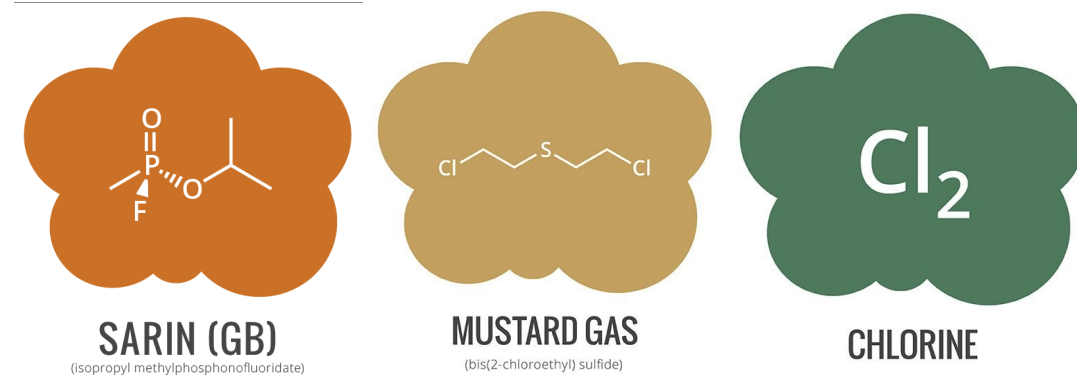


Chemical Warfare in the Syrian Civil War

A Geospatial and Space Time Analysis of Chemical Weapons use

Background

Chemical weapons have been prohibited under international law with varying degree for nearly a century. Despite these constraints, chemical weapons continue to be used in conflict, with the Syrian Civil war being the latest case study. A historical survey of chemical warfare suggests various reasons why states may use this class of weaponry, despite their ban. In World War I and the Iran-Iraq War, the use of chemical weapons was excused through a “right of retaliation,” whereby an alleged war crime can justify the initiation of another, i.e. the use of chemical weapons. In other conflict, such as the Yemeni Civil War and in the Vietnam War, states have decided to use chemical weapons in order to use the full force of their military and technological innovations. Still other cases show that states resort to chemical weapons in times of desperation, notably in the Second Italo-Ethiopian War. In the Syrian Civil War, Sarin, Chlorine, Mustard, and possibly other gases have all been used, though the rationale for their use is not evident. In this project, chemical weapons use in the Syrian Civil War (2011-Present) is analyzed to determine if there is any spatial correlation in attacks, and if so where. Moreover, space time analysis will look to see if any temporal conditions (e.g. a surge in casualties) correlate with the use of chemical weapons.

