54

Health and Climate: Briefing Notes Ahead of COP28

ISGlobal Barcelona Institute for Global Health

Authors: Xavier Rodó, Head of the Climate & Health programme at ISGlobal, and Ivana Cvijanovic, Assistant Research Professor at ISGlobal.

The authors would like to thank Gonzalo Fanjul, Claudia García-Vaz and Kurt Straif for their comments to the draft of this document.

[This document is one of a series of discussion notes addressing fundamental questions about global health. Its purpose is to transfer scientific knowledge into the public conversation and the decision-making process. These documents are based on the best information available and may be updated as new information comes to light.]

30 November 2023

Photo: Tri Le / Pixabay

Climate change poses not only an immense health burden and loss of life, but also a colossal threat to the world's ecosystems, economies and supply chains. Governments worldwide need to take a step forward and establish more ambitious goals with specific commitments in order to address the challenges ahead. To that end, this year's UN Climate Change Conference needs to be a platform for responsibility ●

1. The Facts on Climate Change

• Recent updates from science indicate that **global climate sensitivity, GCS**[1] values might be higher than previously thought, implying that the amount left to spend on CO_2 emissions —the so-called remaining carbon budget or the net amount of CO_2 that humans can still emit without exceeding the 1.5°C of the Paris Agreement— might be much lower than expected and a highly cautionary approach is needed.

• Despite high variability in the estimates of the rate of warming for a given level of greenhouse gases emissions, recent studies suggest that we will **very soon pass the 1.5°C** global temperature anomaly with reference to pre-industrial levels.

[1] GCS tells us how much our planet will warm due to a doubling of the atmospheric carbon dioxide (CO_2) concentration.

The strength of climate feedbacks seems to direct the planet towards amplifying — not dampening— the effects of CO_2 climate forcing. The time left can be as short as around the turn of this same decade, a fact that should put a lot of pressure on policy for achieving the so-long sought limiting and enforced agreements at the forthcoming COP28 negotiations.

• As stated again recently by the UNFCCC, **non-CO_2 greenhouse gases**, such as methane, nitrous oxide and fluorinated gases, trap more heat within the atmosphere than CO_2. Mitigation of these emissions is an important and relatively inexpensive supplement to CO_2-only mitigation strategies (e.g., with costs at or under USD 50/t CO_2 eq). However, no effective action has yet been implemented despite repeated warnings from the climate science community.

• So far, even major global economies have not managed to appropriately reduce the share of their emissions in key sectors such as the **urban transportation** system (e.g., the **USA still increased by 3%** their emissions in the interval 2000-2019, despite considerable efforts being made towards the green transformation of their private vehicle pool). Time is running out extremely fast before measures can be put in place to prevent a disastrous climate transition.

Global warming is already affecting **sea-ice** in an unprecedented and much faster and stronger way than foreseen, with yet unclear consequences on the global climate stability, regional climate extremes and the fate of the Atlantic Thermohaline Circulation.

The **oxygen levels in the oceans have been depleting** since 1960 up to the present (based on the last estimates available as of 2010), and it is expected to further decline by up to 7 % or more below the 1960 level over the next century. Some ocean regions manifest this oxygen decline worse than others — i.e., the top of the northeast Pacific has lost more than 15 % of its oxygen. According to the IPCC's 2019 special report on the oceans, from 1970 to 2010, the volume of "oxygen minimum zones" in the global oceans —where big fish can't thrive but jellyfish can —increased by between 3 and 8 %. This contributes to algal blooms and/or extensive mortalities of marine life, fostering additional bacterial growth in coastal areas. This, in turn, positively reinforces the loop of oxygen depletion. This effect in turn leads to lower pH and fish stocks depletion with enhanced migrations to other areas, thereby contributing to the collapse of fragile economies depending on fisheries for economic survival and dietary protein intake, thereby highly threatening global food security.

Terrestrial productivity and crop production in many regions appears to be strongly affected by the increasing temperature and hydrological variability and extremes linked to global warming. Massive loss of biodiversity mounts dangerously atop with unprecedented consequences for food security and human and animal health.

