Food and Agriculture Organization of the United Nations

The joint Early Warning release

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Rift Valley Fever: New options for trade, prevention and control; Djibouti; 22 April 2015

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Climate models predict persistent above-average rains and risk of flooding in East Africa: FAO, OIE and WHO warn countries to remain vigilant about Rift Valley fever

Contributors: Claudia Pittiglio*, Caryl Lockhart*, Julio Pastor*, Susanna Mikolajewska*†, Patrick Bastiaensen*†, Pierre Formenty*†, Stéphane de la Rocque*†, Assaf Anyamba‡, Jennifer Small‡, Kenneth J. Linthicum‡ and Jean-Paul Chretien‡

* Food and Agriculture Organization of the United Nations (FAO); † World Organisation for Animal Health (OIE); ‡ World Health Organization (WHO); § National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC); ¶ United States Department of Agriculture (USDA) Agricultural Research Service; ‖ Armed Forces Health Surveillance Center (AFHSC)

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Introduction

Rift Valley fever (RVF) is an arthropod-borne arboviral disease that affects ruminants and humans. Most human cases develop a mild influenza-like illness while a small percentage of patients develop a much more severe form of the disease. In ruminants it may be associated with high mortality in neonates and young animals as well as high levels of abortion, resulting in significant socio-economic consequences. The disease is transmitted by mosquitoes of several different species (mainly *Aedes* and *Culex*) and through direct contact with tissue of infected animals (Linthicum *et al.*, 1999). Although currently confined to sub-Saharan Africa, and having spread to the Arab Republic of Egypt and the Arabian Peninsula, this disease poses a threat to non-endemic countries in temperate regions where both hosts and potential vectors co-occur (Than *et al.*, 2013; Xue *et al.*, 2013).

Climatic factors, such as temperature, rainfall and humidity are important drivers of RVF viral activity as they drive vector abundance and population dynamics, thus influencing the risk of disease emergence, transmission and spread. The disease ecology of RVF in East Africa has been investigated. Epidemics occur periodically (from 5 to 15 year cycles) and are significantly associated with climate anomalies such as persistent, unusual, widespread, above-average rainfall and flooding, particularly during El Niño events (Anyamba *et al.*, 2009). Temporarily flooded areas and water pools in low-lying areas, also known as *dambos*, create the conditions for disease-carrying mosquitoes to breed, including the *Aedes* species, whose eggs can survive in soil for long dry periods. During persistent heavy rainfall, the *dambos* become flooded triggering transovarially infected eggs to hatch. This results in increased infected vector population abundance and a greater risk of the disease being transmitted to susceptible ruminant species. Subsequently, as vegetation grows in response to heavy rains, other *Culex* species of mosquito vectors multiply due to the increased availability of suitable environments and by feeding on infected livestock they transmit the virus to other animals and humans (Linthicum *et al.*, 1999; Turell *et al.*, 2008) (Figure 1).

Sero-surveillance efforts have found significant levels of RVF antibodies in domestic and/or wild ruminants in many African countries across different agro-climatic zones. However, many countries are not aware of the circulation of the virus in their territories because systematic surveillance for confirming the presence and distribution of RVF infection is lacking. Limited focal enzootic circulation of RVF has been documented among domestic and/or wild mammalian species.

The most recent RVF outbreaks occurred in the Republic of Botswana (2008, 2010, 2013 - 2014), the Republic of Kenya (2006-2007), the Republic of Madagascar and Mayotte (2008-2009), the Islamic Republic of Mauritania (2010 - 2011, 2013 - 2014), the Republic of Namibia (2011 - 2012), the Kingdom of Saudi Arabia (2010), the Republic of Senegal (2013-2014), the Federal Republic of Somalia (2006-2007) the Republic of South Africa (RSA) (2008-2011), the Republic of Sudan (2007-2008), the Kingdom of Swaziland (2006) and the United Republic of Tanzania (2007). Based on WHO estimates, RVF outbreaks in the Republic of Kenya, the Federal Republic of Somalia and the United Republic of Tanzania during 2006-2007 resulted in a total of 1 098 human infections with 323 deaths (WHO, 2007). In the Republic of Sudan in 2007, a RVF outbreak resulted in 222 human deaths. The RSA, between 2008 and 2011 filed 708 outbreak reports to the OIE, of which 508 in 2010 alone (OIE, 2014a).

