). Another hallmark of the two fields is their emphasis on the importance of a science–society  
99 dialogue (Nye et al. 2013). As suggested by Neimanis et al. (2015), the emergence of SustSci and  
100 EnvHum can be seen as a step further towards trans- and postdisciplinarity in order to better address  
101 wicked environmental and sustainability problems.

102 Yet does the mere existence of SustSci and EnvHum as distinct labels and research fields attest to  
103 another example of academic compartmentalization? Not necessarily if, as some scholars have claimed  
104 (Sörlin 2012), SustSci and EnvHum make an effort to intersect and scholars from both fields  
105 collaborate with one another. In this study, a research group including scholars from both fields sought  
106 to examine to what extent this exchange exists and to identify un(der)explored cross-fertilization  
107 opportunities between the fields. To this end, we conducted a comprehensive science mapping of the  
108 literature published to date (to 2021) in the fields of SustSci and EnvHum with a threefold objective.  
109 The first aim was a better understanding of the structures underlying both research fields: social (who  
110 contributes), intellectual (who inspires) and conceptual (what topics are addressed and how). A second  
111 aim was to identify the key differences and similarities between the two fields. Based on these results,  
112 we complemented science mapping analyses by full-text readings of publications in both fields to  
113 identify and discuss the potential for cross-fertilization between SustSci and EnvHum. The results of  
114 this study aim to foster mutual understanding between these two currently poorly connected yet  
115 potentially complementary research fields, ultimately helping to better address current environmental  
116 and sustainability challenges.

117

## 118 **Materials and methods**

### 119 *Study design*

120 This study relies on the combination of (i) standardized science mapping analyses of SustSci and  
121 EnvHum literature, and (ii) a comprehensive approach informed by our initial understanding of the  
122 literature and a full-text reading of 128 references. This dual approach aimed to overcome the  
123 limitations of quantitative review methods, such as their tendency to overlook insights that are only  
124 present in full texts (Fang et al. 2024), and to enrich our result interpretation and associated discussion.  
125 In this first methodological subsection, we briefly explain this global study design, before detailing the  
126 steps of the science mapping analysis in the next subsections.

127

128 **Science mapping analysis.** To perform reliable and reproducible science mapping analyses of SustSci  
129 and EnvHum literature, we applied the standard workflow described by Aria and Cuccurullo (2017)  
130 and summarized in Fig. 1. A key challenge in initiating this analysis and developing a relevant search  
131 strategy was the fuzzy boundaries of SustSci and EnvHum, which, to our knowledge, are not  
132 consensually defined by the academic community. Firstly, this fuzziness prevented us from making  
133 robust decisions on which research themes, approaches and journals belonged to SustSci, EnvHum, or  
134 neither. For instance, while ecological economics or social-ecological system research could be easily  
135 associated with SustSci rather than EnvHum, it was more difficult to reach an uncontested decision for  
136 fields such as political ecology or environmental justice research, which are claimed by both SustSci  
137 and EnvHum (Rose et al. 2012, p. 1; Clark and Harley 2020, p. 14.6). Secondly, an ethical and  
138 deontological debate emerged regarding whether it is appropriate to classify certain scholars within  
139 specific fields if the scholars themselves did not identify as such. For instance, we considered that not  
140 all scholars in environmental sustainability would consider themselves part of SustSci given that  
141 environmental sustainability research predates the apparition of SustSci as a label. Similarly, not all  
142 scholars in environmental anthropology or posthuman humanities would identify with EnvHum. There  
143 was, therefore, a risk of placing scholars into categories that do not accurately reflect their work.  
144 Thirdly, we recognized that defining the content and boundaries of SustSci and EnvHum based on our  
145 ‘expert’ opinion introduced a high risk of circular reasoning: our results would have been influenced  
146 by our preconceptions, thereby confirming them. For example, if we decided to categorize political  
147 ecology as part of EnvHum rather than SustSci, it could have led to the conclusion that EnvHum paid  
148 more attention to power dynamics than SustSci, primarily due to this initial categorization.

149 Given these challenging choices and our desire to avoid the influence of our own preconceptions and  
150 biases regarding the respective content of SustSci and EnvHum as well as the boundaries between the  
151 two, we opted for a non-normative approach to identify the two literature corpora used for the science  
152 mapping analyses. Specifically, we searched for publications that make explicit reference to these

153 fields. For SustSci, we included all references and journals that use the terms ‘sustainability  
154 science(s)’ or ‘science for sustainable development’ (this second term being found in some early  
155 publications of the field, e.g. Gallopín et al. 2001). For EnvHum, we included those that use the terms  
156 ‘environmental humanities’ or ‘ecological humanities’ (the two terms being considered as synonyms,  
157 e.g. Rose et al. 2012). To ensure transparency and reproducibility, the search strings we used are  
158 detailed in Table S1.

159

160 **Qualitative approach.** The discussion developed in this paper is based on our interpretation of the  
161 outcomes of the science mapping analyses and on a qualitative analysis of key literature. Specifically,  
162 the three subsections of the discussion, which highlight areas of convergence between the two fields,  
163 rely on our interpretation of the keyword and abstract analyses presented in the Results section.  
164 Additionally, we deepened our initial understanding of SustSci and EnvHum literature through  
165 targeted readings of 128 references, including the 15 most cited in each field (cf. the list provided in  
166 Table S2), 65 references in SustSci, and 33 references in EnvHum. Together with the literature  
167 familiar to each co-author, these readings allowed us to capture more subtle dynamics and enrich the  
168 Discussion section, which yet does not aim to be a qualitative analysis per se.

169

#### 170 Standardized literature search

171 **Literature database selection.** We used the Web of Science (WoS) database to identify relevant  
172 references and populate our literature corpuses. This choice was motivated by the fact that WoS (i) is  
173 one of the most complete international databases for scientific peer-reviewed publications, (ii) offers  
174 powerful search engines, and (iii) it includes a large set of metadata that allows detailed science  
175 mapping analyses. Notwithstanding certain inherent limitations (see ‘SI. Supplementary methods’),  
176 these characteristics make WoS – together with Scopus – the most used database for bibliographic  
177 syntheses and meta-analyses (Zhu and Liu 2020), including in the domain of sustainability science  
178 (Kajikawa et al. 2017; Fang et al. 2018). Yet because the choice between WoS and Scopus was shown  
179 to have an impact on the outcomes of science mapping analyses (Echchakoui 2020), we checked the  
180 robustness of our findings by reproducing our key analyses based on literature corpuses obtained from  
181 Scopus (see ‘SI. Supplementary results’).

