Our Team

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LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Wellcome Trust funded

To develop methodology for forecasting of outbreaks and their evaluation

Forecasting Ebola in North Eastern DRC

- Why and what we are forecasting
- The model
- Results
- Forecast evaluation
- Advancing forecasting

Why are we forecasting

Challenge:

- Vaccine candidates ready for phase 3 trials (including J&J prime boost)
- To measure efficacy of vaccine, second trial needs to be based in region with no previous vaccination.
- Current vaccine distributed reactively – administered to contacts of cases
- Cases of Ebola must be present

Objective:

Forecast risk of Ebola cases in each health zone in the region of the outbreak with particular focus on those where cases have not yet been reported.

The model

Static model of spatial risk:

Local transmission Spatial interaction

$$\lambda_{it} = \sum_{t-(D+L)}^{t-D} \gamma N_{i,t-1} + a \sum_{j} \omega_{ij} N_{j,t-1}$$

$$\omega_{ij} = \frac{P_i P_j}{d_{ij}^k}$$ Gravity model

$$N_{i,t} = \wp(\lambda_{i,t})$$

Inputs		
N_{it}	Cases	HDX (Sit Reps)
d_{ij}	Distance	Euclidian distance between centroids
P_i	Population	Aggregates from LandScan estimates
Parameters		
γ	Internal coeff.	fitted
α	Spatial coeff.	fitted
k	Distance exponent	fitted
Constants		
D	Duration of infection	Fixed at 5 days
L	Latent period	Fixed at 7 days

