



# Maladies arbovirales liées à *Aedes albopictus* en France

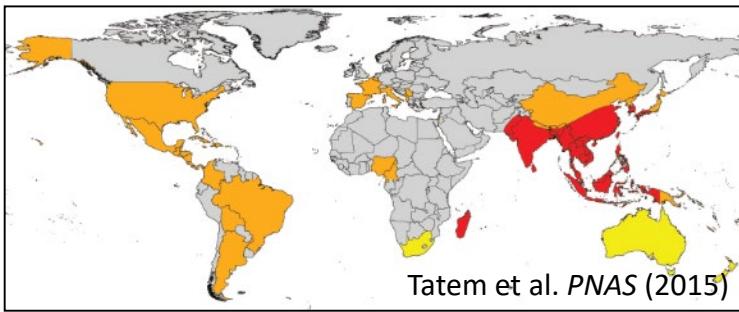
Anna-Bella FAILLOUX

Arboviruses and Insect Vectors  
Department of Virology

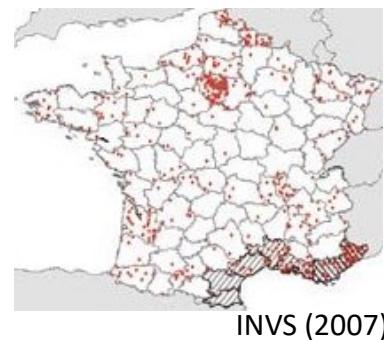


# Globalisation and Human diseases

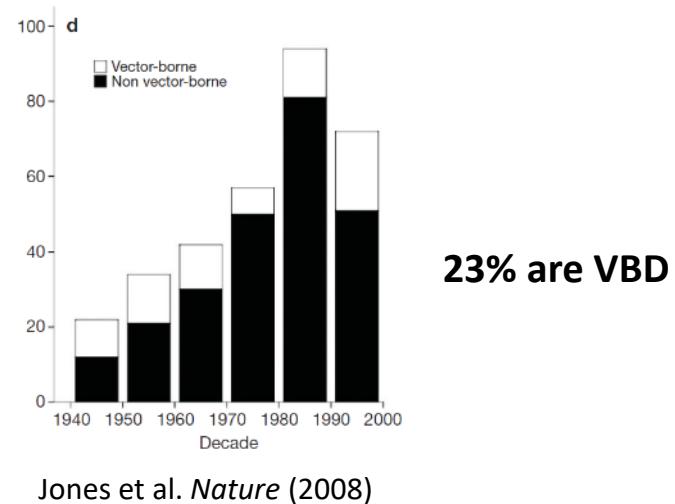
## 1. Expansion of vectors



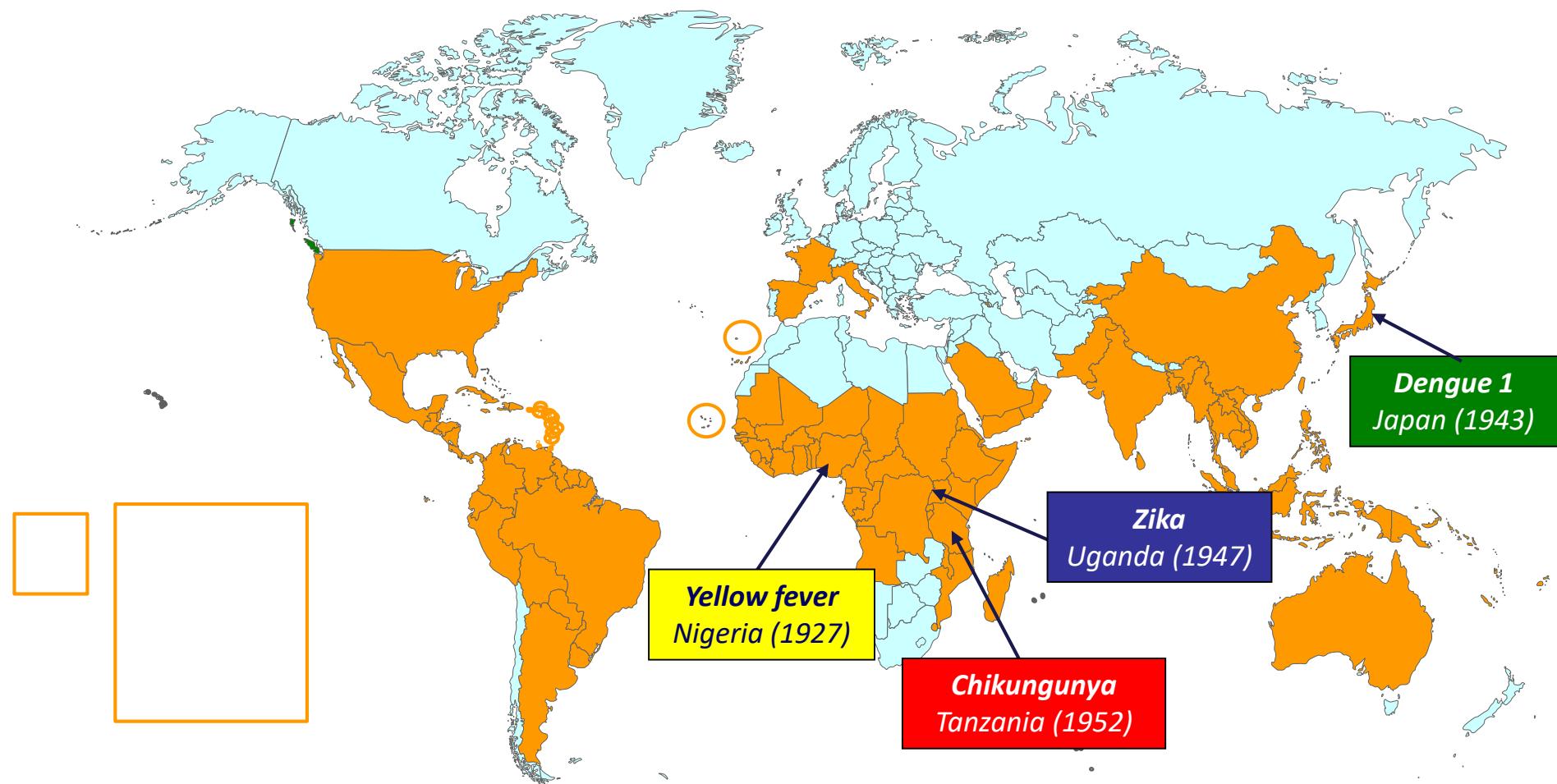
## 2. Expansion of pathogens



## 3. Higher prevalence of infectious diseases



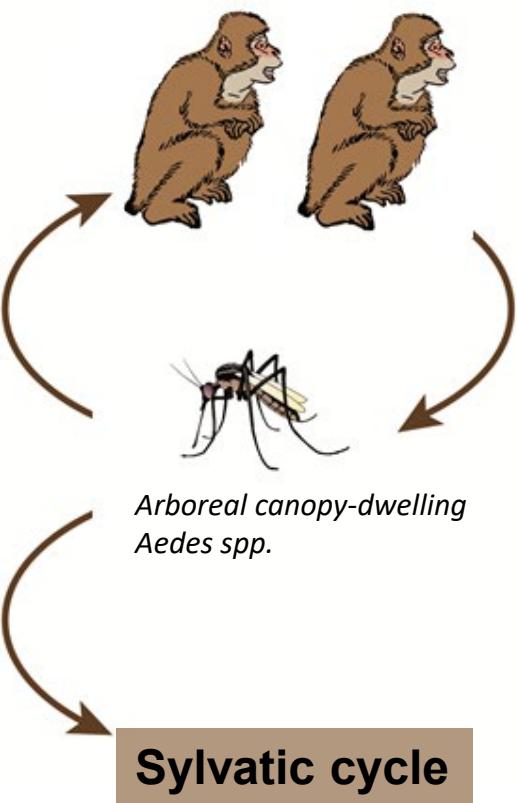
# The most important arboviruses



# Transmission cycles



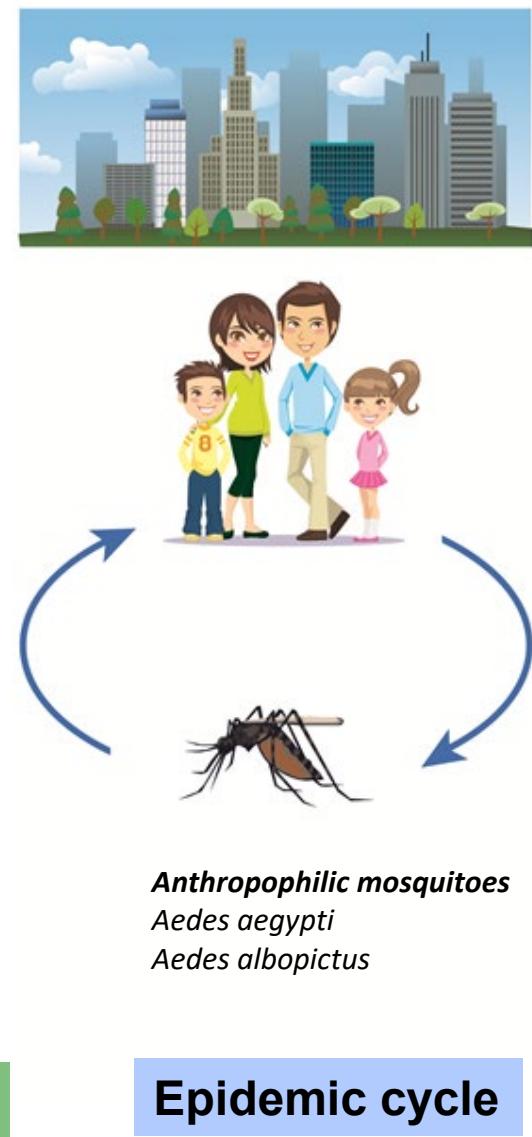
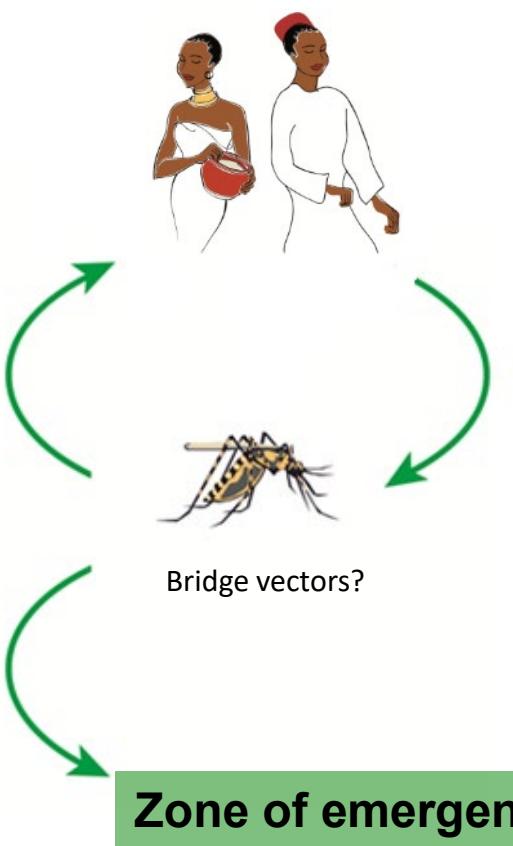
Non-human primates