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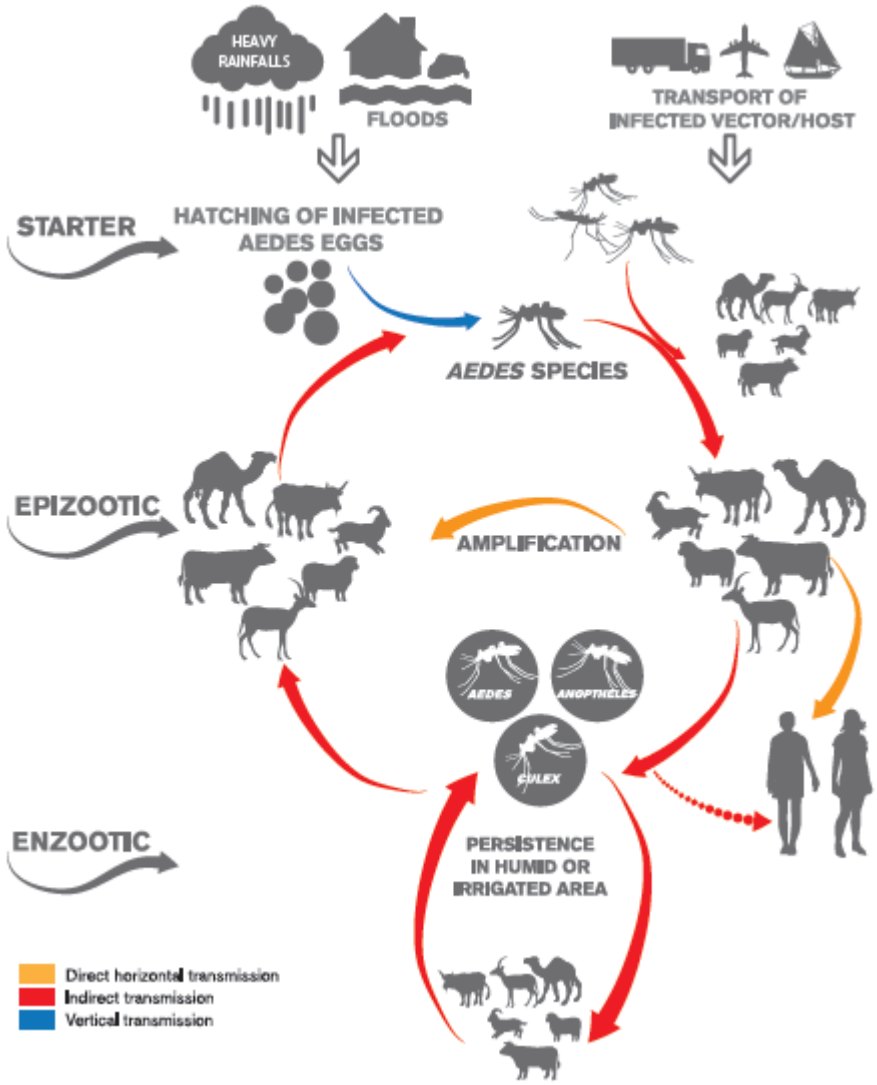


Background

- Climatic factors are important drivers of RVF viral activity
- They drive vector abundance and population dynamics, thus influencing disease emergence, transmission and spread
- Epidemics are significantly associated with climate anomalies
- This allows the possibility of forecasting RVF outbreaks