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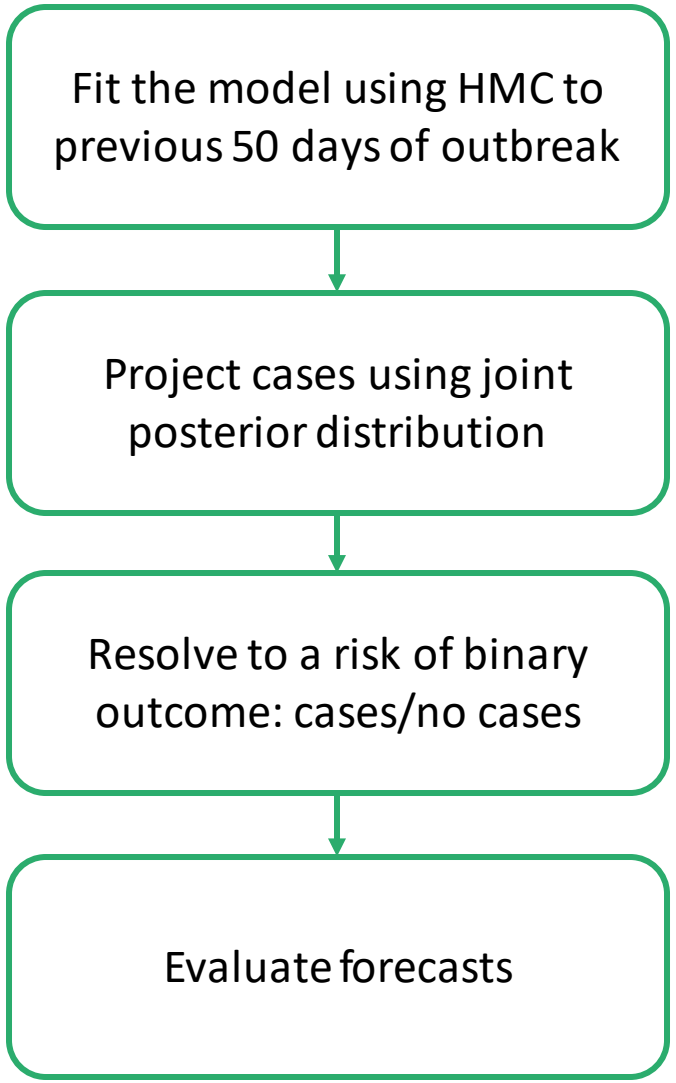
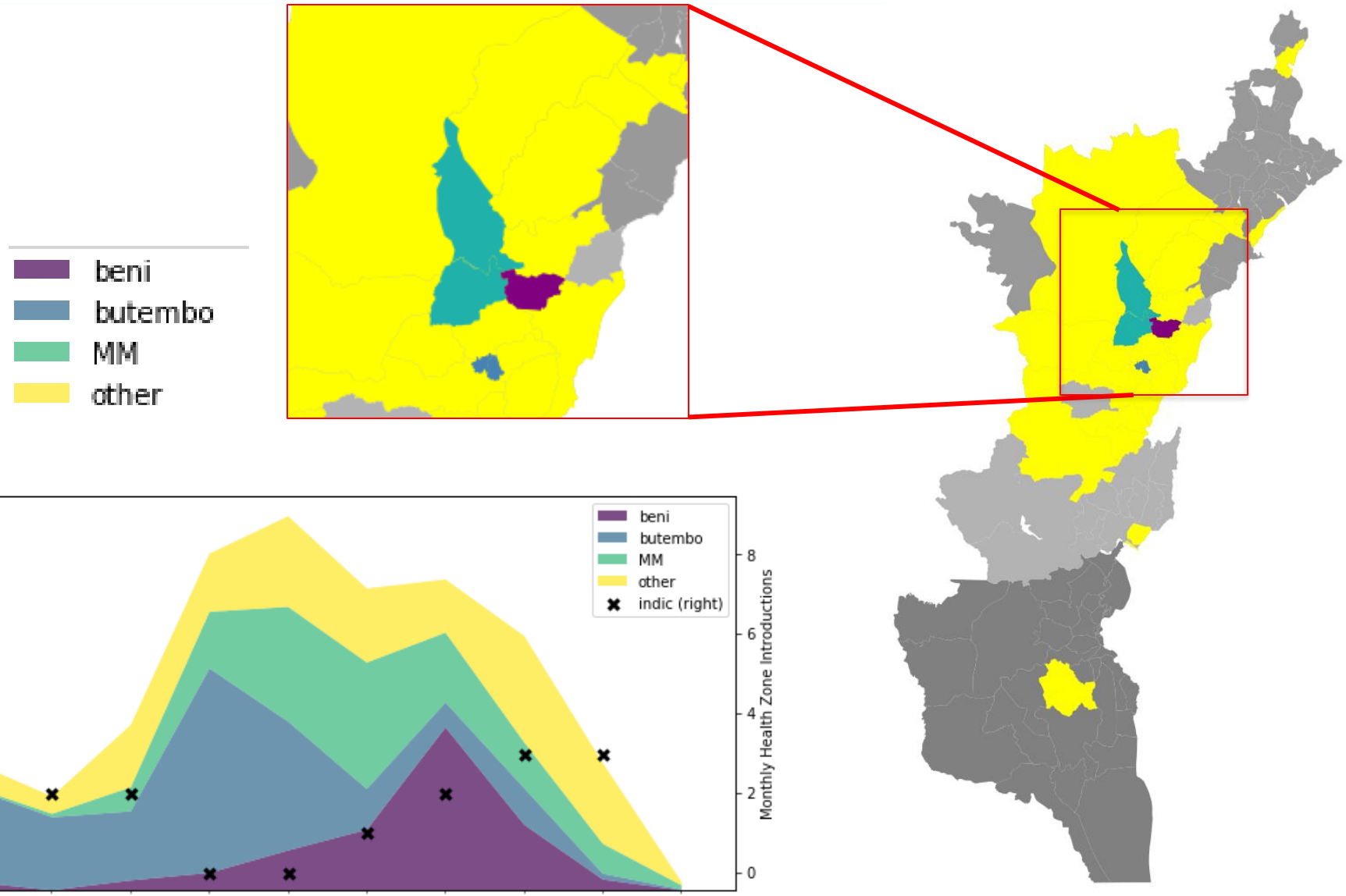