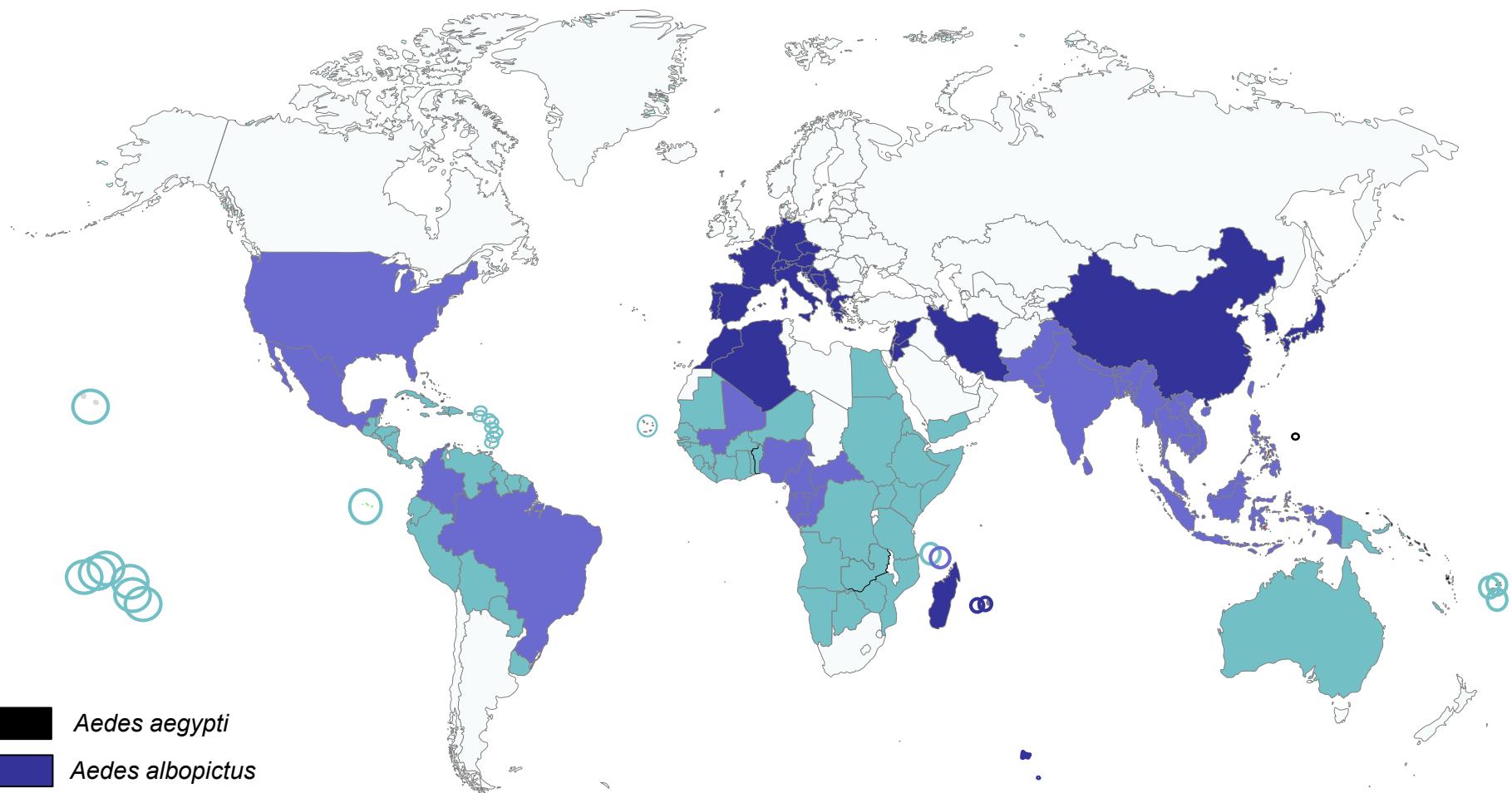
Bridge vectors?



*Anthropophilic mosquitoes*  
*Aedes aegypti*  
*Aedes albopictus*



# The same epidemic vectors

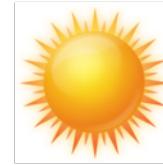
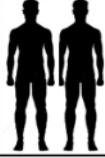
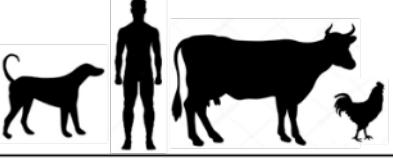
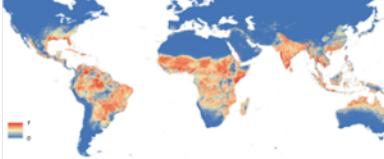
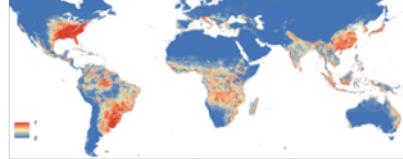


Houé et al. *Emerg. Microbes Infect.* (2019)

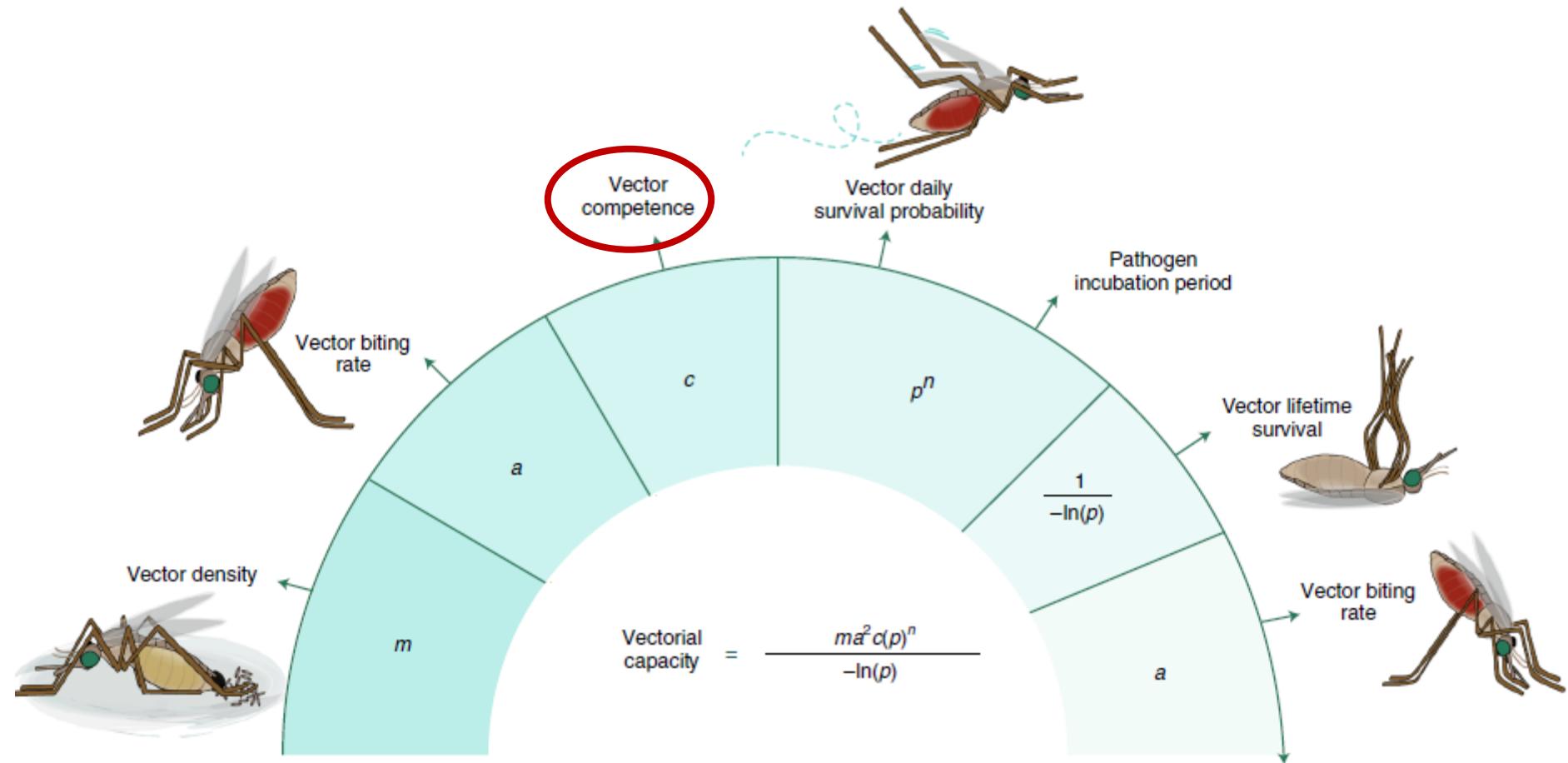


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# *Aedes* mosquitoes

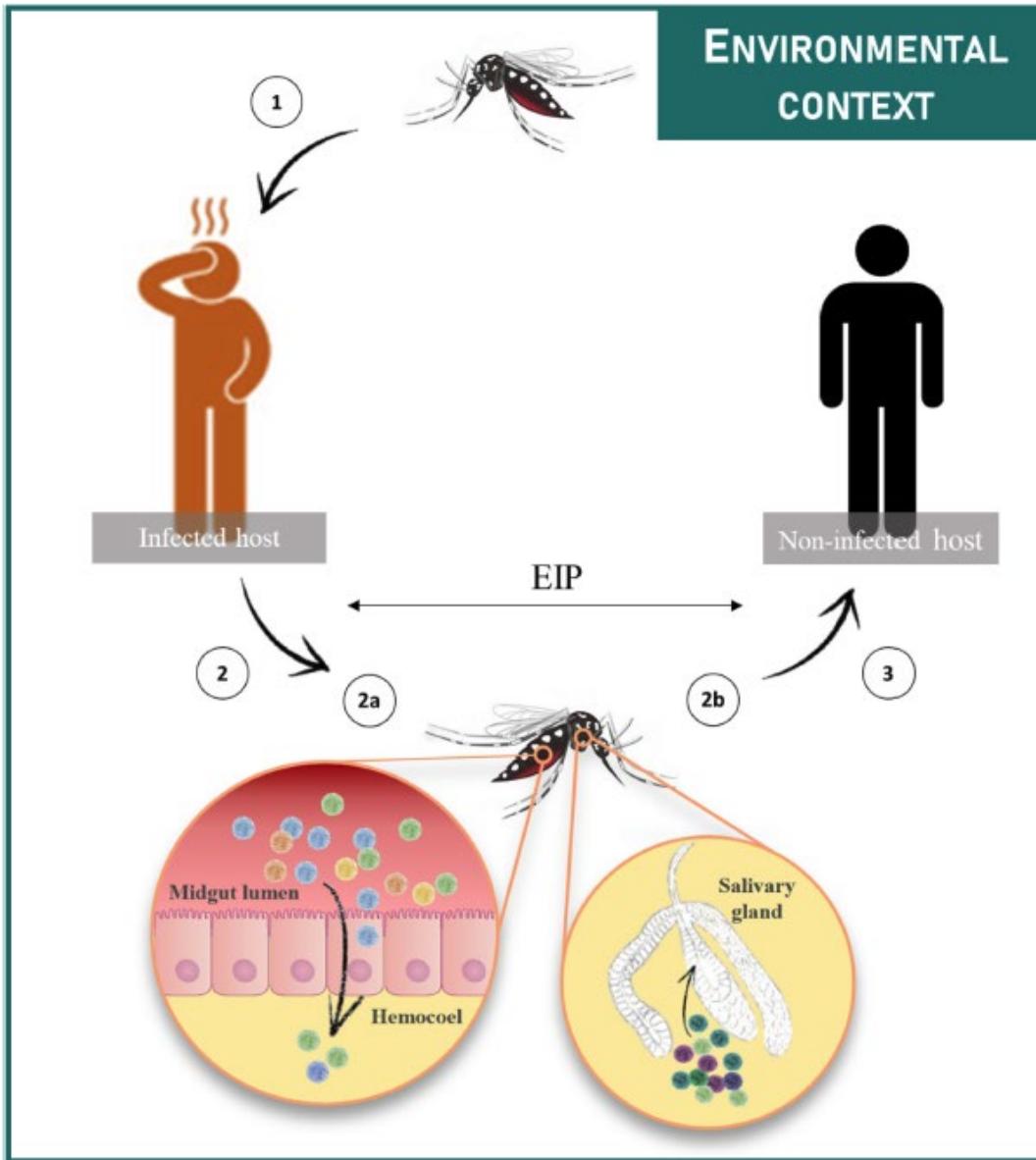
Mosquito species	<i>Aedes aegypti</i> <i>African</i>		<i>Aedes albopictus</i> <i>Asian</i>	
Ecology	 	  		
Active time				
Blood feeding behavior				
Distribution				
Arboviruses transmitted	Dengue, chikungunya, yellow fever, zika		Dengue, chikungunya, zika, Japanese encephalitis	

