



Sources of doubt: actors, forums, and language of climate change skepticism

Ferenc Jankó^{1,2} · Áron Drüszler³ · Borbála Gálos⁴ · Norbert Móricz⁵ ·
Judit Papp-Vancsó² · Ildikó Pieczka⁶ · Rita Pongrácz⁶ · Ervin Rasztoivits⁵ ·
Zsuzsanna Soósné Dezső⁶ · Orsolya Szabó⁵

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Abstract

The paper investigates the reference corpus of a climate change contrarian report. We categorized the journal abstracts according to the endorsement positions on anthropogenic climate change. These results were contrasted by an in-text citation analysis. We focused here on the role of the papers included by the report editors concerning the mainstream claims around climate change. Our results showed moderate differences in the endorsement rates as well as in the sources of contrarian arguments considering the contrarian report in general and the presented journals specifically. These outcomes indicate differences among the journals regarding editorial practice, topic-dependency, and the home field advantage of some authors. Beyond the bibliometric data, our additional rhetorical analysis showed that language and wording are at least as important as the references backing the claims. The well-founded atmosphere of doubt in the climate skeptic report relies on two prevalent factors working together: relevant information accumulated on methodological uncertainties and findings that do not support mainstream knowledge claims (1); and solemn rhetoric supplemented with proper re-contextualization and reinterpretation (2).

Keywords Climate change skepticism · Consensus research · Peer reviewed journals · Scientific rhetoric

Introduction

Climate change skepticism emerged in the 1990s, particularly after the 1997 Kyoto Agreement when several events hallmarked the evolving climate change controversy (Grundmann 2015). The 1998 ‘Chapter 8 Controversy’ was an early direct attack against the IPCC (Intergovernmental Panel on Climate Change) and its 1995 report. The ‘Chapter 8 Controversy’ essentially questioned the review policy and procedural rules the international body utilized (Edwards and Schneider 2001). Concurrently, the ‘Hockey Stick Controversy’—focusing on the third IPCC report on the physical science of climate change published in

✉ Ferenc Jankó
frk@caesar.elte.hu

Extended author information available on the last page of the article

2001 (Demeritt 2006; Frank et al. 2010)—began to gain momentum. Eleven years later, ‘Climategate’ opened the possibility of even more vehement attacks on the scientific community concerning climate change and the IPCC. As a result, the workings of the IPCC were scrutinized and reviewed (e.g. Berkhout 2010; Prins et al. 2010; IAC, 2010; Grundmann 2012, 2013; Maibach et al. 2012; Lahsen 2013a), as the political and scientific context of the IPCC is in a state of ongoing change (Beck and Mahony 2018). Paralleled with these cases, skeptics opposing the IPCC in 2009 and 2013 published several alternative climate change assessment reports.

As a consequence, research on the skeptic movement flourished. Beyond the movement’s social embeddedness, papers attempted to uncover the roots of the climate skeptic movement and its scientists (Lahsen 2008, 2013b; Björnberg et al. 2017; Van Rensburg and Head 2017) as well as the political and economic links and the workings of the movement (e.g. Jaques et al. 2008; Dunlap and McCright 2015; Petersen et al. 2019). Another research branch investigated the climate reality the skeptics constructed by using scientific (mis)information and rhetoric (Nerlich 2010; Jankó et al. 2014, 2017; Medimorec and Penycook 2015; Boussalis and Coan 2016).

In earlier papers, Jankó et al. (2014, 2017) analyzed and compared the reference lists of the IPCC Working Group I. assessment reports Nos. 4 and 5 with the corresponding climate change skeptic reports of the conservative think tank, the Heartland Institute. Cook et al. (2013) provided the impetus to conduct an additional analysis concerning the scientific background of the skeptic reports. Cook et al. categorized nearly 12 000 peer reviewed journal abstracts according to author positions regarding anthropogenic climate change. Their results demonstrated that of the authors who expressed a position about the anthropogenic origins of global warming, 97.1% endorsed the consensus that humans cause climate change; however, 66.4% of the abstracts contained no signs of judgement concerning the matter.

Although debated (most recently see: Cook and Pearce 2020), we followed this study, and our paper sheds some light on the details of the scientific literature in the climate change skeptic assessment report by revealing the referenced papers’ positions concerning anthropogenic global warming (AGW). Using scientometric data and additional rhetorical analysis, we attempt to grasp the roles literature plays in forming and legitimizing the knowledge claims made in the reports. Or conversely, to show how contrarian authors used the literature that contained dissenting arguments. Hence, our research questions are the following: What is the difference among journals regarding the level of consensus endorsement and functions of in-text citations? Which major authors are sources of contrarian arguments? What are the rhetorical features of the citation technique in the climate skeptic report?

Material and methods

For the purposes of the study, we processed the references of a climate skeptic report Climate Change Reconsidered II (Idso et al. 2013) in a database, and excerpted the items published before 1991 ($N=228$) and all papers not published in scientific journals ($N=351$) (see Cook et al. 2013). Every reference received a journal code and repeatedly occurring references were omitted. Following this, all journal article abstracts were analyzed according to the Cook et al. (2013) method (see Table 2 of Cook et al. 2013, and Fig. 1 of Jankó et al. 2020). Cook et al. (2013) originally used seven categories: explicit endorsements

and rejections of AGW were divided into quantified and non-quantified groups; implicit endorsement or rejection; and ‘no position’ abstracts. We made corrections only within the framework of the original method. Contrary to Cook et al. (2013), we immediately introduced an ‘uncertainty’ category and added a further category within the ‘no position’ category. After analyzing the supplementary material of Cook et al. (2013) and checking ‘no position’ abstracts, we noticed abstracts containing specific rhetoric with reference on expected climate change, on climate projections, or simply on global warming (a phrase implying the anthropogenic causes). Hence, we created a ‘no position with axiomatic reference to AGW’ category to solve the assumed monotony of ‘no position’ papers (Table 1).

We also developed a second database to analyze the in-text citations’ functions and examine how references and citations serve the purposes of the contrarian editors and authors. Therefore, we investigated all the in-text citations and classified them into four categories: ‘supporting’ or ‘not supporting’ the AGW relevant (IPCC) claims about climate change, creating ‘uncertainty’ around the claims, or simply ‘neutral’, referring to a method or secondary information. Each reference that was used in different contexts was classified into a dominant category adhering to the following logic: ‘not supporting’ (the strongest function), ‘supporting’, ‘uncertainty’, or ‘neutral’ (the weakest) (examples can be found in Jankó et al. 2014). We also checked the occurrence of the so called ‘transferred citations’ to provide a nuanced picture on the journal statistics (Table. 1).