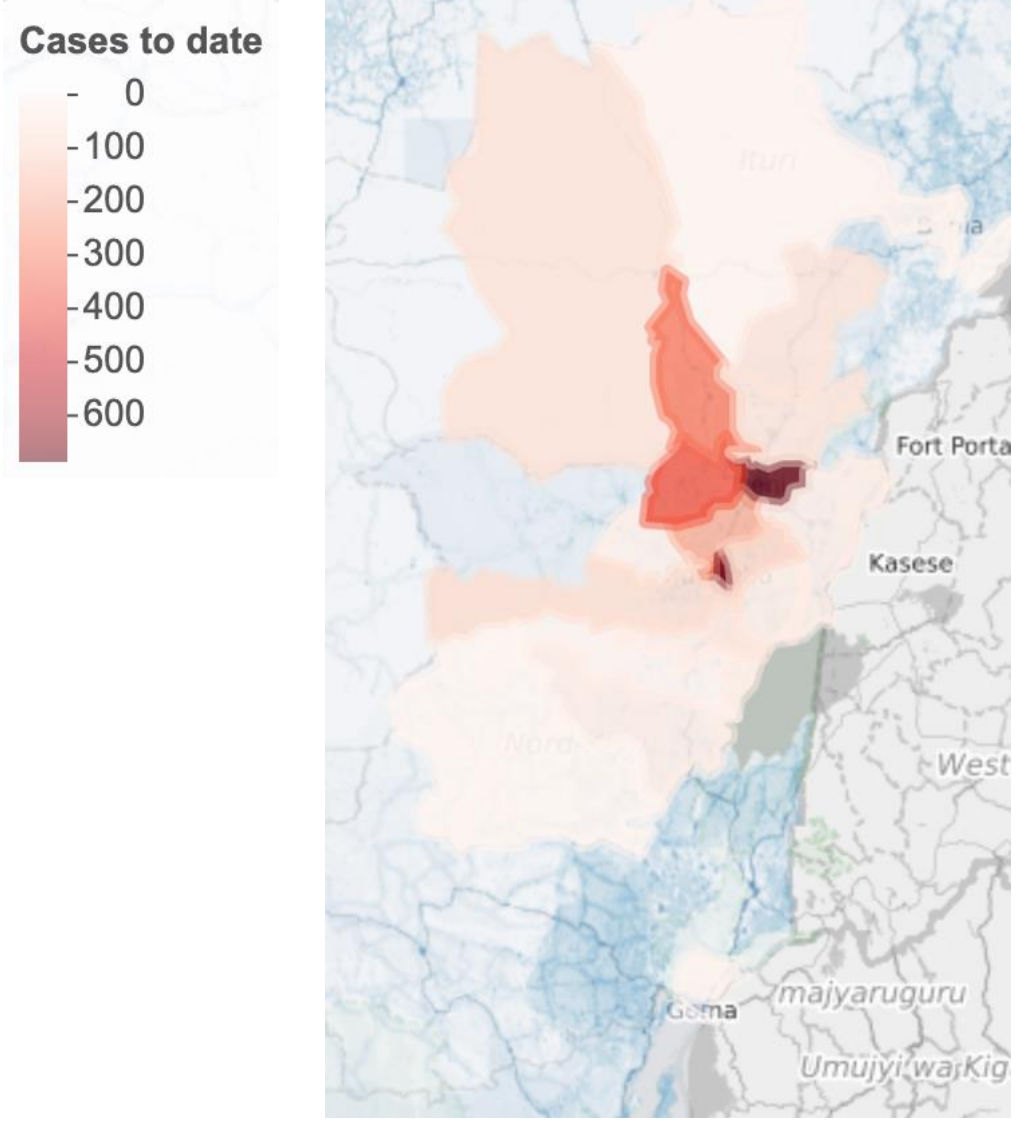
Null model: Health Zones with cases in the previous 28 days

