Crimean Congo Hemorrhagic Fever

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Our team

USRA, Goddard Earth Sciences Technology and Research (GESTAR) Columbia, Maryland and NASA Goddard Space Flight Center, Greenbelt, Maryland

- Assaf Anyamba
  - PhD, *Principal Investigator*
- Bhaskar Bishnoi
  - MSc, *App developer and Analytics*
- Heidi Tubbs
  - BSc, *App developer and Data Development*
- Jennifer Small
  - MSc, *Modelling and Analytics*
- Richard Damoah
  - PhD, *Scientist, Forecast Data Retrievals*

USRA

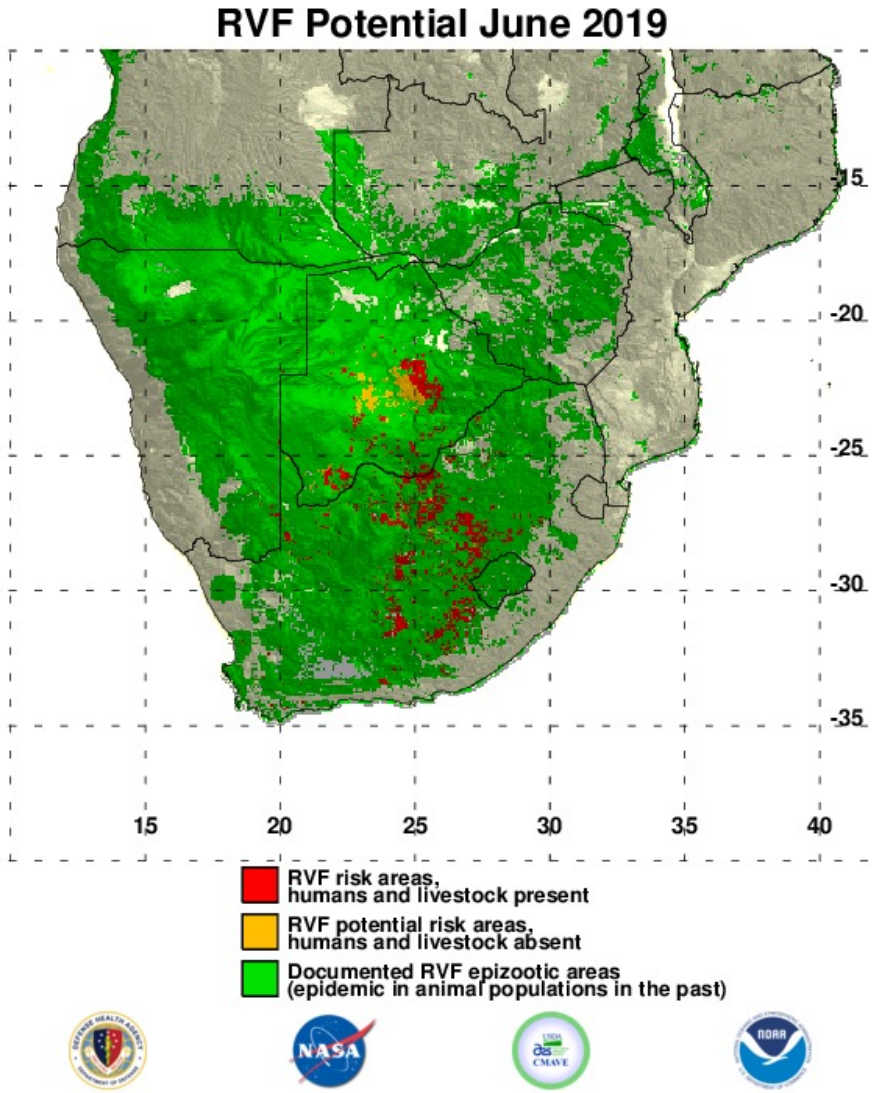
Universities Space Research Association

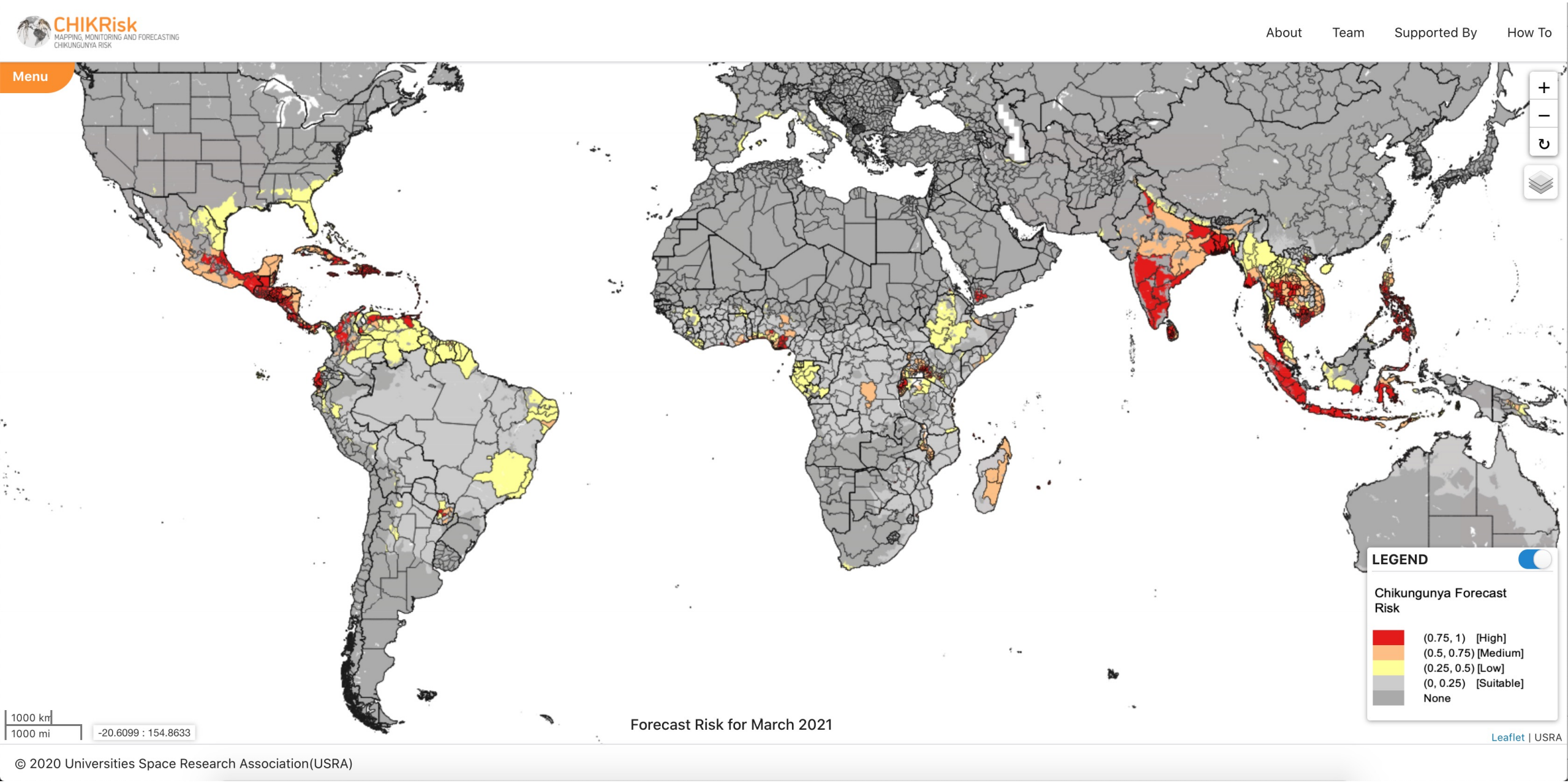
GESTAR

NASA Goddard SPACE FLIGHT CENTER

Our work

- Diseases modulated by climate variability
- ChikRISK web application (https://vbd.usra.edu)
  - Forecasting global chikungunya risk using satellite-derived climate data
- Rift Valley fever and associated El Niño/Southern Oscillation (ENSO)
- Disease risk models for chikungunya, Rift Valley fever, zika, hantavirus, and plague





https://vbd.usra.edu

Last semester…

- Presented a problem to RPI Data Analytics class: gathering disease report data from the internet
- RPI student Ethan Joseph created a web scraper and natural language processing application to extract vital outbreak data
- Paper submitted to the IEEE Big Data conference

https://github.com/sirmammingtonham/vector-borne-disease-analytics

Disease outbreak reports

- ProMED Mail is a program of the International Society for Infectious Diseases (ISID)
  - The largest publicly-available system conducting global reporting of infectious diseases outbreaks
- We actively monitor chikungunya, zika, dengue, and yellow fever
- ProMED Mail archive of CCHF reports from 1995-2020