Every study coauthor participated in the abstract rating and in-text citation-analysis. Each coauthor received the same number of articles, which were rated by only one colleague. Before the actual work began, we conducted two test stages to adjust and harmonize each other’s work and make the method clear to all coauthors. Ultimately, our task is to underscore the uncertainty in this research, i.e. the sometimes vague language of the abstracts, as well as the subjectivity and different background of the coauthors (cf. Cook et al. 2013). The papers without abstracts ($N=86$) or in-text citations ($N=37$) were excluded from the databases. In the end, the two databases were merged, and thus a total of 3,135 papers with abstract ratings, and a total of 4,968 in-text citations were analyzed.

After the quantitative analysis, we sampled the papers ($N=90$) for rhetorical analysis to focus on the interpretative techniques and rhetoric used by the climate skeptic report editors. The journal articles (i.e. the abstracts) in the sample explicitly endorsing AGW, while not supporting the IPCC knowledge claims as in-text functions, that promised to be the most distinctive cases for the rhetorical investigation.

Results

General data

Table 2 is a summary of the general statistics showing the distribution (in absolute and relative terms) between the different abstract rating and in-text function categories. Two basic statements emerge here. Firstly, as we compared our statistics derived from the climate skeptic report and those obtained from Cook et al. (2013), we can conclude that the main patterns are similar. ‘No position’ papers (‘no position’ and ‘no position with axiomatic reference on AGW’ altogether) also have the highest frequencies in the skeptic report, but at a higher level than presented by Cook et al. (79.8% to 66.4%). Hence, a relatively smaller proportion of papers (i.e. abstracts) endorsed AGW from the rest (74.7% to 97.1%) in the skeptic report. Further, we should see that 81.1% of the ‘not supporting’ in-text functions

Table 1 Signposts of the study: material, questions, methods and terms

Source report	The reference base of Idso et al. 2013. Climate change reconsidered II: Physiological science	Its main mission is to argue against the IPCC, based on the claims that climate change is caused by human influence
Question 1	What are the forums, i.e. journals of contrarian knowledge claims? What are the differences among them?	See Methods 1 and 2, Terms 1–4
Question 2	Which major authors are the sources of contrarian arguments?	See Method 1 and 2, Terms 1–4
Method 1	Abstract rating based on the author position on anthropogenic climate change	Source of method: Cook et al. 2013; Jankó et al. 2020
Method 2	Analysis of in-text citations regarding their functions in argumentation	Source of method: Jankó et al. 2014
Term 1	Explicit endorsement	States that mainly humans cause climate change, or refers to it as a known fact
Term 2	Implicit endorsement	Implies that humans cause global warming
Term 3	No position	Does not address the question of AGW
Term 4	In-text function	The intended purpose of citations through interpretation and rhetoric
Question 3	What are the rhetorical features of the citation technique in the climate skeptic report?	See Method 3, Term 5 and 6
Method 3	Rhetorical analysis of selected abstracts and their interpretation in the source report	90 abstracts explicitly endorsing AGW, but used to oppose the IPCC claims as in-text citation
Term 5	Solemn rhetoric	Its purpose is to celebrate the scientists' research, achievements, results and conclusions
Term 6	Transferred citations	Citations used indirectly; when an interpretation of a citation is supplemented and strengthened mentioning its own citations. E.g. Smith et al. demonstrates that... citing Evans et al

Table 2 Distribution of abstract ratings on AGW endorsement and functions of in-text citation related to IPCC claims in absolute numbers and percentages

Abstract ratings:	Explicit endorsement with quantification	Explicit endorsement without quantification	Implicit endorsement	No position	No position with axiomatic reference	Uncertain	Implicit rejection	Explicit rejection without quantification	Explicit rejection with quantification	Altogether
<i>In-text functions:</i>										
Not supporting	9	81	166	1411	234	16	85	17	8	2027
Supporting	9	18	43	65	40	2	4	0	0	181
Uncertainty	7	15	52	201	68	8	4	2	0	357
Neutral	6	19	48	439	44	2	9	1	2	570
Altogether	31	133	309	2116	386	28	102	20	10	3135
Not supporting	0.4	4.0	8.2	69.6	11.5	0.8	4.2	0.8	0.4	100.0
Supporting	5.0	9.9	23.8	35.9	22.1	1.1	2.2	0.0	0.0	100.0
Uncertainty	2.0	4.2	14.6	56.3	19.0	2.2	1.1	0.6	0.0	100.0
Neutral	1.1	3.3	8.4	77.0	7.7	0.4	1.6	0.2	0.4	100.0
Altogether	1.0	4.2	9.9	67.5	12.3	0.9	3.3	0.6	0.3	100.0
Not supporting	29.0	60.9	53.7	66.7	60.6	57.1	83.3	85.0	80.0	64.7
Supporting	29.0	13.5	13.9	3.1	10.4	7.1	3.9	0.0	0.0	5.8
Uncertainty	22.6	11.3	16.8	9.5	17.6	28.6	3.9	10.0	0.0	11.4
Neutral	19.4	14.3	15.5	20.7	11.4	7.1	8.8	5.0	20.0	18.2
Altogether	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

are provided by papers with ‘no position’ abstracts (see 69,6% + 11,5%). (Understandably, this data is higher (84,7%) only in the case of ‘neutral’ in-text functions.) This briefly suggests that the superficial climate debate on anthropogenic influence cannot be explained by the rhetorical state of the journal abstracts alone; because (neutral) rhetoric in terms of AGW is an important tool for scientists as well as for report editors who re-interpret these texts (see Jankó et al. 2020).

Secondly, there is a considerable but not deterministic relationship between abstract categories and in-text functions. Papers with abstracts explicitly or implicitly endorsing AGW serve the IPCC claims to a higher degree in the skeptic report, i.e. they have a ‘supporting’ in-text function in higher percentages. Nevertheless, it becomes clear that these papers with endorsing abstracts can also be used to back contrarian claims, which highlights the importance of the rhetorical analysis to be presented below. In fact, ‘not supporting’ function always shows the highest percentage among the abstract categories. The data of the two contrary, ‘supporting’ and ‘not supporting’ in-text functions’ are only equal in the case of the ‘explicit endorsement with quantification’ category. On the other hand, ‘not supporting’ functions have the highest frequencies in the case of explicitly or implicitly rejecting abstract categories, although the subsamples are quite small here.

Finally, it is important to note that 31.2% of the in-text citations are so-called ‘transferred citations’, which could also be viewed as an interpretative and rhetorical technique of the climate skeptic report to expand its reference base and legitimacy.

Forums of doubt

Taking the journal performances in the case of (explicit or implicit) AGW endorsement into consideration, *Journal of Climate*, *Science*, *Geophysical Research Letters*, *Nature*, and *Journal of Geophysical Research* have the most papers in absolute terms (between 31 and 62 items). The top journals featuring AGW rejection are *Geophysical Research Letters* ($N=23$), *Science* (12), *Journal of Atmospheric and Solar-Terrestrial Physics* (8), *Journal of Geophysical Research* (6), and *Journal of Climate* (5). It is certainly needless to say that these absolute numbers show relatively low percentages (Table 3).