182 **Literature corpus identification and pre-processing.** Searches in the WoS were submitted on 2  
183 February 2022 and targeted all publications up to and including 2021 that are indexed in the WoS  
184 Core Collection. Using the WoS export tool, we then exported all available metadata (full record and  
185 cited references) for all identified references in BibTex files. Data was then imported in the R  
186 environment (R Core Team 2023), which resulted in two distinct literature corpuses: the SustSci

187 corpus (2274 references before screening) and the EnvHum corpus (500 references). Two specific  
188 packages were then used for data screening and analyses: *bibliometrix* (version 3.1.4), which provides  
189 a set of quantitative research tools in bibliometrics and scientometrics (Aria and Cuccurullo 2017), and  
190 *dplyr*, which offers a grammar of data manipulation (Wickham et al. 2022). Document screening was  
191 performed through successive steps (Fig. 1). First, we removed the references with no information  
192 about author(s) or publication year. Second, we used the *duplicatedMatching* function (*bibliometrix*  
193 package) to filter duplicates on the basis of the reference's Digital Object Identifier (DOI) and title.  
194 From the resulting list, we chose to focus solely on articles, editorial materials and reviews for our  
195 subsequent analyses to work with the highest standard publications and with relatively homogeneous  
196 corpora (e.g., when they exist, book abstracts are substantially different from article abstracts). This  
197 choice was also motivated by our observation that articles, editorial materials and reviews represented  
198 the large majority of the EnvHum and SustSci corpora: 95.9% and 81.1% respectively (Fig. S1). The  
199 remaining 18.9% of publications in SustSci were dominated by 'Not Available' document type  
200 (13.0%, Fig S1). This selection process resulted in a final SustSci corpus containing 1678 references,  
201 and an EnvHum corpus containing 398 references (Fig. 1). As books and book chapters represented  
202 only 1.2% of the EnvHum corpus and 1.4% of the SustSci corpus, we were confident about the limited  
203 quantitative impact of not including them in our analyses and results, which was confirmed by the  
204 results obtained through Scopus ('SI. Supplementary results').

205

### 206 *Bibliographic description and comprehensive mapping of literature*

207 A first set of analyses aimed to explore the social and intellectual structures of SustSci and EnvHum  
208 and essentially relied on *bibliometrix* functions. To analyse their respective conceptual structures on  
209 the basis of their keywords, we used VOSviewer software (van Eck and Waltman 2010), which allows  
210 the creation of a thesaurus in order to merge certain keywords together and reduce the analytical voice  
211 generated by different spellings or variants of the same term (see below).

212 **Descriptive analyses and social structure.** For each field, we explored the change over time in the  
213 annual number of publications, as well as the most represented journals and the top contributing  
214 authors. We also used the function *authorProdOverTime* from *bibliometrix* to generate an analysis of  
215 the number of publications and citations of key authors. Taken together, the analyses of key  
216 contributing journals and authors allowed us to evaluate and compare the social structures of SustSci  
217 and EnvHum.

218 **Intellectual structure.** We approached the analysis of SustSci and EnvHum intellectual structures by  
219 analysing the publications and works most cited in each of the two fields. We assumed that if SustSci  
220 and EnvHum publications cited similar authors and publications, then their intellectual structure would  
221 be similar, and vice versa. To this end, we exported the lists of all authors and references cited in each

222 field from the *biblioAnalysis* function, and after cleaning the data we compared the most cited authors  
223 and references between the two fields. Because this analysis relied on the list of references cited in  
224 each document, it was performed only on the documents for which we had this information: 1654  
225 references for the SustSci corpus and 390 references for the EnvHum corpus.

226 **Conceptual structure.** This last aspect was approached by analysing author keyword co-occurrence  
227 within each research field; this was available in 1449 SustSci documents and 289 EnvHum documents.  
228 As a preliminary step, we created a keyword thesaurus (Table S3) that aimed to (i) merge together  
229 singular and plural forms of the same keyword (e.g. ‘ecosystem service’ and ‘ecosystem services’); (ii)  
230 merge together different spellings of the same keyword (e.g. ‘socio-ecological system’ and ‘social-  
231 ecological system’), (iii) merge together similar ideas (e.g. the terms ‘transdisciplinary’,  
232 ‘transdisciplinary collaboration’, ‘transdisciplinary research’ and ‘transdisciplinary science’ were  
233 consolidated into the single keyword ‘transdisciplinarity’), and (iv) ignore keywords referring to  
234 geographic areas (e.g. ‘Alaska’). The most frequent keywords within each field were then highlighted  
235 in a keyword cloud that we used to identify the most salient topics respectively investigated by SustSci  
236 and EnvHum.

237

### 238 Lexical analyses

239 As we considered that keyword analyses might be too archetypal due to the intrinsically reductionist  
240 nature of keywords, we conducted a lexical analysis on available abstracts with the IramuteQ software  
241 (<http://www.iramuteq.org/>). Because the EnvHum corpus was relatively small compared to the SustSci  
242 corpus, we pooled them together for this analysis in order to ensure statistical robustness. The two  
243 corpuses were then compared on the basis of their lexical properties. For this, we conducted an  
244 analysis similar to Reinert ALCESTE methodology that involved descendant hierarchical cluster  
245 analysis (DHCA) (Reinert 1986). This consisted of performing a multivariate analysis close to  
246 correspondence analysis from a table containing the abstract identifiers in rows and the different terms  
247 the abstracts contained in columns. Accordingly, the more two abstracts shared a common lexicon, the  
248 more likely they were to be put in the same lexical class by the analysis. This lexicon was projected in  
249 a multivariate space, highlighting the ‘lexical world’ (i.e., main discourse themes) to which the  
250 abstracts contribute. Each lexical class was characterized by the presence/absence of certain words, or  
251 by the corpus to which its contributing abstracts belong (either the EnvHum or the SustSci corpus),  
252 using chi-square comparison tests. The content of a class was explored through the relative frequency  
253 of certain terms (the ratio between the number of abstracts classified in the class where these terms  
254 appear, and the total number of abstracts where these terms appear).

255

## 256 **Results**

### 257 Two distinct research communities

258 The first finding was that there was no overlap between the two SustSci and EnvHum corpuses we  
259 identified through the WoS search: no publication was found to belong to both corpuses. The fields of  
260 SustSci and EnvHum were also found to rely on distinct research communities. Both emerged as  
261 defined research fields at the beginning of the 2000s, with SustSci exhibiting a stronger presence  
262 initially – the number of publications in EnvHum indexed in the WoS would not become substantial  
263 until a decade later (Fig. 2a). Today, each has an eponymous journal that is central to the field:  
264 *Sustainability Science* (launched in 2006; constituting 41.7% of the SustSci corpus), and  
265 *Environmental Humanities* (launched in 2012; 47.2% of the EnvHum corpus). While many other  
266 journals contain articles relevant to either field (329 journals for SustSci and 140 for EnvHum;  
267 Table 1), only 28 journals were found to contribute articles to both (Table S4). Of these, only two  
268 were in the top 15 contributing journals: *Ambio* and *GAIA-Ecological Perspectives for Science and*  
269 *Society* (Fig. 2b).

