Supplementary materials

Table S1. Data on surface temperature, rainfall and number of natural hazards in Vietnam

Year	Average temperature (^{0}C)	Average temperature baseline (^{0}C)	Average rainfall (mm)	Total natural disaster events	Year	Average temperature (^{0}C)	Average temperature baseline (^{0}C)	Average rainfall (mm)	Total natural disaster events
1963	24.17	-0.302	1830	0	2003	24.90	1.043	1632	5
1964	24.18	0.082	1799	3	2004	24.61	0.385	1626	6
1965	24.30	-0.017	1688	0	2005	24.80	0.838	1801	11
1966	24.67	0.488	1857	1	2006	24.92	0.892	1744	11
1967	23.96	-0.129	1653	0	2007	24.61	0.506	1762	7
1968	24.23	-0.304	1709	0	2008	24.18	0.199	1945	10
1969	24.41	0.535	1601	0	2009	24.80	0.671	1625	6
1970	24.18	-0.062	1880	1	2010	25.06	1.092	1648	7
1971	23.77	-0.438	1880	2	2011	24.14	0.118	1814	5
1972	24.31	-0.008	1857	0	2012	24.91	0.736	1875	4
1973	24.57	0.468	1788	1	2013	24.69	0.895	1894	10
1974	23.99	-0.387	1808	0	2014	24.91	0.540	1685	3
1975	24.26	0.199	1872	0	2015	25.29	1.222	1763	5
1976	23.99	-0.551	1669	0	2016	25.21	1.191	1791	9
1977	24.33	-0.029	1619	1	2017	24.84	1.121	1888	9
1978	24.44	0.112	1914	2	2018	24.82	0.817	1796	7
1979	24.72	0.416	1642	0	2019	25.41	1.811	1639	8
1980	24.69	0.368	1757	3	2020	25.23	1.477	1672	11
1981	24.31	0.490	1768	0	2021	25.04	1.114	1761	8
1982	24.26	0.196	1791	1	2022	24.73	1.033	1752	8
1983	24.40	0.082	1762	3					
1984	24.08	-0.126	1785	3					
1985	24.14	-0.028	1757	2					
1986	24.28	0.088	1944	2					
1987	24.94	1.048	1627	3					
1988	24.56	0.181	1653	2					
1989	24.59	0.034	1633	3					
1990	24.87	0.402	1858	5					
1991	24.91	0.616	1690	7					
1992	24.51	0.101	1648	5					
1993	24.58	0.332	1621	4					
1994	24.78	0.329	1924	3					
1995	24.56	0.377	1744	2					
1996	24.34	0.001	1852	7					
1997	24.75	0.310	1793	4					
1998	25.43	1.307	1713	6					
1999	24.56	0.740	1900	5					
2000	24.50	0.129	1710	11					
2001	24.71	0.693	1923	7					
2002	24.84	0.722	1891	7					
Min	**23.77**	**-0.55**	**1601**	**0**	**Min**	**24.14**	**0.12**	**1625**	**3**
Max	**25.43**	**1.31**	**1944**	**11**	**Max**	**25.41**	**1.81**	**1945**	**11**
Mean	**24.45**	**0.21**	**1770**	**2.7**	**Mean**	**24.86**	**0.89**	**1756**	**7.5**

Table S2. List of original sources contributed the measure "score"

No.	Authors/Organization	Main finding	Contribution to the score of risk
1	Marin-Ferrer M, Vernaccini L, Poljansek K, Index for Risk Management INFORM Concept and Methodology, Report-Version 2017, EUR 28655 EN, doi:10.2760/094023	Concept, methodology and model of three dimensions of INFORM risk: Hazards & Exposure, Vulnerability, and Lack of Coping Capacity.	- Provided the Equation for calculating risk. - Provided the final scores of Risk (0-10) and Risk categories (Very high, High, Medium, Low, Very low) and trend of Risk of each country.
2	EC DRMKC (European Commission Disaster Risk Management Knowledge Centre) (2023) INFORM. European Commission, Brussels. https://drmkc.jrc.ec.europa.eu/inform-index	The results of the INFORM Risk (Hazard and Exposure, Venerability, Lacking of coping capacity) and Severity Indexes, additional analysis, and an introduction to INFORM's new tool analysing the risk of crises and disasters resulting from climate change annually.	Provide the final scores of Risk (0-10) and Risk categories (Very high, High, Medium, Low, Very low) and trend of Risk of each country from 2015 until the present.

