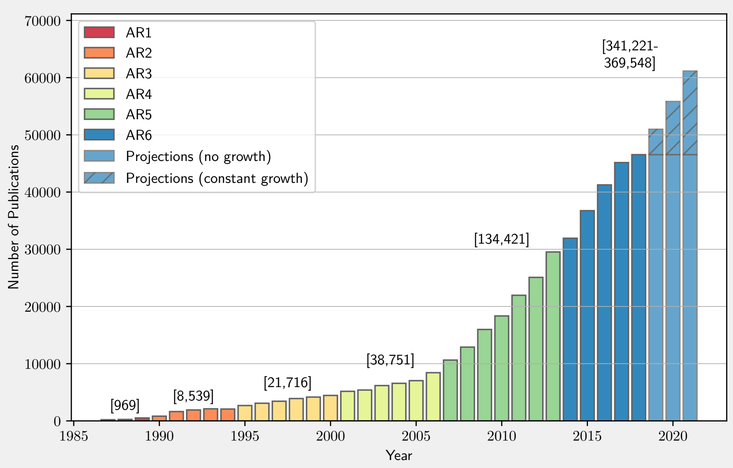
# A Topography of Climate Change Literature

Max Callaghan
callaghan@mcc-berlin.net

## Problem



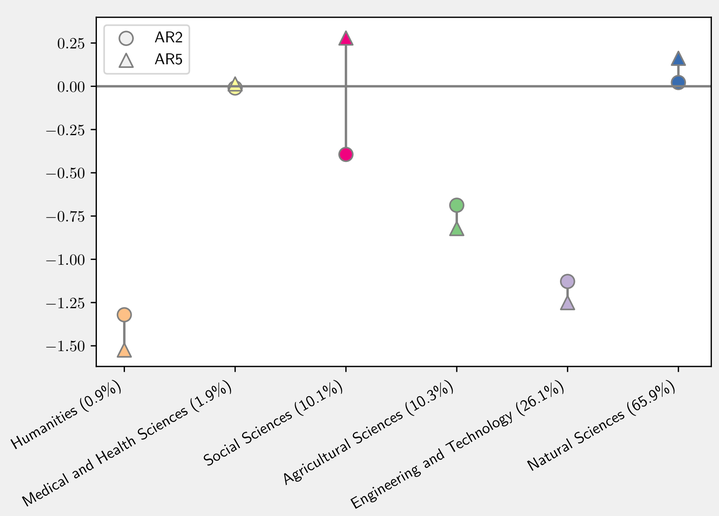

Massive growth of literature on climate change challenges IPCC [4]

## New Concepts

| | AR1 | AR2 | AR3 | AR4 | AR5 | AR6 |
|---|---|---|---|---|---|---|
| **Years** | 1986-1989 | 1990-1994 | 1995-2000 | 2001-2006 | 2007-2013 | 2014- |
| **Documents** | 1,167 | 8,539 | 21,716 | 38,750 | 134,413 | 201,606 |
| **Words** | 2000 | 12480 | 23346 | 34637 | 71867 | 94746 |
| **New words** | change (560) | oil (287) | downscaling (217) | sres (234) | biochar (1791) | mmms (313) |
| | climate (428) | deltac (283) | degreesc (187) | petm (95) | redd (1113) | cop21 (234) |
| | co2 (318) | whole (256) | ncep (130) | amf (88) | cmip5 (679) | c3n4 (214) |
| | climatic (289) | tax (254) | fco (107) | sf5cf3 (86) | cmip3 (587) | sdg (187) |
| | model (288) | landscape (249) | pfc (98) | clc (81) | mofs (299) | zika (182) |
| | atmospheric (281) | alternative (243) | otcs (98) | embankment (81) | sdm (297) | ndcs (168) |
| | effect (280) | availability (242) | dtr (95) | cwd (79) | mof (275) | indc (164) |
| | global (224) | life (239) | nee (89) | etm (75) | biochars (252) | indcs (134) |

