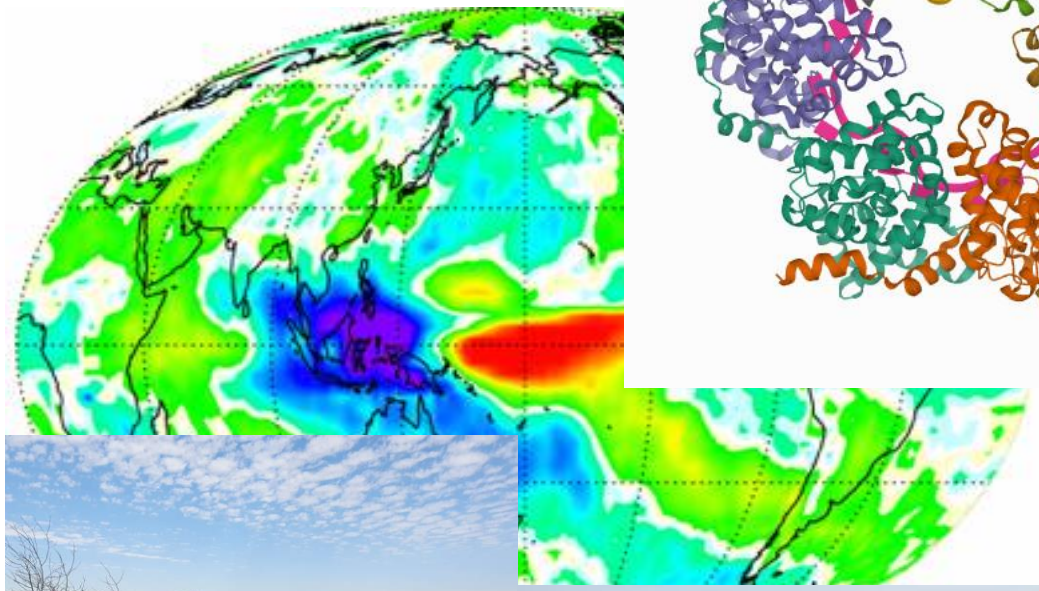
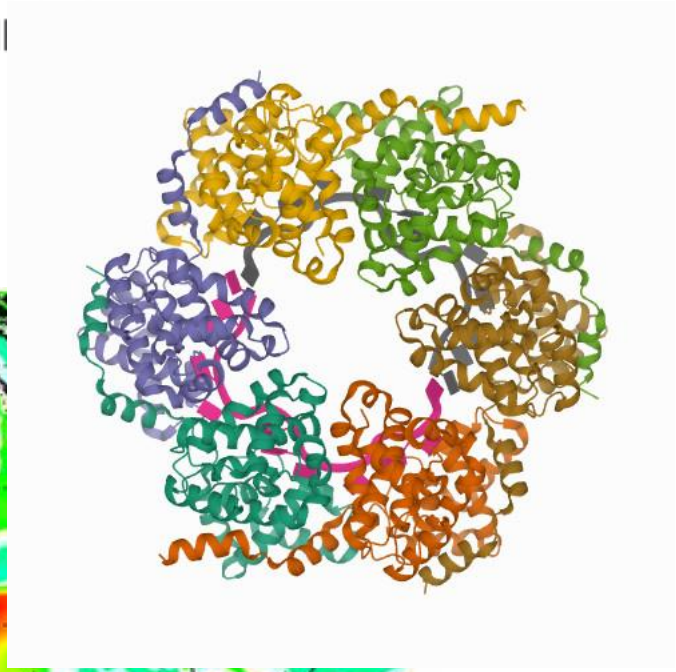
STDF | STANDARDS and TRADE DEVELOPMENT

WORLD ORGANISATION FOR ANIMAL HEALTH





Climate and trade sensitive animal diseases: the case of Rift Valley fever in East Africa

-1-

Modeling and Risk Prediction

Assaf Anyamba

NASA Goddard Space Flight Center

Biospheric Sciences Laboratory

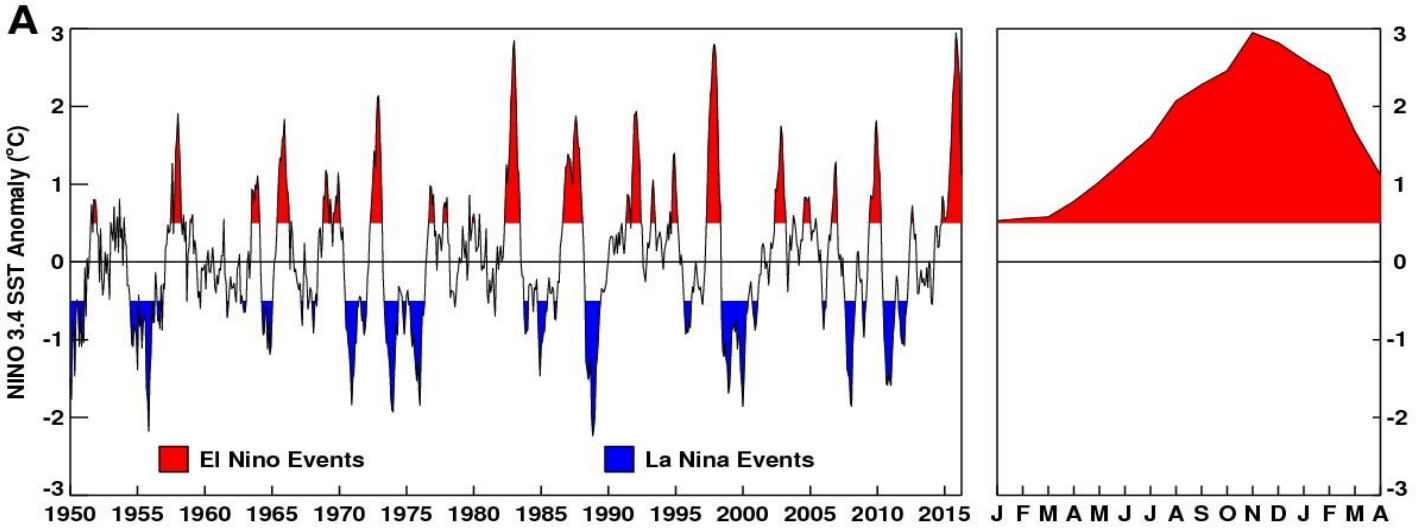
Greenbelt, MD.

Climate Change and Animal Health

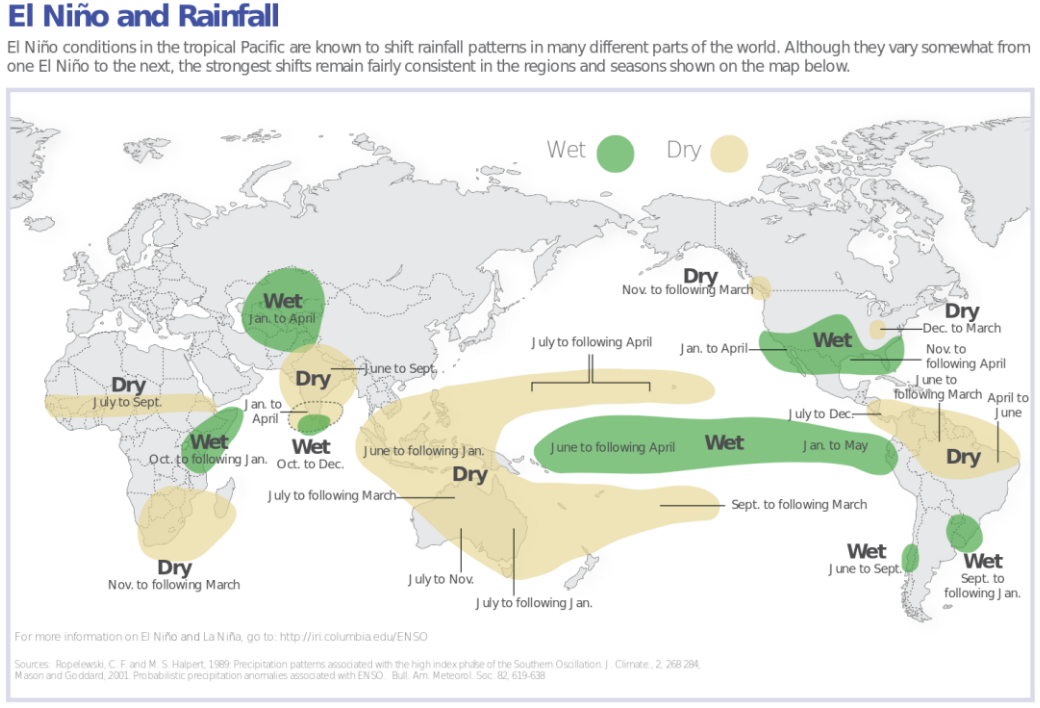
3 May 2022 @ 14.00 – 15.00 (CET)

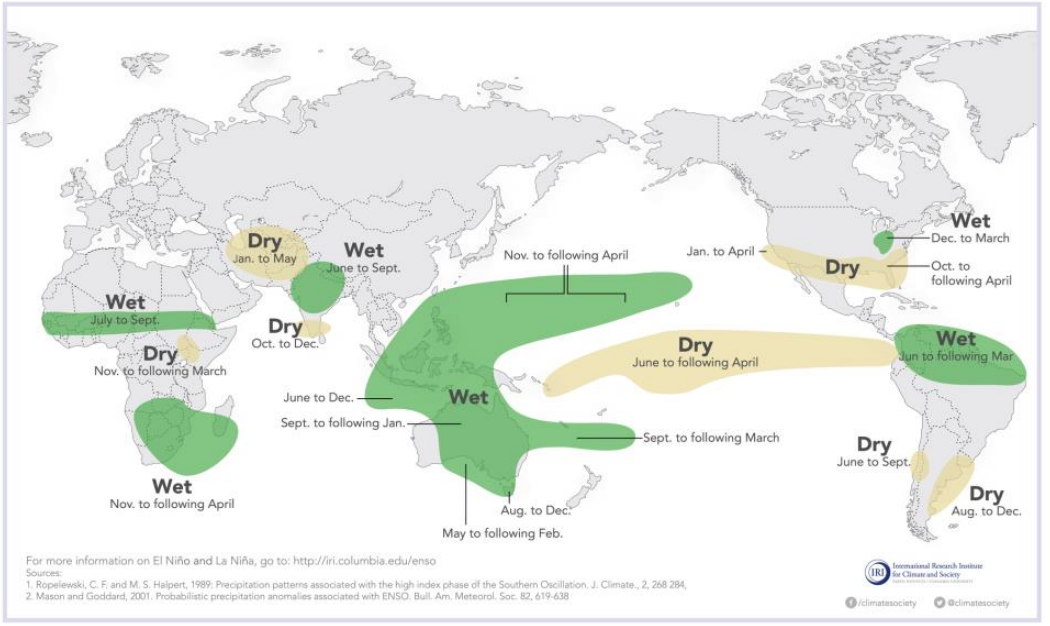
NASA UMBC

ENSO Climate Teleconnections



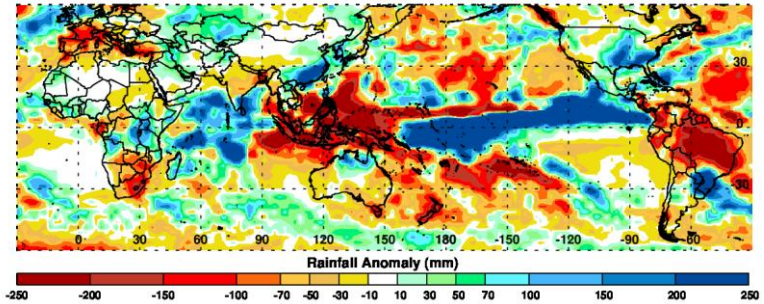
- Interannual Variability - ~6/7 year cycle
- Global scale consequences
- Consequence – agriculture production and disease outbreak patterns