Climate-based forecasting models and EWSs

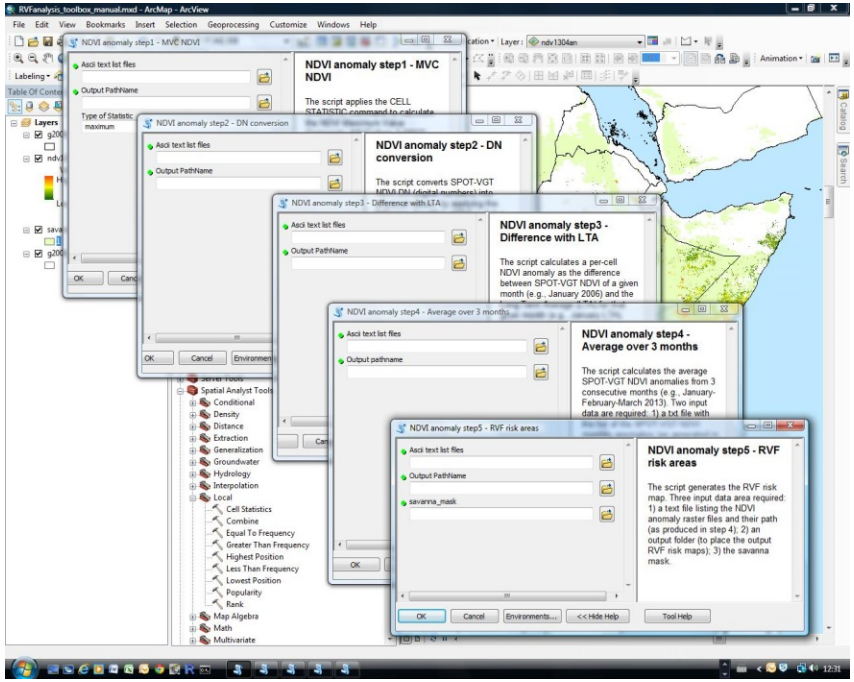
- Near-real-time satellite-based climate data allow to constantly monitor climate
- This facilitates the development of cost-effective, real-time EWSs for VBD
- EWSs inform prevention, risk mitigation, strategic preparedness and enhanced field response
- The Goddard Space Flight Center (GSFC) of NASA, FAO and WHO have been monitoring East Africa for years using NASA GSFC's modelling approach (Anyamba *et al*., 2009)

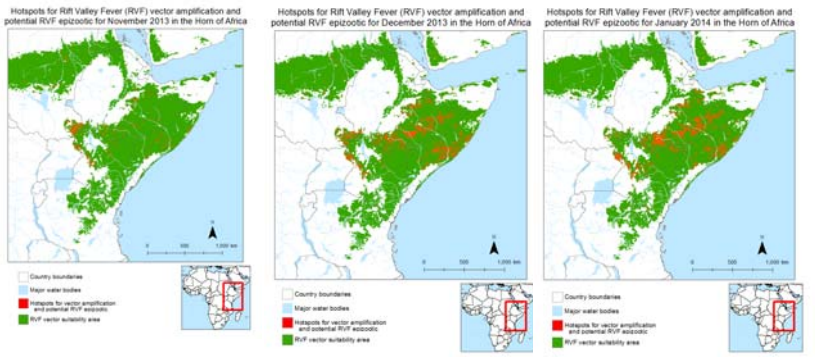
NASA GSFC's EWS

- Uses precipitation and the Normalized Difference Vegetation Index (NDVI)
- Identifies and maps areas with persistent, heavy, above-average rains and vegetation anomalies over the previous 3 months
- Results are then interpreted in relation to El Niño and Sea Surface Temperature (SST) indicators and precipitation forecasts, and compared with historical data
  - Warm El Niño conditions and positive SST are significantly associated with persistent and abnormal rains in East Africa

RVF risk maps in East Africa

- Maps produced on a monthly basis using the NASA model since April 1998 on East Africa
- In 2006-2007, this model predicted RVF in the Horn of Africa several weeks before the 1st signs of the disease were recorded in livestock and humans





