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Gaps and overlaps between sustainability science and the environmental humanities

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1 **Title Page**

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

4
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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.

	Sustainability science	Environmental humanities
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%)

791

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.

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

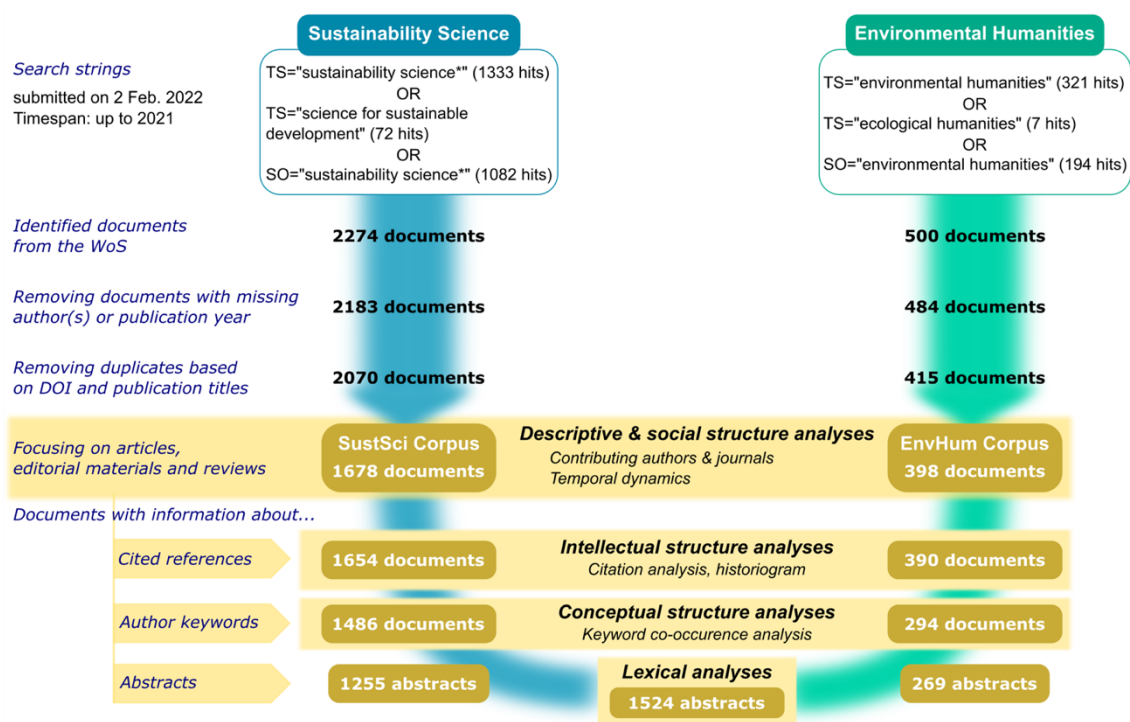
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Figures

