

Climatic Changes and vector-borne diseases: Example of Rift Valley Fever

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22^e Conférence de la Commission régionale de l'OIE pour l'Afrique
Swakopmund, Namibie, 20-24 Février 2017

Disease Ecology at Wildlife/Livestock Interface

- Zimbabwe (UZ) – 2006-2014
- Mozambique (UEM) – 2015-on-going
- Avian influenza at wild/ domestic bird interface
- Infectious diseases at buffalo/ cattle interface
In TFCAs (FMD, bTB, CA, RVF, PPR)
- Coordinator of the RP-PCP



RP-PCP

Research Platform Production and Conservation in Partnership

www.rp-pcp.org



*« Promoting the coexistence between People and Nature in
TFCAs »*

RP-PCP is 10 years!

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- 2007-2017:
 - More than 100 post-graduate students supported (Msc, Mphil, Phd), mostly from SADC
 - More than 110 articles and book chapters
- *RP-PCP TFCA Conference*
 - 22-26th May 2017
 - SE Lowveld Zimbabwe
 - Scientific conference for communities!



Research Platform
"Production and Conservation in Partnership" *Call for Abstracts*

Coexisting (with)in TFCAs: local perspectives


Thematic areas

- Access to natural resources
- Mitigating human wildlife conflicts
- Improving livestock and crop productions by local farmers
- Boundaries of protected areas
- Prevention and control of livestock/wildlife/human diseases
- Sharing benefits generated by wildlife

SOUTH EAST LOWVELD, ZIMBABWE
22 - 26 MAY 2017

Please submit your abstract following recommendations at: rencareconf2017@gmail.com
before the Friday 27th January 2017

Format your abstract as specified at www.rp-pcp.org

UMR **CMAEE** + UPR **AGIRs**
(Director: Thierry LeFrançois) (Director: François Roger)
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LA RECHERCHE AGRONOMIQUE
POUR LE DÉVELOPPEMENT

Joint research unit: **ASTRE**

AnimalS, health, Territories, Risks and Ecosystems

Animal et
gestion intégrée
des risques



Contrôle des maladies
animales exotiques
et émergentes

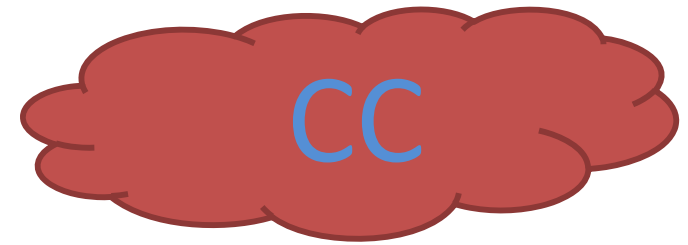


Rift Valley fever, rainfall and livestock trade

- ❑ General introduction
- ❑ RVF epidemiology in Africa
- ❑ Drivers of RVF epidemics
 - ✓ Rainfall anomalies
 - ✓ Live-ruminant trade
- ❑ Mitigation of RVF infection risk for humans
- ❑ One Health and more

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- **Climate change (cc)=**

- + long term change in climate (T°, rainfall)

- + Increase in extreme climatic events (droughts, floods)

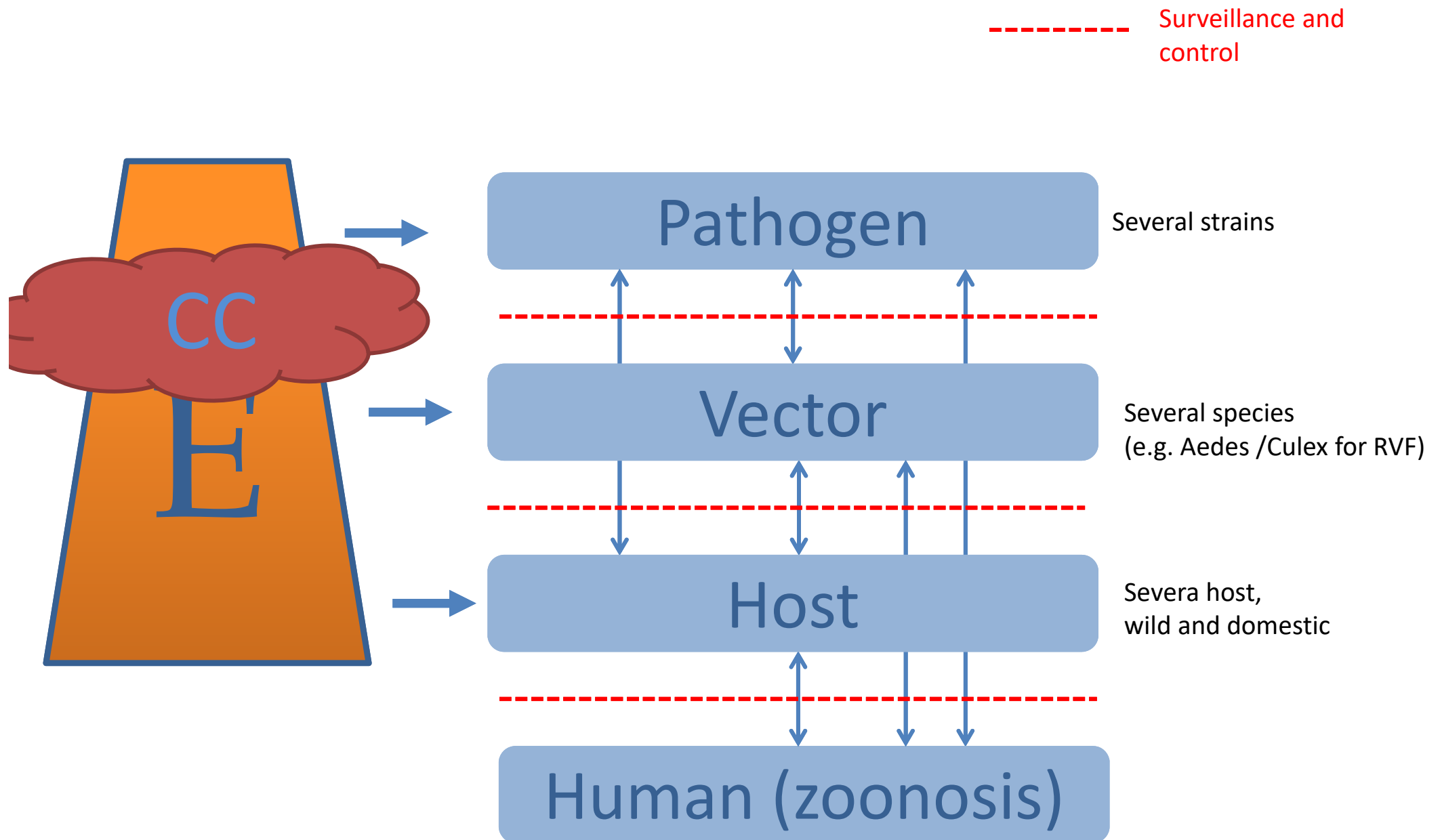
- **It is happening** (felt in southern Africa)

- With other **Global changes** (globalisation, people and goods movement, deforestation etc.)

- **Uncertainty** on the effect of CC

- **And** on the combined effect with other global changes

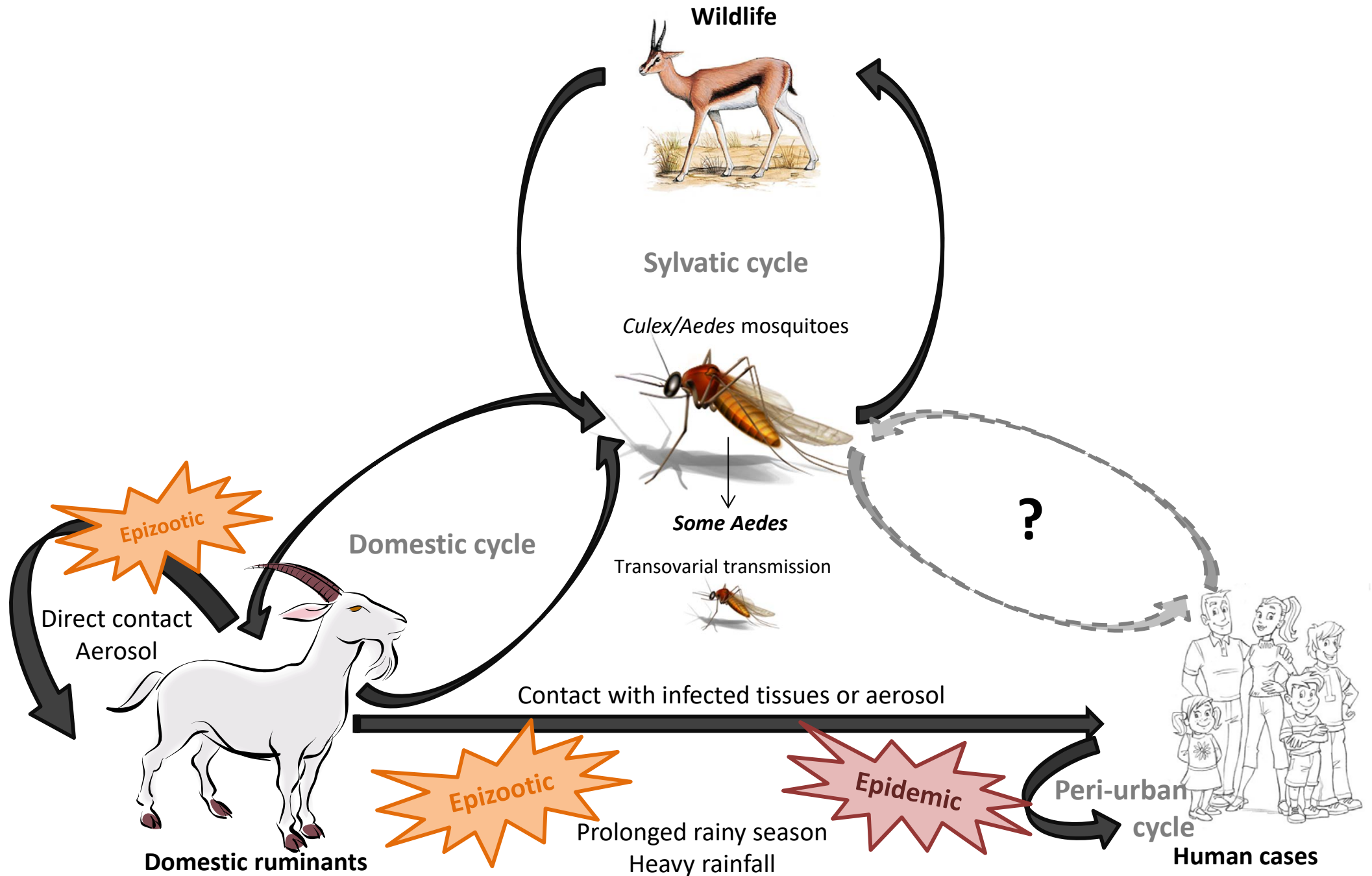
Vector-borne disease: susceptibility to climate change?