# What makes a mosquito competent?



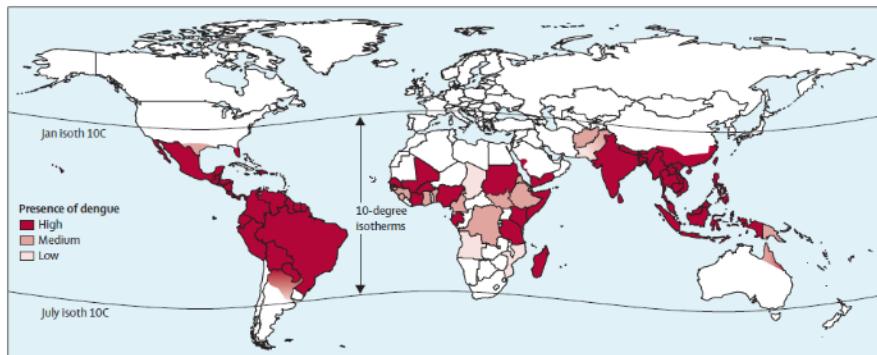
Shaw & Catteruccia. *Nature Microbiol* (2019)

# Vector competence



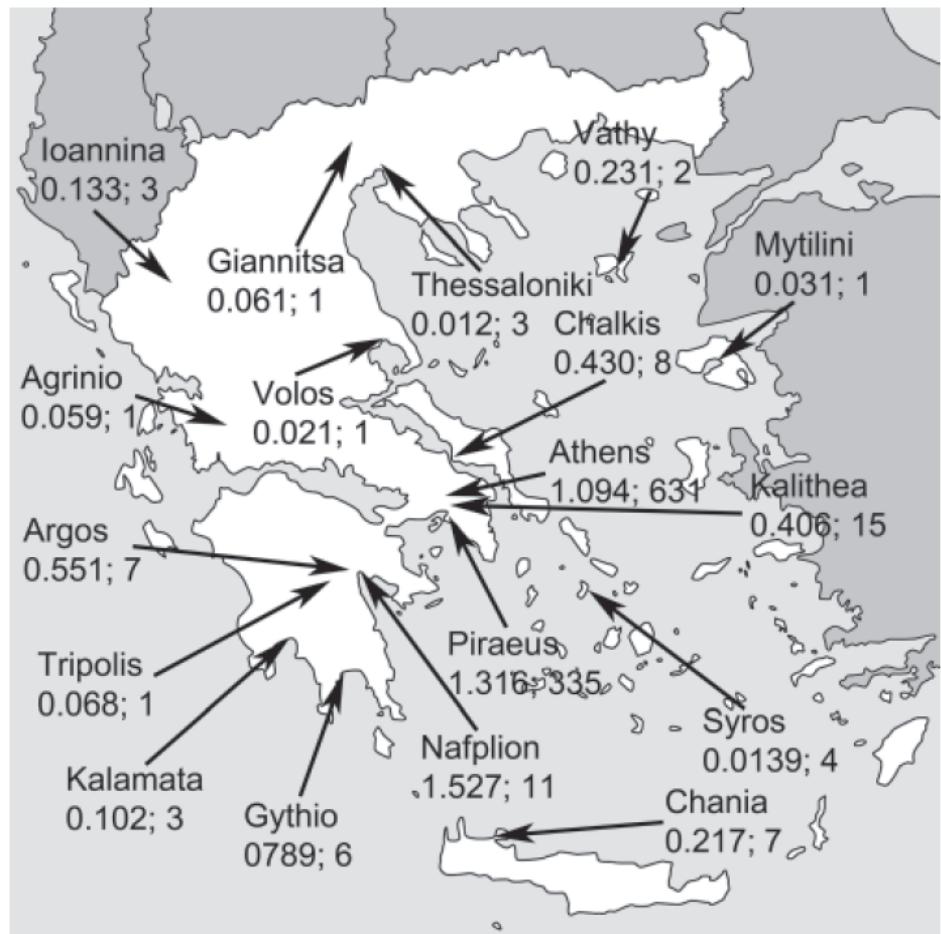
# Dengue: a threat for Europe

## The 1927-28 outbreak in Greece



Guzman & Harris. *The Lancet* (2014)

- DENV-1
- DENV-2
- 1 million cases
- 1000 deaths



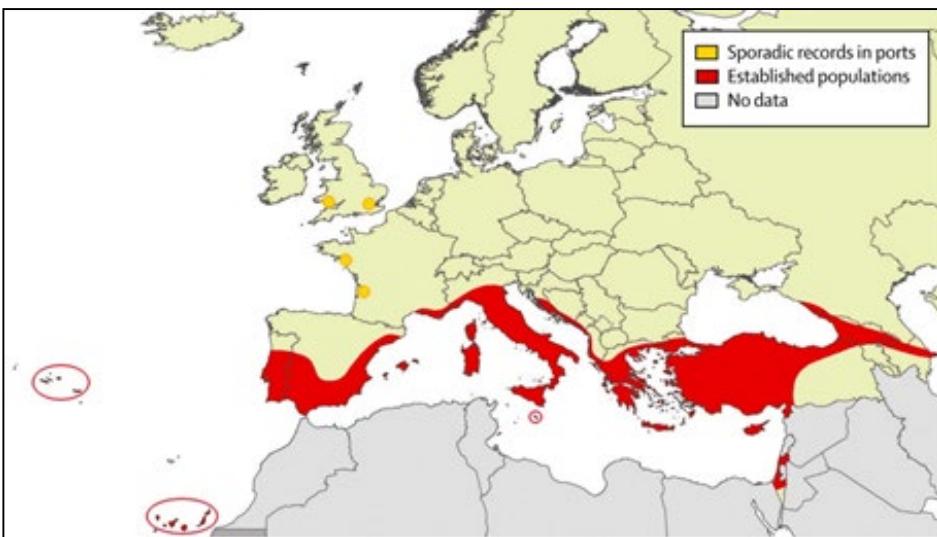
Louis EID (2012)



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# *Aedes aegypti* in Europe

1960



Schaffner & Mathis. *Lancet Infectious Diseases* (2014)

Today

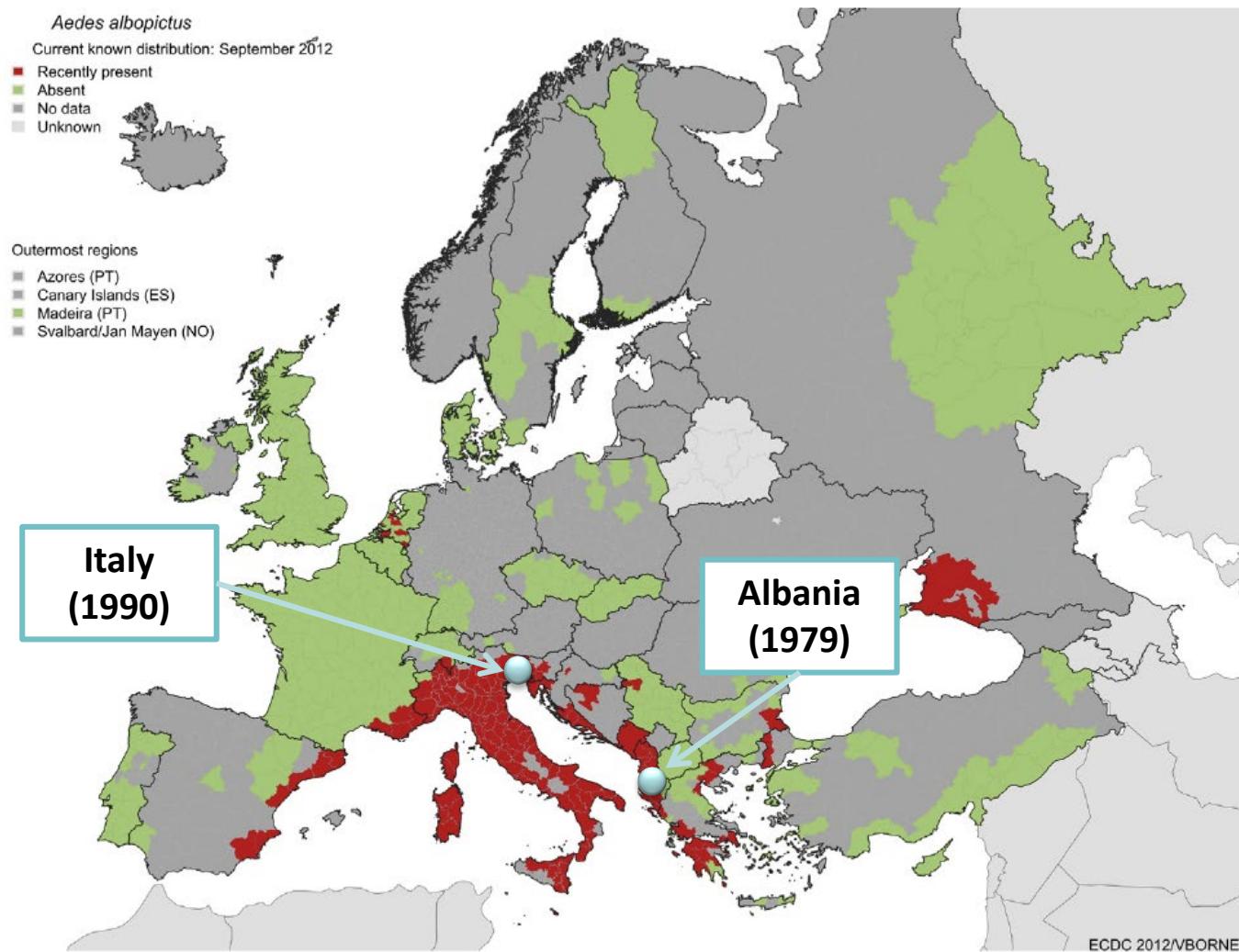


Tomasello & Schlagenhauf. *Travel Medicine and Infectious Diseases* (2013)



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# *Aedes albopictus* in Europe

