Journal of Peace Research

Response to Hsiang, Burke & Miguel: Correcting an error, drawing incorrect conclusions

Ole Magnus Theisen, *Department of Sociology and Political Science, Norwegian University of Science and Technology (NTNU)*

26 September 2014

Abstract

Hsiang, Burke and Miguel revisit my article in the 2012 JPR special issue on 'Climate change and conflict', which assesses the possible influence on weather variability and land pressure on organized violence in Kenya, 1989–2004. They correctly point out a coding error of the squared terms used in that article. Contrary to their claim, however, the main result from my original study holds. In this reply I show that neither contemporaneous temperature nor precipitation are significantly related to the risk of violence once last year's climate is accounted for. HBM's claim of a robust effect of current temperature on violence therefore does not hold. Instead, this revisit verifies that more precipitation at t-1 is associated with more violence.

Introduction

Whether or not weather-related phenomena increase the risk of organized violence is a controversial research topic. Previous review studies (Böhmelt, Bernauer & Koubi, 2012; Deligiannis, 2012; Gleditsch, 2012; Kallis & Zografos, 2013; Klomp & Bulte, 2013; Meierding, 2013; Raleigh, O'Loughlin & Linke, 2014; Scheffran et al., 2012; Theisen, Gleditsch & Buhaug, 2013) all find weak or non-consistent links between short-term variations in climate variables and violent conflict. A recent study by Hsiang, Burke & Miguel (2013) (hereafter HBM), on the other hand, claims that there is a consensus on a strong link between climate factors and violent conflict in the extant literature. In line with this, they claim to find a robust and statistically significant link between contemporaneous temperature and conflict in the data used in Theisen (2012). This is contrary to the conclusions of the original study.

HBM correctly point to a coding error of the squared terms in Theisen (2012). However, updating the squared terms does not alter the conclusion in the original study as well as in the literature at large: higher temperatures are not robustly significantly linked to violence. My original conclusion stands: if the previous year was wet, the risk of violence is higher.

Corresponding authors:
ole.magnus.theisen@svt.ntnu.no

HBM's argument for a robust effect of current year's temperature increasing the risk of violence fails for three reasons:

1. The effect of temperature in the current year is not significant even with a 10 percent level of uncertainty for any of the two dependent variables when current and previous years precipitation is added to the models, in accordance with HBM's earlier work (Burke et al., 2009).
2. The sign and magnitude of the temperature effect are highly sensitive to time controls. In one specification, the effect is negative and highly significant, diametrically opposite to HBM's claimed association.
3. HBM (2014) ignore the main finding of Theisen (2012): a wet year significantly increases the risk of both the onset and incidence of violence in the next year.

HBM (2014) show that the current year's temperature displays a U-shaped relationship to violence in Theisen (2012) study when adjusting for a coding error in the squared terms (Figure 1 in HBM, 2014). They then remove the squared term from the model, leaving a linear and positive effect of temperature on violence. Unlike the contested study by Burke et al. (2009) (see Buhaug, 2010; Raleigh, Linke & O'Loughlin, 2014; Sutton et al. 2010), HBM (2014) only adds information on precipitation in the current year. Had they been consistent with Burke et al. (2009) and included information for temperature and precipitation last year, the effect of temperature at the current year for both dependent variables would have become insignificant (see Table 1, Models 1 and 3). This is the case even if we follow HBM (2014) in applying the unconventional 10 percent level of significance.[1] This significance level is problematic given the large number of observations (N=13,520), which makes it fairly easy to obtain statistically significant results.[2]

HBM (2014) ignore the robust findings from Theisen (2012): more precipitation last year robustly and significantly increases the risk of the onset as well as the incidence of conflict (Table I). Moreover, in a linear specification higher temperature last year significantly and robustly decreases the risk of the incidence of violence, contrary to what HBM claims for the effect of current year.[3] Thus, by not including precipitation and temperature at t-1 HBM (2014) ignore these two findings.[4]

---

[1] In Theisen (2012) these are – for good reasons – called conflict ('onset') and event ('incidence'). For readability I stick to the labels used in HBM (2013b).

[2] HBM acknowledge that the effect of temperature is not always significant at the 5 percent level. Personal communication with Marshall Burke and Solomon Hsiang 16–21 November 2013.

[3] Again HBM (2014) err in claiming that my conclusion is that 'temperature is unrelated to conflict'. On the contrary, I am quite clear on that for incidence temperature at t-1 affects the risk.

[4] The analyses in Theisen (2012) were run with a difference within difference model which arguably is the preferred choice of model in this regard (Angrist & Pitschke, 2009). However, if year dummies are replaced with a linear time-trend and dummies for election years (to account for election-related upheavals), the effect of current year's temperature changes sign for both dependent variables (see Table I, Models 2 and 4). This time it is negatively and significantly related to one of the two dependent variables (incidence). This negative effect of temperature in one specification does not mean that current year's temperature decreases the risk of violence. The model with year dummies still is the preferred option, but the non-robustness of the temperature "effect" is illustrated.