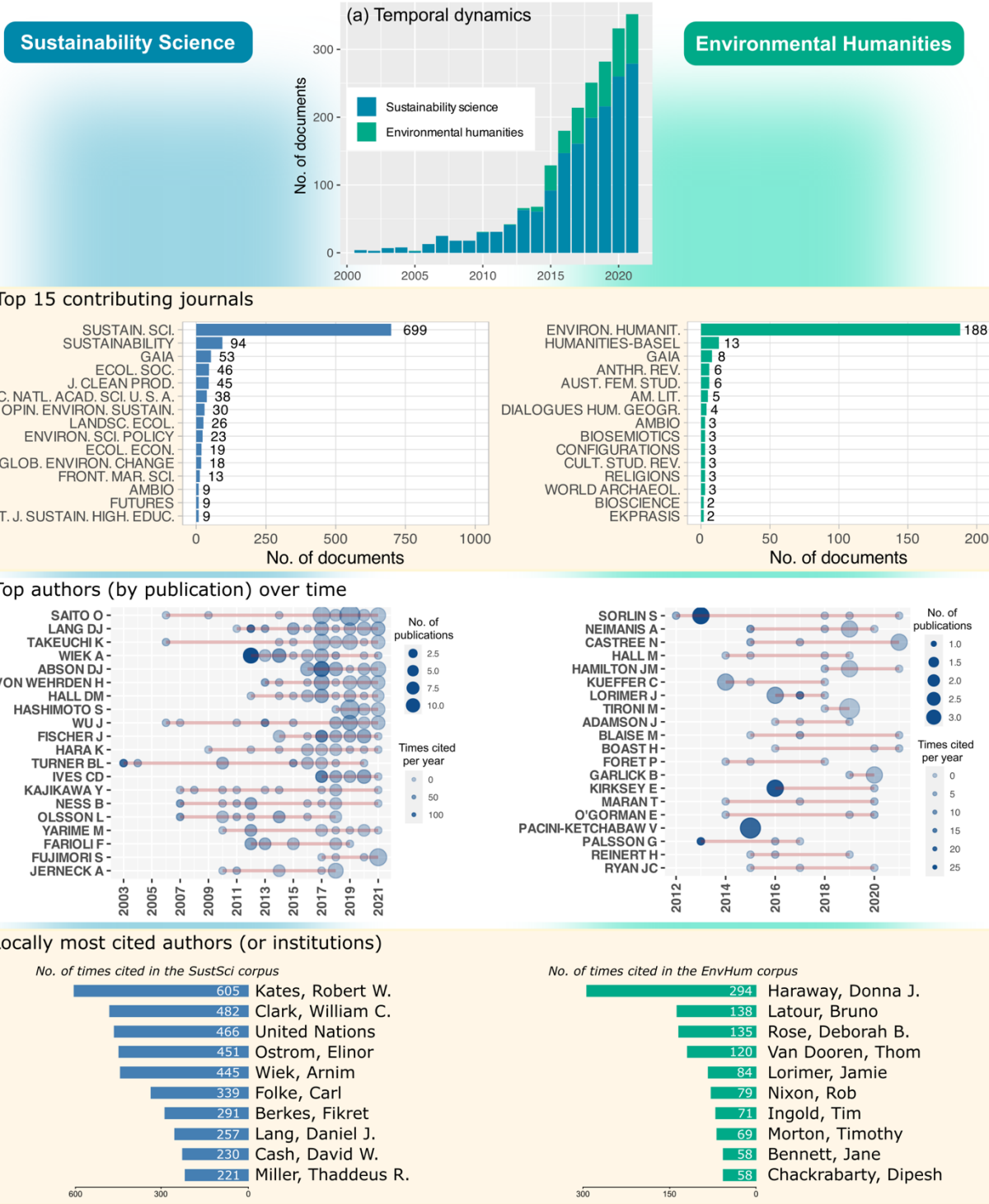
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802 Figure 1: Diagram summarizing the search, screening and analytical steps of our science mapping
 803 analysis. In Web of Science, the ‘TS’ field tag allows terms to be searched in a publication’s title,
 804 abstract, author keywords and keyword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

