Adverse weather amplifies social media activity

Keywords: weather, social media, heat, climate, rain

Extended Abstract

The ubiquity of social media has profoundly altered the way humans communicate, socialize, and coordinate. For example, social media can facilitate conversations about important issues in public health and public policy by incorporating voices from large segments of the global population. Further, the immediacy of social media facilitates quick access to products and services[1], disaster awareness and response[2], crowdfunding, and rapid access to news and information[3].

However, social media has exacerbated the risk of cyber-bullying and harassment and has likely sped the spread of questionable information[4], and has reduced privacy and data security[5]. Consistent with the social displacement hypothesis[6], higher social media use is associated with decreased in-person social interaction with close contacts[7,8], and US adolescents in 2016 spent one hour less per day engaged in in-person social interactions compared to the pre-social media 1980s cohort[9]. While evidence suggests that social media can increase news consumption and group coordination[10], studies also show that social media use can causally degrade mental health[8,11,12], can be habitually addictive[13], can worsen performance attention deficits[11], and can promote online activity while reducing engagement in healthier tasks[8].

Much is known about how environmental conditions shape social media activities once individuals are already online[14–16]. Yet – given the importance of social media activities to human welfare – surprisingly little is known about how external conditions influence participation in social media. And it remains a fundamental question whether such social media participation – in and of itself – is sensitive to environmental conditions. Here we investigate the causal effects of meteorological conditions on participation in social media activities. To do this, we employ over three and a half billion social media posts from tens of millions of Americans across both Facebook and Twitter between 2009 and 2016 coupled with high resolution local meteorological data spanning the contiguous United States.

Over four billion people now use social media, yet the influence of environmental conditions on humanity's dominant mode of digital connection has remained unstudied. Drawing on billions of posts from two popular social media platforms, including the largest in the world (Facebook), we find empirical support for a causal effect of adverse weather on social media use, with both hot and cold temperatures and precipitation increasing participation in social media. Further, we identify similar, non-linear social media responses to meteorological conditions for both Facebook and Twitter and show that compound weather events induce large magnitude increases in online social activity.

Compound extreme cold and heavy precipitation events boost local social media participation by considerably more than the Boston Marathon, Mardis Gras in New Orleans, and even New Year's Eve in New York City. Consistent meteorological effects on social media activity are evident at both the aggregate and individual level, adjusting for location-specific, seasonal, and time invariant between-person differences. These results provide evidence for a novel phenomenon: atmospheric amplification of online social media activity.

