LA-UR-23-30735

Approved for public release; distribution is unlimited.

Title: Identifying Indicators of Sociopolitical Instability in Iran

Author(s): Del Valle, Sara Y.
Vaquera Chavez, Nidia Yadira
Hughey, Lisa Michelle

Intended for: ISTI FY23 Year End Review

Issued: 2023-09-20

Identifying Indicators of Sociopolitical Instability in Iran

Nidia Vaquera, Lisa Hughey, Sara Del Valle
Information Systems & Modeling (A-1)

Information Science and Technology Institute
FY23 Year End Review

September 25, 2023

Introduction: Socio Political Instability

Defined as "*the likelihood that a government will be overthrown by unconstitutional or violent means, including social unrest, violence, hostility, or terrorism.* "

- Global protests and demonstrations have increased 244% in the last decade (*Strohecker, K. 2021*)
- Better understanding of the drivers and motivations behind this increasing instability may help inform preventative or de-escalation measures
  - Identifying measurable indicators and drivers of sociopolitical unrest is the first step in accomplishing this task and may aid with event forecasting through modeling

Los Alamos NATIONAL LABORATORY

Introduction: Socio Political Instability in Iran

Recent socio political unrest in **Iran** has potential implications within the Arab world including government, social and economic change

- The unrest initially erupted in response to the **death** of Mahsa Amini while in custody of Iran's morality police on September 16, 2022

- As a result of these protests, hundreds of protestors including children have died

Approach

Combining heterogeneous data sets → Comparing predictive classification models → Evaluating models at different spatial and temporal resolutions → Looking at feature importance

Data Sources

1. ICEWS

The Inte … nal crises via news ar …

The "Gl … al event data collecte …

The Arm … ns by political agents (…

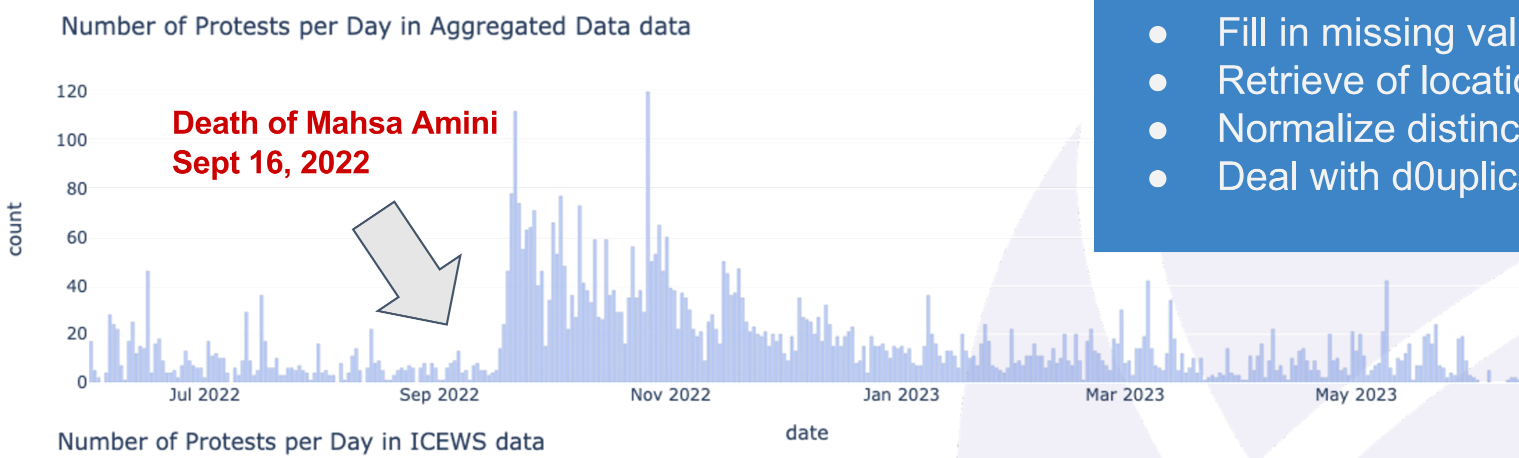
Basically, “who, did-what, to-whom, when, and where”