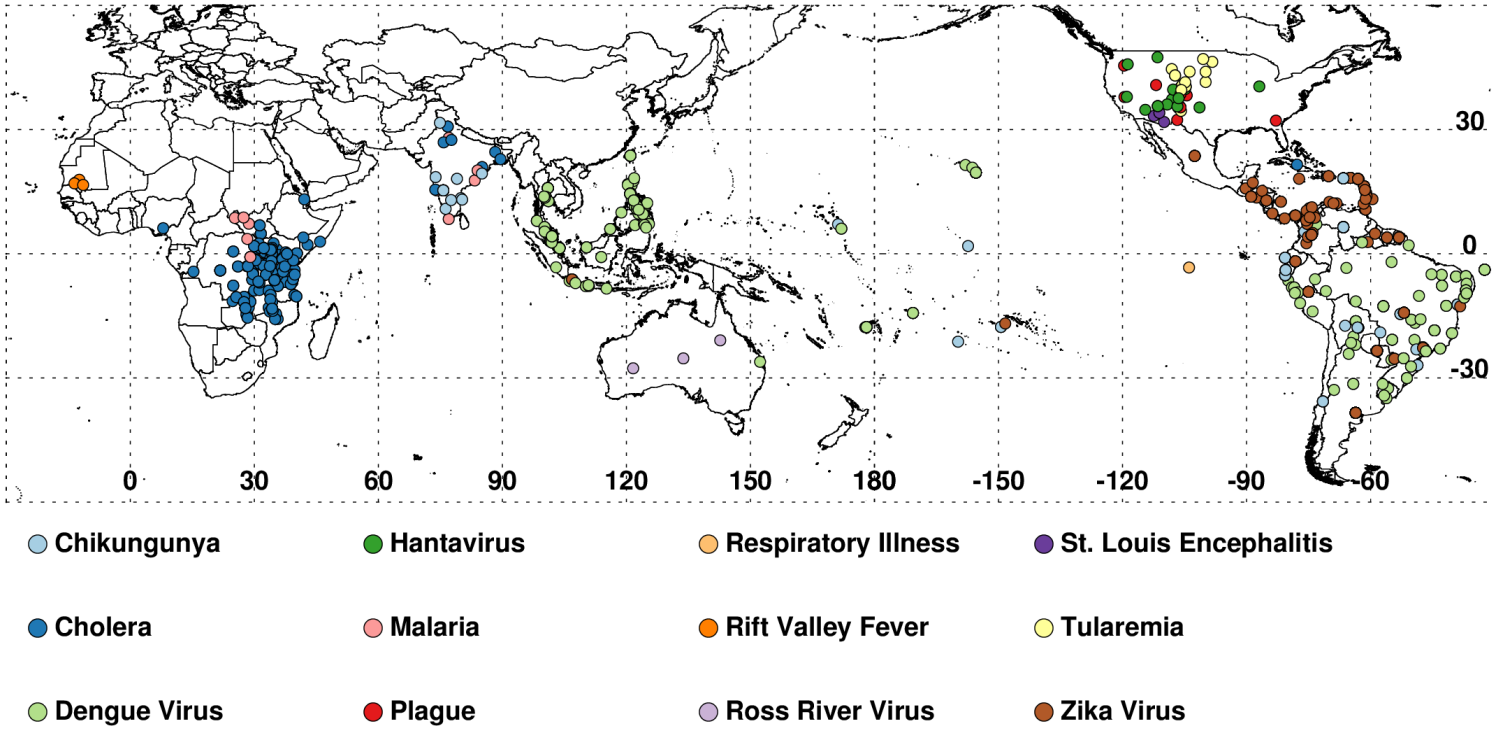




Glantz et al, 1991

ENSO Teleconnections and Disease Outbreaks: 2015/2016

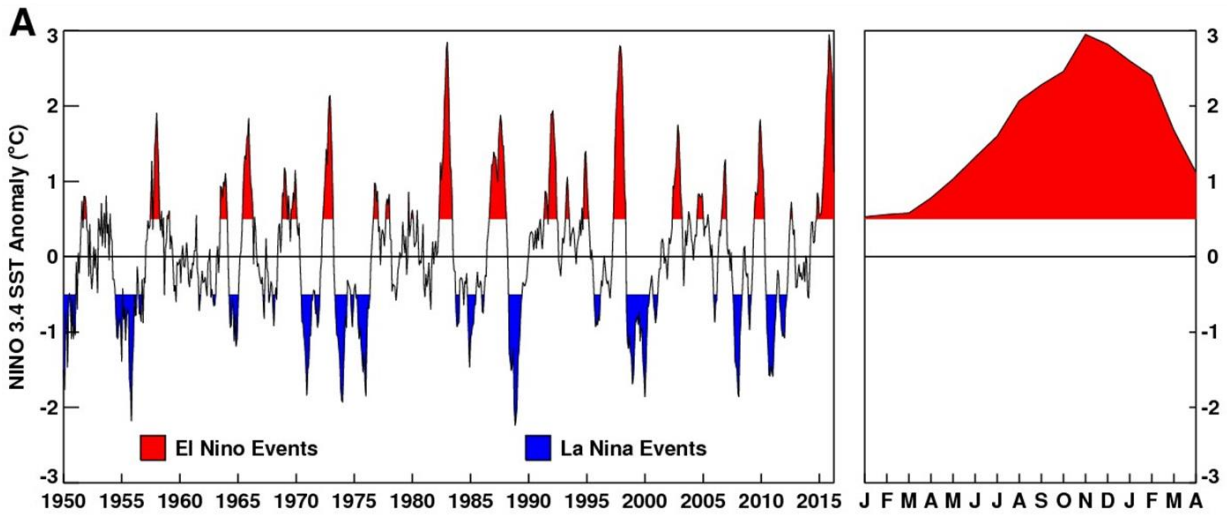


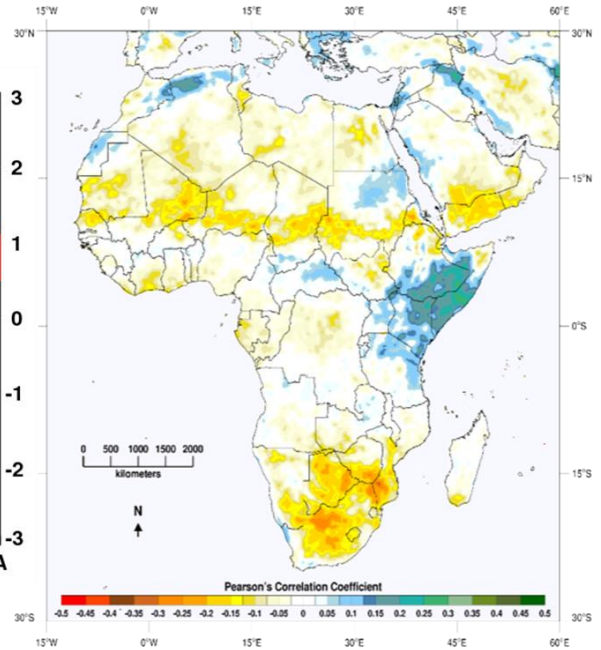


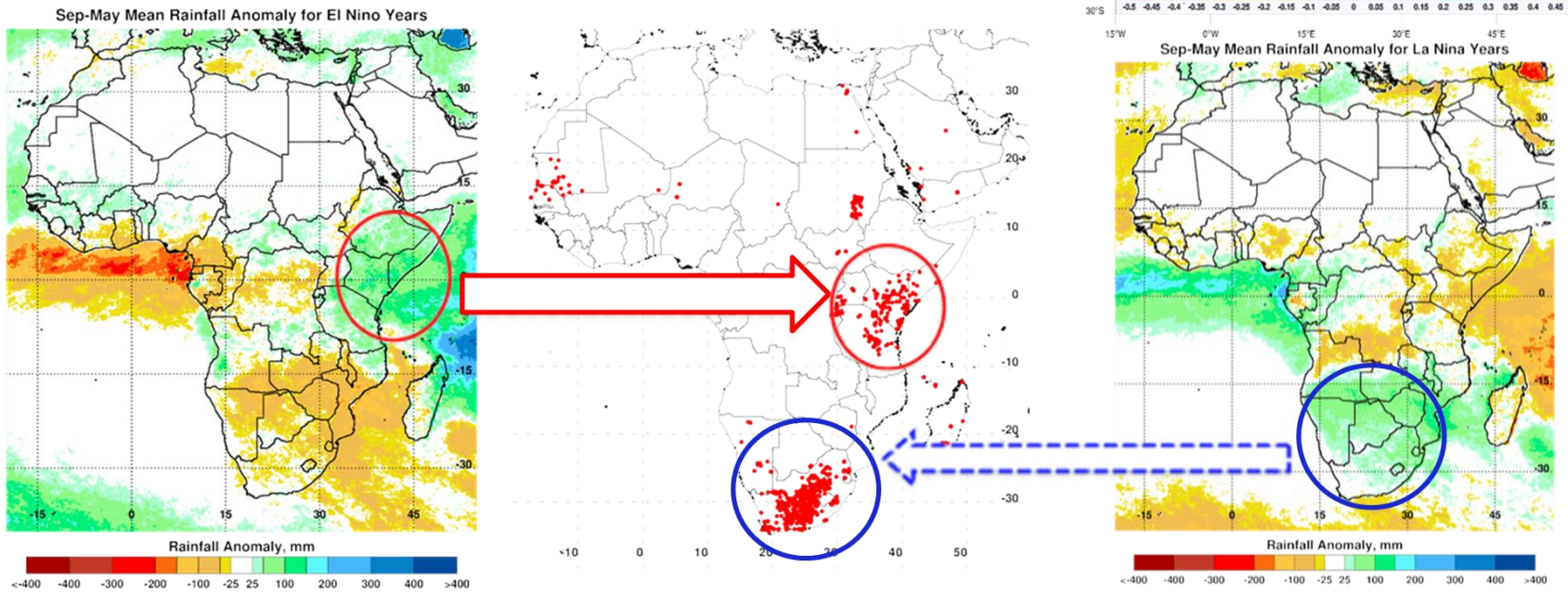
- Variability: 1. **Trigger** 2. **Amplifier**
- Teleconnection impacts – affecting densely populated areas
- Human behavior – amplifies outbreaks

