Global economic losses from natural disasters under climate changes in recent decades (1980-2023)

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Introduction

Natural disasters are associated with enormous global economic losses. A comprehensive quantitative analysis of regional and global economic losses due to extreme natural events is needed, identifying trends in change and their causes. Many studies show that the frequency and intensity of extreme events are changing significantly due to climate change [1] (see also [2]).

Data used

We analyze here changes of global economic losses from natural disasters *E* [3] and their relationship with changes in global surface temperature *T* [4] during past decades.

Results

Figure 1 shows interannual variations global economic losses from natural disasters *E* normalized on mean value <*E*> for the analyzed period 1980-2023. Linear trend of *E*/<*E*> during 1980-2023 was estimated to be equal to (d*E*/<*E*>)/dt = 0.49 (±0.07) decade^{-1} (with standard deviation, SD, in brackets) and coefficient of regression r = 0.72. It is corresponding to the *E* mean increase on 49% per decade.

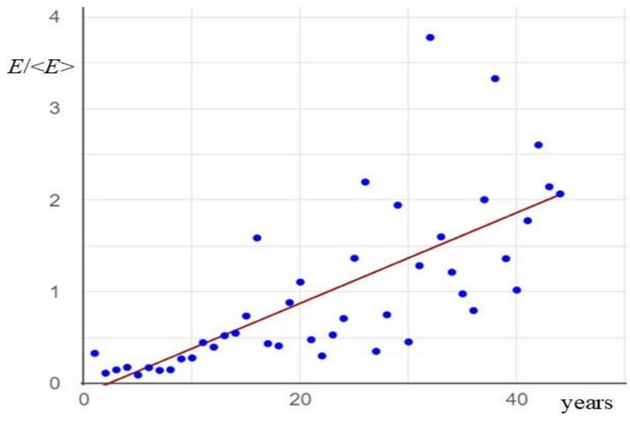

Figure 1. Normalized global economic losses from natural disasters *E*/<*E*> in dependence on time *t* (years – relative to 1979) during 1980-2023. Straight line corresponds to linear regression.

According to Fig. 1 the time dependence of E is nonlinear with an increase of interannual variations (characterized by corresponding SD) during past decades. Linear trend of *E*/<*E*> during 1980-2001 was estimated to be equal to (d*E*/<*E*>)/dt = 0.34 (±0.10) decade^{-1} with coefficient of regression r = 0.60. It is corresponding to the *E* mean increase on 34% per decade with standard deviation 10%/decade. Linear trend of *E*/<*E*> during 2002-2023 was estimated to be equal to (d*E*/<*E*>)/dt = 0.58 (±0.28) decade^{-1} with coefficient of regression r = 0.41. It is corresponding to the *E* mean increase on 58% per decade with standard deviation 28%/decade.

Figure 2 shows normalized global economic losses from natural disasters *E*/<*E*> in dependence on global surface air temperature *T* for the period 1980-2023. The parameter of the *E*/<*E*> sensitivity to the change of T (estimated with the use of corresponding linear regression) was estimated to be equal to (d*E*/<*E*>)/d*T* = 2.2 (±0.4) K^{-1} with coefficient of regression r = 0.65. It is corresponding to the *E* increase more than twice under the *T* increase on 1K. It was noted, that for the most significant correlation was obtained with the 1-year lag of *E* values relative to *T* variations: (d*E*/<*E*>)/d*T* = 2.6 (±0.4) K^{-1} with r = 0.74. In this case the *T* increase on 1K results in a 2.6-fold of *E*.

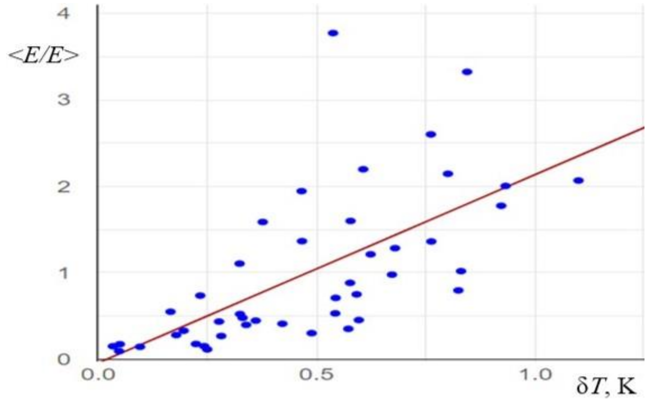

Figure 2. Normalized global economic losses from natural disasters *E*/<*E*> in dependence on anomalies of global surface air temperature δ*T* (relative to 1951-1980) for the period 1980-2023. Straight line corresponds to linear regression.

The dependence of *E* on *T* is also nonlinear with a corresponding SD increase under global warming during past decades. The parameter of the *E*/<*E*> sensitivity to the change of *T* was estimated for 2 subperiods: (d*E*/<*E*>)/d*T* = 1.3 (±0.5) K^{-1} with r = 0.51 for 1980-2001 and (d*E*/<*E*>)/d*T* = 1.3 (±1.2) K^{-1} with r = 0.25 for 2002-2023. It was noted, that for the second subperiod the most significant correlation was obtained with the 1-year lag of *E* values relative to *T* variations: (d*E*/<*E*>)/d*T* = 3.3 (±1.2) K^{-1} with r = 0.54. In this case the *T* increase on 1K leads to more than a threefold increase of *E*.

Summary

The global economic losses from natural disasters *E* increased on 70% during 2002-2023 relative to 1980-2001 with corresponding SD increase almost 3 times.

Sensitivity parameter (d*E*/<*E*>)/d*T* for 2002-2023 with the 1-year lag of *E* values relative to *T* is 2.5 times larger than that for 1980-2001. The corresponding SD value for the second subperiod was obtained 2.4 larger than that for the first subperiod.

These results were obtained within the framework of the RSF project 24-17-00211.

References

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