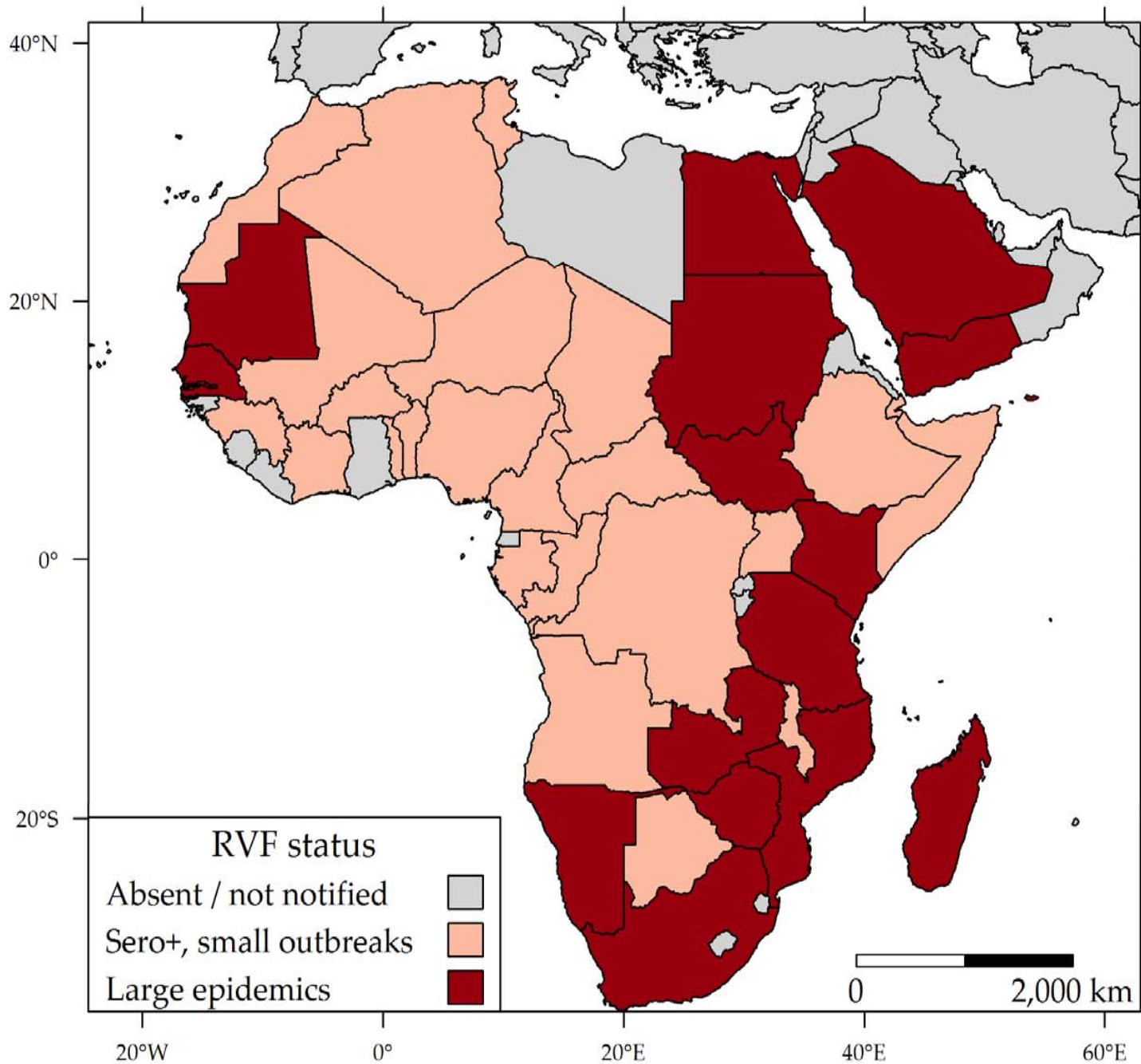
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Rift Valley fever: epidemiological cycle



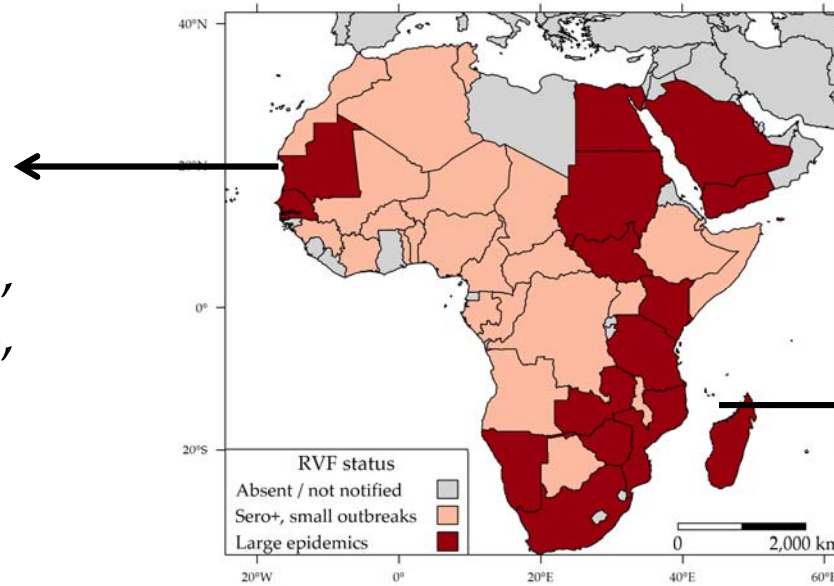
Rift Valley fever: epidemiological situation



Epidemiological situation

Senegal and Mauritania

- ✓ 1987-1988,
- ✓ 1993-1994,
- ✓ 1998,
- ✓ 2002-2003
- ✓ **2010**
- ✓ **2012-2014**