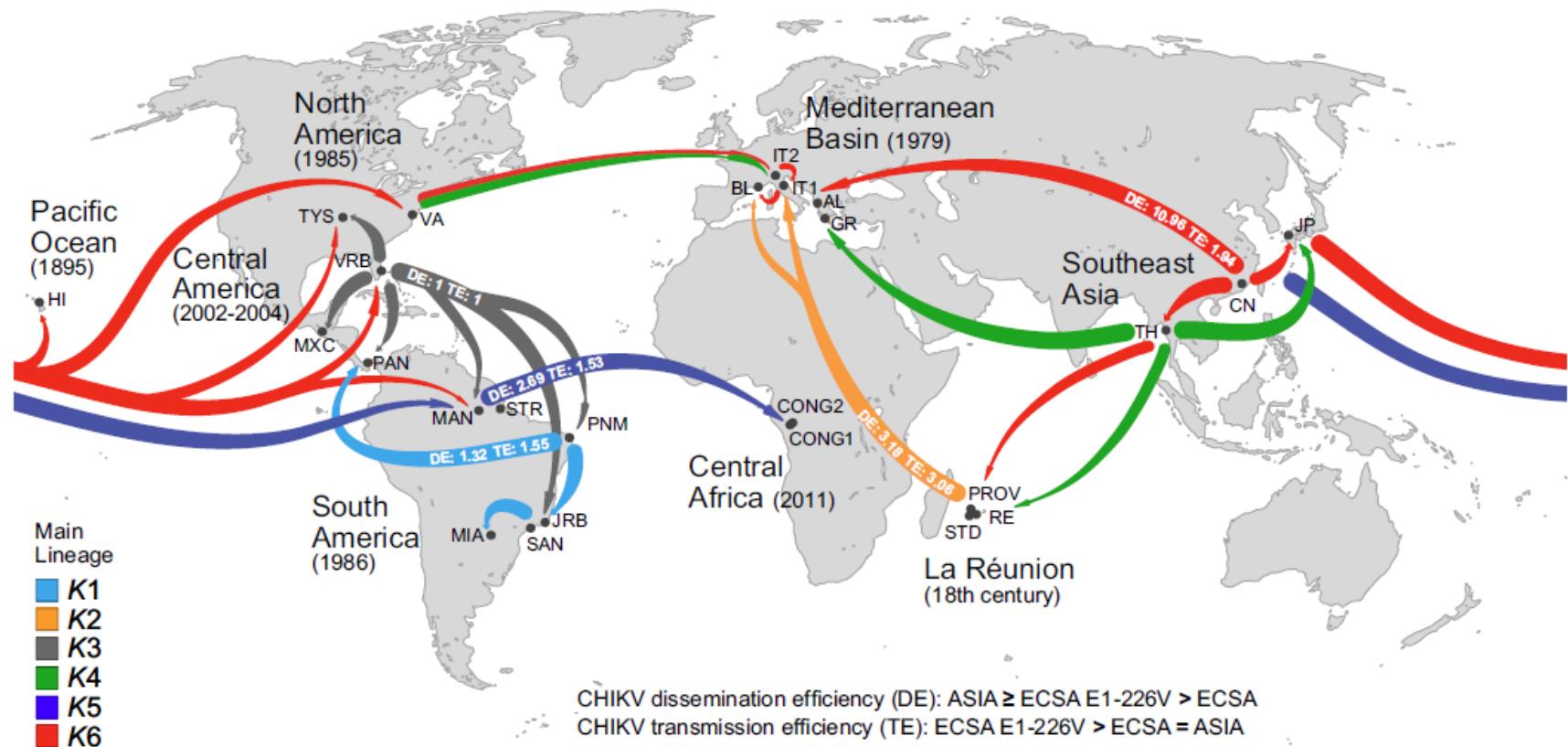


Tomasello & Schlagenhauf *Travel Med Inf Dis* (2013)



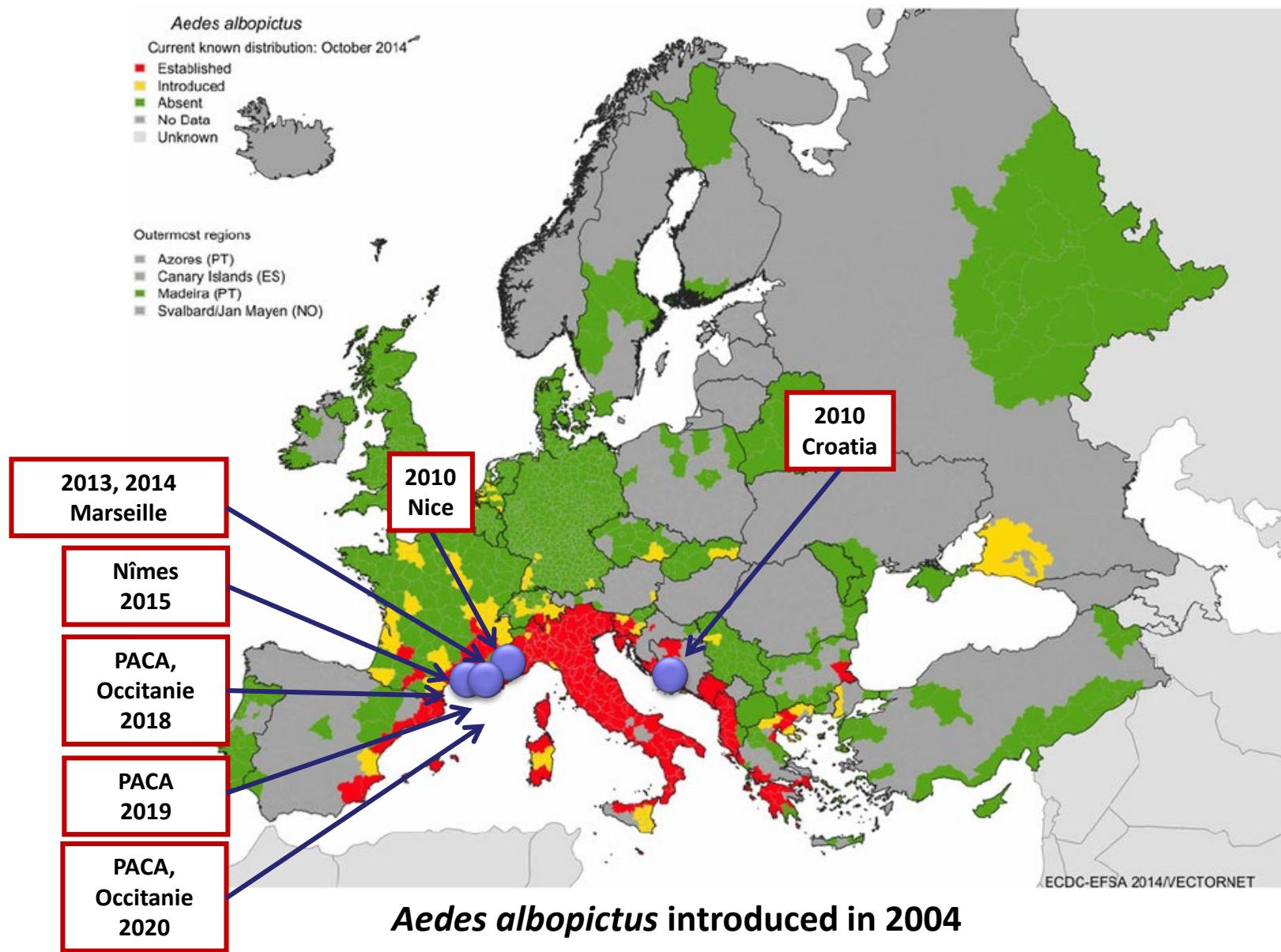
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# A scenario of *Ae. albopictus* migrations

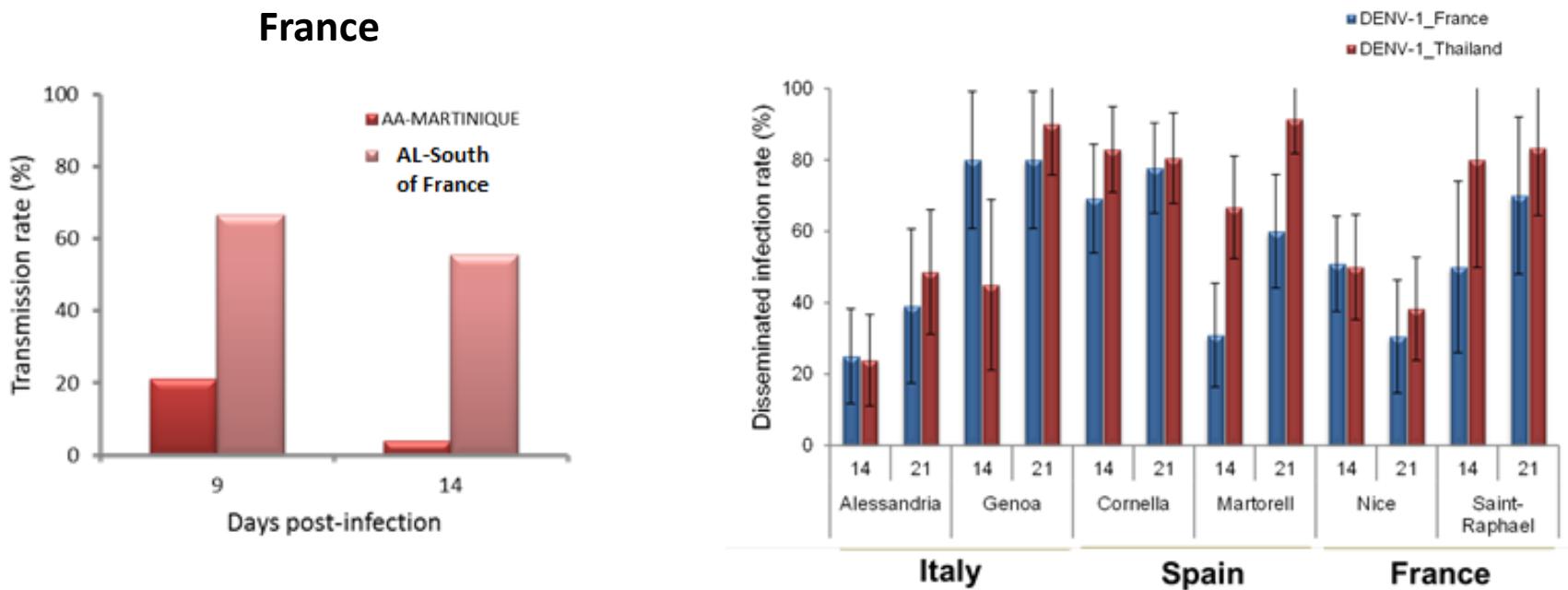


Vega-Rua et al. *Commun. Biol.* (2020)