Table S3. R code and outputs of regression analysis

R code:

```
> model <- lm(Temperature ~ Total natural disaster events, data = data)
> model
```

Output

```
Call:
lm(formula = Temperature ~ Total natural disaster events, data = data)
Residuals:
     Min       1Q   Median       3Q      Max
-0.94712 -0.23370 -0.04359  0.25777  1.02004

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.03054    0.08113   0.376    0.708
Total        0.09505    0.01486   6.395 3.01e-08 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.392 on 58 degrees of freedom
Multiple R-squared:  0.4136,    Adjusted R-squared:  0.4034
F-statistic:  40.9 on 1 and 58 DF,  p-value: 3.013e-08
```

Table S4. R code and outputs of ANOVA and Turkey HSD test

R code:

```
> anova <- aov(Variables ~ Periods, data = data)
> tukey <- TukeyHSD(anova)
> tukey
> library(multcompView)
> cld <- multcompLetters4(anova, tukey)
> print(cld)
```

** Note:*
P1: Period 1963-1972
P2: Period 1973-1982
P3: Period 1983-1992
P4: Period 1993-2002
P5: Period 2003-2012
P6: Period 2013-2022

Output — **Annual average temperature**

```
$Period
               diff           lwr         upr     p adj
P2-P1  0.0023683735 -0.0039045325 0.008641280 0.8728611
P3-P1  0.0052953293 -0.0009775767 0.011568235 0.1440518
P4-P1  0.0082995217  0.0020266157 0.014572428 0.0033852
P5-P1  0.0080930445  0.0018201385 0.014365951 0.0045650
P6-P1  0.0135459622  0.0072730562 0.019818868 0.0000006
P3-P2  0.0029269558 -0.0033459502 0.009199862 0.7394281
P4-P2  0.0059311482 -0.0003417578 0.012204054 0.0739220
P5-P2  0.0057246710 -0.0005482350 0.011997577 0.0926282
P6-P2  0.0111775887  0.0049046827 0.017450495 0.0000356
P4-P3  0.0030041924 -0.0032687136 0.009277098 0.7179167
P5-P3  0.0027977152 -0.0034751908 0.009070621 0.7740362
P6-P3  0.0082506329  0.0019777269 0.014523539 0.0036351
P5-P4 -0.0002064772 -0.0064793832 0.006066429 0.9999987
P6-P4  0.0052464405 -0.0010264655 0.011519347 0.1511071
P6-P5  0.0054529177 -0.0008199883 0.011725824 0.1230448

> cld <- multcompLetters4(anova, tukey)
> print(cld)
$Period
  P6   P4   P5   P3   P2   P1
 "a" "ab" "ab" "bc" "bc"  "c"
```

Output — **Changes in temperature baseline**

```
$Period
              diff           lwr        upr     p adj
P2-P1  0.05262171 -0.1067729697 0.2120164 0.9237693
P3-P1  0.10646852 -0.0529261635 0.2658632 0.3706867
P4-P1  0.18952237  0.0301276842 0.3489171 0.0110847
P5-P1  0.23507329  0.0756786022 0.3944680 0.0008065
P6-P1  0.34840154  0.1890068612 0.5077962 0.0000005
P3-P2  0.05384681 -0.1055478771 0.2132415 0.9165602
P4-P2  0.13690065 -0.0224940294 0.2962953 0.1314280
P5-P2  0.18245157  0.0230568886 0.3418463 0.0160886
P6-P2  0.29577983  0.1363851476 0.4551745 0.0000163
P4-P3  0.08305385 -0.0763408356 0.2424485 0.6408277
P5-P3  0.12860477 -0.0307899176 0.2879994 0.1802596
P6-P3  0.24193302  0.0825383414 0.4013277 0.0005290
P5-P4  0.04555092 -0.1138437653 0.2049456 0.9576644
P6-P4  0.15887918 -0.0005155063 0.3182739 0.0512043
P6-P5  0.11332826 -0.0460664243 0.2727229 0.3024662

> cld <- multcompLetters4(anova, tukey)
> print(cld)
$Period
   P6    P5    P4    P3    P2    P1
  "a"  "ab" "abc" "bcd"  "cd"   "d"
```

