

Twitterネットワークにおける集団注意 の創発ダイナミクス

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FIRST合原最先端数理モデルプロジェクト

- **Introduction**
- Collective attention
- Collective mood
- Discussion

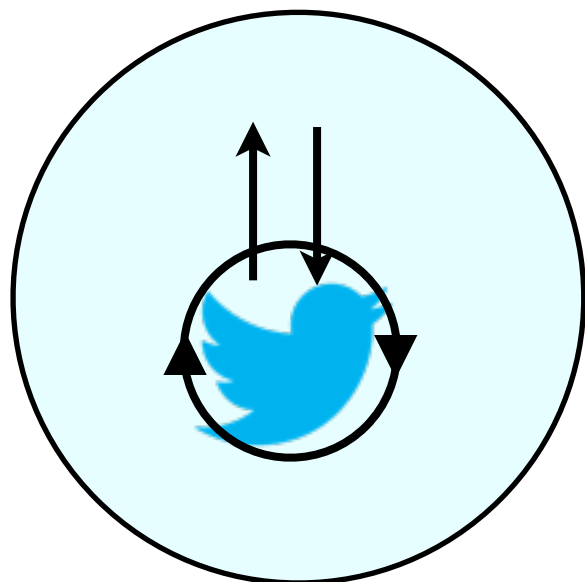
Objective

Understanding collective social dynamics

Collective attention evoked by various sorts of events:
e.g., natural, social, and cultural events

Material

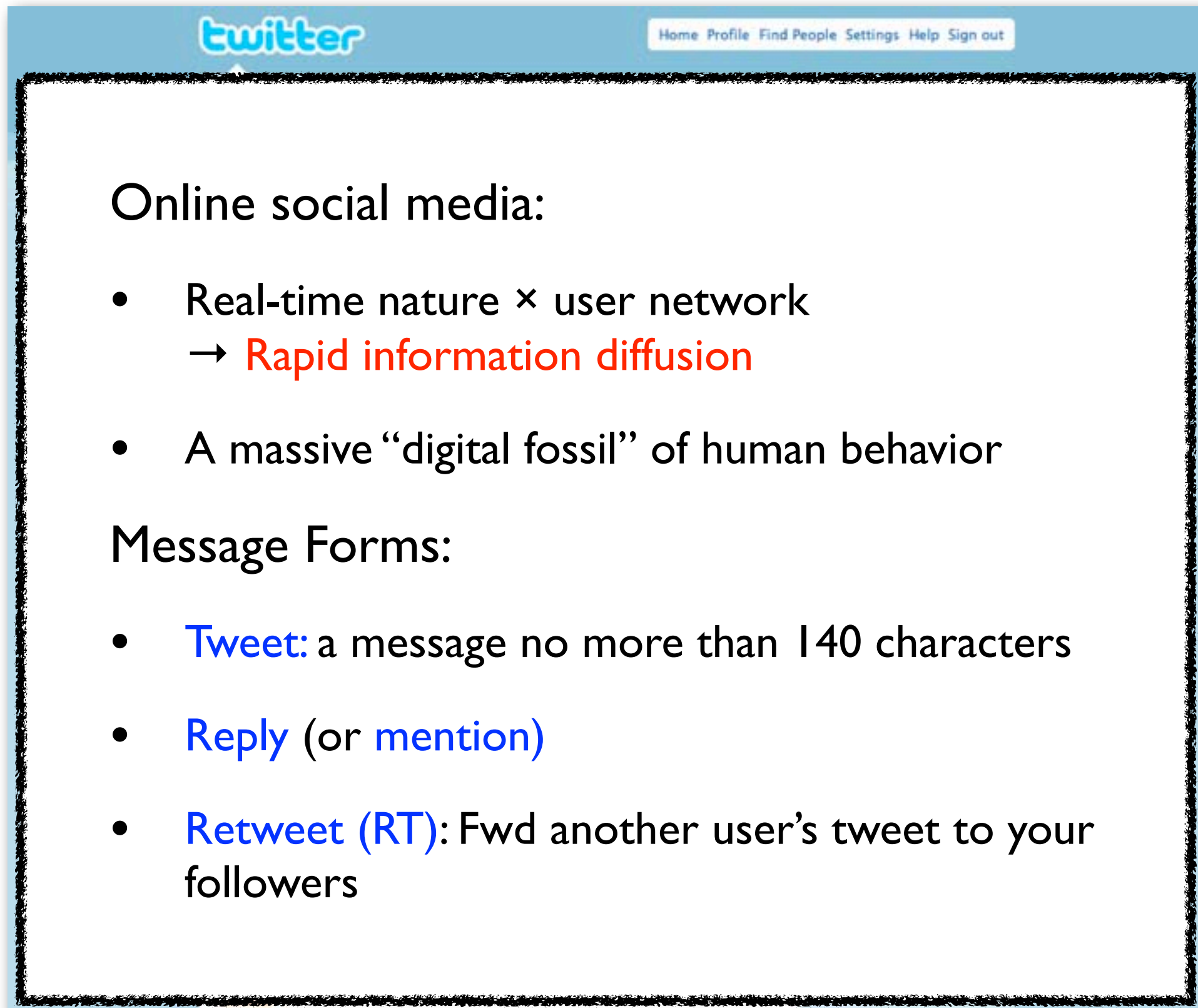
Twitter, a popular SNS



Methodology and observation

- **Collective attention** linked with real-life events
- **Collective mood** as a state of mind

Twitter: What's happening?

A screenshot of the Twitter website interface. At the top, there is a blue header bar with the Twitter logo on the left and a navigation menu on the right containing links for Home, Profile, Find People, Settings, Help, and Sign out. Below the header, the main content area is enclosed in a black, hand-drawn style border. Inside this border, the text "Online social media:" is followed by a bulleted list. The first bullet point states "Real-time nature × user network" with an arrow pointing to the phrase "Rapid information diffusion" in red. The second bullet point states "A massive 'digital fossil' of human behavior". Below this list, the text "Message Forms:" is followed by another bulleted list. The first bullet point defines "Tweet" in blue as a message no more than 140 characters. The second bullet point defines "Reply" (or mention) in blue. The third bullet point defines "Retweet (RT)" in blue as forwarding another user's tweet to your followers.

twitter

Home Profile Find People Settings Help Sign out

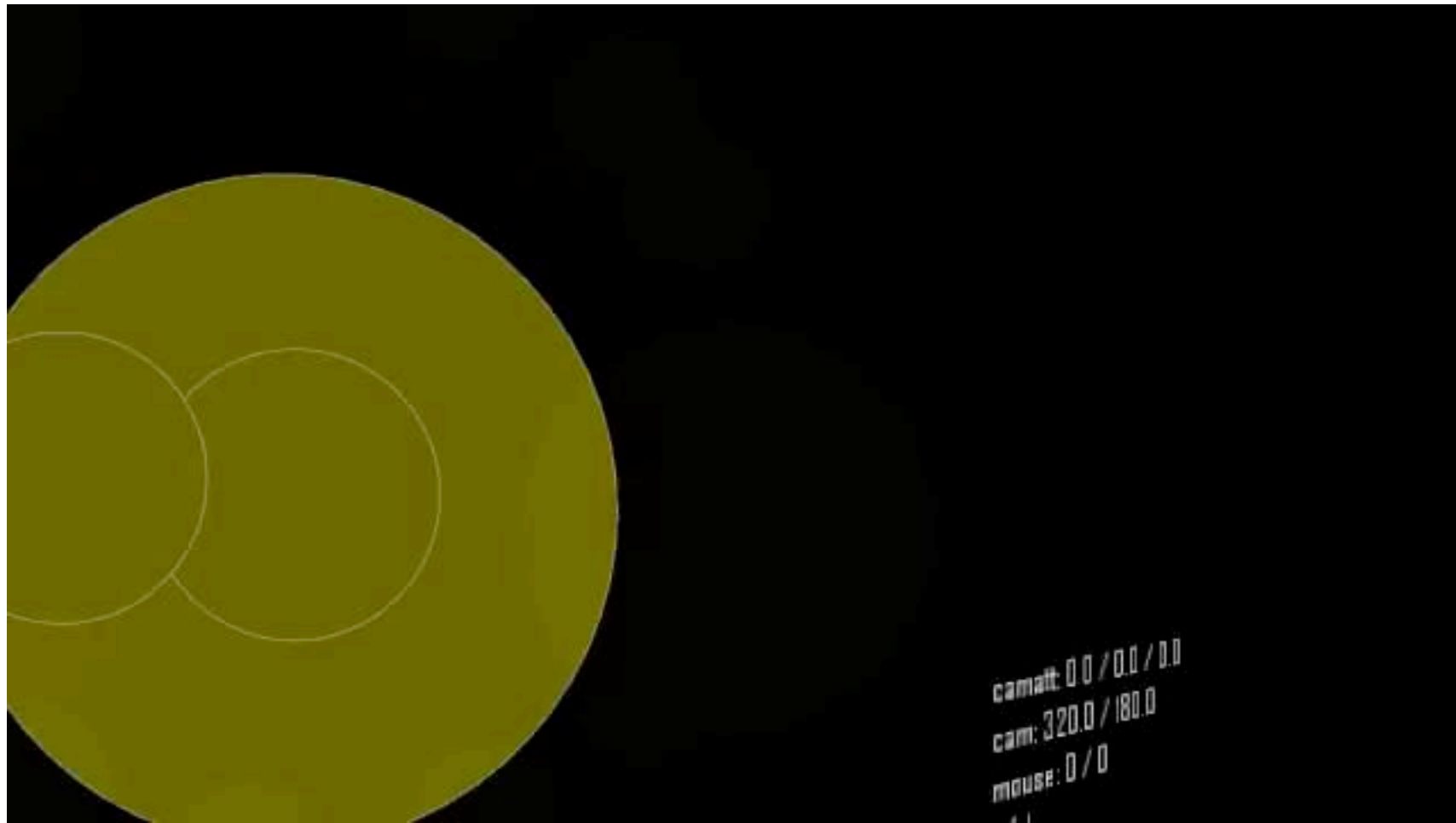
Online social media:

- Real-time nature × user network
→ Rapid information diffusion
- A massive “digital fossil” of human behavior

Message Forms:

- Tweet: a message no more than 140 characters
- Reply (or mention)
- Retweet (RT): Fwd another user's tweet to your followers

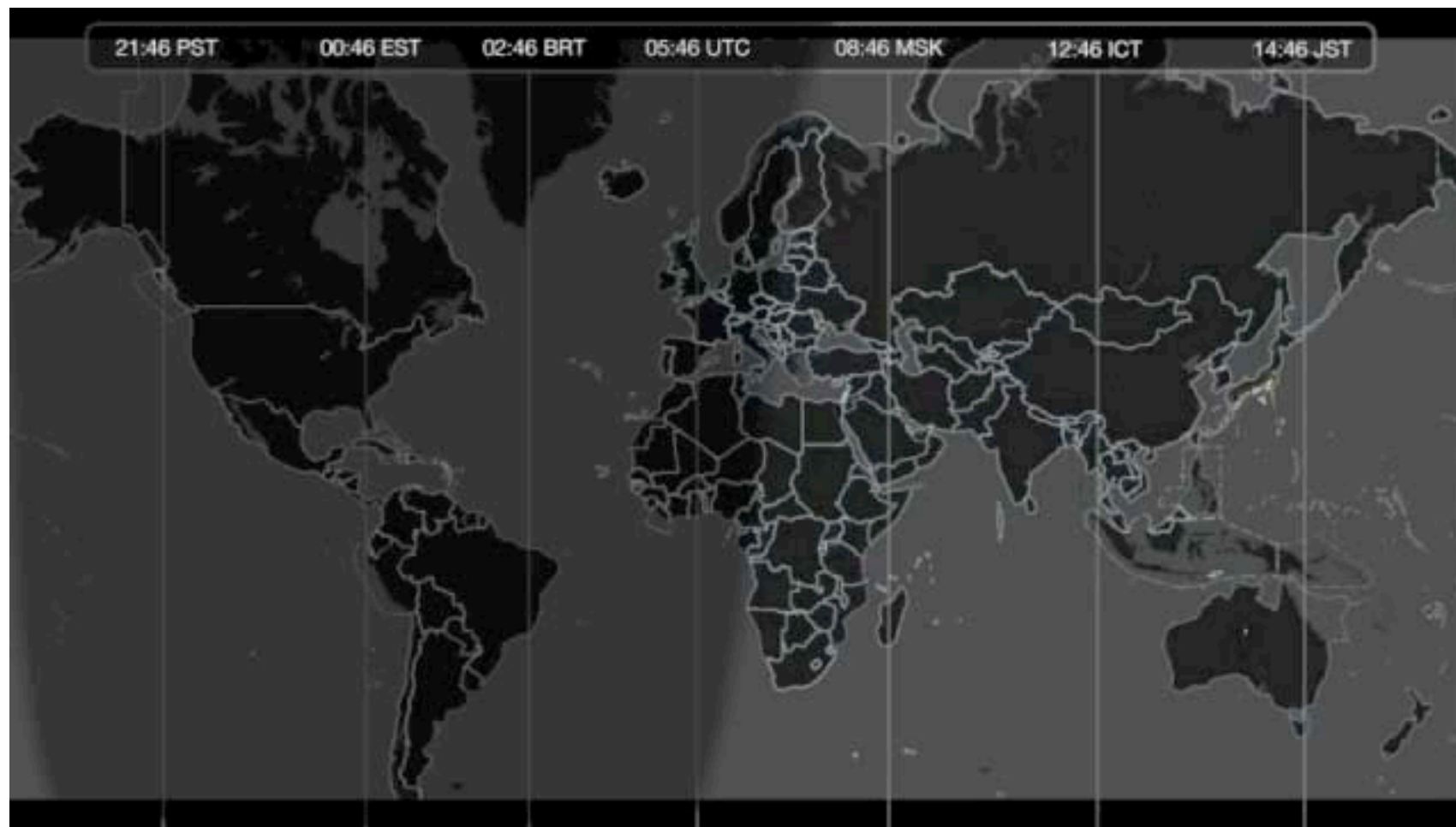
Collective Social Dynamics on Twitter Network



<http://www.rhizomenavigation.net/>

SNS enables a fast information diffusion over user networks

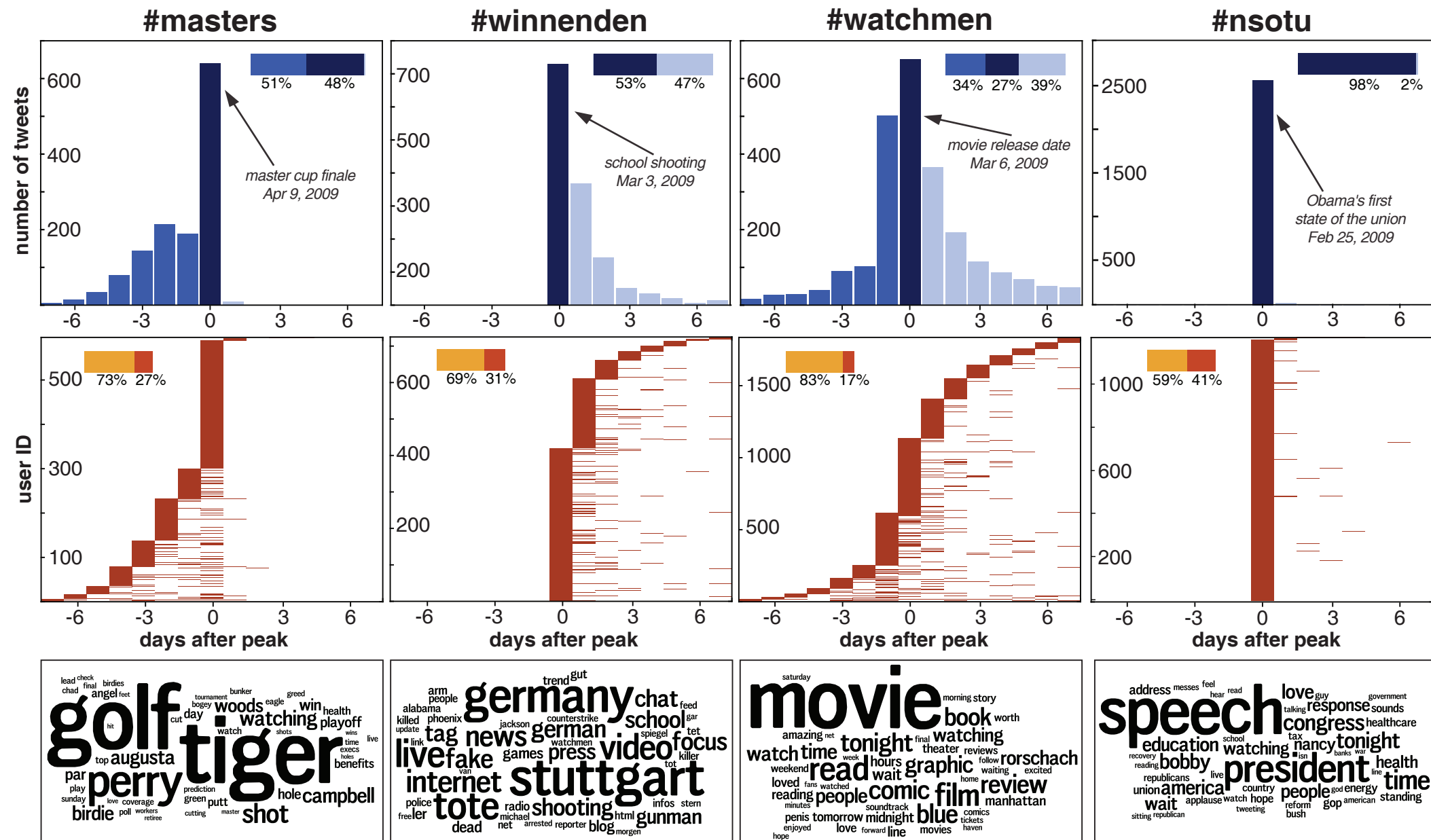
Massive Tweet Stream After Tohoku-oki Earthquake



Visualized by Twitter Inc.

