BIOCOMPLEXITY INSTITUTE
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Risk estimation for DRC Ebola outbreak using a metapopulation model

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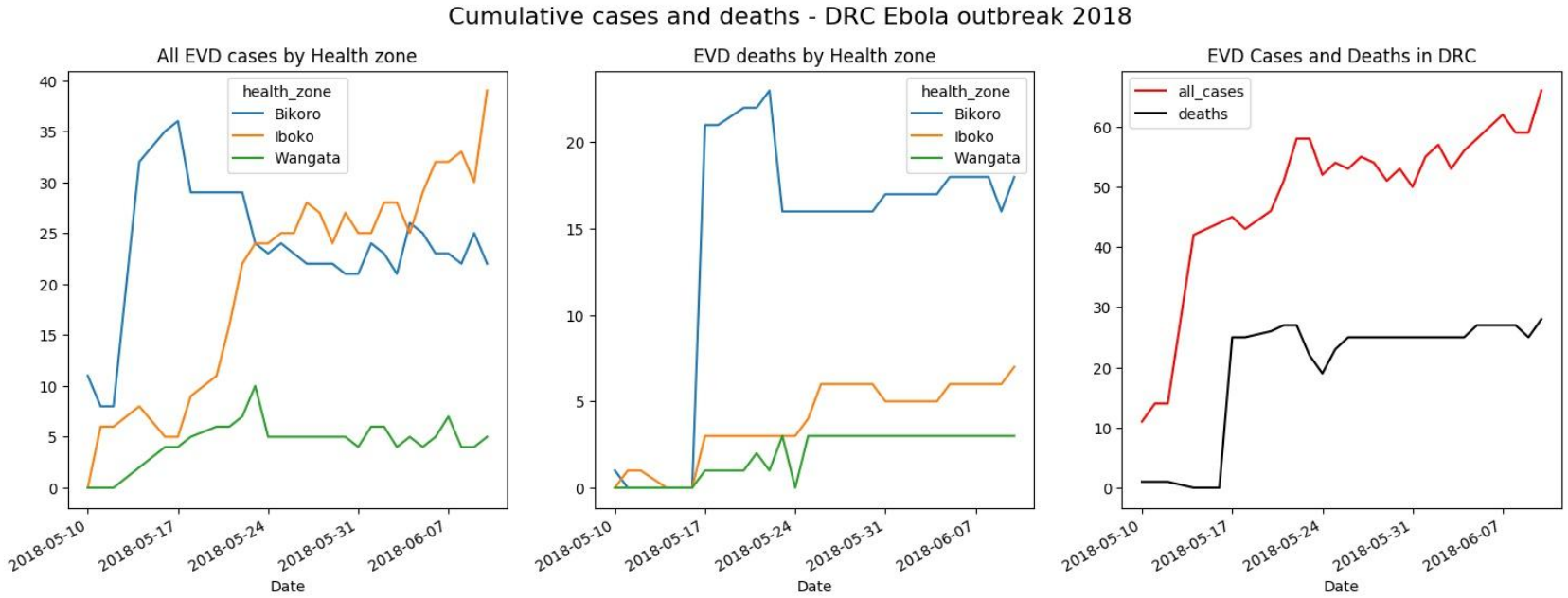
Current scenario

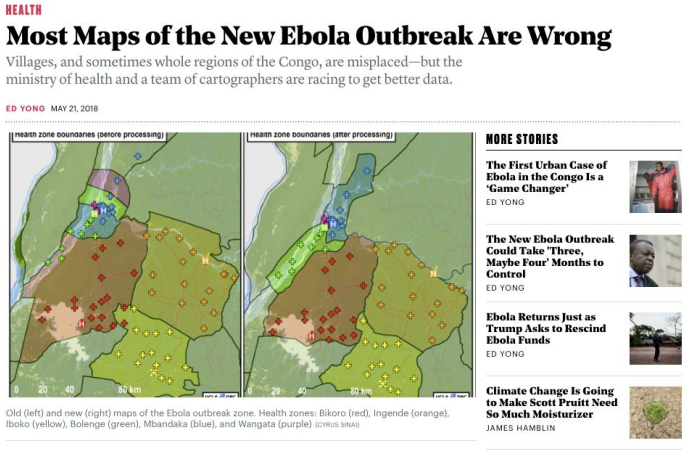


Data source: DRC Ministry of Health (via https://github.com/cmrivers/ebola_drc)

Choropleth animation

- Currently using older Health zone map (source: HDX)
- Shapefiles are being updated on the ground

https://www.theatlantic.com/health/archive/2018/05/most-maps-of-the-new-ebola-outbreak-are-wrong/560777/



HEALTH

Most Maps of the New Ebola Outbreak Are Wrong

Villages, and sometimes whole regions of the Congo, are misplaced—but the ministry of health and a team of cartographers are racing to get better data.

