Find a good title for this abstract

Milankovitch proposed that Earth resides in an interglacial state when its spin axis both tilts to a high obliquity and precesses to align the Northern Hemisphere summer with Earth's nearest approach to the Sun. This general concept has been elaborated into hypotheses that precession, obliquity or combinations of both could pace deglaciations during the late Pleistocene. Earlier tests have shown that obliquity paces the late Pleistocene glacial cycles, but have been inconclusive with regard to precession, whose shorter period of about 20,000 years makes phasing more sensitive to timing errors. No quantitative test has provided firm evidence for a dual effect.

Here I show that both obliquity and precession pace late Pleistocene glacial cycles. Deficiencies in time control that have long stymied efforts to establish orbital effects on deglaciation are overcome using a new statistical test that focuses on maxima in orbital forcing. The results are fully consistent with Milankovitch's proposal but also admit the possibility that long Southern Hemisphere summers contribute to deglaciation.

LETTER

doi:10.1038/nature10626

Combined obliquity and precession pacing of late Pleistocene deglaciations

Peter Huybers[1]

Milankovitch[1] proposed that Earth resides in an interglacial state when its spin axis both tilts to a high obliquity and precesses to align the Northern Hemisphere summer with Earth's nearest approach to the Sun. This general concept has been elaborated into hypotheses that precession[2], obliquity[3,4] or combinations of both[5–8] could pace deglaciations during the late Pleistocene[9,10]. Earlier tests have shown that obliquity paces the late Pleistocene glacial cycles[4,11] but have been inconclusive with regard to precession, whose shorter period of about 20,000 years makes phasing more

account for uncertainty in the ^{40}K decay constant[18,19], it is now represented as occurring at 780 ± 8 kyr (1 s.d.). Terminations are identified by local maxima in the time rate-of-change of the $\delta^{18}O$ record that exceed a value of 0.095‰ per kyr, giving the usual termination features[20] except that termination 3 contains two parts that are labelled 3a and 3b (Fig. 1a). (Thresholds ranging between 0.07‰ and 0.17‰ per kyr would give different numbers of terminations but give similarly significant results.) The average uncertainty in the age of the 12 identified termination features is 8 kyr (1 s.d.), with older ages

One last thing…

- A title is much more likely to attract attention if it starts with the **main findings** or consequences (rather than context)
- Search engines are more likely to find it if it contains **key words** (and not “New results …”)

- Examples
  - “The Laschamp geomagnetic excursion featured in nitrate record from EPICA-Dome C ice core”
  - “Excavating Neandertal and Denisovan DNA from the genomes of Melanesian individuals”
  - “Oxidation products of biogenic emissions contribute to nucleation of atmospheric particles”

2. Authors

Authors

- After the title, the names of the authors are the second item people will read

Why does the author/affiliation list matter ?

- It tells the reader who contributed to the study
- It establishes the authority of your work (affiliations, institutions, etc)
- It allows indexing your paper in databases
- It allows interested readers to contact you
- It matters for your funding agencies

Who should appear as co-author ?

1. Those who wrote the text
2. Those who made the plots
3. Those who analysed the data, ran the simulations
4. Those who provided the data
5. Those who did the field work
6. Those who coordinated the field campaign
7. The engineers and technicians who contributed to the study
8. The students who worked on the data during an internship
9. Those who first emitted the idea
10. The team leader
11. The director of the laboratory
12. The person who provided the funding

Who are the authors ?

Authors ***must*** meet all 3 of the following criteria

1. He/she has made **substantial** contributions to the work (i.e. design of the experiment, data analysis, interpretation, etc.)