270 The two research communities also have distinct contributing authors and publication practices. We  
271 found that SustSci and EnvHum had no researchers in common among their respective top 20 authors  
272 (Fig. 2c), and only one author substantially contributed to both fields (Table S5). Not surprisingly, key  
273 authors from SustSci mainly have a background in natural and environmental sciences, whereas  
274 EnvHum authors are mainly scholars from the social sciences and the humanities. Finally, SustSci is  
275 characterized by a predominance of multi-author publications and relatively high individual  
276 production, whereas EnvHum has a majority of single-author publications and lower individual  
277 production in indexed literature sources (Fig. 2c; Table 1).

278

### 279 Two distinct epistemological legacies and aims

280 The analysis of the authors and publications most cited in each field revealed an important  
281 epistemological gap between SustSci and EnvHum (Fig. 2d). While SustSci is situated at the  
282 intersection between natural and social sciences, with little integration of the humanities, EnvHum sits  
283 at the intersection between social sciences and the humanities, with a less visible integration of the  
284 natural sciences.

285 As seen in Fig. 2d, SustSci literature is mainly inspired by influential scholars working in the fields of  
286 ecological economics, resilience, complex systems, and science–policy interface. In contrast, EnvHum  
287 literature primarily refers to academics interested in ecofeminism and posthumanism, philosophy,  
288 relational anthropology, political science, and environmental history. Quantitatively speaking, the two  
289 research fields have different legacies and no common flagship luminaries.

290 In emphasizing on the references they cite, we found that the two fields have 1.38% references in  
291 common (i.e., 1294 references on a total of 93,808). In addition, by focusing on the references cited by  
292 >1% of the two corpus (i.e., a total of 493 references), only 8 references were found in common (these  
293 references are provided in Table S6). Thus, both author- and reference-level analyses highlighted a  
294 contrast in the so-called ‘intellectual structure’ of SustSci and EnvHum, with yet a thin overlap.

295 In an analysis of co-citation links within each field, we found that SustSci seems more effective at  
296 unifying research than EnvHum. The large majority of SustSci publications are explicitly affiliated to  
297 two papers (Kates et al. 2001; Gallopín et al. 2001) published in 2001 that seem to be the starting point  
298 of SustSci as a defined research field (Fig. S2). This illustrates an aim of SustSci to unify research on  
299 the “dynamic interactions between nature and society” (Clark and Dickson 2003) and to build a shared  
300 analytical framework (e.g., see the integrated framework proposed in Clark and Harley 2020). In  
301 contrast, from the articles indexed in WoS, EnvHum was found to have several filiations (Fig S3),  
302 including an essay by Sörlin (2012) and an article by Palsson et al. (2013). It thus seems that EnvHum  
303 has a less pronounced unifying aim, favouring plurality over establishing a dominant approach  
304 (Schmidt et al. 2020).

305

### 306 *Diverging perspectives and discourses*

307 The analysis of keyword occurrences within each research field suggested that SustSci and EnvHum  
308 focus on similar environmental and sustainability challenges, but with contrasting visions (Fig. 3;  
309 Table S7).

310 Predictably, in both SustSci and EnvHum, the challenges of climate change and biodiversity  
311 conservation are central topics. Yet EnvHum is also concerned about how these challenges are socially  
312 constructed and culturally situated: for example, by analysing how they are understood and shared in  
313 literature (e.g., ‘ecocriticism’), or by discussing related concepts such as the ‘Anthropocene’. Based on  
314 the most frequently used keywords, this critical thinking is less prevalent in SustSci (for instance, the  
315 term ‘Anthropocene’ is part of author keywords in only 16 publications of the SustSci corpus;  
316 Table S7).

317 Author keywords further highlight EnvHum’s emphasis on the power and domination dynamics  
318 among humans (e.g. ‘colonialism’, ‘slow violence’, ‘feminism’) and between humans and nonhumans  
319 (e.g. ‘posthumanism’, ‘ecofeminism’), as well as on the affective and imaginative dimensions of  
320 multispecies relations (e.g. ‘art’, ‘affect’, ‘poetry’). In contrast, keywords used in SustSci emphasize  
321 complex systemic approaches (e.g. ‘social-ecological systems’, ‘methodology’, ‘scenario  
322 planning/analysis’), utilizing different sources of knowledge (e.g. ‘transdisciplinarity’, ‘knowledge co-

323 production', 'participation'), and the need to have an impact outside research spheres (e.g. 'higher  
324 education', 'policy').

325 The distinction between SustSci and EnvHum was also evidenced by their respective lexical worlds  
326 and discourses. Of the 1524 available abstracts included for the lexical analyses, 1324 (86.88%) were  
327 successfully sorted by the descendant hierarchical cluster analysis classification process. The  
328 classification rate was higher for abstracts in the EnvHum corpus (98.88%) than for SustSci abstracts  
329 (84.30%). Five classes were identified, each representing between 17.75% and 22.89% of the  
330 classified abstracts (Table S8). Four of these classes were statistically associated with the SustSci  
331 corpus (chi-square tests; all  $p < 0.0001$ ), and one was statistically associated with the EnvHum corpus  
332 ( $p < 0.0001$ ), testifying of a separation of the two fields in the terms they use and in the dominant  
333 discourses they produce (Fig. 4). The five classes are briefly described below, and more descriptors  
334 are available in 'SI. Supplementary results':

- 335 - Class 1 (Transdisciplinarity and education): statistically associated with the SustSci corpus  
336 ( $p < 0.0001$ ), this class encompassed a discourse about the academic context of SustSci and  
337 appeared to be connected with considerations about inter- and transdisciplinary approaches,  
338 reflecting an overall focus on the relationship between research, education and students, and non-  
339 academic spheres;
- 340 - Class 2 (Systemic understanding for operational solutions): this class – also associated with the  
341 SustSci corpus ( $p < 0.0001$ ) – highlighted a systemic and complex thinking connected to its  
342 concrete application and influence on decision-making;
- 343 - Class 3 (Reconciling social, economic and environmental challenges): this class seemed to reflect  
344 the discourse of ecological economics, i.e. the aim to reconcile socio-economic and environmental  
345 challenges through market-based instruments and the sustainable use of natural resources. It also  
346 echoed with landscape and conservation ecology that develop discourses about concrete territories  
347 at local and regional levels. It was statistically associated with the SustSci corpus ( $p < 0.0001$ );
- 348 - Class 4 (Theoretical and epistemological considerations): this class depicted a theoretical,  
349 ontological and philosophical discourse with a clear mobilization of concepts from the social  
350 sciences (Table S9). This class was also associated with the SustSci corpus ( $p < 0.0001$ ); and
- 351 - Class 5 (Humanities and the environment): this last class was the one associated with the EnvHum  
352 corpus ( $p < 0.0001$ ) and confirmed its focus on power and domination processes, non-human  
353 beings, and arts and narratives.