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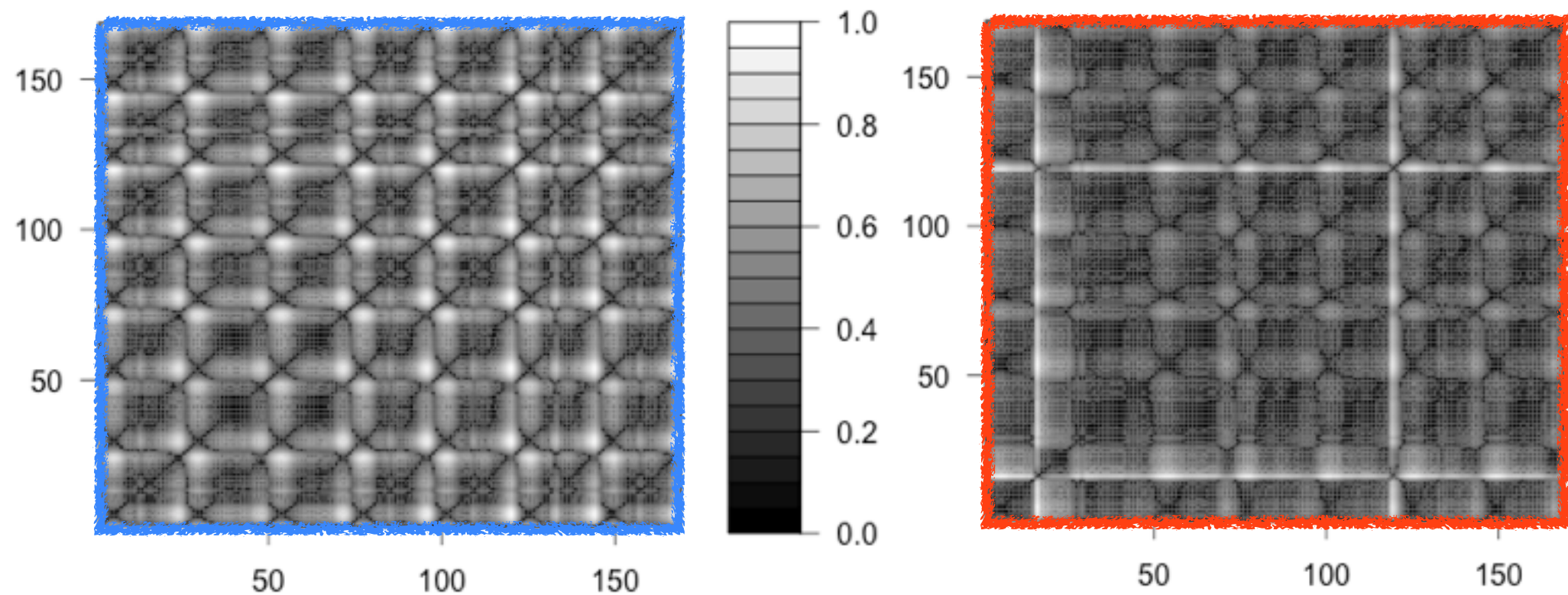
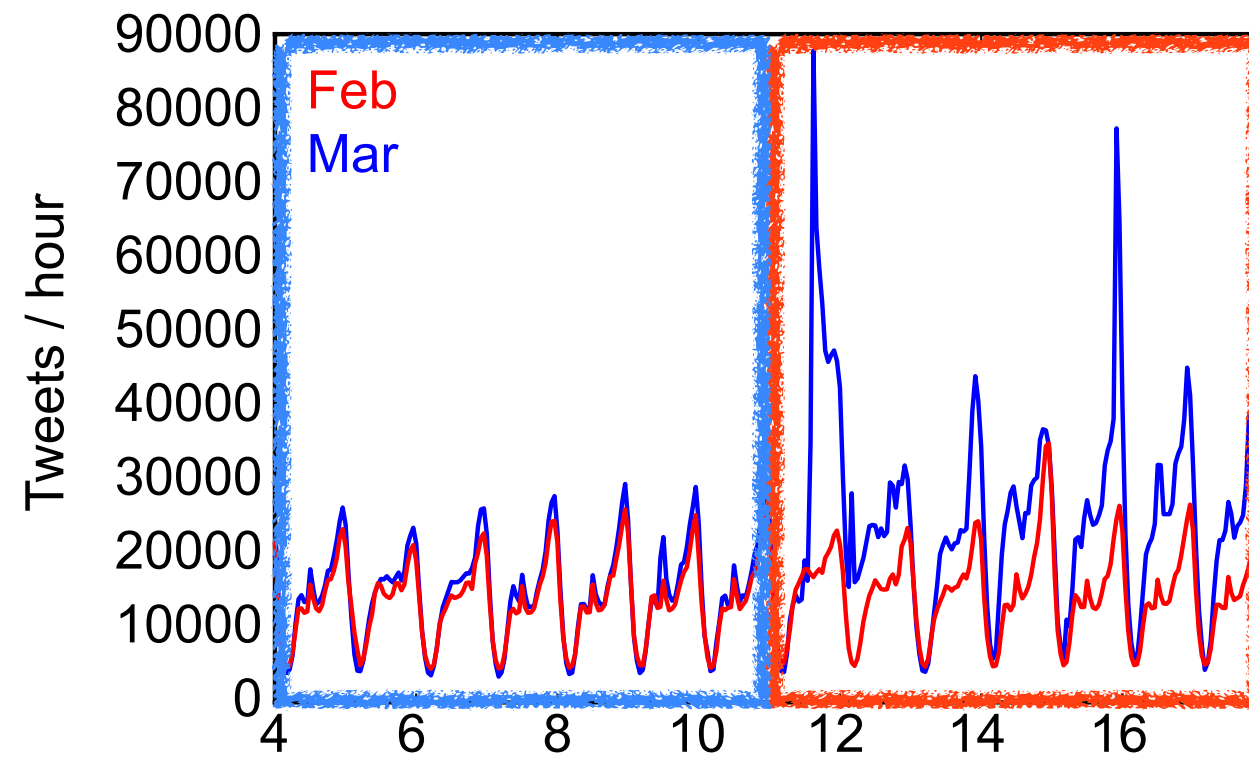
Dynamical Classes of Collective Attention



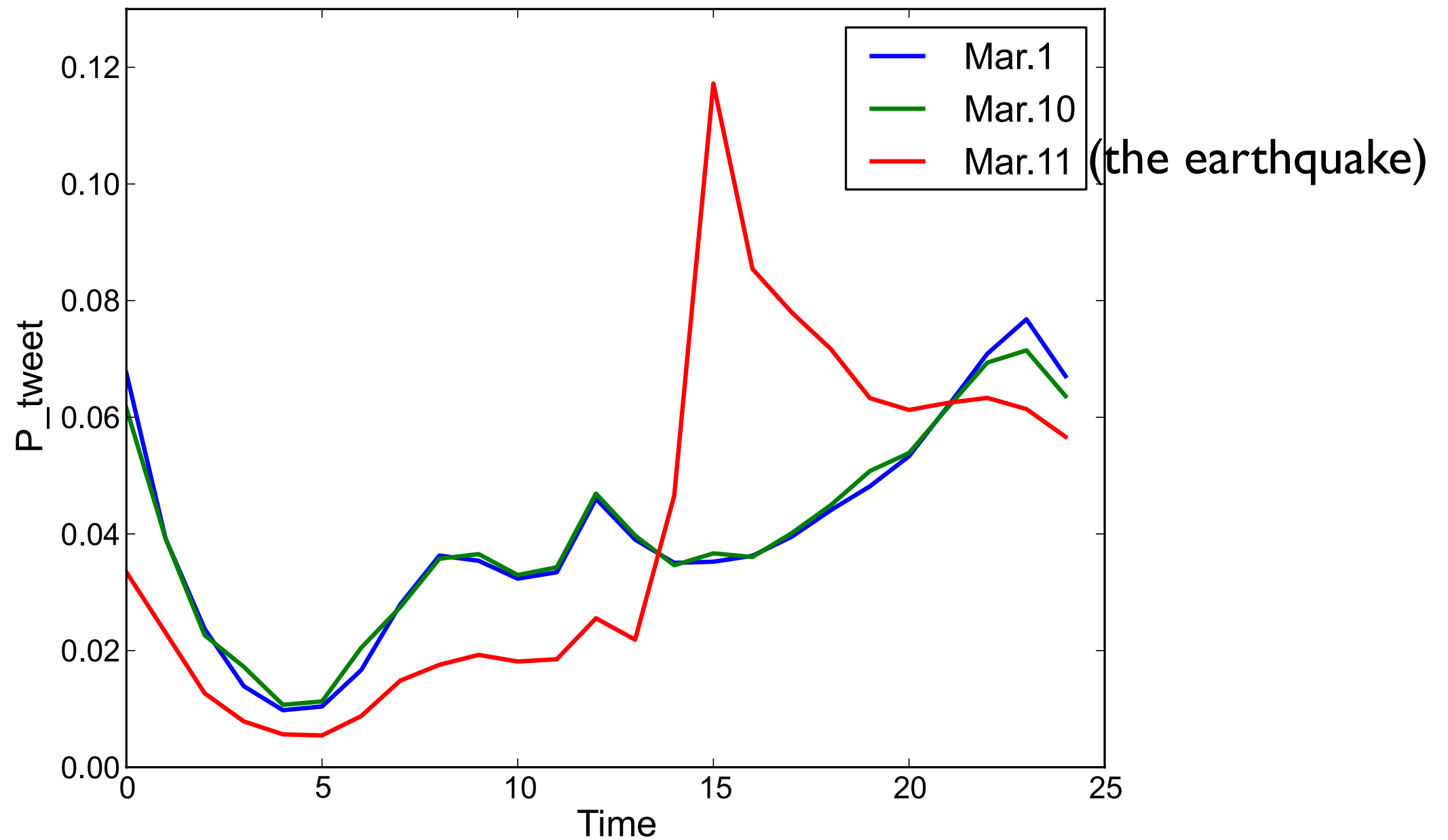
Tweet Collection

- Snowball sampling of user timelines using Twitter REST API from Apr, 2011
- Data
 - 500M tweets (mainly Japanese)
 - 400 thousand users
- Limitations of Twitter API v.1.0
 - 320 requests / h / account
 - Latest 3200 tweets (or less)
 - Twitter server often goes down