# DENV back to continental Europe in 2010



# European *Ae. albopictus* for DENV



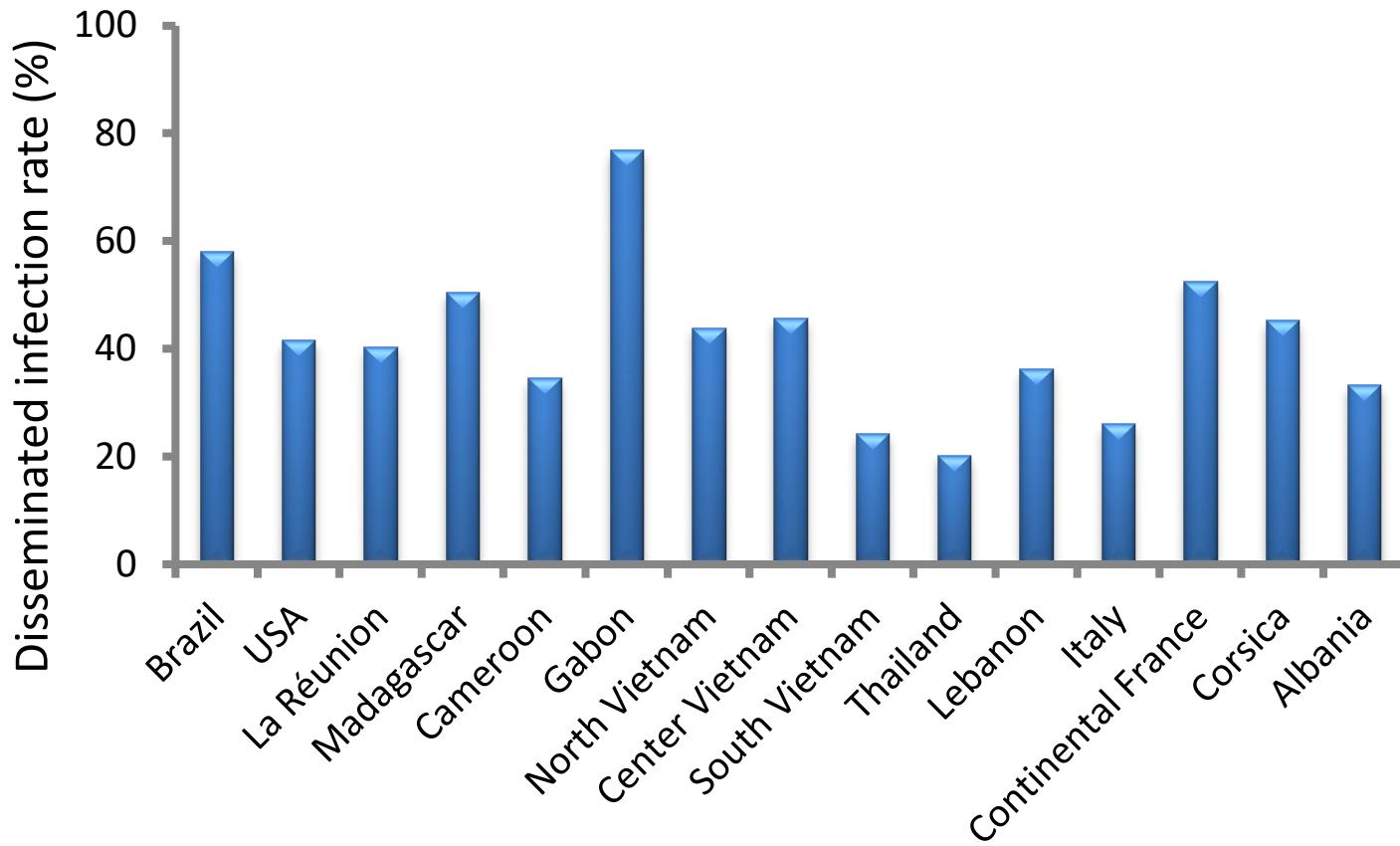
Vega-Rua et al. *PLoS ONE* (2013)

Bellone et al. *Sci. Rep.* (2020)



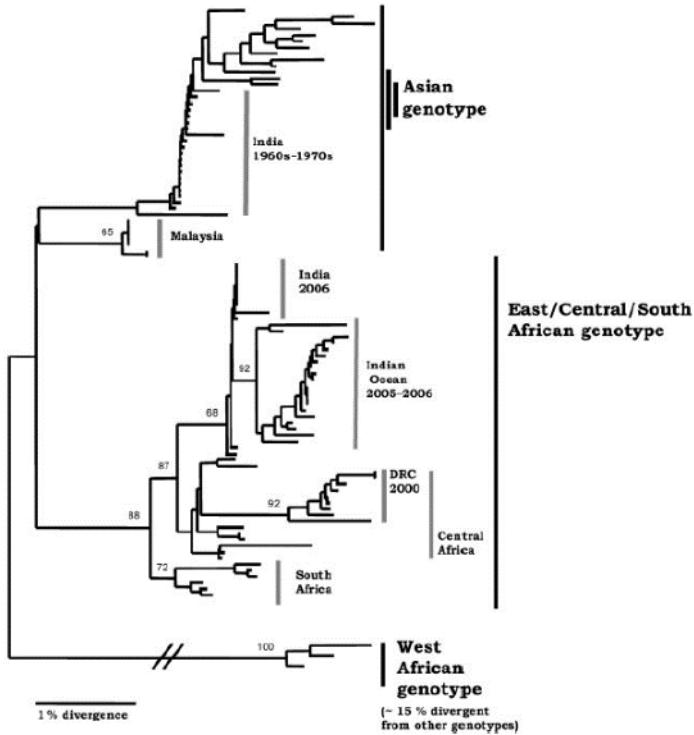
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# *Aedes albopictus* and dengue

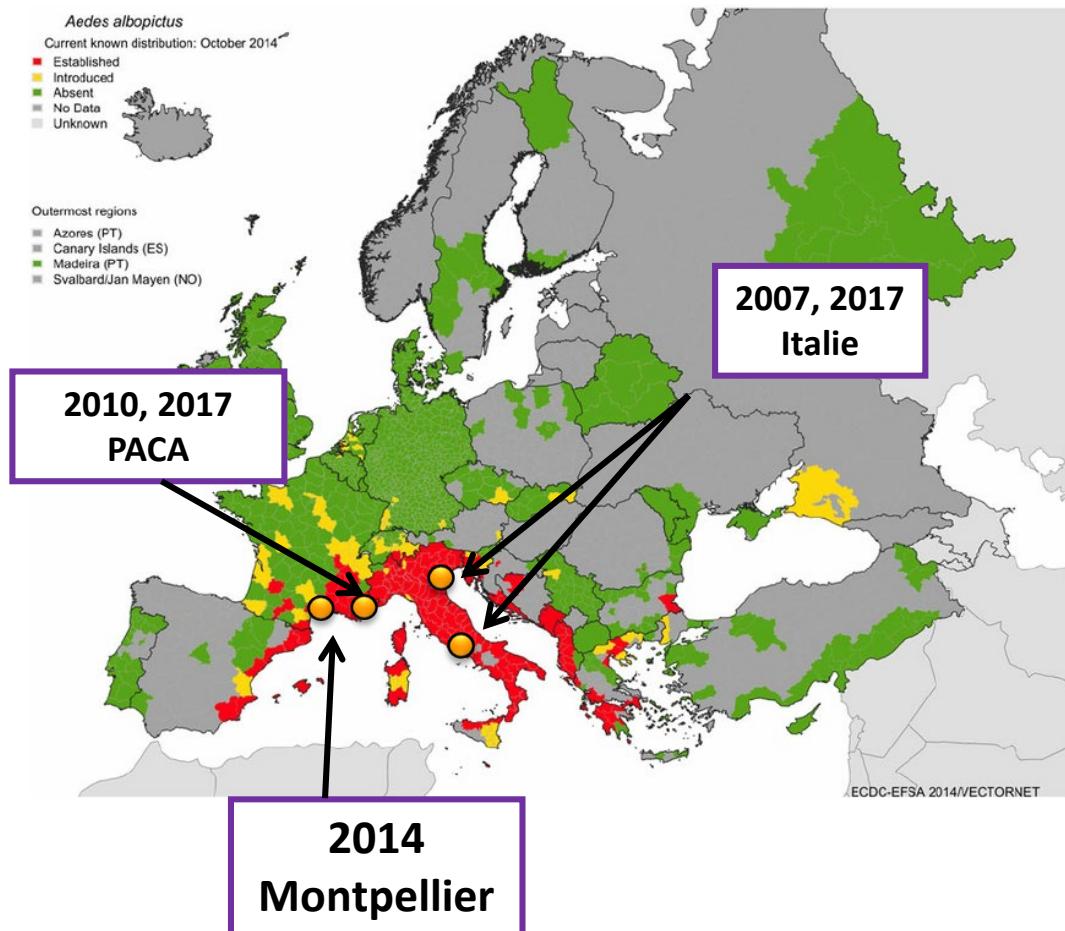


Credit: AIV - IP

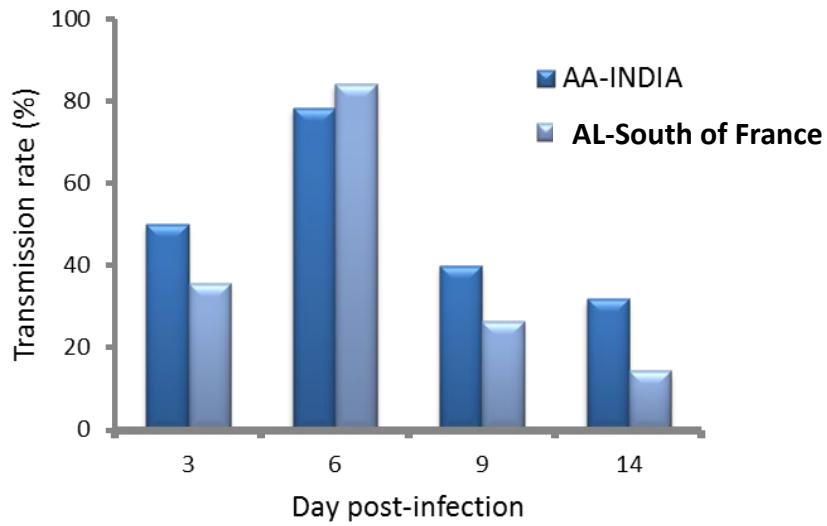
# CHIKV arrive in Europe in 2007



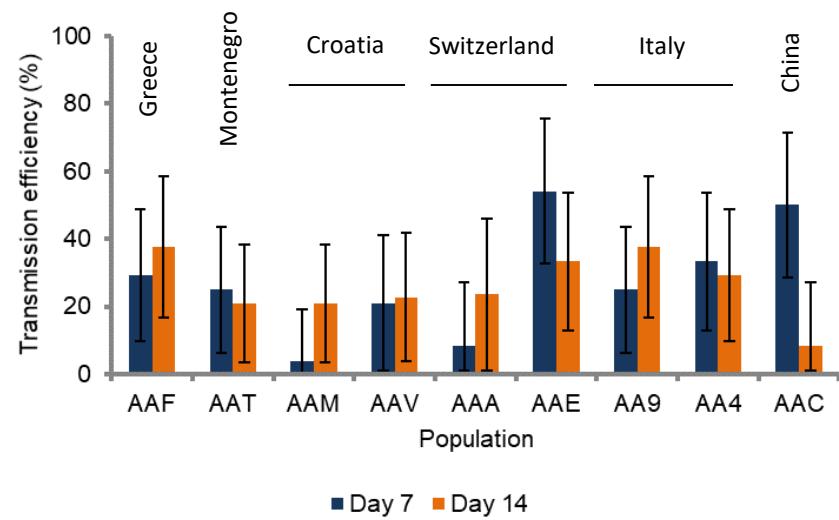
Powers et al. *J Gen Virol* (2005)