354

### 355 *Despite divergences, three key areas of convergence*

356 Corroborating the keyword analysis, lexical analyses evidenced a separation between SustSci and  
357 EnvHum that denotes diverging research focus and interests. Yet, it also appeared from a more

358 qualitative understanding of their lexical worlds that this separation could be nuanced. First, as shown  
359 in Table S7, a substantial number of keywords frequently appeared in the two corpuses, testifying their  
360 common interest in topics such as environmental ethics and knowledge plurality (among other).  
361 Second, an expert-based interpretation of keywords and the topics they refer to suggested that areas of  
362 convergence between SustSci and EnvHum exist (Fig. 3). In particular, through this classification, we  
363 suggested that the two research fields share three key aims: (i) bridging the nature–culture divide, (ii)  
364 transforming socio-political relationships, and (iii) taking into account values, affects and imaginaries  
365 related to environmental and sustainability issues. As a consequence, to enrich the results obtained  
366 through science mapping analyses, we propose a discussion around these areas of convergence based  
367 on our own readings and expertise of the two research fields.

368

## 369 **Discussion**

### 370 *An emerging cross-fertilization between SustSci and EnvHum?*

371 The findings of this science mapping of the literature demonstrated that SustSci and EnvHum are two  
372 distinct research fields, whose respective communities may pursue common aims, but without much  
373 collaboration and with differing theoretical and methodological approaches. Furthermore, our analysis  
374 showed that SustSci and EnvHum offer two different perspectives on the world and current  
375 environmental challenges, with yet a thin overlap (Fig. 5). SustSci, on the one hand, tends to approach  
376 environmental and sustainability issues as heuristic challenges in an uncertain world that require  
377 systemic and transdisciplinary analyses to be accurately understood. In contrast, EnvHum pays greater  
378 attention to power and domination issues, as well as the value-oriented, affective and imaginative  
379 dimensions of a more-than-human world. It also critically analyses, in a more consistent and  
380 comprehensive way than SustSci, how environmental and sustainability knowledges and  
381 understandings are constructed by scientists (and other experts), shared with society, and placed on the  
382 political agenda.

383 We acknowledge that these findings are subject to limitations inherent in quantitative literature  
384 analyses, primarily the reliance on specific search terms to identify the literature corpuses and the  
385 scope of the data within in the selected literature databases. In our analysis, the literature corpuses and  
386 resulting data are shaped by the publications and journals indexed in WoS and Scopus. Consequently,  
387 certain journals relevant to SustSci and/or EnvHum, such as *Green Humanities*, were excluded from  
388 our analysis due to their absence from these databases. However, WoS and Scopus were chosen as the  
389 most exhaustive and authoritative academic databases for our purpose, considering the topics  
390 investigated and the compatibility of science mapping techniques. Additionally, our results are  
391 influenced by our decision to adopt a non-normative search strategy. This approach led to the

392 exclusion of potentially relevant publications that do not explicitly mention SustSci or EnvHum, such  
393 as the concept of ‘Sustainable Humanities’ proposed by Lemenager and Foote (2012). Thus, we  
394 suspect that this choice may have limited our analysis to the ‘core’ literature of SustSci and EnvHum,  
395 potentially overlooking the plurality present in more ‘peripheral’ contributions. Nonetheless, as  
396 discussed in the Methods section, this strategy appeared to be the most appropriate to avoid more  
397 significant issues, such as circular reasoning. Finally, we acknowledge that the field of EnvHum was  
398 less visible than SustSci in international peer-reviewed literature databases and was therefore more  
399 difficult to grasp with automated search strategies. For example, whereas all the articles published in  
400 the *Sustainability Science* journal since its creation in 2006 were included in WoS (in the Science  
401 Citation Index Expanded), the articles published in the *Environmental Humanities* journal between  
402 2012 and 2015 were absent from WoS as the journal is indexed in the Emerging Sources Citation  
403 Index created in 2015. As a result, the 2012 introductory editorial of *Environmental Humanities* (Rose  
404 et al. 2012) – whose first author is D.B. Rose, one of the founding and most influential figures in  
405 EnvHum (and the third most cited author, Fig. 2d) – did not appear in the analysis of co-citation links  
406 as a founder publication (Fig. S2). Nonetheless, our results relied on the analysis of a sample of more  
407 than 2,500 publications indexed in the WoS and were corroborated by the analysis of a second sample  
408 of more than 4,300 publications indexed in Scopus, which is known to offer a better coverage of the  
409 social sciences and books (see ‘Supplementary results’). Consequently, we are quite confident that our  
410 quantitative analysis relied on a sufficient number of publications to offer robust and representative  
411 results.

412 Despite the differences evidenced between SustSci and EnvHum, a qualitative and comprehensive  
413 understanding of our results allows to highlight several communalities. In particular, a simultaneous  
414 development of similar concepts, such as care and stewardship (Bellacasa 2017; West et al. 2018), can  
415 be observed in both research fields (Fig. 5). Furthermore, three key aims common to both fields can be  
416 identified from the keywords they use (Fig. 3). First, they both seek to bridge the nature–culture divide  
417 – through a socio-ecological approach in SustSci and through multispecies approaches in EnvHum, for  
418 example. Second, both fields place importance on socio-political relationships within and outside the  
419 academic sphere, as shown by their focus on transdisciplinary approaches, governance issues, and  
420 power asymmetries. Third, a key aspect of EnvHum is taking into account people’s values, affects and  
421 imaginaries, which also appears to be an emerging topic in SustSci as we will discuss below. This  
422 result illustrates the complementarity of quantitative and qualitative review approaches. It aligns with  
423 findings from similar bibliometric reviews aiming at comparing two research fields and that  
424 highlighted gaps that were then nuanced by a more in-depth qualitative analysis (Arrivabene et al.  
425 2024; Fang et al. 2024).

426 A cross-fertilisation between the two fields therefore seems to be under way – although more visible  
427 through a qualitative look than through bibliometric indicators. While this could be further explored

428 through an in-depth qualitative analysis, we will now discuss this cross-fertilization hypothesis as we  
429 are convinced it could enrich both fields and contribute to construct a more just and sustainable future.

430

### 431 *Bridging the nature–culture divide*

432 The first aspect shared by SustSci and EnvHum is that they propose a similar ontological shift away  
433 from the ‘Great Divide’ between nature and culture in traditional Western thought – a divide that has  
434 been extensively deconstructed by anthropologists as well as environmental scientists (Descola 2005;  
435 Lowe et al. 2009). However, our analysis revealed that the two fields approach this shift in contrasting  
436 ways (Table 2).