Regular and Irregular States of Tweet Stream



Daily Probability Distribution of Tweets



Jensen-Shannon Divergence

$$KL(P, Q) = \sum_i p_i \log_2 \frac{p_i}{q_i}$$

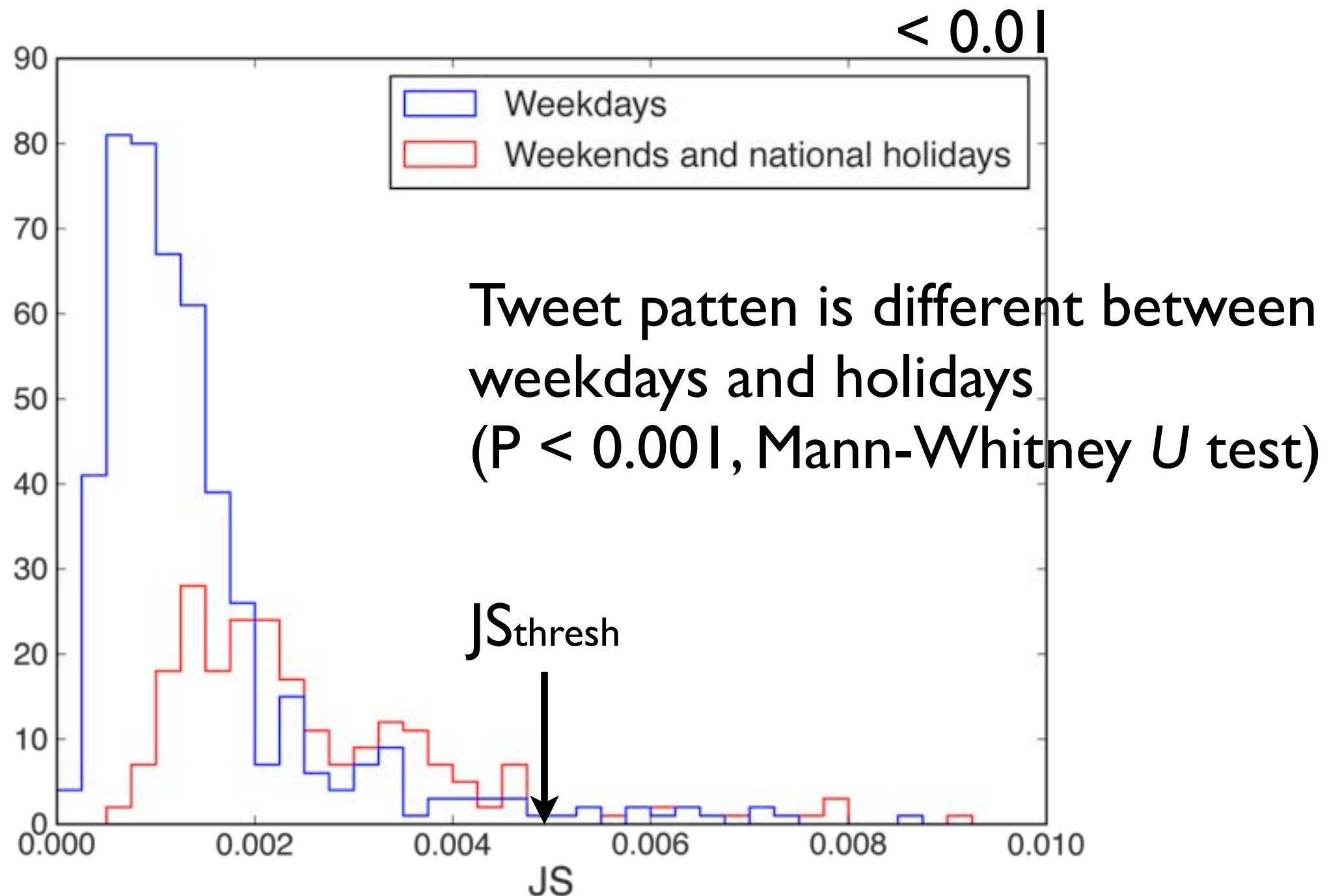
$$JS(P, Q) = \frac{1}{2} \left(KL(P, \frac{P+Q}{2}) + KL(Q, \frac{P+Q}{2}) \right)$$

Distance between two probability distributions, P and Q

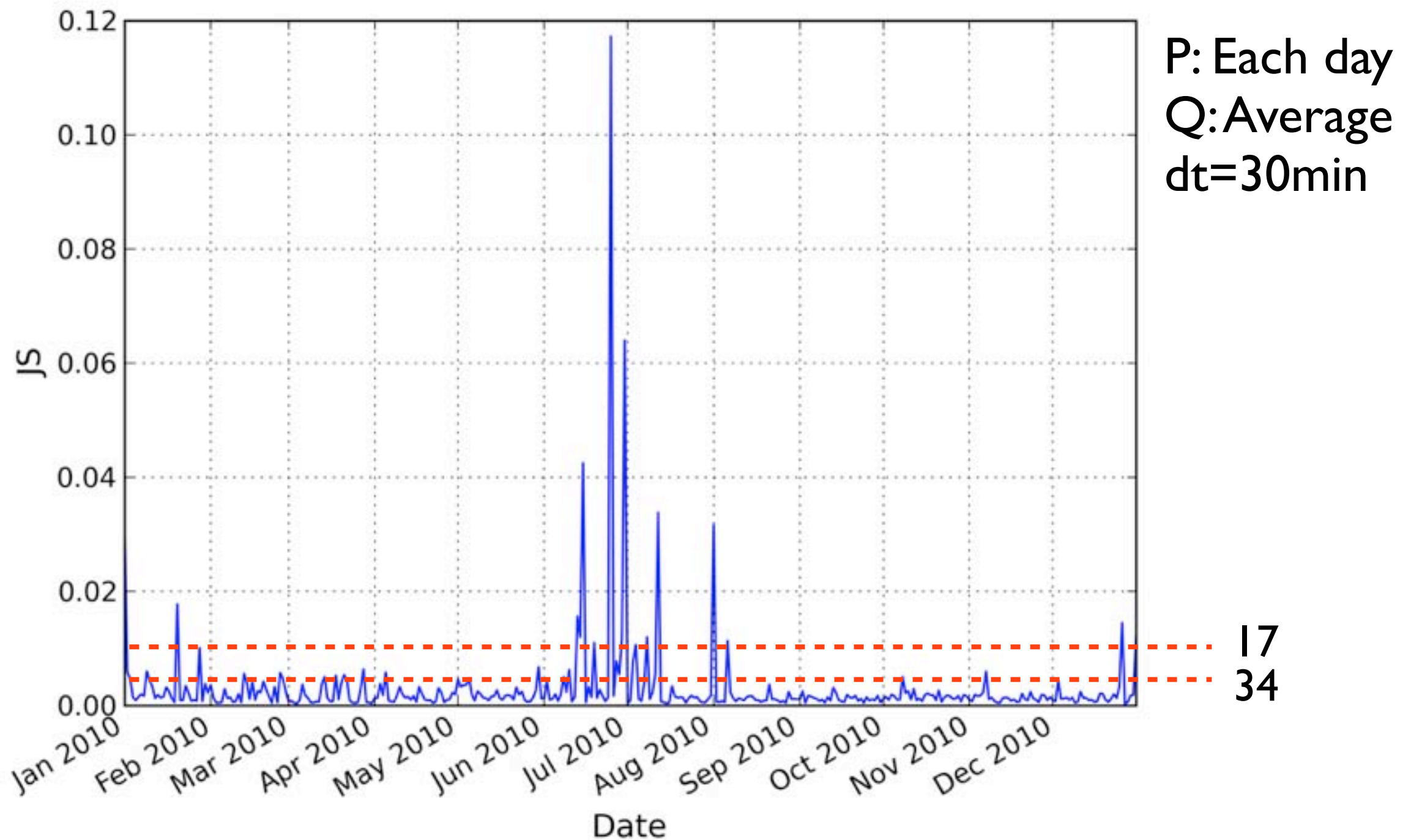
- Symmetric: $JS(P, Q) = JS(Q, P)$ cf. $KL(P, Q) \neq KL(Q, P)$
- Always bounded between 0 and 1 cf. $KL = \infty$ if $q_i = 0$