Anyamba et al, Nat. Sci. Rep. 2019

Teleconnections and Rift Valley fever

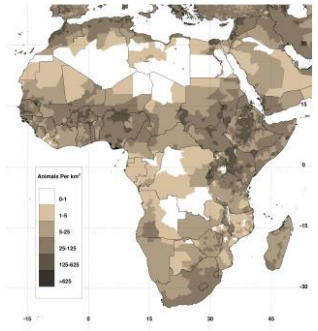




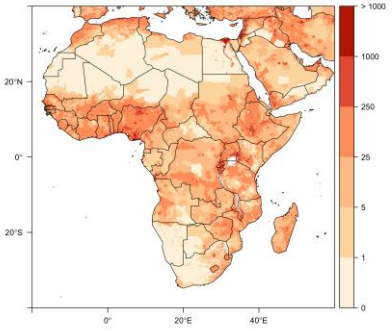


- 2 Major epicenters
- El Niño – Eastern Africa
- La Niña – Southern Africa
- Human Factors (Trade and Animal Movement)

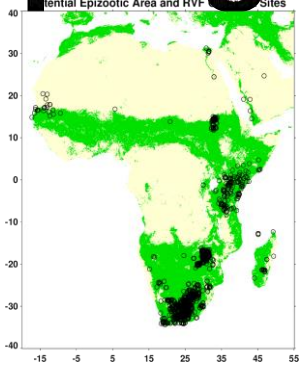
RVF Risk Mapping Model



Livestock population density: cattle, sheep, goats

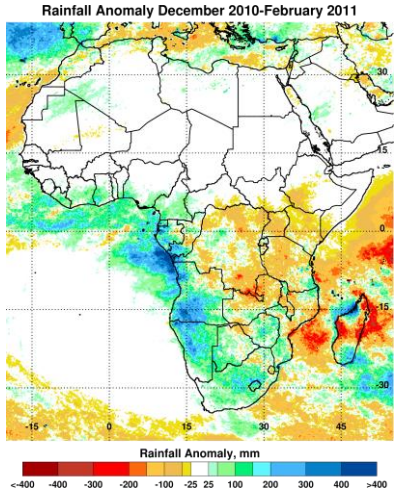


Human population density

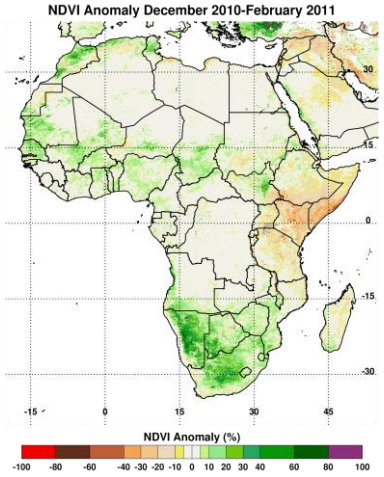