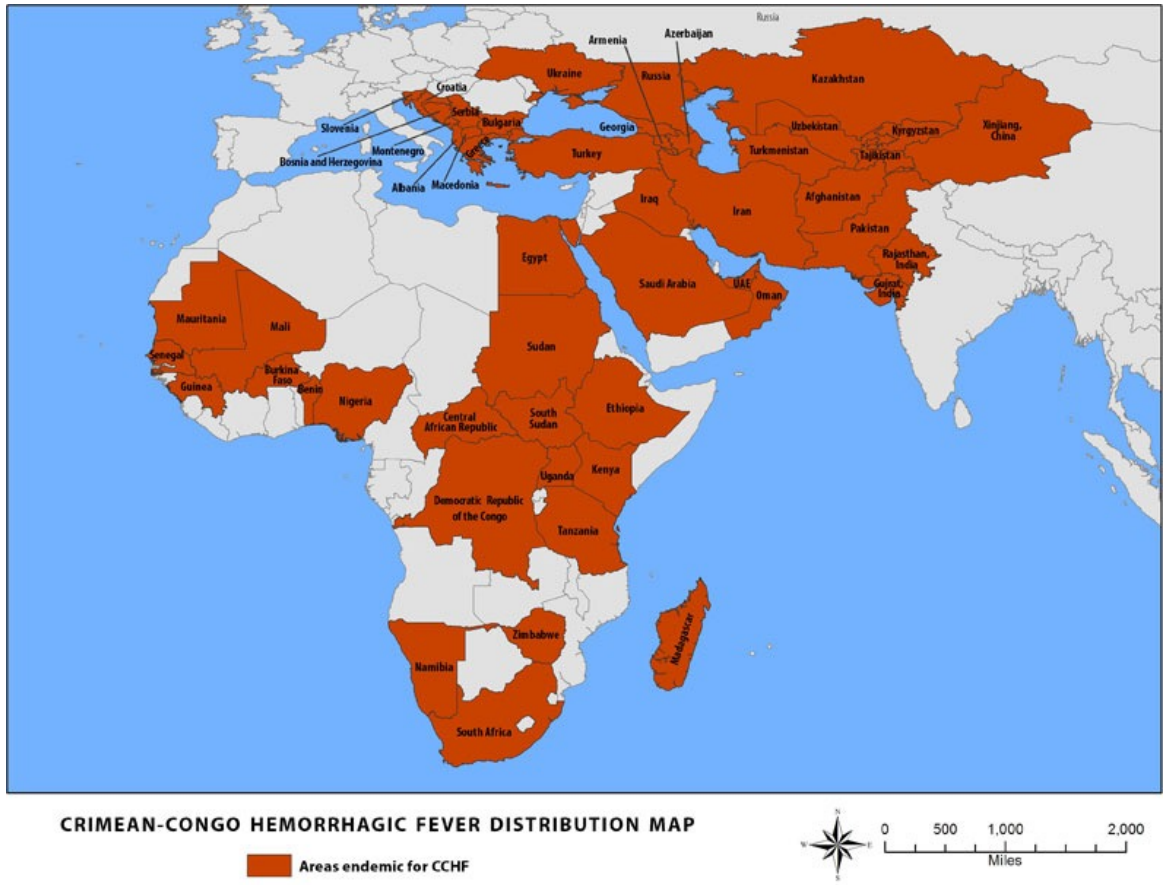
Crimean-Congo hemorrhagic fever (CCHF)

- Caused by tick-borne virus (*Nairovirus*)
- Transmission:
  - bite by infected tick
  - contact with blood of infected animal or human
- Symptoms similar to Ebola (fever, body pain, vomiting, bruising, bleeding)
- Fatality rates range from 9-70%
- High priority among international health organizations