437 In EnvHum, a key challenge is to “productively rethink ‘the human’ in more than human terms”,  
438 which requires “resituat[ing] the human within the environment, and resituat[ing] nonhumans within  
439 cultural and ethical domains” (Rose et al. 2012, p. 3). In this, EnvHum borrows – sometimes explicitly  
440 (Celka et al. 2020) – from Ingold’s distinction between ‘nature’ (seeing ourselves, i.e. humans, as  
441 beings *without* a world) and ‘environment’ (seeing ourselves as beings *within* it) (Ingold 2021). This  
442 challenges the exclusion of nonhumans from the social sciences’ analysis of the human realm (Rose et  
443 al. 2012), while simultaneously breaking with the idea that nature is ‘out there’, untouched by human  
444 ideas, meanings and values. EnvHum has thus proposed multiple ways to rethink the boundaries  
445 between humans and nonhumans, including multispecies approaches (Haraway 2013), environing and  
446 dwelling concepts (Bergthaller et al. 2014; Ingold 2021), and post-humanist perspectives (Haraway  
447 2006).

448 With an opposing starting point but moving in a converging direction, SustSci thinking builds on the  
449 debate that has long animated ecological science on “whether to treat people as a part of, or apart  
450 from, nature” (Lowe et al. 2009, p. 298), with an understanding that in order to “study and manage  
451 human-dominated and -influenced ecosystems effectively, it is essential to truly (not just intuitively)  
452 understand human behaviour or activity” (Liu 2001, p. 2). This increasing consideration of human  
453 affairs by ecological sciences has gone through different phases over time (Lowe et al. 2009), and is  
454 now fully captured by the influential concept of social-ecological systems (Berkes et al. 2003).

455 Similarly, the concepts of ecosystem services (Costanza et al. 2017) and nature’s contributions to  
456 people (NCP; Díaz et al. 2018) have been introduced to emphasize the interplay and intricacy of  
457 various forms of natural and social phenomena, an approach in which scientists and practitioners are  
458 encouraged to consider humans as intimately linked to and co-dependent on their environment, living  
459 *from, with, in* and *as* a more-than-human world (O’Connor and Kenter 2019).

460 In this respect, many cross-fertilization opportunities between SustSci and EnvHum can be envisioned.  
461 For example, SustSci is still struggling to break free from utilitarian approaches and the nature–culture

462 dichotomy, as highlighted by the limitations of concepts such as nature-based solutions, ecosystem  
463 services, and more recently, NCPs (for more details on these limitations, see Schröter et al. 2014;  
464 Kenter 2018; Muradian 2021). Increased dialogue and collaboration with EnvHum scholars could help  
465 to overcome this conceptual deadlock: in particular, the ‘relational turn’ approach that emphasizes  
466 continually unfolding processes and relationships between entities rather than mere interactions has  
467 much to offer to SustSci (West et al. 2020).

468 Conversely, SustSci also has much to offer to EnvHum scholars who have called for taking “threats to  
469 liveability seriously”, and for a better recognition of the threats that all living entities – not only  
470 humans – have, and will have, to face (Tsing 2017). SustSci can provide methods and operational  
471 tools to further explore connections within and between social-ecological systems and to move  
472 towards transformative solutions. Such approaches might allow EnvHum to produce a more  
473 comprehensive understanding of the more-than-human world, which could be more effectively  
474 translated into concrete policies/actions.

475

#### 476 *Transforming socio-political relationships*

477 A core aim of both SustSci and EnvHum is to change socio-political relationships at different levels.  
478 In a reflexive perspective, both fields strive to create relationships (i) within academic spheres through  
479 interdisciplinary approaches, and (ii) between science and society by fostering the involvement of non-  
480 academic stakeholders in research (Funtowicz and Ravetz 1993). In a heuristic perspective, both fields  
481 address socio-political relationships as a research topic to better understand environmental and  
482 sustainability issues.

483 While the terms ‘interdisciplinary’ and ‘transdisciplinary’ are more frequent in SustSci literature than  
484 EnvHum literature (Tables S6), the latter does not disregard this. For example, Bruno Latour (the  
485 second most-cited author by EnvHum scholars, Fig. 2d) emphasizes the need for interdisciplinary  
486 approaches with his conceptualization of ‘hybrids’, understood as objects that combine aspects from  
487 the social and natural realms (Latour 1997). Similarly, without explicitly using the term  
488 ‘transdisciplinary’, Latour extensively questions the place of scientists and scientific knowledge within  
489 societies and with respect to other knowledge systems. So while the contrast between SustSci and  
490 EnvHum can be more semantic than substantial, this can nonetheless impede dialogue and  
491 collaboration.

492 Besides this divergence in terminology, there are deeper differences between SustSci and EnvHum  
493 regarding how (and why) they enlist inter- and transdisciplinary approaches. In SustSci, the integration  
494 of different knowledge sources is mainly applied in order to solve predefined problems and put  
495 forward more effective solutions than possible with a monodisciplinary approach; conflicts and power

496 asymmetries are less frontally addressed (Chambers et al. 2021). In contrast, EnvHum tends to adopt  
497 inter- and transdisciplinary approaches as a political tool, as a way of questioning power relationships  
498 between disciplines as well as between academic and non-academic spheres (Rigby 2019). EnvHum  
499 thus challenges the hierarchization of different regimes of ‘truth’ production (Pestre 2003) that leads to  
500 silencing marginalized disciplines and people (Spivak 1988). Ultimately, EnvHum seeks to reduce  
501 power asymmetries through innovative democratic arrangements such as cosmopolitics (Poirier 2008)  
502 and new environmental ethics (Routley and Routley 1982).

503 SustSci has long been criticized for its apolitical analysis, normative discourse, and neglect of power  
504 relationships (Cote and Nightingale 2012; Clément 2013; Fabinyi et al. 2014; Turnhout et al. 2020).  
505 Today, power and politics are emerging topics in SustSci, which is more explicitly engaging with  
506 environmental justice and ethical issues than before (Temper and Del Bene 2016). As power  
507 imbalances are central in EnvHum, this might be a valuable source of inspiration for SustSci.  
508 Conversely, approaches and methods that allow integrating natural and social data to produce social-  
509 ecological analyses have been widely developed in SustSci and could benefit EnvHum. Similarly,  
510 communicating the transformative potential of research results to practitioners and policymakers  
511 remain a challenge for EnvHum (Castree 2014; Bennett and Roth 2019). SustSci researchers’  
512 experience in interdisciplinary teamwork and in discussions with decisionmakers could enrich the  
513 scope and audience of EnvHum.

