A Topography of Climate Change Research - Results

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Draft current March 26, 2019

1 Results

1.1 Literature growth

	AR1	AR2	AR3	AR4	AR5	AR6
Documents	625	7623	16395	34510	117758	128266
Words	1380	12409	20453	32644	67064	74196
New words	change (296)	loss (552)	downscaling (197)	sres (217)	biochar (1752)	mmms (192)
	climate (262)	efficiency (515)	degreesc (145)	petm (95)	redd (1058)	c3n4 (132)
	model (168)	mol (439)	ncep (130)	amf (87)	cmip5 (656)	cop21 (107)
	effect (160)	ambient (417)	otcs (87)	sf5cf3 (81)	cmip3 (569)	cmip6 (104)
	co2 (156)	coal (404)	nee (87)	cwd (74)	wrf (334)	zika (75)
	atmospheric (152)	photosynthetic (393)	fco (80)	embankment (72)	mofs (288)	brgdgts (71)
	climatic (133)	concern (381)	hadcm2 (78)	aod (69)	sdm (283)	twitter (68)
	global (131)	chamber (353)	dtr (75)	clc (69)	gosat (281)	jing (66)

Table 1: Growth in climate change literature

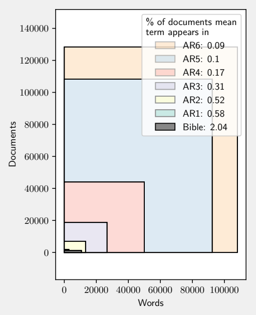


Figure 1: The volume and variety of literature on climate change has grown to unmanageable proportions. Each box represents a document-term matrix (unique documents x unique terms) of the abstracts written in each assessment period. The percentage of documents in which the average word occurs in is given in the key.

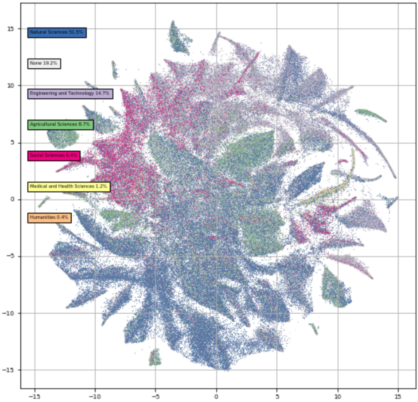


Figure 2: A map of the literature on climate change. Document positions are obtained by reducing the topic scores to two dimensions via t-SNE Documents are coloured by web of science discipline category. See SI table for topic composition of each grid square

1.2 Disciplinary structure

Label some topics particularly representative of certain disciplines, and their growth with reference to below

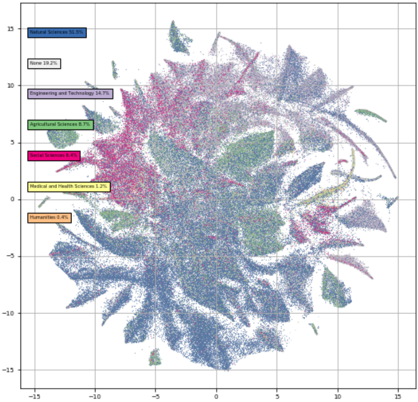


Figure 3: A map of the literature on climate change. Document positions are obtained by reducing the topic scores to two dimensions via t-SNE Documents are coloured by web of science discipline category. See SI table for topic composition of each grid square

- The thematic structure of the topics reflects journal disciplinary categories.
- Different disciplines clearly deal with different themes, although some topics are more interdisciplinary

Show disciplinary entropy of topics in SI, give examples

- Medicine has the most specialized topic distribution
- (Some examples of individual topics using the labels to be added)