# 2010: CHIKV in France

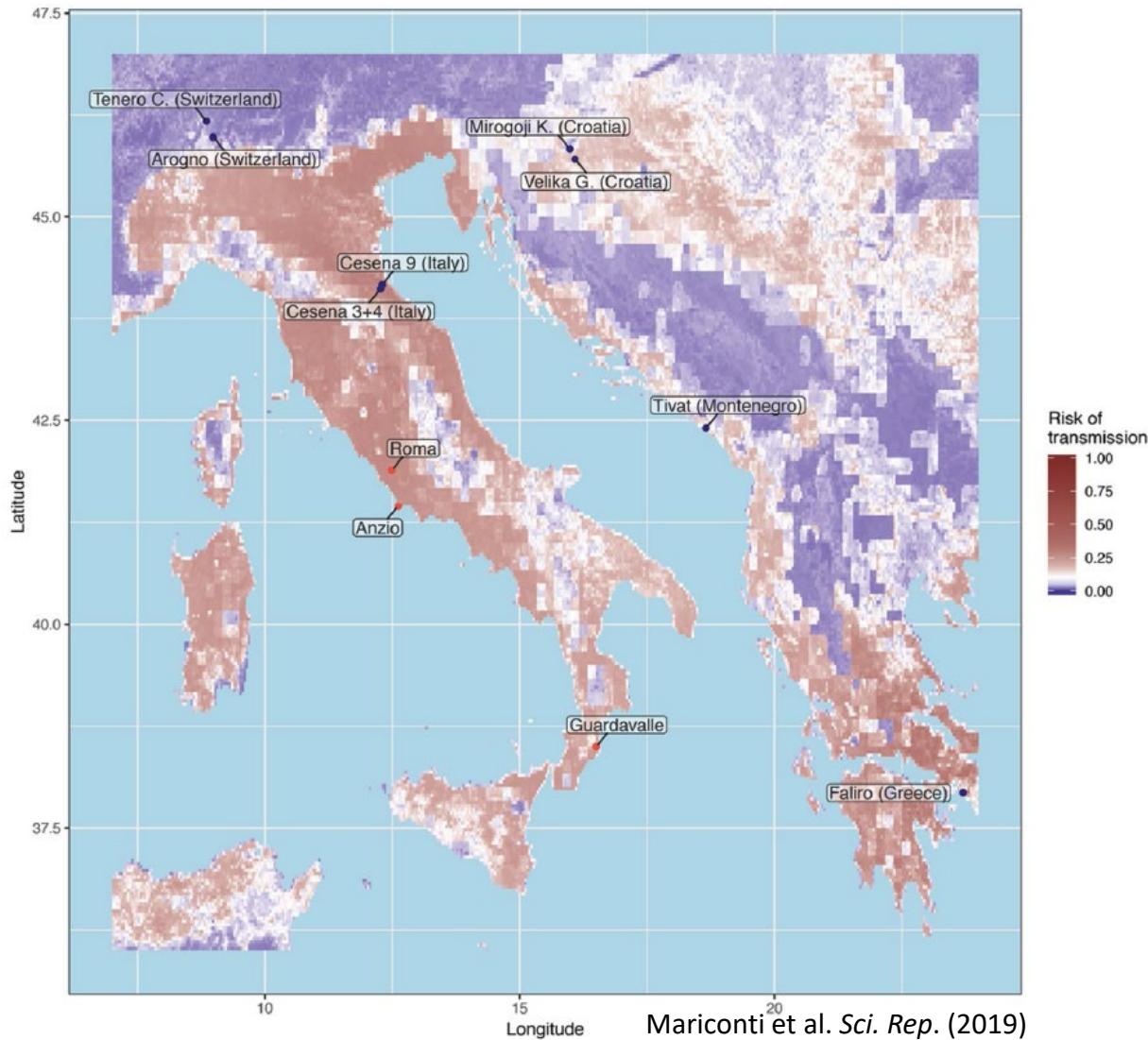


Vega-Rua et al. *PLoS ONE* (2013)



Mariconti et al. *Sci. Rep.* (2019)

# Risk of *Ae. albopictus*-mediated CHIKV transmission in Southern Europe

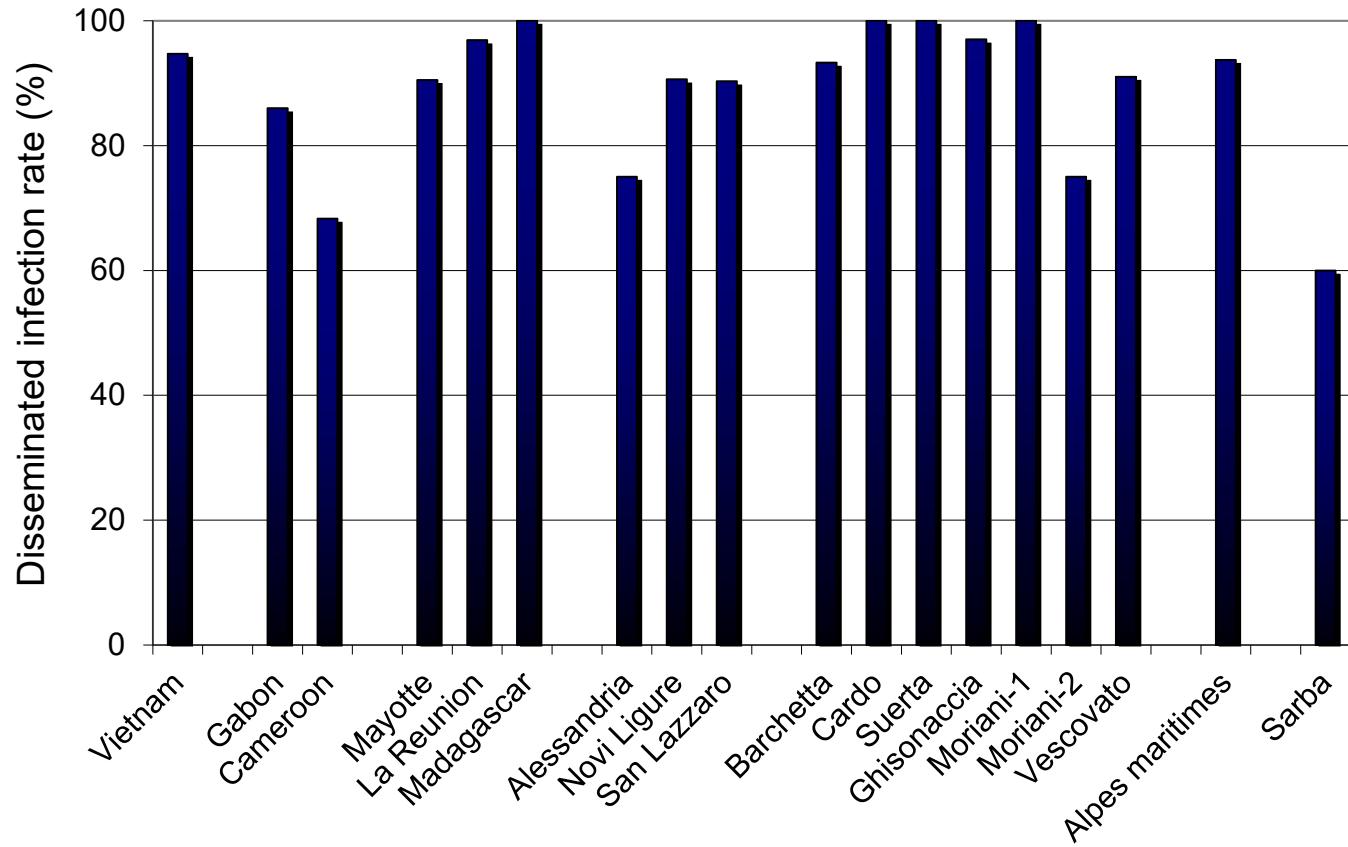


Mariconti et al. *Sci. Rep.* (2019)



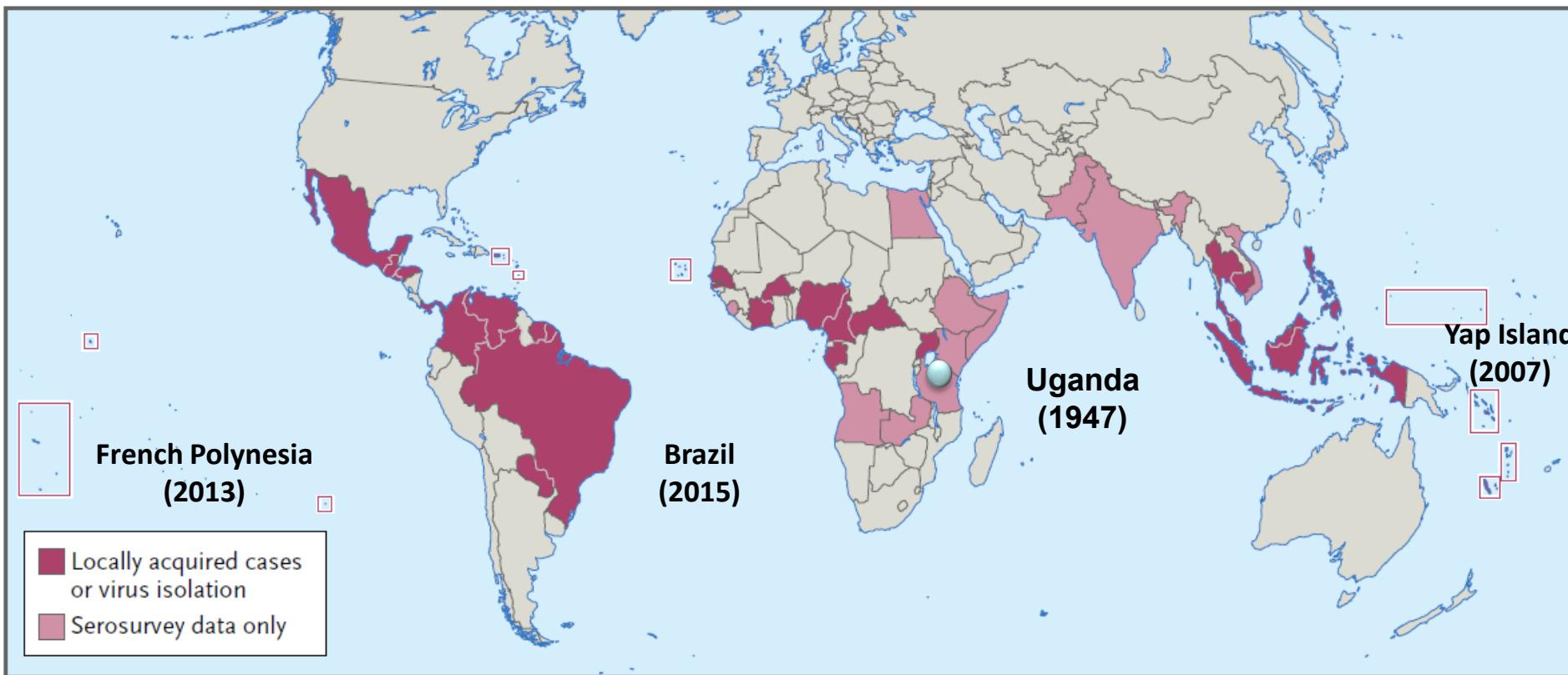
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# *Aedes albopictus* and chikungunya



Credit: AIV - IP

# ZIKV emergence



Fauci & Morens. *N Engl J Med* (2016)



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# May 2015: First cases in Brazil

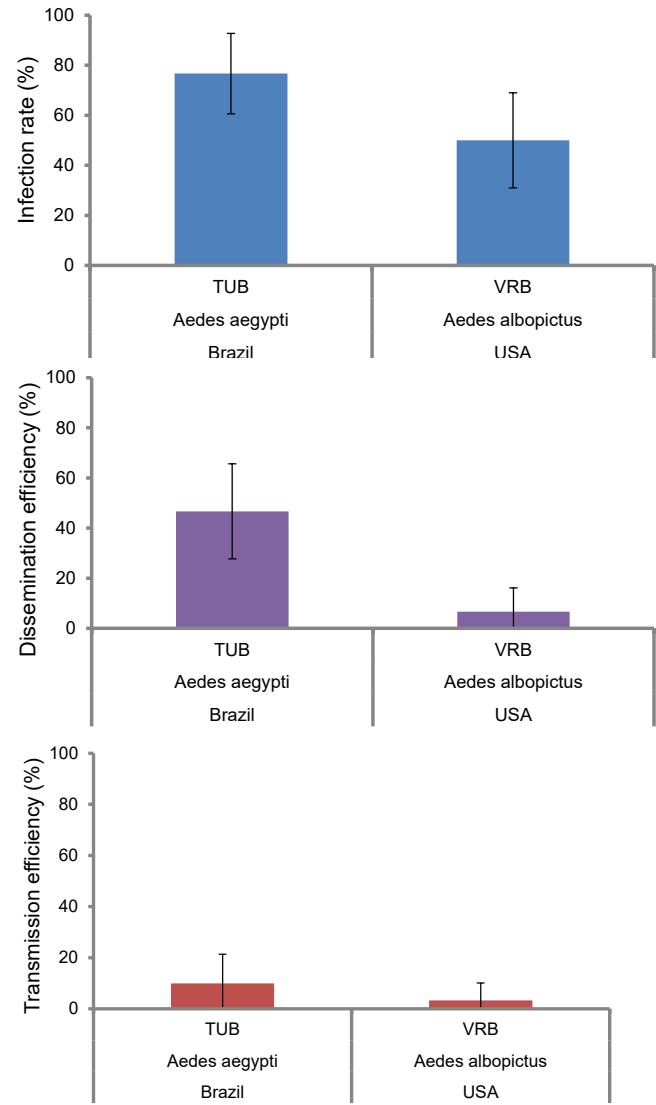
Rio de Janeiro (Brazil)

