

## ***Interactive comment on “Anthropogenic climate change and glacier lake outburst flood risk: local and global drivers and responsibilities for the case of Lake Palcacocha, Peru” by Christian Huggel et al.***

**Will Dr. Frank**

willbefrank@hotmail.de

Received and published: 6 April 2020

Contribution to the Peer Review of

"Anthropogenic climate change and glacier lake outburst flood risk: local and global drivers and responsibilities for the case of Lake Palcacocha, Peru" by Christian Huggel (et al.)

by Dr. Will Frank, Bonn.

C1

The author of this note helped to prepare the legal arguments for Luciano Lliuya's lawsuit against RWE because of the endangerment of the plaintiff's home by a possible glacial outburst flood risk (GLOF) (see Frank, The Huaraz Case, Climate Law Blog, Sabin Center, Columbia Law School, posted Dec. 17th, 2017; available at: <http://blogs.law.columbia.edu/climatechange/2017/12/07/the-huaraz-case-lluiya-v-rwe-german-court-opens-recourse-to-climate-law-suit-against-big-co2-emitter/>).

### A) Summary of Facts

The authors of the study make the following statements, among others:

1) The water volume of Lake Palcacocha has increased significantly since the late 1970s (line 130). The water levels have developed as follows: Volume 1974: 3,690 x 10.000.000 m<sup>3</sup>; Volume 2009: 17,325 x 10.000.000 m<sup>3</sup>; Volume 2016: 17,403 x 10.000.000 m<sup>3</sup>. The water level was lowered by 3 m in 2018. 2) Palcacocha is one of the glacial lakes where glacial flooding can be triggered by rapid landslide processes (line 145). 3) Available studies agree that temperatures in the Peruvian Andes, including the Cordillera Blanca, have risen since the 1960s at a rate of about 0.2 to 0.3°C per decade and about 0.1°C per decade over the last 30 years (line 175). 4) The anthropogenic greenhouse effect has been identified as the most probable cause of warming over time (line 178). 5) El Niño and La Niña and ENSO cannot explain the melting of glaciers over time (lines 186-187). 6) According to various studies, climate change clearly plays a significant role in the melting of glaciers. This assessment is in line with the IPCC, according to which the melting of the glaciers in the Andes is very likely ("very high confidence") to be attributable to climate change (line 190). 7) According to a study from 2014, two thirds of the loss of mass of the glaciers in the Andes can be explained by global warming (line 192). 8) Almost 100% of the increase in the water volume of Lake Palcacocha is due to the melting of the glacier (line 199). 9) The growth of Lake Palcacocha has a clear anthropogenic component ("signal") (line 204).

### B) Remarks

C2

The authors come on the basis of the aforementioned facts to the conclusion:

"It can be said with certainty that without anthropogenic climate change the danger (of a GLOF) would be much lower, primarily because the size of the lake would then be substantially smaller and a long, flat glacier tongue would significantly weaken the energy of a possible rock or glacier retreat" (lines 225 - 228).

Despite the strong evidence for the causal link between the CO<sub>2</sub> emissions of RWE and the endangerment of the plaintiff's property the authors however find that

"at the current state of science an assessment of GLOF hazard attribution to anthropogenic climate change can only be qualitative." (lines 224f) and

"...the company's (= RWE) contribution to Palcacocha GLOF risk is proportionally small and hardly quantifiable." (lines 475 f).

The study by Huggel (et al.) thus doubts the quantifiability of the causal contribution of CO<sub>2</sub>-emissions from RWE to the endangerment of the plaintiff's property. This assessment has possibly two reasons:

The authors of the study also include socio-economic factors as risk factors in their analysis, which in fact can hardly be quantified. These socio-economic aspects are however legally irrelevant to the question of whether a scientifically verifiable causal relationship exists between the emission of CO<sub>2</sub> by certain emitters and the risk of a GLOF. Possible failure of local government agencies to prevent damage does not rule out the primary responsibility of those causing the risk. Similarly, a deliberate acceptance of the risk of a GLOF by parts of the population would not preclude such liability of the causers of the risk, but would at most be of relevance in reducing their liability under the aspect of contributory negligence.

The second reason for the cautious conclusion of the authors of the study with respect to the quantifiability of the causal contribution of CO<sub>2</sub>-emissions by big emitters to the GLOF-risk endangering Huaraz is probably to be seen in the fact that there are not yet

C3

available detailed studies about the regional impacts of climate change in the Andes.

The problem regarding the possible regionalization of the impacts of climate change in the Cordillera Blanca does not, however, exclude the possibility that, even on the basis of current knowledge, a certain range of the size of the causal contribution of climate change to glacial melting in the area of Huaraz can be established.

If it is correct that

- RWE's CO<sub>2</sub> emissions contribute in the magnitude of X percent to global warming,
- according to the IPCC, the melting of the glaciers in the Andes is very likely to be due to climate change or, according to another study, at least two thirds of the loss of mass of the glacier in the Andes can be explained by global warming, - the rise in temperature in the region where the Palcacocha glacier is located is due to global warming as observed in the recent decades, - the increase in the water volume of the lake is almost 100% due to the melting of the Palcacocha glacier due to global warming,
- the GLOF risk for Huaraz is due to the increased water volume of Lake Palcacocha,

then the causal contribution of RWE emissions to the GLOF risk lies between (at most) X percent (RWE's share in the increased pollution of the atmosphere with greenhouse gases) and a percentage of (at least) Y percent taking the remaining uncertainties with respect to the regionalization of global warming to the area of the Cordillera Blanca into account. Example: Assuming that possibly only two thirds of the mass loss of the Palcacocha Glacier can be traced with certainty to global warming because of still existing uncertainties with respect to regional effects of climate warming in the Andes Y (the causal contribution of CO<sub>2</sub> emissions by RWE) would be  $\frac{2}{3} X$ .

This means: Even if it is not yet possible, according to the current state of knowledge, to precisely quantify the causal contribution of individual major emitters of CO<sub>2</sub> to certain consequences of climate change, it does seem possible to determine a range within which this causal contribution must lie and thereby determine the minimum of the respective causal contribution to a certain impact of climate change.

C4

### C) Legal aspects

Even a "proportionally small" contribution to the GLOF-risk in question is not legally insignificant in view of the magnitude of the damage threatened by the GLOF.

The lawsuit filed against RWE is based on German law. As in other legal systems, the principle applies that the plaintiff must prove the facts on which his claim is based.

However, this principle does not apply unconditionally. In the case of damage being caused by multiple parties - as in the case of climate change being caused by a large number of actors - the court can estimate the causal contribution of individual parties.

Thus, even if the causal contribution of CO<sub>2</sub> emissions from RWE power plants cannot (yet) be exactly quantified in view of factors that may play a role in the causal chain it can – as the study of Huggel (et al.) confirms – be quantified to a degree that allows a reasonable estimation on which a judicial verdict on the responsibility of individual big CO<sub>2</sub> emitters can be based.

---

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-44>, 2020.