Ten new insights in climate science 2022

**+++ Supplementary Material +++**

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# Extended Bibliography

Below we provide an extended bibliography for each insight. We first list the references cited in the respective insight in the main manuscript, and then add additional references that have been gathered during the writing process.

These additional references were collected by means of (i) a quick literature scan with Web Of Science; (ii) individual input from expert and coordinating authors.

We also list the search terms for WebOfScience, for the period since January 2021.

## Insight 1 – Questioning the myth of endless adaptation: mitigation is critical to avoid breaching adaptation limits

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(TS=(Climate OR  "Global Warming" OR  Carbon OR Decarbonization OR CO2 OR Greenhouse)  
AND TS=(“Adaptation Effectiveness” OR “Adaptation Feasibility” OR “Limits to Adaptation” OR "adaptation limits" OR "adaptation constraints" OR "constraints to adaptation" OR "limiting adaptation"))

## Insight 2 – Climate-driven impacts and human vulnerability increase the emergence of vulnerable regions

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Comment start (TS=("Global Warming" OR “Climate change”)

AND TS=(carbon release OR cascade OR impact)

AND TS=(vulnerable OR fragile ecosystem)

AND TS=(dieback OR migration OR adaptation OR other impacts)

AND TS=(hotspot OR damage OR socioeconomic)

## Insight 3 – New threats on the horizon from climate-health interactions

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#### Web of Science search terms

(TS=(“Climate Change” AND “Plant diseases” )

OR TS=(“Climate Change” AND “antimicrobial resistance”)

OR TS=(“Climate Change” AND Stillbirth AND “low birth weight” AND “maternal health”)

OR TS=(“Climate Change” AND “Animal health” AND “agriculture”)

OR TS=(“Climate Change” AND “Disease surveillance” AND “early warning systems” AND attribution)

OR TS=(“Climate Change” AND “wildfires” AND “toxicity”))

## Insight 4 – Climate (im)mobility: from evidence to anticipatory action

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#### Web of Science search terms

TS=(

("climate change")

AND (

((climate NEAR/1 (migration OR mobilit\* OR displacement)))

OR

(immobilit\* OR "non-migration" OR "trapped populations")

OR

((anticipatory NEAR/1 action) OR "forecast-based financing" OR "planned relocation" OR "managed retreat")

) )

## Insight 5 – Human security requires climate security

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#### Web of Science search terms

 (TS=(“Climate security” OR “Climate-security nexus”)

OR TS=(“Human security” AND “climate change”) OR TS=(violence or Conflict AND “climate change”))

## Insight 6 – Sustainable land use can make a difference in meeting climate targets

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#### Web of Science search terms

(TS=(“climate” and “land system”)

OR

TS=(“climate” and “land use system”))

## Insight 7 – Sustainable finance practices by private sector actors: The need to broaden impact and strengthen public policy

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#### Web of Science search terms

(TS=(sustainable finance OR finance sector) AND TS=(“Climate finance” OR  “Green finance”  OR Green bonds ) AND TS=(Taxonomy) OR TS=(sustainable finance AND greenwashing))

TS=(finance sector AND climate AND sustainable)

## Insight 8 – Losses and damages: the urgent planetary imperative for climate mitigation and adaptation

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#### Web of Science search terms

(TS=(Climate OR  "Global Warming" OR  Carbon OR Decarbonization OR CO2 OR Greenhouse)

AND TS= (“Loss and Damage”))

## Insight 9 – Inclusive and empowering societal choices for climate-resilient development

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#### Web of Science search terms

(TS=(Climate)

AND TS=(Policy OR decision-making)

AND  TS=( inclusiv\*))

## Insight 10 – Structural barriers and unsustainable lock-ins must be removed to enable effective mitigation

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#### Web of Science search terms

Barriers AND Climate Change Mitigation

# Invitation mail to expert elicitation

         

Dear {{First name}},

We would like to invite you to contribute to the 2022 installment of the *10 New Insights in Climate Science*. This annual series is a major synthesis of essential and recent climate-related research and an important science-policy contribution.