PEAM - Restricts areas of Risk Mapping

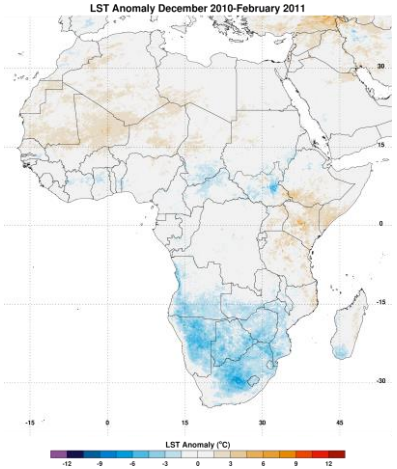
BASELINE INPUTS



Rainfall

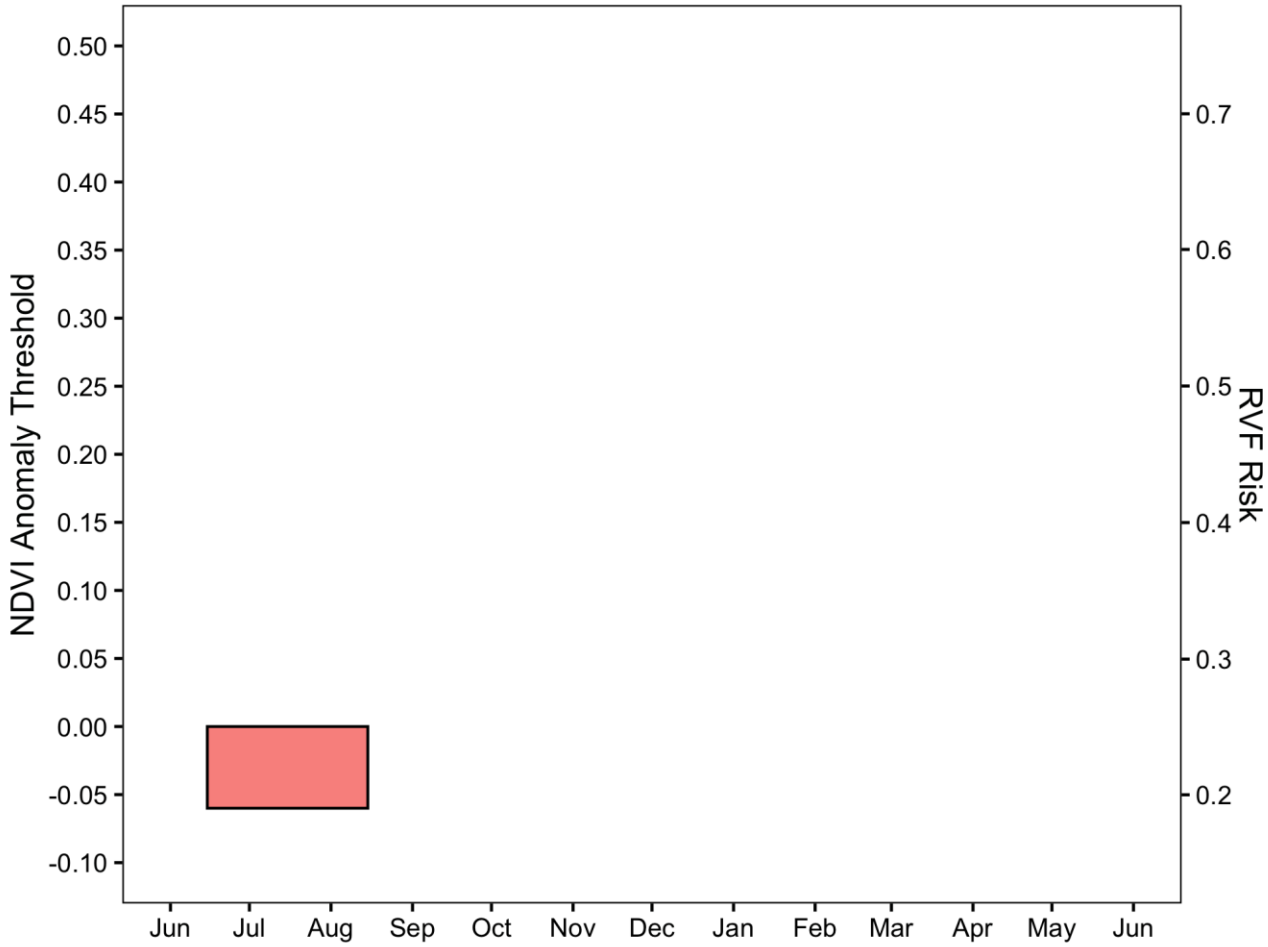


Vegetation

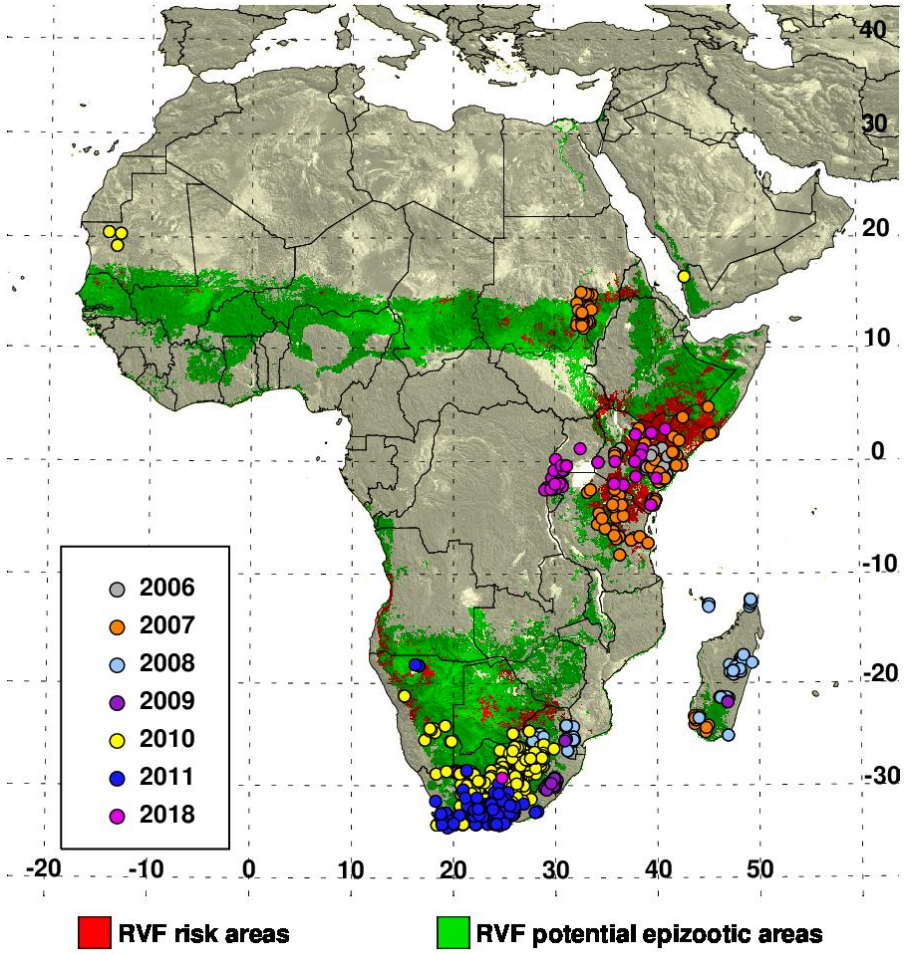


Land Surface Temperature

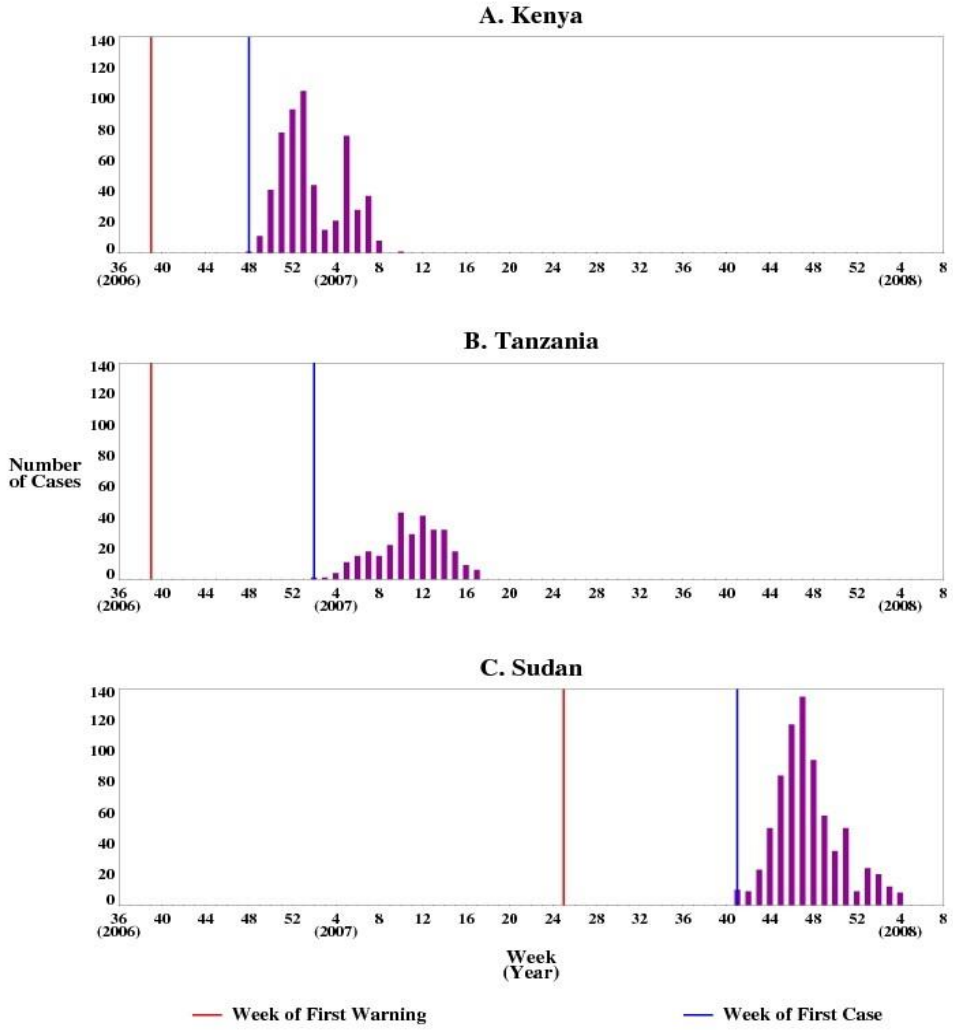
DYNAMIC INPUTS



Summary Risk Map, Outbreaks, Early Warning Timelines

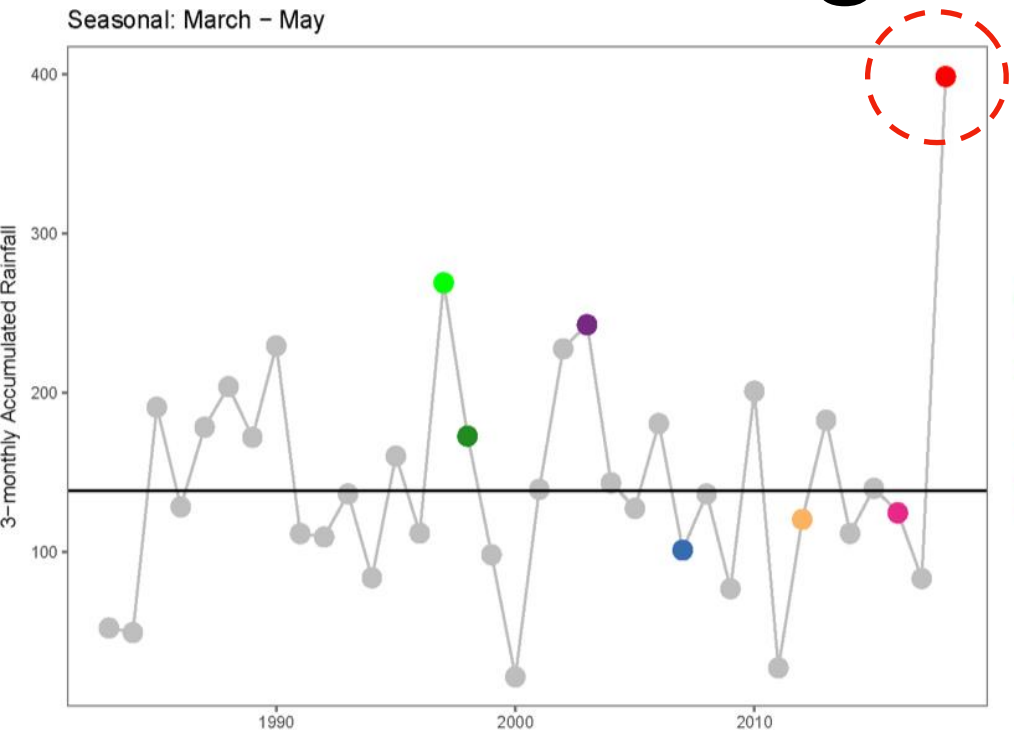


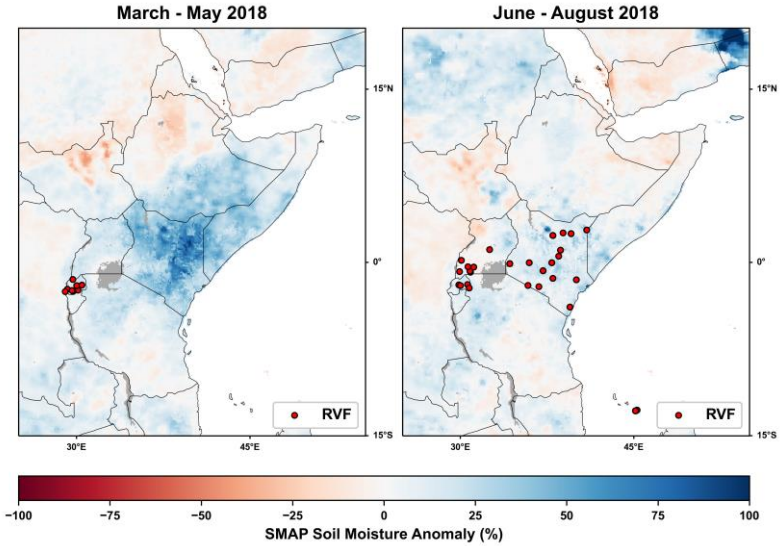
E. Africa: 70%
Sudan: 50%
S. Africa: 30% (2008)
S. Africa: 0% (2009)
S. Africa: 85% (2010-