Lin, *IEEE Trans Inform Theory* 1991

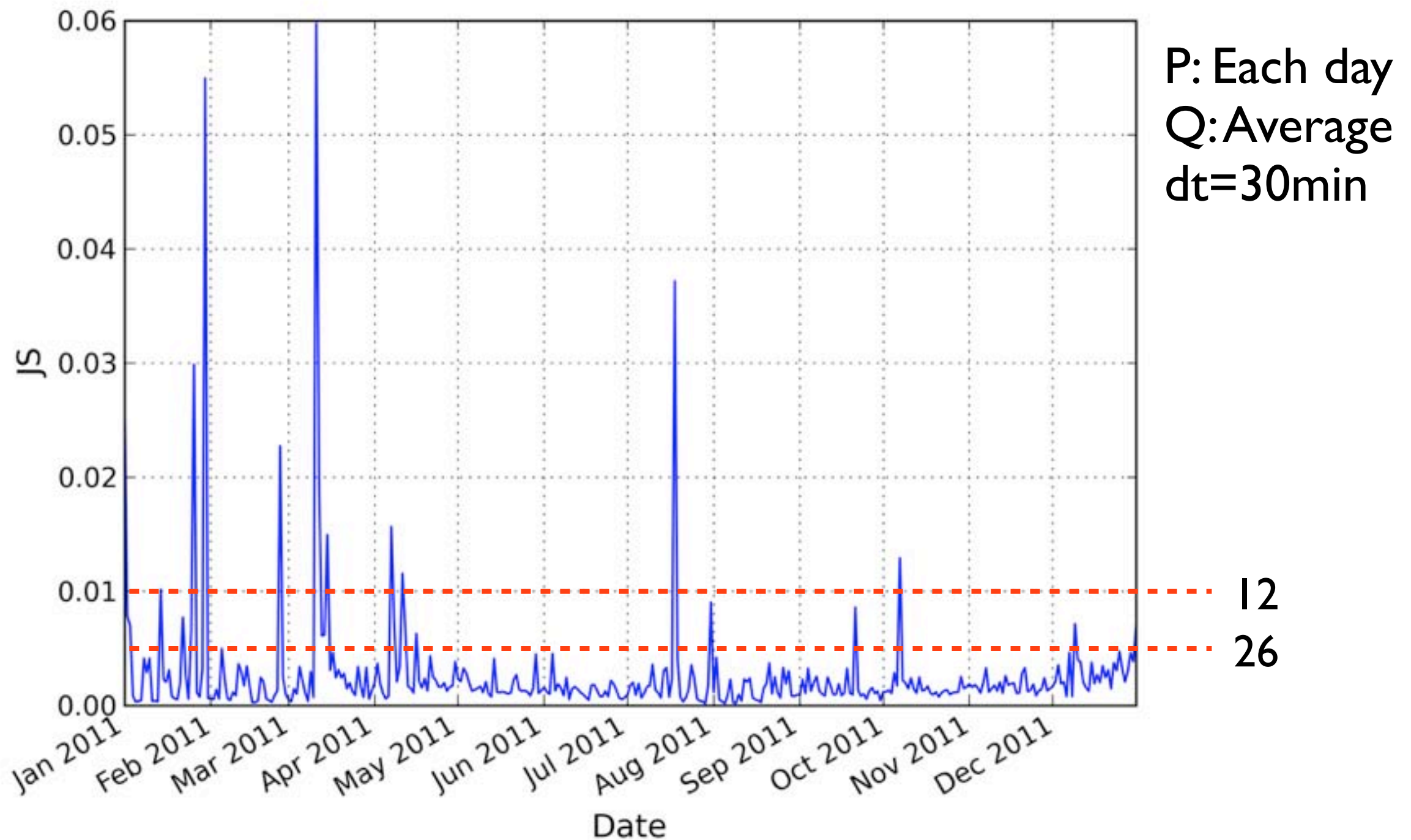
Weekdays and Holidays



Collective Attention 2010



Collective Attention 2011



Semantic Grounding

Morphological analysis of tweet texts
using Mecab and NAIST-jdic

↓
Terms

Conventional

- Popularity (= frequency)

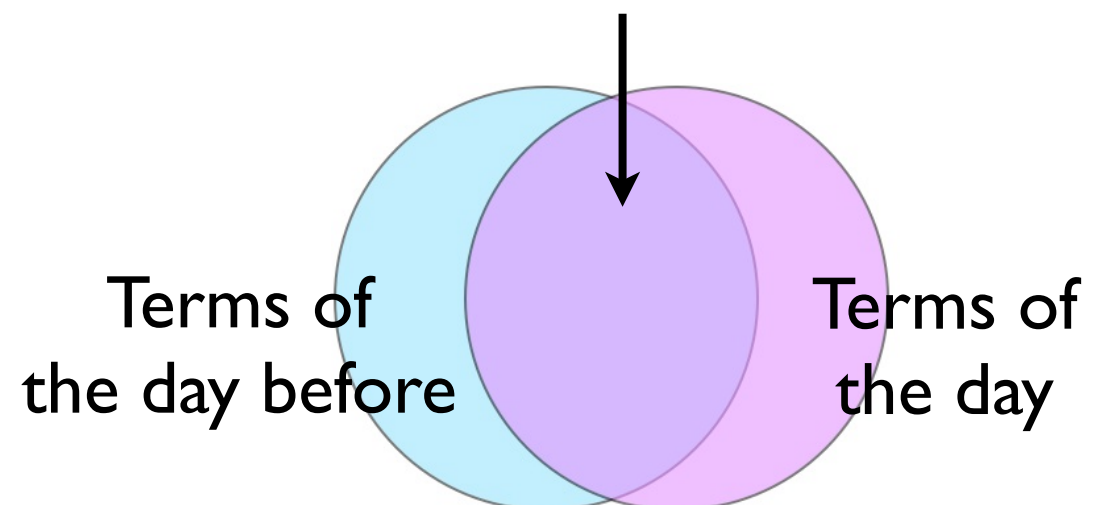
- TF-IDF weighting:

$$tf \times \log \frac{N}{df}$$

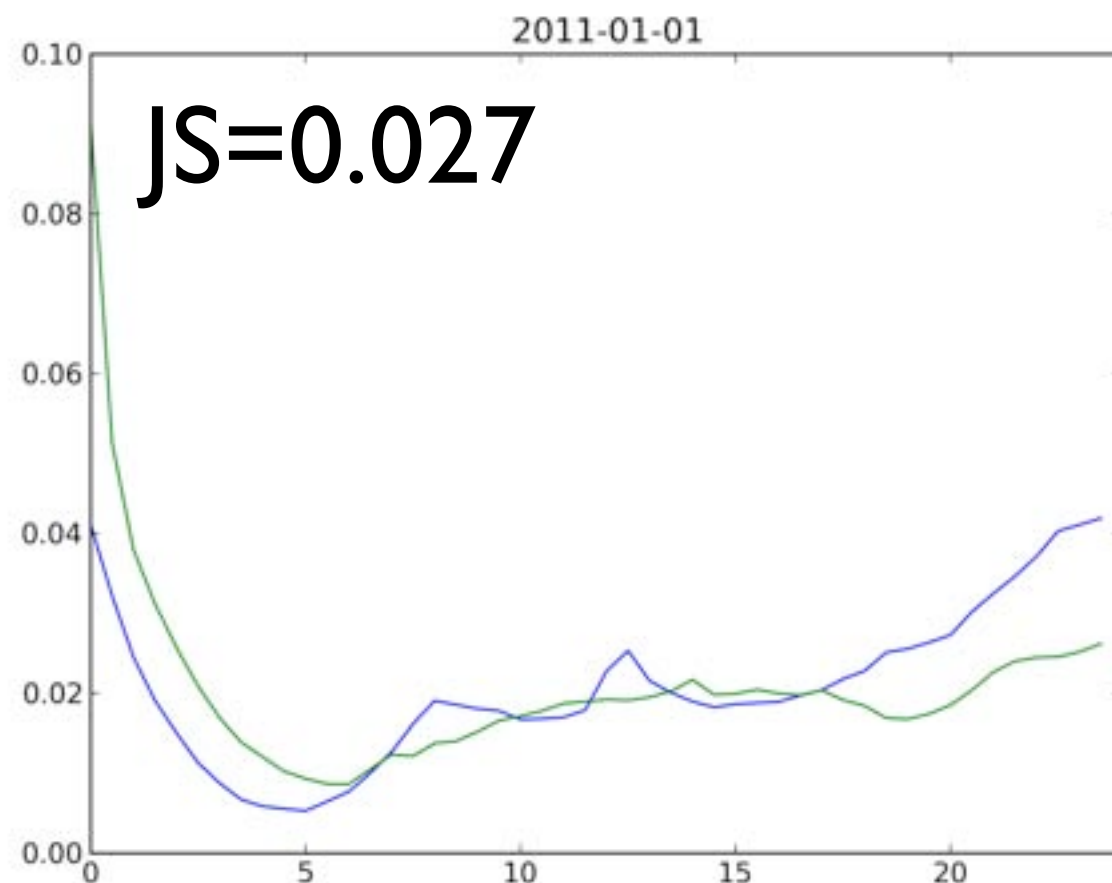
Proposed

Popularity enhancement:

$$\left\{ t \mid tf > tf_{before}, tf \text{ and } tf_{before} \geq mean \right\}$$