The number, extent and duration of **marine heatwaves** has largely increased as it has also the extent, magnitude and duration of ocean dead zones. This has a major effect on marine ecosystems, fisheries and global food security, with large implications on malnutrition, health and poverty/inequities.

Tipping points in ecosystems are closer than thought and de-stabilization of critical regions seems to threaten human populations globally, with unprecedented and not-fully understood consequences. However, uncertainty is in this case not a positive expectation, but an alert to rapid action given the extremely dire consequences that lie ahead.

Stronger climate control is observed atop massive deforestation due to climate variability and ongoing climate change effects. In a highly "humanized" world, this is dangerously indicated by how **tropical ecosystems show lower resilience** to similar past climate forcings in what is becoming a new conundrum to science. Take for instance, the drastic effects of the ongoing 2023 El Niño (despite it being of minor intensity if compared to other well-known events, such as the 1982, 1997 and 2016 El Niños).

• Growing consensus exists within larger portions of the scientific community that

the Earth is rapidly destabilizing through '**cascades of ecosystems collapse'** and **climate-facilitated 'domino effects on sustainability**'. Similar non-stationary trends for ecosystem degradation imply that unstable subsystems are common, multiple climate hazards will occur simultaneously, and multiple climatic and non-climatic risks will interact, resulting in enhanced overall risk. Model simulations show that responses of the climate sub-systems or the critical ecosystems to additional stress produce qualitatively similar emergent phenomena in a consensus result that should not be dismissed lightly. The consistency across models representing varying processes, interactions and contexts may indicate that the accurate representation of internal system dynamics is less important than the external drivers/stressors in simulating complex realities. No further delay in action is therefore justified.

• If, as recent studies indicate, **real-world tipping elements** associated with the climate and **ecological crises** are more likely to be **driven by multiple, fast drivers and extreme events**, it is less likely that early warning signals will be easily observed. Additional contribution by noise in the data would also induce a false sense of security by overestimating the distance remaining before critical thresholds are breached in the real world, where multiple drivers and noise are abundant. Perception of future risks by the political community should change to foresee the dimension of risks ahead. While it is not currently possible to predict how climate-induced consequences and the effects of local human actions on ecosystems connect across temporal and spatial scales, studies coherently show the potential for each to drastically reinforce the other.

• Climate tipping points of particular concern are the **loss of Greenland and Antarctic ice sheets**, abrupt slowdown or shutdown of **Atlantic circulation** and further carbon emissions due to the **loss of permafrost and boreal forests**. In regards to sea-level rise, the most imminent threat comes from the collapse of the west Antarctic ice sheet, followed by the much larger east Antarctic ice sheet. While the Greenland ice sheet is suggested to be more stable in comparison, its meltwaters can affect the stability of the North Atlantic current. This would cause the temperatures in the northern hemisphere to drop substantially.

• Permafrost in the northern Arctic regions has historically contributed to the Earth's carbon sink. But the effects of thaw can change the permafrost region from carbon sink to source. **Abrupt collapse of parts of the permafrost** in the near future could lead to an additional 60-100 billion metric tons of CO_2 emissions. A gradual thaw of all the permafrost over the next 300 years would result in over 200 billion metric tons of CO_2 released in the worst-case scenario. Boreal forests are another major carbon storage reservoir (containing 30 to 40 percent of all land carbon, predominantly in the frozen soils below).

• Tropical forests are critically important for the global climate regulation because of their impact on the radiation, hydrology, and biogeochemical cycles. They are large pools of global carbon, with about 360 Pg of carbon in forest vegetation, that with soil carbon adds up to 800 PgC, almost as much as is stored in the atmosphere. In addition, forests are responsible for much of the carbon removal by terrestrial ecosystems, removing about 29 % of annual CO_2 emissions or 15.6 Gigatons of CO_2 each year. In Southeast Amazonia, the dry season has expanded from four to five months during the past 50 years with four severe droughts since 2005, concomitant to more deforestation in eastern Amazonia over the past 40 years. The increase in tree mortality and a reduction in photosynthesis are both a result of climate change effects across Amazonia. This stress and ongoing pressure on tropical forests is affecting Earth's capacity to regulate global climate and intensifying extremes.