Output — **Annual average rainfall**

	$Period diff lwr upr p adj P2-P1 -0.0029800499 -0.03614298 0.03018288 0.9998106 P3-P1 -0.0098483539 -0.04301129 0.02331458 0.9503189 P4-P1 0.0077133848 -0.02544955 0.04087632 0.9826467 P5-P1 -0.0070448960 -0.04020783 0.02611804 0.9884573 P6-P1 -0.0024765074 -0.03563944 0.03068643 0.9999239 P3-P2 -0.0068683040 -0.04003124 0.02629463 0.9897167 P4-P2 0.0106934347 -0.02246950 0.04385637 0.9305740 P5-P2 -0.0040648461 -0.03722778 0.02909809 0.9991377 P6-P2 0.0005035425 -0.03265939 0.03366648 1.0000000 P4-P3 0.0175617387 -0.01560120 0.05072467 0.6248295 P5-P3 0.0028034579 -0.03035948 0.03596639 0.9998598 P6-P3 0.0073718465 -0.02579109 0.04053478 0.9858307 P5-P4 -0.0147582808 -0.04792121 0.01840465 0.7756286 P6-P4 -0.0101898922 -0.04335283 0.02297304 0.9428542 P6-P5 0.0045683886 -0.02859455 0.03773132 0.9984854
Output	**Total natural disaster events/year** $Period diff lwr upr p adj P2-P1 0.0301030 -0.20856683 0.2687728 0.9990097 P3-P1 0.4617755 0.22310566 0.7004453 0.0000070 P4-P1 0.6207581 0.38208822 0.8594279 0.0000000 P5-P1 0.7270162 0.48834642 0.9656861 0.0000000 P6-P1 0.7585361 0.51986631 0.9972060 0.0000000 P3-P2 0.4316725 0.19300266 0.6703423 0.0000269 P4-P2 0.5906551 0.35198522 0.8293249 0.0000000 P5-P2 0.6969133 0.45824342 0.9355831 0.0000000 P6-P2 0.7284331 0.48976331 0.9671030 0.0000000 P4-P3 0.1589826 -0.07968728 0.3976524 0.3737608 P5-P3 0.2652408 0.02657092 0.5039106 0.0211307 P6-P3 0.2967606 0.05809081 0.5354305 0.0069225 P5-P4 0.1062582 -0.13241164 0.3449280 0.7753246 P6-P4 0.1377781 -0.10089174 0.3764479 0.5342352 P6-P5 0.0315199 -0.20714994 0.2701897 0.9987636 > cld <- multcompLetters4(anova, tukey) > print(cld) $Period P6 P5 P4 P3 P2 P1 "a" "a" "ab" "b" "c" "c"
Output	**Average flood events/year** $Period diff lwr upr p adj P2-P1 -0.03010300 -0.28113446 0.2209285 0.9992245 P3-P1 0.13802112 -0.11301033 0.3890526 0.5864173 P4-P1 0.31583625 0.06480479 0.5668677 0.0060768 P5-P1 0.54136350 0.29033204 0.7923950 0.0000006 P6-P1 0.50034605 0.24931459 0.7513775 0.0000037 P3-P2 0.16812412 -0.08290734 0.4191556 0.3677219 P4-P2 0.34593925 0.09490779 0.5969707 0.0020332 P5-P2 0.57146650 0.32043504 0.8224980 0.0000002 P6-P2 0.53044905 0.27941759 0.7814805 0.0000010 P4-P3 0.17781512 -0.07321633 0.4288466 0.3064478 P5-P3 0.40334238 0.15231092 0.6543738 0.0002175 P6-P3 0.36232493 0.11129347 0.6133564 0.0010933 P5-P4 0.22552725 -0.02550421 0.4765587 0.1018320 P6-P4 0.18450980 -0.06652166 0.4355413 0.2678599 P6-P5 -0.04101745 -0.29204891 0.2100140 0.9965840 > cld <- multcompLetters4(anova, tukey) > print(cld) $Period P5 P6 P4 P3 P1 P2 "a" "a" "ab" "bc" "c" "c"