Figure 1 presents the relative distribution among all categories in the main journals, showing some distinctions between the journals, presumably due to scope, genre or some differences in editorial practice and expectations. For journals with a paleoclimate research focus ‘no-position’ abstracts are extremely common. While in the case of *Nature*, *Journal of Climate* and others, arguing about anthropogenic climate change is a more frequent practice. Higher proportions in rejecting categories could be identified only in some particular journals (e.g. *Energy & Environment*, *Journal of Atmospheric and Solar-Terrestrial Physics*) but their count numbers are rather small.

The time-profiles of the most important journals indicate different “endorsement histories” (Fig. 2). One characteristic trend is the evolving difference between ‘no position’ and endorsing abstracts from the end of the 1990s. Further, the larger frequency and, occasionally, the emerging curve of AGW endorsing abstracts in the cases of the *Journal of Climate*, *Nature* and *Science* is worth mentioning. The appearance of AGW rejecting papers in *Geophysical Research Letters* is yet to be noted from the beginning of the 2000s. Apart from that, the ‘no-position’ trend of the latter is more or less congruent with the entire sample highlighting the different trends in the other journals (cf. Jankó et al. 2020, Fig. 2). As we argued above, more than 80% of the papers with ‘not supporting’ in-text citations have ‘no-position’ ratings. This underscores that the potential of some journals to offer papers

Table 3 Abstract examples in rejecting categories

Paper	Quotation from the abstract	Category
<p>White, W.B., Cayan, D.R., Dettinger, M.D., and Anad, G. (2001). Sources of global warming in upper ocean temperature during El Niño. <i>Journal of Geophysical Research</i> 106, 4349–4367</p>	<p>Global average sea surface temperature (SST) from 40°S to 60°N fluctuates ±0.3 °C on interannual period scales, with global warming (cooling) during El Niño (La Niña). About 90% of the global warming during El Niño occurs in the tropical global ocean from 20°S to 20°N, half because of large SST anomalies in the tropical Pacific associated with El Niño and the other half because of warm SST anomalies occurring over ~80% of the tropical global ocean. From examination of National Centers for Environmental Prediction [Kalnay et al., 1996] and Comprehensive Ocean-Atmosphere Data Set [Woodruff et al., 1993] reanalyses, tropical global warming during El Niño is associated with higher troposphere moisture content and cloud cover, with reduced trade wind intensity occurring during the onset phase of El Niño. During this onset phase the tropical global average diabatic heat storage tendency in the layer above the main pycnocline is 1–3 W m⁻² above normal. Its principal source is a reduction in the poleward Ekman heat flux out of the tropical ocean of 2–5 W m⁻². Subsequently, peak tropical global warming during El Niño is dissipated by an increase in the flux of latent heat to the troposphere of 2–5 W m⁻², with reduced shortwave and longwave radiative fluxes in response to increased cloud cover tending to cancel each other. In the extratropical global ocean the reduction in poleward Ekman heat flux out of the tropics during the onset of El Niño tends to be balanced by reduction in the flux of latent heat to the troposphere. Thus global warming and cooling during Earth’s internal mode of interannual climate variability arise from fluctuations in the global hydrological balance, not the global radiation balance. Since it occurs in the absence of extraterrestrial and anthropogenic forcing, global warming on decadal, interdecadal, and centennial period scales may also occur in association with Earth’s internal modes of climate variability on those scales</p>	<p>Explicit rejection without quantification</p>

Table 3 (continued)

Paper	Quotation from the abstract	Category
Douglass, D.H., & Clader, B.D. (2002). Climate sensitivity of the Earth to solar irradiance. <i>Geophysical Research Letters</i> , 29, doi:10.1029/2002GL015345.	The mean surface temperature of the Earth depends on various climate factors with much attention directed toward possible anthropogenic causes. However, one must first determine the stronger effects such as El Niño/La Niña and volcanoes. A weaker effect, which must exist, is solar irradiance. We have determined the solar effect on the temperature from satellites measurements (available since 1979) of the solar irradiance and the temperature of the lower troposphere. We find the sensitivity to solar irradiance to be about twice that expected from a no-feedback Stefan-Boltzmann radiation balance model. This climate gain of a factor of two implies positive feedback. We also have determined a linear trend in the data. These results are robust under truncation from either end of the of data. These measurements of solar sensitivity are consistent with prior estimates from ocean temperatures on decadal scales and of paleo-reconstructed temperatures on centennial scales	Implicit rejection
Solomon, S., Rosenlof, K., Portmann, R., Daniel, J., Davis, S., Sanford, T., and Plattner, G.-K. (2010). Contributions of stratospheric water vapor to decadal changes in the rate of global warming. <i>Science</i> , 327 (5970), 1219–1223. doi: 10.1126/science.1182488.	Stratospheric water vapor concentrations decreased by about 10% after the year 2000. Here we show that this acted to slow the rate of increase in global surface temperature over 2000–2009 by about 25% compared to that which would have occurred due only to carbon dioxide and other greenhouse gases. More limited data suggest that stratospheric water vapor probably increased between 1980 and 2000, which would have enhanced the decadal rate of surface warming during the 1990s by about 30% as compared to estimates neglecting this change. These findings show that stratospheric water vapor is an important driver of decadal global surface climate change	Implicit rejection