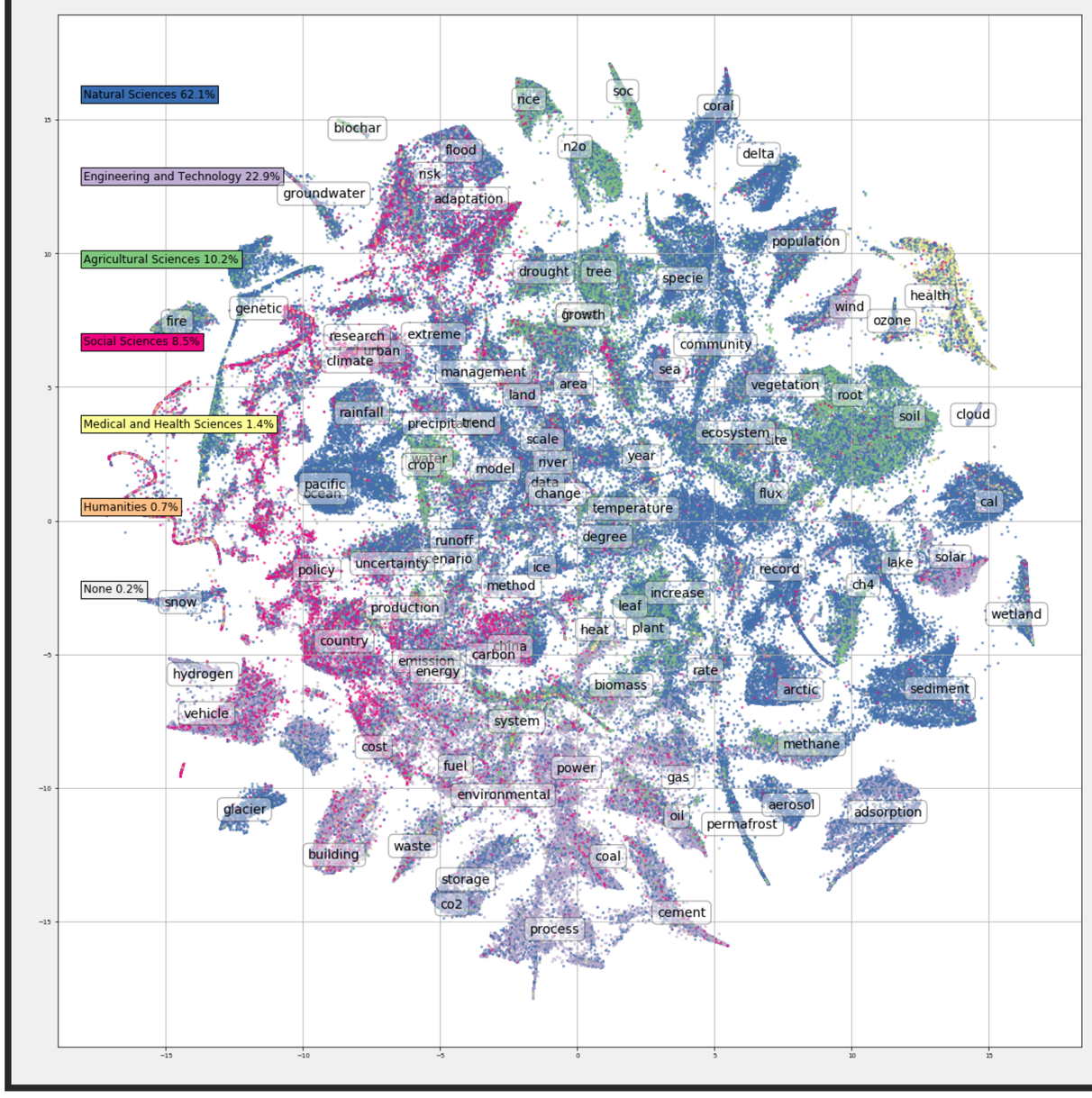
A simple analysis of the words in the documents about climate change shows us that not only are there more articles, they discuss **new concepts**. The **topic model** below [3] mobilises large patterns of words in documents to make broad conceptual developments and differences comprehensible.

## Proportionality




Contrary to suggestions/previously [2, 1], the social sciences are over-represented in IPCC reports, engineering/agricultural sciences are under-represented

## A Topographic Map of 400,000 Climate Change Articles

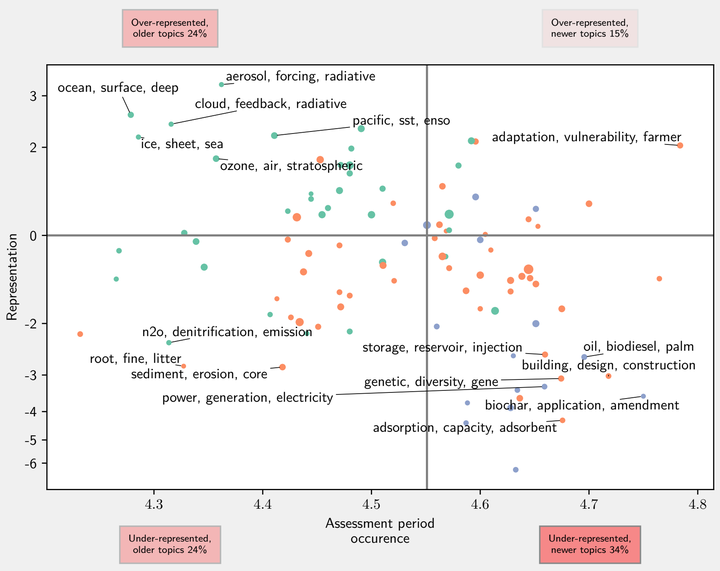



Using T-SNE [5], we can project each document into a 2D space such that documents with similar 100-dimensional topic vectors are close together.

Documents similar in topic tend to be from similar disciplines, with some cross-disciplinary work around the energy system, or on soils.

