Extreme Weather Events and Public Attention and Awareness of Climate Change in China

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overview

Research question: whether/how climate change related extreme weather events (e.g., floods, storms, and droughts) affect public perception of climate change severity and public knowledge and attention to climate change in China?

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- Individual level analysis: Emergency Events Database (EM-DAT) extreme weather events data + a nationally representative survey (CGSS 2010: p*erception of climate severity*; *climate change knowledge*).
- Prefecture-day level analysis: self-collected extreme weather events data + climate change related Baidu search volume index (SVI) (*public attention to climate change*).

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Main findings:

- Individual level analysis: no association.
- Prefecture-day level analysis: no association.

Thanks!

Great written comments from Viktoria Jansesberger and Vally Koubi!

the link

Climate change related natural disasters $\Rightarrow$

- public attention?
- public perception/concern?
- policy preferences?

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Empirical approaches:

- US or European countries when conducting within-country studies: using surveys from one country.
- large scale cross-country surveys often combining a mixture of developed and developing countries.

our contributions

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A weakened relationship in developing countries?

- experiential learning: personal and vicarious experiences can make abstract climate change risks more concrete.
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- often a function of education (e.g., by NGOs and the government) and media exposure to climate change.
- $\Rightarrow$ not enough education/media exposure in developing countries?

the case selection of China

Maybe a bad choice?

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Dai et al. (2015) vs. this paper:

- about 1,000 adults from five economically developed cities vs. a nationally representative sample + Baidu SVI at the prefecture-day level.
- extreme weather events strongly correlated with climate change beliefs vs. no such association.

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Data challenge: systematic government data on extreme weather events/natural disasters in China is not publicly available.

Complementary strategies

$$CC_{i,p,2000} = \alpha + \beta_1 Disaster_p + \beta_2 X_{i,p,2000} + \beta_3 Z_{p,2000} + \epsilon_{p,2000} \quad (1)$$

- $CC_{i,p,2000}$: answers to questions from the Chinese General Social Survey (CGSS), 2010.
- $Disaster_p$: EM-DAT geo-coded *global* extreme weather events coded at the province level.
- $X_{i,p,2000}/Z_{p,2000}$: individual/provincial control variables.

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$$BaiduSVI_{c,t} = \alpha + \beta_1 Disaster_{c,t} + \beta_2 Covid_{c,t} + \beta_3 T_{c,t} + \beta_4 P_{c,t} + \theta_c + \pi_t + \epsilon_{c,t} \quad (2)$$

- $BaiduSVI_{c,t}$: city/prefecture-day Baidu SVI for climate change keywords.
- $Covid_{c,t}/T_{c,t}/P_{c,t}$: daily Covid-19 cumulative cases and death/daily average temperature/total rainfall.
- θ_c/π_t: city fixed effects/day fixed effects.
- $Disaster_{c,t}$: we collected data from official newspapers of the provincial and prefectural party committees $\Rightarrow$ only 5 provinces included.

not a representative sample

individual level: perception of climate change severity

Table 1: Testing the effects of extreme weather events on the perception of climate change severity.

	Dependent variable: Perception of Climate Change Severity								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All disasters $_{2009}$	−0.009								
	(0.017)								
All disasters $_{2000\text{-}09}$		−0.002							
		(0.003)							
$\Delta All\ disasters_{\overline{2000-08},\ 2009}$			0.008						
			(0.020)						
$Flood_{2009}$				−0.035					
				(0.028)					
$Flood_{2000\text{-}09}$					−0.010*				
					(0.006)				
$\Delta Flood_{\overline{2000-08},\ 2009}$						−0.009			
						(0.031)			
$Storm_{2009}$							−0.020		
							(0.025)		
$Storm_{2000\text{-}09}$								−0.001	
								(0.005)	
$\Delta Storm_{\overline{2000-08},\ 2009}$									−0.020
									(0.029)
Observations	3,086	3,086	3,086	3,086	3,086	3,086	3,086	3,086	3,086
Adjusted R^2	0.124	0.125	0.124	0.125	0.127	0.124	0.124	0.124	0.124

Note: individual-level control variables (Gender, Age, Married, Minority member, Urban hukou, CCP member, Religious, Income (logged), Middle school, High school, and College and above) and province-level control variables (Pop. density, SO2 per cap, Electricity per cap, GDP per cap) are included in all models. Standard errors clustered at the province level. Estimated by OLS. * p<0.1; ** p<0.05; *** p<0.01.

individual level: whether fossil fuel use causes climate change

Table 2: Testing the effects of extreme weather events on climate change knowledge – whther climate affected by fossil fuel use.