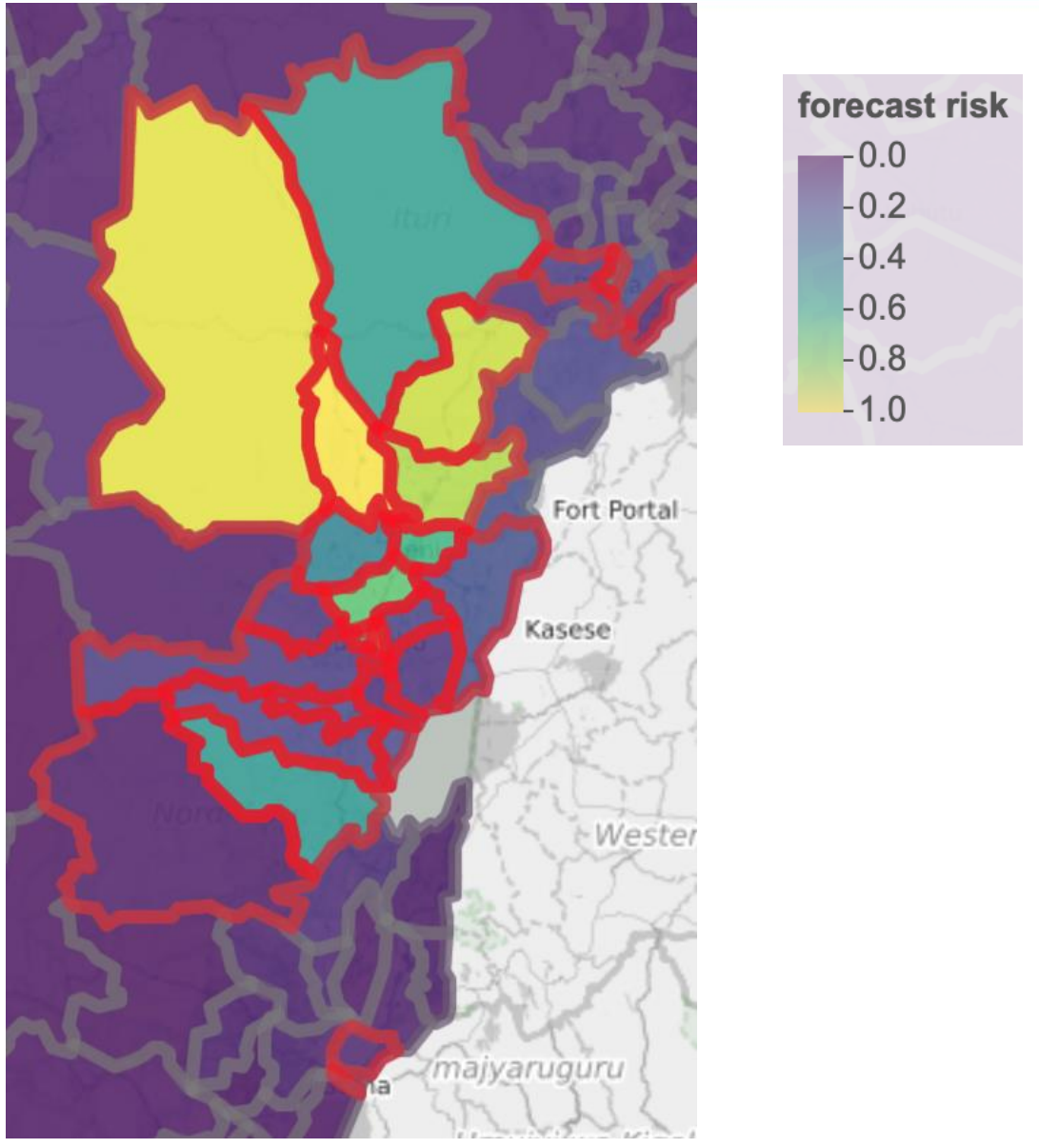


The outbreak



Results – forecasts