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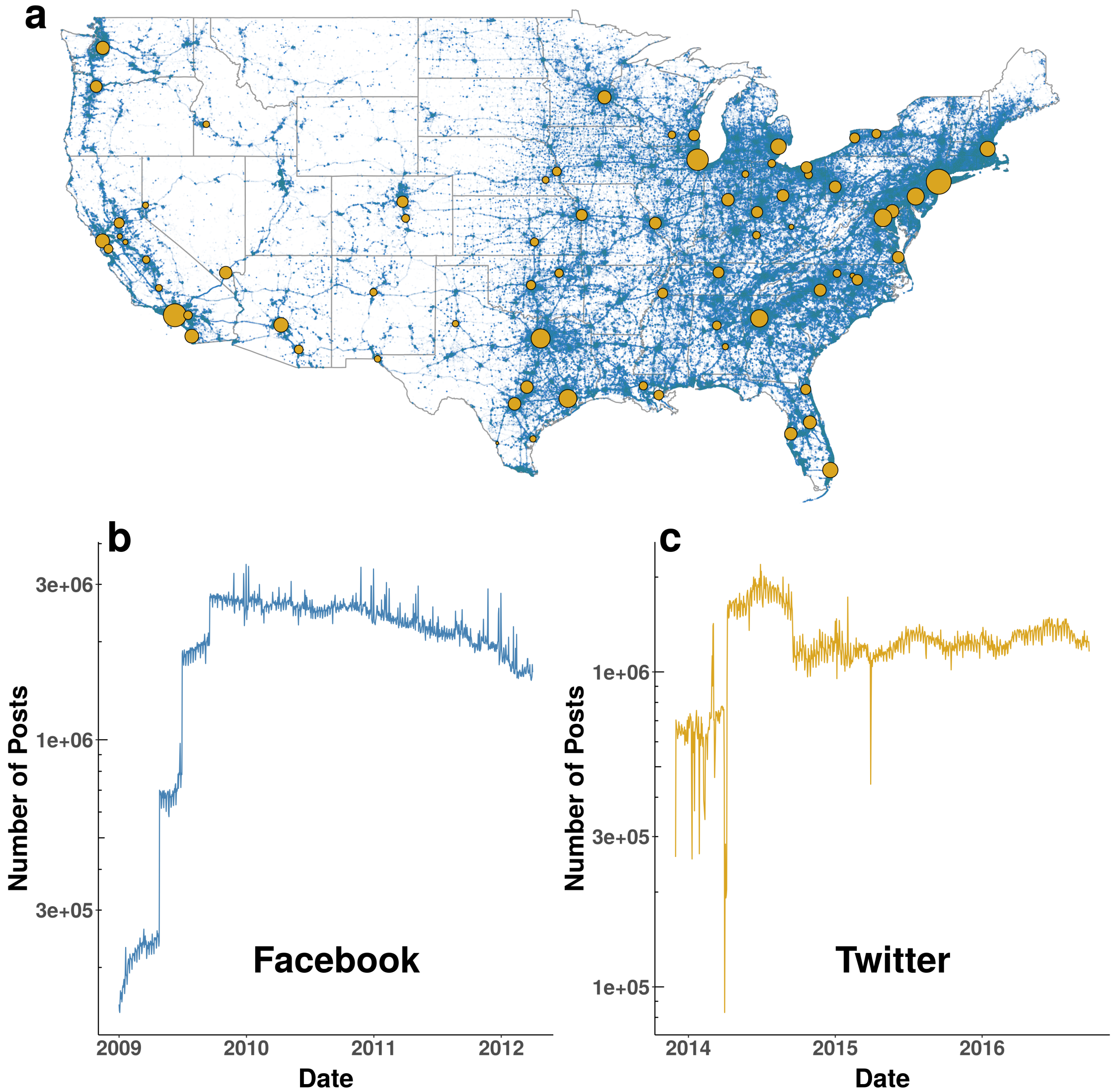

Figure 1. This figure depicts the US locales covered by our sources of social media data as well as the national daily variation in each series. Panel a plots the cross-sectional city-level variation of the social media data, with blue points indicating the location of geolocated tweet data and yellow points denoting the locale of cities in our analysis. Panel b displays the over-time variation in our Facebook data. The decrease in number of posts over time is due to changes in the Facebook platform over those years. Panel c depicts temporal variation in our Twitter data. The decline in number of posts in late 2014 is due to changes Twitter implemented in their geolocation process at that time.