• As conditions become warmer and drier, **wildfires** are happening more frequently and intensely, burning over larger areas and worsening air quality which has very negative impacts on respiratory diseases. Megafires are also threatening the vast reserves of carbon stored in the soils beneath the boreal forests.

• **Increasing climate variability and extremes** are also clear indications of the nature of climate change effects. Despite specific attribution can at most be made probabilistically, it is clear that even so, we are crossing some unprecedented thresholds. The extreme high temperatures and

moisture lead to **heat index values of roughly 60** in Manaus (Brazil), further exacerbated by an unusually long-lasting drought in the Amazon. Similar situations occur in other regions, such as southern Europe (e.g., Spain), where the succession of El Niño-La Niña teleconnections also appears to further amplify both heatwaves in the summer of 2022 and 2023 and the lack of rainfall in what it is possibly the most extreme drought experienced in the last 50 years in some regions of the world. At the same time, since late 1990, nine extreme floods have occurred in eastern Amazonia, the last one in 2021, showcasing the general tendency towards the amplification of climate extremes

2. A Major Threat for Human Health

• **Major heatwaves** are already affecting people's livelihoods. In 2022, in Europe alone, over 70,000 deaths were attributed to heat (with Italy, Greece, Spain and Portugal contributing the most). 2023's summer season (June–July–August) was the warmest since the begining of observational records. In July 2023, temperatures exceeded 50 °C in Death Valley, USA and in Northwest China. In India and Brazil, 2023 heatwaves have reached the 'survivability limits'. In Europe, the hottest day ever was recorded in Catalunya and the highest-ever records of daily minimum temperature in other parts of Spain.

• Hundreds of thousands of people have been unusually affected in 2023 only by **heavy rains causing floods** in many parts of the world, with casualties in the thousands. There is a clear intensification of the hydrological cycle in the last decades that severely increases the frequency of floods. Climate change is increasing the likelihood of more intense floods, such as the devastating storm in Derna, Libya, by up to 50 times and has at least contributed to a 50 % increase in rainfall.

• **Human livability** defined as the human climate niche in terms of temperature and humidity is already threatened. Recent studies indicate that climate change has already put **~9 % of people (>600 million) outside this niche**. By end-of-century (2080–2100), current policies leading to around 2.7 °C global warming could leave one-third (22–39 %) of people outside the niche, with countries such as India and Nigeria and other emerging economies (for example, Indonesia, Pakistan, Thailand) about to be the most affected ones. The worst-case scenarios of ~3.6 °C or even ~4.4 °C global warming could put half of the world population outside the historical climate niche, posing an existential risk.

• Climate change is facilitating the **spread and propagation of zoonotic diseases** affecting humans and animals. We are seeing this in the increasing number of zoonotic events in the tropics and out of them, such as the outbreaks of West Nile virus beyond their typical ranges and the geographical spread of avian flu to new continents, such as South America. There are already other clear examples on highly lethal zoonotic hunting-borne diseases in the Amazon and the southeast Asian tropical forests, in principle highly stable ecosystems. For instance, Nipah virus and *Echinococcus vogeli* spillovers promoted at the intersection between deforestation and the food availability disruption exerted by persistent droughts (vegetation, fisheries) and high temperatures, the latter ultimately modulated by much stronger perceived El Niño events. Also, much less known and indirect effects manifest in other subtropical and even temperate regions on resources for cattle feeding and raising, highly dependent on crop production and largely modulated by droughts.

• Migratory birds (e.g., gulls) can carry **antimicrobial resistance genes (AMR)** across continents and their wind routes are seen to be altered by global and regional

changing climate patterns. In recent studies, over 10 % of their fecal samples carried AMR genes also found at wastewater plants hundreds or thousands of kilometers away. These genes can encode enzymes that cripple carbapenems, which have become last-resort antibiotics to combat multi-drug-resistant bacterial infections.