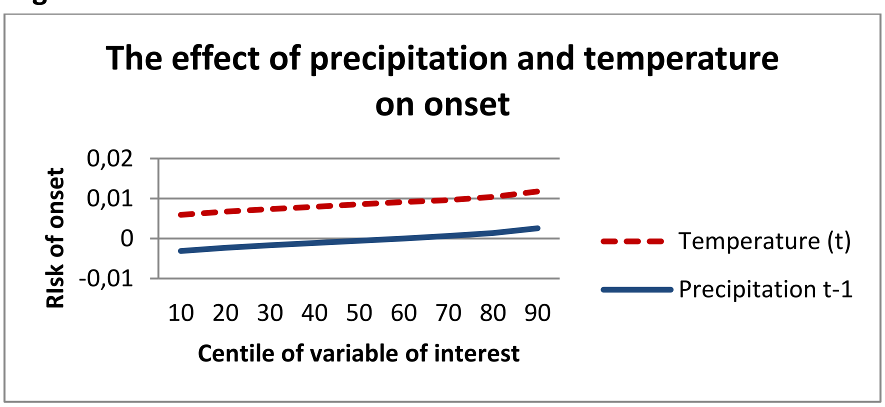
Table I. Climate and violence, in Kenya, 1989–2004, linear models

Variables	(1) Onset	(2) Onset	(3) Incidence	(4) Incidence
Precipitation	-0.000	-0.000	0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Precipitation	0.002***	0.001**	0.008***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Temperature	0.002	-0.001	0.004	-0.006***
	(0.002)	(0.001)	(0.003)	(0.002)
Temperature	0.000	-0.000	-0.007**	-0.003**
	(0.001)	(0.001)	(0.003)	(0.001)
Election		0.004**		0.016***
		(0.002)		(0.003)
Constant	0.009	0.001	0.022***	-0.004
	(0.006)	(0.003)	(0.010)	(0.005)
Year dummies	Yes	No	Yes	No
Trend	No	Yes	No	Yes
Observations	13,520	13,520	13,520	13,520
R-squared	0.004	0.002	0.016	0.008
# units	845	845	845	845

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, † p<0.1. Controls include: share of cells in 1st to 3rd order of proximity with conflict incidence the previous year; time since event in cell. See Appendix for full models.

Figures 1 and 2 display the predicted risk of conflict when moving from the 10th to the 90th percentile for current year's temperature (red dotted line) and for last year's precipitation (solid blue line) for Model 1 (Figure 1) and Model 3 (Figure 2), with all other variables kept at their mean. Figure 1 demonstrates that the effects of temperature and precipitation are of comparable size in increasing the risk of conflict onset. But as shown in Model 1, only the precipitation effect is significant.

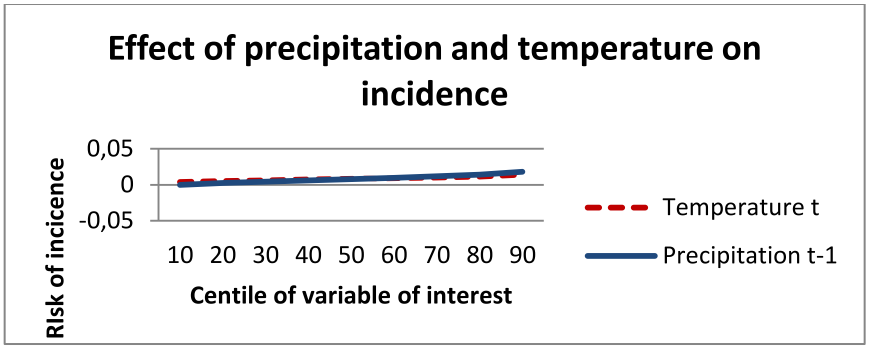
Figure 1. Estimated risk of conflict onset



The graph shows the effect of moving from the 10th to the 90th percentile on the temperature (current year) and precipitation (previous year) variables when all other variables are kept at their mean. Predictions are based on Model 1 in Table I.

Figure 2 shows that the effect of last year's precipitation is approximately twice that of the statistically insignificant effect of current year's temperature. Figures 1 and 2 also show that the effects of the climate variables are quite modest, regardless of whether they are significant or not.

