Rumoring in Informal Online Communication Networks

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Motivation

Informal exchange of information, including gossip and rumor, is a characteristic human behavior. Informal communication channels are often the primary means by which time-sensitive hazard information first reaches members of the public. Relatively little is known about the dynamics of informal online communication in response to extreme events.

Change and External Events

- Using a longitudinal and comparative approach, this project examines the content, structure, and dynamics of online interaction in response to multiple events, across multiple hazards.
- The project aims to understand how the character of conversation and the structure of the underlying social network evolve in response to hazard events.
- Core project activities include an intensive data collection effort as well as modeling of conversation volume and local structural properties.

Twitter

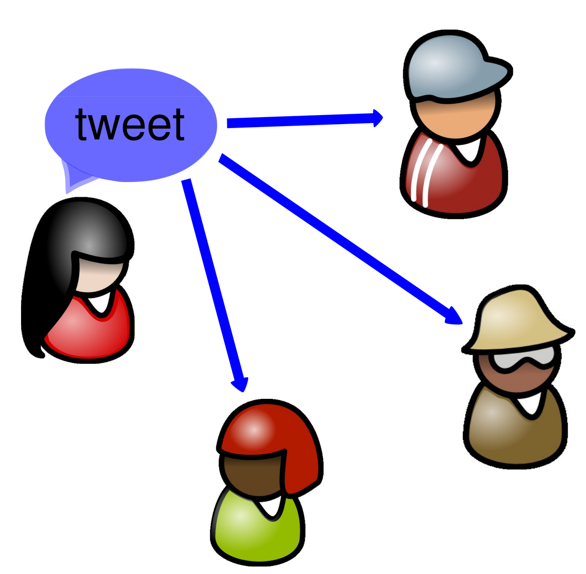
Twitter is a popular microblogging service with 190 million visitors monthly. Users exchange short messages limited to 140 characters and maintain a directed social network of friends and followers. Twitter represents a large-scale, dynamic online communication network.

jhayes1404 Colo. Seafood Lovers Not Worried About **Oil** Reports: The news rekindles fears about seafood safety and contaminat... http://bit.ly/ahyVZa
about 1 hour ago via twitterfeed

SFriedScientist RT @RAREPLANET: Dead Coral Found in Deepwater Near BP **Oil Spill** Well http://bit.ly/dnloAU
about 1 hour ago via TweetDeck

disinfo Scientists Find Damage to Coral — Essential to Marine Life — Near #BP's #**Oil-Spill** Well http://goo.gl/fb/XUlwp #news
about 1 hour ago via Google

Data Collection



We employ keywords as indicators of the underlying discussion frequency, inferring the presence of hazard-related conversation from changes in the overall rate with which particular terms are used.

Example keywords: oil spill, blacktide, BP

We designed an automated collection system to:

- collect all public tweets containing keywords
- collect social ties for a sample of users
- collect a set of covariates on tweets and users

Dataset Statistics

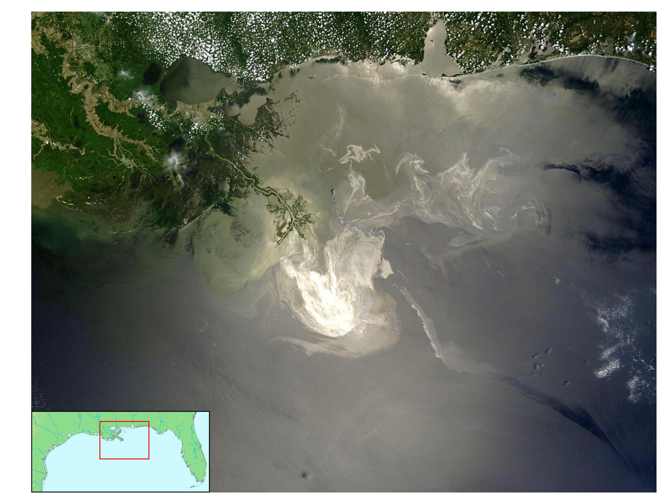
- 16 different hazard types
- 163 keywords tracked (80 current)
- 258 million tweets since October 15, 2009
- 310 million social ties from 27,000 users

Modeling Rumoring

- Twitter is likely to be readily employed for both seeking and disseminating hazard information [2]. Exchange of information is affected by the structure of the social network.
- What determined the extent of rumoring?
- Theories identify the following as rumor determinants [1]: perceived importance, degree of cognitive unclarity, and relevance to behavior of the topic.
- We fit a model for the local Poisson rate estimate using a simple AR(1) model with a Jeffery's prior, controlling for trend and seasonality.

$$Y[t] = T[t] + S[t] + e[t]$$

Deepwater Horizon Oil Spill 2010



On 20 April 2010, an explosion on the Deepwater Horizon offshore drilling rig killed 11 crewmen and resulted in a massive oil spill. It is the largest accidental marine oil spill in the history of the petroleum industry, releasing about 185 million gallons of crude oil.