South-western Indian Ocean

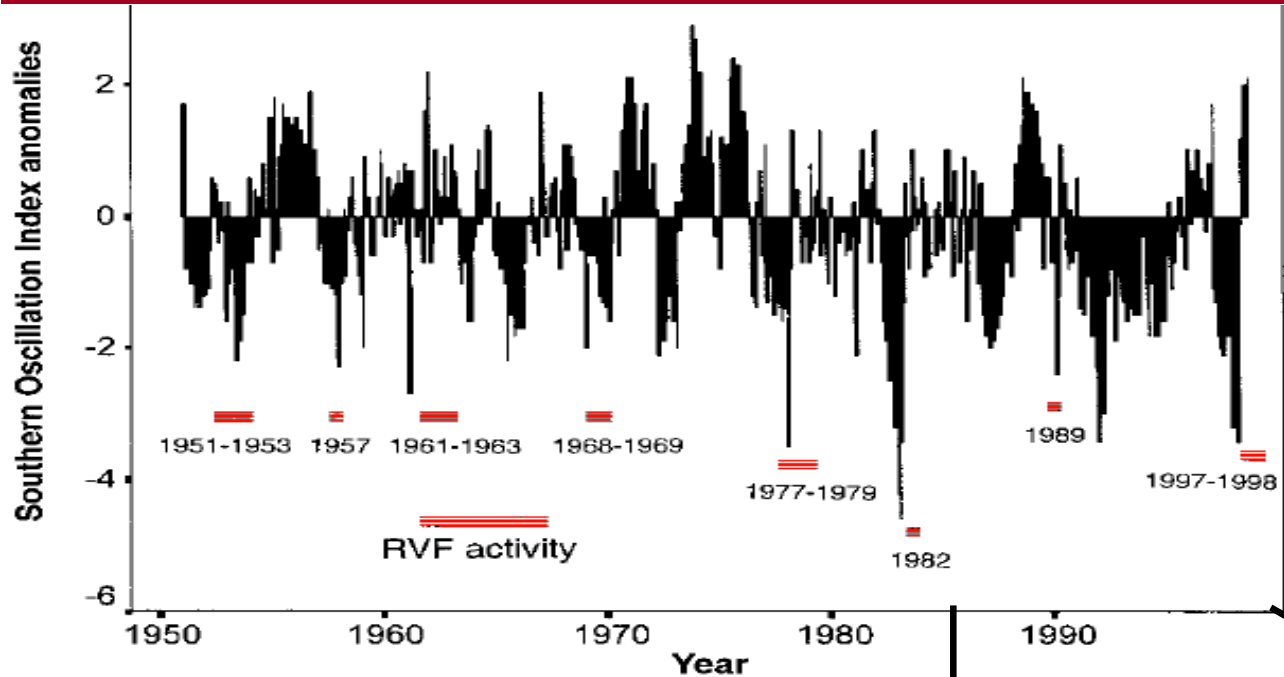
- ✓ Comoros Islands:
2004-2013

- ✓ Madagascar:
1990-1991
2008-2009

Rift Valley fever, rainfall and livestock trade

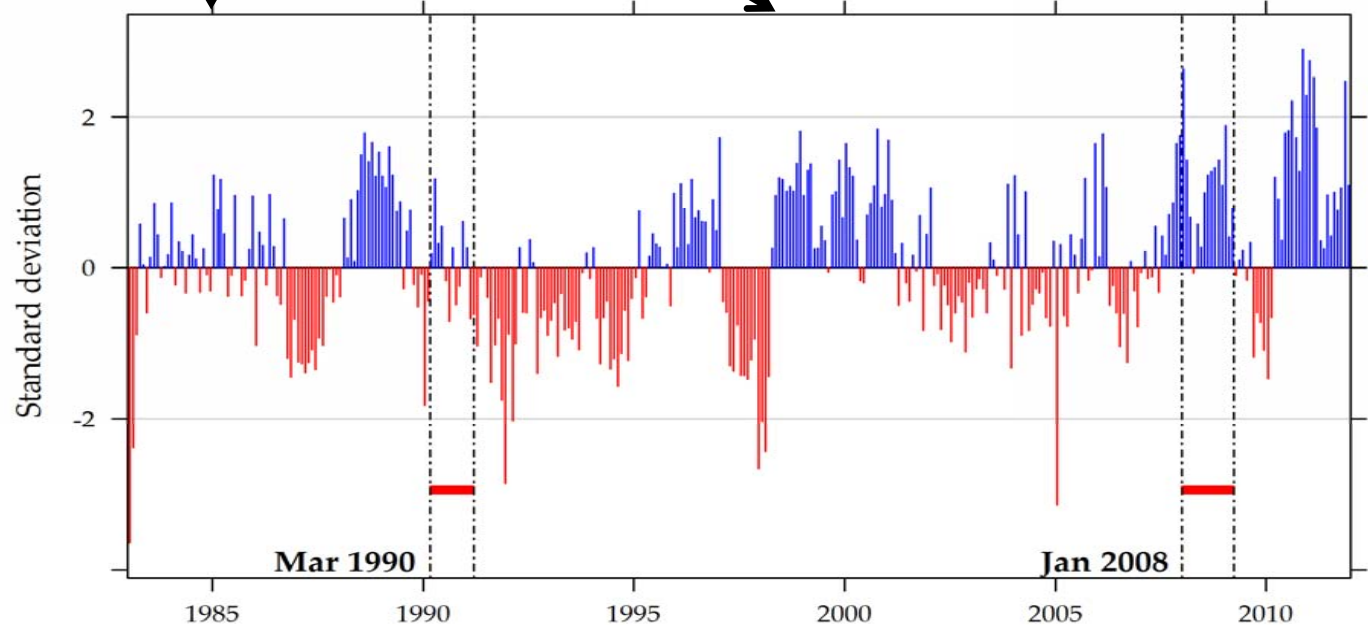
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RVF and southern oscillation index (SOI)



Eastern Africa
Linthicum, 1999

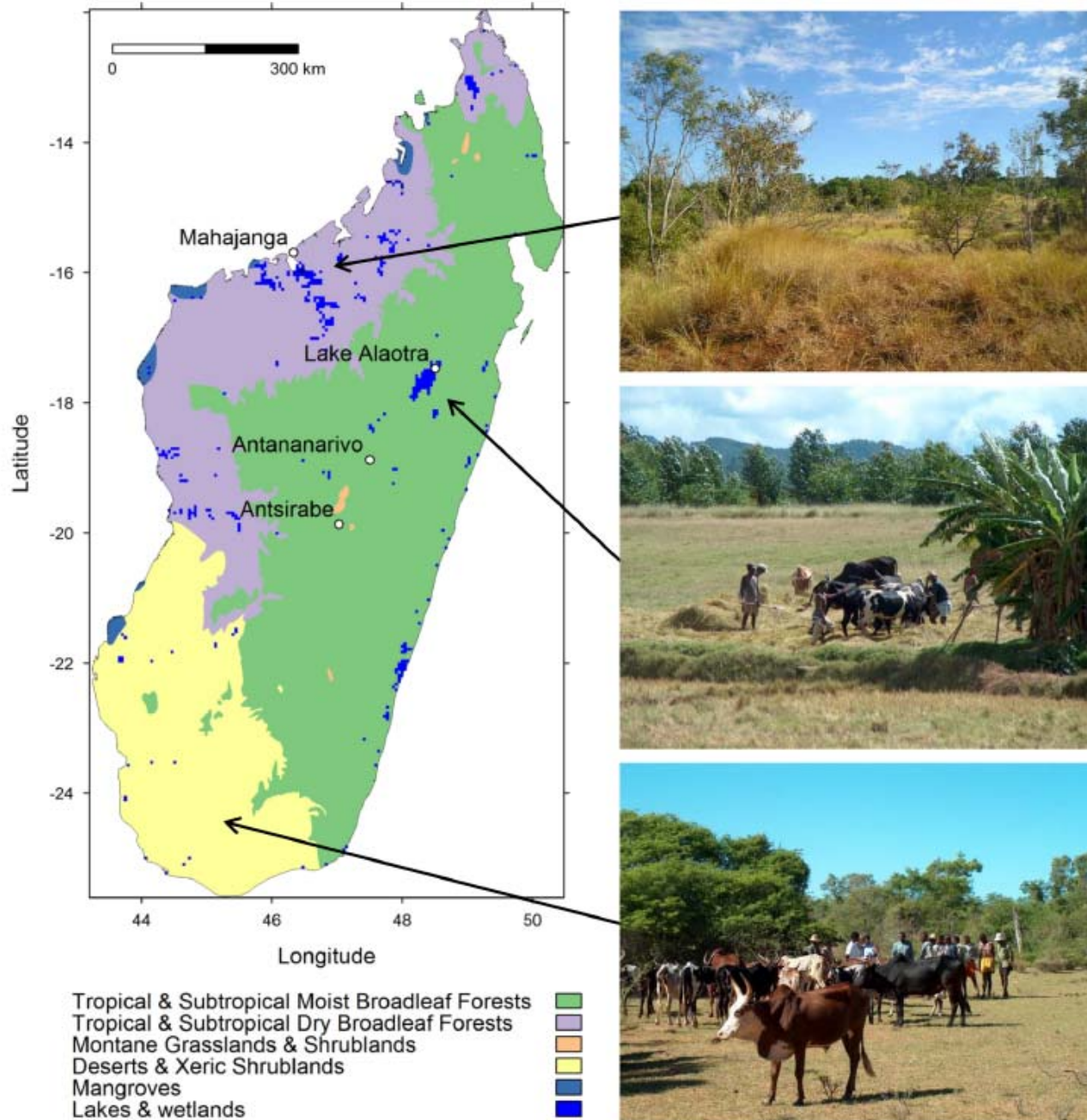
Lancelot et al. PNAS 2017



Madagascar
Source for SOI: IRI

<http://iri.columbia.edu/>

Madagascar: main biomes

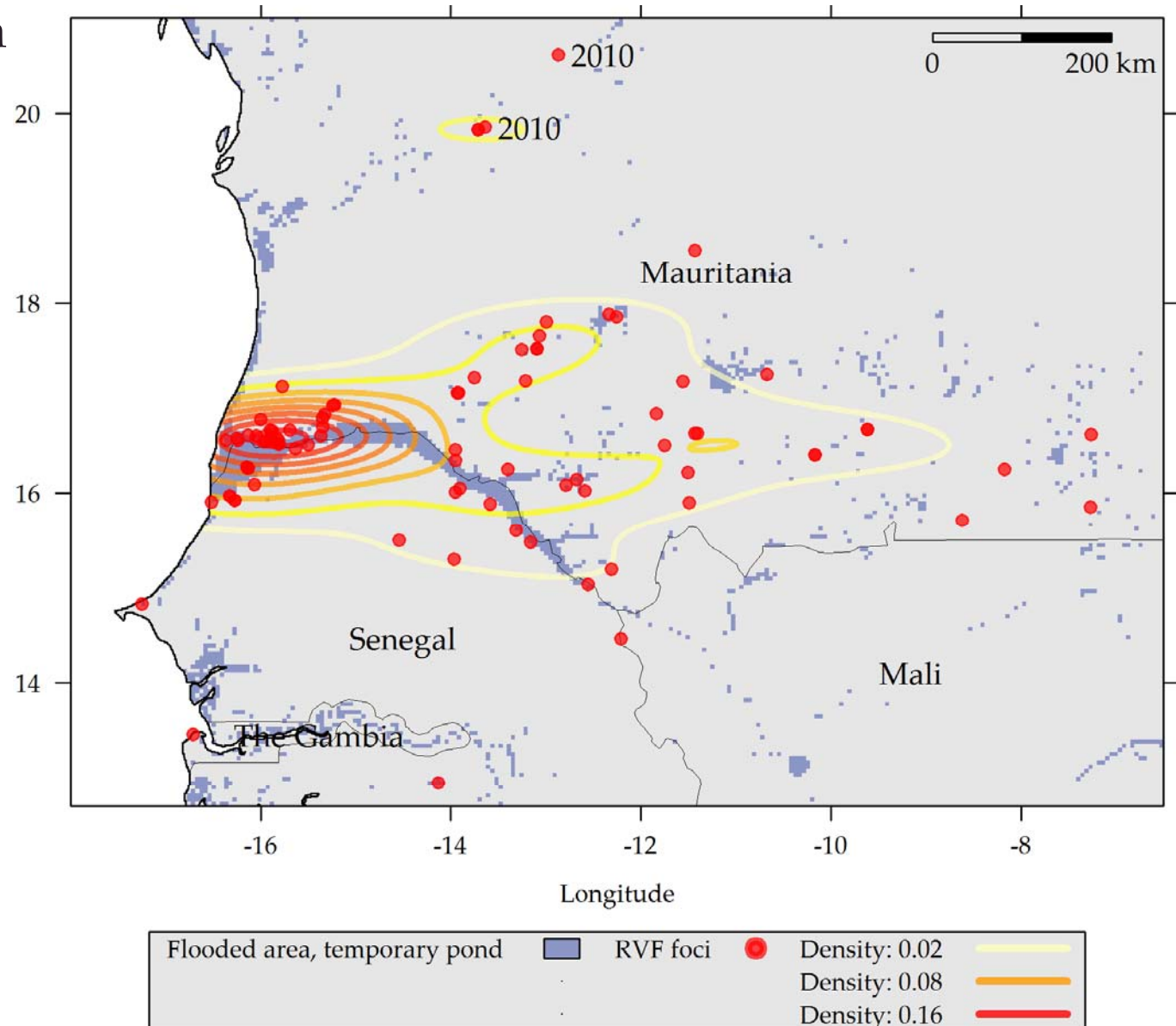


Still no relationship
between SOI & RVF
outbreaks

Main biomes of Madagascar. Source for the biomes: Olson et al. [35]. Credit for the pictures: R. Lancelot