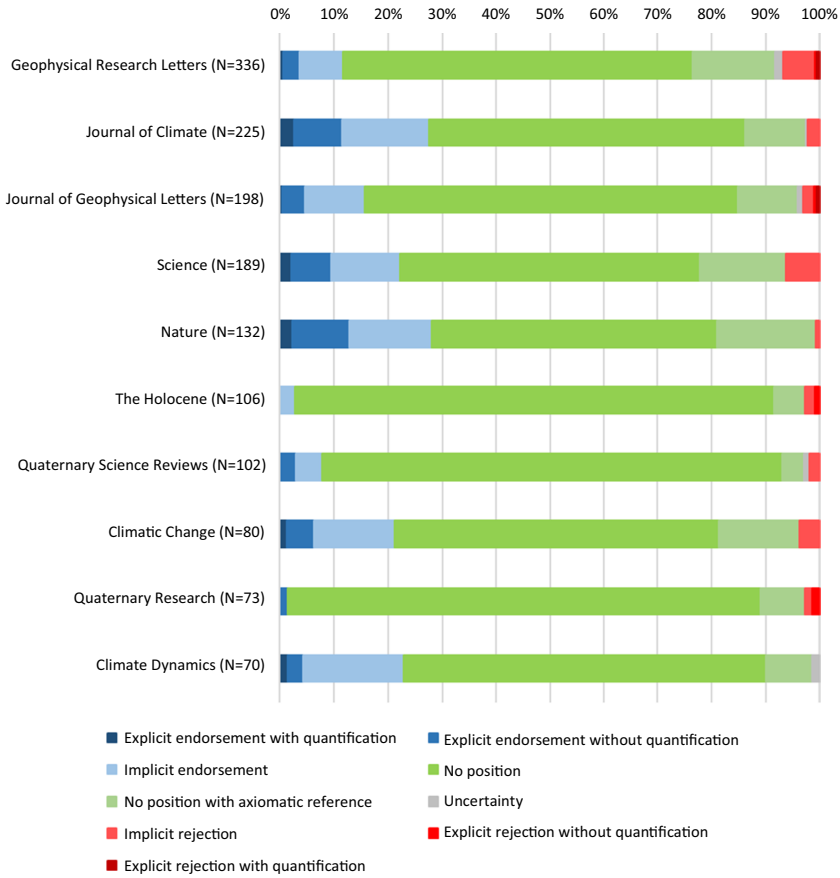


Fig. 1 Levels and ratios of AGW endorsement in the main journals, %

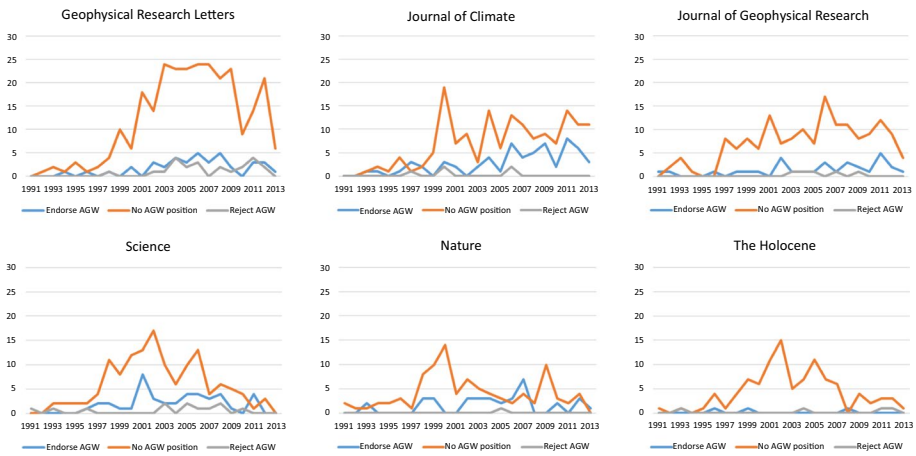


Fig. 2 Journal time-profiles in main AGW endorsement categories, number of articles. Notification: 2013 is not a full year of reference

the skeptics could utilize has significantly decreased. This is visible in Fig. 2 as no-position papers peak in the middle of the period (first of all Science, Nature and The Holocene).

Figure 3 presents data concerning the in-text citation functions related to the IPCC claims and how the contrarian editors used the papers in wording the climate skeptic report. The journal profiles are similar as seen in Fig. 1. While Geophysical Research Letters stands in the middle, Nature and Science articles show lower rates in ‘not supporting’ and ‘uncertainty’ functions, and larger frequencies in ‘supporting’ functions. On the other side, paleoclimate journals have higher proportions of ‘not supporting’ citations, implying that paleoclimate research findings addressing the same climatic system, but without the human fingerprint and in a different manner, play a crucial role in climate skeptic argumentation. Implying the uncertainty of climate models is a usual method used by climate skeptics, hence, this function is higher among papers in Climate Dynamics and Journal of Climate, where climate modelling is in the main scope of the journals.

Based on the aspects we used so far, a modified journal list could also be presented as a foundation and source of contrarian arguments. Without the articles published before 1991, taking out papers only used as ‘transferred citations’ and those only supporting the IPCC claims with their in-text citation functions, Table 4 is obtained (compare with Table 2 in Jankó et al. 2017). Overall, nearly 35% of the journal articles have fallen off the list, although there is one example on the list, Journal of Glaciology, which paper count halved, which causes some moderate changes in the first half of the presented list and some greater changes below that.

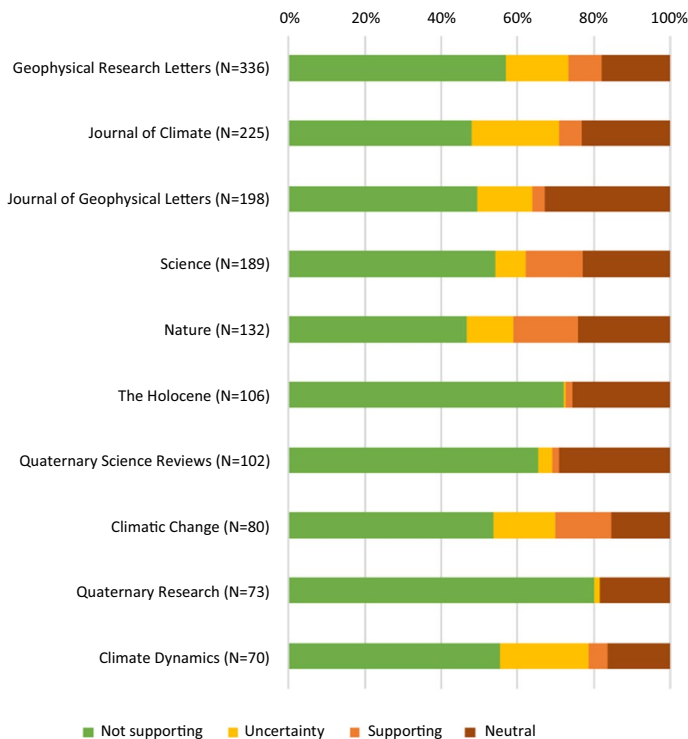


Fig. 3 Dominant functions of in-text citations in face of the IPCC claims in the main journals, %

Table 4 Modified journal list (without articles: before 1991, only as transferred citations, only with 'supporting' functions)