514

### 515 *Taking into account values, affects and imaginaries*

516 A third common aim of EnvHum and SustSci is to ensure the consideration of people’s values, affects  
517 and imaginaries, which “lie at the root of sustainability challenges and are fundamental to the solutions  
518 to some of the world’s greatest challenges” (Ives et al. 2020, p. 208). These considerations have  
519 always been key for EnvHum (Rose et al. 2012), as our analysis shows (Figs 2 and 3). In this field,  
520 these “not only shape emotional attitudes towards the nonhuman world, but also guide human  
521 activities” (Rigby 2019, p. 227), hence EnvHum’s efforts to go beyond the scientific dimensions of  
522 environmental and sustainability issues (Neimanis et al. 2015). For instance, EnvHum scholars pay  
523 particular attention to environmental ‘narratives’ (Schmidt et al. 2020) and counter-narratives,  
524 investigating how the environment is imagined and built by its human dwellers and how it, in turn,  
525 shapes human values, discourses and practices. This focus is reflected by the recent ‘emotional’ or  
526 ‘affective turn’ observed in EnvHum (Bladow and Ladino 2018; Häyrynen et al. 2021).

527 In SustSci, however, our quantitative analysis showed that these concerns are only an emerging topic.  
528 This could arguably reflect the predominance of cognitivism in SustSci, an approach relying on  
529 rational discourse and findings essentially reported through technical models and language at a  
530 relatively abstract level (Heinrichs 2019; Heymann 2019). Recently, SustSci has started to engage

531 with non-cognitivist approaches: for example, the NCP concept and related work on nature’s value  
532 explicitly aim at welcoming a diversity of worldviews (IPBES 2022), building on several decades of  
533 proposals from SustSci scholars (O’Neill et al. 2008; Ives and Kendal 2014; Kenter et al. 2015). Other  
534 scholars have advocated for a so-called ‘sensory SustSci’ that would better acknowledge the  
535 “multisensorial reality of human life” (Heinrichs 2019, p. 3) in order to deepen the understanding of  
536 the drivers of environmental and sustainability transformation (Heinrichs 2019; Ives et al. 2020).  
537 While this emerging agenda aims to combine cognitive scientific approaches with artistic or sensory  
538 approaches in a synergistic way (Magrane 2021), for the moment this remains too limited to be  
539 captured by literature mapping techniques. In this area, it seems clear that SustSci could take  
540 advantage of EnvHum’s longer trajectory on these issues.

541 Having said this, the contrasting perspectives of SustSci and EnvHum on these questions are potential  
542 obstacles to fruitful dialogue. Whereas EnvHum tends to focus on values, affects and imaginaries as a  
543 research topic in and of itself, SustSci tends to apprehend these mainly as a support for the technical  
544 and behavioural changes required for a sustainable transition (Bennett and Roth 2019; Ives et al.  
545 2020). As pointed out elsewhere (Woiwode et al. 2021), this utilitarian approach raises ethical  
546 questions, including a potential risk of reducing values, affects and imaginaries to a mere tool to  
547 achieve sustainability. We argue that reinforced dialogue and collaboration between SustSci and  
548 EnvHum would help to avoid such a risk.

549

## 550 **Conclusion**

551 Acknowledging the need for greater inter- and transdisciplinarity, the research fields of SustSci and  
552 EnvHum emerged in the early 2000s, positioning themselves as efforts to unite research on  
553 environmental and sustainability issues while bridging disciplinary and science–society boundaries.  
554 However, through a science mapping analysis of the literature, this work suggested that the two fields  
555 continue to exhibit academic compartmentalization. First, a lack of porosity between SustSci and  
556 EnvHum, which are grounded in distinct research communities and epistemological legacies, was  
557 evidenced. Second, these fields were found to offer differing perspectives on the world and current  
558 environmental and sustainability challenges: SustSci tends to view these as heuristic challenges in an  
559 uncertain world that require systemic and transdisciplinary analysis, while EnvHum pays greater  
560 attention to issues of power and domination, as well as the value-oriented, affective and imaginative  
561 dimensions of a more-than-human world.

562 Despite these differences, a qualitative approach of the two research fields revealed three shared aims  
563 that could serve as a basis of cross-fertilization. Both fields have developed diverse approaches to  
564 overcoming the nature–culture divide, transforming socio-political relationships, and considering of  
565 people’s values, affects and imaginaries. In particular EnvHum’s focus on power imbalances and non-

566 cognitivist approaches could inspire SustSci scholars and deserves more attention. Conversely,  
567 SustSci's integration of natural and social data, along with its tools for transformation, offer valuable  
568 insights for EnvHum. Overall, scientists and practitioners from both fields should embrace the  
569 opportunity to learn from each other, seeking consilience to address the acute and challenging  
570 environmental and sustainability issues the world faces today.

571

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577

## 578 **Author contributions**

579 All authors conceptualized and designed the study during a series of collective workshops. J.B.  
580 performed the science mapping analyses and prepared the manuscript. F.C. performed the lexical  
581 analyses. C.M., S.M.C., E.F. and M.C.R. supervised the writing of the discussion, which involved the  
582 contribution of all authors. All authors read and approved the final manuscript.

583

## 584 **Data availability**

585 The data that support the findings of this study are available from Clarivate Analytics (Web of Science  
586 Core Collection) but restrictions apply to the availability of these data, which were used under license  
587 for the current study, and so are not publicly available. Data are however available from the  
588 corresponding author upon reasonable request and with permission of Clarivate Analytics.

589

## 590 **Declarations**

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595

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**Tables**

789

790 Table 1: Bibliometric descriptors of the SustSci and EnvHum corpuses.

	<b>Sustainability science</b>	<b>Environmental humanities</b>
No. of references	1678	398
- articles	1353 (80.6%)	321 (80.7%)
- literature reviews	168 (10.0%)	11 (2.8%)
- editorial material	157 (9.4%)	66 (16.6%)
No. of sources	329	140
Timespan	2001–2021	2005–2021
Annual percentage growth rate	23.65	30.75
Average citations		
- per reference	32.6	8.3
- per reference per year	4.2	1.3
Total no. of authors	5835	595
No. of references per author	0.29	0.67
No. of authors per reference	3.48	1.49
No. of single-authored references	264 (15.7%)	281 (70.6%)

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792

793 Table 2: Selection of approaches from SustSci and EnvHum for conceiving the more-than-human  
 794 world and related environmental and sustainability issues. This selection is based on our own expertise  
 795 and is not meant to be exhaustive, but rather a tool to help researchers and practitioners further explore  
 796 the two research fields.