Collective Attention on Jan 1, 2011

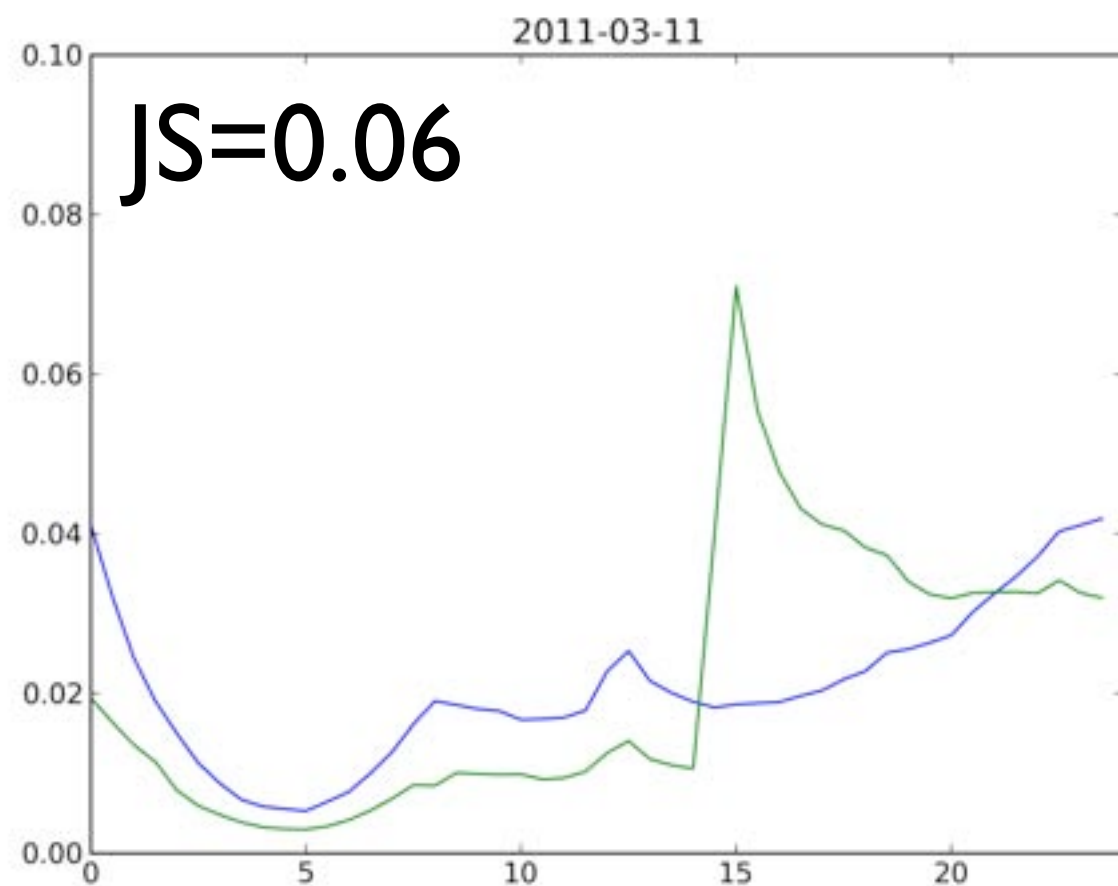


	Popularity	Popularity Enh.	
1	http	asamadetv	182
2	今年	謹賀	64
3	お願い	運勢	59
4	さん	ニューイヤ	51
5	こと	グルーポン	46
6	よう	大吉	43
7	新年	願望	30
8	twitpic	初夢	29
9	そう	Year	26
10	今日	初日の出	26

Annual regular events

New year holiday—New year's greetings and resolutions, first dreams, late TV programs, and so on.

Collective Attention on Mar 11, 2011



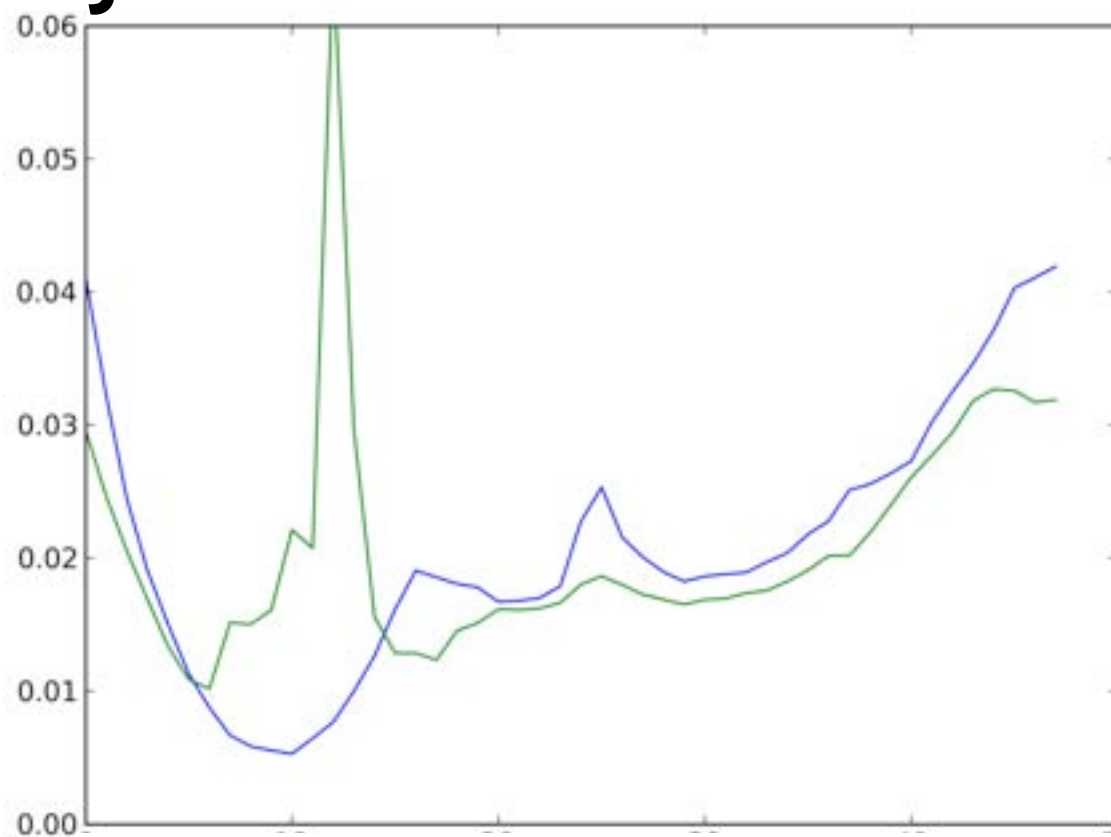
	Popularity	Popularity Enh.	
1	http	津波	1660
2	地震	安否	264
3	無事	停電	213
4	大丈夫	大震災	203
5	こと	揺れ	201
6	よう	ダイヤル	165
7	そう	伝言	164
8	さん	避難	154
9	情報	沿岸	151
10	津波	淡路	132

Natural Disasters

Tohoku-oki earthquake and tsunami, and the subsequent accidental events, such as electric outage, phone line problems

Collective Attention on Jul 18, 2011

JS=0.037

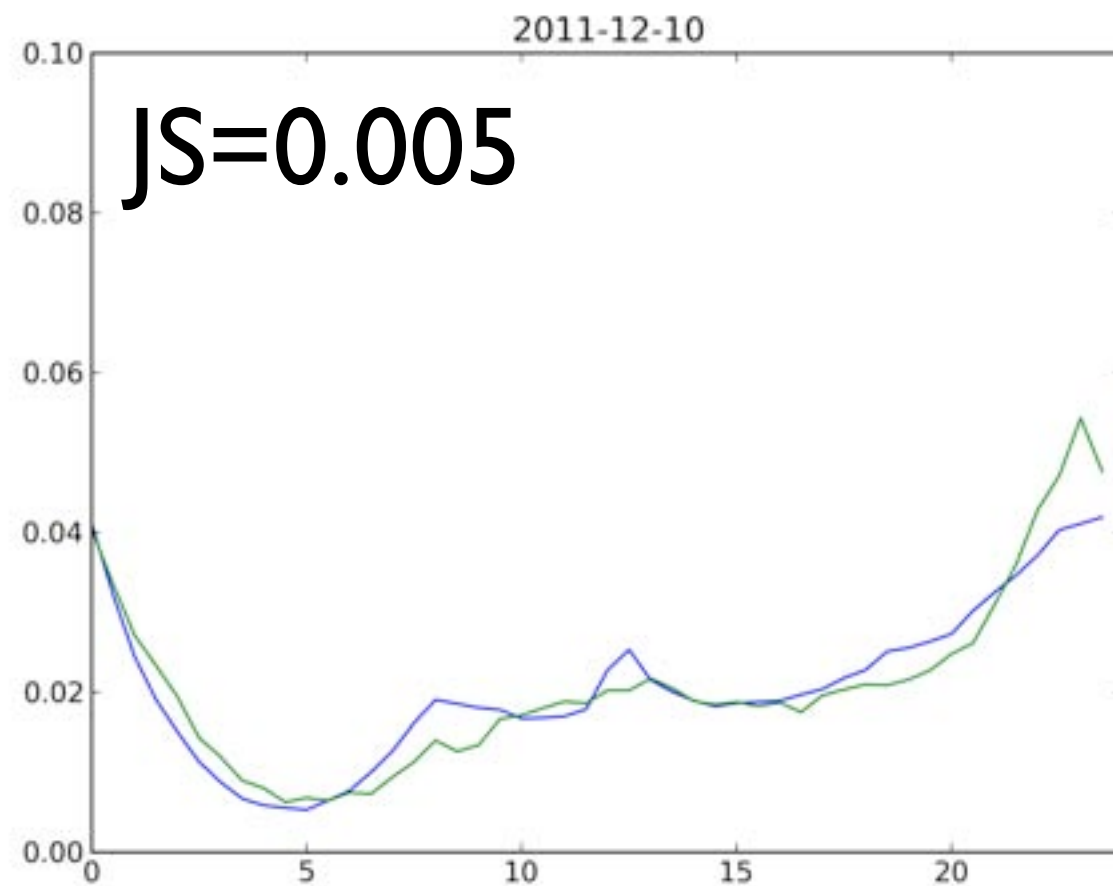


	Popularity	Popularity Enh.	
1	なでしこ	nadeshiko	908
2	http	世界一	145
3	nadeshiko	優勝	92
4	日本	なでしこ	89
5	さん	延長	65
6	アメリカ	シュート	61
7	サッカー	得点	59
8	優勝	JAPAN	46
9	こと	ニッポン	44

Sporting events

“Nadeshiko Japan” won the women’s World cup!