EMPRES early warning messages

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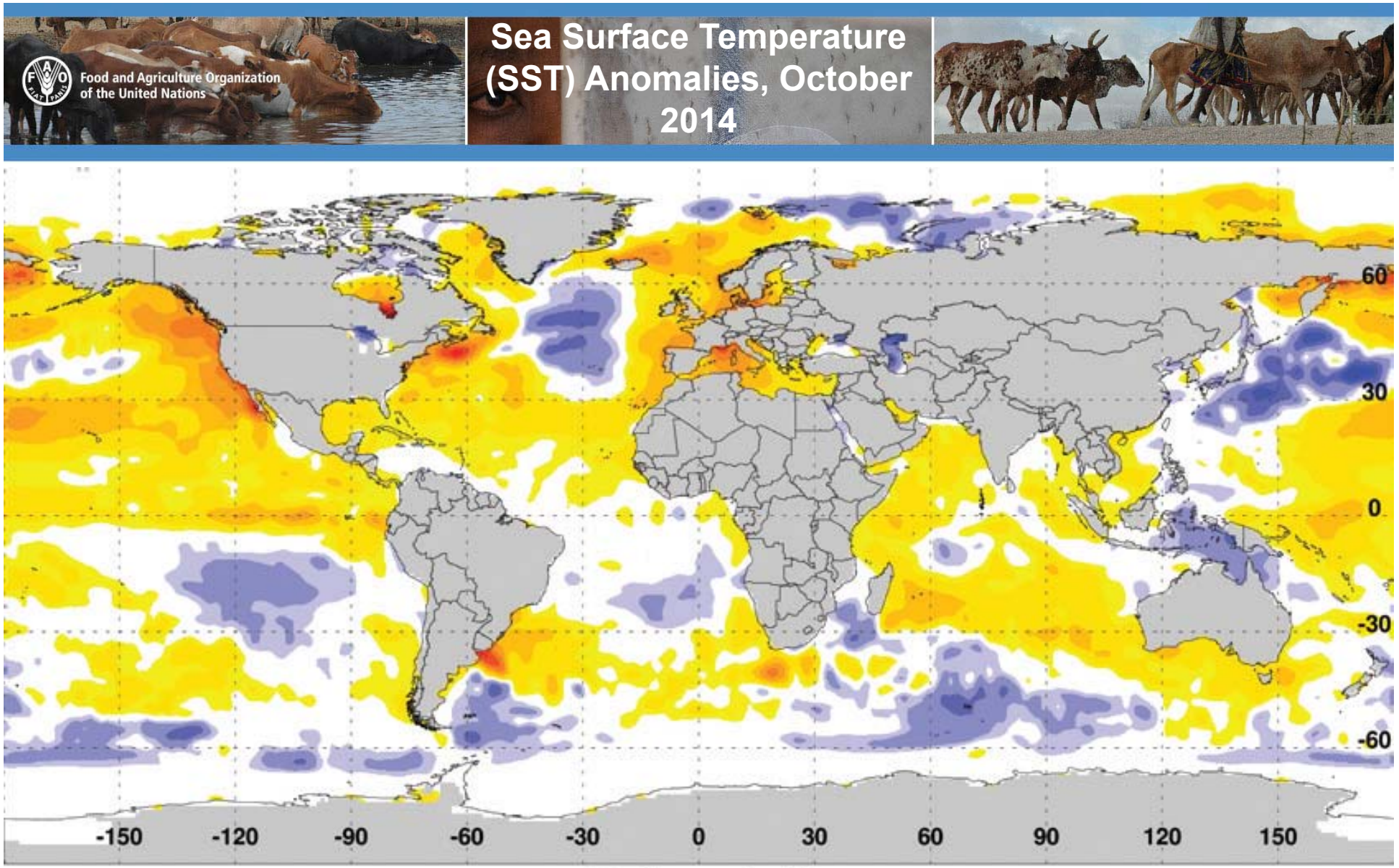
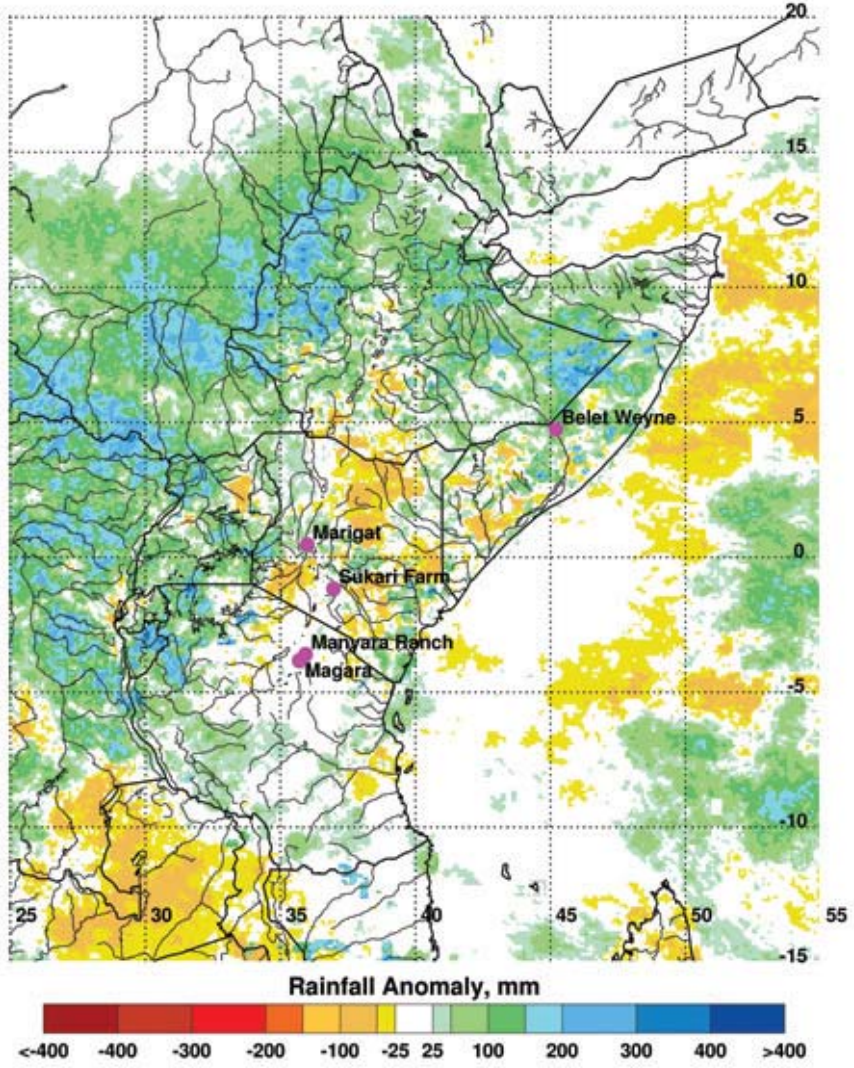