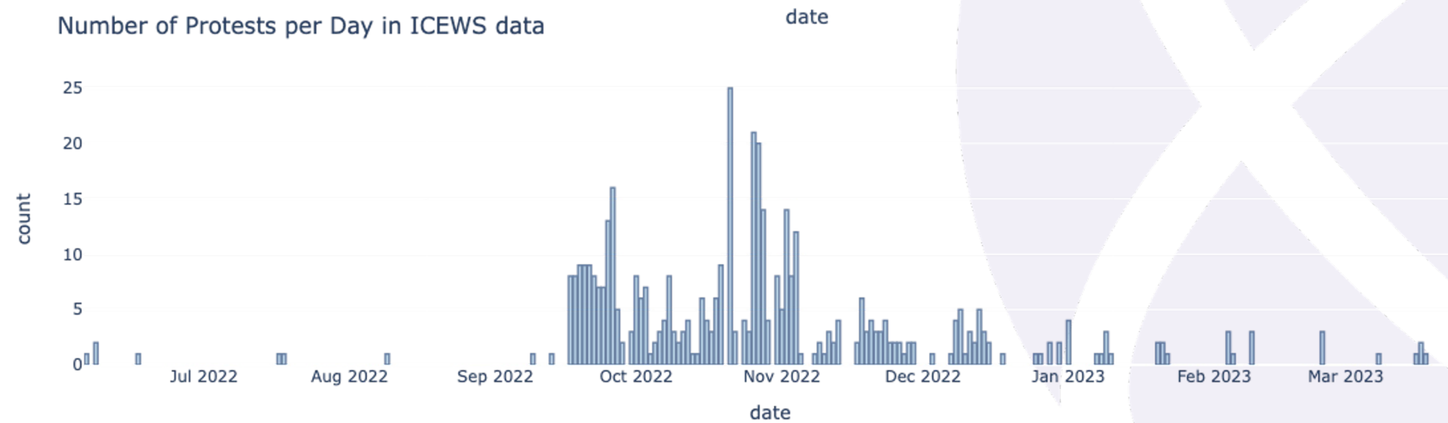
source | event type | target | temporal inf. | spatial inf.
intensity

4. POLECAT

The POLitical Event Classification, Attributes, and Types project is a global political event dataset intended to succeed the ICEWS project