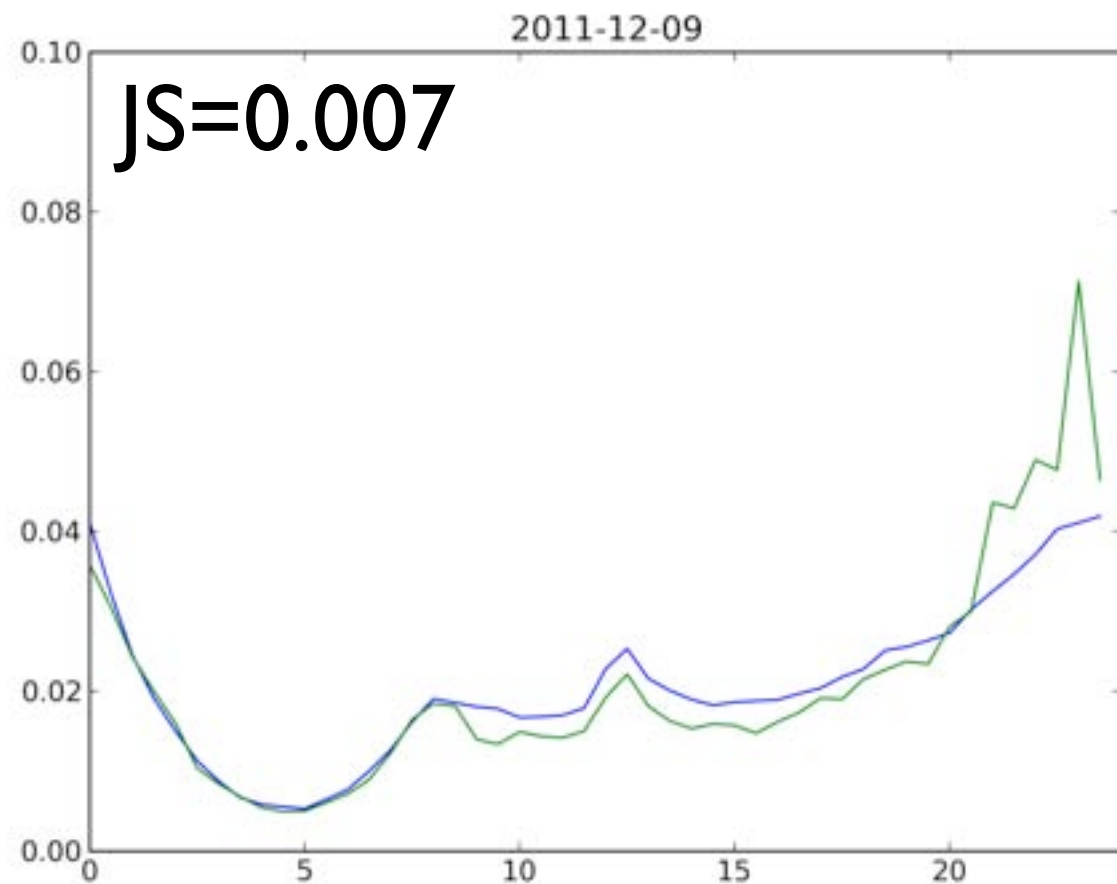
Collective Attention on Dec 10, 2011



	Popularity	Popularity Enh.	
1	http	月蝕	37
2	月食	月食	29
3	さん	皆既	29
4	皆既	ベム	13
5	こと	価格	13
6	そう	撮影	10
7	今日	満月	10
8	これ	限界	10
9	よう	最大	10
10	ちゃん	綺麗	8

Astronomical phenomena
Total lunar eclipse

Collective Attention on Dec 9, 2011

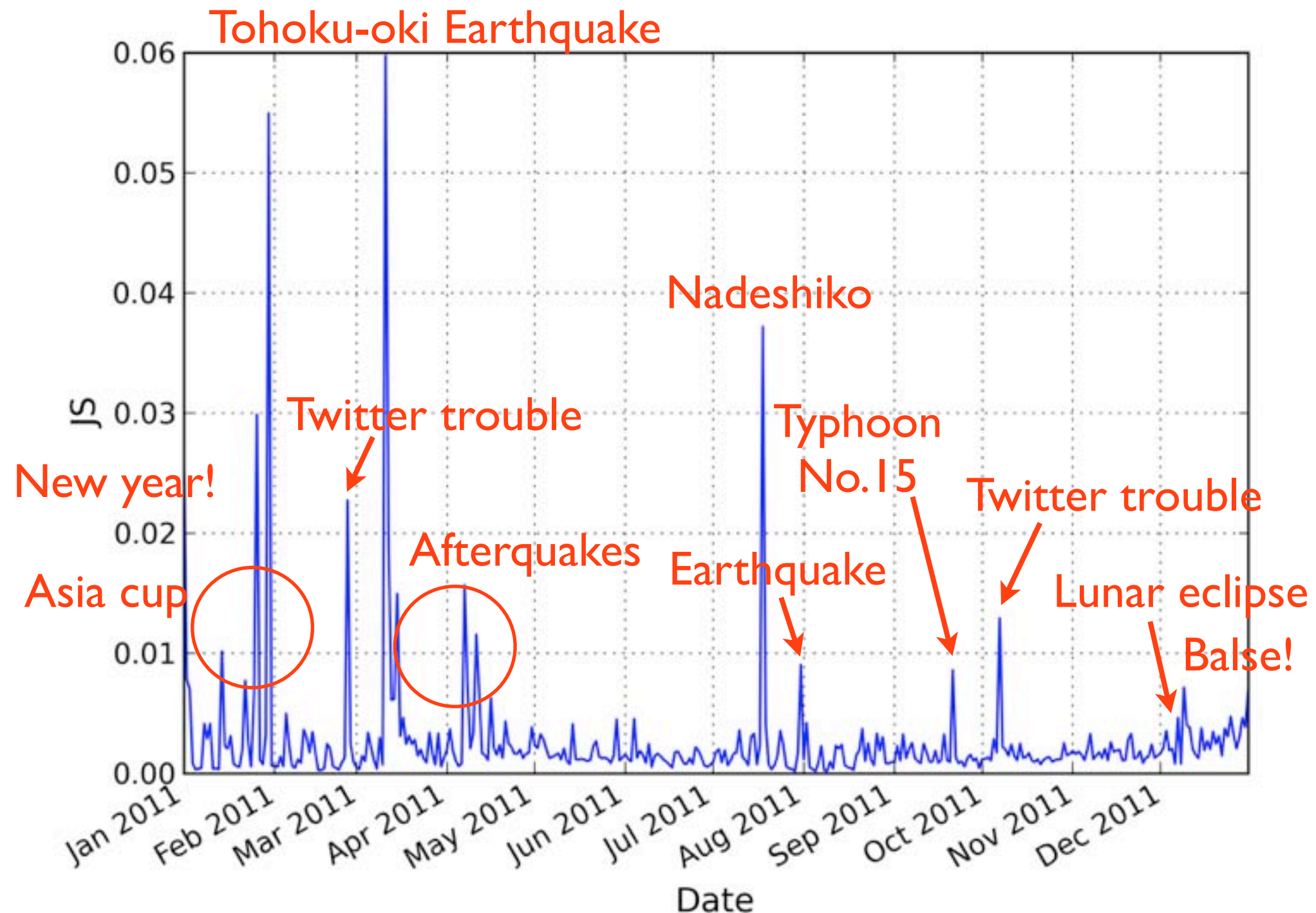


	Popularity	Popularity Enh.	
1	http	バルス	108
2	ラピュタ	ラピュタ	72
3	バルス	ゴミ	33
4	laputa	真央	30
5	さん	ムスカ	29
6	こと	金曜	23
7	よう	ジブリ	20
8	そう	らん	13
9	ムスカ	天空	12
10	ちゃん	マイナス	9