AND

2. He/she has contributed to writing the manuscript or to revising it.

AND

3. He/she has approved the final version.

Authors

Review of Particle Physics

Yao, W.-M.; Amsler, C.; Asner, D.; Barnett, R. M.; Beringer, J.; Burchat, P. R.; Carone, C. D.; Caso, C.; Dahl, O.; D'Ambrosio, G.; De Gouvea, A.; Doser, M.; Eidelman, S.; Feng, J. L.; Gherghetta, T.; Goodman, M.; Grab, C.; Groom, D. E.; Gurtu, A.; Hagiwara, K.; Hayes, K. G.; Hernández-Rey, J. J.; Hikasa, K.; Jawahery, H.; Kolda, C.; Kwon, Y.; Mangano, M. L.; Manohar, A. V.; Masoni, A.; Miquel, R.; Mönig, K.; Murayama, H.; Nakamura, K.; Navas, S.; Olive, K. A.; Pape, L.; Patrignani, C.; Piepke, A.; Punzi, G.; Raffelt, G.; Smith, J. G.; Tanabashi, M.; Terning, J.; Törnqvist, N. A.;sTrippe, T. G.; Vogel, P.; Watari, T.; Wohl, C. G.; Workman, R. L.; Zyla, P. A.; Armstrong, B.; Harper, G.; Lugovsky, V. S.; Schaffner, P.; Artuso, M.; Babu, K. S.; Band, H. R.; Barberio, E.; Battaglia, M.; Bichsel, H.; Biebel, O.; Bloch, P.; Blucher, E.; Cahn, R. N.; Casper, D.; Cattai, A.; Ceccucci, A.; Chakraborty, D.; Chivukula, R. S.; Cowan, G.; Damour, T.; DeGrand, T.; Desler, K.; Dobbs, M. A.; Drees, M.; Edwards, A.; Edwards, D. A.; Elvira, V. D.; Erler, J.; Ezhela, V. V.; Fetscher, W.; Fields, B. D.; Foster, B.; Froidevaux, D.; Gaisser, T. K.; Garren, L.; Gerber, H.-J.; Gerbier, G.; Gibbons, L.; Gilman, F. J.; Giudice, G. F.; Gritsan, A. V.; Grünewald, M.; Haber, H. E.; Hagmann, C.; Hinchliffe, I.; Höcker, A.; Igo-Kemenes, P.; JAckson, J. D.; Johnson, K. F.; Karlen, D.; Kayser, B.; Kirkby, D.; Klein, S. R.; Kleinknecht, K.; Knowles, I. G.; Kowalewski, R. V.; Kreitz, P.; Kursche, B.; Kuyanov, Yu. V.; Lahav, O.; Langacker, P.; Liddle, A.; Ligeti, Z.; Liss, T. M.; Littenberg, L.; Liu, J. C.; Lugovsky, K. S.; Lugovsky, s. B.; Mannel, T.; Manley, D. M.; Marciano, W. J.; Martin, A. D.; Milstead, D.; Narain, M.; Nason, P.; Nir, Y.; Peacock, J. A.; Prell, S. A.; Quadt, A.; Raby, S.; Ratcliff, B. N.; Razuvaev, E. A.; Renk, B.; Richardson, P.; Roesler, S.; Rolandi, G.; Ronan, M. T.; Rosenberg, L. J.; Sachrajda, C. T.; Sakai, Y.; Sarkar, S.; Schmitt, M.; Schneider, O.; Scott, D.; Sjöstrand, T.; Smoot, G. F.; Sokolsky, P.; Spanier, S.; Spieler, H.; Stahl, A.; Stanev, T.; Streitmatter, R. E.; Sumiyoshi, T.; Tkachenko, N. P.; Trilling, G. H.; Valencia, G.; van Bibber, K.; Vincter, M. G.; Ward, D. R.; Webber, B. R.; Wells, J. D.; Whalley, M.; Wolfenstsein, L.; Womersley, J.; Woody, C. L.; Yamamoto, A.; Zenin, O. V.; Zhang, J.; Zhu, R.-Y.

Journal of Physics G: Nuclear and Particle Physics, Volume 33, Issue 1, pp. 1-1232 (2006).

07/2006

Authors

- The order of the authors **does matter**
  - usually the first ones are the most important ones
  - but each community has its habits (e.g. alphabetical order in mathematics)
- The first author should always be the one who directed the study and coordinated the writing

For you as young scientist it is important to appear as first author

Can I change the order of the authors

- while submitting ?
- during the revision ?

One last thing…

- If you are the lead author, then **you** are the one who decides and takes responsibility

- Return the favour = asking a scientist to be co-author when you wish to strengthen a collaboration with him/her.

  Use with care !

3. Abstract

Abstract or Summary ?

Abstract or Summary ?

- **Abstract** : summarises the main points without detail. Articles start with an abstract.
- **Summary** : can be more detailed, including figures, etc. Theses include a summary.

Abstract

Abstract = **teaser / trailer**

What makes a good abstract ?

Abstract

Good abstract are

- **Clear** : short sentences, no jargon
- **Informative** : explain what the study is about, present the main outcome
- **Complete** : cover all key aspects of the work
- **Self-contained** : non-experts must be able to get the idea
- **Catchy** and attractive : to encourage people to continue reading
- **Brief** : typically < 200 words
- **Include keywords** : important for search engines

Abstract

Typical structure of a good abstract (this may vary)

Context	What are the issues ?
Objectives	What do I want to achieve ?
Method	How did I proceed ?
Results	What did I obtain ?
Consequences	What are the impacts and the perspectives ?

Detect the 5 main sections of this abstract

Predicting function-related amino acids in proteins with unknown function or unknown allosteric binding sites in drug-targeted proteins is a task of paramount importance in molecular biomedicine. In this paper we introduce a simple, light and computationally inexpensive structure-based method to identify catalytic sites in enzymes. Our method, termed cutoff lensing, is a general procedure consisting in letting the cutoff used to build an elastic network model increase to large values. A validation of our method against a large database of annotated enzymes shows that optimal values of the cutoff exist such that three different structure-based indicators allow one to recover a maximum of the known catalytic sites. Interestingly, we find that the larger the structures the greater the predictive power afforded by our method. Possible ways to combine the three indicators into a single figure of merit and into a specific sequential analysis are suggested and discussed with reference to the classic case of HIV-protease. Our method could be used as a complement to other sequence- and/or structure-based methods to narrow the results of large-scale screenings.

from : Aubailly & Piazza, Sci. Rep. 5 (2015) 14874

Exercise

Predicting function-related amino acids in proteins with unknown function or unknown allosteric binding sites in drug-targeted proteins is a task of paramount importance in molecular biomedicine. In this paper we introduce a simple, light and computationally inexpensive structure-based method to identify catalytic sites in enzymes. Our method, termed cutoff lensing, is a general procedure consisting in letting the cutoff used to build an elastic network model increase to large values. A validation of our method against a large database of annotated enzymes shows that optimal values of the cutoff exist such that three different structure-based indicators allow one to recover a maximum of the known catalytic sites. Interestingly, we find that the larger the structures the greater the predictive power afforded by our method. Possible ways to combine the three indicators into a single figure of merit and into a specific sequential analysis are suggested and discussed with reference to the classic case of HIV-protease. Our method could be used as a complement to other sequence- and/or structure-based methods to narrow the results of large-scale screenings.