Hyalomma tick

CCHF epidemiology

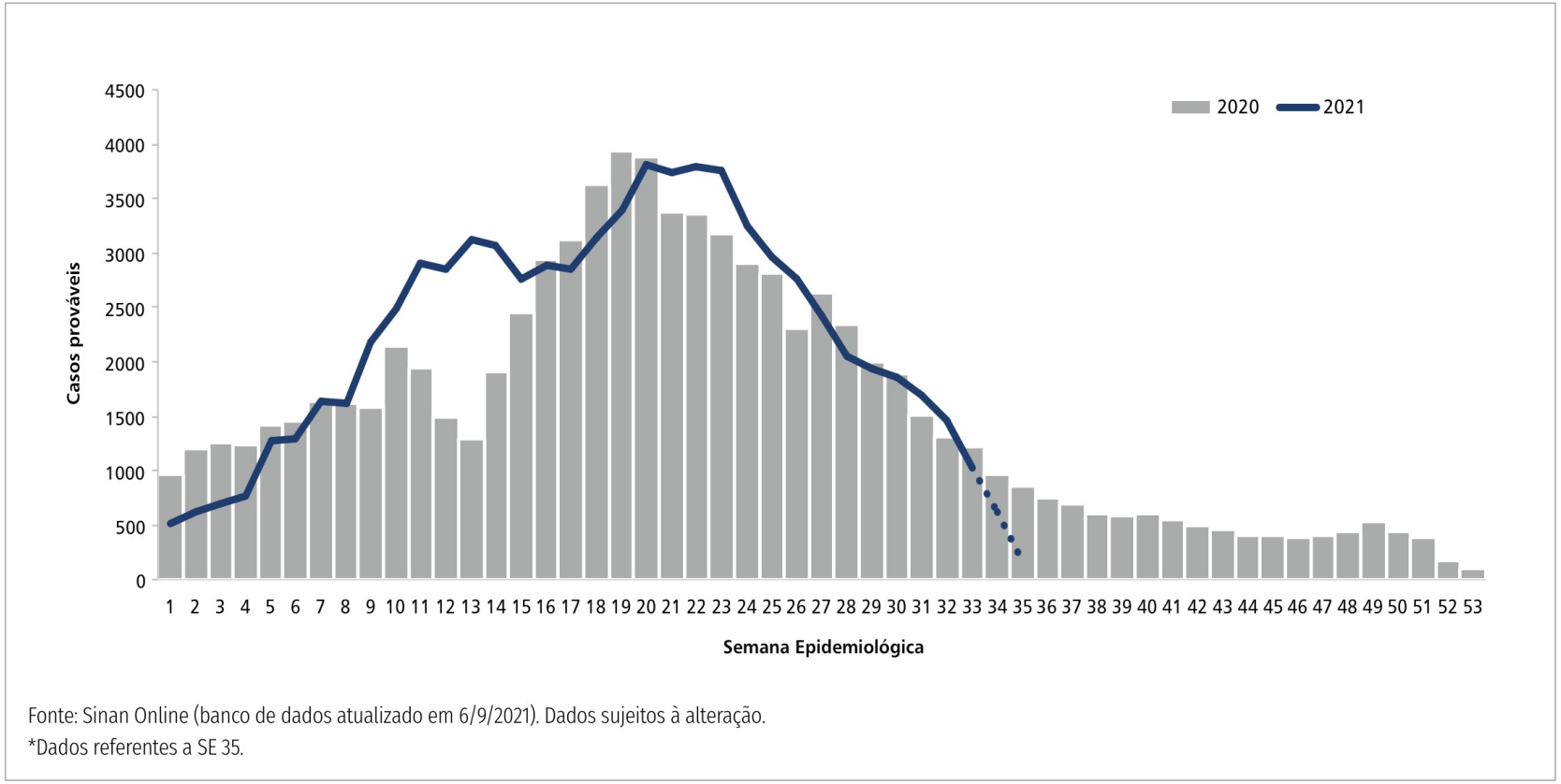
- Typically, small outbreaks are seen in endemic areas
- In 2013 Iran, Russia, Turkey, and Uzbekistan documented more than fifty cases
- Hundreds of cases per year in Turkey, 1300+ in 2009
- In 2016, first local case in Western Europe recorded in Spain