[Future Earth](https://futureearth.org/), [The Earth League](https://the-earth-league.org/), and the [World Climate Research Programme](https://www.wcrp-climate.org/) (WCRP) have been preparing *10 New Insights in Climate Science* policy reports for six consecutive years, all officially received by the UNFCCC. The [latest report](https://10insightsclimate.science/) was launched at COP26 in Glasgow, in a [press conference](https://unfccc-cop26.streamworld.de/webcast/10-new-insights-in-climate-science-2021-report) with UNFCCC Executive Secretary Patricia Espinosa. This publication series curates recent advances in climate change research across disciplines. The synthesis is submitted for peer-review, and published in an academic journal. This synthesis underpins the development of the policy report which provides a climate science year-in-review for journalists, policy makers, and the informed general public.

We have begun preparing the *10 New Insights in Climate Science 2022*, and are scoping expertise from around the globe for inputs on which key findings should be featured. Recognizing your expertise in a relevant field, we want to invite you to contribute to this year’s effort, by answering this [**form**](https://form.jotform.com/220204404211029) **by February 20**.

The core of this questionnaire is this:

1) **Give us your ’pitch’**  
*What essential new insight on climate change, within your field of research, do you think must be highlighted for climate policy negotiators and the general public?*

(Please provide references for the suggested insight.)

The Editorial Board will decide on the final list of ten insights, based on the following criteria:

* The topic has high relevance for climate policy negotiations;
* The insight has a robust scientific foundation;
* The insight is new, with its key references published after January 1, 2021 (older references can be included as background)

**2) Join the effort**  
*Would you be interested in being part of one of the author groups responsible for one of the selected insights? Can you suggest other experts as potential authors?*

This role involves contributing as a co-author to the peer-reviewed paper.The Editorial Board will select a list of authors from the nominations based on relevant expertise, aiming for scientific excellence and a diverse group. We invite 3-5 coauthors for each of the ten insights. Writing begins in March, with the plan to submit the manuscript by early July.  Based on the peer-reviewed manuscript, the author teams, with support from staff science officers, will write a corresponding section for the policy report, explaining the findings in a condensed and simplified format for policymakers and the general public. The aim is for both to be published ahead of the UNFCCC COP27 (starting November 7, 2022).

All invited experts are recognized as co-authors of the peer-reviewed paper and the policy report.

If you have any questions and comments about this request or the overall process, please do not hesitate to contact us at [Clea.Edwards@asu.edu](mailto:Clea.Edwards@asu.edu) and [daniel.ospina@futureearth.org](mailto:daniel.ospina@futureearth.org).

Thank you sincerely in advance for your involvement in this critical effort to support the diffusion of the most relevant and up-to-date climate change science to negotiators, policy-makers, and the general public.

On behalf of Future Earth, The Earth League, WCRP, and the Editorial Board,

Clea Edwards

Arizona State University/The Earth League

Daniel Ospina

Future Earth

# Call text, as published on Jotform, the platform used for the poll

**CALL FOR TOPICS 2022**

The ***10 New Insights in Climate Science*** series, developed jointly by Future Earth, The Earth League, and World Climate Research Programme, is a yearly synthesis highlighting essential recent advances in climate change research from different disciplines. The series is geared toward reaching climate policy negotiators and the general informed public, in the form of an influential **policy report** launched at the UNFCCC COP. The scientific rigour and credibility of the policy report is underpinned by an **academic manuscript** submitted for publication in a peer-reviewed journal. The manuscripts from the 2020 and 2021

installments have been published in the journal *Global Sustainability.*

In order to select the most important recent insights on climate change, we are seeking your input as a member of this broad and heterogeneous research community. Simultanously, we use this questionnaire to identify potential co-authors for the policy report and the academic manuscript.

Please give us your 'pitch'. Share with us what you consider to be an essential new insight on climate change coming from your research field. Relevant topics span a very broad scholarship on the causes, consequences, and possible solutions to climate change; ranging from geo/biophysical foundations, social and behavioural dimensions, and a growing understanding of the potential and pitfalls of various policy instruments.

Completing this questionnaire takes approximately 20 minutes.

**This call closes on February 20, 2021 (00:00 CET)**

If you have any questions or comments, do not hesitate to contact us: clea.edwards@asu.edu and

[daniel.ospina@futureearth.org](mailto:daniel.ospina@futureearth.org)

**About the information collected through this form**

In compliance with **GDPR**:

**Legitimate interest:** Personal data allow us to characterise the group of respondents, and ensure that the inputs collected come from trusted sources and a diverse group of experts.

**Data retention:** Personal data will be stored until the end of 2022, unless explicit consent is given to do so longer. You can request at any point that your personal data is deleted from our database.