from : Aubailly & Piazza, Sci. Rep. 5 (2015) 14874

Avoid in your abstract

- Acronyms (excepts a few ones such as UV, AI, …)
- Looooooooong sentences (especially for the French)
- Cryptic sentences
- Lack of conciseness
- Repetitions / redundant information
- Excessive focus on the methodology
- References (there may be exceptions)

Abstract: ancient style

ESSAI

393335

SUR

LES GLACIERS

ET SUR

LE TERRAIN ERRATIQUE DU BASSIN DU RHONE,

par

JEAN DE CHARPENTIER,

DIRECTEUR DES MINES DU CANTON DE VAUD,

ET PROFESSEUR HONORAIRE DE GÉOLOGIE A L'ACADÉMIE DE LAUSANNE;

Membre de la Société helvétique des sciences naturelles; des Sociétés des sciences de Lausanne, de Marbourg, de Dresde, de Hanau, de Breslau et de Leipsick; membre étranger de la Société géologique de Londres; correspondant de l'académie royale des sciences, inscriptions et belles-lettres de Toulouse, et des Sociétés philomatique, linéenne, et d'histoire naturelle de Paris, de Strasbourg, etc.

Avec des vignettes, des planches, et une carte du terrain erratique du bassin du Rhône.

Abstract: ancient style

Le mémoire que je lus en 1834 à la Société helvétique des Sciences Naturelles, réunie à Lucerne, sur la cause probable du transport des blocs erratiques de la vallée du Rhône[1], fit désirer à Mr le Professeur Agassiz de connaître les faits que je m'étais borné à y indiquer. Dans ce but, il vint en 1836, passer quelques mois dans mon voisinage, pour être à la portée des lieux où l'on peut le mieux étudier les glaciers et le terrain erratique.

Ce savant, ayant été appelé en 1837 à la présidence de la même Société réunie à Neuchâtel, traita ce sujet dans son discours d'ouverture. Ce discours, et une lettre de Mr Jean André De Luc de Genève adressée à la Société pour combattre mon opinion sur le trans-

Abstract

Evaluate each single word in your abstract:
Is it useful, redundant ?
Is there a better alternative ?

Beyond the abstract

Some journals ask for additional material such as

- **Key points** that summarise the main findings

  focus on the main **outcomes**, NOT on what you did

- **Plain language summary** for the layman

  no jargon at all, focus on **societal impacts**

  more examples at
  https://publications.agu.org/plain-language-summaries-collection/

Example

AGU ADVANCING EARTH AND SPACE SCIENCE

Check for updates

Geophysical Research Letters

RESEARCH LETTER

10.1029/2020GL090115

Special Section:
Parker Solar Probe Observations at Venus: VGA1-2

Key Points:
- Plasma double layers are detected near the Venusian bow shock
- Multiple double layers are identified in a small amount of burst data
- Kinetic processes may help mediate interaction between the solar wind and induced magnetospheres

Correspondence to:
D. M. Malaspina,
David.Malaspina@lasp.colorado.edu

Citation:
Malaspina, D. M., Goodrich, K., Livi, R., Halekas, J., McManus, M., Curry, S., et al. (2020). Plasma double layers at the boundary between Venus and the solar wind. *Geophysical Research Letters*, *47*, e2020GL090115. https://doi.org/10.1029/2020GL090115

Received 30 JUL 2020
Accepted 3 OCT 2020
Accepted article online 9 OCT 2020

Plasma Double Layers at the Boundary Between Venus and the Solar Wind

D. M. Malaspina[1,2], K. Goodrich[3], R. Livi[3], J. Halekas[4], M. McManus[3], S. Curry[3], S. D. Bale[3,5], J. W. Bonnell[3], T. Dudok de Wit[6], K. Goetz[7], P. R. Harvey[3], R. J. MacDowall[8], M. Pulupa[3], A. W. Case[9], J. C. Kasper[10], K. E. Korreck[9], D. Larson[3], M. L. Stevens[9], and P. Whittlesey[3]

[1]Department of Astrophysical and Planetary Sciences, University of Colorado Boulder, Boulder, CO, USA, [2]Laboratory for Atmospheric and Space Physics, University of Colorado Boulder, Boulder, CO, USA, [3]Space Sciences Laboratory, University of California, Berkeley, CA, USA, [4]Department of Physics and Astronomy, University of Iowa, Iowa City, IA, USA, [5]Physics Department, University of California, Berkeley, CA, USA, [6]LPC2E, CNRS, and University of Orléans, Orléans, France, [7]School of Physics and Astronomy, University of Minnesota, Twin Cities, Minneapolis, MN, USA, [8]NASA Goddard Space Flight Center, Greenbelt, MD, USA, [9]Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA, [10]Climate and Space Sciences and Engineering, University of Michigan, Ann Arbor, MI, USA

Abstract The solar wind is slowed, deflected, and heated as it encounters Venus's induced magnetosphere. The importance of kinetic plasma processes to these interactions has not been examined in detail, due to a lack of constraining observations. In this study, kinetic-scale electric field structures are identified in the Venusian magnetosheath, including plasma double layers. The double layers may be driven by currents or mixing of inhomogeneous plasmas near the edge of the magnetosheath. Estimated double-layer spatial scales are consistent with those reported at Earth. Estimated potential drops are similar to electron temperature gradients across the bow shock. Many double layers are found in few high cadence data captures, suggesting that their amplitudes are high relative to other magnetosheath plasma waves. These are the first direct observations of plasma double layers beyond near-Earth space, supporting the idea that kinetic plasma processes are active in many space plasma environments.

