Forecasting of Combat Activity in the Syrian Civil War Using Hot Spot

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The overall classification of this presentation is:

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Outline

- Hypothesis
- Syrian Civil War
- Hot Spot vs. Density
- Methodology
- Results
- Conclusion

Hypothesis

Test a methodology for forecasting spatio-temporal patterns of future violent events based on passed violent events.

Can past events serve as a predictor of future events?

Does grouping by time before grouping by space enhance the forecasting accuracy?

Syrian Civil War

- Started March 2011
- Still ongoing
- Global Database of Events, Language, and Tone (GDELT)
    - News media from print, broadcast, and web formats in over 100 languages, updated daily
    - Data from January 2014 – December 2015; 24-month test period
    - Used TimeMapper Visualizer to extract “Material Conflict” for all of Syria
        - Points are weighted at the city level per day
    - 297,127 discrete events

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Hot Spot vs. Density

- Sometimes used interchangeably, not the same
- Density: clusters group of objects based on proximity
    - Can be used to see the “now”
- Hot Spot: Here refers to specific ArcPro tool *Optimized Hot Spot Analysis* which uses the Getis Ord GI* algorithm
    - Identifies statistically significant “hot” or “cold” clusters
- Hot Spot commonly used in crime mapping to plan for future distribution of resources
    - In the literature: Chainey, Tompson, Uhlig

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Methodology

- Broke the dataset into different time sets, then tested to see if the past dataset predicted the future dataset.
- *Grouping Analysis*
  - Clusters data by natural breaks; in this case breaks in time
  - Calculates F-Statistic measuring group similarity/difference
- *Optimized Hot Spot Analysis*
  - Groups data by space
  - Calculates neighbor distance, incremental spatial autocorrelation, Getis Ord GI* statistic
- Assessing accuracy: Hit Rate (HR) is the percentage of new events that occur within the hot spots identified in preceding time period