Rank	Journal	Number of articles	Change, %	% of articles	Cumm. %	Rank change
1	Geophysical Research Letters	242	70.6	11.8	11.8	–
2	Journal of Climate	132	57.6	6.5	18.3	–
3	Journal of Geophysical Research	128	59.3	6.3	24.5	+1
4	Science	111	50.7	5.4	30.0	–1
5	Nature	84	52.2	4.1	34.1	–
6	The Holocene	71	65.1	3.5	37.5	–
7	Quaternary Science Reviews	65	61.9	3.2	40.7	–
8	Climatic Change	50	62.5	2.4	43.2	+1
9	Quaternary Research	50	58.1	2.4	45.6	–1
10	International Journal of Climatology	49	72.1	2.4	48.0	+1
11	Climate Dynamics	42	59.2	2.1	50.0	–1
12	Global and Planetary Change	41	75.9	2.0	52.1	+1
13	Palaeogeogr. Palaeoclimatol. Palaeoecol	35	62.5	1.7	53.8	–1
14	Proceedings of the National Academy of Sciences	29	61.7	1.4	55.2	+1
15	Bulletin of the American Meteorological Society	28	58.3	1.4	56.5	–1
16	Global Change Biology	24	75.0	1.2	57.7	+5
17	Journal of Paleolimnology	24	77.4	1.2	58.9	+5
18	Earth and Planetary Science Letters	23	60.5	1.1	60.0	–
19	Geology	23	57.5	1.1	61.1	–3
20	Journal of Atmospheric and Solar-Terrestrial Physics	22	73.3	1.1	62.2	+3
21	Paleoceanography	22	64.7	1.1	63.3	–1
22	EOS: Transactions of the American Geophysical Union	21	60.0	1.0	64.3	–3
23	Climate Research	20	80.0	1.0	65.3	+2
24	Quaternary International	20	50.0	1.0	66.3	–7
25	Chinese Science Bulletin	17	85.0	0.8	67.1	+6
26	Journal of Quaternary Science	17	70.8	0.8	67.9	+2

Table 4 (continued)

Rank	Journal	Number of articles	Change, %	% of articles	Cumm. %	Rank change
27	Annals of Glaciology	16	80.0	0.8	68.7	+2
28	Journal of Hydrology	16	59.3	0.8	69.5	-4
29	Nature Geoscience	16	64.0	0.8	70.3	-2
30	Boreas	13	65.0	0.6	70.9	-
31	Climate of the Past	13	76.5	0.6	71.6	+4
32	Natural Hazards	12	85.7	0.6	72.1	+11
33	Global Biogeochemical Cycles	11	57.9	0.5	72.7	-1
34	Journal of Glaciology	11	44.0	0.5	73.2	-8
35	Theoretical and Applied Climatology	11	68.8	0.5	73.8	+2
36	Water Resources Research	10	66.7	0.5	74.2	+4

Authors

The most frequently used and/or most cited lead authors are evident in Table 5. To show some interconnectedness in this list, we note that Cook, Esper and Meko are occasionally co-authors, similar to Scafetta and Loehle. The rhetorical state of the articles and their use in the text could be much more complicated and diverse. Some authors show a wide rhetorical range in their abstracts concerning the endorsement of AGW which indicates that rhetoric is accidental to a certain degree. In-text citations can also serve different functions, even in instances where these citations belong to the same author or to the same paper. For example a P. Chylek. article rated as implicitly endorsing AGW was used twice by the skeptic report against the IPCC knowledge claims. Another Chlyek study, implicitly rejecting AGW was cited two times for and three times against the IPCC claims. A similar example is E.R. Cook, who has three papers with IPCC supporting interpretations, two implicitly endorsing, but one implicitly rejecting AGW; however, the dominant in-text use for these is ‘not supporting’. These examples also demonstrate that scientific rhetoric in the abstracts and the life of papers could take different directions when they are cited later, at least in the hands of the climate skeptic report editors. Earlier research indicated the same papers could have different interpretations by the IPCC and by the climate skeptic report (Jankó et al. 2014). Table 5 makes it clear that there are also numerous articles with only transferred citations. Examples when only two papers deliver numerous in-text citations also exist. Nevertheless, there are only two authors (N. Scafetta and J. Esper), who could be highlighted by their high numbers in both aspects of our analysis, i.e. article and citation number.

Language

Our last analytical aspect was to study the rhetorical practice conducted in the climate skeptic report. The starting point of this investigation was the question of the seeming contradiction between abstracts endorsing AGW and the use of these as papers that do not support the IPCC knowledge claims. Thus, we selected those 90 articles that fit into these criteria. Firstly, all the abstracts were revisited to determine whether AGW endorsement was based on the study results, or whether the endorsement was only rhetorical in nature, i.e. writing about anthropogenic climate change as a known fact. This data showed that only 9 papers (10%) presented their results as a source of AGW endorsement. Secondly, the main message of the abstracts was identified and relatedly, the main points of the same papers as cited in the text were analyzed to determine whether a link exists, i.e. overlapping content between the two. We found 65 papers containing this relationship. As we argued elsewhere (Jankó et al. 2020), these examples not only show that papers in endorsing categories could be used to legitimize opposing claims but also reveal that results not fitting into the consensus or not reflecting the dominant climatic evidence could be presented using the AGW rhetoric. In the other cases (18 from 25), we have mostly transferred citations; thus, there is no need to explain the missing link. After all, in the remaining 7 studies, we should emphasize that the abstract scope and content does not match either the reviewed part or the highlighted message of a given paper.

In Table 6 we show three examples. The main message of the first abstract is that there are widespread positive temperature trends in the Antarctic summer, which should be monitored to determine the balance between natural and anthropogenic forcings. In contrast, the

Table 5 Authors with largest number of articles or in-text citations (as lead authors) according to level of AGW endorsement and in-text function categories

Major journal	Time frame of publications	Level of AGW endorsement				Functions of in-text citations related to IPCC claims										
		Endorse AGW		Implicit AGW endorsement	No position with axiomatic reference	Uncertainty	Implicit AGW rejection	Explicit AGW rejection		Articles altogether	Supporting	Uncertainty	Not supporting	Neutral	Transferred citation	In-text citations altogether
		With	Without					With	Without							
		Quantification				Quantification										
Bergeron, Y	ecol	1991–2006	2	2	3	1	8	19	4	23	23					
Bond, G	s	1995–2001	3	3		3	42	25	53	67						
Chylek, P	grl	2004–2009	1	1	1	1	4	5	1	16						
Cook, E.R	-	1997–2010	2	5		2	9	4	28	34						
Changnon, S.A	cc	1999–2011	7	3		10	1	2	13	16						
Esper, J	grl	2002–2012	1	9	2	12	1	9	6	47						
Hodell, D.A	-	1995–2007	5	5		5	13	14	21	27						
Idso, S.B	-	1991–1998	1	1	1	3	6	1	6	6						
Keigwin, L.D	-	1996–2000	1	1		2	7	4	9	11						
Kobashi, T	-	2008–2011	1	2		4	10	2	12	12						
Landsea, C.W	mwr	1994–2010	3	1	3	9	1	5	12	12						
Lindzen, R.S	grl	1997–2011	2	4		7	7	5	5	12						

Table 5 (continued)