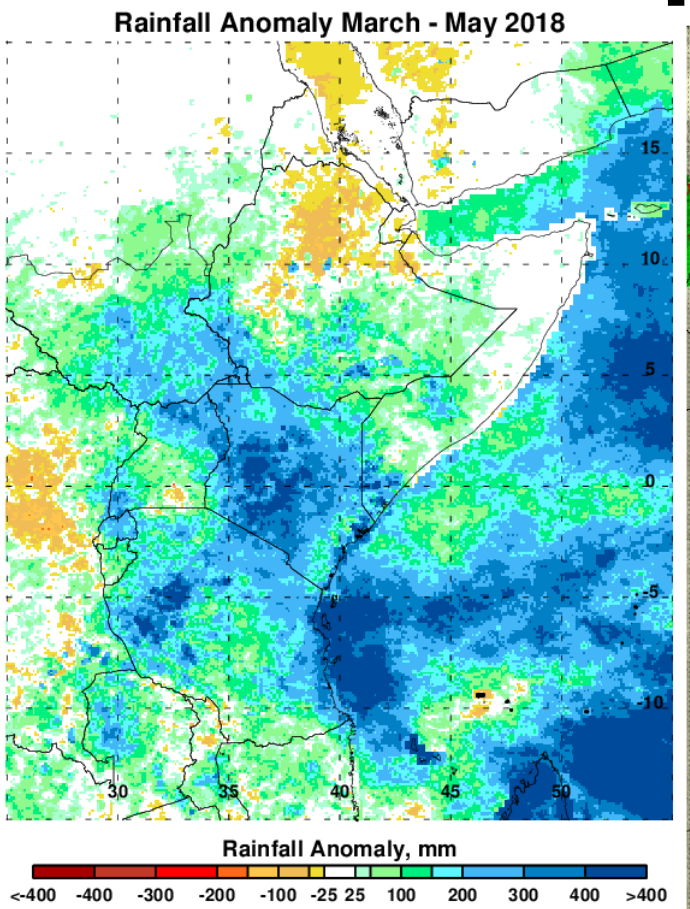


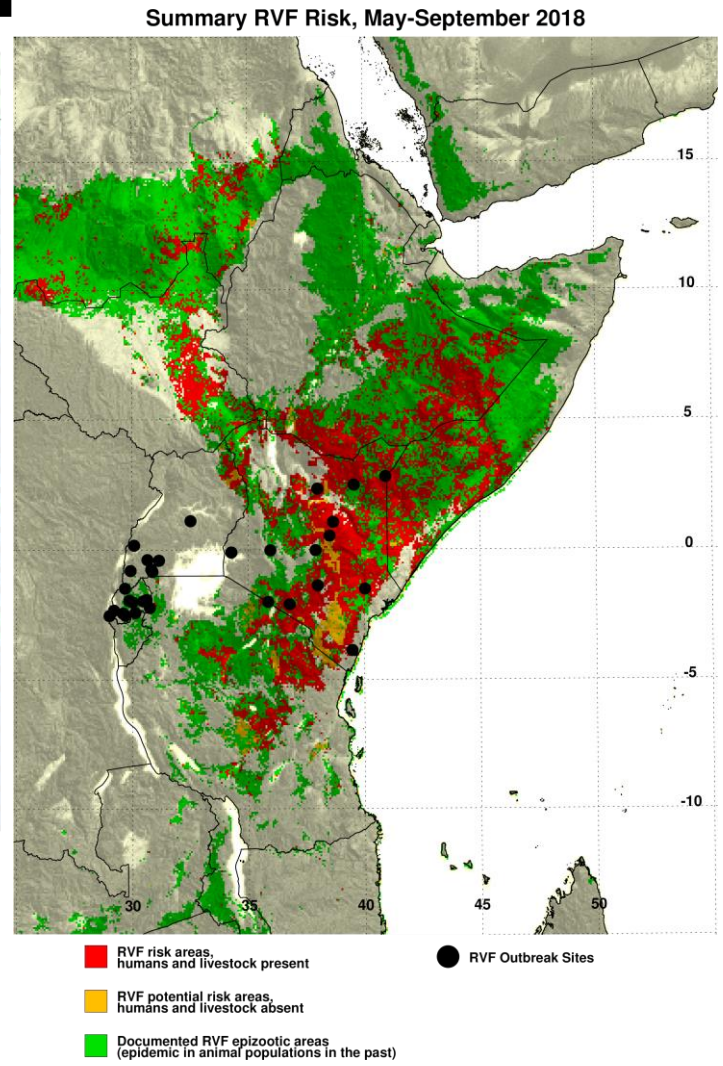
Anyamba et al, PNAS 2009, AJTMH 2010 Linthicum et al, ARE 2016

Climate Change & Extremes Impacts









Anyamba et al, In progress

Contributors

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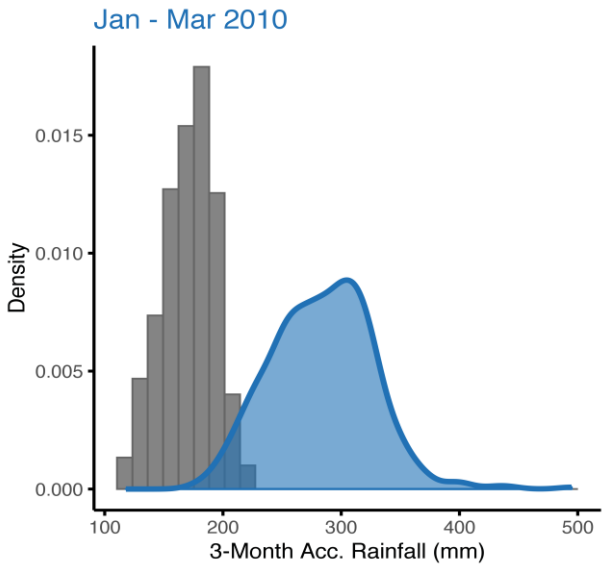
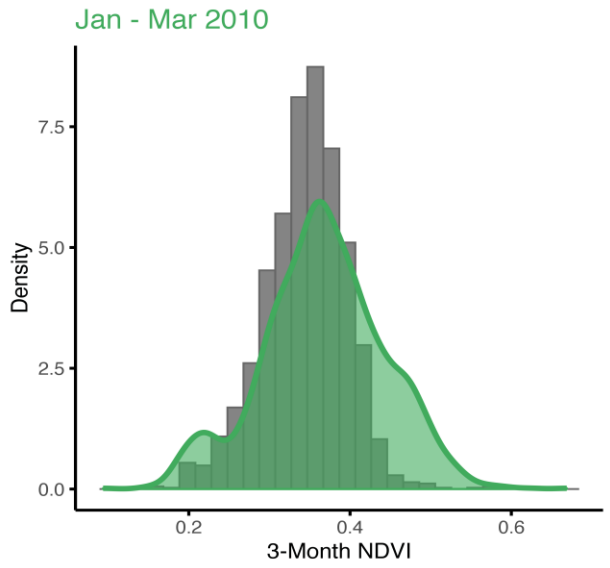
NOAA/CPC
Dr. Wassila Thiaw

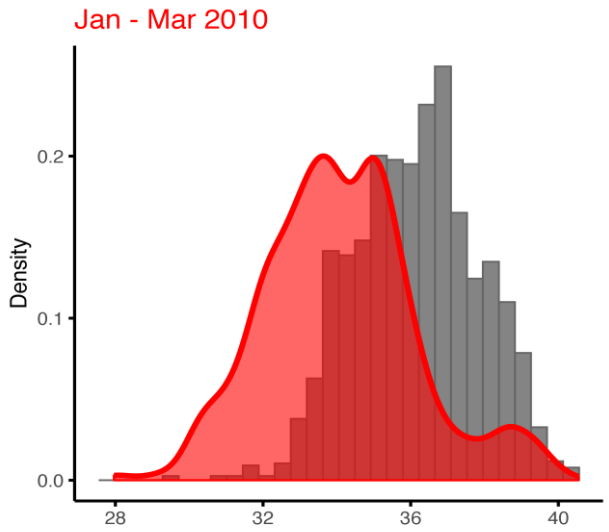
- **NASA Applied Sciences Program – Health and Air Quality (17-HAQ17-0065)**
- **NASA, Soil Moisture Active-Passive (SMAP) Mission Science Team (80NSSC21K0777)**
- **Armed Forces Health Surveillance Division (AFHSD) Global Emerging Infections Surveillance (GEIS) Branch 2009-2018**