• Drastic changes occur in the **distribution and ranges of important vector borne diseases** that were formerly thought to be tropical-only and that now are being seen in temperate areas more and more often, such as the autochthonous dengue and West Nile disease cases in regions of Spain, Greece and Italy. Another worrying example is the outbreak of Japanese encephalitis virus (JEV), a tropical disease, that sickened 45 people in 2022 in southeastern Australia, killing six persons. More worrisome is the fact that mechanistic pathways of transmission are not yet fully understood. A mix of mosquitoes, waterbirds, and domestic animals appears to emerge as key links. Together with larger climate variability induced by global warming, this combination seems to produce the perfect mix. In this regard, an unprecedented La Niña event in late 2021 yielding the wettest November month on record for that region, caused the mosquito population to surge in ways never seen before.

• Unfortunately, these diseases, which are increasingly affecting more people in the tropics, often do not receive attention unless they reach the wealthy temperate countries, where such events make headlines. This highlights the high level of inequity and the perverse way in which the world distinguishes among impacted persons based on their origin •

3. Proposals for Action

• Phasing out fossil fuels is going much slower than the climate situation requests. For instance, the so-called *'Sunnylands statement'* despite a meritorious effort of aligning the United States and China ahead of COP28 —the world's two biggest emitting countries—, falls short of expectations. So many years after climate research has proven the role on non-CO_2 greenhouse gases on the global warming effect and the role of forests in helping trap carbon dioxide, merely stating that the agreement implies planning a side-meeting on non-CO_2 gases and vague promises of abating methane and boosting economic efficiency and the circular economy are totally insufficient. More ambitious goals with specific commitments already for before 2030 (not 2035) should be made at the COP28 summit. Credibility is hard to achieve when China is still approving new coal-fired power plants.

The proposal for G20 leaders to triple global renewable energy capacity by 2030 and accelerate the substitution for coal, oil, and gas generation is not fit for the purpose; it is totally insufficient. Terms of any agreement should never take any potential overshoot time into account.

Loss-and-Damage fund should be implemented now in an actionable, measurable and effective way. Moreover, planning is needed for the locations that are expected to become unhabitable (due to the extreme heat and/or droughts) as we pass the 2-degrees global temperature increase. It is necessary to start discussing the national relocation plans to prepare for the unprecedented displacement of people expected.

The carbon stock left to trade before the world attains the 1.5 °C should not be any more subject to discussion, as the amount left is unable to become a solution and market options largely increase inequity between rich and poor countries.

Tropical forests have a critical role in supporting biodiversity, storing carbon, regulating the water cycle and also influencing the radiation balance via albedo. Tropical forests are decisive tools for global climate re-stabilization. COP28 should therefore establish an aggressive protection system of tropical forests, with a mechanism set in conjunction to the Convention on Biological Diversity (CBD) COP16, for the crucial role tropical forests have in regulating global climate. An additional specific fund should be urgently established to help rapid protection of tropical ecosystems globally, providing clear stimulous to local countries for their biodiversity preservation. Given the large global co-benefits implied for the planet, such a fund should efficiently compensate for any historical and future loss in the associated economic activity incurred by ecosystems preservation and restoration.

We call for the urgent and efficient implementation once and for all of the Global Stocktake at COP28, but one that fully recognizes and precisely quantifies the large share of the most industrialized countries in the current climate change crisis. Fair compensation to the most affected countries should be articulated immediately. The Stocktake should be started together with the creation of an accompanying international independent body capable of sanctioning those countries most responsible of the current climate crisis and that fail to comply with phasing out greenhouse gases emissions ●

References

• https://unfccc.int/sites/default/files/resource/Technical_Paper_2020-Low_Emission_Report.pdf

• The Global Stocktake at COP28. Editorial. Nature Clim. Change, https://doi.org/10.1038/s41558-023-01832-z

• Herring, David, and Rebecca Lindsey. "Can We Slow or Even Reverse Global Warming?" *National Oceanic and Atmospheric Administration,* 2020

• Lenton, T.M., Xu, C., Abrams, J.F. *et al.* Quantifying the human cost of global warming. *Nat Sustain* 6, 1237–1247 (2023). https://doi.org/10.1038/s41893-023-01132-6