<b>SustSci approaches</b>	<b>EnvHum approaches</b>
<ul style="list-style-type: none"> <li>• Social-ecological systems (Berkes et al. 2003)</li> <li>• Ecosystem services (Costanza et al. 2017)</li> <li>• Nature’s contributions to people (Díaz et al. 2018)</li> <li>• Nature-based solutions (IUCN, International Union for Conservation of Nature 2020)</li> <li>• Novel ecosystems (Macdonald and King 2018)</li> <li>• Biocultural approaches (Hanspach et al. 2020)</li> <li>• Inter- and transdisciplinarity (Lang et al. 2012)</li> <li>• Knowledge co-production (Chambers et al. 2021)</li> <li>• Sensory SustSci (Heinrichs 2019)</li> <li>• Relational values (Chan et al. 2016)</li> <li>• Art-based SustSci (Heras et al. 2021)</li> <li>• Mindfulness and sustainability (Wamsler et al. 2018)</li> </ul>	<ul style="list-style-type: none"> <li>• ‘Posthuman’ perspectives (Haraway 2006)</li> <li>• Cosmopolitics (Poirier 2008)</li> <li>• New environmental ethics (Routley and Routley 1982)</li> <li>• Ontological turn (Keck et al. 2015)</li> <li>• Affective or emotional turn (Bladow and Ladino 2018; Häyrynen et al. 2021)</li> <li>• Human-scale geographies (Rigby 2019)</li> <li>• Multispecies ethnography (Haraway 2013)</li> <li>• Distributive agency (Bennett 2010; Tsing 2021)</li> <li>• Ecocriticism (Bergthaller et al. 2014)</li> <li>• Subaltern studies (Spivak 1988)</li> <li>• Ecofeminism (Gaard 1993)</li> <li>• Common world pedagogies (Taylor and Pacini-Ketchabaw 2015)</li> <li>• Postcolonial studies/approaches/ecologies (DeLoughrey et al. 2016)</li> <li>• Storytelling (Lyons and Howarth 2022)</li> <li>• Relational turn (Selg 2016; West et al. 2020)</li> <li>• Care &amp; stewardship (Bellacasa 2017; West et al. 2018)</li> </ul>

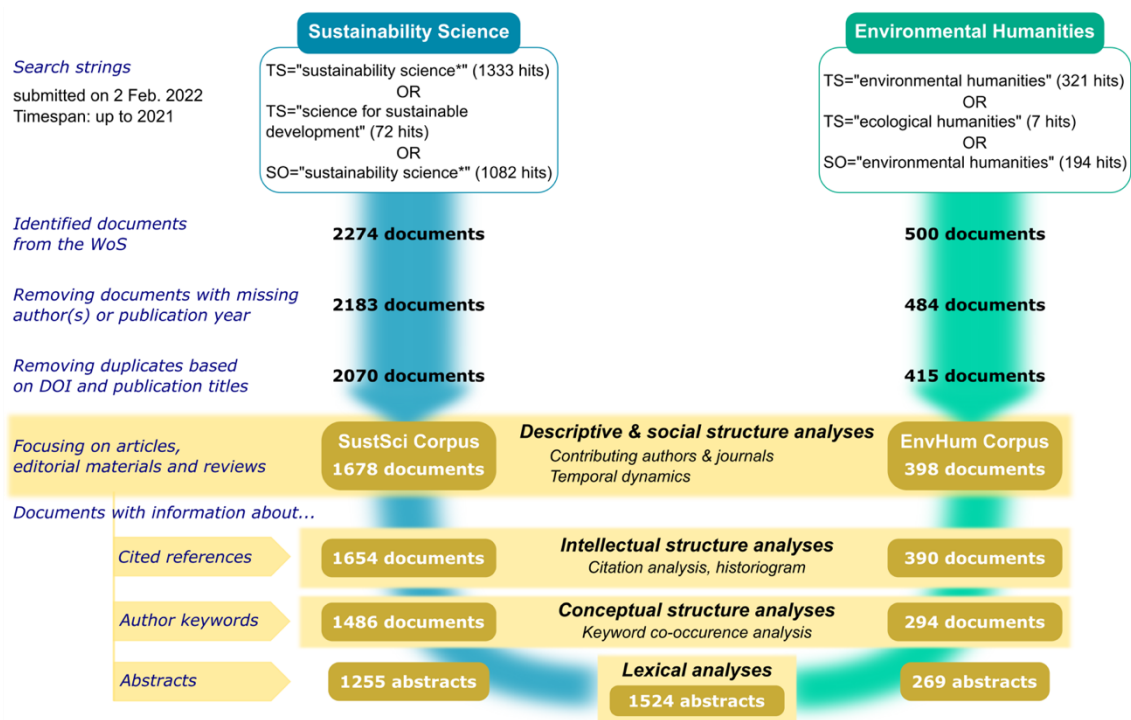
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# Figures

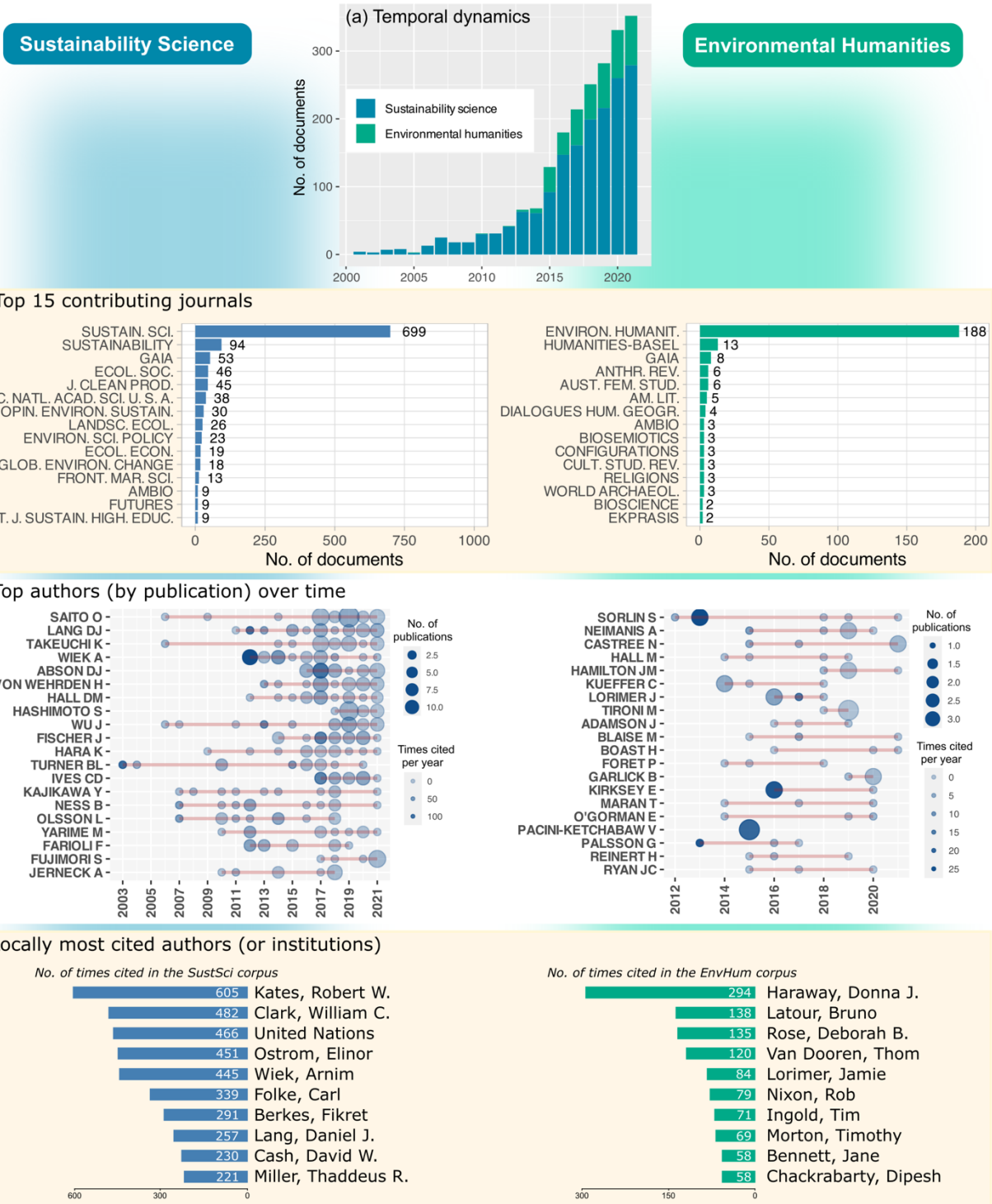
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802 Figure 1: Diagram summarizing the search, screening and analytical steps of our science mapping  
 803 analysis. In Web of Science, the ‘TS’ field tag allows terms to be searched in a publication’s title,  
 804 abstract, author keywords and keyword plus; the ‘SO’ field tag allows terms to be searched in the  
 805 source names (e.g. journal and book titles).