Personal data will not be shared with third parties, nor will it be used for any other purpose that the development of the *10 New Insights in Climate Science*. If you have any questions about the collection and processing of these personal data, or if your change your mind after filling this form, please contact clea.edwards@asu.edu and [daniel.ospina@futureearth.org](mailto:daniel.ospina@futureearth.org).

By filling this form you accept that we will

collect and process some of your **personal data**.

**Give us your pitch**

What essential new insight on climate change do you think must be highlighted for climate policy negotiators and the general public?

The Editorial Board will decide on the final list of ten insights, considering the following criteria:

The topic has high relevance for climate policy negotiations.

The insight has a robust scientific foundation.

The insight is new, based on key references published after 2020.

(Relevant context or support references published before 2021 can be included separately as 'background references')

**What essential new insight on climate change do you think must be highlighted for climate policy negotiators and the general public? \***

**Please provide one key reference for the insight suggested above. \***

These should be peer-reviewed papers, published after 2020. Please include only one reference in this box. Additional references can

be suggested below.

**Additional key reference (I)**

**Additional key reference (II)**

**Any comments or additional suggestions?**

**Would you like to provide additional key references or background information? \***

Yes

No

**Do you want to suggest another insight? \***

YES, I want to suggest another insight.

NO, that is fine.

**Give us your second pitch**

**--- same as above ---**

**Give us your third pitch**

**--- same as above ---**

**About you**

This information will allow us to characterise the group of respondents, and ensure that the inputs collected come from trusted sources and a diverse group of experts.

**Country of your home institution (primary affiliation) \***

**What best describes your current research focus? \***

Natural science

Social science

Across natural and social sciences

**Are you affiliated to any of the three organizations that jointly develop the '10 New Insights in**

**Climate Science' series? (Future Earth, The Earth League, World Climate Research Programme) \***

YES

NO

**Have you contributed to previous installments of the ‘10 New Insights in Climate Science’ series? \***

YES

NO

**Which are you affiliated with? \***

Future Earth

The Earth League

World Climate Research Programme

**Can we contact you in case there is a need for clarification on your responses? If so, please add your email address.**

[example@example.com](mailto:example@example.com)

**Since you are affiliated to Future Earth, could let us know more specifically how?**

e.g. Global Research Projects or Knowledge-Action Network, Global Hub. Which?

**Gender \***

**Nominations for co-authors**

Each co-author is part of a small team responsible for writing one of the insights for the scientific manuscript and the policy report.

**Can you recommend at least one expert on the topic(s) you have suggested who we should consider inviting to be a co-author?**

**Would you be interested in being a co-author for one insight, suited to your area of expertise? \***

Sure!

Maybe, but I need to know more.

No, thank you.

Thanks! Please provide us with the information necessary to get in touch with you.

**Institutional affiliation \***

If you have multiple affiliations, feel fee to list them all or just the main one

**Email \***

example@example.com

**If you agree, we would like to store your contact information for future instalments of the '10 New Insights in Climate Science' series. That would mean storing this information beyond 2022. \***

Approve

Don't approve

**Manuscript reviewers**

**Can we suggest you as a reviewer for the scientific manuscript? \***

Sure!

No, thank you.

Thanks! Please provide us with the information necessary to get in touch with you.

**Full name \***

First Name Last Name

**Email \***

**If you agree, we would like to store your contact information for future instalments of the '10 New Insights in Climate Science' series. That would mean storing this information beyond 2022. \***

Approve

Don't approve

**Any final comment?**

# Sorting and merging of inputs

The 99 inputs were sorted into three categories:

a) “The input (text/reference) can be used for a new suggested topic or incorporated into an existing one.” (48 inputs)  
b) “This input (text/reference) seems too narrow to build a topic around as it is, or too old (less than two references after Jan 1, 2020). Could possibly be included into an insight later.” (39inputs)  
c) “No potential for becoming a topic (not matching criteria described in the call).” (12 inputs)

An initial list of 31 merged topics was formed from a), and the topics and references in b) were integrated in this list where possible.

# List of topics distilled from the call input

1. Human Health  
Rising negatives of climate change on human health - adaptation needs 4

2. Sufficiency   
Demand-side/Consumption reductions towards 'sufficiency' are necessary, in combination with technical solutions

3. What engenders climate action?   
What are effective and publicly acceptable climate policies and decision-making processes?