Aggregated Data Sources



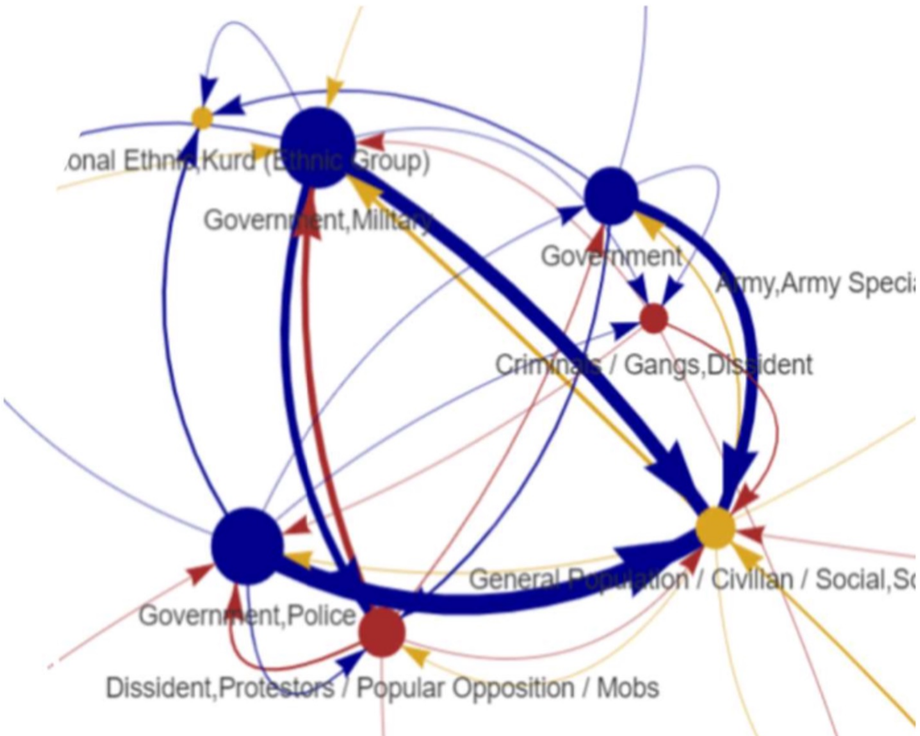


The data sources were harmonized

- Fill in missing values
- Retrieve of location information
- Normalize distinct event coding
- Deal with d0uplicates

Los Alamos
NATIONAL LABORATORY

Bi-Directional Weighted Graph for Hostile Environments



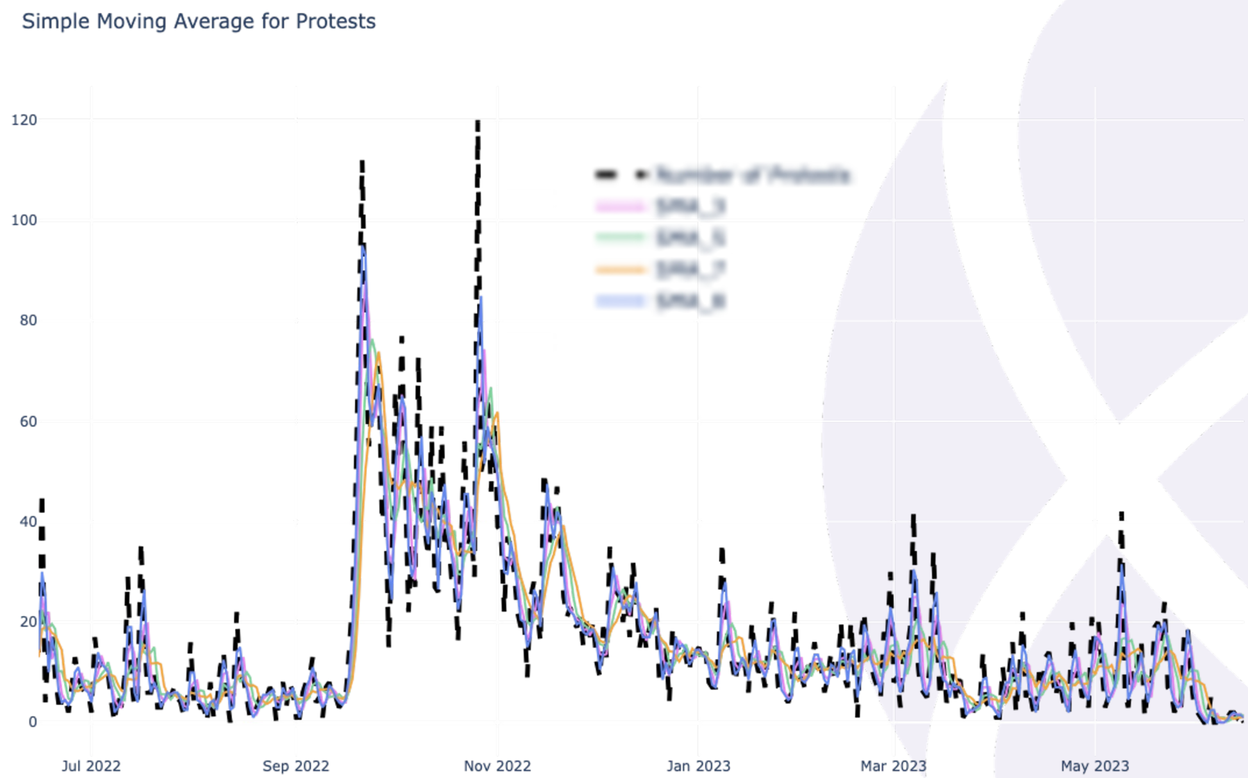
Blue: Government Aggressions Red: Rebels Yellow: Civilians