Output	**Average storm events/year**
	`$Period`
	`diff lwr upr p adj`
	`P2-P1 0.06020600 -0.18287831 0.3032903 0.9770926`
	`P3-P1 0.41126050 0.16817620 0.6543448 0.0000911`
	`P4-P1 0.40103000 0.15794569 0.6441143 0.0001404`
	`P5-P1 0.46635125 0.22326694 0.7094356 0.0000084`
	`P6-P1 0.58750613 0.34442182 0.8305904 0.0000000`
	`P3-P2 0.35105450 0.10797020 0.5941388 0.0010847`
	`P4-P2 0.34082400 0.09773969 0.5839083 0.0016213`
	`P5-P2 0.40614525 0.16306094 0.6492296 0.0001131`
	`P6-P2 0.52730013 0.28421582 0.7703844 0.0000005`
	`P4-P3 -0.01023050 -0.25331481 0.2328538 0.9999956`
	`P5-P3 0.05509075 -0.18799356 0.2981751 0.9845458`
	`P6-P3 0.17624563 -0.06683868 0.4193299 0.2819075`
	`P5-P4 0.06532125 -0.17776305 0.3084056 0.9673831`
	`P6-P4 0.18647613 -0.05660817 0.4295604 0.2257171`
	`P6-P5 0.12115488 -0.12192943 0.3642392 0.6828245`
	
	`> cld <- multcompLetters4(anova, tukey)`
	`> print(cld)`
	`$Period`
	`P6 P5 P3 P4 P2 P1`
	`"a" "a" "a" "a" "b" "b"`
	Note: this analysis excludes data on 07 abnormal storm events (Severe weather, Hail, Lightning)

Output	**Average drought events/year**
	`$Period`
	`diff lwr upr p adj`
	`P2-P1 8.465451e-17 -0.12693759 0.12693759 1.0000000`
	`P3-P1 3.010300e-02 -0.09683459 0.15704059 0.9810843`
	`P4-P1 9.030900e-02 -0.03662859 0.21724659 0.3017901`
	`P5-P1 3.010300e-02 -0.09683459 0.15704059 0.9810843`
	`P6-P1 6.020600e-02 -0.06673159 0.18714359 0.7260531`
	`P3-P2 3.010300e-02 -0.09683459 0.15704059 0.9810843`
	`P4-P2 9.030900e-02 -0.03662859 0.21724659 0.3017901`
	`P5-P2 3.010300e-02 -0.09683459 0.15704059 0.9810843`
	`P6-P2 6.020600e-02 -0.06673159 0.18714359 0.7260531`
	`P4-P3 6.020600e-02 -0.06673159 0.18714359 0.7260531`
	`P5-P3 -2.775558e-17 -0.12693759 0.12693759 1.0000000`
	`P6-P3 3.010300e-02 -0.09683459 0.15704059 0.9810843`
	`P5-P4 -6.020600e-02 -0.18714359 0.06673159 0.7260531`
	`P6-P4 -3.010300e-02 -0.15704059 0.09683459 0.9810843`
	`P6-P5 3.010300e-02 -0.09683459 0.15704059 0.9810843`

Table S5. The number of estimated disaster events in major social & economic areas of Vietnam from 1963–2022

Disaster Subtype	Major social-economic areas						
	North Mountain & Midlands	**Red River Delta**	**North Central Coast**	**South Central Coast**	**Central Highlands**	**South East**	**Mekong Delta**
Coastal flood	0	0	4	2	0	1	0
Flash flood	9	0	6	5	4	2	0
Riverine flood	13	3	21	20	10	5	15
General Flood	10	4	13	11	6	1	3
Total flood	**32**	**7**	**44**	**38**	**20**	**9**	**18**
Storm	3	2	3	5	1	0	3
Tropical cyclone	22	20	59	36	8	5	4
Total storm	**25**	**22**	**62**	**41**	**9**	**5**	**7**
Drought	2	0	3	1	2	3	2
Others natural	7	2	3	1	0	0	3
Total climate hazards	**66**	**31**	**112**	**81**	**31**	**17**	**30**

Table S6. Estimated damages caused by storms and floods from 1963-2022 in Vietnam

Type of disaster	**Periods (1963–2022)**					
	1963–1972	**1973–1982**	**1983–1992**	**1993–2002**	**2003–2012**	**2013–2022**
Storm						
Death (people)	7,112	478	3,791	5,187	1,332	765
Injured (people)	0	674	5,573	1,951	3,445	965
Homeless (people)	0	664,500	2,421,475	473,700	805,665	7,715
Total affected (people)	750,000	17,103,174	14,519,867	4,563,286	8,363,047	11,000,078
Total damage (×1000 US$)	471,770	0	110,515	2,632,095	4,482,142	8,258,798
Flood						
Death (people)	668	168	624	2,665	1,360	584
Injured (people)	0	0	224	710	517	216
Homeless (people)	70,361	79,000	8,179	145,025	51,585	8250
Total affected (people)	399,902	4,707,000	3,253,512	15,053,060	5,798,987	4,287,306
Total damage (×1000 US$)	90,163	0	201,462	2,176,791	3,254,328	802,918