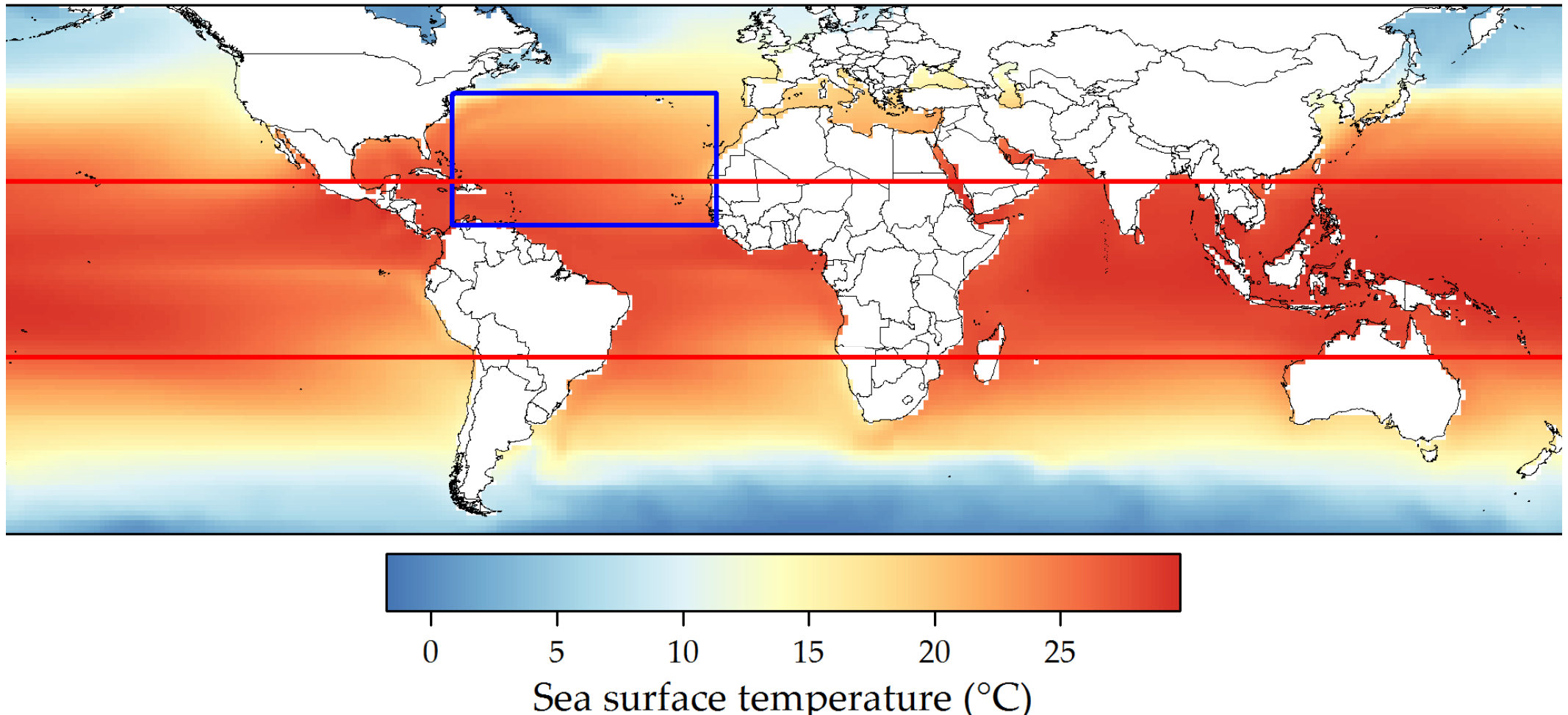
West Africa: RVF foci since 1987 [Arsevska, 2016]

- ❑ Intense RVFV activity in the region
- ❑ Not restricted to Senegal River basin:
 - ✓ Northern and south-eastern Mauritania
 - ✓ Dakar and Thies
 - ✓ The Gambia and southern Senegal



RVF & sub-tropical North Atlantic index, West Africa

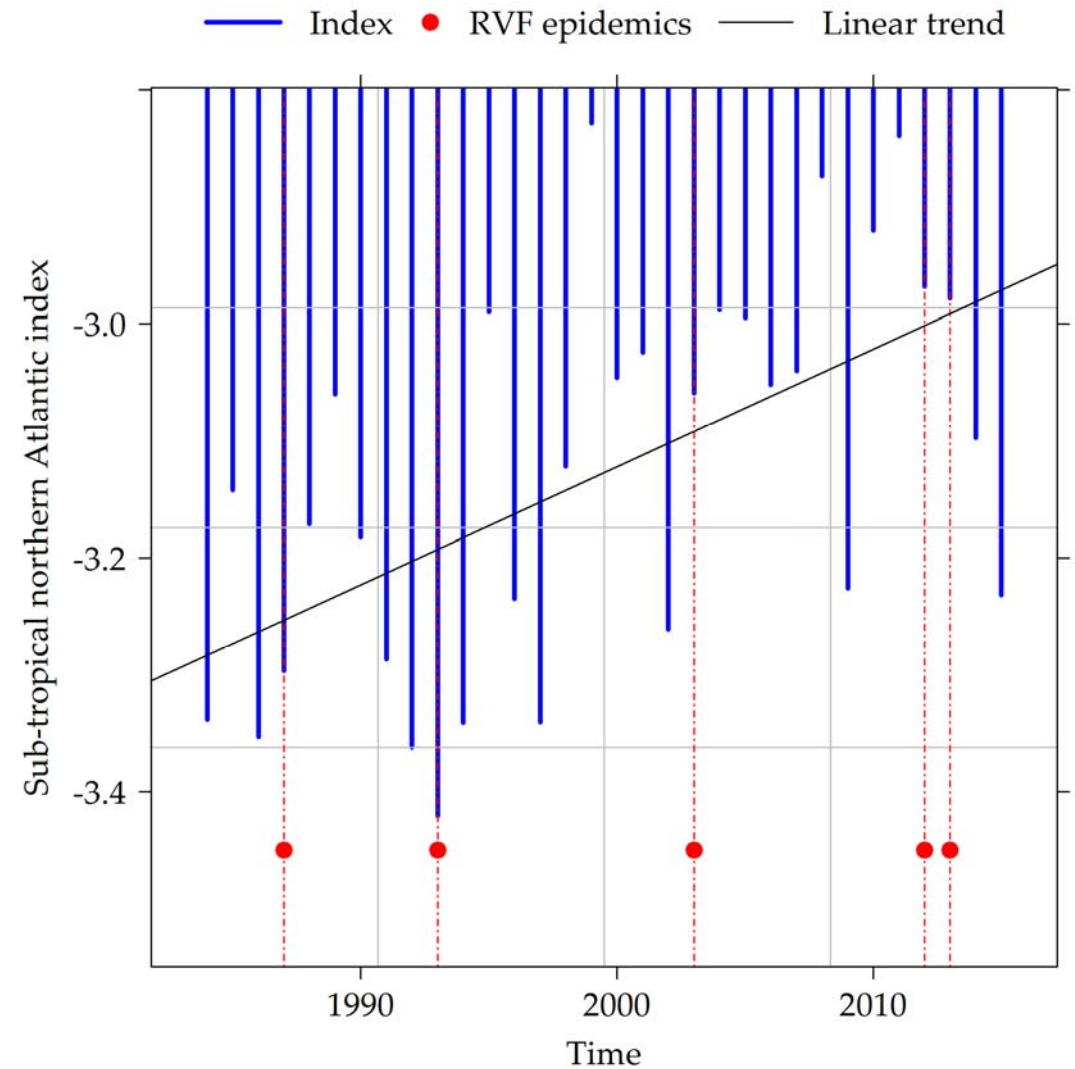
STNAI: sea-surface temperature difference between sub-tropical northern Atlantic ocean (**blue frame**) and global tropical ocean (**red frame**) [Giannini, 2013]