Event Intensity: ranges from **-10** to **10**

Hostile events (intensity between **-5** and **-10**)

- The most **hostile** actions were performed by **government** sectors upon **civilians**
- The second largest group of **hostile** actions were performed by **civilians** upon **government** sectors
- Hostile **government** aggressions occurred **3 times** more often than **civilian** protests

Simple Moving Averages (SMA) to Predict Future Events



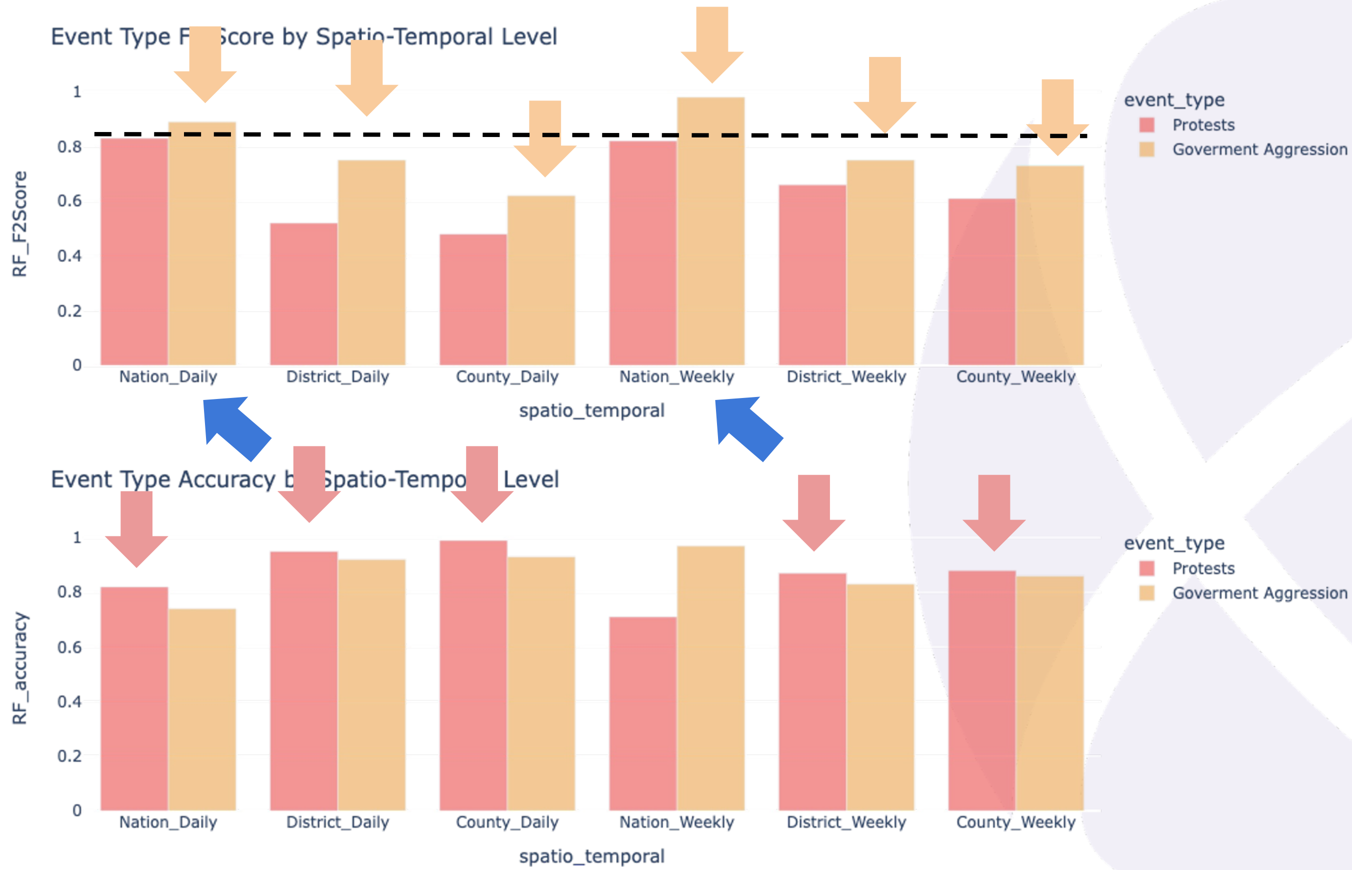
Lead up days	Mean Square Error (MSE)
2	11.5
3	13.5
5	10.4
7	8.2
8	11.3