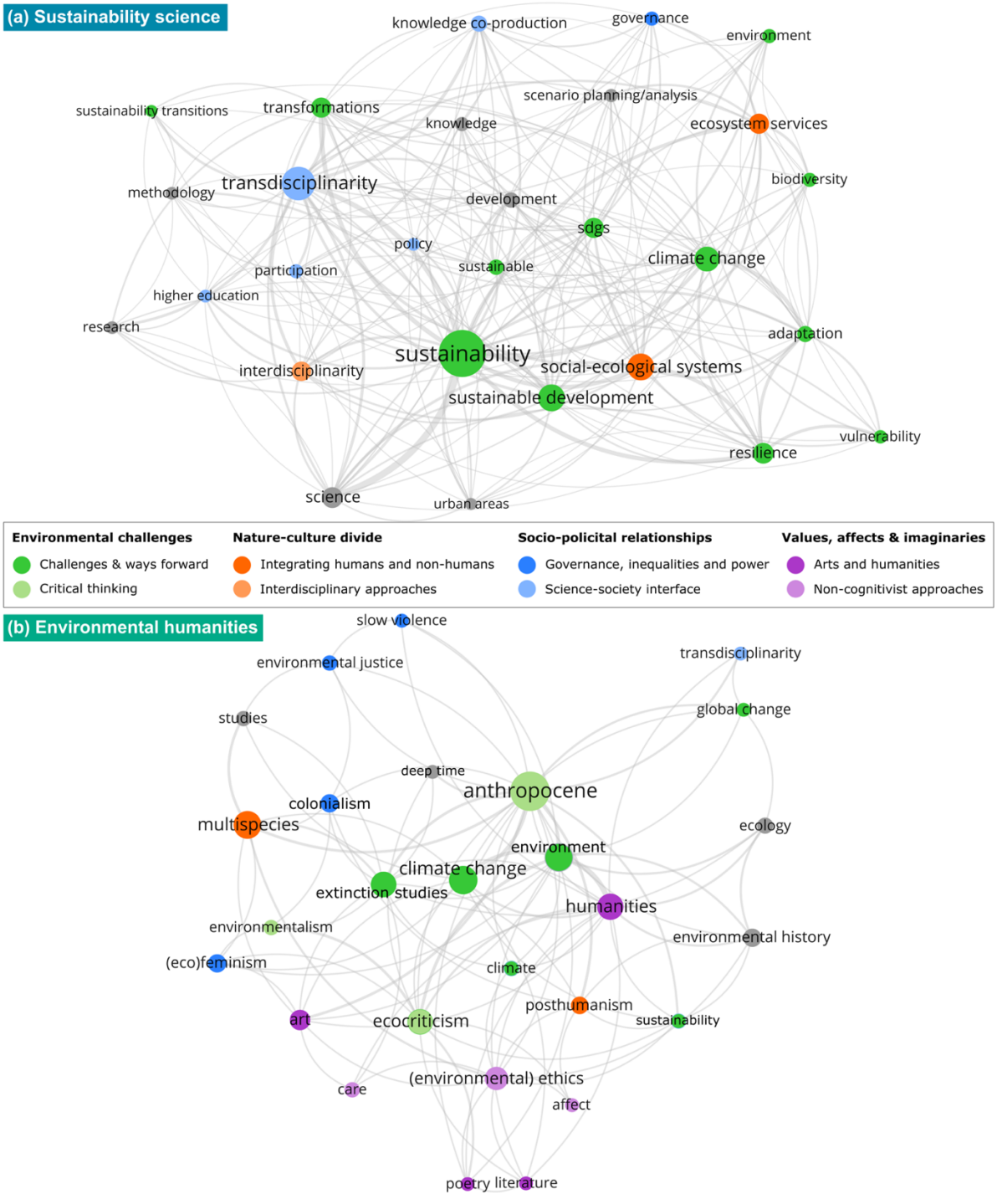
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808 Figure 2: Differences between the SustSci and EnvHum corpuses. For each research field: (a) number
 809 of documents published from 2001 (publication year of the first document indexed in the Web of
 810 Science) through 2021; (b) top 15 contributing 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).

