(Translated from French)

Dear Mrs. Moinat, (Defense lawyer)

Following your request, please find enclosed the answers provided by Swiss and foreign climate scientists to your questions related to the trial of young climate activists who sought to raise collective awareness about the climate emergency by staging a tennis match inside Credit Suisse's premises in November 2018, without causing property damage. These answers provide a scientific overview on the level of global warming, its causes, and the associated risks.

Yours sincerely,

Co-authors

Prof. Samuel Jaccard, University of Lausanne, Switzerland

Prof. Corinne Le Quéré, Research Professor of the Royal Society at the University of East Anglia, UK

Dr. Valérie Masson-Delmotte, CEA Research Director at the Laboratory for Sciences of Climate and Environment, University of Paris Saclay, IPSL, Paris, France

Dr. Gian-Kasper Plattner, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland

Prof. Martine Rebetez, University of Neuchâtel, Switzerland & Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Lausanne, Switzerland

Dr. Joeri Rogelj, Imperial College London, Grantham Institute for Climate Change and the Environment, UK

Prof. Sonia I. Seneviratne, Swiss Federal Institute of Technology in Zurich (ETH Zurich), Zurich, Switzerland

Prof. Thomas Stocker, University of Bern, Bern, Switzerland

Co-signatories

Prof. David N. Bresch, Swiss Federal Institute of Technology (ETH Zurich), Zurich, Suisse

Prof. Stefan Brönnimann, University of Bern, Bern, Switzerland

Prof. Andreas Fischlin, emeritus, Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland

Prof. Martin Grosjean, University of Bern, Bern, Switzerland

Prof. Nicolas Gruber, Swiss Federal Institute of Technology in Zurich (ETH Zurich), Zurich, Switzerland

Prof. Fortunat Joos, University of Bern, Bern, Switzerland

Dr. Jean Jouzel, Emeritus Research Director at CEA and CNRS, Laboratory for Sciences of Climate and Environment, University of Paris Saclay, IPSL, Paris, France

Prof. Reto Knutti, Swiss Federal Institute of Technology in Zurich (ETH Zurich), Zurich, Switzerland

Prof. Olivia Romppainen-Martius, University of Bern, Bern, Switzerland

Prof. Christoph Schär, Swiss Federal Institute of Technology in Zurich (ETH Zurich), Zurich, Switzerland

Prof. Julia Steinberger, University of Lausanne, Lausanne, Switzerland

Prof. Jean-Pascal van Ypersele, Université catholique de Louvain, Belgium

Prof. Heini Wernli, Swiss Federal Institute of Technology in Zurich (ETH Zurich), Zurich, Switzerland

1. How does global warming impact Switzerland and what will the consequences be if no serious measures are taken in the short-term towards achieving carbon neutrality?

→ The Earth is warming because of past and current greenhouse gas emissions from human activities[1]. The effects of climate change can now be seen and measured around the world, such as from air temperatures increasing over land and oceans, melting glaciers, thawing permafrost, rising sea levels, intensifying extreme heat events in most parts of the world, as well as heavier precipitation in several regions and worsening droughts some regions[1,2]. In Switzerland too, climate change is already evident in many facets of nature, society, and the economy[3,4,5,6,7]

→ The recent CH2018 report coordinated by the National Centre for Climate Services shows that observed warming in Switzerland is twice that of the global average (+2°C compared to +1°C globally). Further warming induces the following risks[4]: a) dry summers, b) increasingly heavy rainfall, especially in winter, c) more tropical days, and d) winters with less snow. Perturbations to the hydrological cycle (drier in summer, wetter in winter) lead to increasing consequences as a function of global warming for water management, agriculture and forest management, biodiversity preservation (notably in high mountains), electric power generation, and tourism[3,4,5,6]. Heatwaves are also a threat to public health[4,6,7]. Furthermore, indirect climate change impacts that may stem from effects occurring in other countries should not be underestimated, such as a destabilisation of social structures that may increase migration[2,8], global food crises[8] and impacts on global climate stability (tipping points, see #10)[1,3].