Random Forest vs XGBoost to Forecast Events

Event Type	Time	Space	RF Accuracy	RF F2 Score	XGB Accuracy	XGB F2 Score
Protests	Daily	Nation	0.82 ± 0.1	0.83 ± 0.10	0.82 ± 0.05	0.53 ± 0.05
		District	0.95 ± 0.006	0.52 ± 0.08	0.94 ± 0.01	0.66 ± 0.06
		County	0.99 ± 0.1	0.48 ± 0.07	0.98 ± 0.003	0.28 ± 0.0
	Weekly	Nation	0.71 ± 0.15	0.82 ± 0.13	0.88 ± 0.16	0.88 ± 0.14
		District	0.87 ± 0.03	0.66 ± 0.09	0.87 ± 0.02	0.68 ± 0.10
		County	0.88 ± 0.001	0.61 ± 0.06	0.95 ± 0.006	0.72 ± 0.20
Goverment Aggression	Daily	Nation	0.74 ± 0.06	0.89 ± 0.06	0.73 ± 0.05	0.71 ± 0.06
		District	0.92 ± 0.01	0.75 ± 0.05	0.92 ± 0.01	0.58 ± 0.05
		Country	0.93 ± 0.005	0.62 ± 0.03	0.95 ± 0.004	0.57 ± 0.04
	Weekly	Nation	0.97 ± 0.02	0.98 ± 0.11	0.99 ± 0.05	0.98 ± 0.05
		District	0.83 ± 0.03	0.75 ± 0.07	0.81 ± 0.02	0.81 ± 0.09
		County	0.86 ± 0.02	0.73 ± 0.05	0.88 ± 0.01	0.77 ± 0.0