Plain Language Summary Venus has no internally generated magnetic field, yet electric currents running through its ionized upper atmosphere create magnetic fields that push back against the flow of the solar wind. These induced fields cause the solar wind to slow and heat as the flow is deflected around Venus. This work reports observations of very small plasma structures that accelerate particles, identifiable by their characteristic electric field signatures, at the boundary where the solar wind starts to be deflected. These small plasma structures observed at Venus have been studied in near-Earth space for decades but have never before been found near another planet. These structures are known to be important ...ctrical currents in space plasmas and the blending of dissimilar plasmas. Their ... strong demonstration that these small plasma structures are a universal plasma ...

Example : Abstract

Abstract The solar wind is slowed, deflected, and heated as it encounters Venus's induced magnetosphere. The importance of kinetic plasma processes to these interactions has not been examined in detail, due to a lack of constraining observations. In this study, kinetic-scale electric field structures are identified in the Venusian magnetosheath, including plasma double layers. The double layers may be driven by currents or mixing of inhomogeneous plasmas near the edge of the magnetosheath. Estimated double-layer spatial scales are consistent with those reported at Earth. Estimated potential drops are similar to electron temperature gradients across the bow shock. Many double layers are found in few high cadence data captures, suggesting that their amplitudes are high relative to other magnetosheath plasma waves. These are the first direct observations of plasma double layers beyond near-Earth space, supporting the idea that kinetic plasma processes are active in many space plasma environments.

Example : Plain language summary

Plain Language Summary Venus has no internally generated magnetic field, yet electric currents running through its ionized upper atmosphere create magnetic fields that push back against the flow of the solar wind. These induced fields cause the solar wind to slow and heat as the flow is deflected around Venus. This work reports observations of very small plasma structures that accelerate particles, identifiable by their characteristic electric field signatures, at the boundary where the solar wind starts to be deflected. These small plasma structures observed at Venus have been studied in near-Earth space for decades but have never before been found near another planet. These structures are known to be important to the physics of strong electrical currents in space plasmas and the blending of dissimilar plasmas. Their identification at Venus is a strong demonstration that these small plasma structures are a universal plasma phenomena, at work in many plasma environments.

Example : Key points

Key Points:

- Plasma double layers are detected near the Venusian bow shock
- Multiple double layers are identified in a small amount of burst data
- Kinetic processes may help mediate interaction between the solar wind and induced magnetospheres

Plain-language summary: tips

- Think about your audience (e.g. journalists, science-interested public). What is their level of science-specific knowledge? What is going to interest them in your work?
- Get rid of jargon
- Explain what your study is about
- Explain what you found
- **Explain why this matters**. People are asking you "Why should I care ?"

from AGU

When should I write the abstract ?

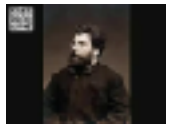
- Write your abstract **after** all other parts have been written

4. Introduction

- What makes a good introduction ?