Source: NASA/GSFC GIMMS GROUP

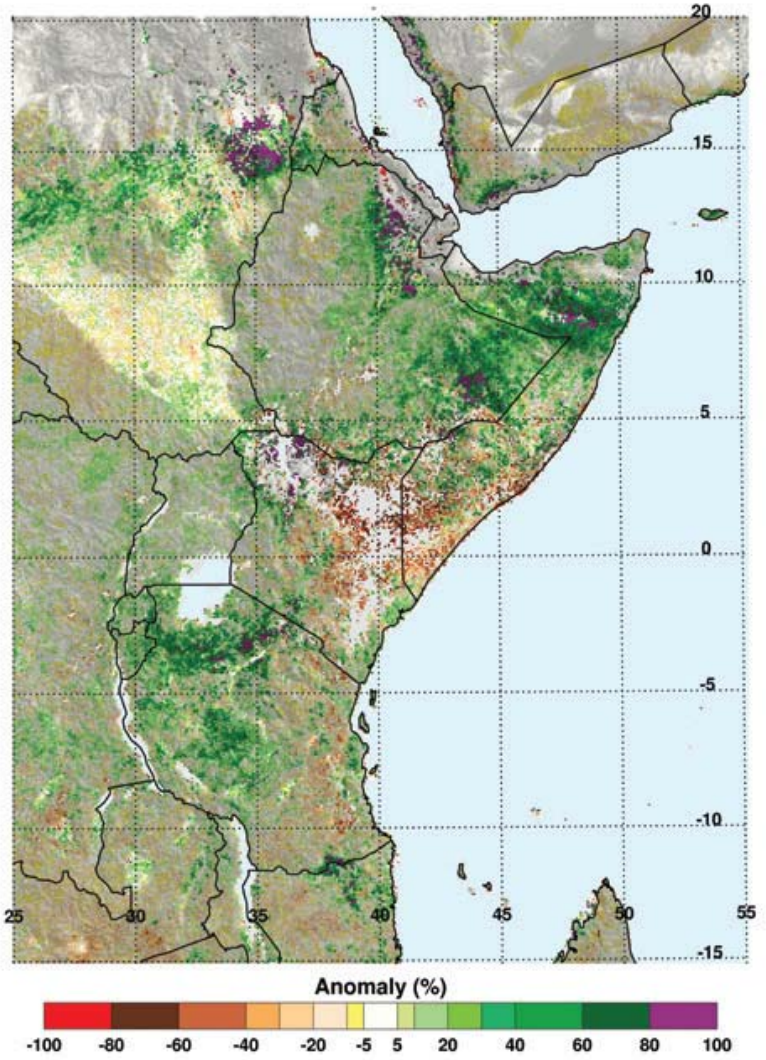
Rainfall anomaly (1 Sept.-20 Nov. 2014)