Major journal	Time-frame of publications	Level of AGW endorsement				Functions of in-text citations related to IPCC claims										
		Endorse AGW		Implicit AGW endorsement	No position with axiomatic reference	Uncertainty	Implicit AGW rejection	Explicit AGW rejection		Articles altogether	Supporting	Uncertainty	Not supporting	Neutral	Transferred citation	In-text citations altogether
		With	Without					With	Without							
		Quantification		Quantification												
Loehle, C	ee	2003–2011	2	1	1	1	1	1	6	2	10	4	1	16		
Magny, M	-	1993–2004	1	1				2			6	2	8	8		
Mayewski, P.A	-	1997–2009	1	2				3		1	14	3	13	18		
McDermott, F	-	1999–2001	1	1				2			8	4	5	12		
Meko, D.M	-	2001–2007	2	2				2			6	1	5	7		
Molg, T	jgr	2003–2009	2	4				6			11	7	3	18		
Rein, B	-	2004–2005	2	2				2			8	3	6	11		
Scafetta, N	jast	2003–2013	2	2	5	2	6	15			28	3	12	31		
Shaviv, N.J	jgr	2002–2008	3	3	1	1	5				11		4	11		
Soon, W	-	2000–2013	6	6	2		8				15		3	15		
van Geel, B	-	1996–2003	5	5			5			1	15	2	15	18		

eeol Ecology, s Science, grl Geophysical Research Letters, cc Climatic Change, mwr Monthly Weather Review, ee Energy and Environment, jgr Journal of Geophysical Research, jast Journal of Atmospheric, Solar-Terrestrial Physics

Table 6 Abstracts and in-text citations contrasted, three examples

Paper	Quotation from the abstract	Quotation from Idso et al. (2013)
Monaghan, A.J. and Bromwich, D.H. 2008. Advances in [...] Identifying and attributing natural- and human-caused climate change signals from the comparatively short Antarctic dataset is confounded by large year-to-year fluctuations of temperature, atmospheric pressure, and snowfall." [...] The new near-surface temperature and snowfall records roughly double the length of previous such datasets, which have complete spatial coverage over the continent. They indicate complex patterns of regional and seasonal climate variability. Of particular note is the occurrence of widespread positive temperature trends during summer since the 1990s, the season when melt occurs. In forthcoming years, careful monitoring of the summer trends will be required to determine whether they are associated with a natural cycle or the start of an anthropogenic warming trend.[...]	They point out, "snowfall is the largest contributor to the growth of the ice sheets, and near-surface temperature controls surface melting, which in turn has important impacts on the stability of Antarctic ice shelves and glaciers," which ultimately impact global sea level.[...] On the Antarctic Peninsula, by contrast, temperature measured at the Faraday/Vernadsky station rose at the phenomenal rate of 0.56 °C per decade from 1951 to 2000. But the peninsula comprises a mere 4 percent of the continent's total surface area, and its warming, although dramatic, is only a small-scale anomaly.[...] Monaghan and Bromwich conclude, "overall there have not been statistically significant Antarctic nearsurface temperature trends since the International Geophysical Year" of 1957–1958. i.m. 431–432	Thus, over the first 115 years of Overpeck et al.'s record, as the air's CO ₂ concentration rose by an average of 0.24 ppm/year, air temperature rose by an average of 0.013 °C/year. Over the final 35 years of the record, when the air's CO ₂ content rose at a mean rate of 1.17 ppm/year (nearly five times as fast), the rate-of-rise of surface air temperature decelerated, to a mean value (0.011 °C/year), just the opposite of what one would have expected on the basis of greenhouse gas-induced warming theory. i.m. 450
Overpeck, J., Hughen, K., Hardy, D., Bradley, R., Case, [...] From 1840 to the mid-twentieth century, the Arctic warmed to the highest temperatures in four centuries. This warming ended the Little Ice Age in the Arctic and has caused retreats of glaciers, melting of permafrost and sea ice, and alteration of terrestrial and lake ecosystems. Although warming, particularly after 1920, was likely caused by increases in atmospheric trace gases, the initiation of the warming in the mid-nineteenth century suggests that increased solar irradiance, decreased volcanic activity, and feedbacks internal to the climate system played roles	From 1840 to the mid-twentieth century, the Arctic warmed to the highest temperatures in four centuries. This warming ended the Little Ice Age in the Arctic and has caused retreats of glaciers, melting of permafrost and sea ice, and alteration of terrestrial and lake ecosystems. Although warming, particularly after 1920, was likely caused by increases in atmospheric trace gases, the initiation of the warming in the mid-nineteenth century suggests that increased solar irradiance, decreased volcanic activity, and feedbacks internal to the climate system played roles	Thus, over the first 115 years of Overpeck et al.'s record, as the air's CO ₂ concentration rose by an average of 0.24 ppm/year, air temperature rose by an average of 0.013 °C/year. Over the final 35 years of the record, when the air's CO ₂ content rose at a mean rate of 1.17 ppm/year (nearly five times as fast), the rate-of-rise of surface air temperature decelerated, to a mean value (0.011 °C/year), just the opposite of what one would have expected on the basis of greenhouse gas-induced warming theory. i.m. 450

Table 6 (continued)

Paper	Quotation from the abstract	Quotation from Idso et al. (2013)
<p>Mason, O. W. and Jordan, J. W. 2002. Minimal late Holocene sea level rise in the Chukchi Sea: Arctic insensitivity to global change? <i>Global and Planetary Changes</i> 32: 13–23</p>	<p>... Radiocarbon ages ($n = 27$) on paleo-marsh beds along several Seward Peninsula lagoons allows the reconstruction of sea level over the last 6000 years in northwest Alaska and indicate a modest sea level rise, ~1.5 m, or 0.27 mm year⁻¹. Neoglacial (1600–200 cal BC) storm deposits from Kotzebue Sound to Barrow are 1–1.5 m below modern storm surge elevations, supporting the inference of a lower eustatic sea level. Our data-constrained sea level curve establishes that the Chukchi Sea responds at a considerably slower rate than other regions of the world, supporting recent models of isostatic response for the arctic</p>	<p>They learned “in the Chukchi Sea, storm frequency is correlated with colder rather than warmer climatic conditions.” Consequently, they say their data “do not therefore support predictions of more frequent or intense coastal storms associated with atmospheric warming for this region.” i.m. 925</p>

skeptic report highlights that the warming on the Antarctic Peninsula is only a small scale anomaly, and that near surface temperature trends in Antarctica were not statistically significant. In the second example, the abstract concludes that warming after 1920 was caused mainly by atmospheric trace gases; however, other natural forcings also played a role. The skeptic report questioned the carbon-dioxide–global temperature warming link using the findings from the same paper. In the third example, the abstract addresses the studied sea level changes and the response of the Chukchi Sea, while the skeptic assessment reported about the missing positive relationship between storm frequency and warmer climatic conditions. These situations could be easily explained as ‘cherry picking’ (see Farmer and Cook 2013); however, we should be wary of such a superficial judgement because abstracts cannot and should not reflect all the findings in scientific papers.