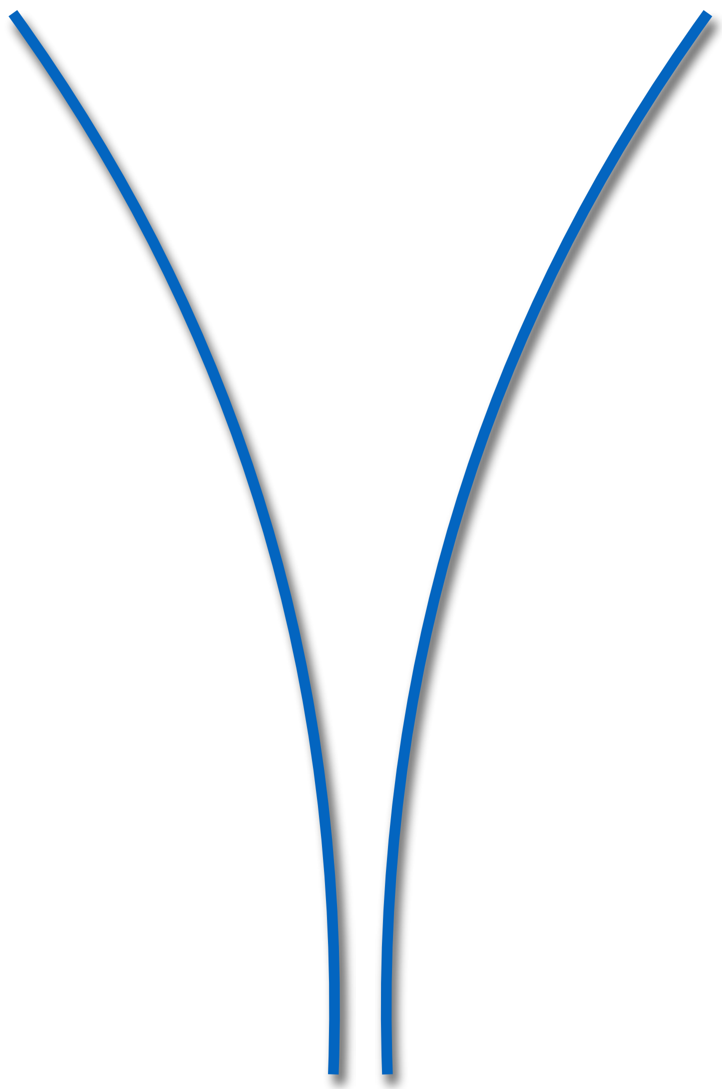
Introduction

- Your introduction is like an **opening**
- The tone and the style are important. If too dull, then the reader may well skip the article



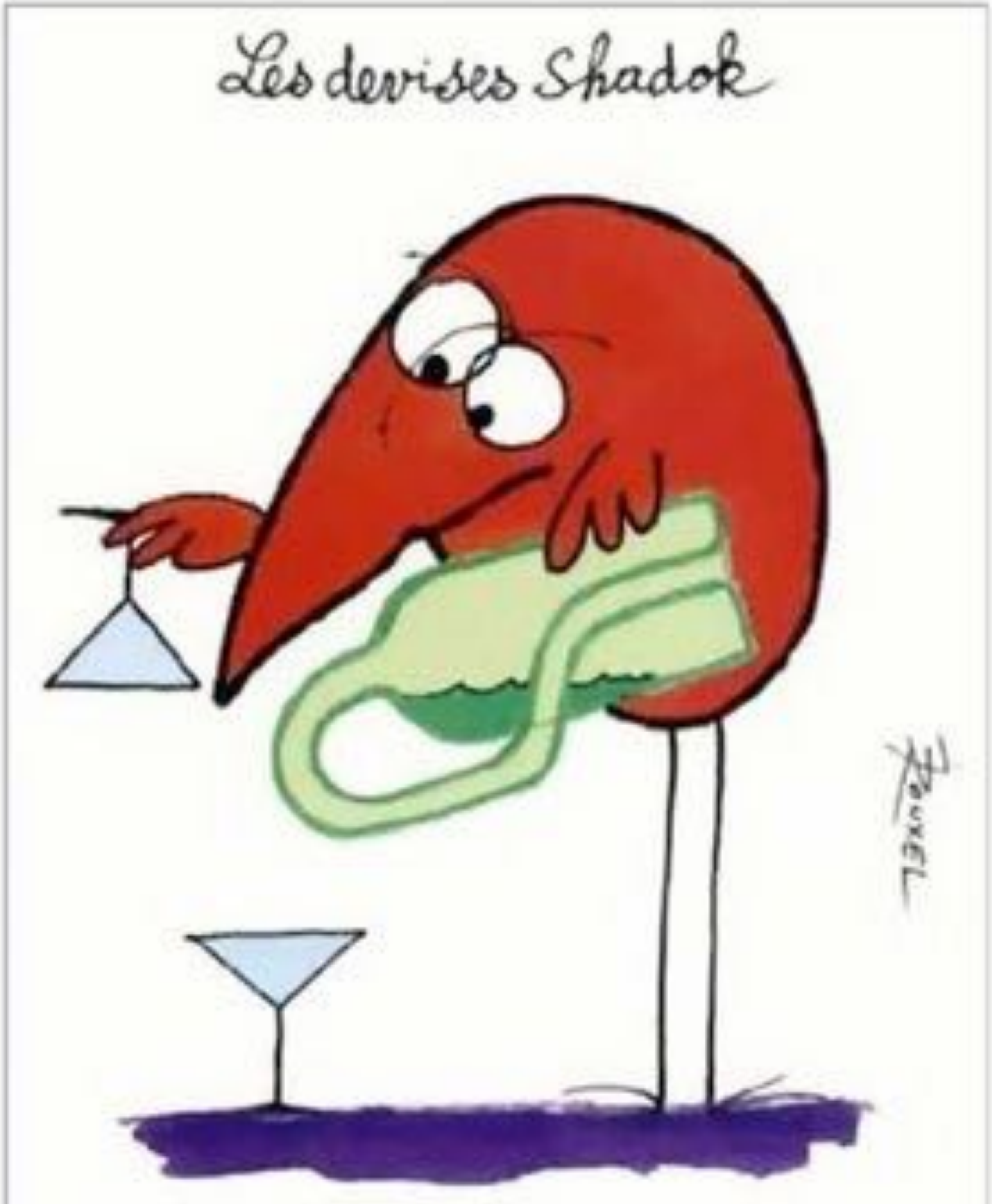
Introduction: main points

- Start with the **big picture** and progressively narrow down the scope to your topic
- Explain the state of the art and why **your** contribution matters
- End by clearly stating **what problem you will be addressing**



Introduction

Very IMPORTANT:
Say explicitly what problem/issue you will be addressing



If there is no solution then there is no problem either

Properly cite the literature

- Take time to go through the literature and check who already addressed your problem…

  Many authors ignore (intentionally or unintentionally) what others have written before on the same topic.