→ The Paris Agreement[9] signed in 2016 and ratified in 2017 by Switzerland aims to "strengthen the global response to the threat of climate change [...] by holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change " (Article 2.1.a[9]). The recent IPCC

---

1 https://www.ipcc.ch/sr15/ ; https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

2 IPCC SR15, Chapter 3: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Chapter3_Low_Res.pdf

3 https://www.bafu.admin.ch/bafu/en/home/topics/climate/publications-studies/publications/klimabedingte-risiken-und-chancen.html

4 https://www.nccs.admin.ch/nccs/en/home/the-nccs/priority-themes/ch2018-climate-scenarios.html

5 https://sciencesnaturelles.ch/uuid/20df2273-360c-5bce-941d-72d4f0eeb52e?r=20200527115808_1565159762_2c5b1f1d-490c-56d7-ae4f-4ac3da1d4bcf

6 https://www.bafu.admin.ch/bafu/fr/home/documentation/communique/anzeige-nsb-unter-medienmitteilungen.msg-id-76786.html

7 https://www.bafu.admin.ch/bafu/fr/home/themes/climat/publications-etudes/publications/canicule-et-secheresse.html

8 https://www.ipcc.ch/srccl/ ; https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM_Updated-Jan20.pdf

9 https://treaties.un.org/doc/Treaties/2016/02/20160215%2006-03%20PM/Ch_XXVII-7-d.pdf

report "Global Warming of 1.5°C"[1] as well as the IPCC's special reports on "Climate Change and Land"[8] and "The Ocean and Cryosphere in a Changing Climate"[10] show that limiting warming to 1.5°C rather than 2°C would help prevent many impacts, some of them irreversible. A climate change at 2°C rather than 1.5°C would result in an increase in hot extremes in most inhabited regions[1,2], heavier rainfall in several regions[1,2], more droughts in some regions[1,2], the extinction of a number of plant and animal species[1,2], much higher risks of permafrost degradation and food supply instability[8], and a 10-35 percent probability of an ice-free Arctic in September (vs. 1 percent with warming of 1.5 degree Celsius)[10]. But even a global warming stabilised at +1.5°C would incur more risks than at the current level (around +1.1°C[11]): it would represent a major threat to warm-water coral reefs[10] and be associated with a high risk of dryland water scarcity, of wildfire damage, of permafrost degradation, and of food supply instabilities[8].

2. When is global carbon neutrality ("neutralité carbone") likely to be achieved, and what does this mean for Switzerland?

→ "Neutralité carbone" [in French] refers to the necessity of reaching net-zero CO_2[1] or net-zero greenhouse-gas emissions[41] to halt global warming. The primary greenhouse gas emitted by human activities, carbon dioxide (CO_2), displays exceptional persistence in the climate system that can last hundreds or even thousands of years after emission. As long as net-zero CO_2 emissions are not reached, the Earth's global temperature will continue to rise. Hence, achieving net-zero CO_2 is a priority in order to stabilise the rising temperatures.

→ The IPCC Special report on Global Warming of 1.5°C (SR15[1]) shows that we need to reach net-zero CO_2 on a global scale by 2050 to stand a 50% or so probability of stabilising global warming at 1.5°C. Furthermore, this report[1] shows that failure to stabilise global warming at 1.5°C may cause many additional impacts and risks, bring about losses and damages, and incur higher adaptation and risk management costs, and potentially irreversible impacts (see #1). Reaching worldwide net-zero CO_2 by 2040 would be necessary in order to stand a higher probability (about 66%) of limiting the global temperature rise to 1.5°C. With every decade of climate inaction, global warming increases by 0.08 to 0.25°C[12].

---

10 https://www.ipcc.ch/srocc/ ; https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/03_SROCC_SPM_FINAL.pdf

11 https://public.wmo.int/en/resources/united_in_science ; https://trello-attachments.s3.amazonaws.com/5f560af19197118edf74cf93/5f59f8b11a9063544de4bf39/cdb10977949b38128408f5322f9f676d/United_In_Science_2020_8_Sep_FINAL_LowResBetterQuality.pdf

12 Estimating the Transient Climate Response to cumulative carbon Emissions (TCRE) at 0.8-2.5°C/1000 PgC (https://link.springer.com/article/10.1007/s40641-015-0030-6;

→ Intermediate targets are necessary to achieve a net-zero CO_2 budget. The IPCC report on Global Warming of 1.5°C shows that the lower the emissions in 2030, the less difficult it will be to limit global warming to 1.5°C beyond that date with little or no overshoot[1]. If no action is taken rapidly to reduce greenhouse gas emissions, direct consequences include the risk of cost escalation, lock-in in carbon-emitting infrastructure, stranded assets, and reduced flexibility in future response options in the medium to long term[1]. This may in turn cause further inequality in how countries at different stages of development are impacted[1].

→ The Paris Agreement puts forth the "common but differentiated responsibilities" of the different countries worldwide towards reaching global warming stabilisation targets[9]. Thus, developed countries – including Switzerland – which have already emitted a larger share of CO_2 emissions in proportion to their population have a moral and historical responsibility to make greater efforts than emerging countries, given their historical emissions and the associated economic development benefits on the one hand, and their capacity to act on the other hand.