In a rhetorical sense, several things could happen to a given paper when we place it into the citation context. As we pointed out earlier, solemn language, i.e. epideictic in Aristotelian sense, characterizes the climate skeptic report (Jankó et al. 2014). Medimorec and Pennycook (2015) showed this rhetoric parallels with more certainty in wording the arguments that have clearly visible links to the language of science popularizations (Fahnestock 1986). Unsurprisingly, solemn language was the most common type of rhetoric, appearing in 51 of the 90 papers. The script of such a citation is easy to follow. First, the subject is highlighted. Second, the research venue and method are addressed and sometimes celebrated as a source of legitimation. After that, the report editors turn to the results and discuss what the authors found and how the authors concluded, regularly using quotations and ‘transferred citations’ from the original text for further support.

Beyond the pure category, it was possible to identify a number of versions of this rhetoric. For example, the skeptic report authors rectify the message of the cited paper through the overstatement and re-contextualization of the results, or through the reinterpretation and supplementation of the conclusions of the cited papers (Table 7, examples No. 3–6.). In these cases, the opportunities of rhetoric are demonstrated, how a different context amplifies or blurs the original intention of the papers and their authors. However, the technique of reinterpretation is nothing but a regular, in fact an expected activity of reviewers and report editors.

Nevertheless, the second-most common rhetorical technique was neutral ($N=34$). In these cases, the rhetorical context of the so called ‘transferred citations’ has barely changed by moving them from the citing paper to the report, and were often shown within a word-for-word quotation. The role of the ‘transferred citations’ was to legitimize the papers citing them, thereby legitimizing the reviewing editors’ claims.

Conclusions

Concluding concerning the research questions, our study showed that the reference corpus of the contrarian report has remarkable deflection, particularly with its distinct endorsing rates pushing further questions to the foreground. The discrepancy between similarly high endorsing rates and the majority of non-supporting citations against the IPCC claims could be resolved with some focus on rhetoric. First, rhetoric is important, as our analysis showed AGW endorsement is mainly a rhetorical action. Thus, endorsement in abstracts is not in conflict with the “skeptical use” of papers. Second, rhetorical analysis showed that language and wording are at least as important as the references backing the claims, i.e. this method is a proper complement to the bibliometric numbers characterizing the literature.

Table 7 Rhetorical types of in-text citations, examples

Paper	Rhetorical type	Quotation from Idso et al. (2013)
<p>Buntgen, U., Brazdil, R., Heussner, K.-U., Hofmann, J., Konic, R., Kyncl, T., Pfister, C., Chroma, K., and Tegel, W. 2011. Combined dendro-documentary evidence of Central European hydroclimatic springtime extremes over the last millennium. <i>Quaternary Science Reviews</i> 30: 3947–3959</p>	<p>Solemn, epideictic</p>	<p>Buntgen et al. (2011) “introduce and analyze 11,873 annually resolved and absolutely dated ringwidth measurement series from living and historical fir (<i>Abies alba Mill.</i>) trees sampled across France, Switzerland, Germany and the Czech Republic, which continuously span the AD 962–2007 period,” and which “allow Central European hydroclimatic springtime extremes of the industrial era to be placed against a 1000 year-long backdrop of natural variations.” The nine researchers found “a fairly uniform distribution of hydroclimatic extremes throughout the Medieval Climate Anomaly, Little Ice Age and Recent Global Warming.” Such findings, Buntgen et al. stated, “may question the common belief that frequency and severity of such events closely relates to climate mean states.” i.m. 844–845</p>

Table 7 (continued)

Paper	Rhetorical type	Quotation from Idso et al. (2013)
<p>Paeth, H., Scholten, A., Friederichs, P., and Hense, A. 2008. Uncertainties in climate change prediction: El Niño-Southern Oscillation and monsoons. <i>Global and Planetary Change</i> 60: 265–288</p>	<p>Solemn, epideictic</p>	<p>Paeth et al. (2008) compared 79 coupled ocean-atmosphere climate simulations derived from 12 different state-of-the-art climate models forced by six IPCC emission scenarios with observational data in order to evaluate how well they reproduced the spatio-temporal characteristics of ENSO over the twentieth century, after which they compared the various models' twenty-first century simulations of ENSO and the Indian and West African monsoons to one another. With respect to the twentieth century, this work revealed "all considered climate models draw a reasonable picture of the key features of ENSO." With respect to the twenty-first century, on the other hand, they note "the differences between the models are stronger than between the emission scenarios," while "the atmospheric component of ENSO and the West African monsoon are barely affected." Their "overall conclusion" is that "we still cannot say much about the future behavior of tropical climate." They consider their study to be merely "a benchmark for further investigations with more recent models in order to document a gain in knowledge or stagnation over the past five years." i.m. 124</p>

Table 7 (continued)

Paper	Rhetorical type	Quotation from Idso et al. (2013)
<p>Ring, M.J., et al., 2012. Causes of the global warming observed since the nineteenth century. <i>Atmospheric and Climate Sciences</i> 2: 401–415. doi: 10.4236/acs.2012.24035</p>	<p>Solemn, epideictic with overstatement and re-contextualization of the results</p>	<p>Ring et al. (2012) did not calculate a sensitivity range, but rather estimated equilibrium warming with a spectral decomposition model of the four main global temperature data sets, fit to long-lived greenhouse gases, compensating aerosols, changes in tropospheric ozone and land use, solar irradiance, and volcanic activity in a model estimating land and ocean temperatures, with a 40-layer oceanic model to allow for latitudinal advection of heat. Their equilibrium temperature change ranged from 1.5 to 2.0 °C, and they noted “These are on the low end of the estimates in the IPCC’s <i>Fourth Assessment Report</i>.] So, while we find that most of the observed warming is due to human emissions of [long-lived greenhouse gases], future warming based on these estimations will grow more slowly than that under the IPCC’s “likely” range of climate sensitivity, from 2.0 °C to 4.5°.” Notably, the fourth author of this paper, University of Illinois climate modeler Michael Schlesinger, has been one of the most outspoken advocates of stringent and immediate controls of greenhouse emissions and, in earlier work, he had produced some of the largest estimates of equilibrium warming from carbon dioxide. i.m. 28</p>

Table 7 (continued)

Paper	Rhetorical type	Quotation from Idso et al. (2013)
Khatiwala, S., Primeau, F., and Hall, T. 2009. Reconstruction of the history of anthropogenic CO ₂ concentrations in the ocean. <i>Nature</i> 462: 346–349	Solemn, epideictic with critical reinterpretation of the authors' messages	Khatiwala et al. (2009) note the world's oceans play "a crucial role in mitigating the effects of rising atmospheric CO ₂ to the climate system." They derived "an observationally based reconstruction of the spatially-resolved, time-dependent history of anthropogenic carbon in the ocean over the industrial era [AD 1765 to AD 2008]." [...] Writing about Khatiwala et al.'s work in the November 19, 2009 issue of <i>The New York Times</i> , Sindyá Bhanoo presented a distinctly pessimistic slant to the scientists' findings, [...] Bhanoo quotes Khatiwala himself as saying the recent trend to lower values of the ocean's uptake rate of anthropogenic carbon "implies that more of the emissions will remain in the atmosphere." Quite to the contrary, however, the finely intertwined relationship of the two parameters of Fig. 2.6.1.1 clearly demonstrates, well within the accuracy of the various measurements involved, that the global ocean is constantly adjusting its uptake rate of anthropogenic carbon on multi-decadal time scales to "keep up" with the rate at which the air's CO ₂ content rises in response to anthropogenic carbon inputs. [...] i.m. 229–231