- **Ethical conduct**
  - properly acknowledge what others have done before you
  - give them credit in a fair way (do not only cite team members)

Do not auto-cite yourself excessively

REPORT

How Long Is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension

BENOIT MANDELBROT

SCIENCE • 5 May 1967 • Vol 156, Issue 3775 • pp. 636-638 • DOI: 10.1126/science.156.3775.636

References

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GOOGLE SCHOLAR

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GOOGLE SCHOLAR

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GOOGLE SCHOLAR

Questions

- Should the introduction already mention the main results (spoiler) ?

5. Method

Method

- **Method** = how did I proceed ?
  - what data ?
  - experimental protocol
  - data processing and management
  - working hypotheses (be explicit)

- **Traceability** : other people must be able to replicate your study

- **FAIR** : Findable, Accessible, Interoperable, Reusable

Method

Example: the discovery of cold fusion was a major breakthrough

But no one was able to replicate the work of the discoverers...

6. Results

Results

- Present all your results **clearly**
- Highlight what is **novel, unusual, surprising**…
- If there are many results : don’t try to interpret them too much before you have provided the global picture
- **No cherry picking** : present what works and what does NOT work (or remains unexplained)

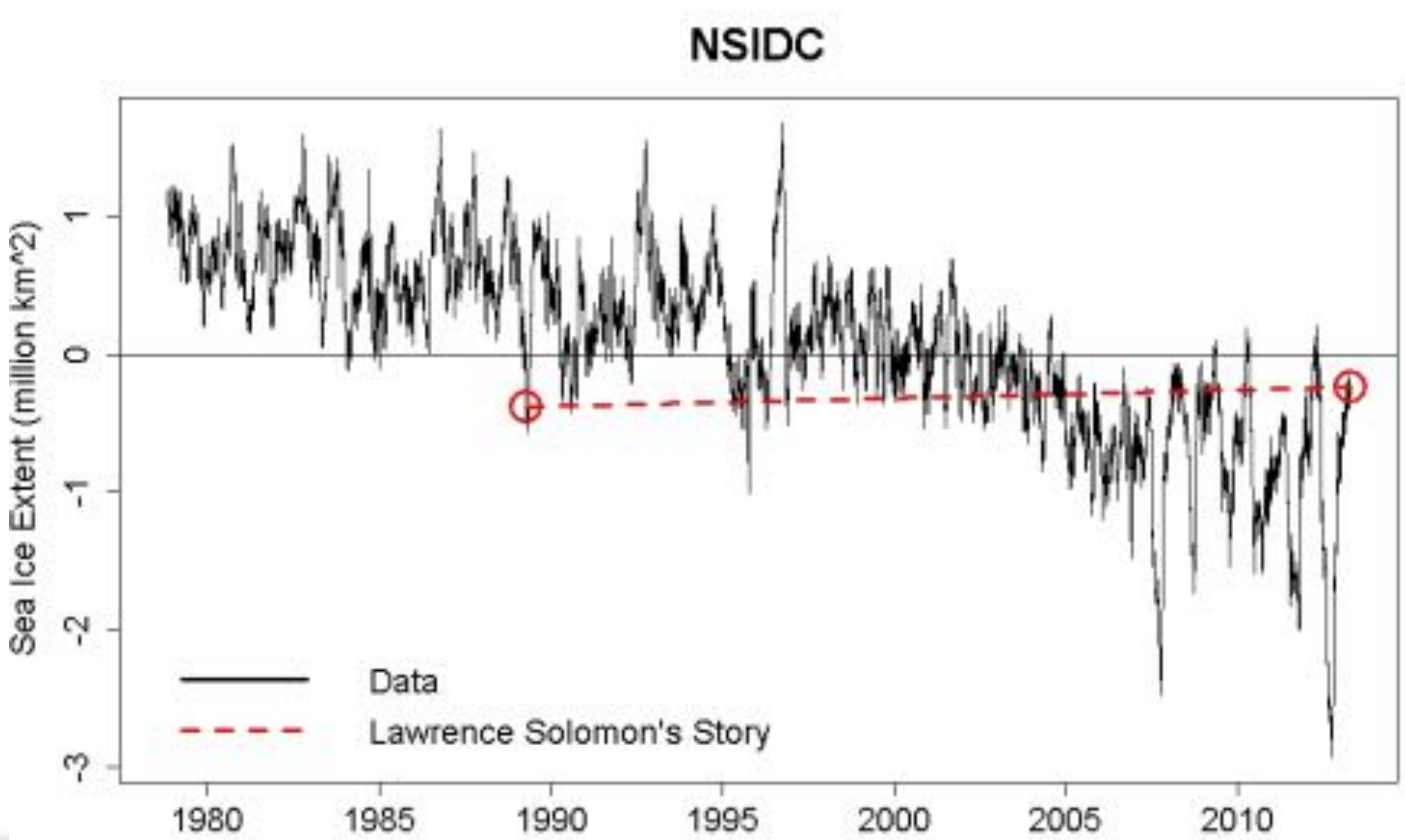
No cherry picking

Leite's Culinaria

No cherry picking

Cherry picking, suppressing evidence, or the fallacy of incomplete evidence is the act of pointing to individual cases or data that seem to confirm a particular position while ignoring a significant portion of related and similar cases or data that may contradict that position. Cherry picking may be committed intentionally or unintentionally. This fallacy is a major problem in public debate.