Source: cdc.gov

Outbreak seasonality

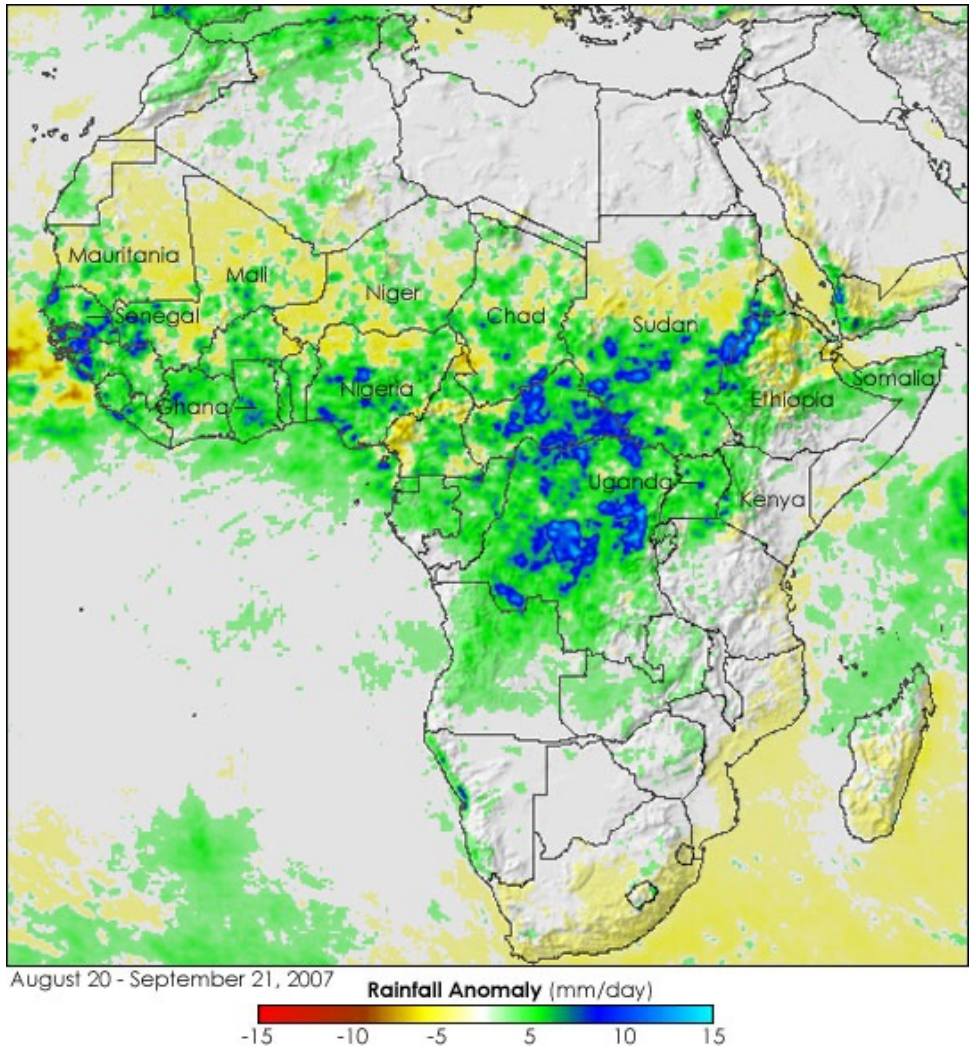
- Vector-borne diseases are typically seasonal
- Case counts follow an epidemic curve