→ Switzerland is long overdue in implementing legislation to reduce CO_2 emissions and other greenhouse gas emissions (CO_2 emissions account for about 80% of total greenhouse gas emissions in Switzerland[13]). In December 2018, the National Council failed to agree on the revision of the CO_2 Act, which has yet to be adopted. In April 2020, the Federal Office for the Environment expected Switzerland to miss its target to curb greenhouse gas emissions by 20% in 2020 compared to 1990[14]. The Swiss Parliament plans to introduce a 50% greenhouse gas emissions reduction target by 2030 in the new CO_2[15] law, but the possibility of offsetting emissions abroad by at least 25%[15] limits the emissions reduction scope in Switzerland.

→ Although the Federal Council has set a target of achieving carbon neutrality by 2050 [16,17] , Switzerland is under no direct international obligation to comply. This target is not being discussed within the framework of the CO_2 law currently being drafted by the Parliament, which does not go beyond 2030[16]. In addition, the Federal Council proposes that fossil fuels could remain in use after the aforementioned 2050 target is met[17]. Currently, there is no legislation

https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter2_Low_Res.pdf; https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter12_FINAL.pdf), and given current emissions of about 10 PgC per year, excluding indirect effects inducing additional delays (installation of fossil-fuel dependent infrastructure). For emission reduction timescale effects for other variables, see https://iopscience.iop.org/article/10.1088/1748-9326/11/1/014010/meta

13 https://www.bafu.admin.ch/bafu/en/home/topics/climate/state/data/greenhouse-gas-inventory.html

14 https://www.bafu.admin.ch/bafu/fr/home/documentation/communique/anzeige-nsb-unter-medienmitteilungen.msg-id-78720.html

15 https://www.swissinfo.ch/fre/toute-l-actu-en-bref/loi-sur-le-co2--75--des-réductions-d-émissions-à-réaliser-en-suisse/46017966

16 https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-76206.html

17 https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-80266.html

committing Switzerland to a net-zero CO_2 emission target by a date compatible with a stabilisation of global warming at 1.5°C although the Paris Agreement was approved almost 5 years ago, on 12 December 2015.

3. What is a carbon budget? What is our current carbon budget in order to remain below 1.5°C?

→ Carbon emissions from human activities accumulate in the atmosphere. A carbon budget is the amount of CO_2 emissions not to be exceeded in order to stabilise global warming at a given temperature. The IPCC's special report on Global Warming of 1.5°C (IPCC SR15[1]) states that humanity has already used 2200 ± 320 Gigatonnes of CO_2 ($GtCO_2$) of the budget corresponding to a global warming stabilisation at 1.5°C (with a probability of 50%). In 2018, the remaining budget was estimated at 580 $GtCO_2$ for a 50% probability of limiting global warming to 1.5°C, and at 420 $GtCO_2$ for a 66% chance (two thirds) of achieving same[1].

→ In order to limit global warming to 1.5°C, factors other than CO_2 must be addressed and their effects must be stabilised and/or reduced (other greenhouse gases, pollution particles). Moreover, the uncertainty range surrounding the remaining carbon budget is contingent on the actions taken to reduce said factors as well as on the unpredictability of greenhouse gas emissions from thawing permafrost (a process that may potentially amplify warming). The potential release of additional carbon emissions as a result of permafrost thaw in the future and the release of methane from wetlands could lower the carbon budget by 100 $GtCO_2$ over the course of this century, and by more beyond that timeframe[1].

4. How many gigatonnes of greenhouse gas emissions are released every year? Are these emissions decreasing?

→ Greenhouse gas emissions were of the order of 42 $GtCO_2$ per year in 2018[1]. For a two-thirds probability of limiting global warming to 1.5°C, the remaining carbon budget (around 420 $GtCO_2$, see answer #3) at the end of 2018 was therefore equivalent to about 10 years of emissions at the level of 2018. These emissions have not significantly decreased over the last decade. In fact, they have increased by 0.1% in 2019[18] and only dropped in a limited and temporary fashion (around 4-7%) in 2020 due to lockdown measures that slowed transport use and industrial activity during the first months of the COVID19 pandemic[18]. Global CO_2 emissions have since resumed their upward

[18] Le Quéré, C., et al. 2020, Nature Climate Change, doi: https://doi.org/10.1038/s41558-020-0797-x. Expected carbon emissions reductions are estimated to be around 4-7% for 2020 as a result of the COVID19 pandemic.

trajectory and are nearing 2019 levels. If the economy fully recovers, global CO_2 emissions will reach pre-pandemic levels again (considering the post-2008[19] financial crisis rapid return to normal in terms of CO_2 emissions). CO_2 concentrations in the atmosphere have kept rising in 2019 and 2020 (the impact of the temporary emission decrease will probably not be perceptible[11]) while the CO_2 budget still available to limit global warming to 1.5°C has continued to decrease.