[Wikipedia, 2021]



Lawrence Solomon (2019)

Results

- **Question** : If a study leads to **negative** results (e.g. the expected effet was not observed), should I nevertheless publish that ?

> *"Scientific findings are like an iceberg, it floats with around 10% of published discovery above 90% of negative results."*

See for example : https://www.negative-results.org/

Alas, very few people publish negative results…

7. Discussion

Discussion

- The discussion is the core of your study
- This is where **you** will provide your added value

Highlight what is YOUR original contribution to the issue

Discussion

- Sell your results: highlight what is new
- But do not oversell : be careful with “best”, “first”, “novel”, “first ever”, “new paradigm”, …
- Put your results in context: compare with others, be honest, discuss what does NOT work

Golden rule : Say what you mean, and mean what you say

Discussion

Tell a story : good articles are often structured like a story, with a buildup of tension, followed by an unwinding

8. Conclusion

Conclusion

- Conclusion ≠ abstract !
- Conclusion =
  - **Synthesis** of the results
  - Emphasise what **progress** has been made
  - Highlight the **impacts**, the larger implications
  - If relevant, discuss **perspectives** and new ways of elaborating on this problem

Conclusion

- Many readers will jump directly from the abstract to the conclusions.
- The reader is not supposed to have to read the article in order to understand the conclusion

What are the main parts in this conclusion ?

Control is a central issue in most complex systems, but because a general theory to explore it in a quantitative fashion has been lacking, little is known about how we can control a weighted, directed network—the configuration most often encountered in real systems. Indeed, applying Kalman's controllability rank condition (equation (3)) to large networks is computationally prohibitive, limiting previous work to a few dozen nodes at most. Here we have developed the tools to address controllability for arbitrary network topologies and sizes. Our key finding, that N_D is determined mainly by the degree distribution, allows us to use the tools of statistical physics to predict N_D from $P(k_{in}, k_{out})$ analytically, offering a general formalism with which to explore the impact of network topology on controllability.

The framework presented here raises a number of questions, answers to which could further deepen our understanding of control in complex environments. For example, although our analytical work focused on uncorrelated networks, the algorithmic method we developed can identify N_D for arbitrary networks, providing a framework in which to address the role of correlations systematically. Taken together, our results indicate that many aspects of controllability can be explored exactly and analytically for arbitrary networks if we combine the tools of network science and control theory, opening new avenues to deepening our understanding of complex systems.

What are the main parts in this conclusion ? **Exercise**

Control is a central issue in most complex systems, but because a general theory to explore it in a quantitative fashion has been lacking, little is known about how we can control a weighted, directed network—the configuration most often encountered in real systems. Indeed, applying Kalman's controllability rank condition (equation (3)) to large networks is computationally prohibitive, limiting previous work to a few dozen nodes at most. Here we have developed the tools to address controllability for arbitrary network topologies and sizes. Our key finding, that N_D is determined mainly by the degree distribution, allows us to use the tools of statistical physics to predict N_D from $P(k_{in}, k_{out})$ analytically, offering a general formalism with which to explore the impact of network topology on controllability.

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Conclusion : to avoid

- Avoid rhetoric and personal statements

  "In the end, this study was enriching because it allowed me to discover a laboratory, and also learn how a high-resolution mass spectrometer works."

- Avoid jargon that can be understood only by reading the full article

  "The ZX232 protocol, which we have introduced the MVA method for DBAs, outperforms the older ZH127 protocol for extracting…"

Alternative formats

- Conclusions with bullets offers extra conciseness and clarity

To summarise, our study reveals that:

- *The intrinsic properties of ****
- *No substitute has be found for ****
- *An enhancement of *****

Together, these results suggest that ….