Epidemic curve of chikungunya cases, Brazil, 2020 and 2021

The climate factor

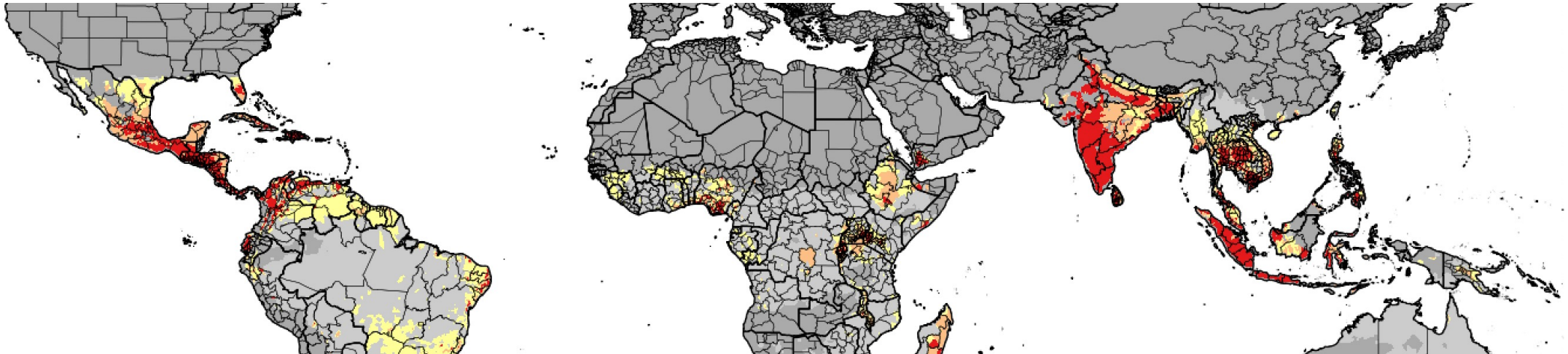
- Vector-borne disease outbreaks are driven by vector population dynamics, which are in turn influenced by climate (variability)
- Examples of climate variables:
  - Precipitation
  - Land surface temperature
  - Air temperature
  - Soil moisture
  - Vegetation (NDVI)