5. Given the current rate of greenhouse gas emissions, when will the 1.5°C carbon budget be spent?

→ Considering the current rate of greenhouse gas emissions, we only have about eight years of carbon budget left for a 66% probability (two-thirds) of limiting warming to 1.5°C, and twelve years of carbon budget left for a 50% probability (half) (see #3 and #4).

6. On the subject of curbing global warming, can we defer our greenhouse gas emissions reduction targets into the future? And if so, what would be the consequences?

→ Strong and sustained action must be taken immediately if we are to ensure that global warming remains below the critical thresholds set within the scope of the Paris Agreement[9], which aims to limit the threat and impacts of climate change by keeping the temperature rise well below 2°C and to pursue efforts to limit the temperature rise to 1.5°C through sustainable and responsible action.

→ Given the short remaining time frame (between 8 and 12 years at current emission levels, for a two-thirds or half chance of stabilising global warming at +1.5°C, respectively – see #5), any delay will induce a higher – and potentially irreversible – risk of failing to meet the target, or will lead to taking actions that are inherently riskier (e.g. intense pressure on land and soil to remove carbon previously emitted into the atmosphere through a large-scale use of bioenergy with carbon capture and storage[8]). Any delay in implementing effective carbon emissions reduction measures today means that even more drastic and harmful action will have to be taken at a later stage in the hope of meeting global warming target levels, although they will most likely be unattainable by then[20].

---

19 Peters, G. P. et al. Rapid growth in CO_2 emissions after the 2008–2009 global financial crisis. Nat. Clim. Change 2, 2–4 (2012). https://www.nature.com/articles/nclimate1332

20 https://www.unenvironment.org/resources/emissions-gap-report-2018; https://wedocs.unep.org/bitstream/handle/20.500.11822/30798/EGR19ESFR.pdf?sequence=15

7. How do fossil fuels impact climate change?

→ Human activities (use of fossil fuels and land) are responsible for nearly all of the global warming observed to date (1.1°C)[11,21,22]. Natural climate variability cannot account for the observed warming trends over the last century[21,22].

→ CO_2 emissions from human activities are responsible for about 80% of the global warming induced by the increase in greenhouse gases[21]. Global warming has been directly proportional to cumulative CO_2 emissions since the industrial revolution[21]. The remaining 20% result from CH4, N2O, CFC, and HFC emissions[21].

→ The rise in CO_2 concentration in the atmosphere is directly linked to the combustion of fossil fuels and the production of cement (86%[23], of which cement accounts for about 3%[23]) and to a lesser extent to land use change (deforestation, destruction of peat bogs; about 14%[23]).

→ In addition, the use of fossil fuels contributes to CH4 emissions (about 35%)[24].

8. What damage has climate change caused to date?

→ Unfortunately, much – and sometimes irreversible – damage has already been caused[1,2,8,10], and the future damage will be much greater. Among other things, climate change is directly responsible for the thawing of ice-covered areas, the rise in sea level, an increase in the frequency and severity of numerous extreme climatic events, and adds to local human pressure to worsen the inexorable loss of biodiversity[1,2,8,10].

→ Much recent scientific work has shown how human-induced global warming has changed the features of extreme meteorological and climatic events (for example the intensity, duration, and probability of occurrence of heatwaves and the intensity of events associated with extreme precipitation events, including tropical cyclones)[2,11,25,26,27,28]. Climate change has also increased

---

21 IPCC AR5: https://www.ipcc.ch/report/ar5/wg1/; https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf

22 IPCC SR15, Chapter 1: https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter1_Low_Res.pdf

23 Friedlingstein et al. 2019, ESSD: https://essd.copernicus.org/articles/11/1783/2019/essd-11-1783-2019.pdf

24 http://globalcarbonatlas.org/en/CH4-emissions

25 IPCC SROCC, Chapter 6: https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/10_SROCC_Ch06_FINAL.pdf

26 Van Oldenborgh, G.J., et al. 2017, ERL. https://iopscience.iop.org/article/10.1088/1748-9326/aa9ef2

27 Vogel, M.M et al. 2019, Earth's Future. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019EF001189

28 https://www.worldweatherattribution.org/wp-content/uploads/WWA-Prolonged-heat-Siberia-2020.pdf

the risk of forest fires[29]. Some recent extreme events would have had a near-zero probability of occurrence without the impact of human emissions on the climate. [27,28,30].