Data: <http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.oisst.v2.html>

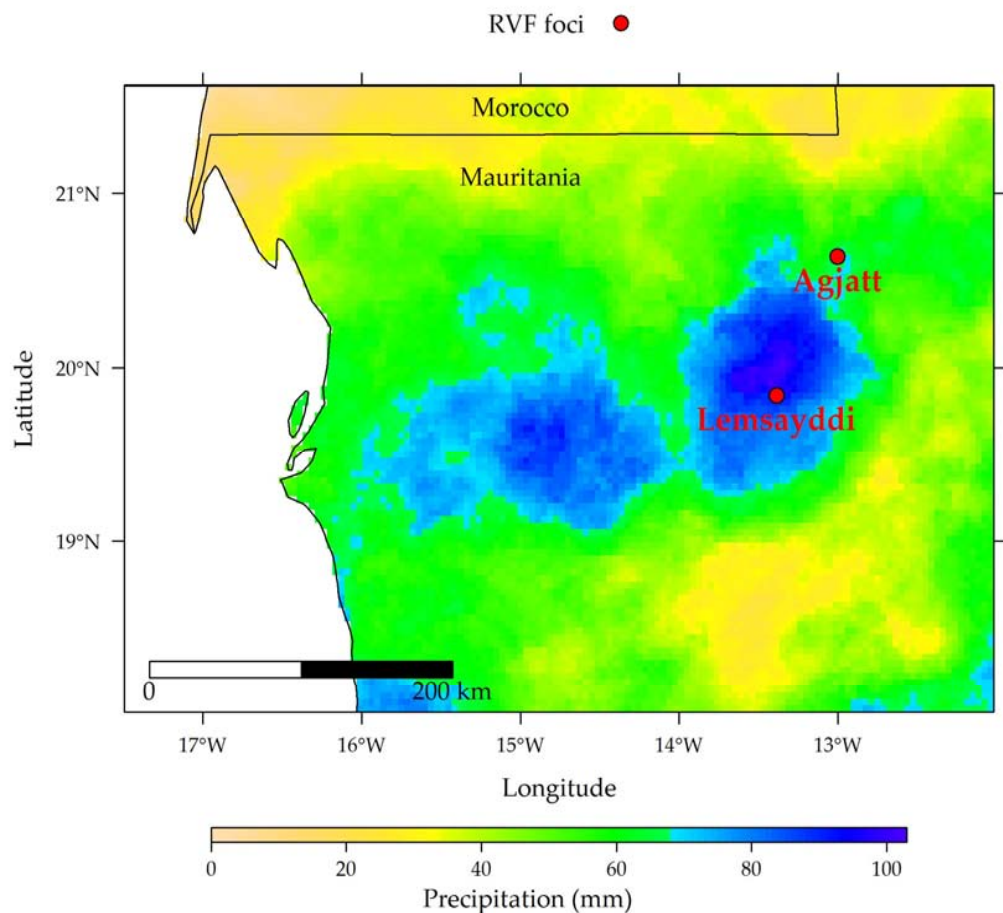
RVF & sub-tropical North Atlantic index, West Africa

- Rainfall in the Sahel positively associated with STNAI ($R^2 = 0.41$, $P = 7 \cdot 10^{-5}$)
- Positive linear time trend in STNAI ($P = 10^{-3}$) but no linear association between STNAI and the occurrence of RVF outbreaks ($P = 0.5$)



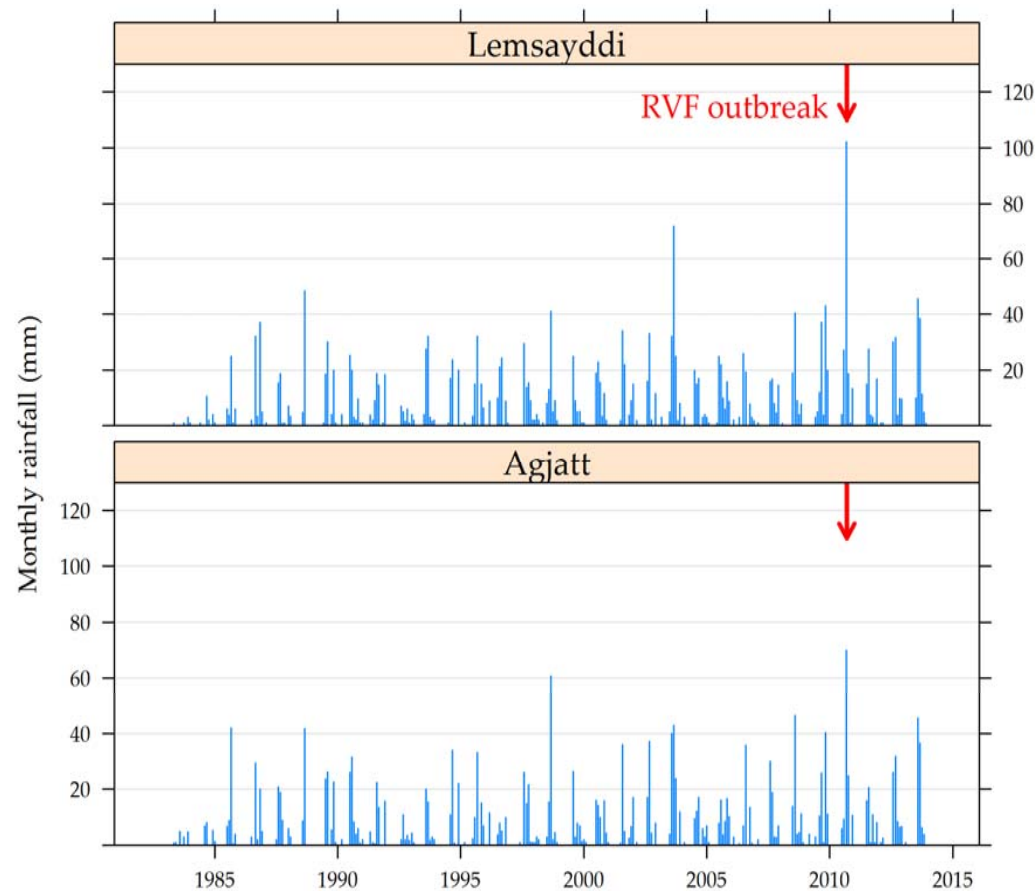
Exceptional rainfall in the desert

A unique rainfall event, Sept. 2010



[El Mamy, 2011, 2014]

Rainfall time series 1983-2014



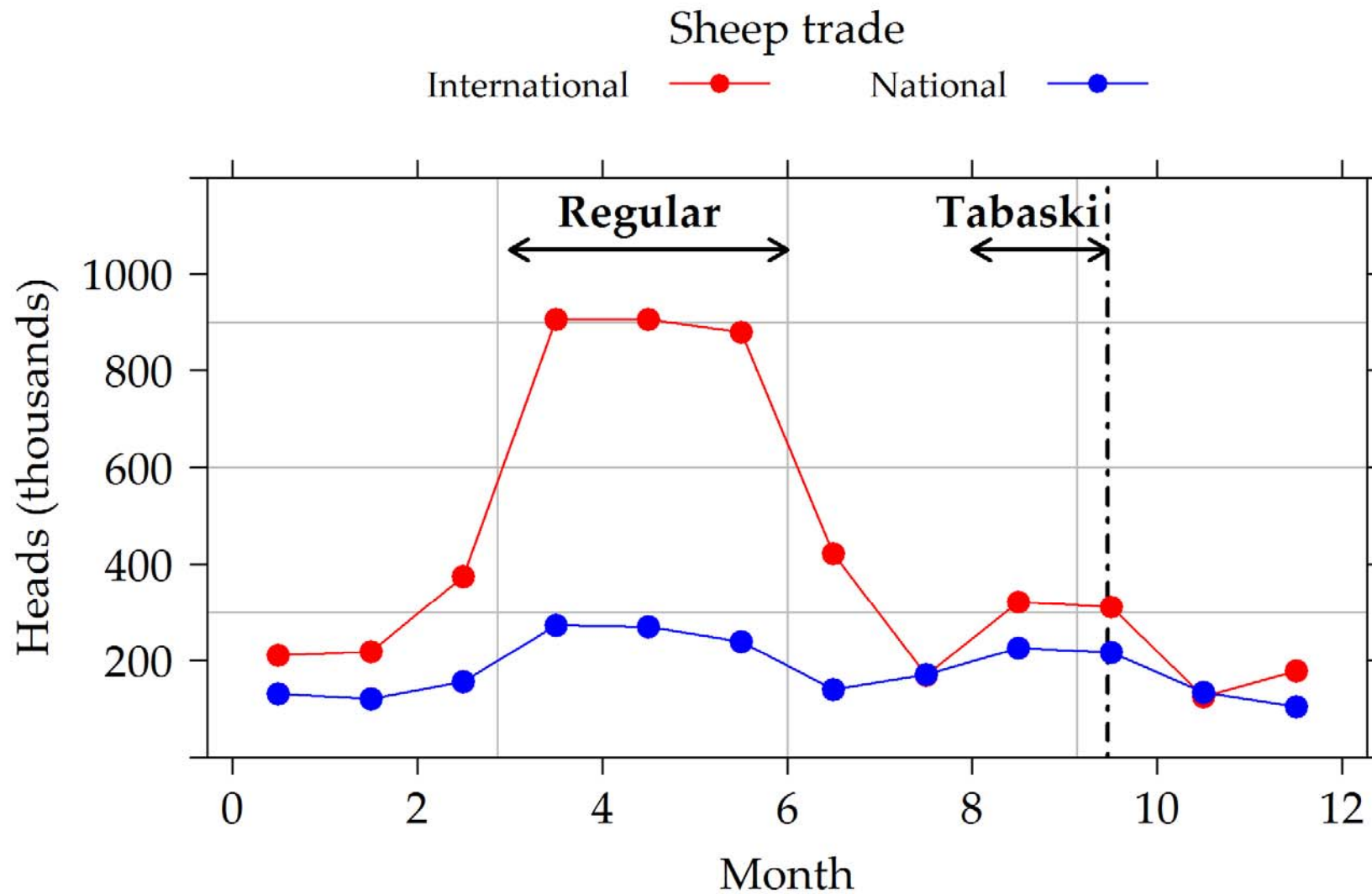
[Maidment, 2014]