• Wadman, M. (2023) Rude awakening. Science, doi: 10.1126/science.adn0659

• Woksepp H, Karlsson K, Börjesson S, Karlsson Lindsjö O, Söderlund R, Bonnedahl J. Dissemination of carbapenemase-producing Enterobacterales through wastewater and gulls at a wastewater treatment plant in Sweden. Sci Total Environ. 2023 Aug 15;886:163997. doi: 10.1016/j.scitotenv.2023.163997. Epub 2023 May 9. PMID: 37164093

• San-José, A., Mayor, P., Carvalho, B., and Rodó, X. (2023) Climate determines transmission hotspots of Polycystic Echinococcosis, a life-threatening zoonotic disease, across Pan-Amazonia. Proc. Nat. Acad. Sci. USA, 120 (33) e2302661120. https://doi.org/10.1073/pnas.2302661120

• Andy Aschwanden *et al.* (2019) Contribution of the Greenland Ice Sheet to sea level over the next millennium. *Sci. Adv.* 5, eaav9396DOI:10.1126/sciadv.aav9396

• https://data1.geo.tu-dresden.de/ais_gmb/

• Eliza J. Dawson, Dustin M. Schroeder, Winnie Chu, Elisa Mantelli, Hélène Seroussi, (2022). Ice mass loss sensitivity to the Antarctic ice sheet basal thermal state, Nature Communications, 10.1038/s41467-022-32632-2, 13, 1

• Watts, J. D., Farina, M., Oechel, W.-C. *et al.* (2023) Carbon uptake in Eurasian boreal forests dominates the high-latitude net ecosystem carbon budget, Global Change Biology, 29, 7, (1870-1889)

• Lopatka, A. (2023). Climate change is redefining Arctic wildfires, Physics Today, 76, 1, (17-18), https://doi.org/10.1063/PT.3.5153

• Seaver Wang, Adrianna Foster, Zeke Hausfather *et al.*, (2023). Mechanisms and Impacts of Earth System Tipping Elements, Reviews of Geophysics, 61, 1, https://doi.org/10.1029/2021RG000757

• Whitman, E., Parisien, MA., Thompson, D.K. *et al.* Short-interval wildfire and drought overwhelm boreal forest resilience. *Sci Rep* 9, 18796 (2019). https://doi.org/10.1038/s41598-019-55036-7

• https://climate.nasa.gov/news/2905/boreal-forest-fires-could-release-deep-soil-carbon/#:~:text=Boreal%20forests%20are%20located%20in,is%20found%20in%20the%20soils

• Lamboll, R.D., Nicholls, Z.R.J., Smith, C.J. *et al.* Assessing the size and uncertainty of remaining carbon budgets. *Nat. Clim. Chang.* (2023). https://doi.org/10.1038/s41558-023-01848-5

• Artaxo P, Hansson HC, Andreae MO, Back J, Alves EG, Barbosa HMJ, et al. Tropical and Boreal Forest–Atmosphere Interactions: A Review. Tellus B: Chemical and Physical Meteorology, 74 (2022), 24–163. https://doi.org/10.16993/tellusb.34

• Gatti, L.V., Basso, L.S., Miller, J.B. *et al.* Amazonia as a carbon source linked to deforestation and climate change. *Nature* 595, 388–393 (2021). https://doi.org/10.1038/s41586-021-03629-6

• Ballester J, van Daalen KR, Chen Z, Achebak H, Antó JM, Basagaña X, Robine JM, Herrmann FR, Tonne C, Semenza JC, Lowe R. The effect of temporal data aggregation to assess the impact of changing temperatures in Europe: an epidemiological modelling study. The Lancet Regional Health – Europe. Nov 2023. doi: 10.1016/j.lanepe.2023.100779

How to cite this document:

Rodó, X and Cvijanovic, I. **Health and Climate: Briefing Notes Ahead of COP28**. Barcelona Institute for Global Health (ISGlobal). Series: Health and Environment, No.54. November 2023.

https://www.isglobal.org/

ISGlobal Barcelona Institute for Global Health

A partnership of: "la Caixa" Foundation

Clínic Barcelona · Universitat de Barcelona · Generalitat de Catalunya · Gobierno de España · Parc de Salut MAR · upf. Universitat Pompeu Fabra Barcelona · Ajuntament de Barcelona