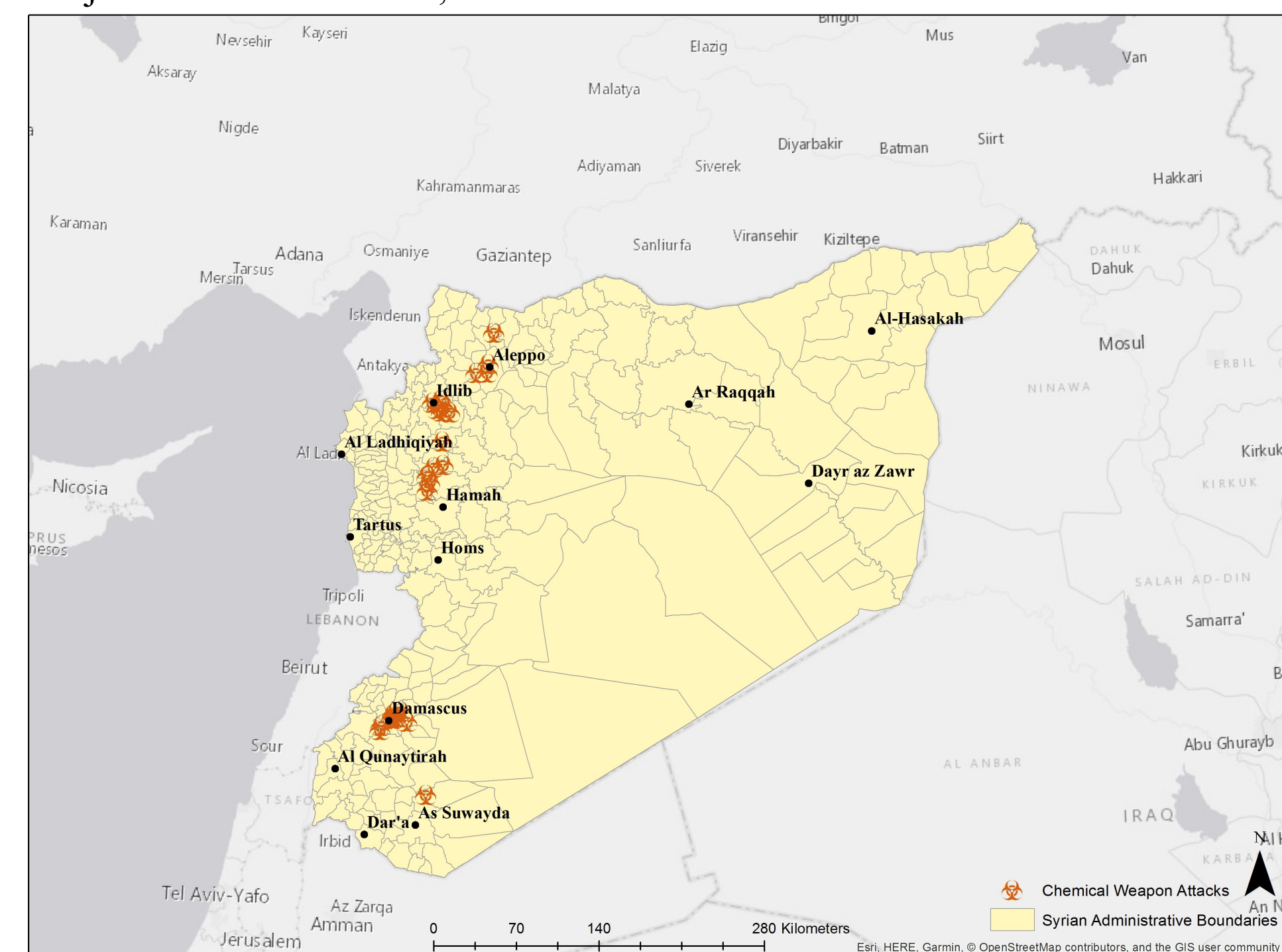


Data

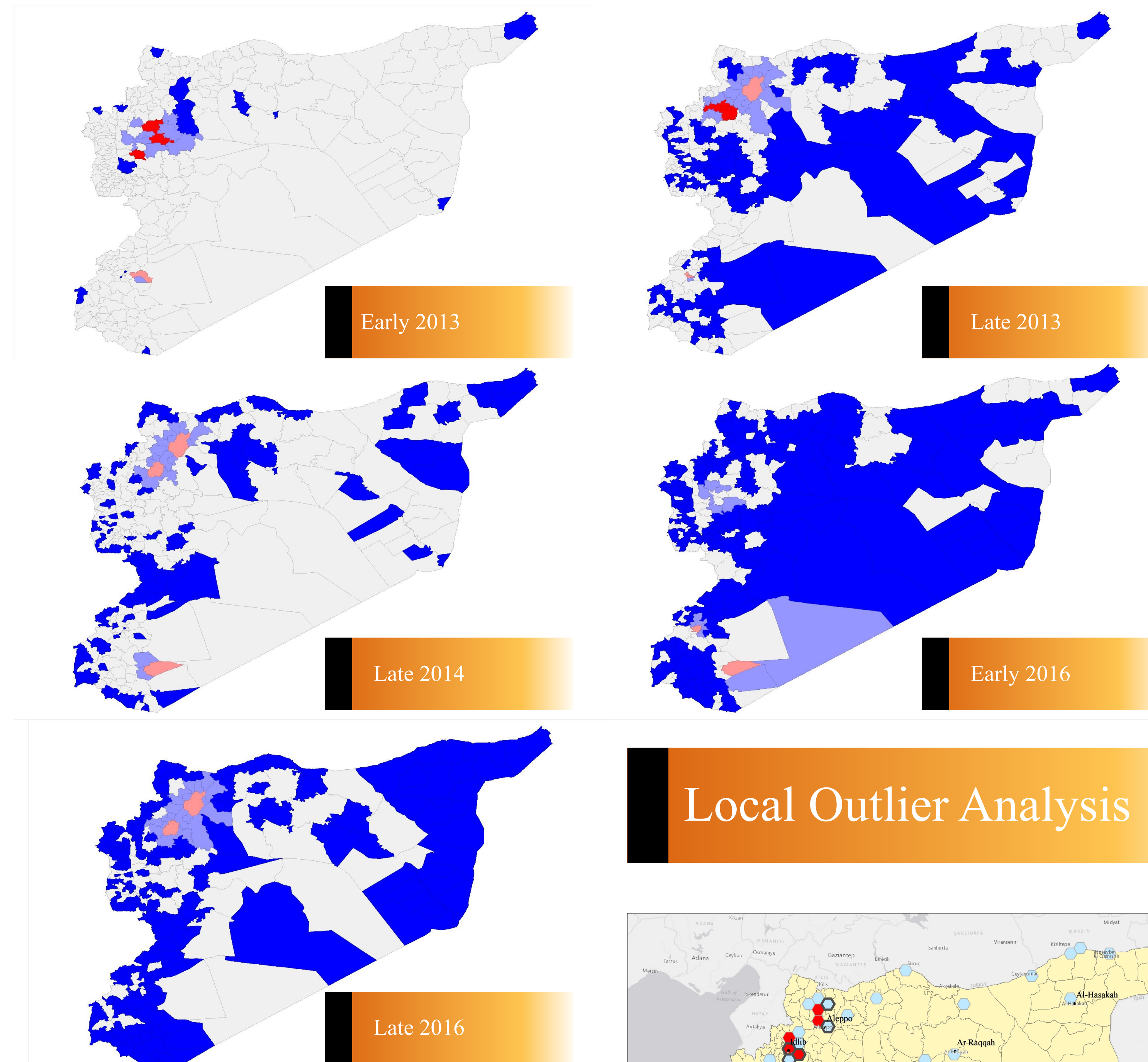
Data regarding the timing, location, and casualty count of chemical weapon attack were derived from descriptive materials provided by the Organization for the Prohibition of Chemical Weapons (OPCW), the chief international body in charge with the investigation and monitoring of such weapons, and the United Nations, who holds a working relationship with the OPCW. After identifying the municipalities in which attacks occurred, the data was geocoded. Other data regarding casualty counts in the war were provided by the Tufts GIS Data Lab.