Case Study

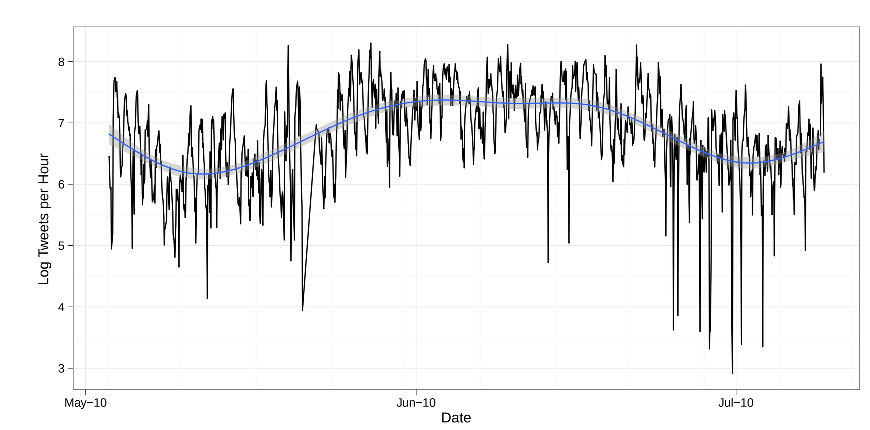


Figure: The time series for the keyword "oil spill" exhibits seasonality without general trend. However, note the changes in communication volume. We are currently exploring possible explanations of this activity in terms of rumor determinants.

Results

We fit the simple AR(1) model with a Jeffery's prior to the "oil spill" time series. Results are as follows:

- Intercept and AR(1) term are significant.
- Trend term is slightly significant.
- Day of week terms are not significant, while hour of day indicators for daylight hours are significant.

We are working to include covariates such as the estimates of oil flow and uncertainty in these estimates, level of news coverage, wildlife impact, food safety impact, etc.

Seasonality in Conversation Dynamics

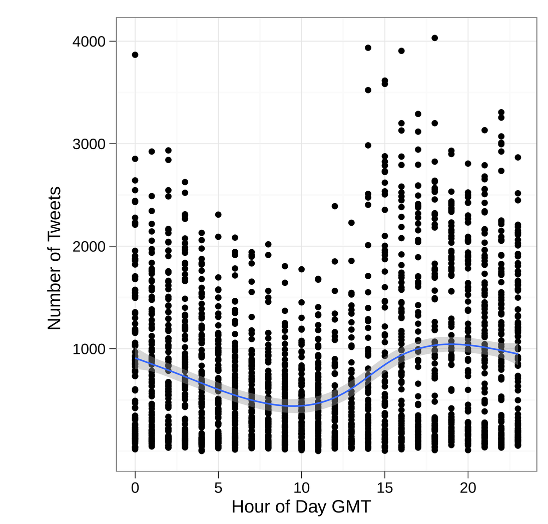


Figure: One of the most consistent patterns in online communication on Twitter is daily seasonality. This figure shows the daily seasonality for the keyword "oil spill."

Local Network Structure

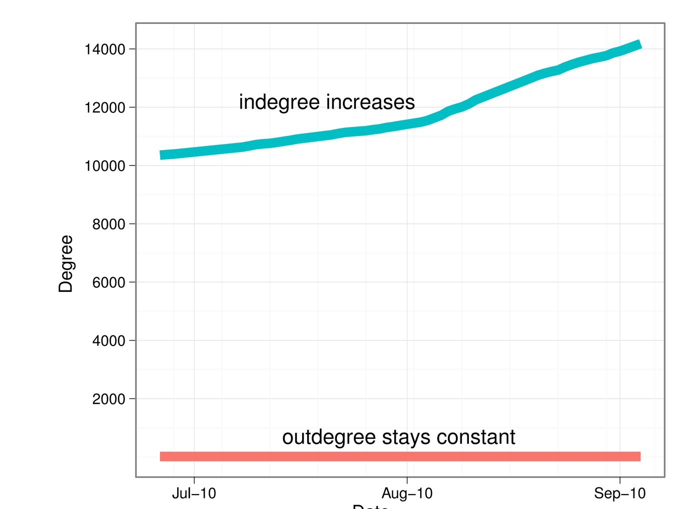


Figure: Here we show the degree of the **epagov** Twitter account. While the EPA rarely received information from other users, they are a hub of information.

Future Directions

- Comparison of changes in conversation and local structure across hazards.
- Incorporate additional predictors such as warnings and alerts.
- Decomposition of local network properties.

References

[1] Allport and Postman. 1947. The Psychology of Rumor. New York: Holt.

[2] Sutton, Palen, and Shlovski. (2008). "Emerging Use of Social Media in the 2007 Southern California Wildfires," ISCRAM, Wash., DC, USA, May 2008.

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NCASD — Networks, Computation, and Social Dynamics

This material is based on research supported by the **Office of Naval Research** under award N00014-08-1-1015.

Scalable Methods for the Analysis of Network-Based Data