	Dependent variable: Climate affected by fossil fuel use								
					fuelf				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All disasters $_{2009}$	−0.008								
	(0.015)								
All disasters $_{2000\text{-}09}$		−0.002							
		(0.002)							
$\Delta All\ disasters_{\overline{2000-08},\ 2009}$			0.009						
			(0.021)						
$Flood_{2009}$				−0.016					
				(0.018)					
$Flood_{2000\text{-}09}$					−0.003				
					(0.003)				
$\Delta Flood_{\overline{2000-08},\ 2009}$						−0.012			
						(0.025)			
$Storm_{2009}$							0.023		
							(0.018)		
$Storm_{2000\text{-}09}$								−0.002	
								(0.004)	
$\Delta Storm_{\overline{2000-08},\ 2009}$									0.035**
									(0.015)
Observations	3,093	3,093	3,093	3,093	3,093	3,093	3,093	3,093	3,093
Adjusted R^2	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.062

Note: individual-level control variables (Gender, Age, Married, Minority member, Urban hukou, CCP member, Religious, Income (logged), Middle school, High school, and College and above) and province-level control variables (Pop. density, SO2 per cap, Electricity per cap, GDP per cap) are included in all models. Standard errors clustered at the province level. Estimated by OLS. * p<0.1; ** p<0.05; *** p<0.01.

individual level: whether CO2 causes global warming

Table 3: Testing the effects of extreme weather events on climate change knowledge – whether CO2 increase will cause global warming.

	Dependent variable: CO2 increase will cause global warming								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All disasters $_{2009}$	0.007								
	(0.011)								
All disasters $_{2000\text{-}09}$		0.001							
		(0.002)							
$\Delta All\ disasters_{\overline{2000-08},\ 2009}$			0.001						
			(0.013)						
$Flood_{2009}$				−0.005					
				(0.011)					
$Flood_{2000\text{-}09}$					−0.001				
					(0.003)				
$\Delta Flood_{\overline{2000-08},\ 2009}$						−0.005			
						(0.015)			
$Storm_{2009}$							0.015		
							(0.012)		
$Storm_{2000\text{-}09}$								0.004*	
								(0.002)	
$\Delta Storm_{\overline{2000-08},\ 2009}$									0.002
									(0.014)
Observations	3,105	3,105	3,105	3,105	3,105	3,105	3,105	3,105	3,105
Adjusted R^2	0.164	0.165	0.164	0.164	0.164	0.164	0.165	0.167	0.164

Note: individual-level control variables (Gender, Age, Married, Minority member, Urban hukou, CCP member, Religious, Income (logged), Middle school, High school, and College and above) and province-level control variables (Pop. density, SO2 per cap, Electricity per cap, GDP per cap) are included in all models. Standard errors clustered at the province level. Estimated by OLS. *p<0.1; **p<0.05; ***p<0.01.

Baidu SVI: climate change keywords

Table 5: Testing the effects of natural disasters on Baidu SVI regarding climate change key words.