Coordinate System: Geographic Coordinate System

Projection: UTM Zone 37, North

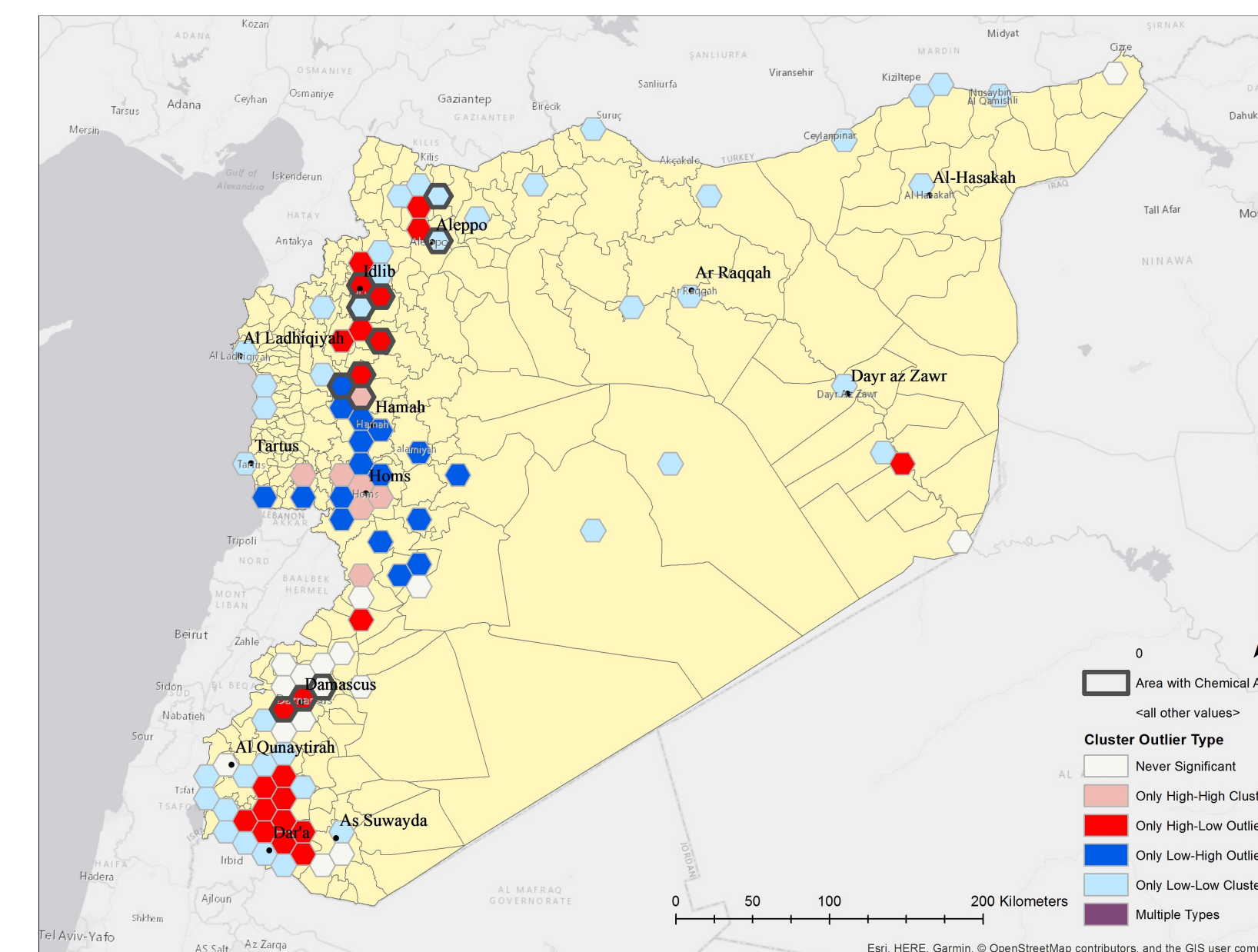


Local Moran's I



- Not Significant (51)
- High-High (0)
- Low-Low (200)
- Low-High (20)
- High-Low (2)
- Neighborless (1)

Local Outlier Analysis



Methodology

After all verifiable chemical weapons attacks were geocoded, a spatial join was used to copy the information to administrative boundaries. Clustering of chemical weapons attacks were calculated over time using univariate local Moran's I, utilizing the GeoDa software.

Temporal data on casualties in the Syrian Civil War was analyzed using local outlier analysis. Chemical weapons attacks were then joined with the hexagon grid to determine if chemical weapons attacks occur in areas with high clustering of casualties.

Coordinate System: Geographic Coordinate System

Projection: UTM Zone 37, North

Results and Limitations

When looking at clustering overtime, one can notice how chemical weapons attacks have fairly consistently been used in Northern Syria, largely near Idleb and Aleppo. While these maps do not show it, there are also a significant number of attacks that occur around the capital of Damascus. The Local Outlier Analysis hints that there is a strong correlation between chemical weapons attacks usage and clusters of high casualties. This hints at the idea that chemical weapons are used in areas that may be contentious or in particularly fatal battle areas. However, this relationship could be in reverse: chemical weapons attacks increase significantly the casualty rates in the areas in which they are used.

Data has been the largest limiting factor in studying this field. Chemical weapons use allegations, let alone other variables in conflict, are difficult to document and verify, making the data regarding location, casualties, and perpetrator incomplete and without the ideal precision for analysis. Ideally, analyzing how chemical weapons use varies with changing frontlines of the Syrian Civil War, would have been analyzed in detail, though again the data was not available. Also looking at proximity to other facilities would be of interest.