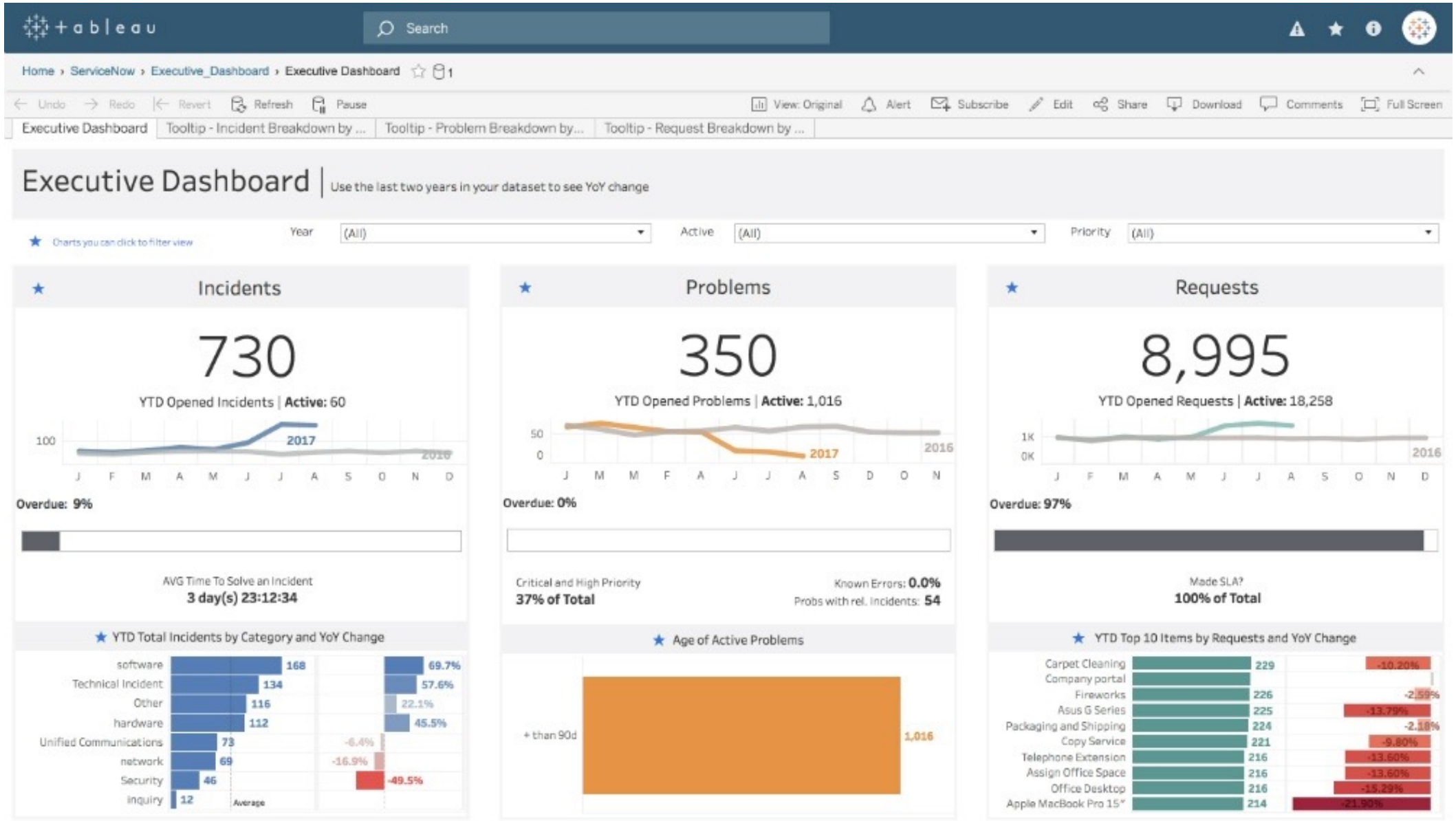


Source: earthobservatory.nasa.gov

Potential for analysis

- Are there climate drivers for CCHF outbreaks?
- What is the seasonality of CCHF in different countries?
- What are the trends in the number of cases?
  - Use code by Ethan Joseph to extract case counts from reports
- Can we use climate factors to predict areas at risk of CCHF outbreak?
- Can we create a dashboard to visualize the above results?
- Other analyses – be creative ☺

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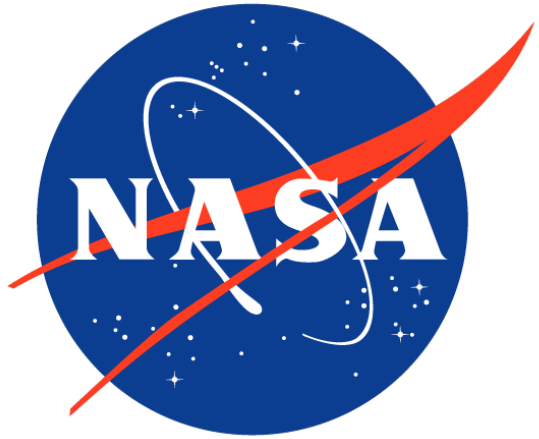
Executive Dashboard | Use the last two years in your dataset to see YoY change
Charts you can click to filter view
Year (All)
Active (All)
Priority (All)
Incidents
730
YTD Opened Incidents | Active: 60
100
2017
2016
J F M A M J J A S O N D
Overdue: 9%
AVG Time To Solve an Incident
3 day(s) 23:12:34
YTD Total Incidents by Category and YoY Change
software 168 69.7%
Technical Incident 134 57.6%
Other 116 22.1%
hardware 112 45.5%
Unified Communications 73 -6.4%
network 69 -16.9%
Security 46 -49.5%
inquiry 12
Average
Problems
350
YTD Opened Problems | Active: 1,016
50
0
2017
2016
J M M F A J J A S D O N
Overdue: 0%
Critical and High Priority
37% of Total
Known Errors: 0.0%
Probs with rel. Incidents: 54
Age of Active Problems
+ than 90d
1,016
Requests
8,995
YTD Opened Requests | Active: 18,258
1K
0K
2016
J F M A M J J A S O N D
Overdue: 97%
Made SLA?
100% of Total
YTD Top 10 Items by Requests and YoY Change
Carpet Cleaning 229 -10.20%
Company portal
Fireworks 226 -2.59%
Asus G Series 225 -13.79%
Packaging and Shipping 224 -2.18%
Copy Service 221 -9.80%
Telephone Extension 216 -13.60%
Assign Office Space 216 -13.60%
Office Desktop 216 -15.29%
Apple MacBook Pro 15" 214 -21.90%

The datasets



- ProMED Mail archive of CCHF reports 1995-2020
- Land surface temperature: Terra/MODIS
- Precipitation: GPM IMERG
- Vegetation (NDVI): Terra/MODIS
- Population: GPWv411

Datasets are freely available to download

Also freely available on Google Earth Engine (requires account)

Questions?