→ According to the IPBES (2019)[31], climate change is "a direct factor that is increasingly exacerbating the impact of other drivers on nature and human well-being", such as changes in the use of land and seas, the direct exploitation of living organisms, pollution and invasion by exotic species. This damage affects all socioeconomic indicators, hitting vulnerable populations first and foremost.

→ In addition, the combustion of fossil fuels and the increasing atmospheric CO_2 concentrations result in ocean warming, with more intense, longer, and more frequent marine heatwaves[10], and with stratification of surface waters, leading to deoxygenation and less CO_2 absorption[10]. It also results in a decrease of the pH and the 'acidification' of seawater[1,2,10]. The consequences already observed in marine ecosystems can be illustrated by the degradation of tropical coral reefs, with increasingly frequent bleaching phenomena, and the decrease in fish catches in tropical regions[2,10].

→ The IPCC Report on Climate Change and Land assesses that climate change, including associated increases in frequency and intensity of extreme events, has had a negative impact on food security and terrestrial ecosystems and has contributed to land desertification and degradation in many regions[8].

→ The effects of climate change induce further pressure on numerous global resources such as water resources, land available for agriculture, ecosystem services, and health.

9. What are feedback loops?

→ A feedback is a self-amplifying mechanism, whereby the response to a forcing leads to a further amplification of this forcing. Greenhouse gas emissions resulting from human activities since the industrial revolution are responsible for an imbalance in the world energy balance, leading to heat accumulation in the climate system and a number of consequences. Numerous reactions in the climate system amplify this irregularity in the Earth energy balance and operate on very short (water vapour, clouds) or slower time scales (carbon cycle). The sequences of cause and effect thus generate an amplificatory feedback (or vicious circle).

---

29 https://sciencebrief.org/briefs/wildfires

30 Vautard, R., et al. 2020, ERL, https://iopscience.iop.org/article/10.1088/1748-9326/aba3d4

31 https://ipbes.net/global-assessment (Summary for policymakers: https://zenodo.org/record/3553579#.X2MlqS2B0RA)

→ A substantial positive feedback (i.e. amplification) is the loss of sea ice in the Arctic as a result of climate warming. The decrease in the area of sea ice and the dwindling of snow cover in the adjacent continents change the features of areas that lose their 'mirror feature' (whereby part of solar radiation is reflected into space). This results in increased absorption of energy and contributes to an increase in warming intensity in the Arctic region (where it is 2 to 3 times larger than that of the global average)[32].

→ The impact of climate change on vegetation could reduce its capacity to absorb carbon at high warming levels, which would lead to a further increase in CO_2 concentrations[33]. In particular, more frequent forest fires in some regions could contribute to this phenomenon[34]. However, many uncertainties remain in quantifying exactly how these feedbacks affect climate projections[8].

→ An important potential amplificatory feedback is associated to possible carbon emissions following the thawing of the permafrost and the release of methane from wetlands, estimated at some 100 $GtCO_2$ over the course of this century (and more beyond that timeframe) and not included in the estimate of the carbon budgets (see #3)[1].

10. What are tipping points?

→ A tipping point is defined in the IPCC Special Report on Ocean and cryosphere as "a level of change in system properties beyond which a system reorganises, often in a non-linear manner, and does not return to the initial state even if the *drivers* of the change are abated. For the *climate system*, the term refers to a critical threshold at which global or regional *climate* changes from one stable state to another stable state. Tipping points are also used when referring to *impact*: the term can imply that an impact tipping point is (about to be) reached in a natural or *human system*."[35].

→ A tipping point (or point of no return) is a transition in which a hitherto rare phenomenon becomes generalised.

→ The exceeding of a climate tipping point can cause serious and often harmful changes to the state of the system.

---

32 IPCC SROCC, Chapitre 3: https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/07_SROCC_Ch03_FINAL.pdf

33 https://www.nature.com/articles/s41586-018-0848-x

34 https://www.nature.com/articles/s41558-020-0707-2

35 https://www.ipcc.ch/srocc/chapter/glossary/

→ Some tipping points[2] include the cryosphere (West-Antarctic ice sheet, Greenland ice sheet), the thermohaline circulation (slowing of the Atlantic Ocean's meridional overturning circulation), the El Niño oscillation, and the role of the Southern Ocean in the carbon cycle.