Source for rainfall :Tamsat

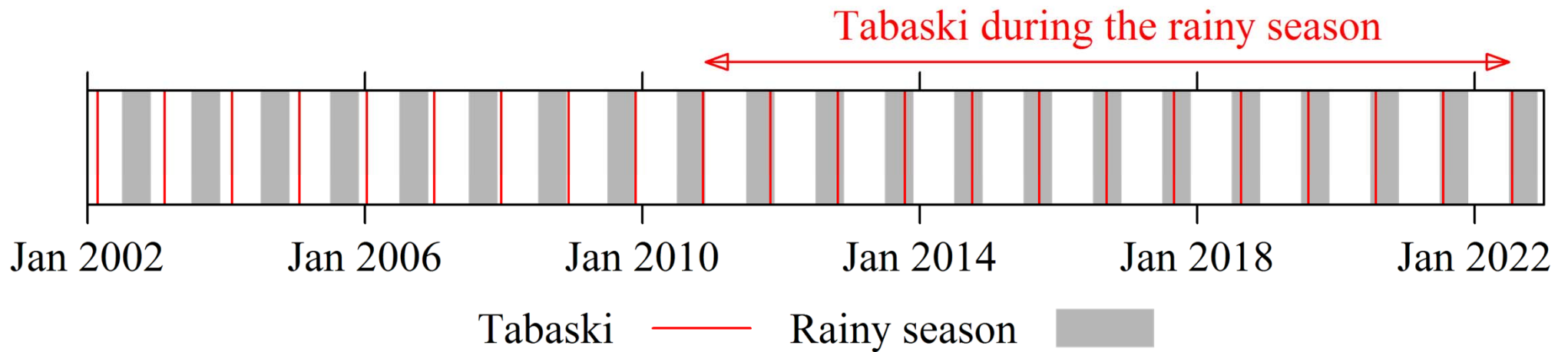
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Terrestrial transboundary trade: sheep in Mauritania



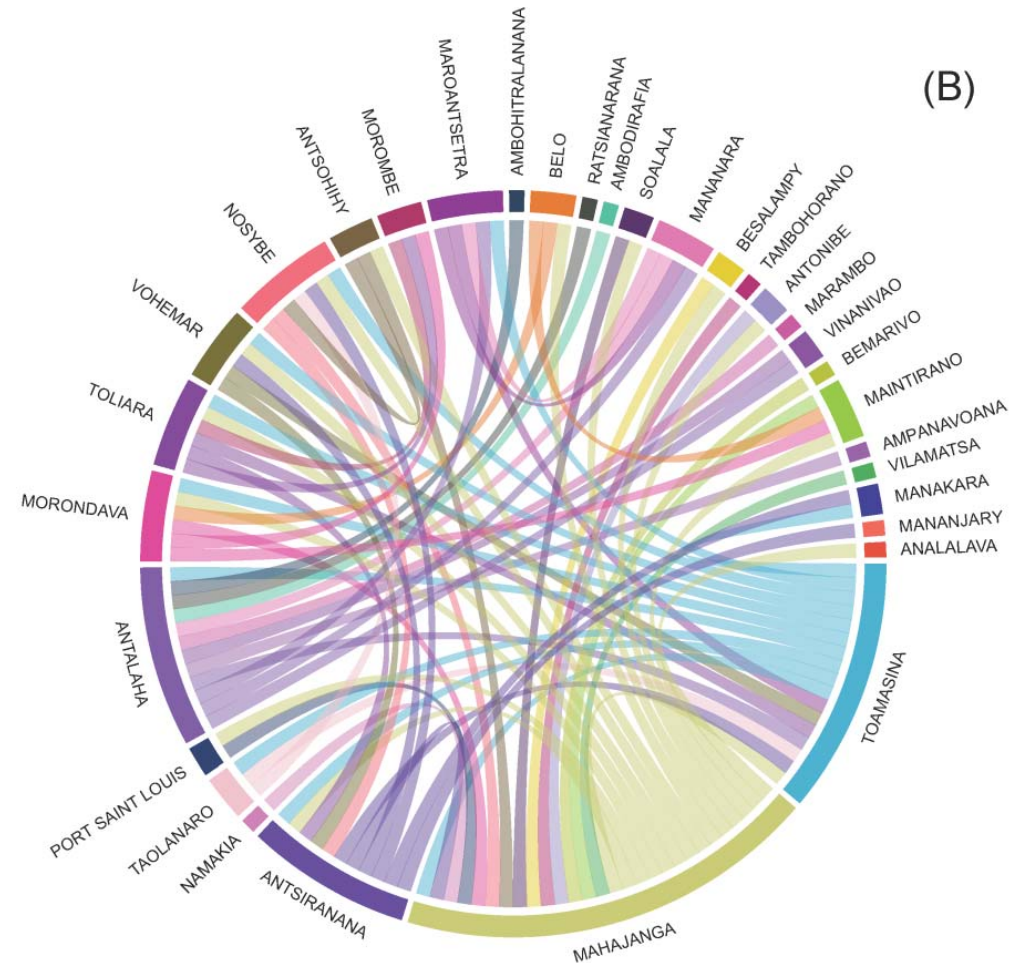
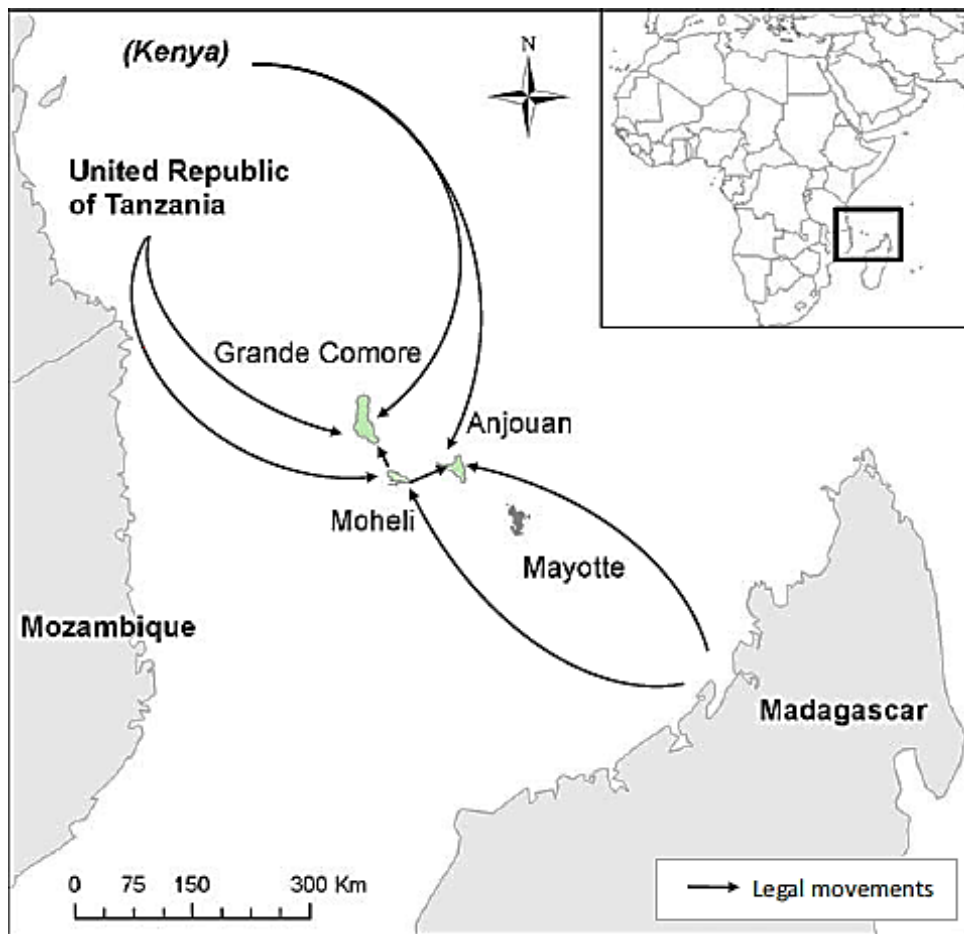
Livestock trade during RVFV transmission period