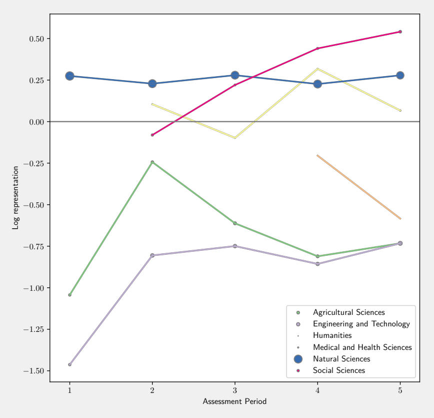


Figure 4: The representation within the IPCC of each discipline over time

- The natural sciences have always made up the greatest share of IPCC citations and documents about climate change
- The natural sciences were particularly over-represented in earlier assessment periods
- contrary to what is claimed, the natural sciences are not over-represented as compared to social sciences, these are now the most over-represented
- the disciplines that are under-represented are the agricultural sciences and engineering (also humanities to a small extent although they make up an extremely small share of all documents about climate change)
- (some examples of topics which portray this story - the ones which will be labelled above)

1.3 IPCC working group structure

Just 4 subplots, mashing together ar1-2, and 3-4

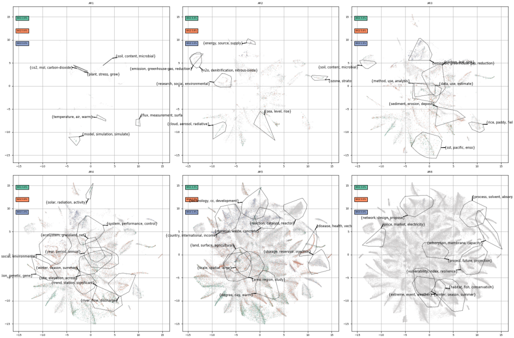
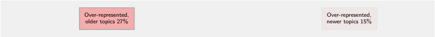


Figure 5: A map of the literature on climate change. Document positions are obtained by reducing the topic scores to two dimensions via t-SNE Documents are coloured by working group citations. In each assessment period, the largest cluster of documents relating to each of the 10 fastest growing topics is outlined.

- The thematic structure is also reflected in the division of labour between IPCC working groups. Documents cited by each working group appear in discrete parts of the map (which correspond also to the disciplinary structure)
- Some topics cut across working groups [e.g. Urban, say more about]
- Some fast growing topics [e.g. health] are well represented in IPCC [WGII], whereas others (particularly on negative emissions) are not so well represented.

Figure 6: Optional figure, instead of above, one large wg map, with the topics below labelled



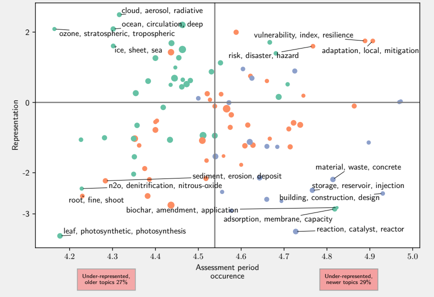


Figure 7: The IPCC representation and age of the topics. Representation shows the log of the share of topic documents in IPCC citations divided by the share of topic documents among all documents. Assessment period occurence shows the assessment period in which the mean topic document was published

- Those topics that deal with working group III issues (materials and recycling, negative emissions, buildings) are in general fast growing and under-represented in IPCC reports
- Some working group III topics (on scenarios, on policies, and on international trade and cross country comparisons) are however over-represented in IPCC reports [see SI]
- Working group I topics are in general older and better represented. Could also be same topics but new knowledge
- Of the newer topics that are well represented, many are on WG III issues [detail required]
- Are WGII better at reflecting changes in the literature?
- Another plot showing lines for each topic showing growth in literature and growth in ipcc?