June 2015 – May 2016

1,683 mosquitoes captured (720 ♀ + 963 ♂)

Mosquito species	Number captured	♀ / ♂	ZIKV-infected pools
<i>Aedes aegypti</i>	550	315 ♀	2
		235 ♂	1
<i>Aedes albopictus</i>	26	20 ♀	0
		6 ♂	0
<i>Culex quinquefasciatus</i>	1107	385 ♀	0
		722 ♂	0

Ferreira-de-Brito et al. *Mem Inst Oswaldo Cruz* (2016)



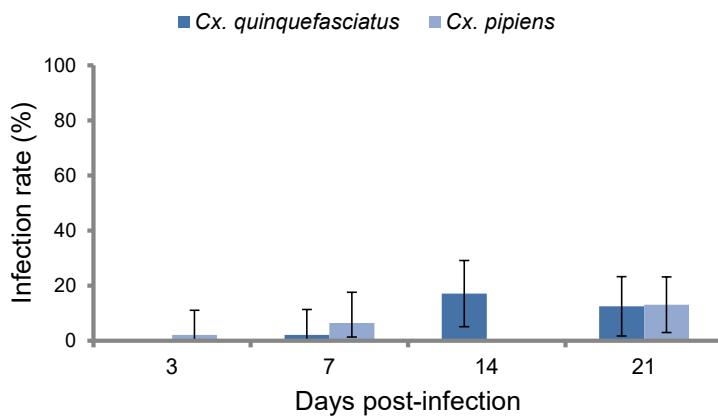
Chouin-Carneiro et al. *PLoS Negl Trop Dis* (2016)



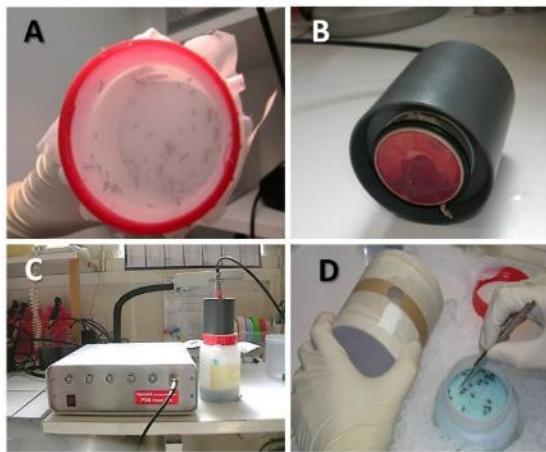
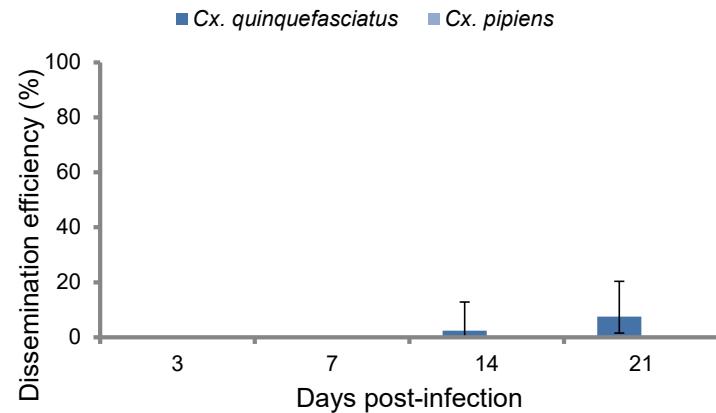
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# *Cx. pipiens* complex and ZIKV

## Infection

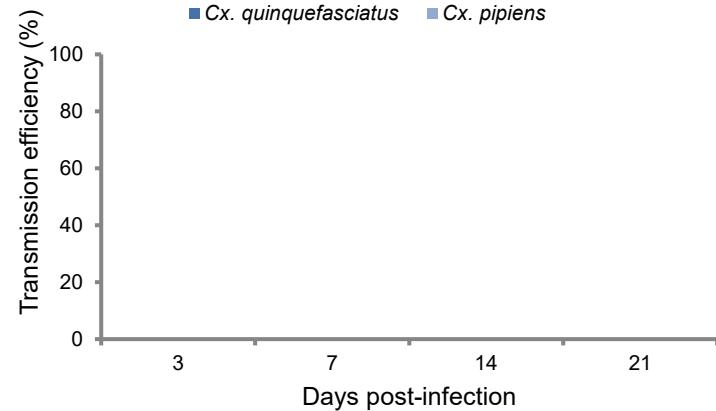


## Dissemination



Credit: A. Vega-Rua (IP)

## Transmission



Amraoui et al. *Eurosurveillance* (2016)



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# No transmission by *Culex spp.*

Intra-thoracic inoculation

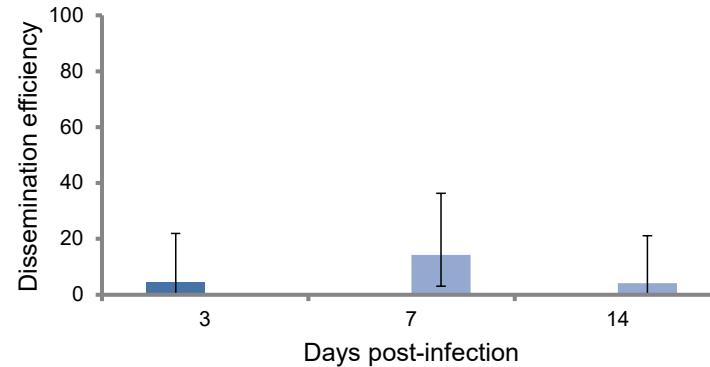


~2500 viral particles

Amraoui et al. *Eurosurveillance* (2016)

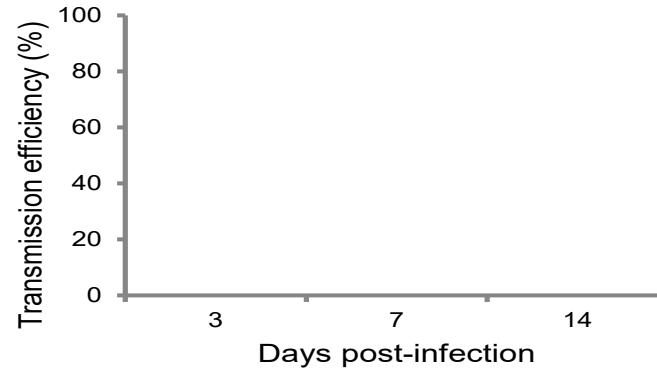
## Head (Replication)

■ *Cx. quinquefasciatus* ■ *Cx. pipiens*



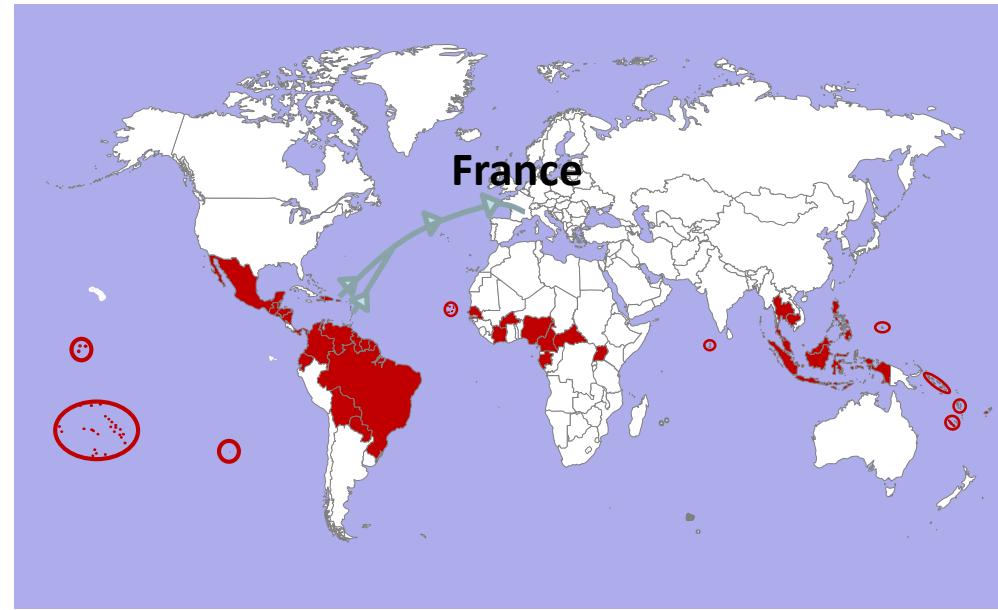
## Saliva (Transmission)