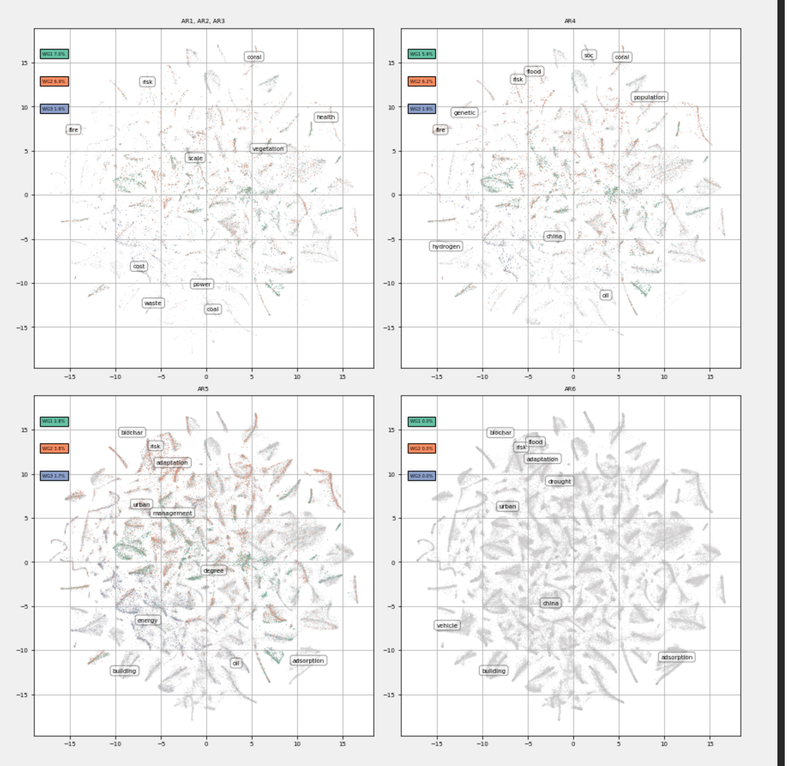
The majority of topics are from the natural sciences

## Supply/Demand of Solutions



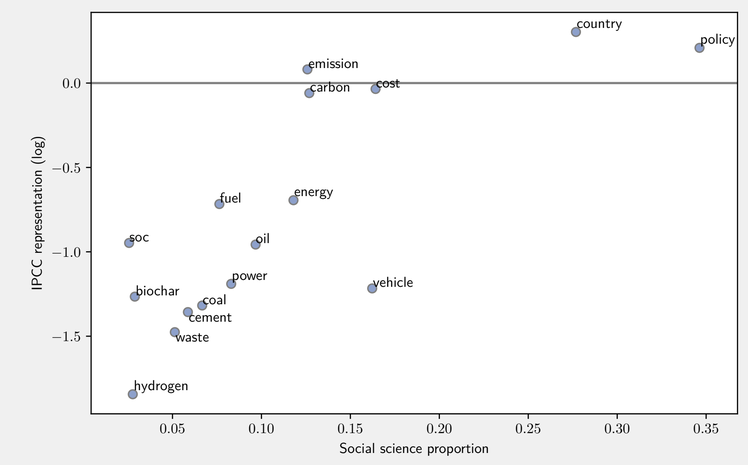

Physical science topics are well represented and have been around longer. Solution-oriented topics, particularly in WGIII are newer and under-represented.

## Evolution




Solutions topics have grown fast in recent assessment reports, as have topics on impacts and vulnerability. New WGII topics are better covered by IPCC reports. We can also witness the emergence of new topics such as coral bleaching.

## Social Science & Solutions




Those WGIII topics with a higher share of social science documents are better-represented in IPCC. Either the IPCC must engage with the social science literature, or the social sciences must cover solutions-topics.

## Further work

Computer-assisted systematic map of climate impacts.
Quantification of knowledge transfer pyramid.
Tools/methodologies for computer assisted evidence synthesis.

## References

[1] Andreas Bjurström and Merritt Polk. Physical and economic bias in climate change research: A scientometric study of IPCC Third Assessment Report. *Climatic Change*, 108(1):1–22, 2011.

[2] David G. Victor. Embed the social sciences in climate policy - David Victor. *Nature*, 520:7–9, 2015.

[3] D D Lee and H S Seung. Learning the parts of objects by non-negative matrix factorization. *Nature*, 401(6755):788–91, 1999.

[4] Jan C. Minx, Max Callaghan, William F. Lamb, Jennifer Garard, and Ottmar Edenhofer. Learning about climate change solutions in the IPCC and beyond. *Environmental Science & Policy*, 2017.

[5] Laurens van der Maaten and Geoffrey Hinton. Visualizing Data using t-SNE. *Journal of Machine Learning Research*, 9:2579–2605, 2008.

## Acknowledgements

This research is funded by a PhD scholarship from the Heinrich Böll Stiftung