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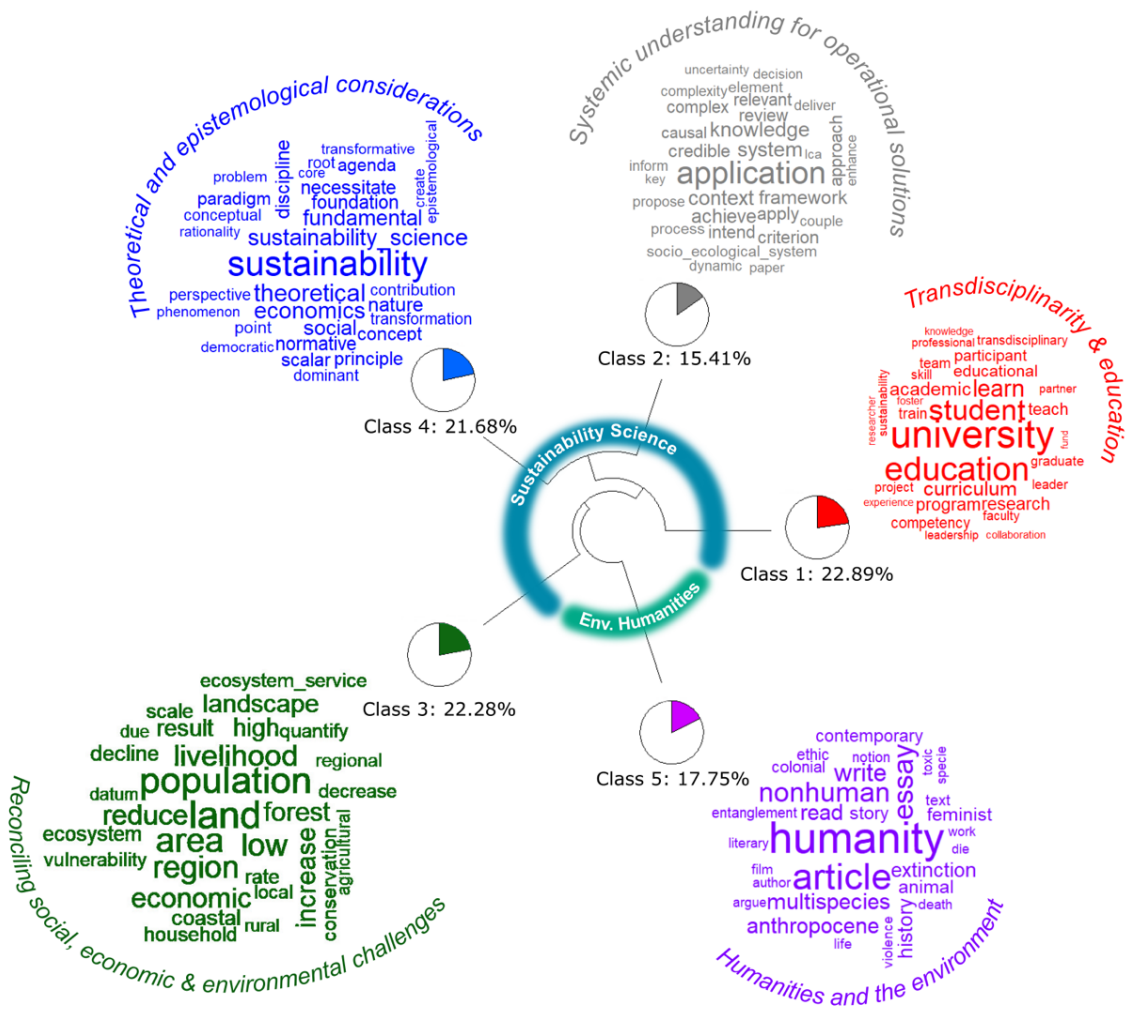


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808 Figure 2: Differences between the SustSci and EnvHum corpuses. For each research field: (a) number  
 809 of documents published from 2001 (publication year of the first document indexed in the Web of  
 810 Science) through 2021; (b) top 15 contributing journals, ranked by decreasing number of publications  
 811 within the field; (c) top 20 authors and their scientific publications over time (the size of the circles  
 812 indicates the number of an author's publications, the colour indicates the number of times authors  
 813 were cited); (d) the 10 locally most cited authors (and associated citation counts).

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824 Figure 4: Dendrogram of the Reinert and word clouds from the lexical analysis of the abstracts of  
 825 SustSci and EnvHum corpuses pooled together. For the sake of readability, only the 30 most frequent  
 826 words in each lexical class are represented. The central circle illustrates that four classes were  
 827 significantly associated with SustSci publications, while the fifth was significantly associated with  
 828 EnvHum publications (chi-square tests; all  $p < 0.0001$ ).

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831 Figure 5: Representation of the two complementary lenses through which SustSci and EnvHum look at  
 832 environmental and sustainability issues. The relational and ontological turn, as well as the concepts of  
 833 care and stewardship, are developing in both research fields, suggesting an opportunity for a shared  
 834 analytical lens.