■ *Cx. quinquefasciatus* ■ *Cx. pipiens*



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# Risk for Europe

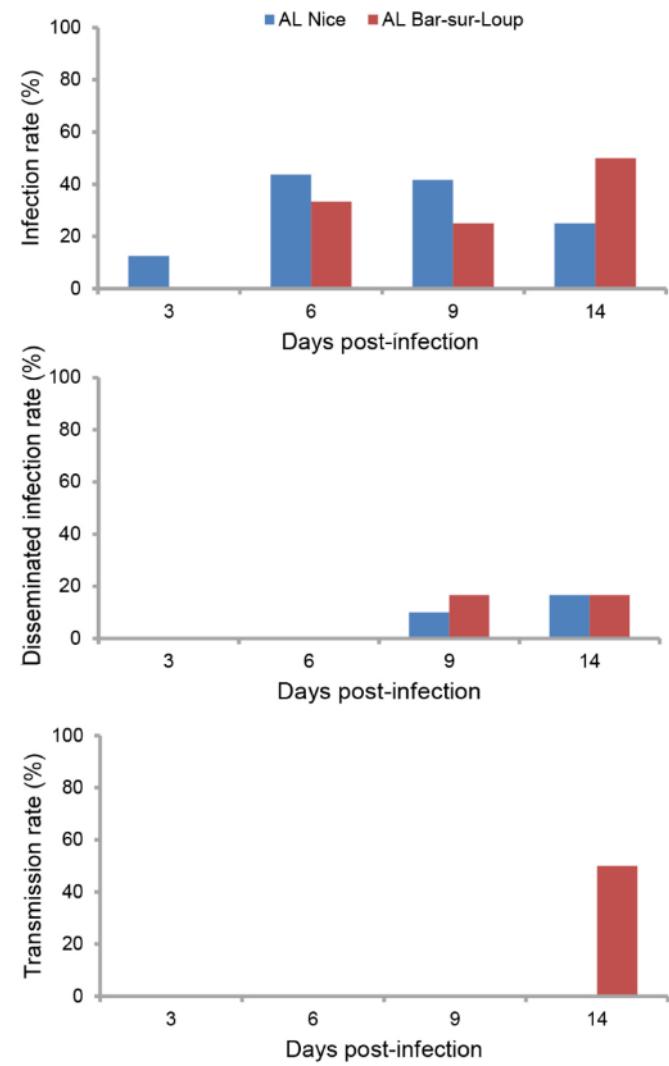


## French Overseas departments

Guadeloupe

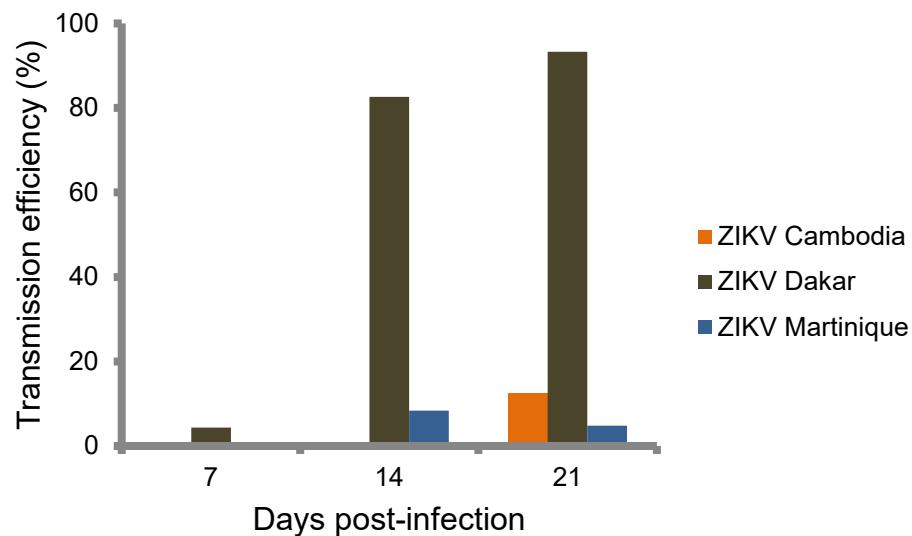
Martinique

French Guiana

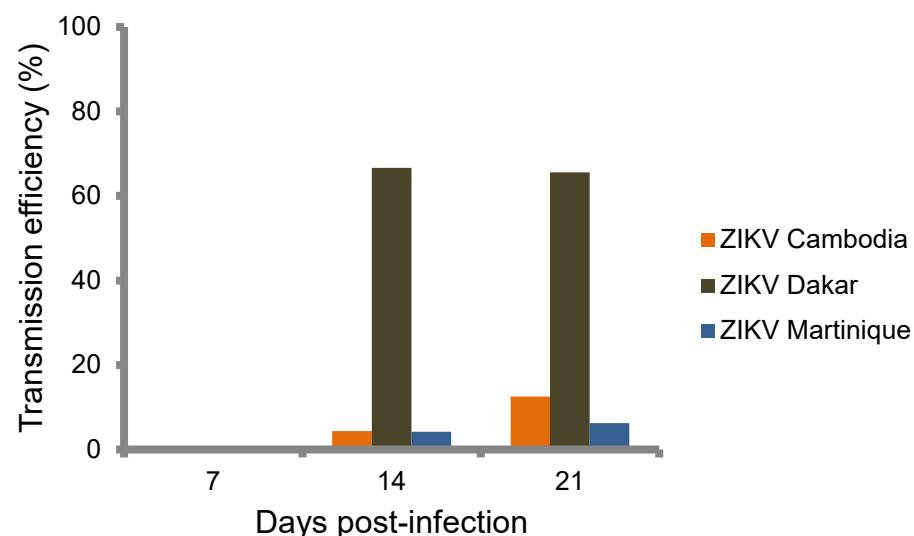


# *Ae. albopictus* France more competent for African ZIKV

Corsica



Montpellier

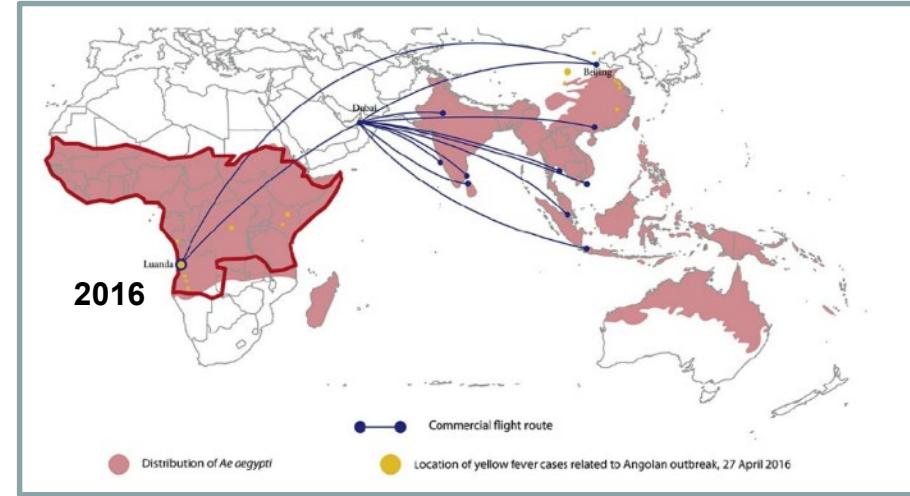
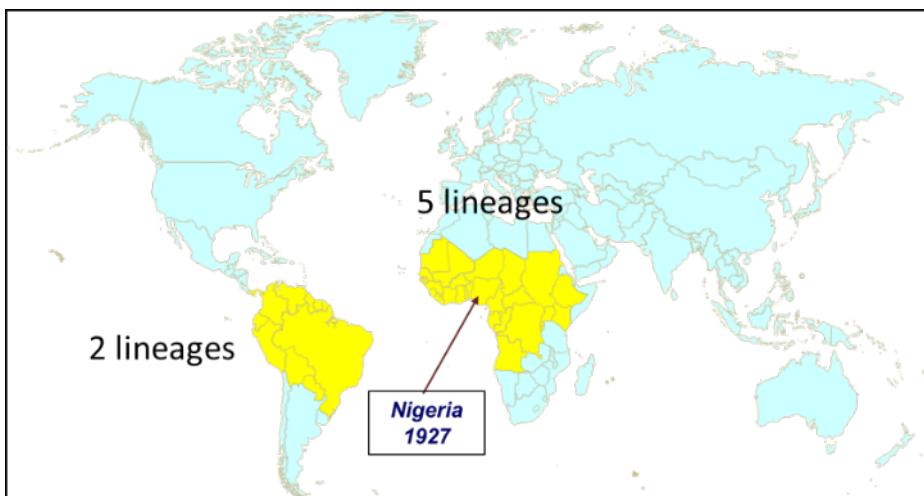


Vazeille et al. *Emerg. Microbes Infect.* (2019)



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# Yellow fever remains a major public health issue

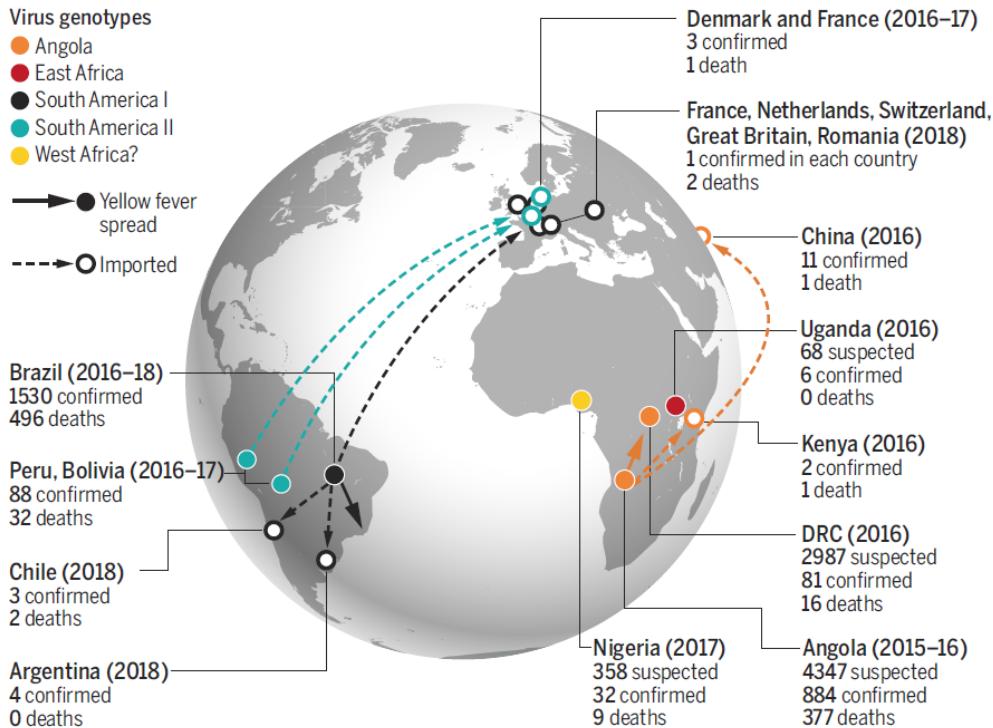


Wasserman et al. *Int J Infect Dis* (2016)

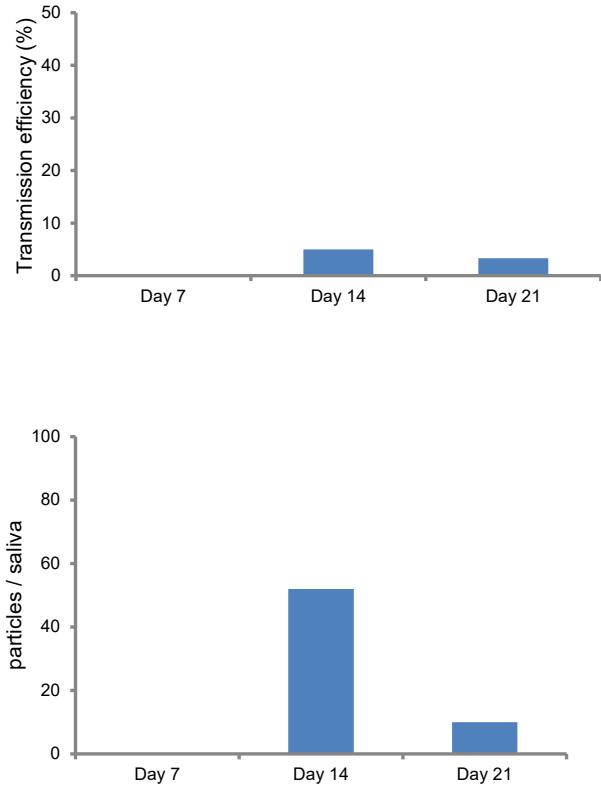
Each year:

- 200,000 cases
- 30,000 deaths

# Risk for Europe



Barrett. Science (2018)



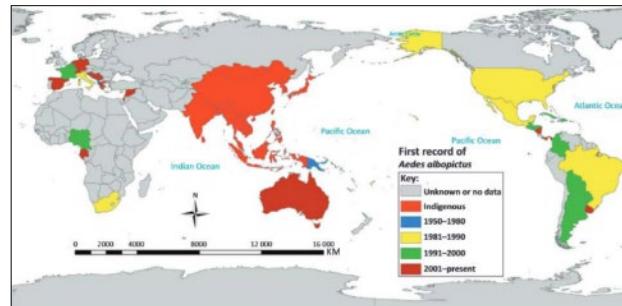
Amraoui *et al.* Eurosurveillance (2016)



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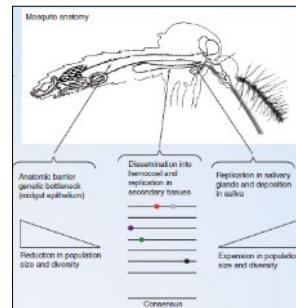
# Emergence of arboviruses in two steps

## 1. Adaptation of the vector to a new biotope



Bonizzoni et al. *Trends Parasitol* (2013)

## 2. Adaptation of the virus to different vectors



Coffey et al. *Future Microbiol* (2013)

# Arboviruses and Insect Vectors Unit



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