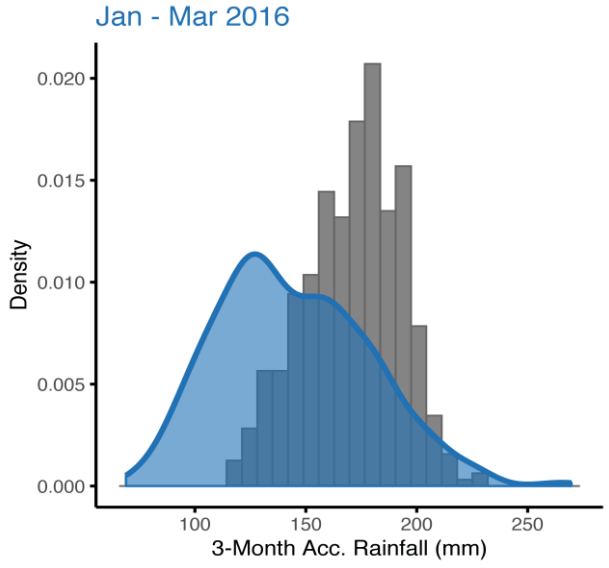
Extra / Backup Slides

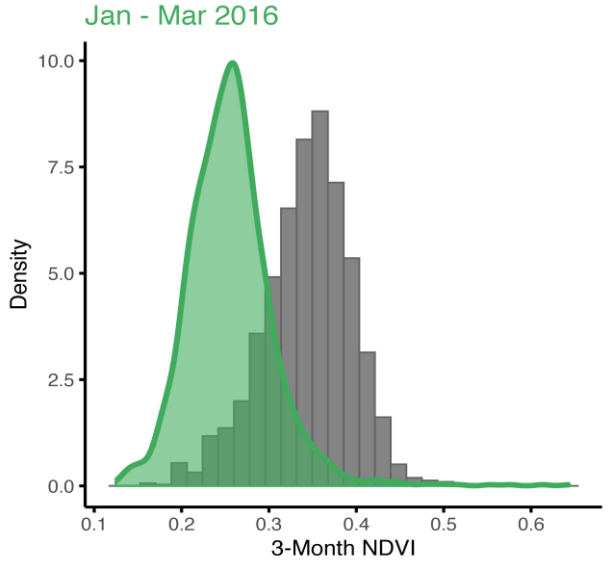
Shifts Matter to Disease Outbreaks

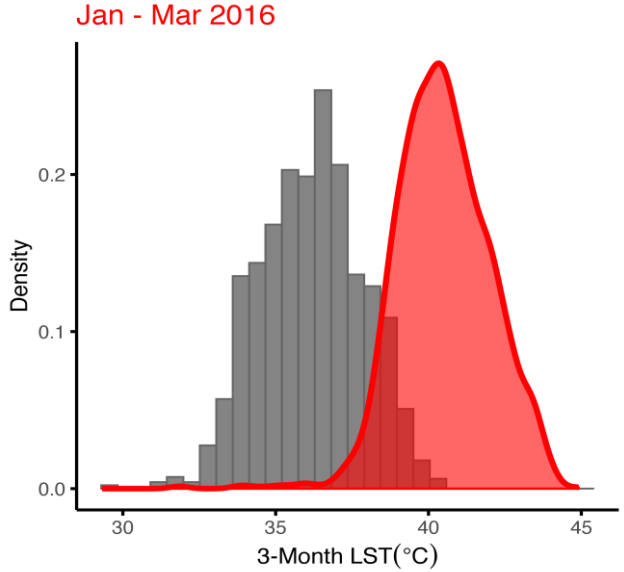




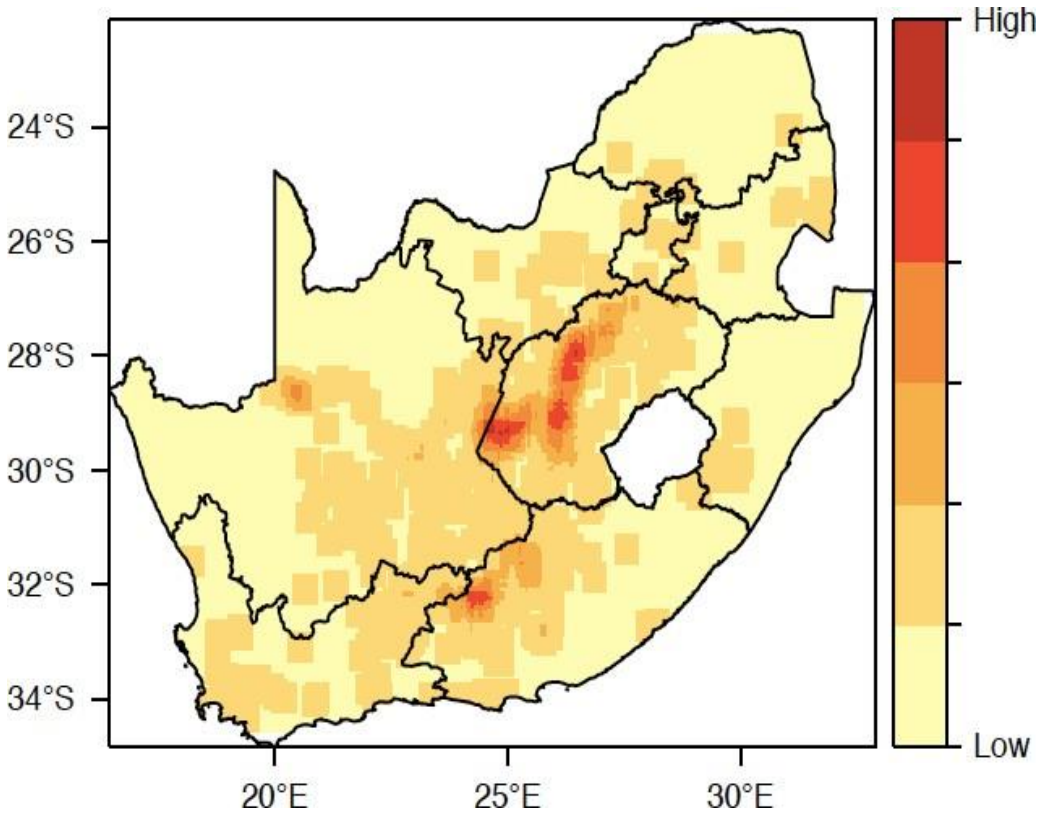


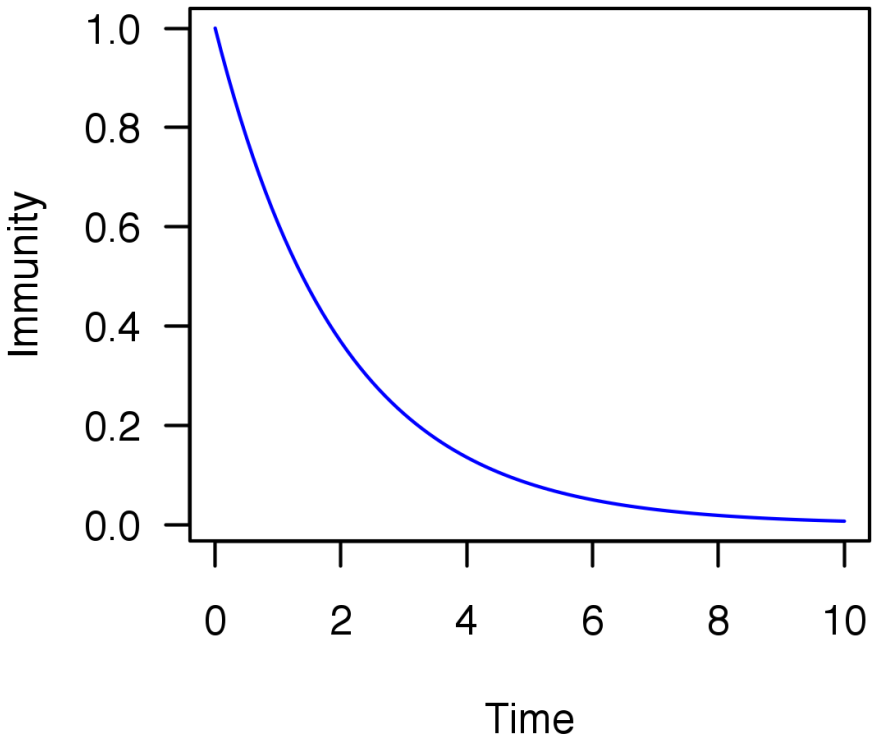






Herd Immunity – X factor





- Estimate annual rate of change/ degradation in immunity - if at all
- Needs a lot data – at farm level: # number of livestock, type, immunization status, age etc.

Food and Agriculture Organization of the United Nations

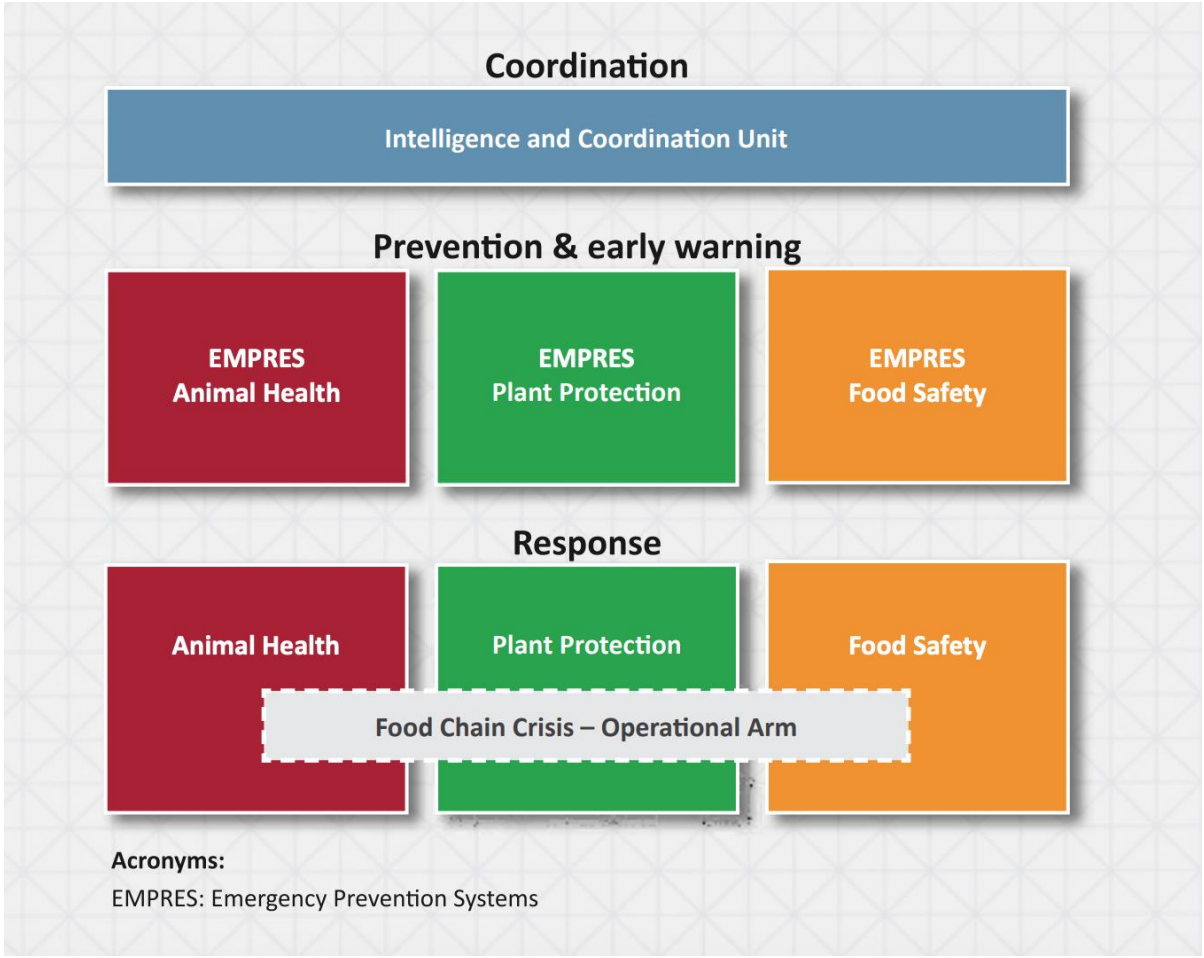
Climate and trade sensitive animal diseases: the case of Rift Valley fever in East Africa

RVF Early Warning Decision Support Tool (DST)

Climate Change and Animal Health – STDF webinar - 3 May 2022

FAO Animal Health Service

The Emergency Prevention System (EMPRES) for transboundary animal and plant pests



THE EMPRES MANDATE

Managing animal and plant health, natural resources, fisheries and forestry

State of Play :animal health, plant health, forest health, fisheries/aquaculture health

Mapping of areas

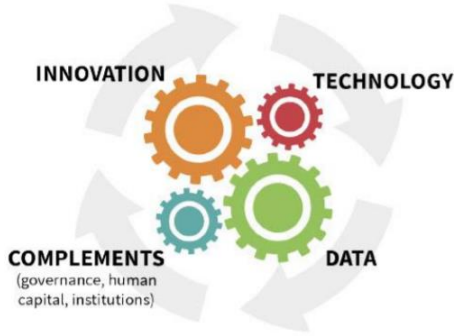
- Early warning
- Risk assessment
- Surveillance
- Capacity development
- APPDs prevention and resilience
- Emergency preparedness and response
- Coordination and governance

RVF Early Warning Decision Support Tool (DST) – Anticipate and mitigate the risk of RVF

Real-time monitoring, risk forecasting, mapping & assessment to guide informed early actions for prevention and control

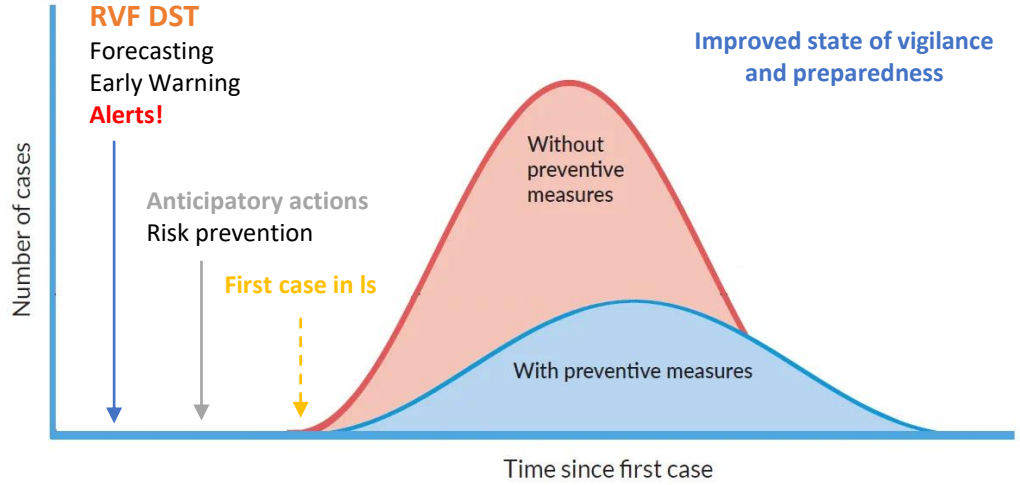
- **DST** identifies **climatic anomalies** to **forecast areas at risk** of **RVF vector amplification**
- **Prediction capacity**: 1-2 months before the first case is observed
- **Integrated** in **FAO Hand-in-Hand** geospatial platform / RVF events from **EMPRES-i**
- **Facilitate real-time data sharing, consultation among experts, risk interpretation**
- **Scalable** to other **regions** and **diseases**