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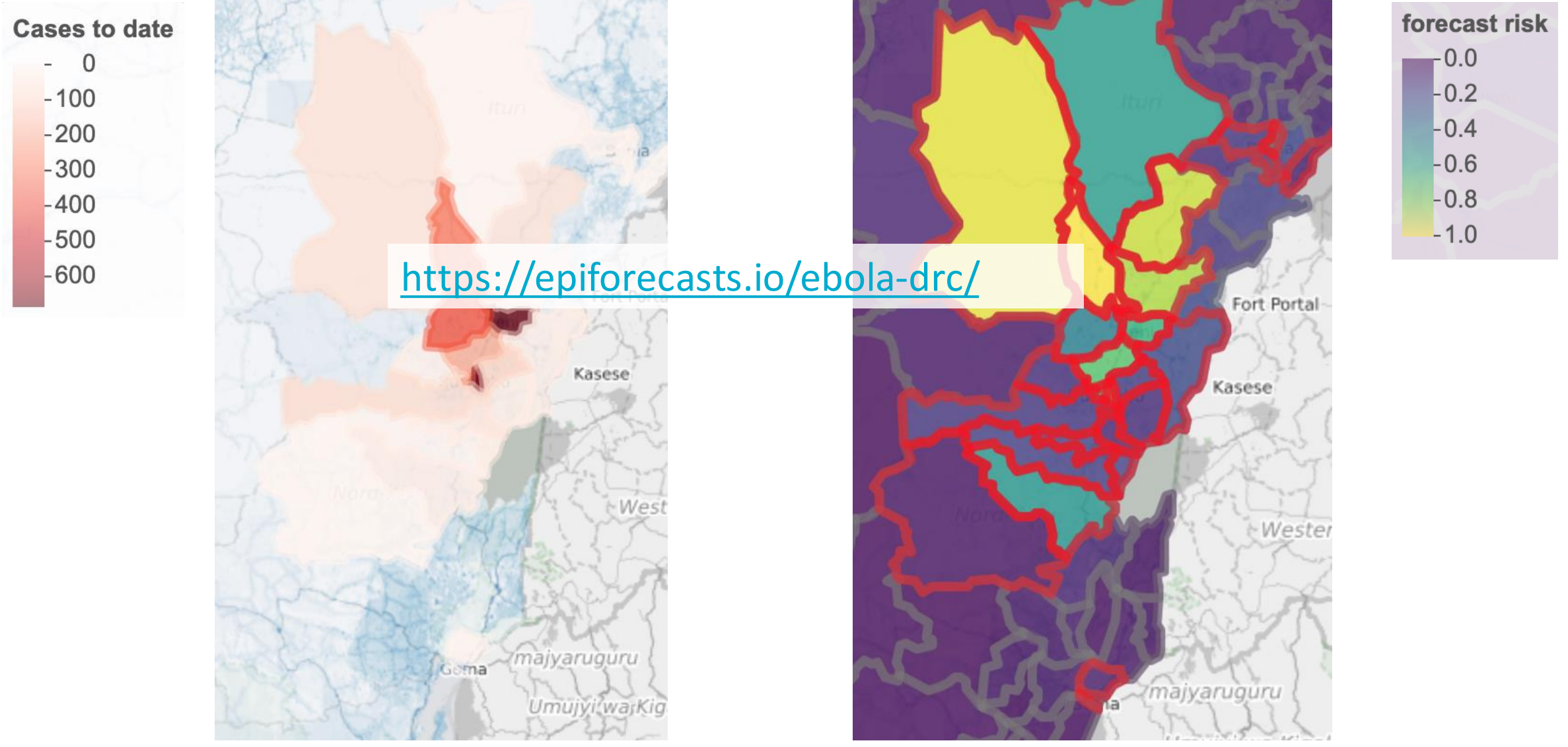