ED YONG MAY 21, 2018

Old (left) and new (right) maps of the Ebola outbreak zone. Health zones: Bikoro (red), Ingende (orange), Iboko (yellow), Bolenge (green), Mbandaka (blue), and Wangata (purple) (CYRUS SINAI)

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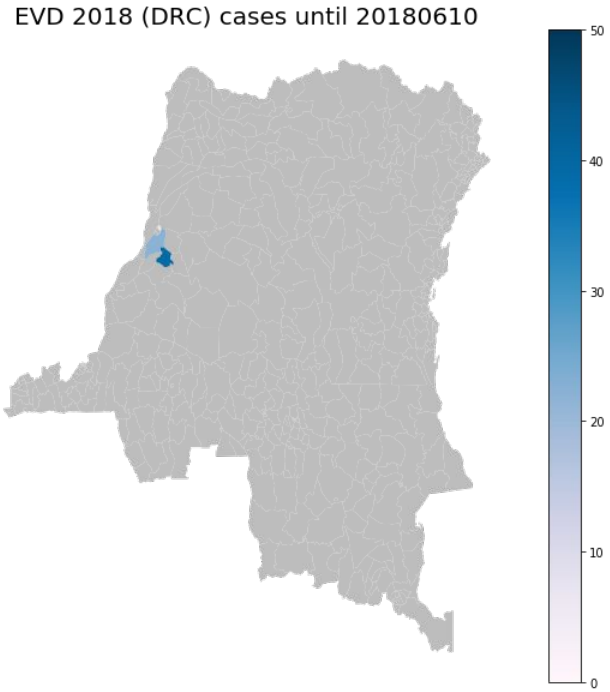
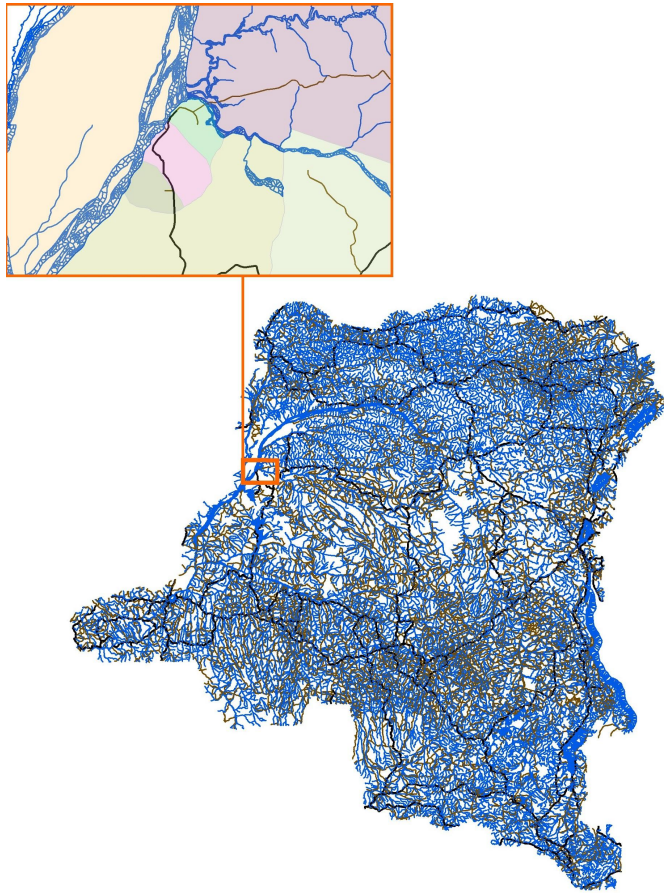
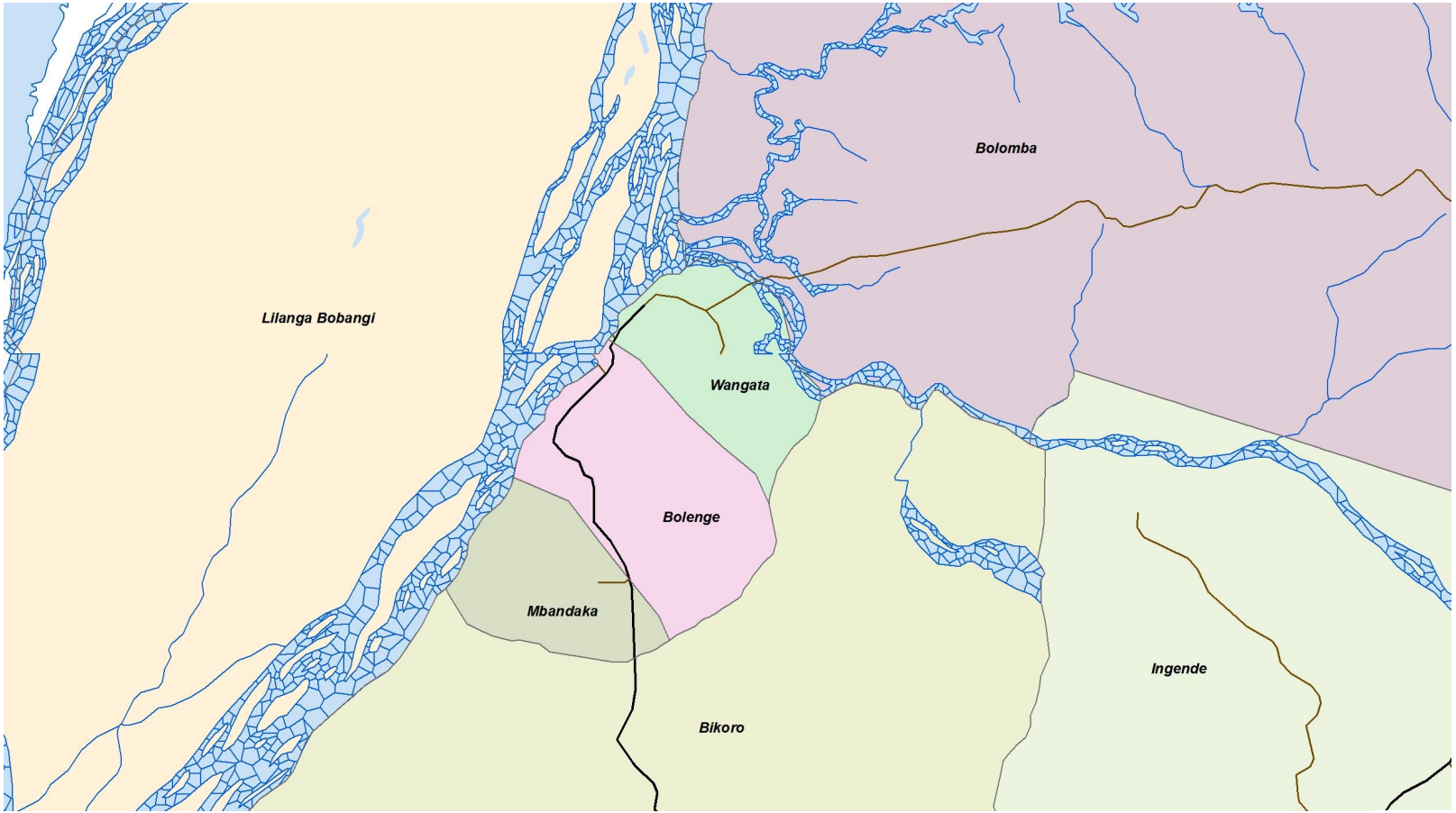