2 SI

	ipcc_share	share	representation	primary_wg	title	year_av
0	0.002379	0.005924	0.401653	3	{building, construction, design}	4.894737
1	0.000379	0.001086	0.348792	3	{biochar, amendment, application}	4.850000
2	0.003909	0.009568	0.408559	3	{reservoir, injection, storage}	4.844444
3	0.002041	0.005162	0.395314	3	{oil, palm, biodiesel}	4.790698
4	0.002821	0.005569	0.506457	3	{vehicle, transport, road}	4.780488
5	0.002428	0.008688	0.279475	3	{waste, material, landfill}	4.767442
6	0.005644	0.006277	0.899129	3	{price, market, electricity}	4.760870
7	0.006471	0.006011	1.076522	3	{sector, transport, industry}	4.687500
8	0.002192	0.005074	0.431930	3	{soc, stock, organic-carbon}	4.680851
9	0.005821	0.008857	0.657215	3	{technology, cc, storage}	4.666667
10	0.004449	0.010304	0.431797	3	{power, electricity, nuclear}	4.622222
11	0.014656	0.011468	1.277995	3	{country, project, cdm}	4.600000
12	0.010824	0.009846	1.099359	3	{cost, benefit, economic}	4.541667
13	0.012490	0.008997	1.388326	3	{policy, government, maker}	4.531915
14	0.008099	0.014018	0.577781	3	{energy, source, supply}	4.531915
15	0.001975	0.006498	0.304021	3	{coal, combustion, gasification}	4.529412
16	0.003428	0.007448	0.460164	3	{fuel, fossil, hydrogen}	4.509804
17	0.003911	0.009177	0.426164	3	{gas, hydrate, pressure}	4.470588
18	0.005214	0.004797	1.086801	2	{urban, city, urbanization}	4.969697
19	0.003656	0.004850	0.753851	2	{food, diet, consumption}	4.888889
20	0.008343	0.007806	1.068710	2	{health, disease, vector}	4.857143
21	0.006868	0.007834	0.876607	2	{community, diversity, local}	4.825000
22	0.010395	0.004993	2.082001	2	{adaptation, strategy, mitigation}	4.809524
23	0.005688	0.006045	0.940972	2	{coral, reef, fish}	4.795455
24	0.007047	0.004370	1.612741	2	{vulnerability, assessment, social}	4.781250
25	0.011066	0.007840	1.411500	2	{risk, disaster, hazard}	4.772727
26	0.009565	0.008769	1.090742	2	{coastal, sea, rise}	4.740000
27	0.003780	0.005396	0.700602	2	{groundwater, recharge, aquifer}	4.714286
28	0.004939	0.006559	0.753073	2	{flow, stream, streamflow}	4.688889