South-western Indian Ocean: sea trade

From Africa to Comoros & Madagascar

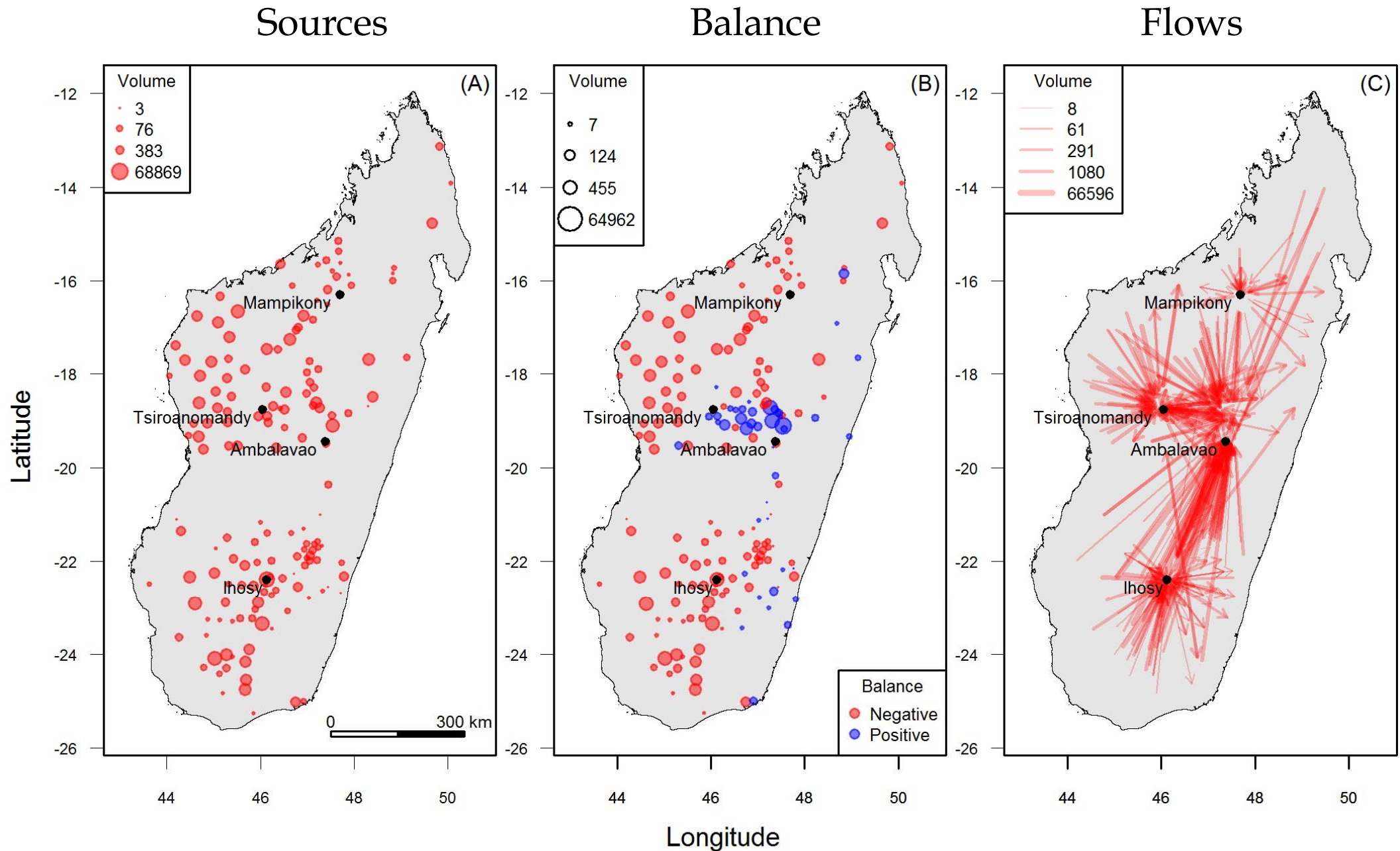
Between Malagasy sea ports



[Cetre-Sossah, 2014]
[Maquart, 2016]

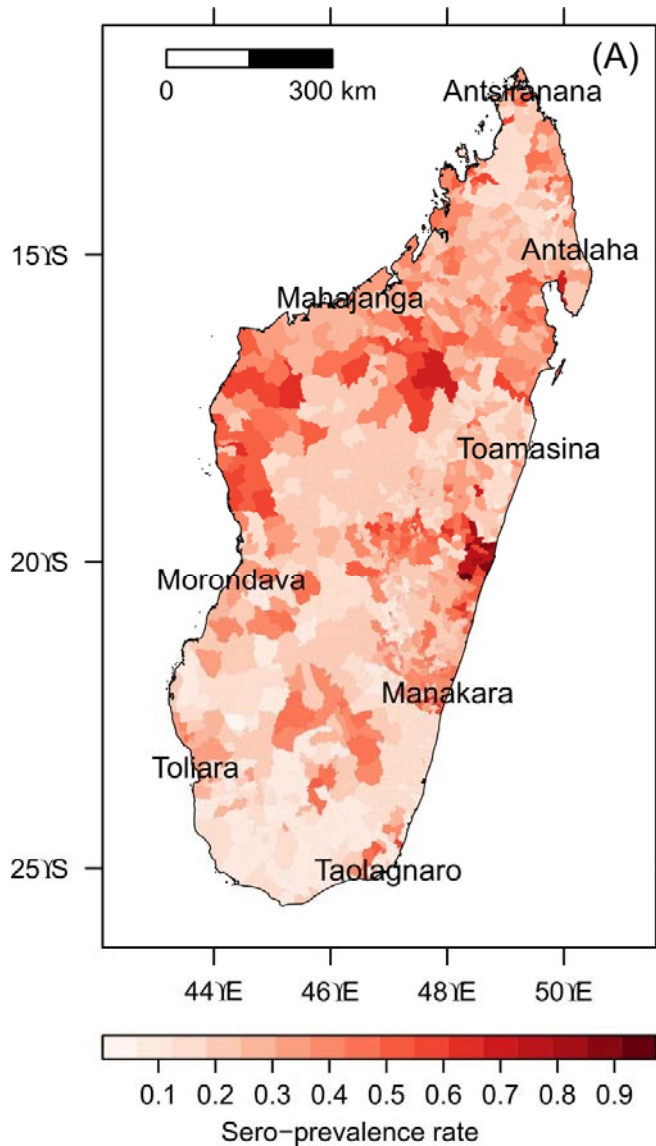
data: Scetauroute international, 2004

National trade: cattle in Madagascar

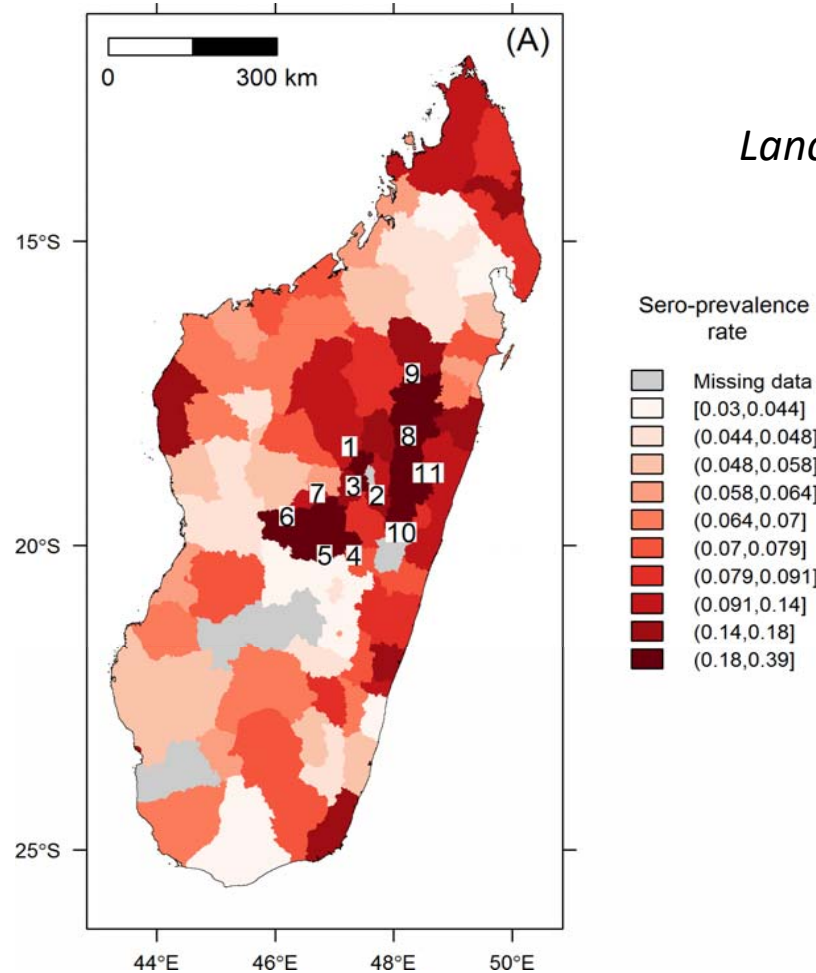


Cattle trade and human infection risk, Madagascar

Risk of infection in cattle

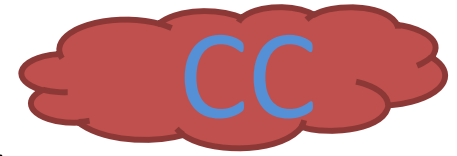


Risk of infection in humans



Lancelot et al. PNAS 2017

- Human risk increases with cattle trade intensity from infected areas
- High human risk in densely populated central highlands



- **Examples** (Chevalier et al. 2016, Lancelot et al. 2017)

- Human African Trypanosomiasis (HAT)
 - Droughts In the 70s
 - > pastoralist migration
(from Upper Volta to Ivory Coast)
 - > **Spread of HAT**
- Human relapsing fever (*Borrelia crocidurae*) soft tick → humans and rodents in West Africa
 - **Dry season after heavy rains**
 - > **ticks shift feeding on humans -> cases**