Figure 2. Estimated risk of conflict incidence



The graph shows the effect of moving from the 10th to the 90th percentile on the temperature (current year) and precipitation (previous year) variables when all other variables are kept at their mean. Predictions are based on Model 3 in Table I

HMB (2014:4) conclude that 'temperature has a significant and robust effect on both local conflict onset and local conflict incidence in Kenya.' This simply is not true. When the model is specified in the same way as in the earlier work of two of the authors (Burke et al. 2009), by using climate variables for current as well as the previous year, the temperature effect turns insignificant. Moreover, this also means that the effect of temperature in Theisen (2012) is not consistent with the finding of Burke et al. (2009). Or is it? The effect of temperature found in Burke et al. (2009) is itself demonstrably not robust to a number of modeling changes, most notably an extension of the period under study (Buhaug, Hegre & Strand, 2010). This is also something HBM recognize (Burke et al. 2010). A more sober claim seems appropriate: A non-robust effect of temperature in Theisen (2012) can be reconciled with a non-robust effect of temperature in Burke et al. (2009) as demonstrated by Buhaug, Hegre & Strand (2010). This would be more in line with the conclusion of recent reviews on this topic (Böhmelt, Bernauer & Koubi, 2012; Meierding, 2013; Scheffran et al., 2012; Theisen, Gleditsch & Buhaug, 2013).

References

Angrist, Joshua D & Jörn-Steffen Pischke (2009) *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton, NJ: Princeton University Press.

Bernauer, Thomas, Tobias Böhmelt& Vally Koubi (2012) Environmental changes and violent conflict. *Environmental Research Letters* 7(1):1–8.

Buhaug, Halvard; Håvard Hegre & Håvard Strand (2010) Sensitivity analysis of climate variability and civil war. PRIO Paper, last accessed at http://file.prio.no/Publication_files/Prio/Sensitivity%20Analysis%20of%20Climate%20Variability%20and%20Civil%20War%20(PRIO%20Paper%202010%20v1).pdf 6 January 2012.

Burke, Marshall B; Edward Miguel, Shanker Satyanath, John A Dykema & David B Lobell

(2009) Warming increases the risk of civil war in Africa. *PNAS* 106(49): 20670–20674.

Burke, Marshall B; Edward Miguel, Shanker Satyanath, John A Dykema & David B Lobell (2010) Climate robustly linked to African civil war. *PNAS* 107(51): E185.

Deligiannis, Tom (2012) The evolution of environment-conflict research: Toward a livelihood framework. *Global Environmental Politics* 12(1): 78–100.

Gleditsch, Nils Petter (2012) Whither the weather? Climate change and conflict. *Journal of Peace Research* 49(1):3–9.

Hsiang, Solomon; Marshall Burke & Edward Miguel (2013) Quantifying the influence of climate on human conflict. *Science* 341(6151). DOI: 10.1126/science.1235367.

Hsiang, Solomon; Marshall B Burke & Edward Miguel (2014) Correcting a coding error reconciles temperature-conflict results in Kenya. Online comment to *Journal of Peace Research*. URL

Kallis, Giorgos & Christos Zografos (2014) Hydro-climatic change, conflict and security. *Climatic Change*. 123(1):69–82.

Klomp, Jeroen & Erwin Bulte (2013) Climate change, weather shocks, and violent conflict: a critical look at the evidence. *Agricultural Economics* 44(s1):63–78.

Meierding, Emily (2013) Climate change and conflict: Avoiding small talk about the weather. *International Studies Review* 15(2):185–203.

Raleigh, Clionadh, Andrew Linke & John O'Loughlin (2014). Extreme temperatures and violence. *Nature Climate Change* 4(2):76–77.

Scheffran, Jürgen; Michael Brzoska, Jasmin Kominek, Michael P Link & Janpeter Schilling (2012) Climate change and violent conflict. *Science* 336(6083): 869–871.

Sutton, A E; J Dohn, K Loyd, A Tredennick, G Bucini, A Solorzano, L Prihodko & N P Hanan (2010) Does warming increase the risk of civil war in Africa? *PNAS* 107(25): E102–E102.

Theisen, Ole Magnus (2012) Climate clashes? Weather variability, land pressure and organized violence in Kenya, 1989–2004. *Journal of Peace Research* 49(1): 81–96.