- Cost effective
- Disease-specific
- Easy to monitor
- Available on near real-time



Monitor environmental conditions → Forecast High Risk areas → Validation Risk-based surveillance → Inform Decision Makers → Implement Preventive Measures & Mitigation Strategies

Tracking climate variability and changing environments



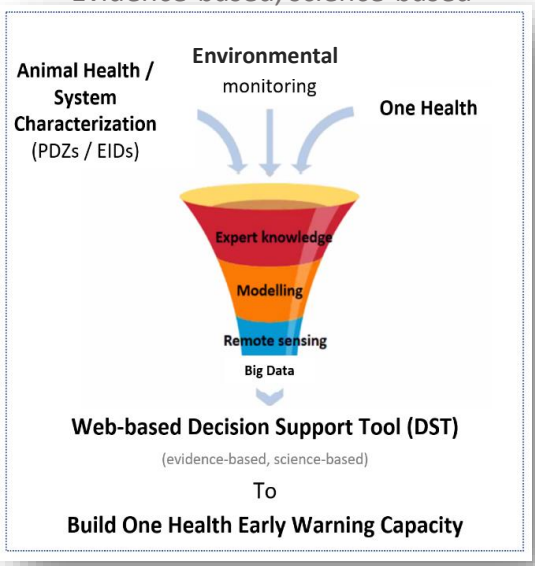
Shift to the left

- Early Warning, Detection, Response
- Tackling disease emergence at source

Web-based RVF Early Warning Decision Support Tool (DST)

Innovative Approach

Evidence-based, science-based



RVF Decision Support Tool

https://www.fao.org/documents/card/en/c/cb5875en

Monitoring, prevention and control

Alerts and RVF Monthly Updates

Capacity building

EXPERT KNOWLEDGE

Suitability for RVF vector amplification
- Risk maps/forecast (based on NASA model)
- Precipitation
- Temperature
- Vegetation
- Soil type
- Humidity
- Land cover
- Elevation
- Irrigation areas
- Flooding/dambos
- Seasonality (ENSO)

RVF endemic areas
- RVF core areas
- RVF events

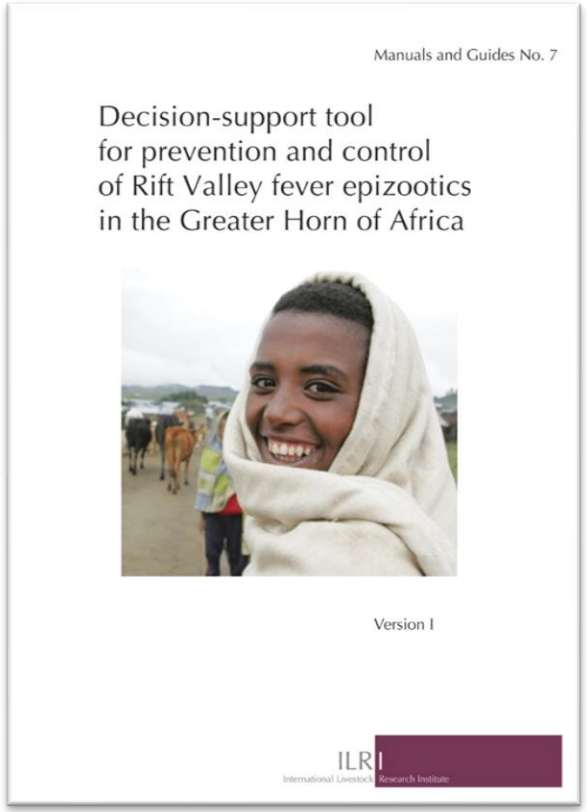
Risk of exposure
- Livestock species
- Human population

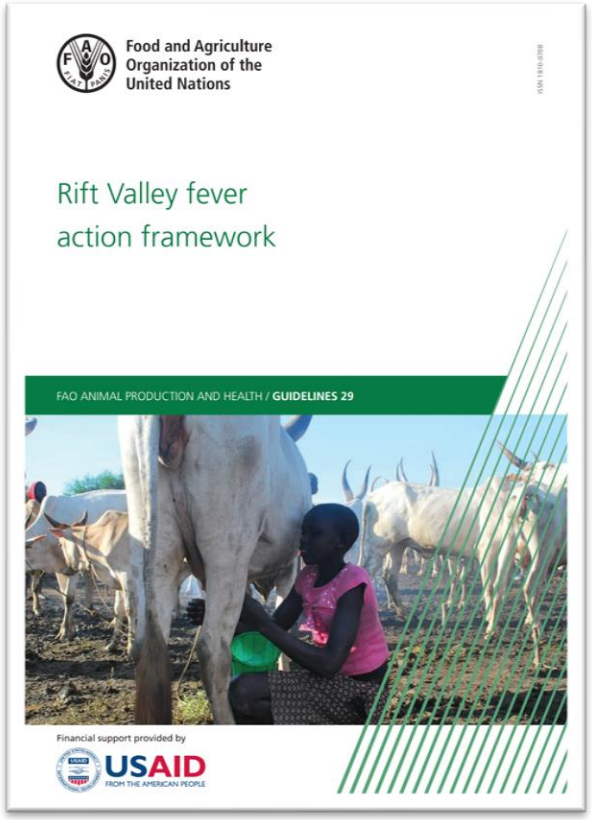
Risk of spread (infrastructure)
- Markets
- Villages
- Roads
- Livestock routes …

Supportive documents
- RVF FAO Manuals
- FAO/ILRI Decision Support Framework
- RVF dynamic model for VA
- FAO RVF Action Framework

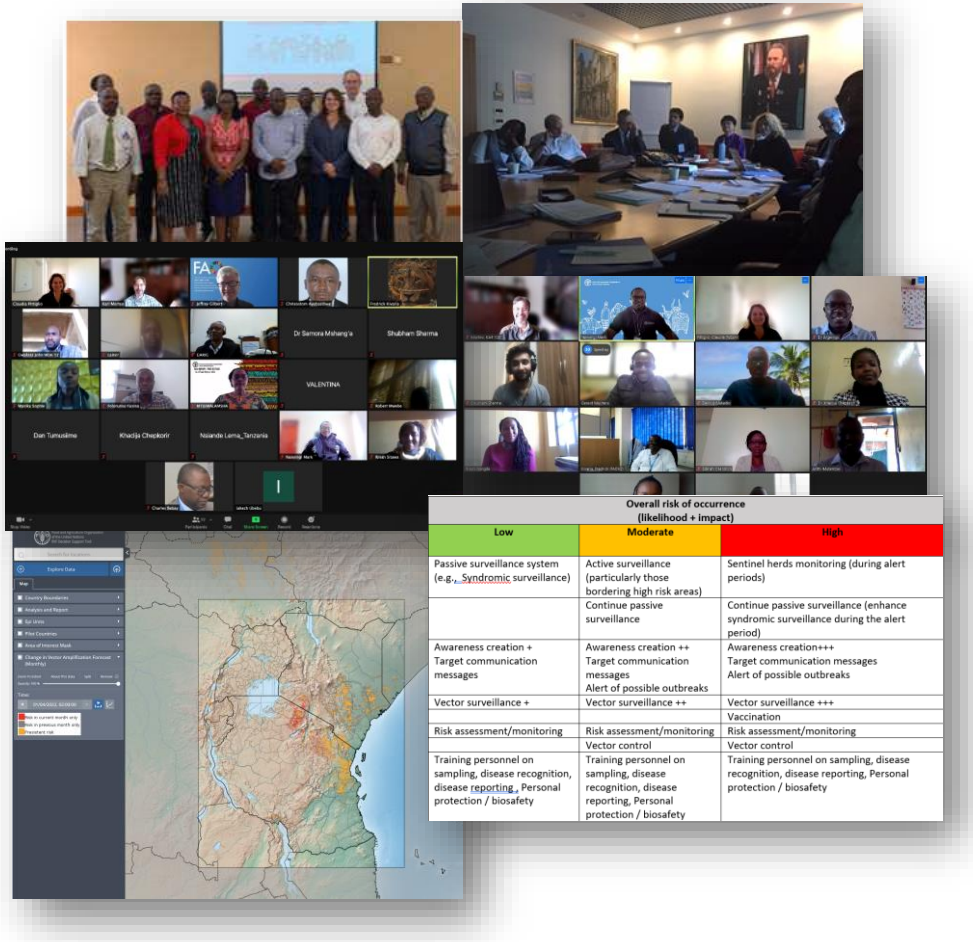
Integrated approach to guide informed early actions for prevention and control

- Real-time consultation among experts for risk interpretation, assessment, monitoring
- Data-sharing of geospatial data, risk maps, supporting documents for capacity building



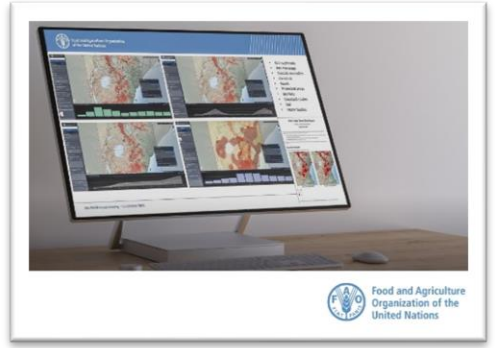


https://www.fao.org/3/cb8653en/cb8653en.pdf



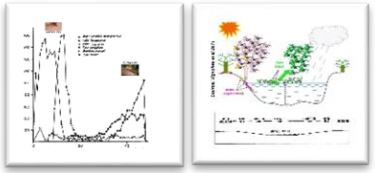
RVF Risk Modelling and DST: major milestones and way forward

FAO web-based RVF Early Warning Decision Support Tool (DST)



1 — Year: 2007-2011
Increased FAO expertise in **RVF risk modelling, prevention, control**

2 — 2012-2016
Calibration of a **dynamic model** developed by NASA (Anyamba 2009)



3 — 2017
Transition from a desktop to **cloud-based platform** (Google Earth Engine)

4 — 2018
Increased spatial and temporal resolution of the **RVF risk maps** (available every **month** at **250 m)**
-
Dar es Salaam RVF Meeting recommendations

5 — 2019
Integration with **expert knowledge** (e.g., FAO-ILRI DSF) on RVF eco-epidemiology

6 — 2020
Increased interoperability (FAO Hand-in-Hand)

7 — 2021
Building One Health Early Warning capacity at regional and national level
-
Rift Valley Fever Action Framework

8 — 2022

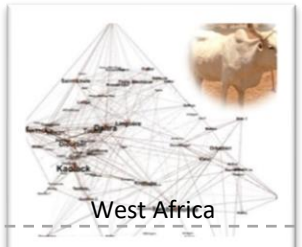
9
Scalable to other countries/diseases

Scenario analysis (What if?)