Take home message

- Not all conclusions need to be structured : e.g. Nature

Check for updates

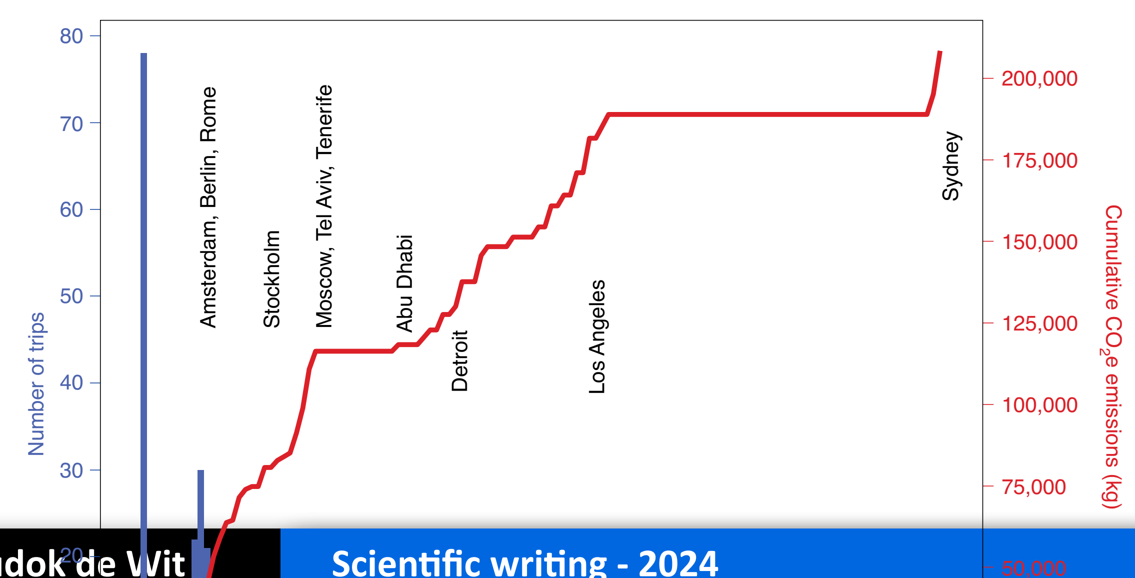
comment

The carbon footprint of large astronomy meetings

The annual meeting of the European Astronomical Society took place in Lyon, France, in 2019, but in 2020 it was held online only due the COVID-19 pandemic. The carbon footprint of the virtual meeting was roughly 3,000 times smaller than the face-to-face one, providing encouragement for more ecologically minded conferencing.

Leonard Burtscher, Didier Barret, Abhijeet P. Borkar, Victoria Grinberg, Knud Jahnke, Sarah Kendrew, Gina Maffey and Mark J. McCaughrean

The scientific evidence that we live in a climate emergency calls for urgent action[1]. As a society, we are collectively failing to live within our environmental boundaries[2], with possibly catastrophic consequences for human civilization[1]. The time to address these issues is now[1,3]. The United Nations Emissions Gap Report from 2019 states that each year a global reduction of emissions of 7.6% is required to limit the average global temperature rise to 1.5 °C (ref. [3]) — the target that was outlined in the Paris Agreement in 2016. At the current rate of emissions, we will exceed the 'carbon budget'



Take home message

emissions of joining EAS 2020 compared to working in the home office.

The future of conferencing

We conclude that the internet-related emissions of EAS 2020 were negligible compared to the travel-related emissions alone of EWASS 2019. This finding is in common with other recent estimates for large international conferences, for example, a virtual annual meeting of the American Geophysical Union (AGU) was calculated to emit less than 0.1% of the travel emissions of the face-to-face AGU 2019 meeting[16].

One approach to cut emissions while retaining scientific and social connections globally is to 'attach' smaller satellite meetings to the large annual meetings of the respective regional astronomical societies. For example, the weeks before and after the (Northern Hemisphere) winter American Astronomical Society and (Northern Hemisphere) summer EAS meetings could be used for smaller meetings that are held in the vicinity, requiring minimal extra travel emissions to join them. A meeting schedule could be coordinated globally by the International Astronomical Union.

fall thanks to an increasing fleet of night trains across Europe at least and, in the future, short flights that can be powered by synthesized fuel or batteries. Such a scheme of regional hubs has been tried and evaluated as successful by various groups in the last year[17,18].

Lastly, we also see a possibility to move to an entirely online meeting format without any (large) physical meetings in the future. Such meetings could be held in the 'nearly carbon neutral conferencing' format[19], that is, essentially with pre-recorded talks and live discussion sessions, to minimize the time where everyone needs to be online simultaneously, and therefore allow global collaboration across many time-zones.

The emerging picture is that there is a real opportunity for future meetings to adopt practices that provide a range of attendance possibilities for participants, which promote a more sustainable, accessible and diverse meeting concept for the growing international community. While discussions are ongoing regarding the future of meetings, we expect that the post-COVID-19 future will hold a mix of purely virtual conferences, next to hybrid meetings where some participants join in person and others use a

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Acknowledgements

L.B. would like to ackno on a draft article from M L. Kaper, S. Lucatello, S. A. Schouten-Voskamp.

Competing interests

L.B. was a member of the EAS 2020 meeting. M.J.M organizing committee of remaining authors declar

NATURE ASTRONOMY | VOL 4 | SEPTEMBER 2020 | 823–825 | www.nature.com/natureastronomy

One last thing…

- Good conclusions mirror the **question** that was asked in the introduction and clearly show what progress has been made
  - Where did we start from ?
  - What did we achieve ?
  - What should the next steps be ?

Take home message

- Highlight your **take home message**

If the reader had to remember one single sentence, what should it be ?

YOU should decide what matters rather than let the reader guess it

Take home message: example

Control is a central issue in most complex systems, but because a general theory to explore it in a quantitative fashion has been lacking, little is known about how we can control a weighted, directed network—the configuration most often encountered in real systems. Indeed, applying Kalman's controllability rank condition (equation (3)) to large networks is computationally prohibitive, limiting previous work to a few dozen nodes at most. Here we have developed the tools to address controllability for arbitrary network topologies and sizes. Our key finding, that N_D is determined mainly by the degree distribution, allows us to use the tools of statistical physics to predict N_D from $P(k_{in}, k_{out})$ analytically, offering a general formalism with which to explore the impact of network topology on controllability. The framework presented here raises a number of questions, answers to which could further deepen our understanding of control in complex environments. For example, although our analytical work focused on uncorrelated networks, the algorithmic method we developed can identify N_D for arbitrary networks, providing a framework in which to address the role of correlations systematically. Taken together, our results indicate that many aspects of controllability can be explored exactly and analytically for arbitrary networks if we combine the tools of network science and control theory, opening new avenues to deepening our understanding of complex systems.

Take home message: example

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