Accuracy and F2 score for the 2 event types at distinct spatio temporal levels

Random Forest vs XGBoost to Forecast Events

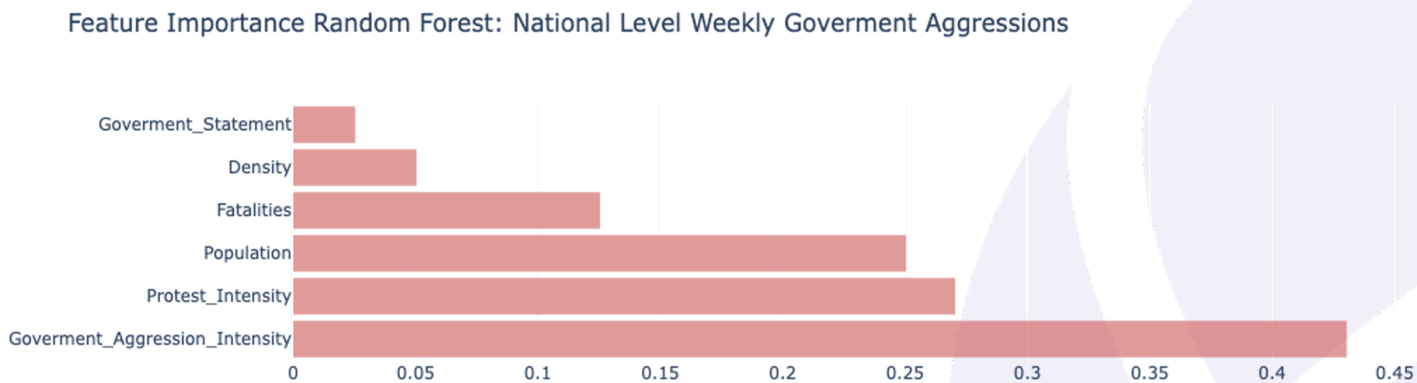


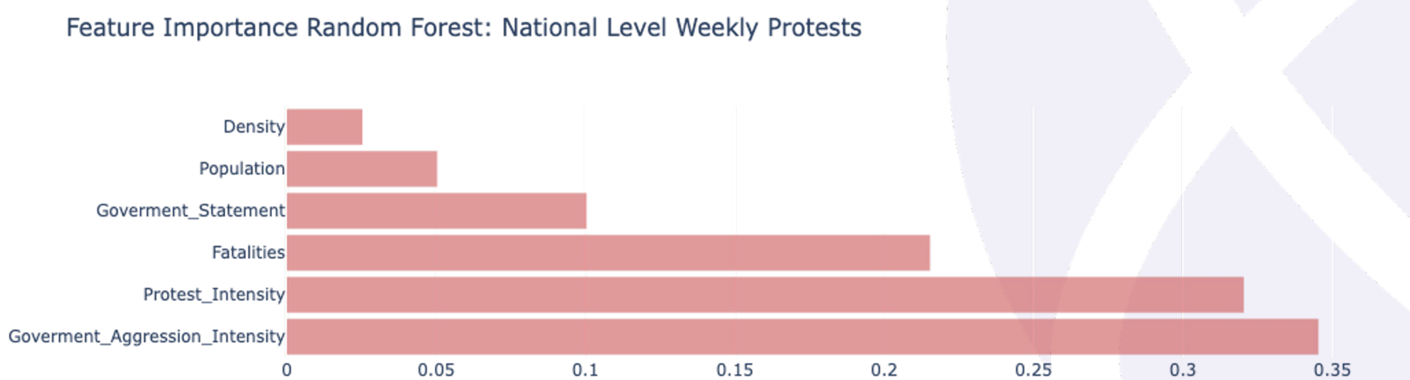
Both event types have **higher F2 Scores** at **broader spatial** levels (**nation**)

F2 Scores are **higher** for **Goverment Agression** than for Protest at equal spatio-temporal levels

Los Alamos NATIONAL LABORATORY

Feature Importance





Ranked features by relative importance at ***national*** level ***weekly*** events

The **strongest feature** across all spatio-temporal levels and event type predictions was **goverment aggresion intensity**

Los Alamos NATIONAL LABORATORY

Conclusions

What worked

- More data helped cover gaps and missing events in the timeline
- **Government aggression** was established as the strongest predictor for both RF and XgBoost models

What did not worked

- Moving averages (SMA) to identify trends or patterns using **fatalities** counts
- Augmentation of the data did not produce as good results as expected for more granular spatial levels like county and district (the **nation** level models were the best when using one data source (ICEWS) and when using all data sources combined)

Conclusions

Next steps

- Exploring the data through **network analysis**
  - Model data as a network of source and target actors
  - Engineer features from network properties