Source: AFHSC/Div GEIS Operations and NASA/GSFC GIMMS



NDVI anomalies

Source: AFHSC/Div GEIS Operations and NASA/GSFC GIMMS



Tripartite FAO, OIE and WHO recommendations

- Given the predicted risk for RVF activity in identified areas of Sudan, South Sudan, Somalia, Kenya and Tanzania, countries were encouraged to:
  a) Heighten **surveillance** level in humans and animals in at-risk areas;
  b) Increase their level of **preparedness**, and implement **targeted vaccination** in known at-risk areas;
  c) **Raise awareness and communicate** with communities about the risk of emergence of the disease in animals first and later in humans;
  d) **Monitor** the NASA/AFHSC/USDA RVF Risk Monitoring site for updates (http://www.ars.usda.gov/ Business/Docs.htm?docid=23464)

Surveillance in at-risk areas

- The communities in areas with above-average rainfall conditions should be subject to heightened surveillance, including:
  - increased monitoring of **sentinel herds** where available
  - increased surveillance in **markets** or places where large numbers of at-risk animals are traded or congregate
  - focus placed on identification and reporting of non-specific **clinical signs** such as abortions or neonatal mortalities in ruminants
- **One Health** integrated approach - Surveillance systems should be strengthened, with an active collaboration of the national ministries responsible for public health, agriculture and livestock

Vaccination

- Vaccination can help to limit virus circulation in endemic areas and prevent epidemics in free areas
- Most effective when used in conjunction with other control strategies (e.g. surveillance, quarantine and movement controls)
- Clone 13 offers high level of protection with less virulence. Countries at risk are strongly encouraged to register it
- Mass vaccination is one of the tools for preventing RVF epidemics in animals. However, vaccination is not recommended in the event of known RVF circulation, as inappropriate vaccination can promote the spread of the virus
- Requirements for RVF vaccine production are available in the Manual of Diagnostic Tests and Vaccines for Terrestrial Animals 2014 Chapter 2.1.1.4. http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.01.14_RVF.pdf

Vector control

- Efforts to prevent RVF transmission through mosquitoes should be part of the overall One Health approach
- Virus transmission through vectors in at-risk areas can be decreased through:
  - insecticides
  - repellents (on animals and humans)
  - mosquito netting
  - strategic larvicidal treatment in mosquito breeding habitats

One Health communication & public awareness

- Essential to protect livestock and humans from RVF infections by limiting their exposure
- Should inform the public, but also targeting at-risk professions (farmers, veterinarians, slaughter house personnel, etc.)
- One Health approach - Encourage veterinary and public health authorities in at-risk countries to jointly develop a comprehensive health education programme

Public health messages for risk reduction should focus on

- Reducing the risk of animal-to-human transmission:
  - Gloves and other protective clothing should be worn and care be taken when handling sick animals or their tissues or when slaughtering animals;
  - All animal products (i.e. fresh blood, raw milk or animal tissue) should be thoroughly cooked before eating
- Protecting the community against the mosquito bites:
  - impregnated mosquito nets
  - personal insect repellent
  - light coloured clothing
  - long-sleeved shirts and trousers
  - avoiding outdoor activity at peak biting times of the vectors
- Implementing standard precautions in health care settings - http:// www.who.int/csr/resources/publications/ standardprecautions/en/index.html

Trade issues (1)

The 2014 revised Chapter on RVF (8.13) of the Terrestrial Animal Health Code clearly identifies:

a)Country/zone free from RVFV infection: Notifiable RVF and either:

- Historical freedom
- No RVFV infection in ruminants for > 10 years (demonstrated by a RVF-specific surveillance programme) and no indigenous human cases

b)Country/zone infected with RVFV during the inter-epizootic period: Virus activity at a low level + factors predisposing to an epidemic are absent + no clinical cases in animals or humans

c)Country/zone infected with RVFV, during an epizootic: RVF outbreaks occur at an incidence substantially exceeding that of the inter-epizootic period.

Trade issues (2)

- For trade purposes, the infective period was reduced from 6 months to 14 days
- Even in the presence of RVF, the Code accepts trade of ruminants and meat from infected countries if conditions of quarantine, vaccination and maturation of meat are met
- Based on timely and prompt notification to the OIE
- FAO, ILRI and Eastern Africa partners recently updated the 2010 (Risk-based) *Decision-support framework for prevention and control of Rift Valley fever epizootics in the Greater Horn of Africa*, on how to plan and monitor activities in different RVF alert stages - http://hdl.handle.net/10568/21783

Conclusions

- Need to continue monitoring
- Need to continue issuing early warning messages
- Need to assure that the right people receive these warnings
- Need to be clear on the follow-up actions needed
- Need to field-validate the predictions, i.e. surveillance

Thanks