Modelling: Risk categorization/ Animal movement / Risk of Spread

Risk Of RVF Introduction + **Risk Of RVF Spread** = **Risk of RVF Occurrence**

East and West Africa



West Africa

Multi-Criteria Decision Analysis (MCDA)

Joint FAO-IGAD **(May 2021, July 2021, February 2022)**

Joint FAO-NASA

IGAD alert

July 2020)

Food and Agriculture Organization of the United Nations

alert

FAO and IGAD alert countries in eastern Africa to enhance preparedness for Rift Valley fever

May 31st, 2021

Key facts

1. RVF is an acute, vector-borne, viral, and zoonotic disease that has severe impacts on livelihoods, markets, an
2. The disease goats, cattle and is spre the movem
3. Heavy rains habitat suit determining competent mosquitoes (e.g. Aedes and Culex), thus influencing the risk of RVF emergence, transmission and spread.
4. The dynamic prediction model calibrated by FAO builds upon the work by Anyamba *et al.*, (2009; 2010), which utilizes vegetation and rainfall anomalies as a proxy for ecological dynamics to map areas at potential risk of RVF in Eastern Africa.
5. The FAO RVF Early Warning panel of experts verifies the risk areas with the experts on the ground and assesses if conditions warrant an RVF alert (FAO 2019).
6. RVF outbreaks can disrupt the livestock sector in depleting the future generation of affected herds and therefore constitutes an important socio-economic and food security threat to vulnerable households. In addition, it can also affect the funds directly available to households through their animals and impact their capacities to access health care and child education. Moreover, it results trade ban and affect national and regional economy.

Rift Valley fever (RVF) is an endemic vector-borne zoonotic disease that represents a threat to human health, animal health, and livestock production, in the Eastern Africa Region. The epidemiology of RVF is complex, making monitoring of RVF risk and carrying out efficient and

On 12 May 2021, the FAO Animal Health Service, based on the analysis of data available through the FAO web-based RVF Early Warning Decision Support Tool (RVF DST), Global Livestock Early Warning System (GLEWS+), Global Animal Disease Information System (EMPRES-i) and expert knowledge, concluded that the **risk of RVF occurrence in the region remains high both in animals and humans in the next three months (June-August 2021), either due to favorable environmental conditions and/or through potential movement of infected animals**, and highlighted the urgent need to ensure adequate preparedness for potential disease outbreaks, in particular through the One Health coordination.

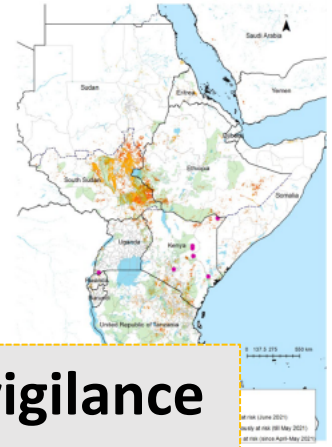
Despite diverse climatic conditions in the region over the past four months, with heavy rains and floods in some countries and below-average rains and dryness in others, large suitable hotspots for RVF vector amplification persist in the region. Concerns remain for large, predicted hotspots in central-southern Kenya, South Sudan, northern Tanzania and localized hotspots in Uganda, Sudan, Somalia, Rwanda, Burundi, Ethiopia, as well as in eastern Saudi Arabia and Yemen. Suitable areas are predicted in proximity to irrigated lands, swamps and/or high density of susceptible livestock (Figure 1). The rainfall forecast for the period June-August 2021 highlights above-average rains in the region, particularly in July and August, suggesting that the risk remains high in those countries.

Useful Links

- Rift Valley fever surveillance (FAO Manual 2018) www.fao.org/3/I8475EN/i8475en.pdf
- Recognizing Rift Valley fever (FAO Manual 2003) www.fao.org/3/y4611e/y4611e00.htm
- Preparation of Rift Valley fever contingency plans (FAO Manual 2002) www.fao.org/3/Y4140E/Y4140E00.htm
- Decision-support tool for prevention and control of Rift Valley fever epizootics in the Greater Horn of Africa. (ILRI and FAO. 2009) Version I. ILRI Manuals and Guides. no. 7. 28p. Nairobi (Kenya): ILRI. cgspace.cgiar.org/handle/10568/22
- Real-time monitoring and forecasting of Rift Valley fever in Africa (FAO FCC Information Sheet 2019) www.fao.org/3/ca5511en/ca5511en.pdf

Animal Health and FAO Regional Offices, launched a new online, open-access 'mobile first' course on efficient recognition, surveillance, prevention and control of Rift Valley Fever (RVF). The course will soon be available in a "just in time" basis in the field, and also in a downloadable version for offline use as needed. For more information, please contact eufmd-training@fao.org.

Figure 1. Confirmed RVF outbreaks (2020 – 2021) and forecasted risk of RVF vector amplification for June 2021



F Early Warning Decision Support

ns used on these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement. Final boundary between the Sudan and South Sudan has not yet been determined. Final status of the Abyei area is not yet determined.

Therefore, FAO and IGAD are advising the countries to increase awareness, improve preparedness at national, subnational and community levels to safeguard livestock, livelihoods and public health, especially for exposed and vulnerable communities (farmers, pastoralists), and improve coordination with public health and environment services around the on-going risk of RVF outbreaks.

More specifically, FAO and IGAD recommend

- National Veterinary Authority to increase awareness about the disease, assess the current situation and the specific risk to the country regarding RVF, and identify the actions to support the country to increase its preparedness to RVF outbreaks.
- National Veterinary Authority to get in touch with their public health counterparts to coordinate joint preparedness activities, especially in countries where there is no One Health platform; to ensure a coordinated One Health and humanitarian approach to this threat.

The overall effect is improved state of vigilance and preparedness

Food and Agriculture Organization of the United Nations

Southern A
fever (RVF)

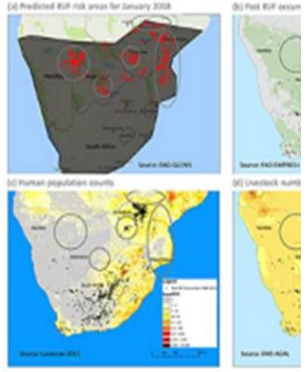
According to a cl
and Space Admin
heavy rains durin
conditions for the

Based on the risk
period October-D
amplification are

Botswana, south-western and northern Zimbabwe
generated from remotely-sensed data on precipitati
amplification.

Considering that precipitation forecasts for February
FAO advises that the veterinary services and livest
occurrence of RVF outbreaks in human and/or ani

Map 1: (a) Predicted RVF risk areas are shown in red and h
1969-2014 overlaid on (b) the vector suitability areas (gre
(in tropical livestock unit). (e) Predicted precipitation ano
to blue, while below-normal rainfall is shown from yellow t



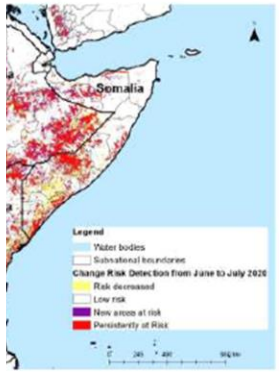
er 2020, which coincide mostly with the rainy season in
dry season in the United Republic of Tanzania, Kenya and
whole region, particularly in northwestern Kenya, eastern
ern Ethiopia. This suggests that the region will continue to
F for July 2020 is still high for the region, particularly for
alia and Ethiopia.

n of the risk between June and July 2020 highlighted the

emains at high risk of RVF occurrence due to persistent
ector breeding and development;
uitable for vectors with an overall increase of the risk areas

nd at risk (potential for June 2020) is now at low risk of

is expected to occur in Tanzania (28% increased), Ethiopia
h Sudan (10% increased) and Kenya (9% increased).



2020 (source: FAO RVF Monitoring, Early Warning and Decision Support Tool)

May 2018: RVF reported in South Africa

June 2018: RVF reported in Kenya

December 2020: RVF reported in Kenya

- **Challenge**
  - ✓ Maintaining vigilance during the IEP
  - ✓ Getting unified alert across the region, and averting unnecessary rumours and consequences
  - ✓ Inadequate political support for unified action/s
- **Solution**
  - ✓ FAO-IGAD quarterly RVF alerts (July 2020) - https://www.fao.org/3/cb8651en/cb8651en.pdf
    - ❑ **Primary objective**
      - ➢ Political buy-in
      - ➢ Safeguard trade and livelihoods
- **Expected results**
  - ✓ Countries remain vigilant
  - ✓ Preemptive action taken
  - ✓ Improved cooperation
- **Specific examples of actions taken following the alert**
  - ✓ Oct'19/Apr'20 – preventative vaccination – Kenya
  - ✓ Jan' 22 – preemptive sero-surveillance – Kenya
  - ✓ Apr'22 – Rwanda
    - ❑ Proactive sero-surveillance
    - ❑ Vaccination ≈ 700 animals
    - ❑ RCCE

Food and Agriculture Organization of the United Nations

IGAD

alert

FAO AND IGAD ALERT COUNTRIES IN EASTERN AFRICA TO REMAIN VIGILANT FOR RIFT VALLEY FEVER

15 February 2022

an endemic vector-borne zoonotic disease that human health, animal health and livestock ern Africa region. The epidemiology of RVF is oring of RVF risk and carrying out efficient and s challenging. To increase knowledge on RVF n disease management policies, the Food and of the United Nations (FAO) has developed and VF Early Warning Decision Support Tool (RVF DST) orecasting based on precipitation and vegetation r environmental factors. To this end, FAO, in rgovernmental Authority on Development (IGAD), untries in the region through joint alert messages

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Thank you

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