29	0.003390	0.004045	0.837956	2	{irrigation, agricultural, farmer}	4.685714
30	0.004707	0.006209	0.758095	2	{design, problem, propose}	4.666667
31	0.006803	0.011655	0.583704	2	{process, solvent, absorption}	4.659574
32	0.019525	0.020043	0.974159	2	{management, research, resource}	4.642857
33	0.008902	0.011893	0.748544	2	{production, farm, product}	4.636364
34	0.010507	0.011277	0.931736	2	{environmental, economic, environment}	4.625000
35	0.008601	0.011720	0.733940	2	{population, genetic, trait}	4.625000
36	0.006655	0.005343	1.245617	2	{flood, flooding, damage}	4.612245
37	0.018768	0.019054	0.984999	2	{effect, treatment, response}	4.607843
38	0.006175	0.005023	1.229508	2	{drought, index, severe}	4.590909
39	0.002843	0.004361	0.651870	2	{wetland, marsh, habitat}	4.574468
40	0.010799	0.015166	0.712078	2	{system, performance, hybrid}	4.574468
41	0.019503	0.009749	2.000633	2	{scenario, future, project}	4.562500
42	0.013295	0.017117	0.776749	2	{specie, habitat, distribution}	4.530612
43	0.007284	0.006929	1.051147	2	{fire, burn, wildfire}	4.528302
44	0.009041	0.008489	1.064992	2	{crop, yield, wheat}	4.521739
45	0.011434	0.011108	1.029320	2	{ecosystem, grassland, ecological}	4.520000
46	0.006602	0.007130	0.925965	2	{river, discharge, basin}	4.519231
47	0.006069	0.011218	0.541015	2	{site, difference, elevation}	4.508197
48	0.009703	0.008817	1.100468	2	{runoff, basin, hydrological}	4.500000
49	0.030407	0.017160	1.771979	2	{climate, future, impact}	4.490196
50	0.010291	0.011798	0.872218	2	{forest, stand, deforestation}	4.470588
51	0.008788	0.006662	1.319205	2	{rainfall, monsoon, rain}	4.452830
52	0.025311	0.015150	1.670688	2	{change, response, shift}	4.452830
53	0.005326	0.011729	0.454083	2	{plant, seed, trait}	4.450980
54	0.005945	0.008702	0.683157	2	{biomass, root, bioenergy}	4.442308
55	0.007797	0.018922	0.412066	2	{soil, organic, microbial}	4.433962
56	0.008279	0.008628	0.959571	2	{vegetation, ndvi, cover}	4.425926
57	0.004651	0.007479	0.621884	2	{tree, growth, ring}	4.423077
58	0.004100	0.007980	0.513838	2	{lake, diatom, level}	4.418182
59	0.008638	0.010727	0.805255	2	{rate, decomposition, litter}	4.346939
60	0.004183	0.012282	0.340597	2	{sediment, deposit, erosion}	4.327586
61	0.004912	0.005929	0.828363	2	{rice, paddy, field}	4.272727
62	0.005104	0.011192	0.456056	2	{leaf, photosynthesis, photosynthetic}	4.230769
63	0.014864	0.013707	1.084390	1	{temperature, thermal, warm}	4.769231
64	0.005583	0.007337	0.760837	1	{china, province, chinese}	4.744186
65	0.008584	0.007283	1.178654	1	{wind, speed, wave}	4.680851
66	0.008742	0.010883	0.803270	1	{method, uncertainty, use}	4.634615
67	0.007277	0.007358	0.988971	1	{area, region, study}	4.627451
68	0.013331	0.008421	1.582983	1	{permafrost, arctic, thaw}	4.615385
69	0.018462	0.016393	1.126269	1	{scale, spatial, large}	4.606061
70	0.016348	0.014289	1.144123	1	{winter, summer, spring}	4.557692
71	0.018716	0.011524	1.624067	1	{trend, station, significant}	4.529412
72	0.007325	0.007607	0.962903	1	{heat, heating, thermal}	4.521739
73	0.011034	0.009966	1.107139	1	{year, period, annual}	4.500000
74	0.017933	0.014594	1.228811	1	{emission, reduction, ghg}	4.490196
75	0.013351	0.013794	0.967934	1	{carbon, low, economy}	4.490196
76	0.011862	0.008300	1.429124	1	{land, surface, agricultural}	4.480769
77	0.014508	0.012224	1.186830	1	{degree, day, latitude}	4.479167
78	0.039097	0.027162	1.439368	1	{increase, decrease, result}	4.473684
79	0.011670	0.014918	0.782273	1	{data, use, information}	4.469388
80	0.010473	0.013579	0.771306	1	{water, demand, deep}	4.469388
81	0.011644	0.014063	0.827964	1	{concentration, nutrient, doc}	4.466667
82	0.010378	0.007601	1.365244	1	{event, extreme, weather}	4.461538
83	0.006685	0.004704	1.421362	1	{glacier, retreat, glacial}	4.454545
84	0.016790	0.010821	1.551667	1	{precipitation, annual, wet}	4.452830
85	0.039170	0.025302	1.548123	1	{model, simulation, simulate}	4.452830
86	0.006673	0.006943	0.961149	1	{level, high, low}	4.437500
87	0.026127	0.015363	1.700563	1	{sst, enso, anomaly}	4.428571
88	0.012565	0.017035	0.737588	1	{co2, carbon-dioxide, mol}	4.384615
89	0.011501	0.010133	1.135014	1	{solar, cycle, activity}	4.369231
90	0.014573	0.018636	0.781982	1	{record, cal, holocene}	4.354839
91	0.021559	0.011103	1.941790	1	{ocean, global, atmosphere}	4.339286
92	0.005655	0.011018	0.513309	1	{delta, value, thousand}	4.338710
93	0.024389	0.011200	2.177503	1	{cloud, aerosol, radiative}	4.333333
94	0.009019	0.010510	0.858157	1	{flux, surface, measurement}	4.322034
95	0.012059	0.008213	1.468423	1	{ice, sea, antarctic}	4.316667
96	0.001819	0.003852	0.472269	1	{n2o, denitrification, nitrous-oxide}	4.283019
97	0.006916	0.008917	0.775654	1	{methane, hydrate, source}	4.281250
98	0.005003	0.006828	0.732803	1	{ch4, oxidation, emission}	4.274510
99	0.013494	0.008502	1.587183	1	{temperature, degreesc, warm}	4.113924

