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# Temporal patterns in conflict prediction An improved shape-based approach

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#### Motivation



Combine strengths of both benchmarks, and create a model with low error and ability to capture variability  $\rightarrow$  the "Shape Finder"

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#### Work flow of the Shape Finder



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## Step 1–Sequencing

- \* Partition data into overlapping sequences of length 10 months
- \* For example, Mozambique Jan–October 1995, Mozambique Feb–November 1995, Mozambique March-December 1995 etc.

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#### Step 2–Sequence comparison



Figure: Euclidean distance assigns  $i^{th}$  observation in X to  $i^{th}$  observation in Y. Dynamic Time Warping assigns one data point in X to several points in Y (Chadefaux 2021; Keogh and Ratanamahatana 2005).

Only consider a filtered set (p) of subsequences for comparison with  $s \rightarrow$  keep subsequences only if distance to s is below threshold

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# Step 3–Prediction

- \* Calculate "average futures" of all subsequences in filtered set; the mean value of the data points immediately following each sequence in  $p(\bar{p})$
- \* Divide test data into four sets, each comprising 12 months  $\rightarrow$  After each year, retrain model using the predicted values for previous years

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Results

#### Evaluation metrics

<u>Mean squared error</u>,  $MSE = \frac{1}{n} \sum_{n=1}^{n} (\hat{y} - y)^2$ 

\* But rewards overly conservative predictions

Difference explained,  $DE = \frac{1}{n} \sum e^{-5|\Delta \hat{y} - \Delta y| \times \Delta y}$ 

- \* Capture deviation between predicted and actual changes
- \* Nonlinear weighting that penalizes large deviations

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#### **Evaluation metrics**





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#### Well-performing cases



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## Uncertainty Estimates

- \* Draw 25 bootstrap samples, only considering subsequences in reference repository *p*
- \* More to come for next prediction window

# References I



Chadefaux, Thomas. 2021. A shape-based approach to conflict forecasting. International Interactions, 1–15. https://doi.org/10.1080/03050629.2022.2009821.

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