	Dependent variable: Baidu SVI															
	"climate change"				"global warming"				"climate"				"global climate change"			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
All disasters $_t$	−0.172				−0.614*				0.219				−0.187*			
	(0.120)				(0.316)				(0.146)				(0.102)			
All disasters $_{t-1}$		−0.197				−0.939***				0.069				−0.099		
		(0.131)				(0.291)				(0.176)				(0.086)		
All disasters $_{t-2}$			−0.191				−0.943***				−0.120				−0.121	
			(0.138)				(0.272)				(0.201)				(0.092)	
All disasters $_{t-3}$				−0.065				−0.990***				−0.204				−0.028
				(0.161)				(0.272)				(0.180)				(0.106)
Total confirmed Covid	0.055***	0.055***	0.055***	0.055***	0.044***	0.044***	0.044***	0.044***	0.017	0.017	0.017	0.017	0.026***	0.026***	0.026***	0.026***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.018)	(0.018)	(0.018)	(0.018)	(0.005)	(0.005)	(0.005)	(0.005)
Total Covid death	3.182	3.179	3.180	3.194	1.049	1.013	1.016	1.015	−2.598	−2.614	−2.634	−2.642	1.027	1.036	1.034	1.044
	(2.010)	(2.011)	(2.012)	(2.012)	(1.811)	(1.812)	(1.811)	(1.810)	(2.701)	(2.704)	(2.706)	(2.708)	(0.732)	(0.728)	(0.730)	(0.729)
Mean daily temperature	−0.108	−0.109	−0.110	−0.113	−0.158	−0.153	−0.158	−0.153	−0.462**	−0.455**	−0.450**	−0.447**	0.072	0.068	0.068	0.066
	(0.096)	(0.097)	(0.097)	(0.098)	(0.157)	(0.155)	(0.156)	(0.156)	(0.194)	(0.194)	(0.194)	(0.193)	(0.071)	(0.072)	(0.072)	(0.071)
Daily precipitation	0.006	0.005	0.003	0.002	0.009	0.011	0.002	−0.0002	−0.022	−0.017	−0.015	−0.015	0.008	0.005	0.005	0.004
	(0.013)	(0.013)	(0.014)	(0.014)	(0.023)	(0.022)	(0.023)	(0.023)	(0.020)	(0.020)	(0.020)	(0.020)	(0.012)	(0.012)	(0.012)	(0.012)
Observations	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575
Adjusted R^2	0.333	0.333	0.333	0.333	0.608	0.608	0.608	0.608	0.536	0.536	0.536	0.536	0.130	0.130	0.130	0.130

Note: OLS estimates with fixed prefecture and fixed day effects and cluster standard errors at the prefecture level. *p<0.1; **p<0.05; ***p<0.01.

Baidu SVI: climate change keywords

Table 7: Testing the effects of natural disaster types on Baidu SVI regarding climate change key words.

	Dependent variable: Baidu SVI											
	"climate change"			"global warming"			"climate"			"global climate change"		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Flood $_t$	−0.053			−0.859*			0.260			−0.169		
	(0.135)			(0.451)			(0.203)			(0.168)		
Heavy rain $_t$		−0.491			−1.293			0.039			−0.629***	
		(0.393)			(1.065)			(0.461)			(0.217)	
Storm $_t$			−0.845**			−0.257			1.144**			−0.425
			(0.359)			(0.320)			(0.467)			(0.312)
Total confirmed Covid	0.055***	0.055***	0.055***	0.044***	0.043***	0.043***	0.017	0.017	0.017	0.026***	0.026***	0.026***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.018)	(0.018)	(0.018)	(0.005)	(0.005)	(0.005)
Total Covid death	3.196	3.187	3.205	1.037	1.079	1.116	−2.597	−2.620	−2.627	1.031	1.029	1.049
	(2.009)	(2.010)	(2.004)	(1.818)	(1.817)	(1.815)	(2.694)	(2.707)	(2.717)	(0.734)	(0.732)	(0.725)
Mean daily temperature	−0.113	−0.110	−0.113	−0.160	−0.170	−0.181	−0.460**	−0.454**	−0.456**	0.070	0.071	0.066
	(0.097)	(0.096)	(0.096)	(0.157)	(0.158)	(0.158)	(0.195)	(0.193)	(0.195)	(0.071)	(0.072)	(0.071)
Daily precipitation	0.002	0.005	0.004	0.007	0.003	−0.005	−0.020	−0.017	−0.019	0.006	0.008	0.005
	(0.013)	(0.013)	(0.014)	(0.023)	(0.023)	(0.023)	(0.020)	(0.021)	(0.020)	(0.012)	(0.012)	(0.012)
Observations	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575	17,575
Adjusted R^2	0.333	0.333	0.333	0.608	0.608	0.608	0.536	0.536	0.536	0.130	0.130	0.130

Note: OLS estimates with fixed prefecture and fixed day effects and cluster standard errors at the prefecture level. * p<0.1; ** p<0.05; *** p<0.01.

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Why null result?

- lack of media coverage?
- too much media coverage on air and water pollution?

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- EM-DAT data (province level) and our newspaper-based data (prefecture level) too coarse.

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- EM-DAT data (province level) and our newspaper-based data (prefecture level) too coarse.
- personally experiencing an extreme weather event vs. hearing about an event from the news.
- 2020 not a good year: attention fixating on Covid-19 and simply not paying attention to other potentially salient issues regardless of whether one personally experienced a natural disaster or not.