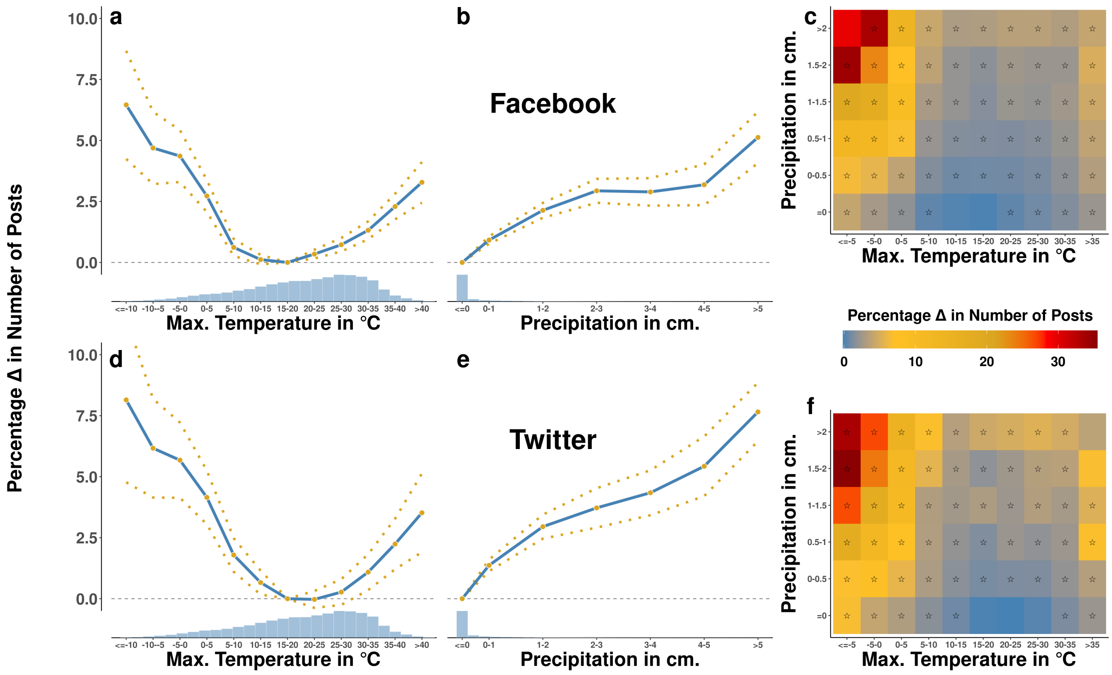

Figure 2. Panel a displays the marginal effects estimated from our fixed effects regression model from Equation 1 of daily maximum temperatures on the log of the number of Facebook posts. Both colder and warmer temperatures amplify posting to Facebook relative to the 15-20°C reference range. Panel b depicts the marginal effect of precipitation on posting to Facebook. Greater amounts of daily precipitation amplify posting to the platform. Panel c depicts the effects associated with the interaction surface between temperature and precipitation on Facebook. Large and substantive increases in social media activity occur due to cold, wet temperatures. Panel d plots the marginal effects of daily temperature on posting to the Twitter platform. Panel e displays the effects of added daily precipitation on posting to Twitter. Panel f depicts the interaction surface between temperature and precipitation for the Twitter data. The functional forms of the marginal and interaction effects of temperature and precipitation are highly similar for both Facebook and Twitter, with effect sizes slightly larger for the effects of the weather on posting to Twitter. Shaded error bounds represent 95% confidence intervals calculated using heteroskedasticity-robust standard errors multiway clustered on both city and calendar date. Stars in the cells in the interaction plots indicate that the 0.5th-99.5th percentile range of 1,000 cluster bootstrapped model estimates do not contain zero.

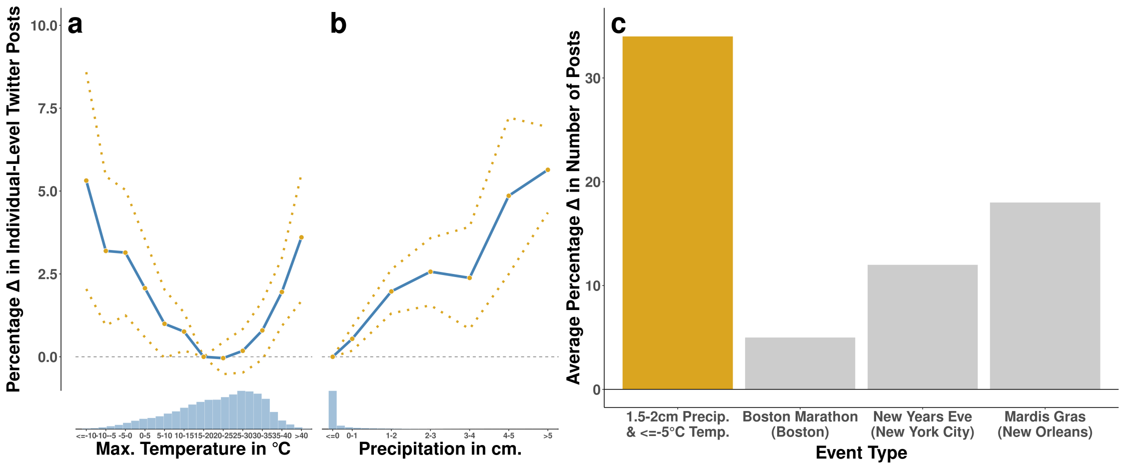

Figure 3. Panels (a) and (b) conduct an individual-level regression – employing individual fixed effects – on a randomly sampled subset of 10,000 Twitter users active on more than 25% of days in our sample. As can be seen, similar effects are observed within individuals, indicating our results are not purely driven by changes in sample composition due to altered weather conditions. Shaded error bounds represent 95% confidence intervals calculated using heteroskedasticity-robust standard errors multiway clustered on both city and calendar date. Panel (c) compares the pooled average effect size for both the Facebook and Twitter of adverse weather conditions (less than -5°C and 1.5-2cm of precipitation) to the average effect of other events in our data. Adverse weather conditions increase social media activity by 34%, which is approximately three times the typical increase in activity on New Year's Eve in New York City. All effects in (c) are significantly different from zero at the $p < 0.01$ level.