Ex. Tick-borne Encephalitis in Europe

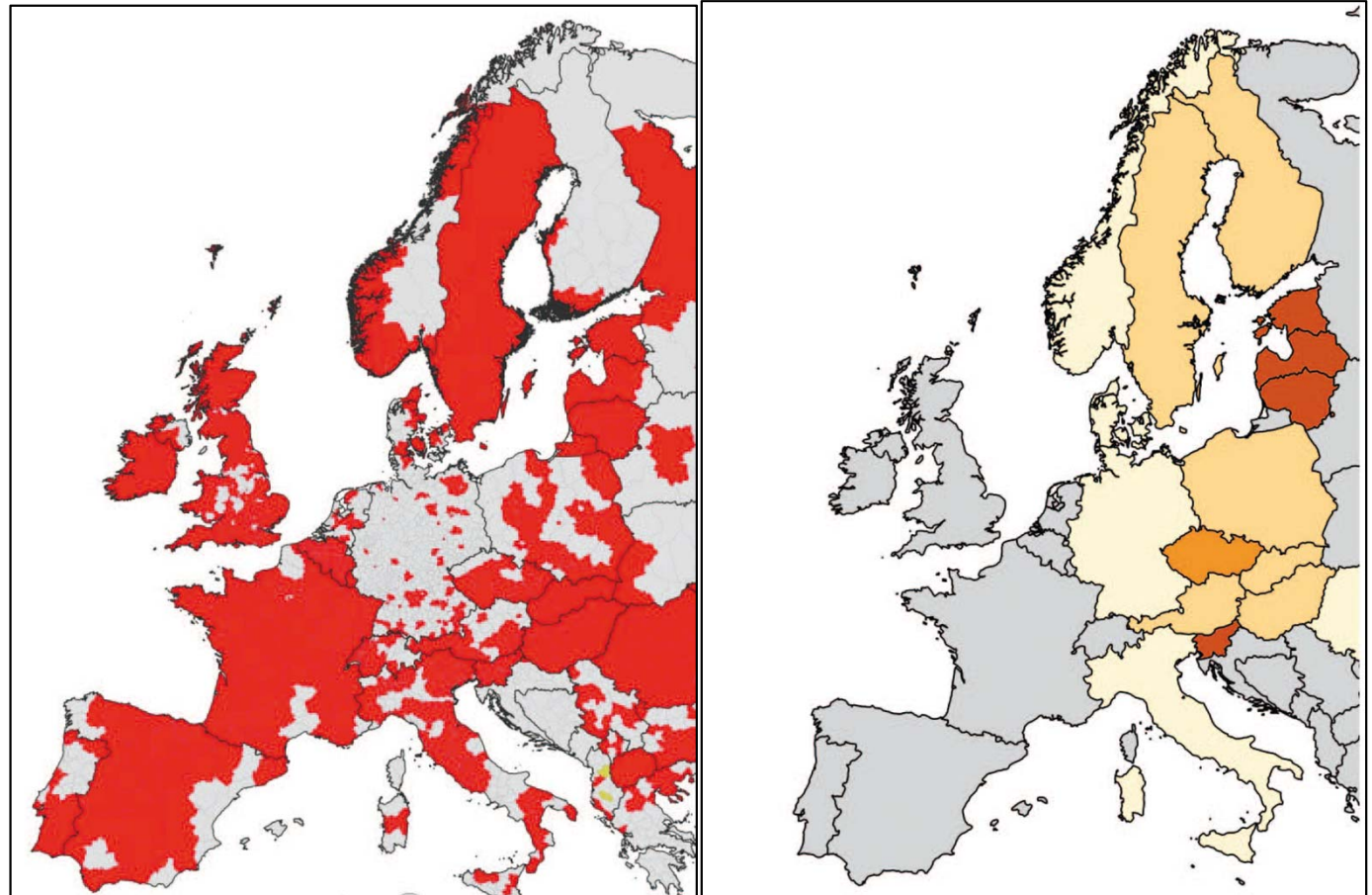
Climate change effect on vector distribution

But not homegenous across Europe

→ Effect of pauperisation of Eastern states due to the end of the soviet regimes

◆ Less vaccination

◆ More exposition to ticks in forests (using Nat. Res.)



Known distribution of *Ixodes ricinus* in Europe and TBE incidence
Data source: VBornet (tiques) / ECdC (TBE), février 2015.
Lancelot et al., in press

Godfrey et al. 2011

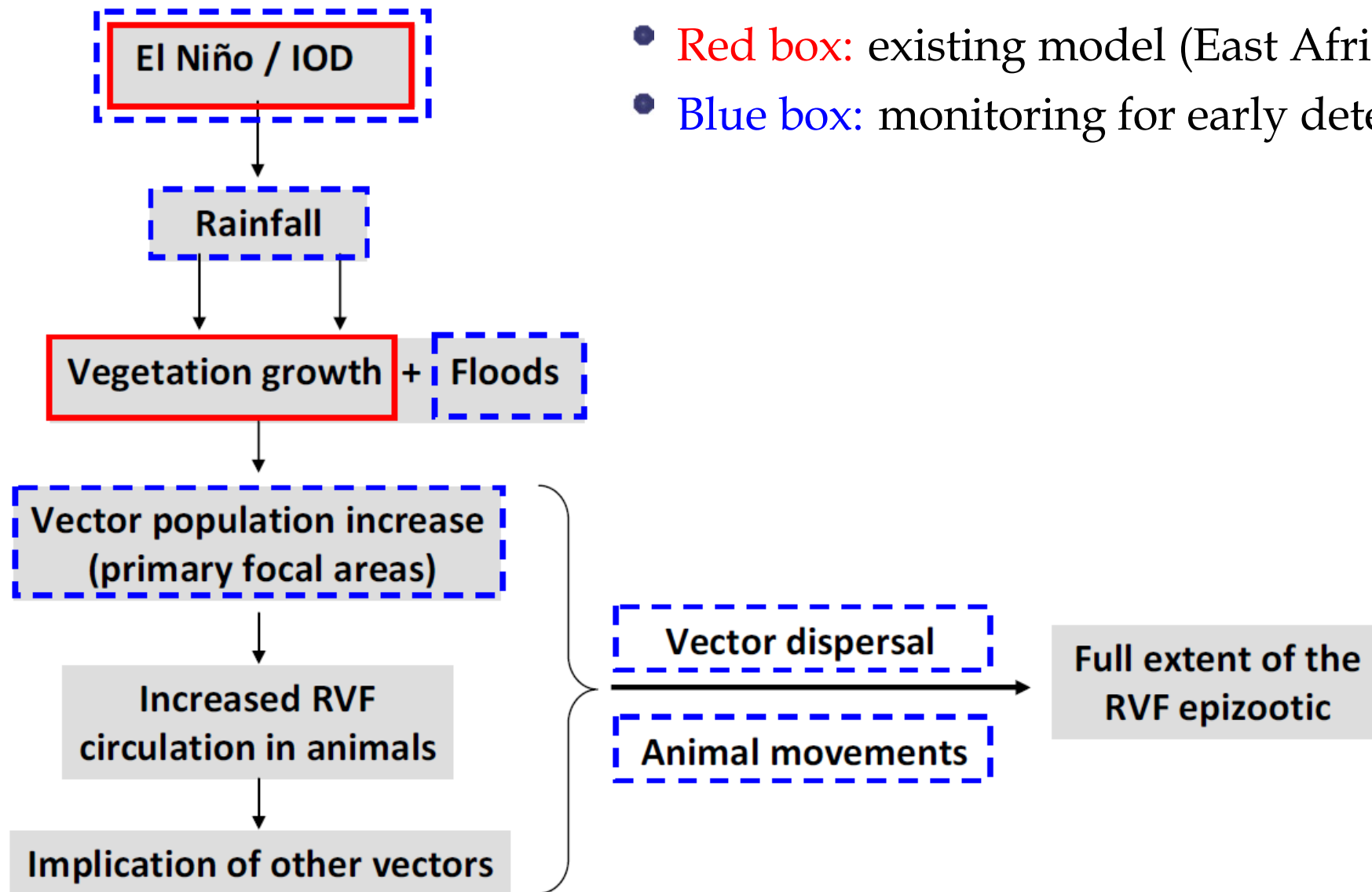
Climate change and Vector-borne disease

- ❑ Climate change will impact vector-borne diseases
- ❑ Because VBD are complex systems, forecasting the impact of CC is difficult
- ❑ In addition, CC operates in combination with other Global changes
- ❑ Implication for surveillance and control?

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FAO-WHO recommendations [expert consultation 2008]



- **Red box:** existing model (East Africa)
- **Blue box:** monitoring for early detection

Surveillance

&

Prevention

- ✓ Climatic indicators (SOI): only works for eastern Africa
- ✓ Rainfall: near-real time information systems (e.g. TAMSAT) readily available, under-utilized
- ✓ Vector population increase: difficult to assess in field conditions (lack of entomologists, high cost)
- ✓ Animal movements: need for collaborative, regional databases
→ quarantine (Madagascar/Comoros) / import bans / livestock markets closed
- ✓ Risk-based surveillance: sentinel animals and repeated, cross sectional surveys [Arsevska, 2015]

- ✓ Vaccinate ruminants to protect human
- ✓ Nation-wide, mass vaccination not an option in the long term
- ✓ Risk-based vaccination: target population at strategic season in high-risk areas

→ Regional, harmonized approach: surveillance and vaccination

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A one-health approach for RVF (de la Rocque & Formenty, 2014)

- ❑ Forecasting & preparedness (e.g. joint human & animal contingency plan & surveillance networks)
- ❑ Alert (e.g. assess field suspicions, share data)
- ❑ Outbreak control (e.g. joint surveillance in humans & animals, control animal movements, information campaigns)
- ❑ Post-epidemic stage (e.g. post-epidemic evaluation & cost assessment)



- Availability of accurate data from different sources, jointly analysed and used
- Cost / efficiency of interventions

One health regional approach

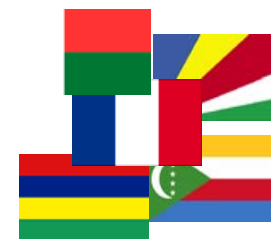
□ Regional approach: the right scale

- ✓ Transboundary vector borne disease
- ✓ Facing same environment and drivers
- ✓ Under regional economic communities
- ✓ Enable to share resources and capacities
- ✓ Crucial in low income countries and region



□ One health in practice : Indian Ocean

- ✓ AnimalRisk-OI network + SEGA human disease network =
- ✓ Joint human & animal unit under the Indian Ocean Commission
- ✓ Communication and epidemiological intelligence (bulletin, weekly TWC...)
- ✓ Shared capacity building (fetc) and lab capabilities
- ✓ Common intervention (e.g.: RVF in Comoros)



More than One Health

❑ Interaction research-surveillance

- ✓ Co-build research questions (e.g. drivers for RVFV epidemics)
- ✓ Provide adapted recommendations (e.g. risk based surveillance)



Effect on
trade and
tourism

Money
+
Human
resources

Applied
vs basic
research

Public
opinion

Quality
of data



Thanks to all our collaborators



Thanks for your attention

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+ Lancelot et al. In press, Chevalier et al. In press