4: Inclusive climate decision making   
Climate decision-making needs more effective, inclusive forms of decision making

5. Halting Deforestation (Amazon)   
Must halt deforestation and forest degradation in the Amazon rainforest before 2030 for any chance at reaching Paris goals

6: Limitations of Adaptation   
Lack of evidence that current adaptation efforts are reducing climate risks

7: Negative Emissions   
Possibilities for Negative Emissions (technical solutions)

8: The Holocene has truly been ended   
“Holocene conundrum” (mismatch between models and proxies) for Holocene global mean temperature resolved

9: Better Human-Earth Integrated Models   
Need systematic development of integrated models that better account for interplay between human societies and the rest of the earth’s systems

10: Climate Security  
Climate security and inter/national security are one and the same

11: Women and girls: agents [& victims]   
Women and girls are important agents of change in the climate space

12: Digital footprints   
Accountability needed for cryptocurrency mining and other major energy users in the e-world

13: Arctic Climate Feedbacks   
Global warming targets are increasingly threatened by arctic carbon-climate feedbacks

14: Sea-level rise   
New assessment of the Global Sea level Budget

15: Teleconnection: Arctic Sea Ice - Indian Summer Monsoon   
The relationship between Arctic Sea ice and extreme Indian Summer Monsoon Rainfall

16: Oceanic Plastic Pollution contributing to CC   
Plastic pollution may alter the marine carbon biogeochemical cycle and contribute to climate change

17: Heat extremes and Health   
Heightening heat extremes are leading to record rates of illness and death

18: Wildfires and phytoplankton blooms   
Wildfires induce massive ocean phytoplankton blooms by delivering nutrient-rich aerosols

19: Antibiotic Resistance and CC   
Antibiotic Resistance and Climate Change

20: Natural Carbon Sinks and Sources   
The risks of changes in natural carbon sinks and sources.

21: Rethinking agriculture   
Animal agriculture and alternative forms of ‘regenerative’ agriculture

22: CC projections in mountains   
Climate change projections in mountains are still highly uncertain.

23: Plant disease   
Plant disease outbreaks are increasing and spreading, threatening food security

24: Climate extremes (general)   
Climate extremes: increasingly frequent, intense, and dangerous

25: Biodiversity loss from Aridity   
Terrestrial biodiversity threatened by increasing global aridity velocity under high-level warmin

26: Migration   
Migration - many topics: uninhabitable regions, reverse migration, (in-)voluntary immobility

27: Finance Sector and Climate Change   
CC as a financial risk and the finance sector as a lever to tackle CC

28: Carbon emissions inequality   
Extreme poverty eradication does not collide with climate targets, while further poverty alleviation requires substantial emission reductions by high-emitters in order to avoid overshoot

29: Climate clubs  
The idea of a 'climate club' gaining considerable political traction, potentially making the G7 one.

30: Eliminating fossil fuel subsidies

31: High time for peak fossil fuel production

# Definition of geographical regions

**North America:** All American countries north of Colombia including the Caribbean.

**South America:** All American countries south of Panama.

**Africa:** African countries west and south of Egypt, including Egypt.

**Oceania:** countries in Australasia, Melanesia, Micronesia and Polynesia

**Asia:** Based on [United Nations geoscheme](https://unstats.un.org/unsd/methodology/m49/) (includes Western Asia, Central Asia, Eastern Asia, Southern Asia and Southeastern Asia).

**Northern, Western and Southern Europe**: Based on the [United Nations geoscheme](https://unstats.un.org/unsd/methodology/m49/).

**Northern Europe:** Åland Islands, Guernsey, Jersey, Sark, Denmark, Estonia, Faroe Islands, Finland, Iceland, Ireland, Isle of Man, Latvia, Lithuania, Norway, Svalbard and Jan Mayern, Sweden, United Kingdom of Great Britain and Northern Ireland

**Southern Europe:** Albania, Andorra, Bosnia and Herzegovina, Croatia, Gibraltar, Greece, Holy See (Vatican City), Italy, Malta, Montenegro, North Macedonia, Portugal, San Marino, Serbia, Slovenia, Spain

**Western Europe:** Austria, Belgium, France, Germany, Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland

**Eastern Europe:** Belarus, Bulgaria, Czechia, Hungary, Republic of Moldova, Poland, Romania, Russian Federation, Slovakia, Ukraine