https://epiforecasts.io/ebola-drc/

Results – model parameters

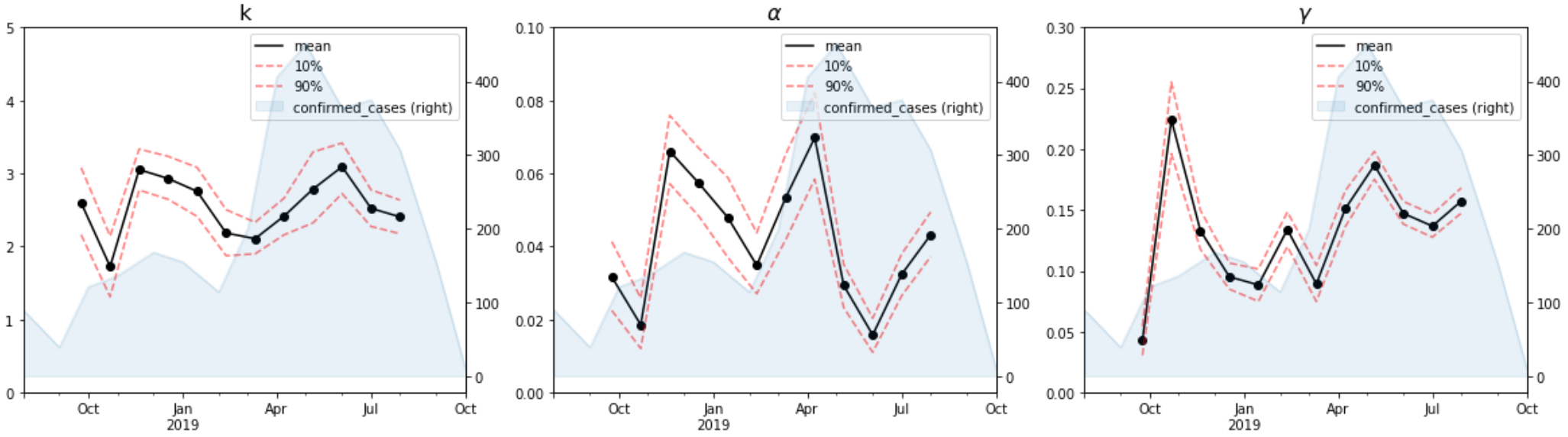
- Variation in posterior distribution of parameters over time
  - Different localities involved?
  - Interventions
  - Other factors

$$\lambda_{it} = \sum_{t-(D+L)}^{t-D} \gamma N_{i,t-1} + a \sum_{j} \omega_{ij} N_{j,t-1}$$