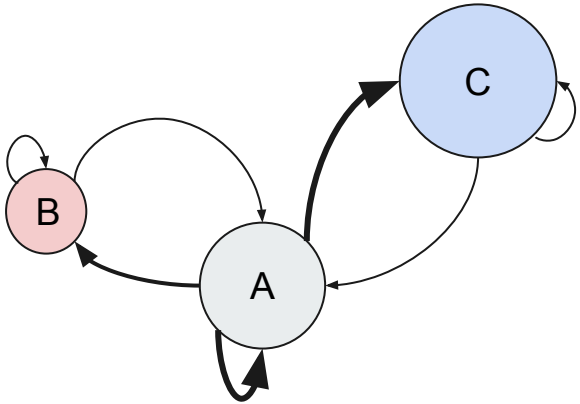
Network construction

- Combining road network and river network
- Based on Digital Chart of the World inland water and road files (diva-gis.org)
- Challenges:
  - Rivers represented as polygon.
- Solution:
  - River banks to edges - connecting river banks through voronoi edges (see Figure)
- Derive travel times between population weighted centroids of health zones
- Travel speeds: 3 m/s, 9 m/s and 20 m/s travel speeds for river, minor route, and major route

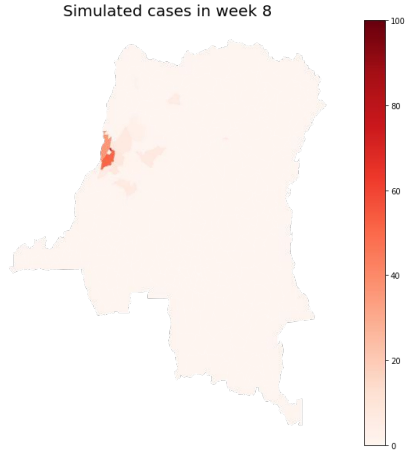



Bolomba
Lilanga Bobangi
Wangata
Bolenge
Mbandaka
Ingende
Bikoro

Disease model



- SEIR* model for each of the health zones
- Gravity model (using travel times) connecting the patches
  - 30% of population considered commuters
- InfectionRate=0.133 (mean 7.5 days)
- RecoveryRate=0.1 (mean 10 days)



* Can also use Legrand model (with F, H states).

Top risk zones

Initial seeding in Bikoro (10 cases on day 0)

District: Health Zone	Relative risk
Equateur:Bikoro	0.524
Mbandaka:Wangata	0.347
Equateur:Lilanga Bobangi	0.127

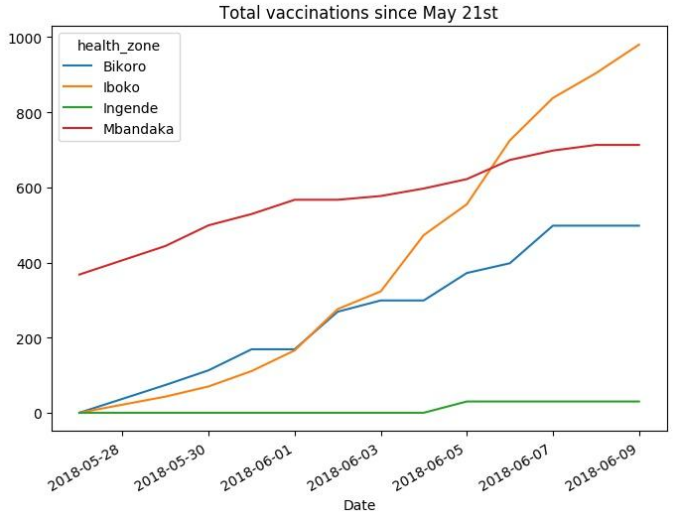
Increased transmissibility regime to identify other potential locations for cases

District: Health Zone	Relative risk
Equateur:Bikoro	0.376
Mbandaka:Wangata	0.322
Equateur:Lilanga Bobangi	0.151
Equateur:Ingende	0.026
Equateur:Iboko	0.026
Tshuapa:Boende	0.018
Equateur:Bolomba	0.014
Kisangani:Makiso-Kisangani	0.012
Mai-Ndombe:Kiri	0.012
Equateur:Ntondo	0.010

Updated risk profile

Seeding 11 cases in Iboko (based on cases in the past three weeks)

District: Health Zone	Relative risk
Equateur:Iboko	0.939
Mbandaka:Wangata	0.030
Equateur:Bikoro	0.030



Ongoing interventions

(WHO SITREP - June 5th)

- Ring vaccination since May 21st (2000+ doses administered)
- MSF isolation facilities
  - Mbandaka's main hospital (20 beds)
  - Bikoro hospital (15 beds)
- Two Ebola treatment centres (ETC) are being set up in Iboko and Itipo.
- Contact tracing: As of 31 May 2018, a total of 880 contacts remain under active follow-up.
- Risk communication, infection prevention (safe burials), etc.

Detailed synthetic population can be constructed for faithfully representing interventions.

Srinivasan Venkatramanan et al. "Using data-driven agent-based models for forecasting emerging infectious diseases", Elsevier Epidemics 2018
https://www.sciencedirect.com/science/article/pii/S1755436517300221

Contact

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Code: https://github.com/srinivvenkat/DRC_Ebola_2018/