11. Have we reached some of them already? If not, when are we likely to reach them?

→ The IPCC report on Global Warming of 1.5°C assesses that the risk of the current climate reaching a tipping point (about +1°C) is moderate and increases with global warming, becoming high at about +2.5°C of global warming[1,2]. For the polar ice sheets, the 1.5°C-2°C temperature range presents a moderate risk, associated with a potential instability of Antarctic ice sheet dynamics or irreversible loss of the Greenland ice sheet, which may be related to a sea level rise of up to 1-2 m on a two-century time scale[1,2,10,36]. Scientific evidence showing an increase in the frequency of extreme El Niño events with the level of global warming leads to an assessment of high risk even at a global warming of +1.5°C[1,2,36]. Potential ocean and cryosphere tipping points are among the elements speaking in favour of a limitation of global warming well below 2°C [1,10,36]. There exist regional tipping points for many systems too, including forest systems such as boreal and tropical forests[2].

12. Is it true that if these tipping points are reached, it will take centuries before the effects can subside?

→ Crossing a tipping point triggers irreversible changes for at least several decades or even centuries. Impacts such as sea-level rise are inexorable for at least thousands – or even tens of thousands – of years.

[36] Aslo see https://threadreaderapp.com/thread/1204374046739177472.html

13. During the initial trial, Professor Sonia Seneviratne stated "I cannot say why, despite the alarming situation, "nothing is happening". Still, I would not say that nothing is happening *at all,* as there are a few positive developments. We remain very far from the Paris Agreement's objectives, but some developments are not totally negative. In Europe, there is a tendency towards emissions stabilisation. Unless I am mistaken, in some countries we are beginning to see a decoupling of CO_2 emissions and GDP, which in the past were totally correlated."
Do you share this observation? Do you agree with Prof. Seneviratne's views on a future decoupling? Will this emissions stabilisation trend be sufficient to limit global warming to 1.5°C?

→ This observation, based on recent studies, is correct[23,37]. Still, it remains essential to put this statement into context and not to take it as a sign that there is less urgency to reduce emissions, as the progress achieved is minimal compared to the efforts needed to achieve a net-zero CO_2 budget. Additional CO_2 emissions automatically induce additional warming, potentially further amplified by feedback loops. It is thus essential to go much beyond a stabilisation of emissions (which lead to further CO_2 accumulation in the atmosphere) and to manage to initiate a sharp decrease in emissions which is continuously getting larger every year. This calls for fundamental and structural changes in the energy, land management, industry, and urban planning sectors. This tendency towards a stabilisation of emissions is therefore absolutely insufficient to limit global warming to 1.5°C.

→ The only way to efficiently stabilise global warming at 1.5°C consists of rapidly achieving net-zero CO_2 emissions in every country. Apart from Bhutan and Suriname[38], no other country is anywhere close to this goal, and the emission reduction commitments made so far by countries under the Paris Agreement would not succeed in stabilising global warming at 1.5°C[39,40]. About five times more effort than pledged to date would be needed[40].

→ Moreover, the decrease in emissions in some European countries has been associated with an increase in emissions in other countries, due to an increased consumption of imported products

---

37 Le Quéré et al. 2019, Nature Climate Change: https://www.nature.com/articles/s41558-019-0419-7.pdf

38 https://eciu.net/netzerotracker

39 According to the estimates of the IPCC report on Global Warming of 1.5 degrees Celsius[1], the global emissions outcome of currently nationally stated mitigation ambitions as submitted under the Paris Agreement would lead to global greenhouse gas emissions in 2030 of 52 - 58 GteqCO2 per year. Pathways reflecting these ambitions would not limit global warming to 1.5°C (paragraph D1; https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf)

40 The UNEP emissions gap report[20] concludes that the Nationally Determined Contributions (NDCs) formulated by countries in 2020 need to be significantly strengthened. Countries need to triple their NDC ambitions in order to stabilise global warming well below 2 degrees Celsius, and they must increase them around fivefold in order to stabilise warming at 1.5 degrees Celsius.

and industrial relocations to other countries and other parts of the world[41] – which is why it is important to address the consumption footprint of a country as a whole. This is particularly the case in Switzerland[42].

→ In this context, the 2018 IPCC special report (SR15[1]) also stressed the strategic importance of financial investments and of an immediate shift of investments from fossil fuels to low-carbon energy and energy efficiency systems (funding needs will increase by a factor of 5 to 6 between now and 2050 for a global warming stabilisation at 1.5°C). This point was also put forth in recent UNEP reports (Emission Gap Report[20], Production Gap Report[43]).

→ The latter is particularly important in the context of banking investments as several investment banks such as Credit Suisse have continued to make large investments in fossil fuel companies, even after the Paris Agreement was approved[44].