$$\omega_{ij} = \frac{P_i P_j}{d_{ij}^k}$$

$$N_{i,t} = \wp(\lambda_{i,t})$$

- Important to re-fit the model regularly



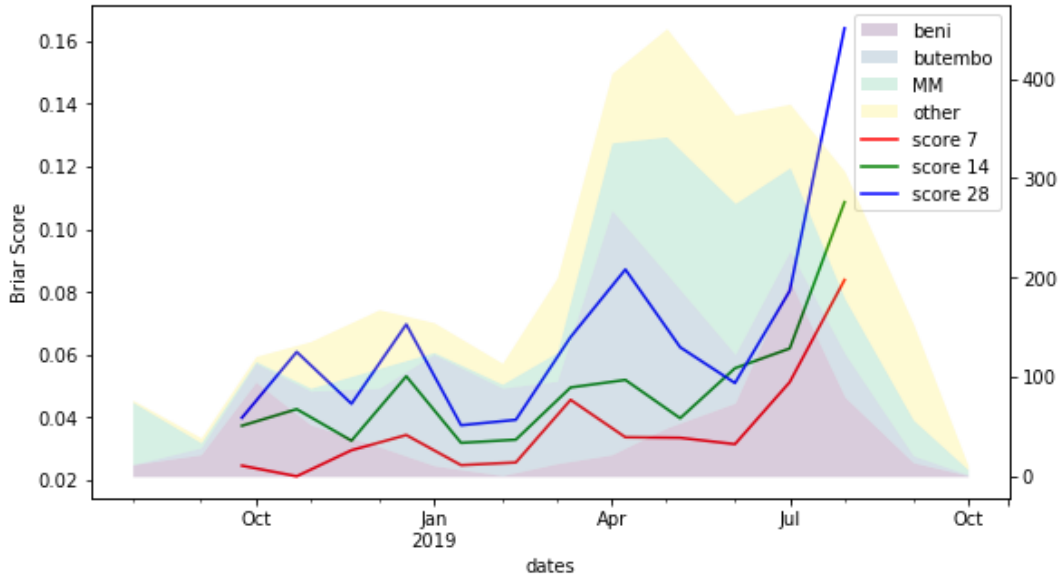
Forecast evaluation – proper scoring

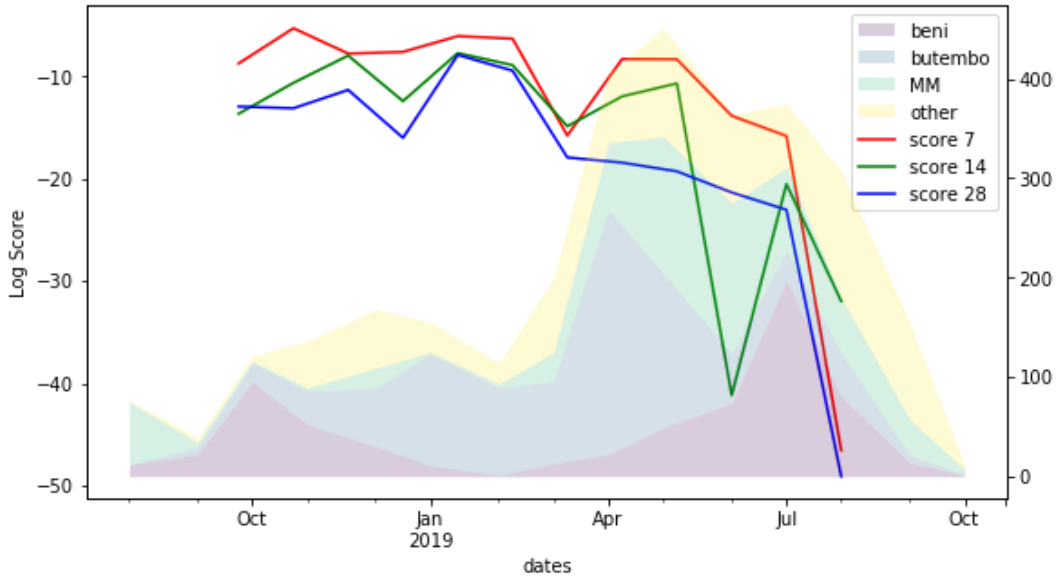
$$BS = \frac{1}{N}\sum_{i=1}^{N}(p_i - o_i)^2$$

The sum over *N* events of the square of the difference between the probability of observing an event and the observation o_i status (1 or 0)

$$LS = \sum_{i=1}^{N} \begin{cases} \log(p_i) & : o_i = 1 \\ \log(1 - p_i) & : o_i = 0 \end{cases}$$

The sum over *N* events of the log probability of **observing or not observing events** that **have or have not** occurred