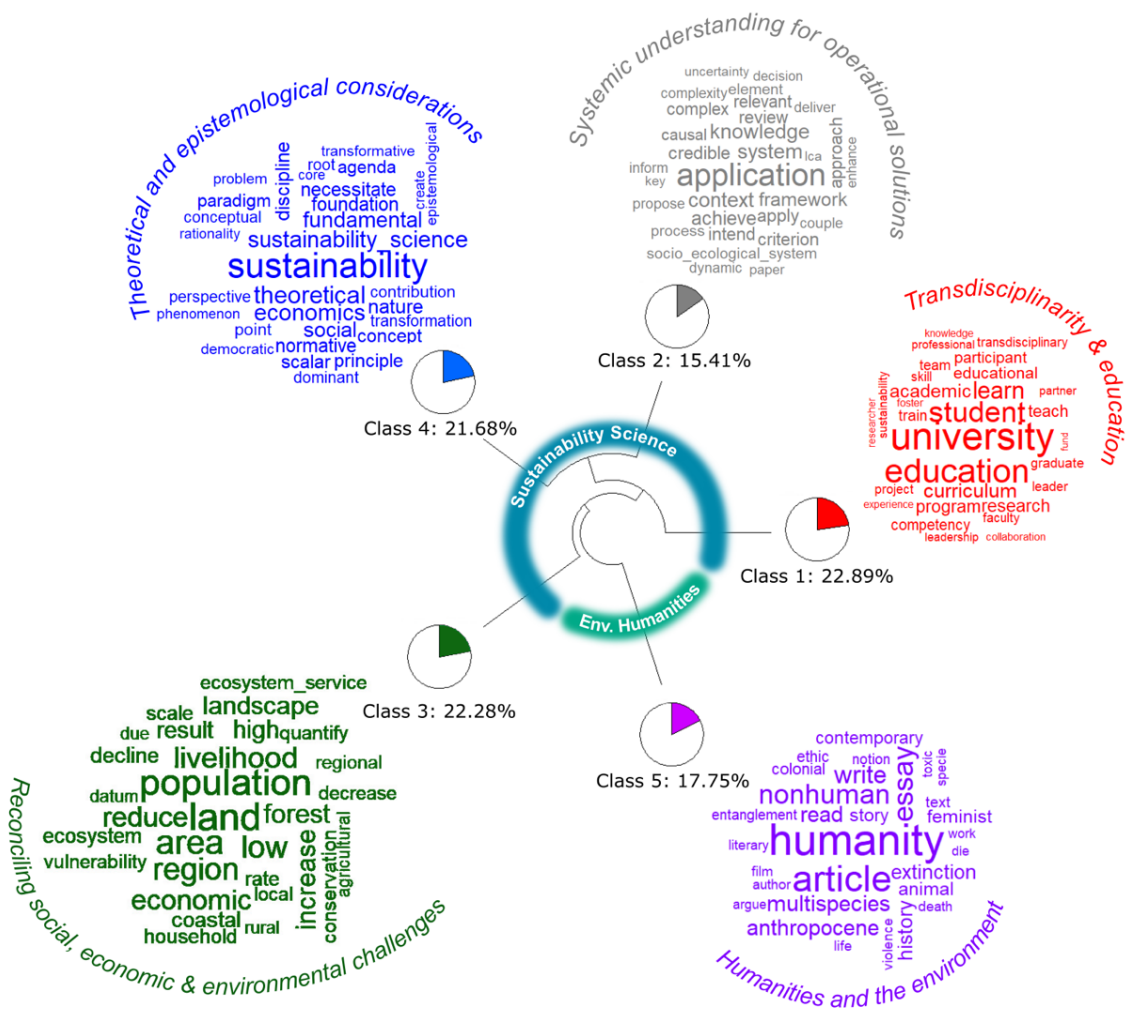
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816 Figure 3: Network of the most frequent author keywords in (a) SustSci and (b) EnvHum, classified
 817 into categories. For the sake of readability, in (a) only the 28 most frequent author keywords (used in
 818 at least 20 publications) were included, and the term ‘sustainability science’ itself was ignored; in (b)
 819 only the 27 most frequent author keywords (used in at least 5 publications) were included, and the
 820 term ‘environmental humanities’ itself was ignored (see ‘Methods’). The thematic keyword
 821 classification was based on our interpretation to facilitate links between figures and text.

822



823

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 $p < 0.0001$).

829



830

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.