Appendix. Additional tables

Table A1. Climate and violence, linear models

Variables	(1) Onset	(2) Onset	(3) Onset	(4) Onset	(5) Onset	(6) Onset	(7) Incidence	(8) Incidence	(9) Incidence	(10) Incidence	(11) Incidence	(12) Incidence
Precipitation dev. *t*	-0.000				-0.000	-0.000	0.002				0.001	-0.000
	(0.001)				(0.001)	(0.001)	(0.001)				(0.001)	(0.001)
Precipitation dev. *t-1*		0.003***			0.002***	0.001**		0.009***			0.008***	0.004***
		(0.001)			(0.001)	(0.001)		(0.001)			(0.001)	(0.001)
Temperature dev. *t*			0.003†		0.002	-0.001			0.006**		0.004	-0.006***
			(0.002)		(0.002)	(0.001)			(0.003)		(0.003)	(0.002)
Temperature dev. *t-1*				-0.001	0.000	-0.000				-0.009***	-0.007**	-0.003**
				(0.002)	(0.001)	(0.001)				(0.003)	(0.003)	(0.001)
Election						0.004**						0.016***
						(0.002)						(0.003)
Neighboring events	0.031	0.031	0.031	0.031	0.031	0.031	0.191***	0.191***	0.192***	0.201***	0.200***	0.179***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.026)	(0.052)	(0.052)	(0.052)	(0.053)	(0.053)	(0.053)
Time since event	-0.009	-0.009	-0.009	-0.009	-0.009	-0.009	-0.034	-0.034	-0.034	-0.034	-0.034	-0.029†
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.009)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.016)
Constant	0.007	0.007	0.015†	0.007	0.013†	0.001	0.019†	0.023**	0.037***	0.027**	0.037***	-0.004
	(0.006	(0.006)	(0.008	(0.006	(0.008)	(0.003)	(0.011)	(0.011)	(0.014)	(0.011)	(0.013)	(0.005)

	)		)	)								
Year dummies	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
Trend	No	No	No	No	No	Yes	No	No	No	No	No	Yes
Observations	13,520	13,520	13,520	13,520	13,520	13,520	13,520	13,520	13,520	13,520	13,520	13,520
R-squared	0.002	0.003	0.003	0.002	0.004	0.002	0.012	0.015	0.012	0.013	0.016	0.008
# units	845	845	845	845	845	845	845	845	845	845	845	845

Robust standard errors in parentheses *** p<0.01, ** p<0.05, † p<0.1.

Table A2. Climate variables for t and t-1 in same models, original and corrected squared terms

	Model 1/5 Original Conflict	Model 1/5 Corrected Conflict	Model 7/11 Original Events	Model 7/11 Corrected Events
Prec t dev. *t*	0.001	-0.000	0.008	0.002
	(0.003)	(0.001)	(0.006)	(0.001)
Prec t sq dev. *t*	-0.000	-0.000	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
F-stat/sig.	0.29/0.7465	0.29/0.7465	1.27/0.2809	1.27/0.2809
Prec dev. *t-1*	0.004	0.003***	0.017***	0.008***
	(0.003)	(0.001)	(0.005)	(0.002)
Prec sq dev. *t-1*	-0.000	-0.000	-0.002†	-0.002†
	(0.000)	(0.000)	(0.001)	(0.001)
F-stat/sig.	4.46/0.0119***	4.46/0.0119***	15.41/0.0000***	15.41/0.0000***
Temp dev. *t*	-0.002	0.003	-0.007	0.005†
	(0.005)	(0.002)	(0.007)	(0.003)
Temp sq dev. *t*	0.001	0.001	0.003	0.003
	(0.001)	(0.001)	(0.002)	(0.002)
F-stat/sig.	1.32/0.2678	1.32/0.2678	1.95/0.1435	1.95/0.1435
Temp dev. *t-1*	-0.005	0.000	-0.026***	-0.007**
	(0.003)	(0.001)	(0.007)	(0.003)
Temp sq dev. *t-1*	0.001**	0.001**	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
F-stat/sig.	2.14/0.1184	2.14/0.1184	8.06/0.0003***	8.06/0.0003***
Constant	0.003	0.010	0.011	0.030†
	(0.016)	(0.010)	(0.026)	(0.015)
Controls as in article	Yes	Yes	Yes	Yes
Observations	13,520	13,520	13,520	13,520
R-squared	0.004	0.004	0.017	0.017
Number of et_id	845	845	845	845

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, † p<0.1

Table A3. Climate variables for t and t-1 in same models

VARIABLES	(1) conflict	(2) Conflict	(3) event_corr	(4) event_corr
SPI6 drought *t*	-0.002		-0.003	
	(0.002)		(0.003)	
SPI6 drought *t-1*	-0.001		-0.007***	
	(0.001)		(0.003)	
Distance to drought *t*		-0.004		-0.004
		(0.004)		(0.008)
Distance to drought *t-1*		0.014**		0.044***
		(0.006)		(0.013)
Temp *t*	0.009**	0.008**	0.019***	0.018***
	(0.004)	(0.004)	(0.007)	(0.007)
Temp *t-1*	-0.004	-0.003	-0.022***	-0.022***
	(0.003)	(0.003)	(0.006)	(0.006)
Constant	-0.104	-0.107	0.134	0.132
	(0.105)	(0.104)	(0.223)	(0.222)
Controls as in article	Yes	Yes	Yes	Yes
Observations	13,520	13,520	13,520	13,520
R-squared	0.003	0.003	0.014	0.014
Number of et_id	845	845	845	845

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1