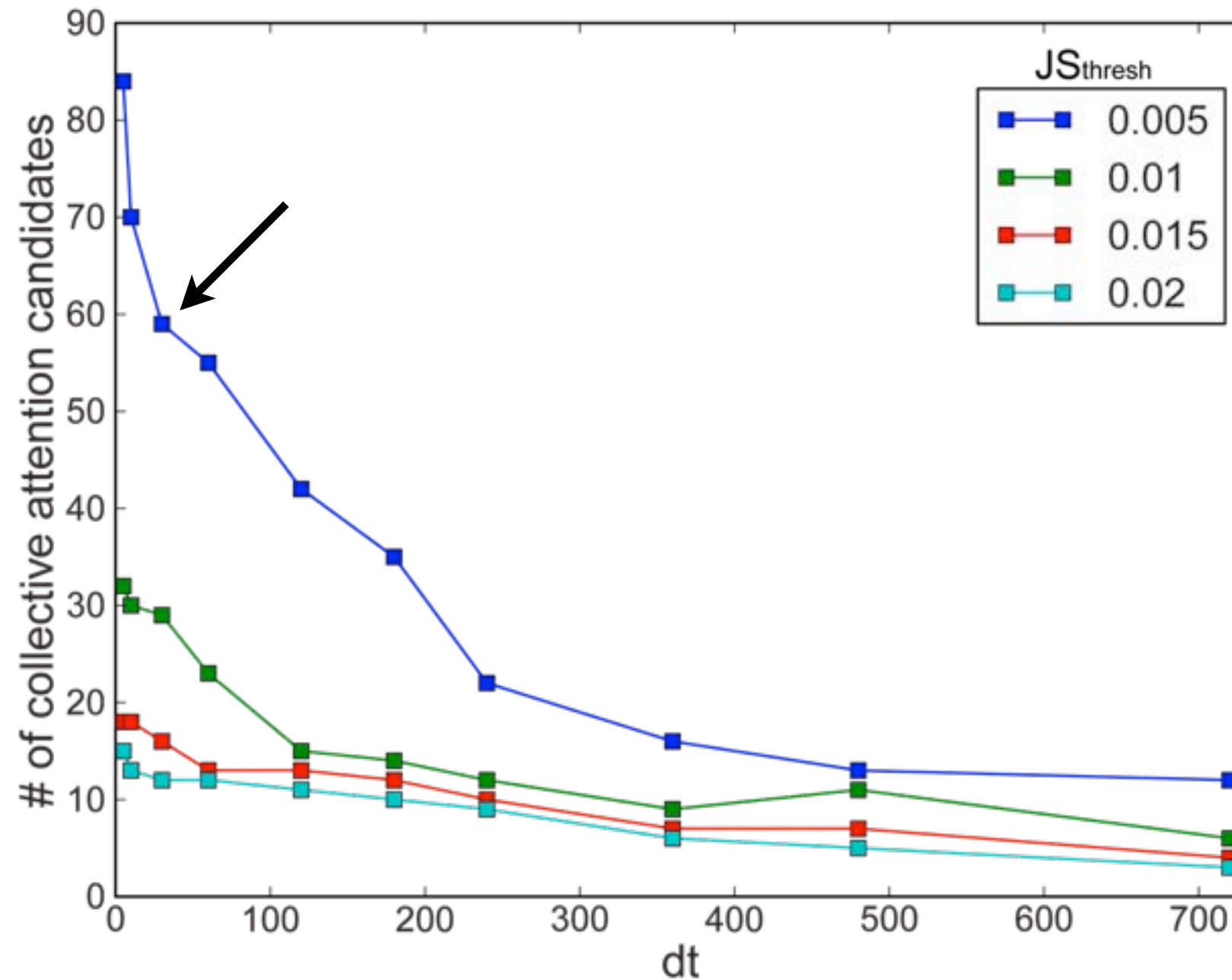
Culture

Synchronized tweets in Castle in the Sky (天空の城ラピュタ)

Summary of Collective Attention 2011



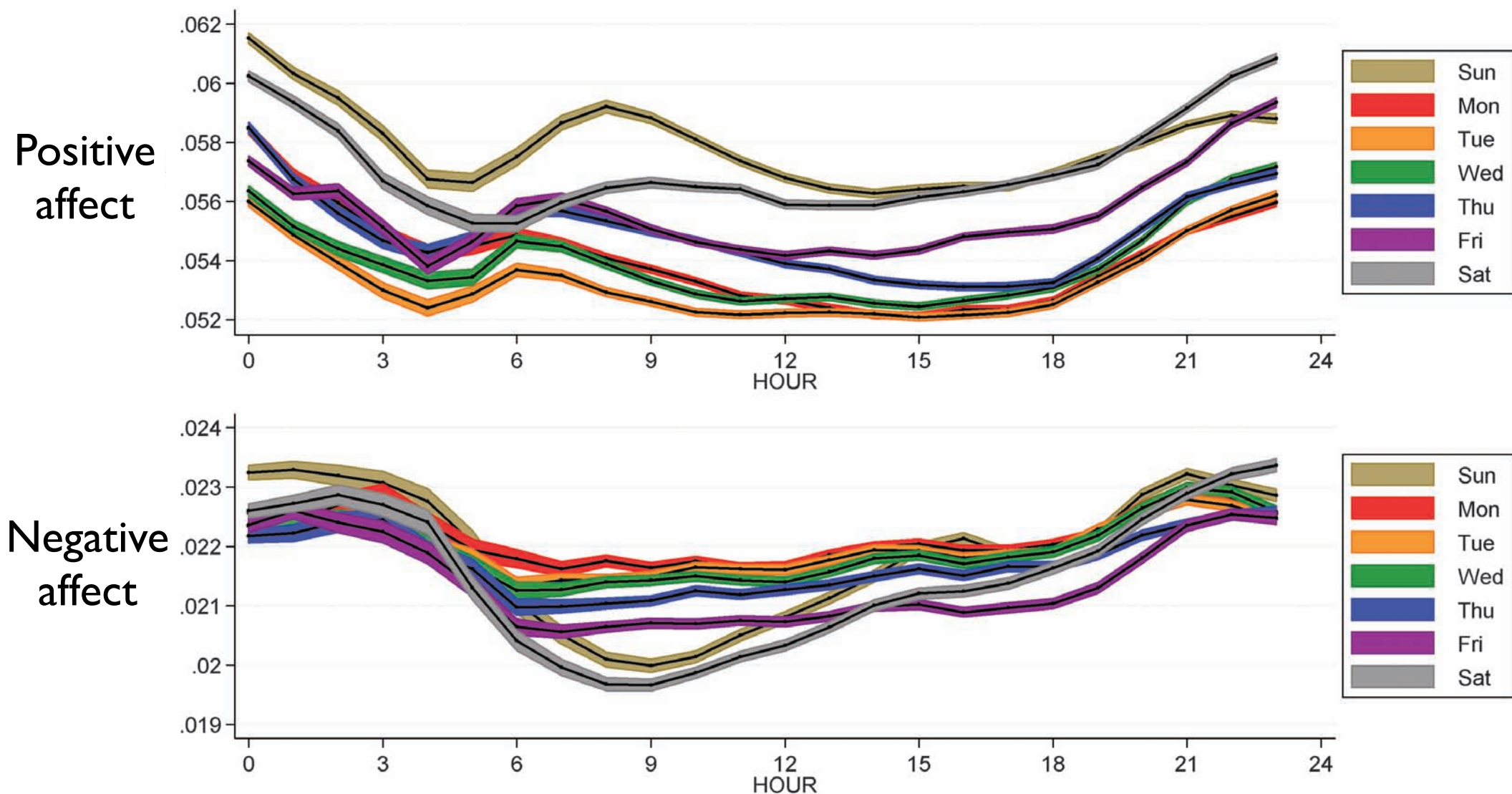
Parameter Dependence: dt and JS_{thresh}



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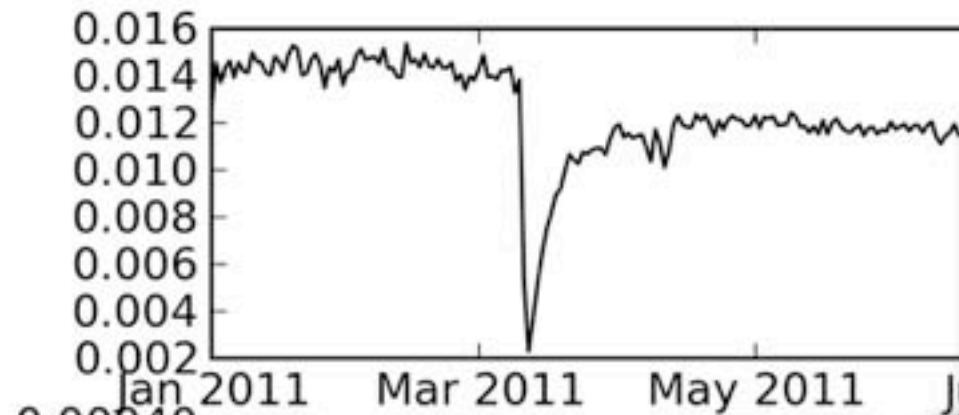
Twitter-Mining Captures Global Mood Patterns

509 million tweets generated over 2 years
by 2.4 million people in 84 countries



Mood Swing After the Quake

(笑)

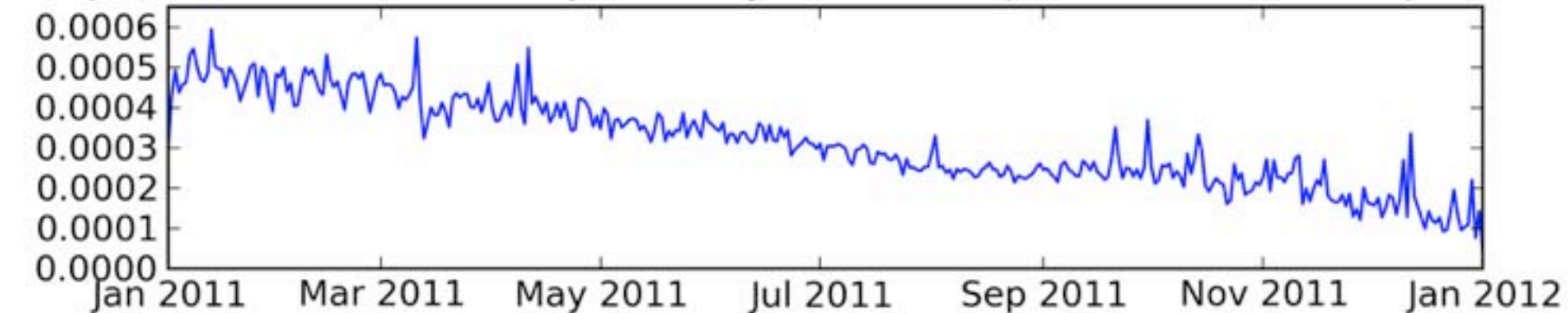


(怒) 合法的？人体実験 (怒) RT @deeeeee: 人に非ず。この発言「長期低線量被曝のデータはチェルノブイリでもとっていない。今回がデータをとれる最後の機会」〔放射能〕福島県民はやはり「モルモット」にされているのではないか？ <http://t.co/q3GatKt>

(怒)



(泣)



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Discussion

- **Retrospective summary**
This method provides an informative retrospective summary of collective attention from Tweet stream
- **Classes of collective attentions:**
Natural phenomena, sporting events, culture, politics, annual regular events
- **Finding structure in time** -> Latent properties

Future Directions

- Information diffusion on Twitter networks, including rumor spreading
- Sentiment analysis before and after the Great East Japan Earthquake

etc.