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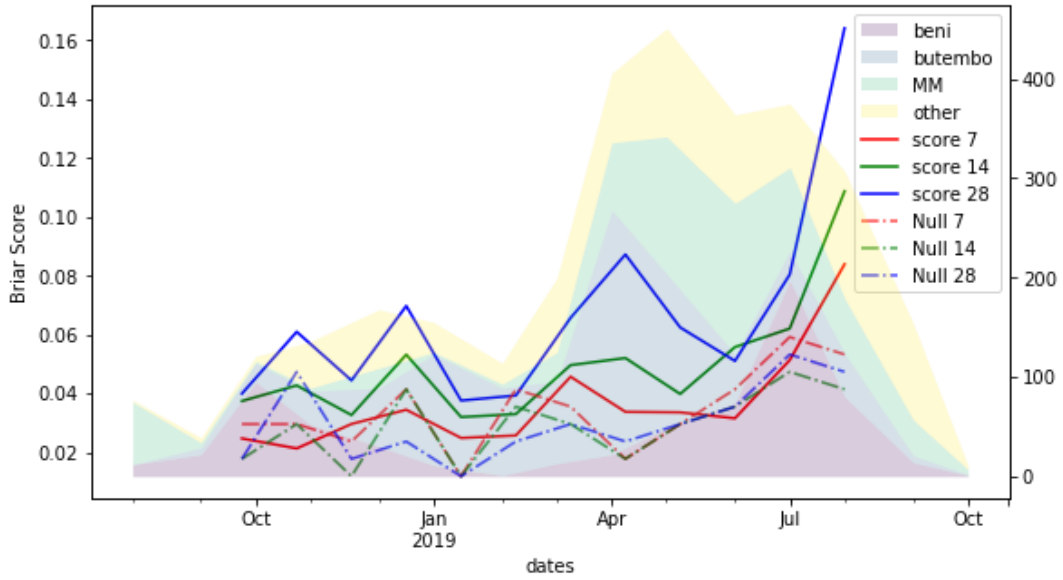
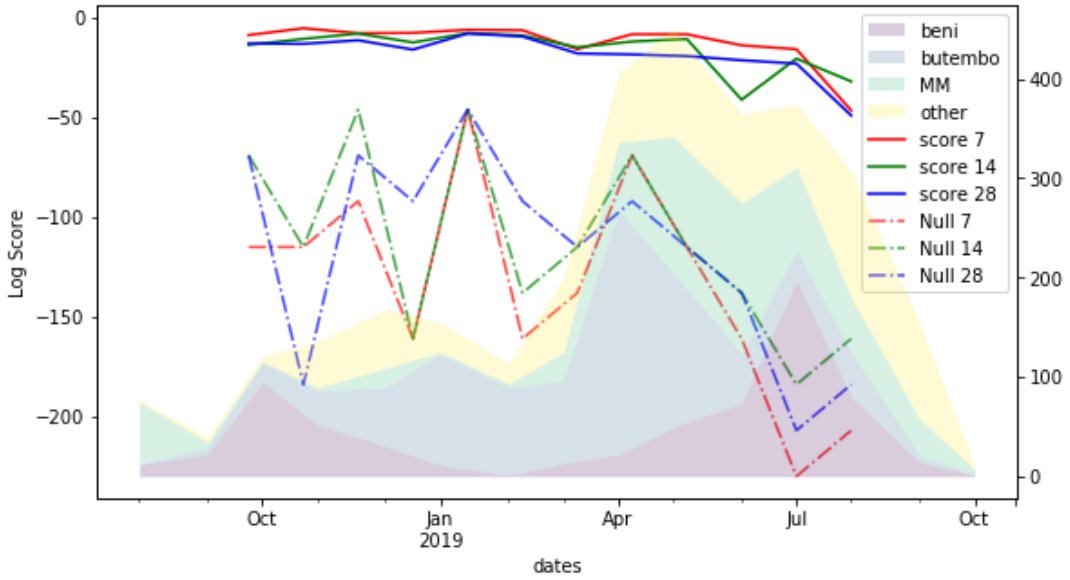
Comparing the forecast to the null model

Null model: Health Zones with cases in the previous 28 days





Advancing forecasting – real world evaluation

Does forecast evaluation tell us what we really need to know?

- Expert elicitation – with and without the forecast
- Quantifying risk effectively
- Understanding what kind of information is most useful when

Summary

- Our model provides risk of Ebola cases in DRC at a health zone level (https://epiforecasts.io/ebola-drc/)
- Parameter values and forecast performance varies over the course of the outbreak – particularly in recent months
- Variation in performance may be due to different settings and impact of interventions
- Providing useful forecasts in the future will require holistic evaluation – not just quantitative

Thank you

Especially to:

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