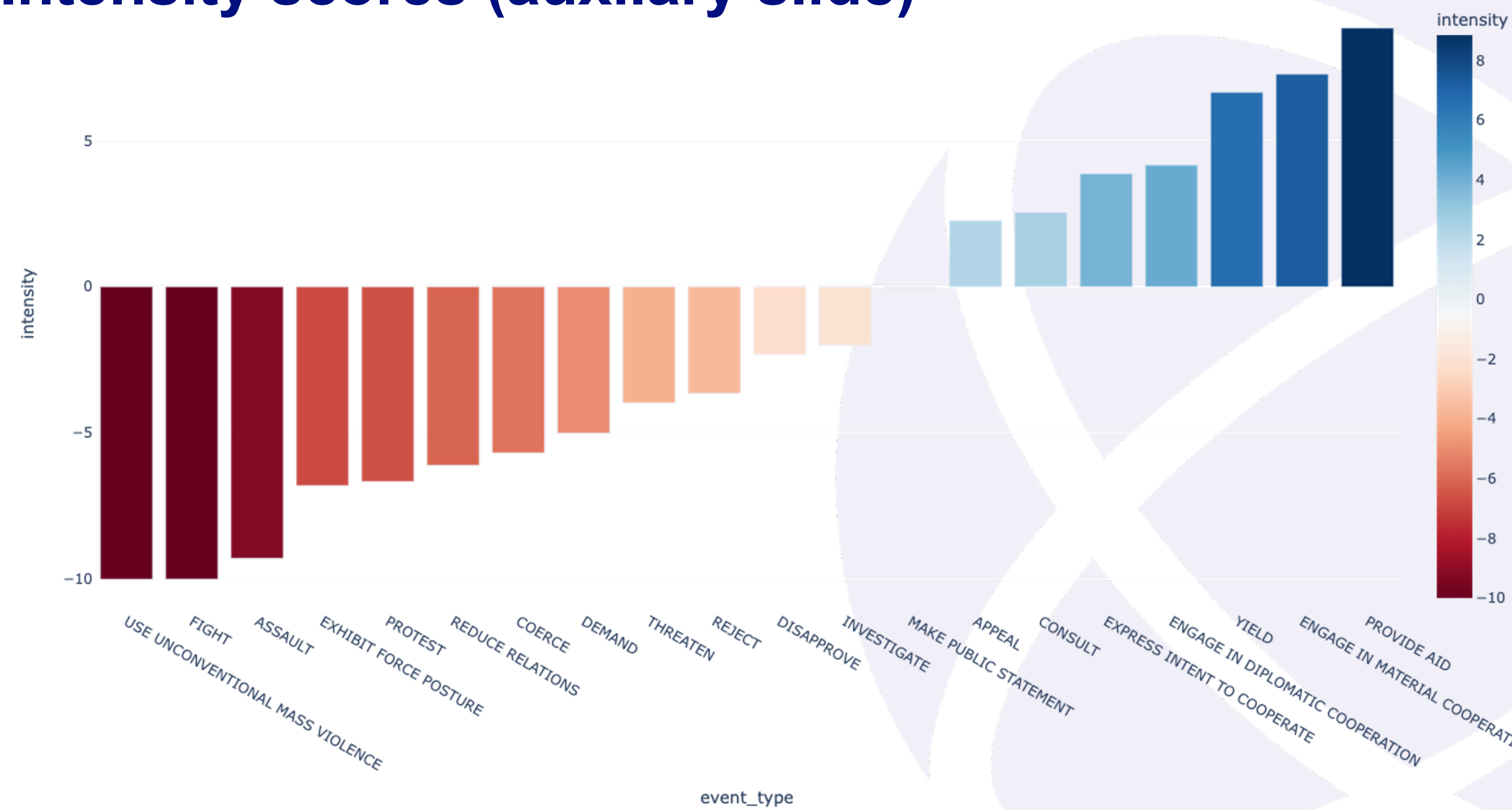
- Test approach on other regions with socio political instability around the world

Los Alamos NATIONAL LABORATORY

Thank you

Los Alamos
NATIONAL LABORATORY

Intensity scores (auxilary slide)



Los Alamos
NATIONAL LABORATORY