CGSS: flood and environmental values

Table 4: Testing the effect of extreme weather events on respones to environment related questions.

	whether environmental problems in China are severe	pay attention to envitonmental issues	pay higher price to protect the environment	pay more tax to protect the environment	lower living standard to protect the environment
All disasters $_{2009}$	-0.012 (0.013)	0.041 (0.027)	0.023 (0.031)	0.004 (0.003)	0.030 (0.034)
All disasters $_{2000\text{-}09}$	-0.002 (0.002)	0.006 (0.003)**	0.007 (0.003)**	-0.006 (0.033)	0.008 (0.003)**
$\Delta All\ disasters_{\overline{2000-08},\ 2009}$	-0.005 (0.017)	0.015 (0.037)	-0.025 (0.047)	-0.050 (0.043)	-0.026 (0.049)
$Flood_{2009}$	0.003 (0.025)	0.082 (0.036)**	0.087 (0.040)**	0.065 (0.043)[a]	0.116 (0.046)**
$Flood_{2000\text{-}09}$	-0.002 (0.004)	0.019 (0.006)***	0.019 (0.009)**	0.016 (0.009)*	0.022 (0.010)**
$\Delta Flood_{\overline{2000-08},\ 2009}$	0.017 (0.033)	0.053 (0.051)	0.064 (0.051)	0.038 (0.055)	0.101 (0.060)*
$Storm_{2009}$	-0.016 (0.014)	0.007 (0.040)	-0.012 (0.040)	-0.033 (0.039)	-0.033 (0.048)
$Storm_{2000\text{-}09}$	-0.004 (0.004)	0.002 (0.007)	0.006 (0.006)	0.002 (0.006)	0.007 (0.007)
$\Delta Storm_{\overline{2000-08},\ 2009}$	-0.003 (0.015)	-0.001 (0.037)	-0.038 (0.037)	-0.048 (0.036)	-0.066 (0.035)*

Note: the coefficient estimates of natural disater variables from 45 regressions are summarized in this table: individual-level control variables (Gender, Age, Married, Minority member, Urban hukou, CCP member, Religious, Income (logged), Middle school, High school, and College and above) and province-level control variables (Pop. density, SO2 per cap, Electricity per cap, GDP per cap) are included in all models. Standard errors clustered at the province level. Estimated by OLS. * p<0.1; ** p<0.05; *** p<0.01. a: p-value is 0.132.

individual level results

	climate change severity	CO2 causing climate change	burning fuel causing climate change
$\text{all disaster}_{2009}$			
$\text{all disaster}_{2000-2009}$			
$\Delta\text{all disater}_{\overline{2000-08},2009}$			
flood_{2009}			
$\text{flood}_{2000-2009}$	$-$		
$\Delta\text{flood}_{\overline{2000-08},2009}$			
storm_{2009}			
$\text{storm}_{2000-2009}$		$+$	
$\Delta\text{storm}_{\overline{2000-08},2009}$			$+$

individual level results

	climate change severity	CO2 causing climate change	burning fuel causing climate change
$\text{all disaster}_{2009}$			
$\text{all disaster}_{2000-2009}$			
$\Delta\text{all disater}_{\overline{2000-08},2009}$			
flood_{2009}			
$\text{flood}_{2000-2009}$	$-$		
$\Delta\text{flood}_{\overline{2000-08},2009}$			
storm_{2009}			
$\text{storm}_{2000-2009}$		$+$	
$\Delta\text{storm}_{\overline{2000-08},2009}$			$+$

younger, single, urban, more educated, living in provinces with lower population density and more electricity production $\Rightarrow$ better climate change knowledge and more likely to perceive climate change to be damaging.

individual level results: a placebo test

	attention to env. issues	env. problems severity	higher price to protect env.	more tax to protect env.	lower living std. to protect env.
all disaster$_{2009}$					
all disaster$_{2000-2009}$	+		+		+
Δ all disater$_{\overline{2000-08},2009}$					
flood$_{2009}$	+		+		+
flood$_{2000-2009}$	+		+	+	+
Δ flood$_{\overline{2000-08},2009}$					+
storm$_{2009}$					
storm$_{2000-2009}$					
Δ storm$_{\overline{2000-08},2009}$					−