→ Lastly, although some European countries have reduced their CO_2 emissions in recent years, this has not been the case in Switzerland. Indeed, the country was excluded from the list of 18 countries selected in Le Quéré et al's 2019 study[37] on successful decarbonisation for it failed to meet the study criteria, namely to have experienced a significant decrease in CO_2 emissions (relative to variability) for at least a decade, both in nationwide emissions and in carbon footprint, true indicators of the national efforts made to reduce CO_2 emissions. Emissions (CO_2, energy only) have decreased by 1.5% per year in the last decade, but Switzerland's very high carbon footprint has grown by 1.3% per year due to consumption (see Figure 1 below, from globalcarbonatlas.org). Thus, Switzerland is performing worse than a number of other neighbouring countries and/or countries with a similar level of development (Germany, Austria, Belgium, Bulgaria, Croatia, Denmark, Spain, the USA, Finland, France, Hungary, Ireland, Italy, the Netherlands, Portugal, Romania, Sweden) with respect to the reduction of its CO_2 footprint[37].

41 https://www.hautconseilclimat.fr/wp-content/uploads/2019/09/hcc_rapport_annuel_2019_v2.pdf

42 https://www.bafu.admin.ch/dam/bafu/fr/dokumente/klima/fachinfo-daten/kenngroessen_thg_emissionen_schweiz.pdf.download.pdf/Kenngr.ssen_2020_F.pdf

43 https://www.unenvironment.org/resources/report/production-gap-report-2019

44 https://www.swissinfo.ch/fre/economie/transition-écologique_les-banques-accusées-de-trop-investir-dans-les-énergies-fossiles/44853276

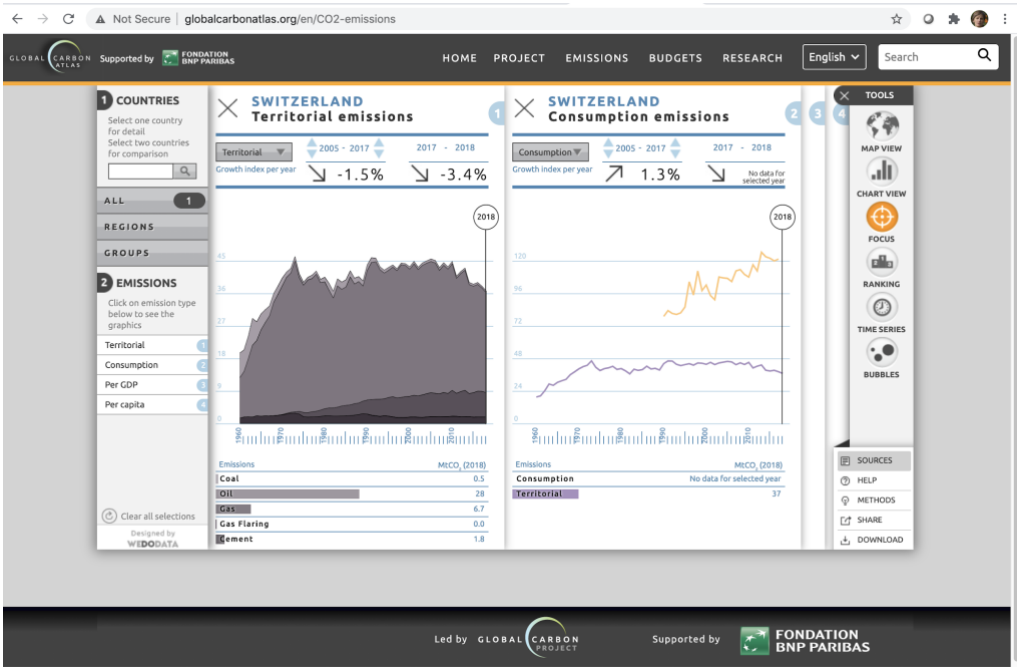

Figure 1 Swiss carbon footprint: left) territorial emissions; right) consumption-related carbon emissions. Source: globalcarbonatlas.org

14. On a personal level and given your scientific expertise, are you worried about the situation?

→ Yes, we are very worried: In particular, in light of the already observed effects of a global warming that had been anticipated for several decades (see 1st IPCC report from 1990[45]); in light of the growing risks of severe and sometimes irreversible impacts; in light of our quantitative understanding of possible climate futures; and in light of the lack of any major reductions of global CO_2 emissions since, and in spite of, the 2015 Paris Agreement. Our concern is further heightened by the gap between the commitments made in that agreement and the capacity and willingness[39,40] to actually implement them.