Table 2: Top 10 topics in climate change literature

title	top words	top docs	share
climat, chang, impact	[climat, chang, impact, respons, futur, effect, shift, sensit, affect, may]	Climate oscillations and changes over Russia; World Regionalization of Climate Change (1961-2010)	2.73%
soil, moistur, microbi	[soil, moistur, microbi, organ, respir, content, miner, depth, matter, ef-	PARTITIONING OF SOIL RESPIRATION IN A FIRST ROTATION BEECH PLANTATION; Responses of soil respiration to N fertilization in a loamy soil	2.73%

	flux]	under maize cultivation	
emiss, reduct, reduc	[emiss, reduct, reduc, greenhous, factor, total, estim, inventori, nox, measur]	China's CH4 and CO2 emissions: Bottom-up estimation and comparative analysis; Monitoring total emissions from industrial installations	2.21%
carbon, dioxid, sequestr	[carbon, dioxid, sequestr, sink, organ, cycl, storag, stock, terrestri, atmospher]	Interpreting carbon-isotope excursions: carbonates and organic matter; PARTICULATE FLUXES OF CARBONATE AND ORGANIC-CARBON IN THE OCEAN - IS THE MARINE BIOLOGICAL-ACTIVITY WORKING AS A SINK OF THE ATMOSPHERIC CARBON	1.74%
temperatur, air, mean	[temperatur, air, mean, surfac, minimum, maximum, daili, increas, effect, degreesc]	Observed changes in shallow soil temperatures in Northeast China, 1960-2007; Beyond the Mean: Biological Impacts of Cryptic Temperature Change	1.71%
record, dure, glacial	[record, dure, glacial, reconstruct, last, period, holocen, event, late, core]	HIGH-RESOLUTION CLIMATE RECORDS FROM THE NORTH-ATLANTIC DURING THE LAST INTERGLACIAL; HIGH-RESOLUTION CLIMATIC INFORMATION FROM SHORT FIRN CORES, WESTERN DRONNING MAUD LAND, ANTARCTICA	1.7%
speci, distribut, rang	[speci, distribut, rang, rich, invas, nich, predict, extinct, shift, abund]	Northward range extensions of some mesopelagic fishes in the Northeastern Atlantic; Natural occurrence and backwater infection of C-4 plants in the vegetation of the Yangtze hydropower Three Gorges Project region	1.7%
increas, concentr, decreas	[increas, concentr, decreas, effect, atmospher, doc, result, organ, nutrient, may]	TERRESTRIAL HIGHER-PLANT RESPONSE TO INCREASING ATMOSPHERIC [CO2] IN RELATION TO THE GLOBAL CARBON-CYCLE; Hydrological response to climate change in the Black Hills of South Dakota, USA	1.61%
forest, tropic, stand	[forest, tropic, stand, deforest, disturb, stock, boreal, redd, harvest, wood]	Spatially explicit estimates and temporal changes of forest tree biomass in a typical department of forest management, Turkey; Analysis of the changes in forest ecosystem functions, structure and composition in the Black Sea region of Turkey	1.56%
energi, renew, consumpt	[energi, renew, consumpt, effici, demand, save, sector, sourc, industri, use]	Energy issues and energy priorities; Energy efficiency and CO2 emissions in Swedish manufacturing industries	1.56%

Table 3: Top 10 topics in climate change literature