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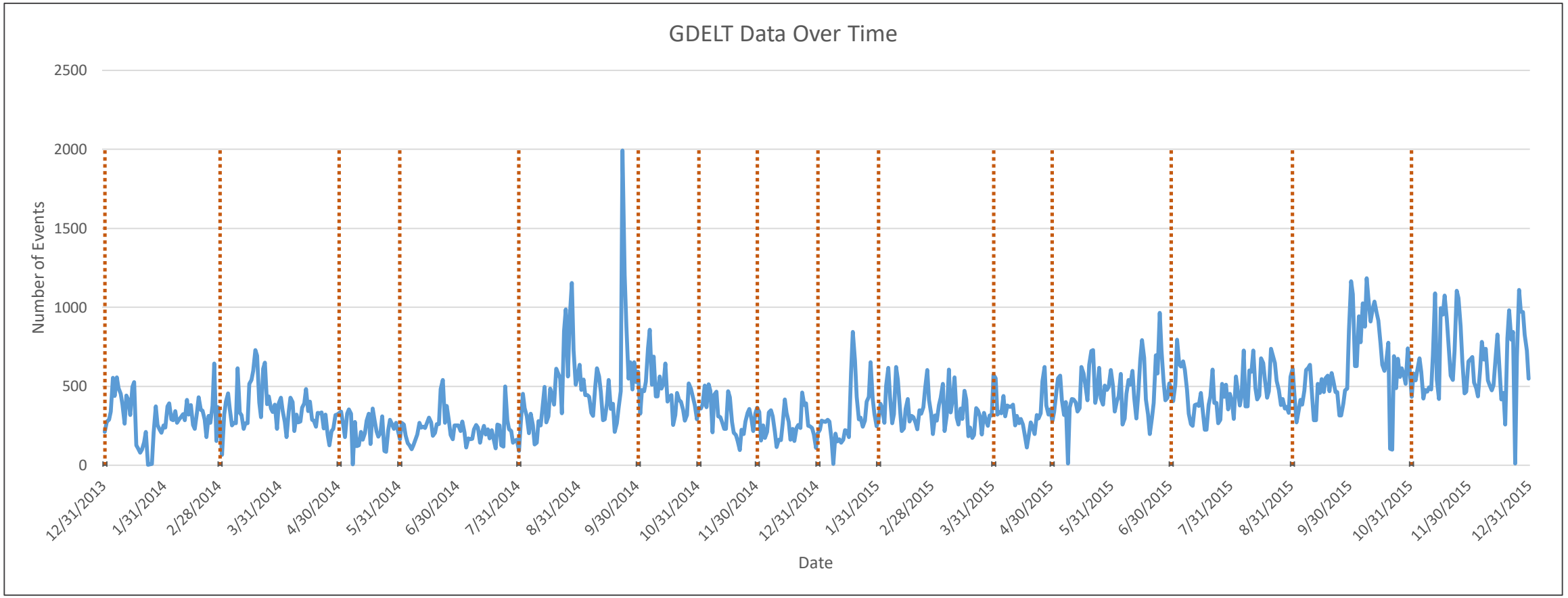
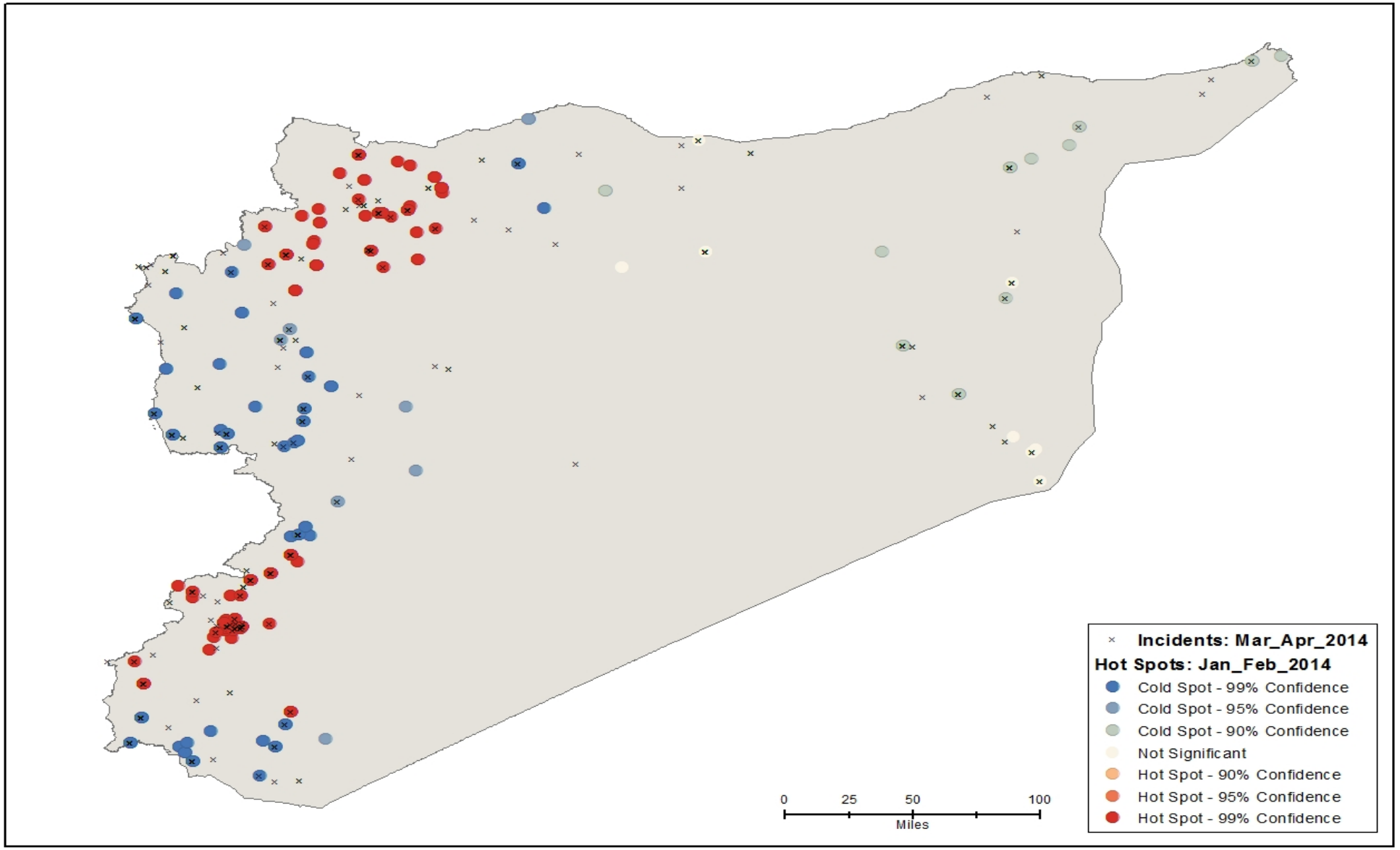
Results



The blue line represents the GDELT hits per day. The orange dash lines represent the fifteen groups formed by the grouping analysis.



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Results

- Hit rate range: 36.9 – 63.3%
- Average hit rate: 47.7%
- Average False Positive: 5.8%

- Average crime mapping hit rates: 8-20%
- Average hit rate for GDELT without the addition of the grouping analysis: 29.3%
    - Adding in the grouping method increased the average hit rate by 18.4%

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Conclusion

Hot spot analysis commonly used in crime mapping; can also be applied to a war environment

Adding in the grouping analysis to the hot spot methodology increases the accuracy of forecasting future areas of violence

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