Table 7 (continued)

Paper	Rhetorical type	Quotation from Idso et al. (2013)
<p>Damon, P.E. and Laut, P. 2004. Pattern of strange errors plagues solar activity and terrestrial climatic data. EOS: Transactions, American Geophysical Union 85: 370, 374</p>	<p>Solemn, epideictic with reinterpreted and supplemented conclusions</p>	<p>To be sure, some of the Sun-climate relation studies have been challenged. In 2004, Damon and Laut (2004) reported what they described as errors made by Friis-Christensen and Lassen (1991), Svensmark and Friis-Christensen (1997), Svensmark (1998), and Lassen and Friis-Christensen (2000) in their presentation of solar activity data correlated with terrestrial temperature data. The Danish scientists' error, in the words of Damon and Laut, was "adding to a heavily smoothed ('filtered') curve, four additional points covering the period of global warming, which were only partially filtered or not filtered at all." This in turn led to an apparent dramatic increase in solar activity over the last quarter of the twentieth century that closely matched the equally dramatic rise in temperature manifest by the Northern Hemispheric temperature reconstruction of Mann et al. (1998, 1999) over the same period. With the acquisition of additional solar activity data in subsequent years, however, and with what Damon and Laut called the proper handling of the numbers, the late twentieth century dramatic increase in solar activity disappears. This new result, to quote Damon and Laut, means "the sensational agreement with the recent global warming, which drew worldwide attention, has totally disappeared." In reality, however, it is only the agreement with the last quarter-century of the discredited Mann et al. "hockey stick" temperature history that has disappeared. This new disagreement is important, for the Mann et al. temperature reconstruction is likely in error over this period of time. i.m. 255</p>

Table 7 (continued)

Paper	Rhetorical type	Quotation from Idso et al. (2013)
Wood, K.R. and Overland, J.E. 2010. Early twentieth century Arctic warming in retrospect. <i>International Journal of Climatology</i> 30: 1269–1279	Solemn, epideictic with reinterpreted and supplemented conclusions	Wood and Overland (2010) note “the recent widespread warming of the Earth’s climate is the second of two marked climatic fluctuations to attract the attention of scientists and the public since the turn of the twentieth century.” [...] Wood and Overland conclude the “early climatic fluctuation is best interpreted as a large but random climate excursion imposed on top of the steadily rising global mean temperature associated with anthropogenic forcing.” However, the early warming also could be interpreted as a large but random climate excursion imposed on top of the steadily rising global mean temperature associated with Earth’s natural recovery from the global chill of the Little Ice Age. And there is no reason not to conclude the same about the most recent Arctic warming: in a major analysis of past rates of climate change in the Arctic, White et al. (2010) conclude, “thus far, human influence does not stand out relative to other, natural causes of climate change.” i.m. 462
Guilyardi, E. 2006. El Niño mean state-seasonal cycle interactions in a multi-model ensemble. <i>Climate Dynamics</i> 26: 329–348	Neutral	[T]hey note the lack of consensus they found “mirrors parallel findings in changes in ENSO behavior conducted by van Oldenborgh et al. (2005), Guilyardi (2006) and Merryfield (2006),” and they state these significant issues “most certainly impact global climate change predictions.” [...] Zhang and Jin (2012) indicate “ENSO behaviors in coupled models have been widely evaluated,” citing Neelin et al. (1992), Delecluse et al. (1998), Latif et al. (2001), Davey et al. (2002), AchutaRao and Sperber (2002, 2006), Capotondi et al. (2006), Guilyardi (2006), and Zhang et al. (2010). i.m. 100; 126

Digging to the deepest point before reading all the references again, we revealed significant differences in the forums where the papers were published concerning editorial practice, topic-dependency, and certain home field advantages of some authors. Nevertheless, in a particular sense, the whole skeptic report could be characterized as a collection of cherry-picked information and research findings indicating the uncertainties of methods and not supporting the IPCC knowledge claims. These are all decontextualized and re-contextualized into the frames of the skeptical argumentation. Doubt about the anthropogenic influence on climate change has thus the following foundations. Authors and forums (i.e. journals), willingly or unwillingly delivering relevant information accumulated on methodological uncertainties and findings that do not support mainstream knowledge claims (1), and rhetoric, especially solemn rhetoric supplemented with proper re-contextualization and reinterpretation (2).

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Affiliations

Ferenc Jankó^{1,2}  · **Áron Drüszler³** · **Borbála Gálos⁴** · **Norbert Móricz⁵** · **Judit Papp-Vancsó²** · **Ildikó Pieczka⁶**  · **Rita Pongrácz⁶**  · **Ervin Rasztovits⁵** · **Zsuzsanna Soósné Dezső⁶**  · **Orsolya Szabó⁵**

Áron Drüszler
aron.drueszler@univie.ac.at

Borbála Gálos
galos.borbala@uni-sopron.hu

Norbert Móricz
moriczn@erti.hu

Judit Papp-Vancsó
vancsojudit@gmail.com

Ildikó Pieczka
pieczka@nimbus.elte.hu

Rita Pongrácz
prita@nimbus.elte.hu

Ervin Rasztovits
ervin.rasztovits@gmail.com

Zsuzsanna Soósné Dezső
dezsozsuzsi@caesar.elte.hu

Orsolya Szabó
szabo.orsolya@erti.naik.hu

¹ Department of Social and Economic Geography, Eötvös Loránd University, Pázmány P. st. 1/c, Budapest 1117, Hungary

² Alexandre Lamfalussy Faculty of Economics, University of Sopron, Erzsébet u. 9., Sopron 9400, Hungary

³ Department of Meteorology and Geophysics, University of Vienna, Althanstraße 14 / UZA-II / 2G556, 1090 Vienna, Austria

⁴ Institute of Environmental and Earth Sciences, Faculty of Forestry, University of Sopron, Bajcsy-Zs. E. u. 4., Sopron 9400, Hungary

⁵ Department of Ecology and Forest Management, National Agricultural Research and Innovation Center, Forest Research Institute, Várkerület 30/A, Sárovar 9600, Hungary

⁶ Department of Meteorology, Eötvös Loránd University, Pázmány P. st. 1/a, Budapest 1117, Hungary