45 https://www.ipcc.ch/report/climate-change-the-ipcc-1990-and-1992-assessments/ (https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_full_report_fr.pdf)

List of signatories

Co-authors

Prof. Samuel Jaccard, University of Lausanne, Switzerland; Lead Author, IPCC 6th Assessment Report (2018-2021)

Prof. Corinne Le Quéré, Research Professor of the Royal Society at the University of East Anglia, UK; Co-chair of the Global Carbon Project (2009-2013); Lead Author, IPCC 5th Assessment Report (2010-2013); Member of UK Committee on Climate Change (CCCUK); Chair of French Haut Conseil pour le Climat.

Dr. Valérie Masson-Delmotte, CEA Research Director at the Laboratory for Sciences of Climate and Environment, University of Paris Saclay, IPSL, Paris, France; Co-chair of IPCC Working Group 1 for 6th cycle of evaluation (2015-2022); Member of French Haut Conseil pour le Climat; Author of UN report "United in Science" (2020).

Dr. Gian-Kasper Plattner, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland; Head of Technical Science Unit of IPCC Working Group 1 for 5th cycle of evaluation (2008-2015); Lead Author, IPCC 6th Assessment Report (2018-2021).

Prof. Martine Rebetez, University of Neuchâtel, Switzerland & Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Lausanne, Switzerland; Member of ProClim Steering Committee (Switzerland)

Dr. Joeri Rogelj, Imperial College London, Grantham Institute for Climate Change and the Environment, UK; Coordinating Lead Author, IPCC Special Report on Global warming of 1.5°C (2017-2018); Lead Author, IPCC 6th Assessment Report (2018-2021).

Prof. Sonia I. Seneviratne, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Switzerland; Coordinating Lead Author, IPCC Special Report on Extreme Events and Disasters (2009-2012); Lead Author, IPCC Special Report on Global warming of 1.5°C (2017-2018); Coordinating Lead Author, IPCC 6th Assessment Report (2018-2021).

Prof. Thomas Stocker, University of Bern, Bern, Switzerland; Co-chair of IPCC Working Group 1 for 5th cycle of evaluation (2008-2015); Member of the Organe Consultatif sur les Changements Climatiques (OCCC, Switzerland).

Co-signatories

Prof. David N. Bresch, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Suisse; Member of ProClim Steering Committee (Switzerland); Member of the Organe Consultatif sur les Changements Climatiques (OCCC, Switzerland).

Prof. Stefan Brönnimann, University of Bern, Bern, Switzerland; Lead Author, IPCC 5th Assessment Report (2010-2013)

Prof. Andreas Fischlin, emeritus, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Switzerland; Vice-chair of IPCC Working Group 2 for 6th cycle of evaluation (2015-2022); Member of the Organe Consultatif sur les Changements Climatiques (OCCC, Switzerland).

Prof. Martin Grosjean, University of Bern, Bern, Switzerland; Director, Oeschger Centre for Climate Change Research.

Prof. Nicolas Gruber, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Switzerland; Chair of Steering Committee of Center for Climate System Modeling (C2SM), ETH Zurich; Lead Author, IPCC Special Report on Ocean and Cryosphere in a Changing Climate (2017-2019).

Prof. Fortunat Joos, University of Bern, Bern, Switzerland; Vice-chair of IPCC Working Group 1 in the 3rd cycle of evaluation (1997-2001).

Dr. Jean Jouzel, Emeritus Research Director at CEA and CNRS, Laboratory for Sciences of Climate and Environment, University of Paris Saclay, IPSL, Paris, France; Vice-chair of IPCC Working Group 1 for 4th and 5th assessment cycles (2002-2015).

Prof. Reto Knutti, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Switzerland; Lead author, IPCC 4th Assessment Report (2004-2007); Coordinating Lead Author, IPCC 5th Assessment Report (2010-2013).

Prof. Olivia Romppainen-Martius, University of Bern, Bern, Switzerland; Member of ProClim Steering Committee (Switzerland).

Prof. Christoph Schär, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Switzerland; Lead Author, IPCC 5th Assessment Report (2010-2013).

Prof. Julia Steinberger, University of Lausanne, Lausanne, Switzerland; Lead Author, IPCC 6th Assessment Report, Working Group 3 (2019-2022).

Prof. Jean-Pascal van Ypersele, Université catholique de Louvain, Belgium; Vice-chair of IPCC for the 5th cycle of evaluation (2008-2015).

Prof. Heini Wernli, Swiss Federal Institute of Technology Zurich (ETH Zurich), Zurich, Switzerland; Chair of Institute for Atmospheric and Climate Science, ETH Zurich.