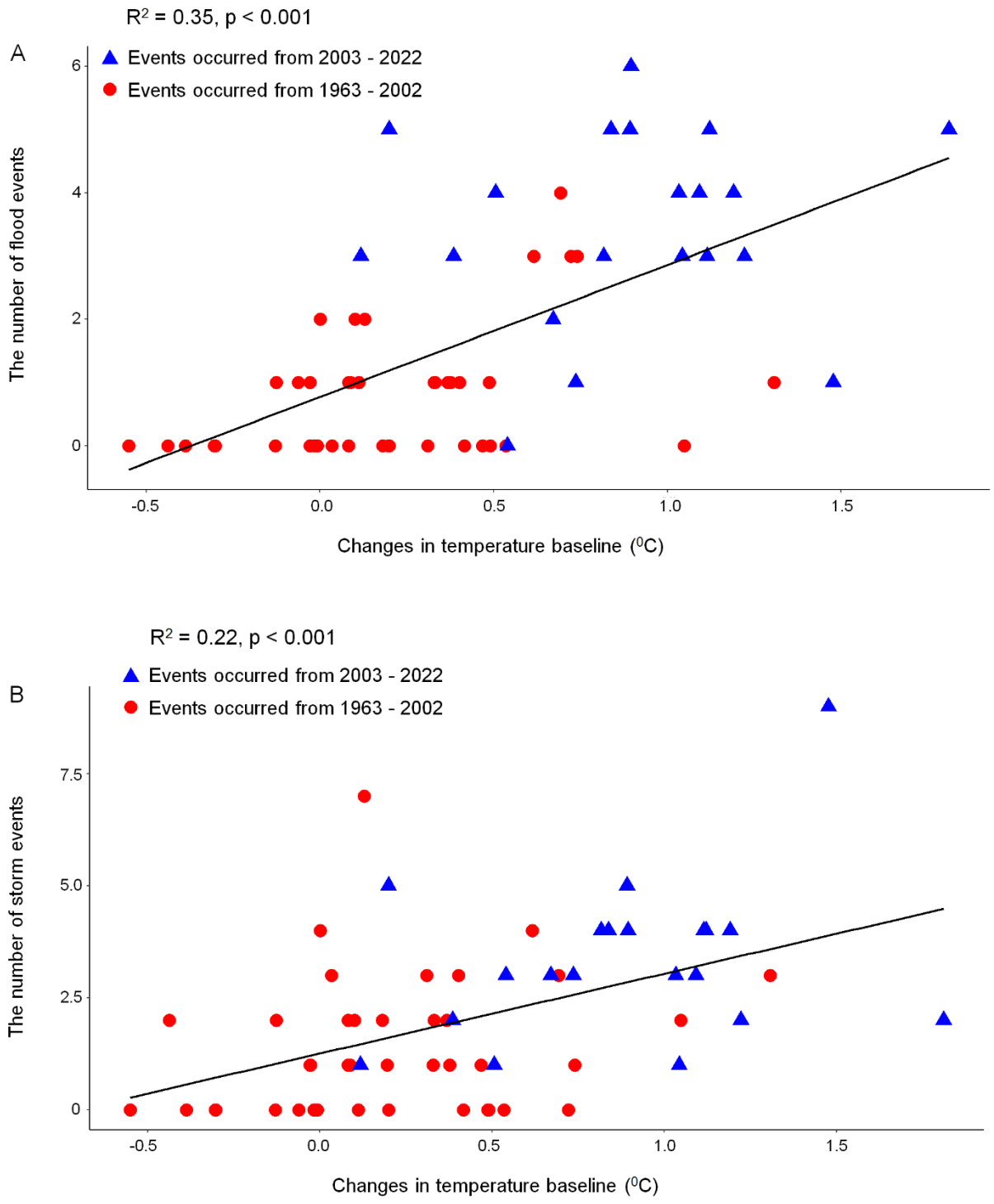

Fig. S1. The correlation between temperature baseline and floods, storms

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